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NEBRA LoRa CONCENTRATOR MODULE



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Product Overview

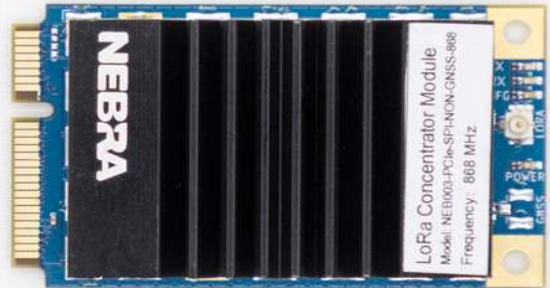
The Nebra LoRaWAN module is a LoRaWAN Concentrator module with mini-PCIe form factor based on the SX1302/3. This enables easy integration into routers and other networking equipment, adding gateway capabilities. The module can be used in any embedded platform offering a mini-PCIe slot with an SPI or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

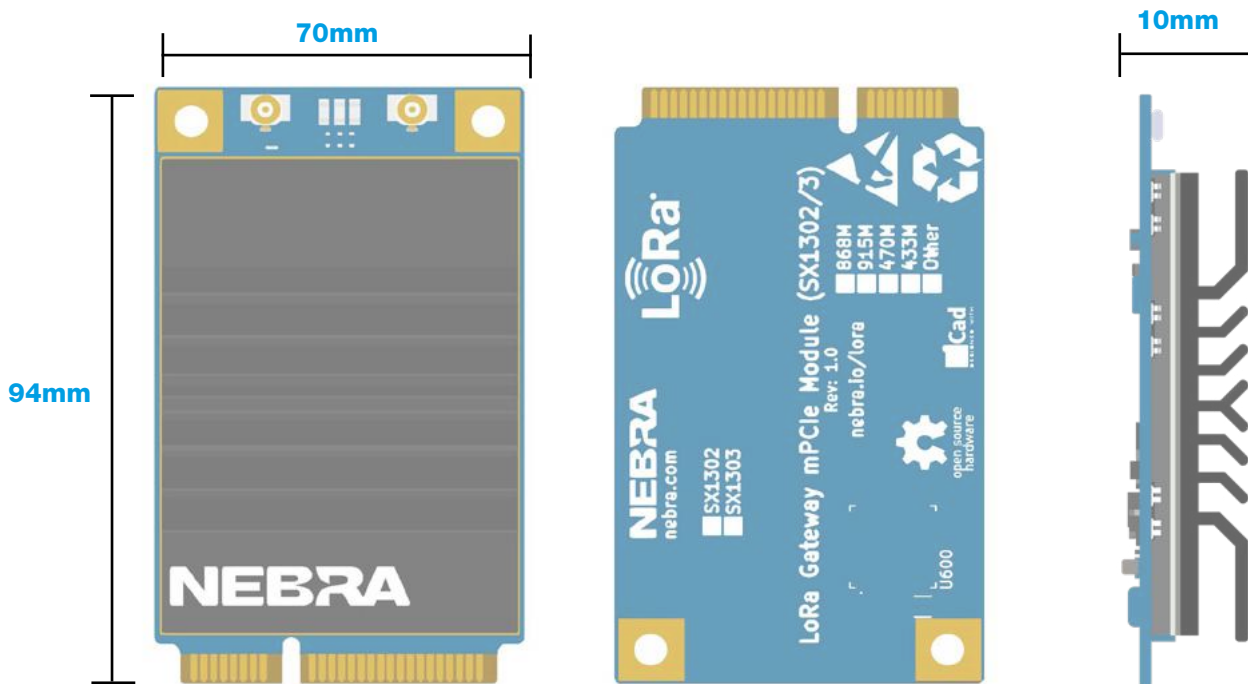


Specification

| 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

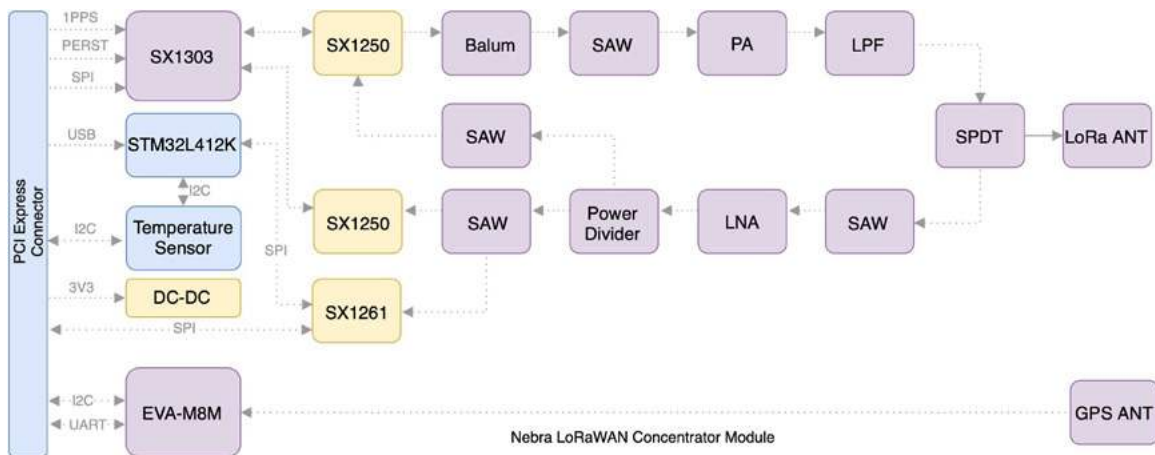


RF Characteristics

