



# NEBRA

NEBRA LoRa CONCENTRATOR MODULE



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## Product Overview

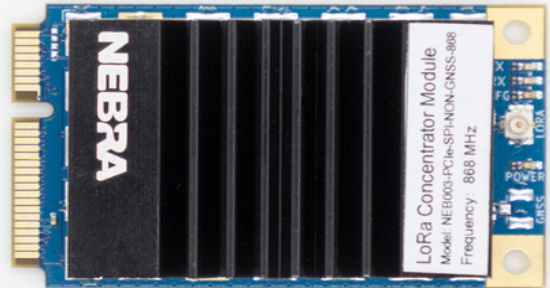
The Nebra LoRaWAN module is a LoRaWAN Concentrator module with mini-PCIe form factor based on the SX1302/3. This enables easy integration into routers and other networking equipment, adding gateway capabilities. The module can be used in any embedded platform offering a mini-PCIe slot with an SPI or USB connection\*.

Despite its small size this is an 8 channel concentrator module SF5 - SF12 . By integrating it together with a computing core a fully fledged gateway solution can easily be created.

### Features:

- Mini PCIe form factor, mounted heat-sink.
- SX1302/3 base band processor emulates 49 x LoRa demodulators, 10 parallel demodulation paths. It supports 8 uplinks channel and 1 downlink channel.
- 2x SX1250 Tx/Rx front-ends high/low frequency.
- Built-in USB to SPI conversion.
- Operates at 3.3V, making it compatible with standard 3G/LTE card slots of Mini PCI-e type.
- Tx power up to 27 dBm, Rx sensitivity down to -139 dBm @ SF12, BW 125 kHz.
- Supports global license-free frequency band (EU433, CN470, IN865, EU868, US915, AU915, KR920, and AS923).

\*depending on model

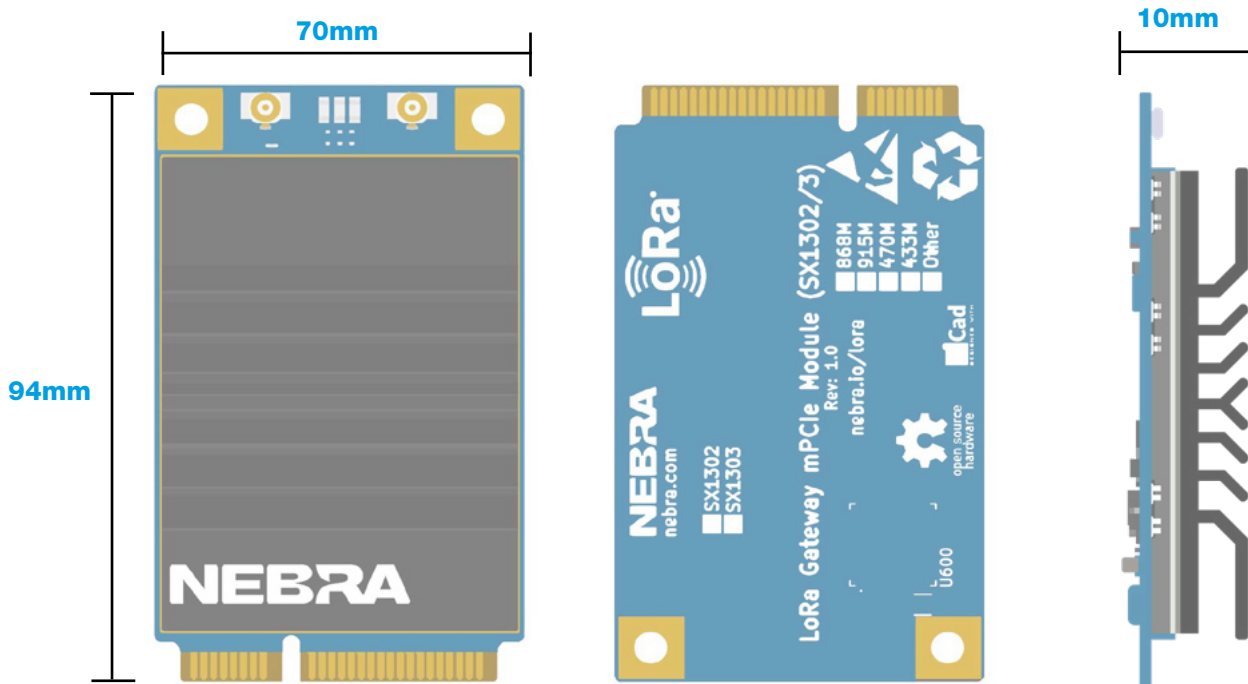


## Specification

SPECIFICATION	Nebra LoRa Concentrator
Frequency MHz	868, 915, 433, 470
Modulation Type	ISM Band LoRa®
LoRa Chipset	SX1302/3
Host Interface	SPI, USB
Sensitivity	-139dBm
Maximum Tx Power	27dBm*
LEDs	Green (Power), Red (Tx), Blue (Rx)
Form Factor	Mini PCI Express
Power Consumption	Tx (Max)<415mA,Rx <40mA, standby 7.5mA
Antenna Connector	uFl
Operating Temperature	-40°C to 85°C
Dimensions	94mm (Length) x 70mm (Width) x 10mm (Height)
Certification	TBC
Weight	TBC

