RAK833 WisLink LPWAN Concentrator Datasheet

Overview

Description

The **RAK833 WisLink LPWAN Concentrator** is a family of LoRa concentrator modules with mini PCIe form factor based on SX1301, which enables an easy integration into an existing routers and other network equipments with gateway capabilities.This can be used in any embedded platform offering a free mini-PCIe slot with USB and SPI connectivity.

RAK833 WisLink LPWAN Concentrator is a complete and cost efficient gateway solution offering up to 10 programmable parallel demodulation paths. It is targeted at smart metering fixed networks and Internet of Things applications with up to 500 nodes per square kilometer (km²) in moderately interfered environment. These modules have the industry standard PCI Express Mini Card form factor which enables easy integration into an application board.

Product Features

- Full LoRaWAN 1.0.2 stack support
- Compact size in the form of a mPCIe 52pin form factor card
- SX1301 base band processor emulates 49 x LoRa demodulators, 10 parallel demodulation paths. It supports 8 uplinks channel and 1 downlink channel.
- Max Tx Power of 20dBm
- RX sensitivity of -136dBm
- Compatible with 3.3V mPCIe type slots, common for 3G/LTE modules
- With an option for SPI interface board or both SPI and USB interfaces
- Perfect for a Plug-and-Play Setup when used together with the mPCIe to USB adapter (check this option above to include the board)

Specifications

Overview

The overview shows the top and back view of the RAK833 board. It also presents the block diagram that shows how the board works.

Board Overview

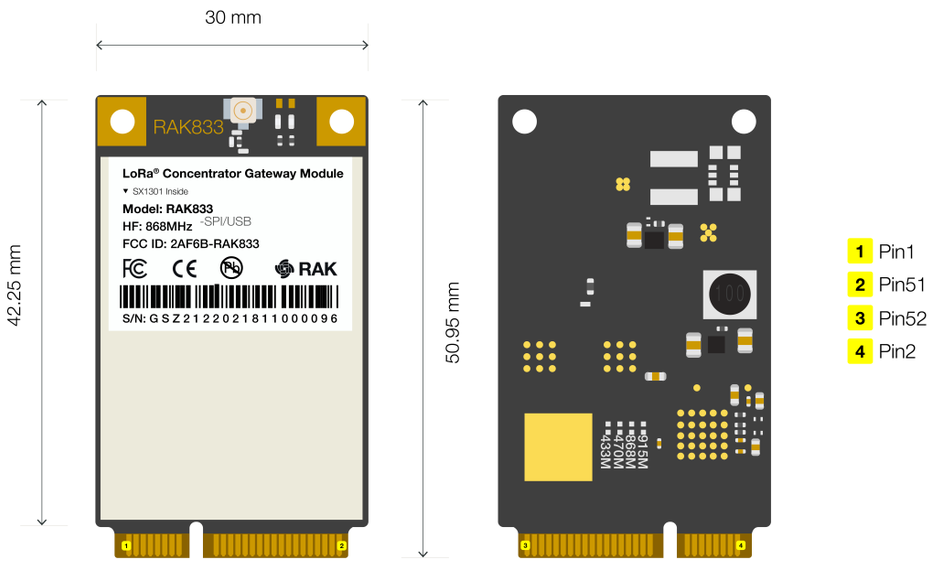

Figure 1: RAK833 WisLink LPWAN Concentrator Dimension

Block Diagram

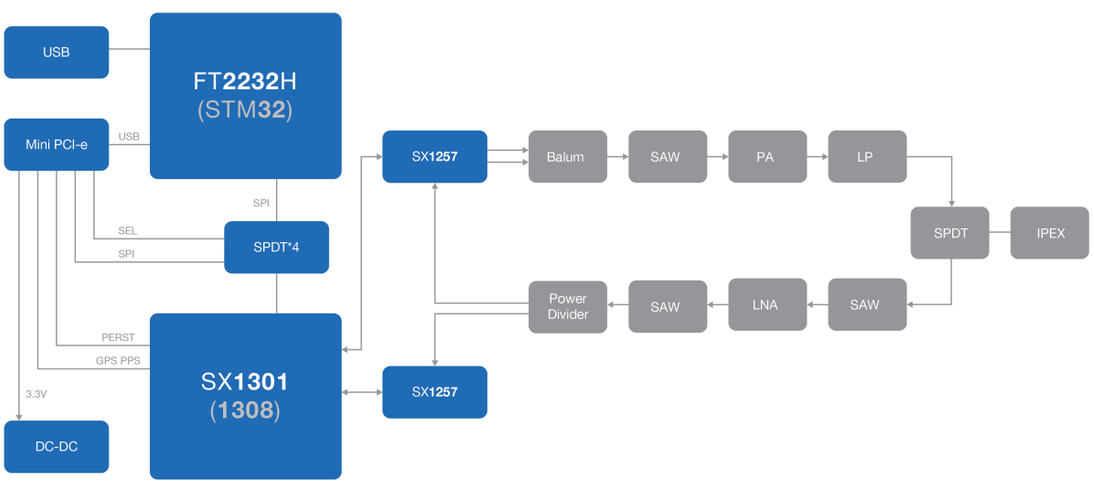

Figure 2: RAK833 WisLink LPWAN Concentrator Block Diagram

Hardware

The hardware is categorized into seven parts. It discusses the interfacing, pinouts and its corresponding functions and diagrams. It also covers the parameters and standard values of the board in terms of electrical, mechanical, and environmental.