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

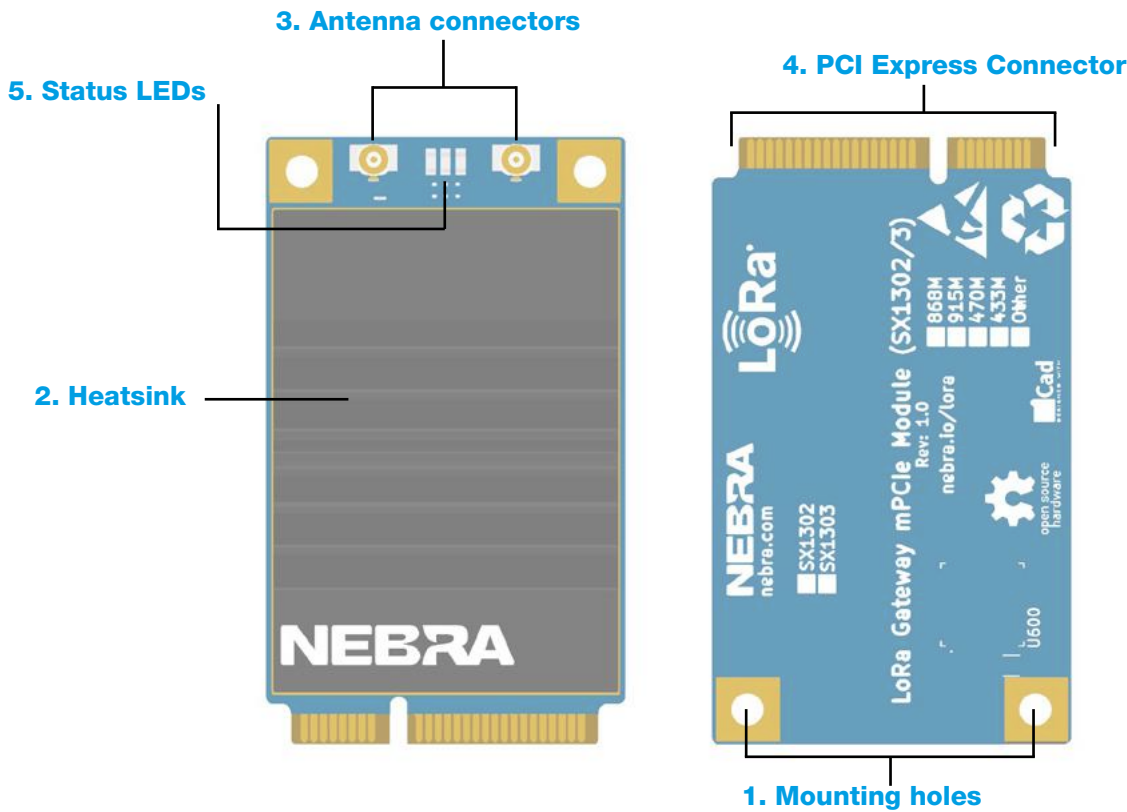
Block Diagram

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

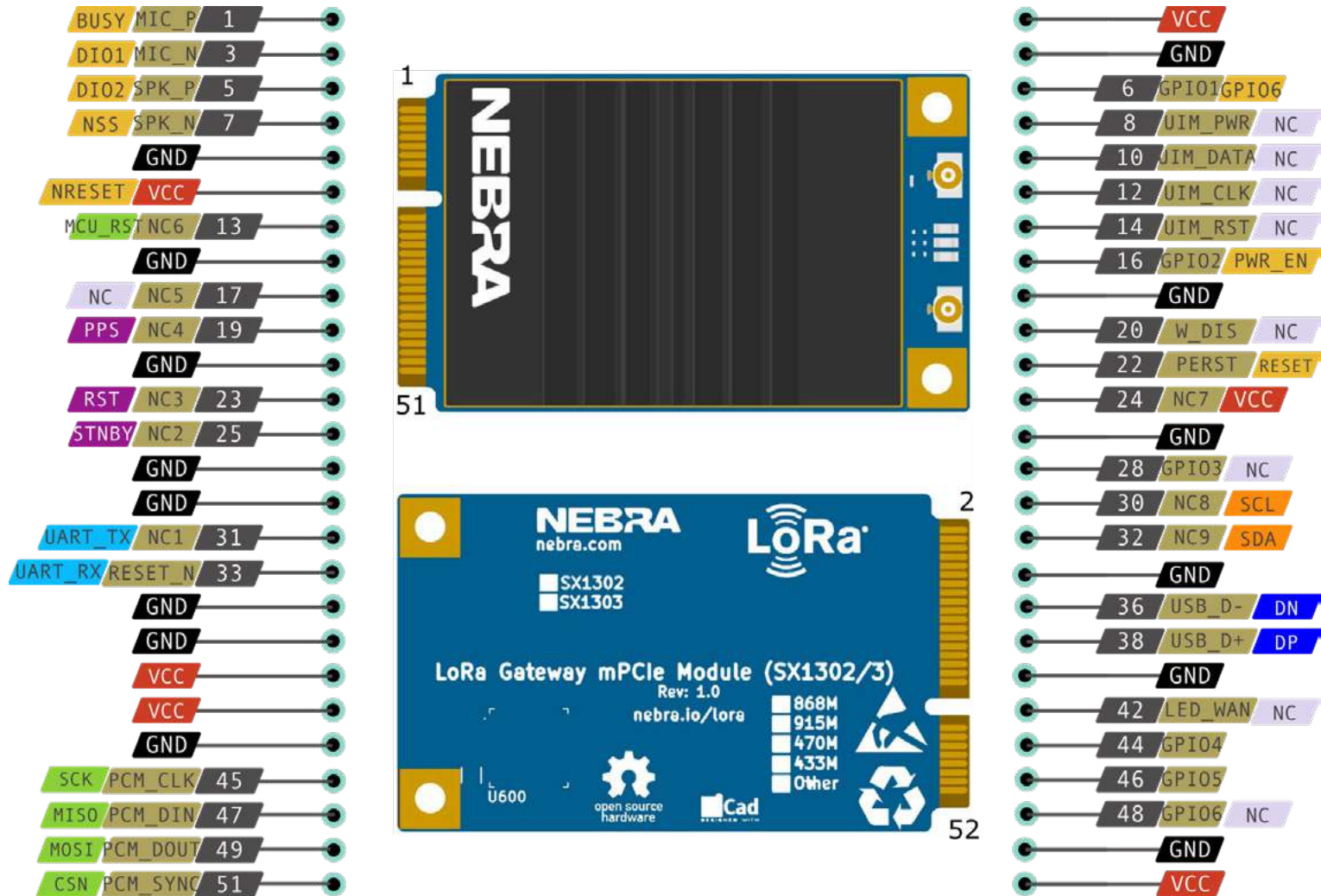
Nebra concentrator module includes the RESET active-high input signal to reset the radio operations as specified by the SX1302/3 specification.