\*Maximum Tx power may be capped to a lower amount in some regions

## Dimensions

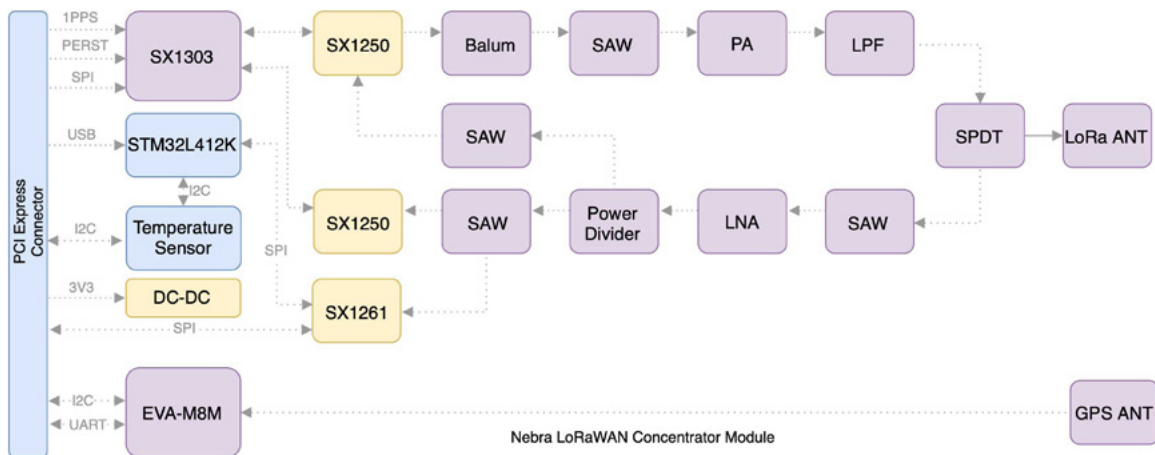


## RF Characteristics

Signal Bandwidth KHz	Spreading Factor	Sensitivity dBm
125	7	-139
125	7	-125
250	12	-123
500	7	-134
500	12	-120

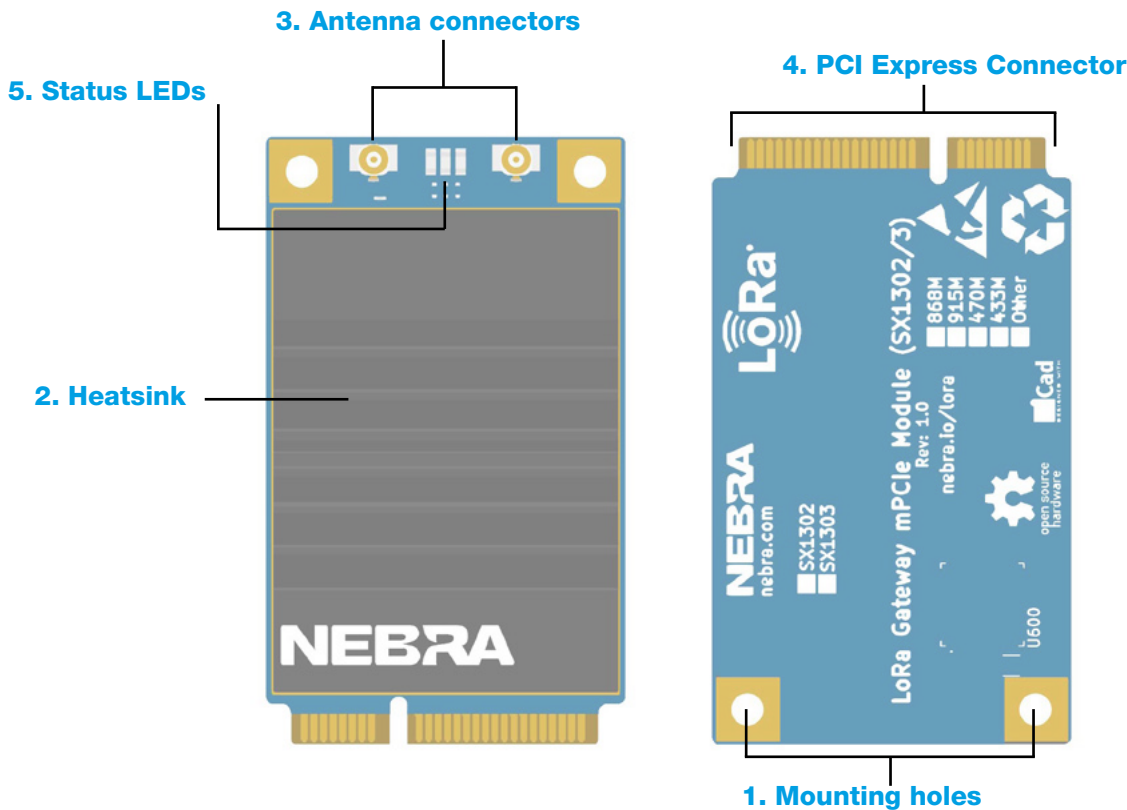
## Block Diagram

Nebra LoRaWAN Concentrator integrates one SX1302/3 chip and two SX1250. The other chip is for RF signal, which represents the core of the device. This provides the related LoRa modem and processing functionalities. Additional signal conditioning circuitry is implemented for PCI Express Mini Card compliance, and one uFL connector available for external antenna integration.