Antenna interface

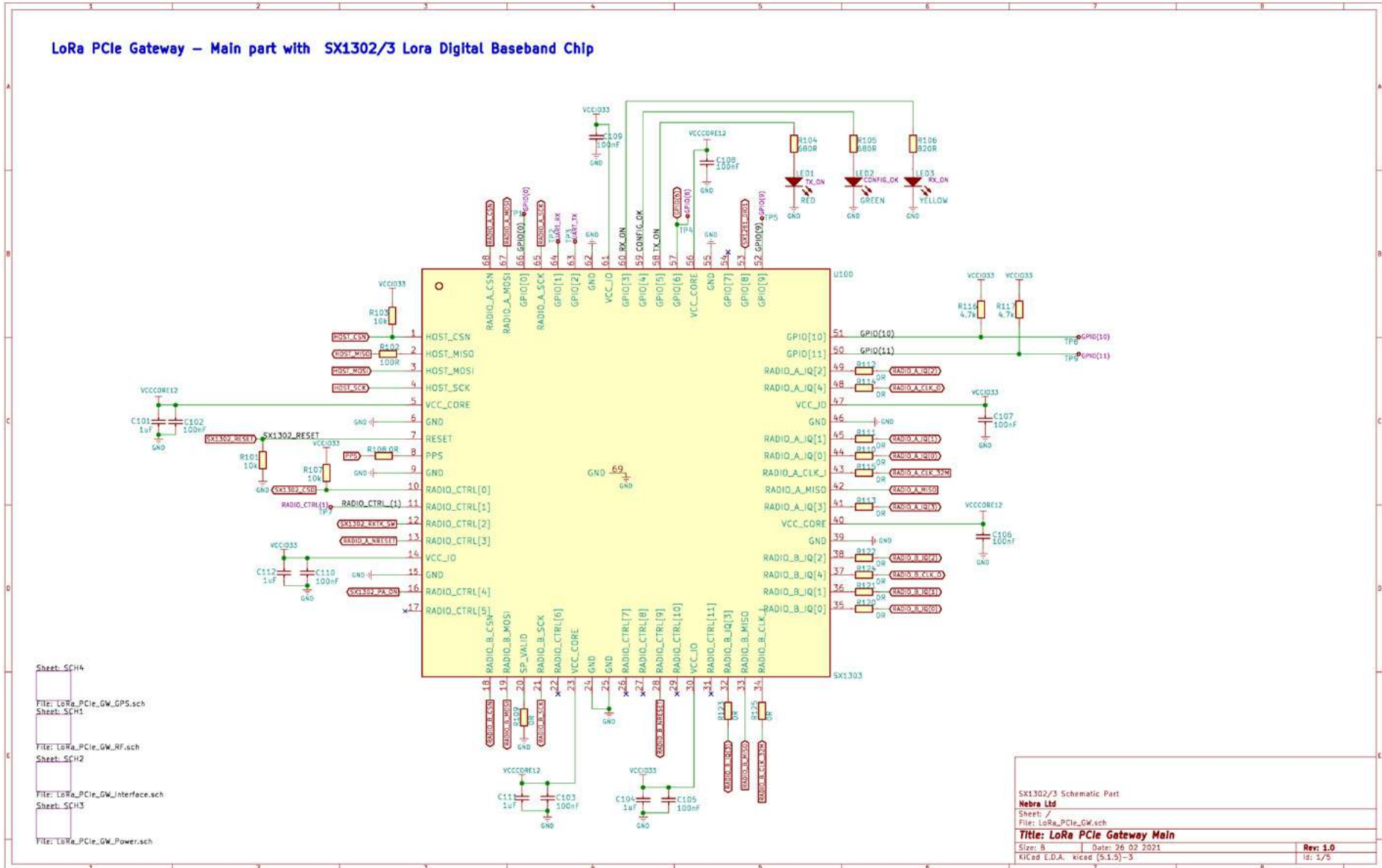
The module has one RF interfaces over a standard UFL connectors (Hirose U. FL-R-SMT) with a characteristic impedance of 50Ω. The RF port supports both Tx and Rx, providing the antenna interface.