## Interfaces

The Nebra concentrator comes with a number of interfaces for its operations and status indicator. It is designed to be fully automated with very little physical interaction required.



- 1.** The mounting holes are required to secure the mPCIe module down when inserted to ensure that it doesn't come loose or disconnect from the socket.
- 2.** The heatsink covers the top half of the concentrator module and is used to dissipate any heat generated from the on-board ICs.
- 3.** Depending on your model of Nebra concentrator module you will have either one or two antenna connectors. The LoRa antenna connector and a GPS antenna connector which are both U.FL connectors.
- 4.** Mini PCI Express connector used to connect the module to another expansion board. The connector provides all the interface options and communication between the Host board and the module.
- 5.** There are three status LEDs to indicate some basic functionality. The Green LED indicates the module is configured (CFG), Yellow LED (middle) indicates the module is receiving a signal (Rx) and the Red LED indicates it is transmitting a signal (Tx)

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## Power

Nebra LPWAN Concentrator module must be supplied through the 3.3Vaux pins by a DC power supply. The voltage must be stable, because during this operation the current drawn from 3.3Vaux can vary significantly, based on the power consumption profile of the SX1302/3 chip .

## SPI

SPI interface is provided on the HOST\_SCK, HOST\_MISO, HOST\_MOSI, HOST\_CSN pins of the system connector. The SPI interface gives access to the configuration register of SX1302/3 via a synchronous full-duplex protocol. Only the slave side is implemented.

## USB

Nebra LPWAN Concentrator can support the high speed USB to SPI by the MCU USB bridge. It includes a USB 2.0 compliant interface, representing the interface for any communication with an external host application processor. The module itself acts as a USB device and can be connected to any USB host equipped with compatible drivers.

## I2C & UART

Nebra module integrates EVA-M8M GPS module which has UART and I2C interface. The PINs on golden finger provide an UART connection and an I2C connection, which allows direct access to the GPS module. The PPS signal is not only connected to SX1302/3 internally, but also connected to golden finger which can be used by host board.

## GPS

Nebra concentrator card includes the GPS\_PPS input for received packets time-stamped.

## RESET

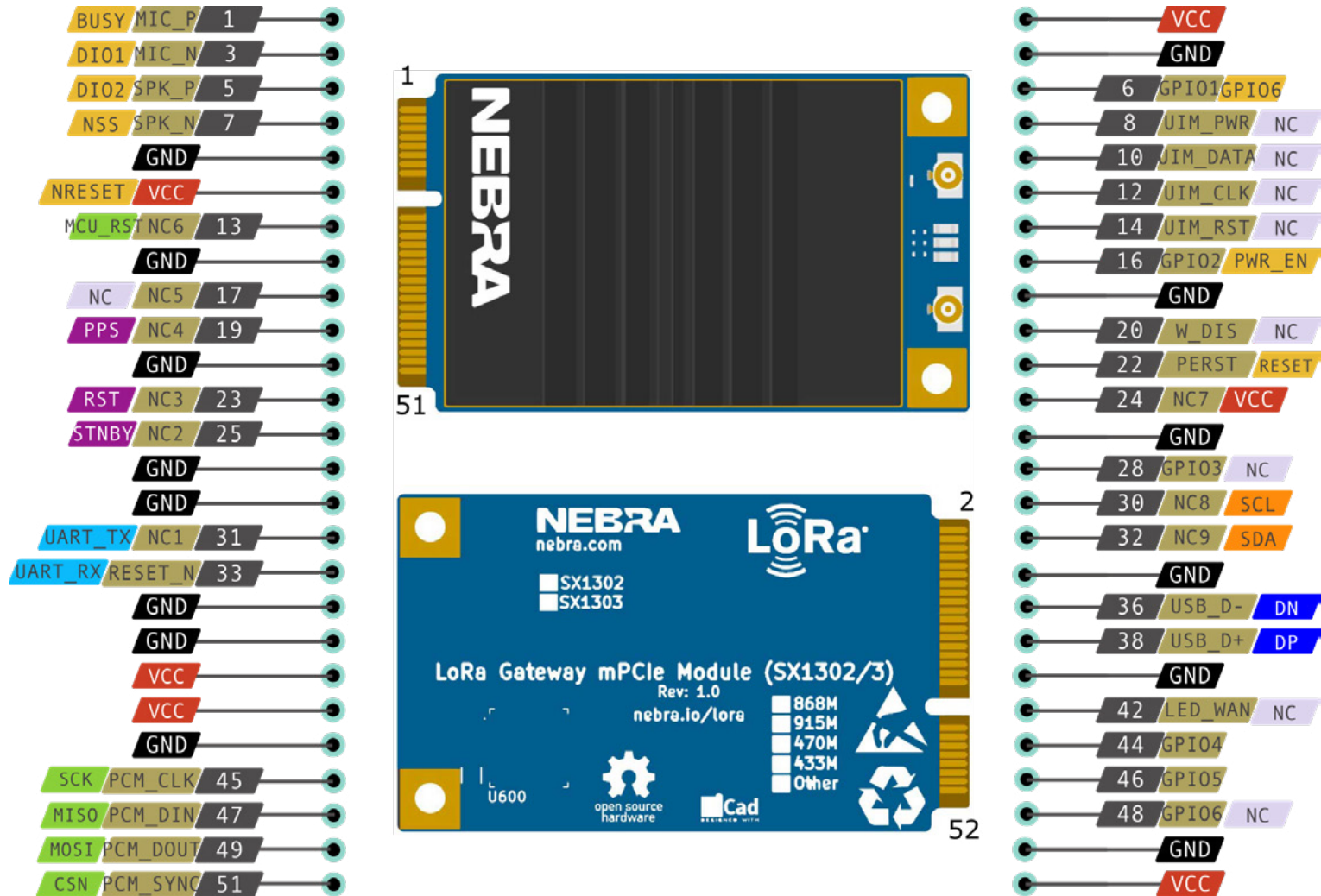
Nebra concentrator module includes the RESET active-high input signal to reset the radio operations as specified by the SX1302/3 specification.

## Antenna interface

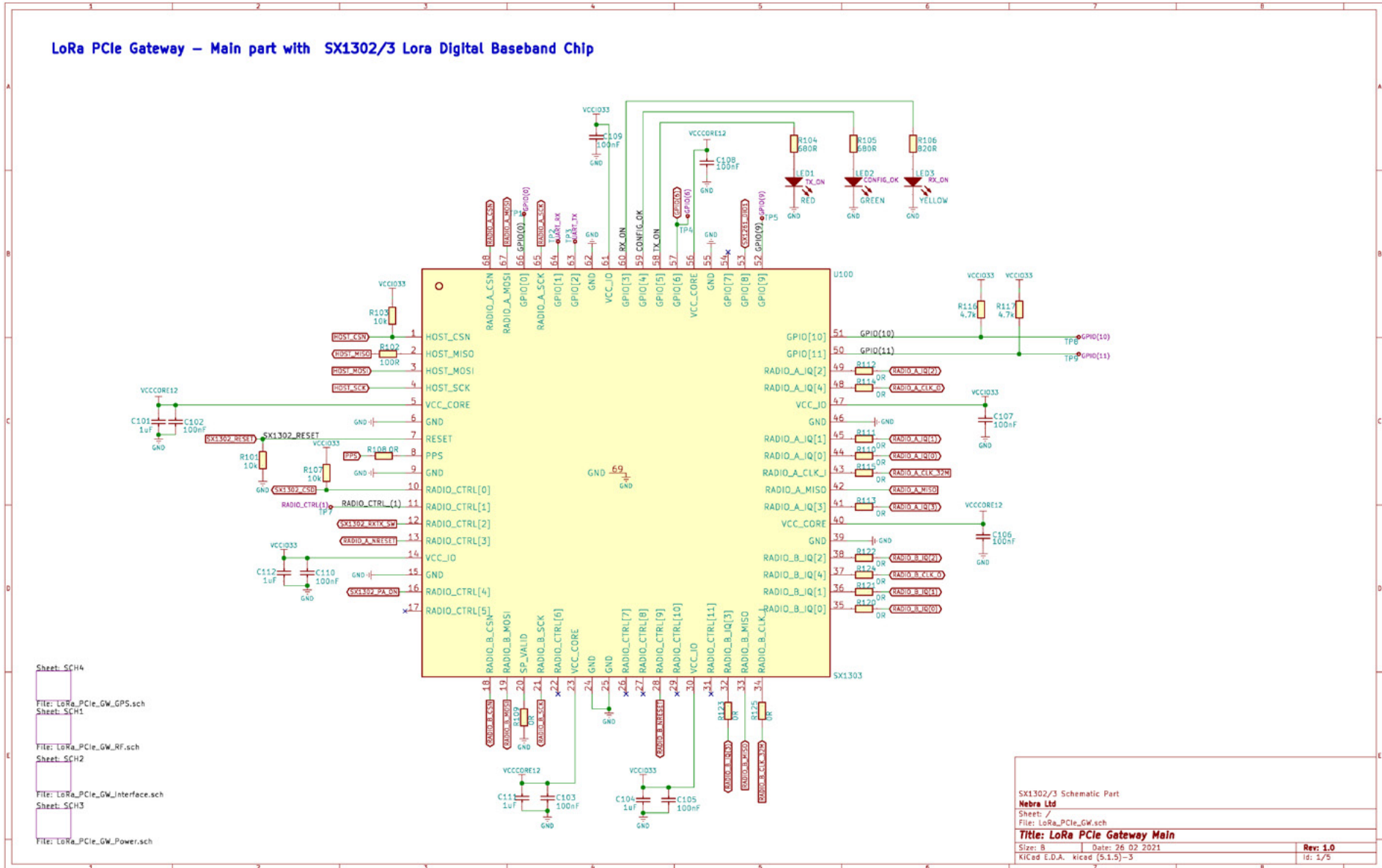
The module has one RF interfaces over a standard UFL connectors (Hirose U. FL-R-SMT) with a characteristic impedance of 50Ω. The RF port supports both Tx and Rx, providing the antenna interface.