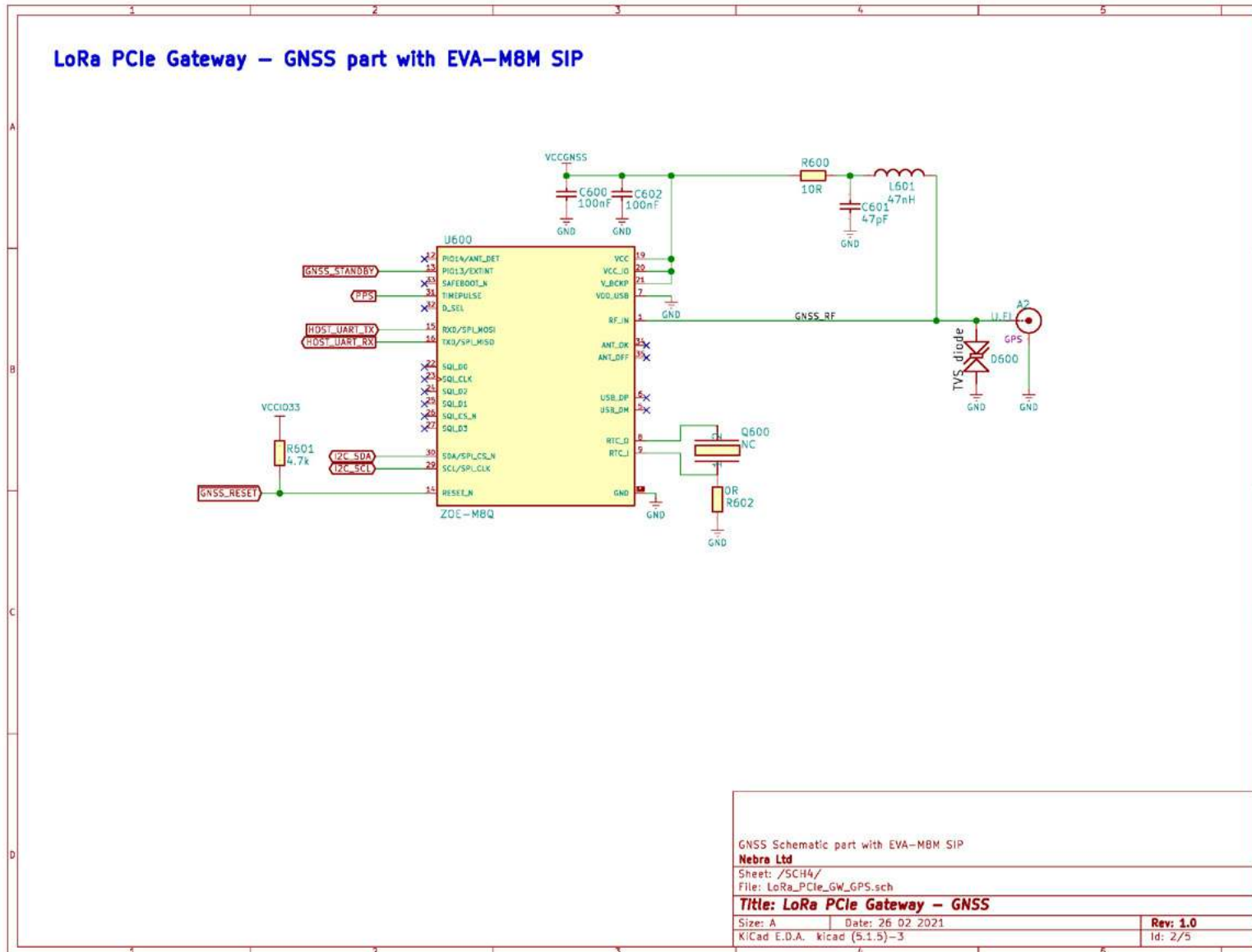
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Board Pinout