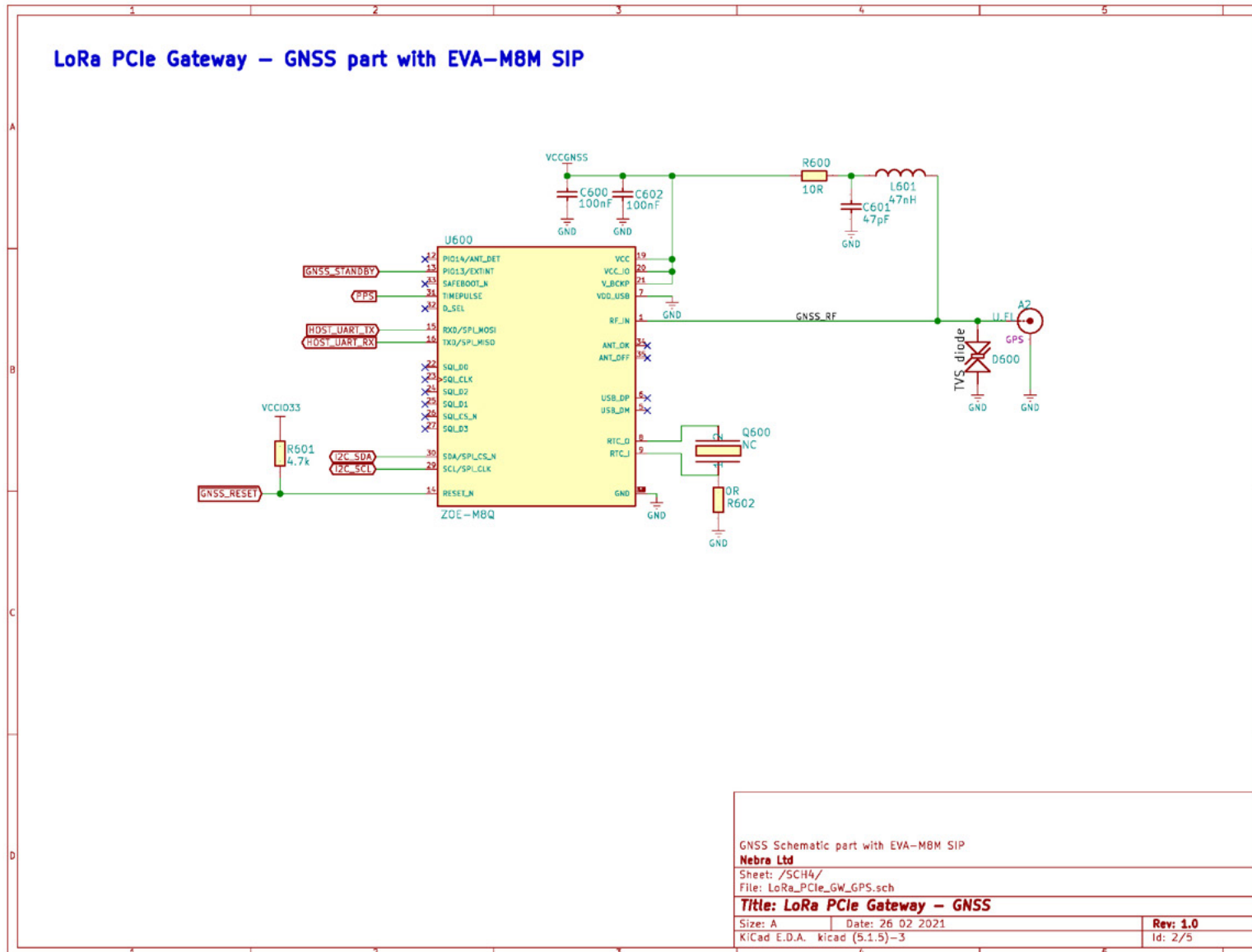
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## Board Pinout

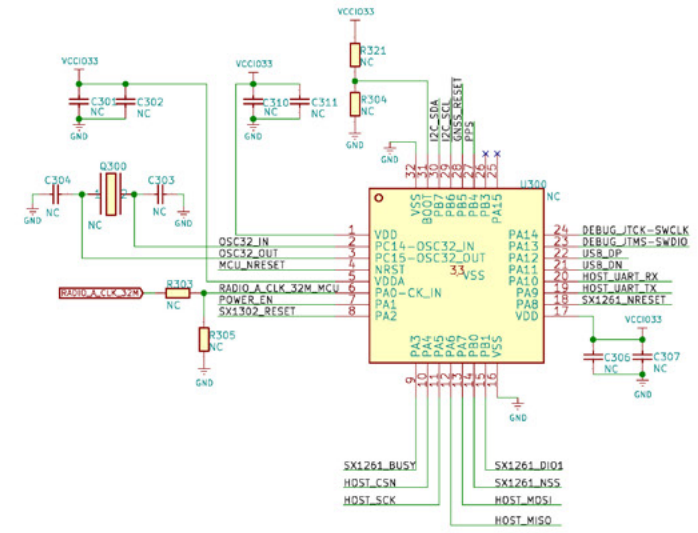
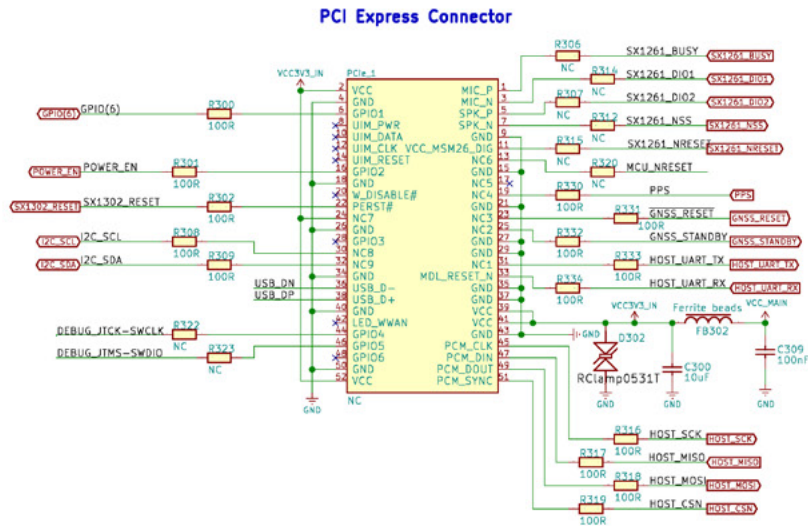








### LoRa PCIe Gateway Interface – mini-PCIe Interface Connector & MCU USB Bridge



Series 0 ohm resistors = DNP when MCU/USB is used

MCU = DNP when Lora Gateway module is used through SPI interface over PCIe connector

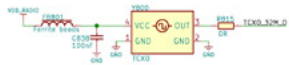
SWCLK, SWDIO, and MCU\_NRESET are connected to mini-PCIe

VCC\_MAIN comes from 5V or 3.3V

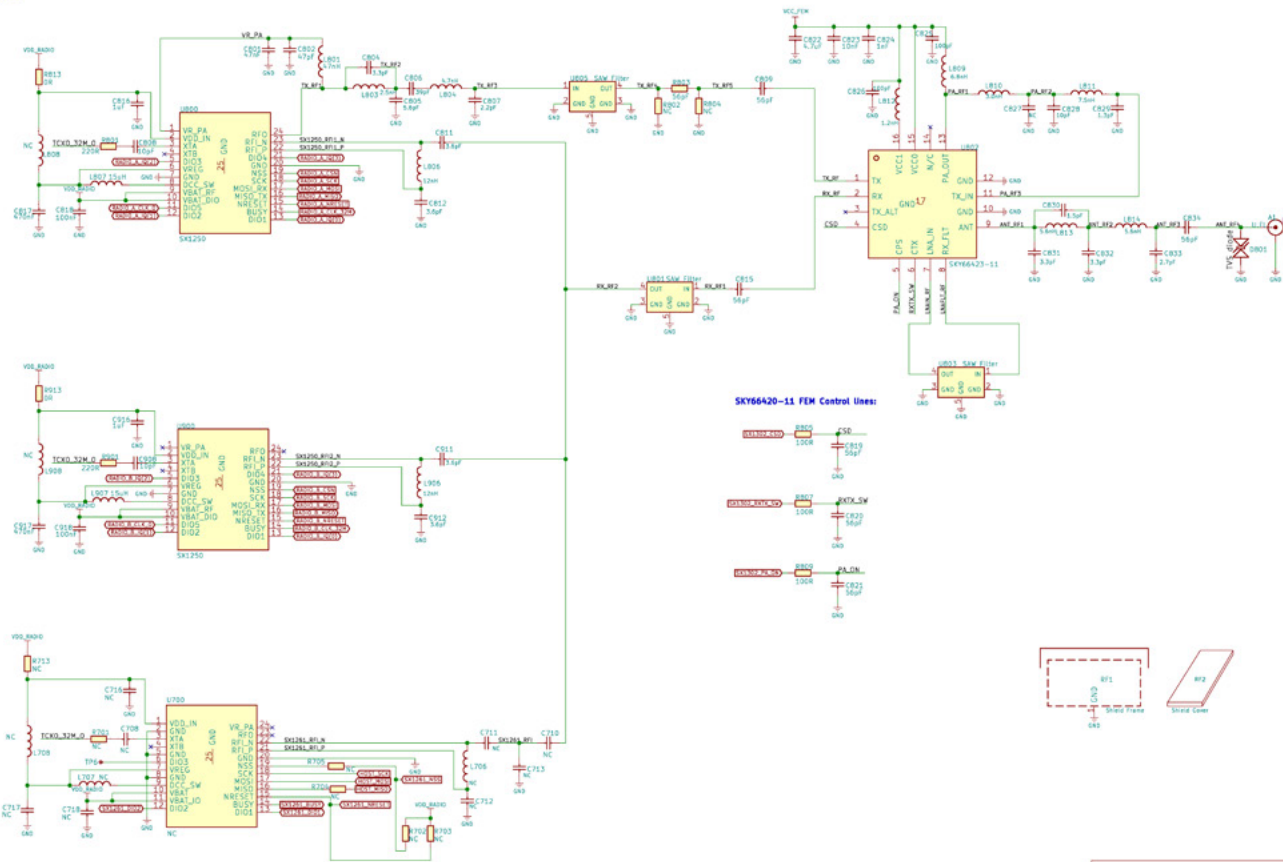
mini-PCIe Interface Connector & MCU USB Bridge  
 Nebra Ltd  
 Sheet: /SCH2/  
 File: LoRa\_Pcie\_GW\_Interface.sch  
**Title: LoRa PCIe Gateway Interface**  
 Size: B Date: 26 02 2021 Rev: 1.0  
 KiCad E.D.A. kicad (5.1.5)-3 Id: 3/5