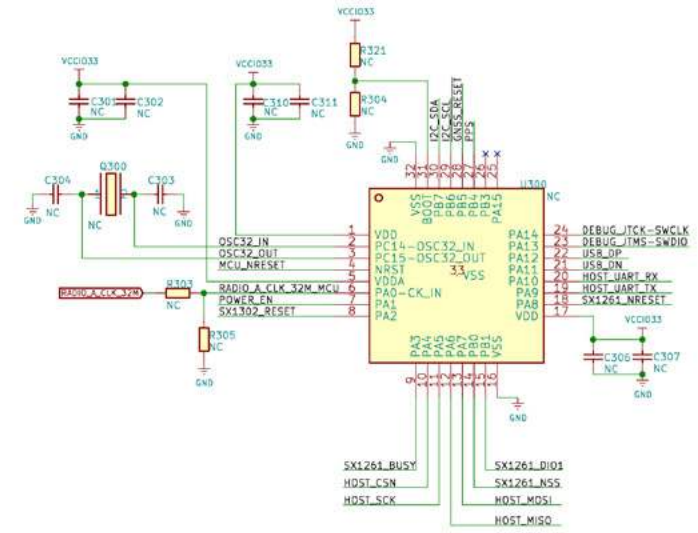
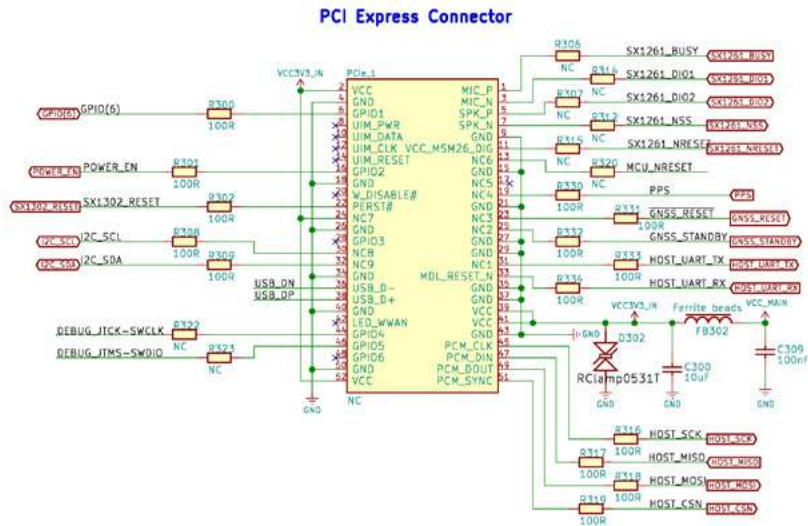


- mPCIe Pin Number
- Ground
- GPS Module
- I2C
- mPCIe Pin Function
- 3V3 Power
- UART
- USB
- SX1261/SX1302/3
- Not Connected
- SPI