### LoRa PCIe Gateway – RF Part with 2x SX1250 RF Front-Ends:

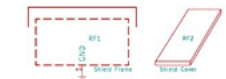
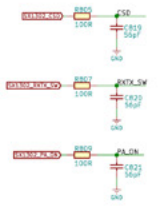
32MHz TCXO – Clipped Sinewave Output



See LoRa\_Reference\_Clock\_Section\_V1.1 for recommended etc



SKY66420-11 FEM Control Lines:



RF Front End Schematic Part	
Nebra Ltd	
Sheet: PCB17	
File: LoRa_Pcie_GW_RF.kicad	
Title: LoRa PCIe Gateway RF Part	
Rev: A	Date: 08 02 2021
KiCad 1.0.A - kicad (5.1.5)-3	Rev: 1.0
	02 5/2

## Board Pinout

PIN	mPCIE	Module PIN	POWER	Description
1	MIC_P	SX1261_BUSY		
2	VCC	VCC	3V3	
3	MIC_N	SX1261_DI01		
4	GND	GND	GND	Connected to ground
5	SPK_P	SX1261_DI02		
6	GPIO1	GPIO6		
7	SPK_N	SX1261_NSS		
8	UIM_PWR	NC		Not connected
9	GND	GND	GND	Connected to ground
10	UIM_DATA	NC		Not connected
11	VCC	SX1261_NRESET		
12	UIM_CLK	NC		Not connected
13	NC6	MCU_NRESET		
14	UIM_RESET	NC		Not connected
15	GND	GND	GND	Connected to ground
16	GPIO2	POWER_EN		
17	NC5	NC		Not connected
18	GND	GND	GND	Connected to ground
19	NC4	PPS		GPS PPS
20	W_DISABLE	NC		Not connected
21	GND	GND	GND	Connected to ground
22	PERST	SX1302_RESET		
23	NC3	GNSS_RESET		Reset GPS module
24	NC7	VCC	3V3	
25	NC2	GNSS_STANDBY		
26	GND	GND	GND	Connected to ground
27	GND	GND	GND	Connected to ground
28	GPIO3	NC		Not connected
29	GND	GND	GND	Connected to ground
30	NC8	I2C_SCL		
31	NC1	HOST_UART_TX		
32	NC9	I2C_SDA		
33	MDL_RESET_N	HOST_UART_RX		
34	GND	GND	GND	Connected to ground
35	GND	GND	GND	Connected to ground
36	USB_D-	USB_DN		
37	GND	GND	GND	Connected to ground
38	USB_D+	USB_DP		

PIN	mPCIE	Module PIN	POWER	Description
39	VCC	VCC_MAIN	3V3	Comes from 5V or 3V3
40	GND	GND	GND	Connected to ground
41	VCC	VCC_MAIN	3V3	Comes from 5V or 3V3
42	LED_WWAN	NC		Not connected
43	GND	GND	GND	Connected to ground
44	GPIO4	JTCK_SWCLK		
45	PCM_CLK	HOST_SCK		
46	GPIO5	JTMS_SWDIO		
47	PCM_DIN	HOST_MISO		
48	GPIO6	NC		Not connected
49	PCM_DOUT	HOST_MOSI		
50	GND	GND	GND	Connected to ground
51	PCM_SYNC	HOST_CSN		
52	VCC	VCC	3V3	

## Operating Frequencies

### SX1302

Nebra SKU	Description	Frequency	Barcode
NBR-0077	Nebra SX1302 LoRa Concentrator (SPI no GPS)	915 MHz	646648341398
NBR-0078	Nebra SX1302 LoRa Concentrator (SPI no GPS)	868 MHz	646648341404
NBR-0079	Nebra SX1302 LoRa Concentrator (SPI no GPS)	470 MHz	646648341411
NBR-0080	Nebra SX1302 LoRa Concentrator (SPI no GPS)	433 MHz	646648341428
NBR-0081	Nebra SX1302 LoRa Concentrator (SPI with GPS)	915 MHz	646648341435
NBR-0082	Nebra SX1302 LoRa Concentrator (SPI with GPS)	868 MHz	646648341442
NBR-0083	Nebra SX1302 LoRa Concentrator (SPI with GPS)	470 MHz	646648341459
NBR-0084	Nebra SX1302 LoRa Concentrator (SPI with GPS)	433 MHz	646648341466
NBR-0085	Nebra SX1302 LoRa Concentrator (USB no GPS)	915 MHz	646648341473
NBR-0086	Nebra SX1302 LoRa Concentrator (USB no GPS)	868MHz	646648341480
NBR-0087	Nebra SX1302 LoRa Concentrator (USB no GPS)	470 MHz	646648341497
NBR-0088	Nebra SX1302 LoRa Concentrator (USB no GPS)	433 MHz	646648341503
NBR-0089	Nebra SX1302 LoRa Concentrator (USB with GPS)	915 MHz	646648341510
NBR-0090	Nebra SX1302 LoRa Concentrator (USB with GPS)	868 MHz	646648341527
NBR-0091	Nebra SX1302 LoRa Concentrator (USB with GPS)	470 MHz	646648341534
NBR-0092	Nebra SX1302 LoRa Concentrator (USB with GPS)	433 MHz	646648341541

### SX1303

Nebra SKU	Description	Frequency	Barcode
NBR-0093	Nebra SX1303 LoRa Concentrator (SPI no GPS)	915 MHz	646648341558
NBR-0094	Nebra SX1303 LoRa Concentrator (SPI no GPS)	868 MHz	646648341565
NBR-0095	Nebra SX1303 LoRa Concentrator (SPI no GPS)	470 MHz	646648341572
NBR-0096	Nebra SX1303 LoRa Concentrator (SPI no GPS)	433 MHz	646648341589
NBR-0097	Nebra SX1303 LoRa Concentrator (SPI with GPS)	915 MHz	646648341596
NBR-0098	Nebra SX1303 LoRa Concentrator (SPI with GPS)	868 MHz	646648341602
NBR-0099	Nebra SX1303 LoRa Concentrator (SPI with GPS)	470 MHz	646648341619
NBR-0100	Nebra SX1303 LoRa Concentrator (SPI with GPS)	433 MHz	646648341626
NBR-0101	Nebra SX1303 LoRa Concentrator (USB no GPS)	915 MHz	646648341633
NBR-0102	Nebra SX1303 LoRa Concentrator (USB no GPS)	868MHz	646648341640
NBR-0103	Nebra SX1303 LoRa Concentrator (USB no GPS)	470 MHz	646648341657
NBR-0104	Nebra SX1303 LoRa Concentrator (USB no GPS)	433 MHz	646648341664
NBR-0105	Nebra SX1303 LoRa Concentrator (USB with GPS)	915 MHz	646648341671
NBR-0106	Nebra SX1303 LoRa Concentrator (USB with GPS)	868 MHz	646648341688
NBR-0107	Nebra SX1303 LoRa Concentrator (USB with GPS)	470 MHz	646648341695
NBR-0108	Nebra SX1303 LoRa Concentrator (USB with GPS)	433 MHz	646648341701

## Environmental Requirements

This product should be operated only in a well ventilated environment to ensure there is enough heat dissipation.

Unless otherwise indicated, all operating condition specifications are at an ambient temperature of 25°C. Operation beyond the operating conditions is not recommended and extended exposure beyond them may affect device reliability.

## Safety Instructions

**To avoid malfunction or damage to this product, please observe the following:**

Do not expose to water or moisture

Do not expose to any source of heat. The Nebra LoRaWAN module is designed for reliable operation and has been tested at normal ambient room temperatures (25°C)

Take care when handling to avoid mechanical, shock, vibration or electrical damage to the connectors or components inside

*Any modification to the LoRaWAN module will void any warranty*



## Compliance Information

### Certification

Below is a list of approved regions with links to certification for viewing.

Approval	Country	Hardware Frequency	Status	Frequency Plan
CE	European Economic Area		TBA	EU 868
UKCA	United Kingdom		TBA	EU 868
FCC	United States of America		TBA	US 915
RCM	Australia & New Zealand		TBA	AU 915

### Certification Codes

Certification	Code
FCC	TBA
ISED	TBA

### RoHS

All our Nebra concentrator modules have been tested under the EU RoHS Directive 2011/65/EU and its amendmant directive 2015/863/EU. You can view the certification here -

### Open Source Hardware Certification

We are proud to announce that the Nebra LoRa mPCIe Concentrator project is certified as Open Source Hardware by the Open Source Hardware Association (OSHWA). The registration number for this project is UK000026.



## Trademarks

Nebra, the Nebra Logo are all trademarks of Nebra LTD t/a Pi Supply (UK Company Number 06732600)

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## Warranty Information

All goods supplied by Nebra Ltd are warranted free from defects for 12 months from the date of supply. Warranty will cover hardware only and where possible we will repair or replace if sufficient evidence is provided of a possible defect.

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## Contact Information

United Kingdom, London

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East Sussex, TN3 9BJ, England

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## Change Notes

Version	Date	Change	Initials
v1.0	30/03/22	Draft	CR
v1.1	12/04/22	Updated info	CR