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

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Sheet: /SCH2/

File: LoRa_Pcie_GW_Interface.sch

Title: LoRa PCIe Gateway Interface

Size: B Date: 26 02 2021

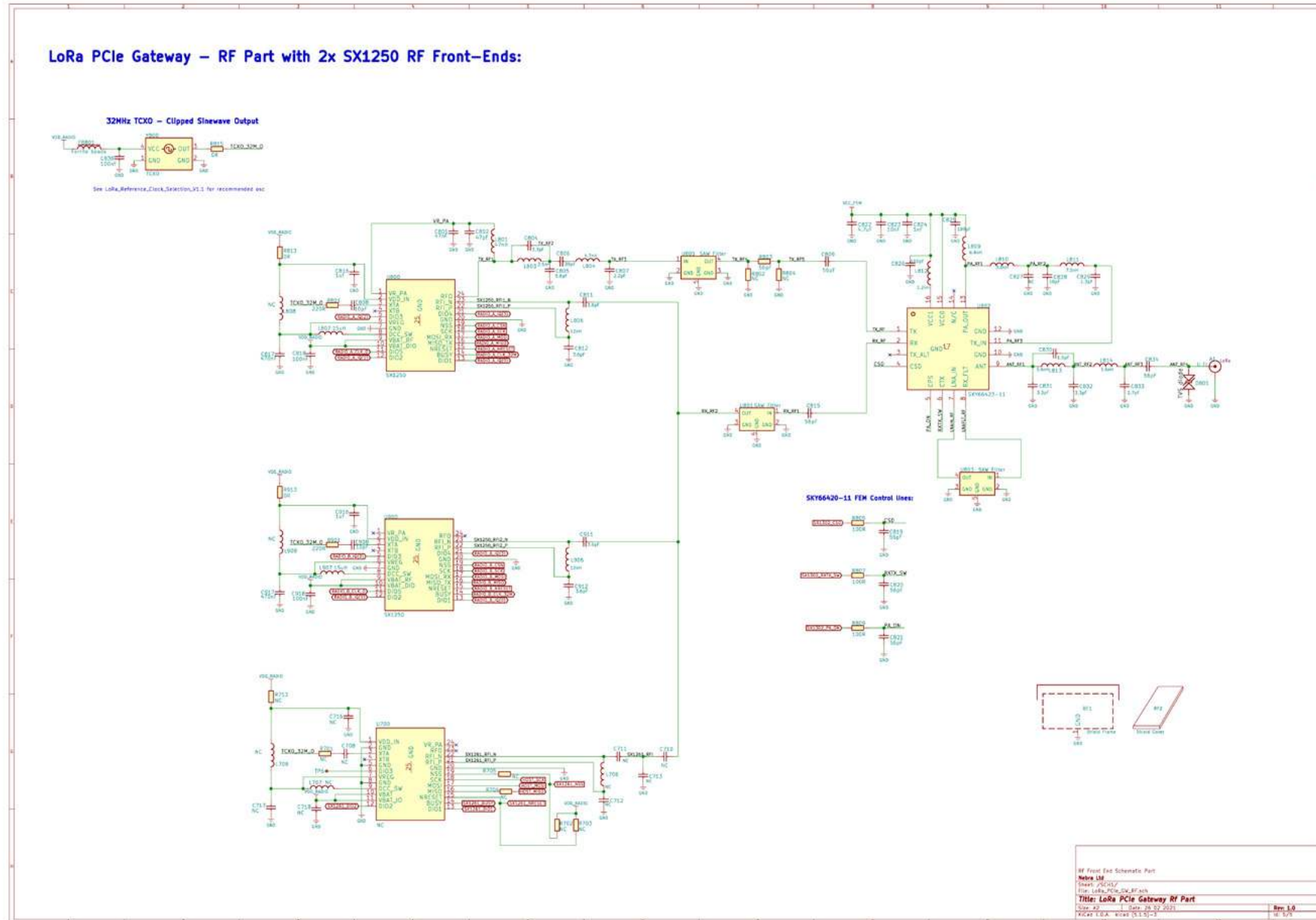
Rev: 1.0

KiCad E.O.A. kicad (5.1.5)-3

Id: 3/5

Schematic Diagram SX1250

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



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)

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.

Contact Information

United Kingdom, London

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East Sussex, TN3 9BJ, England

Change Notes

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