Interfaces

GPS_PPS

The RAK833 WisLink LPWAN Concentrator includes the GPS_PPS input for received packets time-stamped. It integrates **one (1) SX1301** chip, **two (2) SX1255/7**, and other chip for RF signal, which represents the core of the device, providing the related LoRa modem and processing functionalities. Additional signal conditioning circuitry is implemented for PCI Express Mini Card compliance, and one u.FL connectors are available for external antennas integration.

Module supply input

RAK833 WisLink LPWAN Concentrator 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 SX1301 chip (see **SX1301 DS** datasheet).

Antenna RF interfaces

The modules have one RF interface over a standard **U. FL connectors** (Hirose U. FL-R-SMT) with a characteristic impedance of 50 Ω. The RF port (ANT1) supports both Tx and Rx, providing the antenna interface.

SPI interface

An SPI interface is provided on the PCIe*SCK, PCIe* MISO, PCIe*MOSI, PCIe* CSN pins of the system connector. The SPI interface gives access to the configuration register of SX1301 via a synchronous full-duplex protocol. Only the slave side is implemented.

USB interface

> ⚠️ **WARNING**
>
> This feature is not available for RAK833-SPI version

RAK833 WisLink LPWAN Concentrator can support the high speed USB to SPI by **FT2232H**, it includes a high-speed USB 2.0 compliant interface with maximum 480 Mb/s data rate, 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. For more information, please refer to the data sheet of **FT2232H** .

RESET

RAK833 WisLink LPWAN Concentrator includes the RESET active-high input signal to reset the radio operations as specified by the SX1301 Specification.

SPDT_SEL

RAK833 WisLink LPWAN Concentrator includes the SPDT_SEL input for selecting SPI or USB interface.

- SPDT_SEL="H", USB Port Enable,
- SPDT_SEL="L", SPI Port Enable.

Pin Definition

The following table lists the pin numbers of RAK833 WisLink LPWAN Concentrator and its corresponding names and description. Refer to figure below for a pinout diagram.

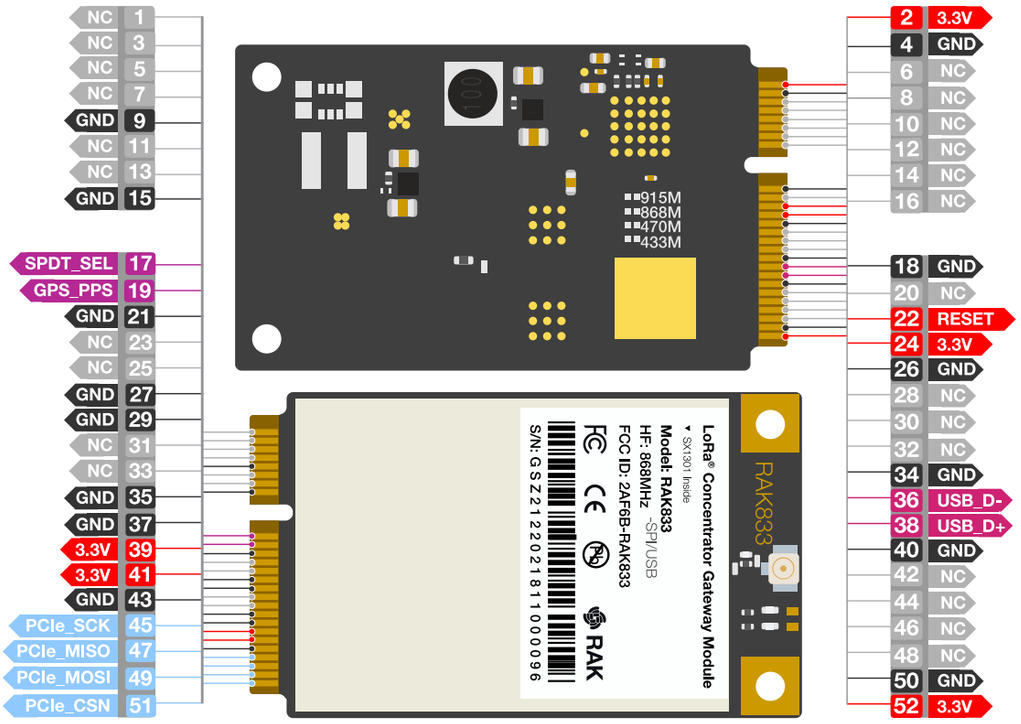

Figure 3: RAK833 WisLink LPWAN Concentrator Pinout Diagram

No	Mini PCIEx PIN Rev. 2.0	RAK833 PIN	Power	I/O	Description	Remarks
1	WAKE#	NC	-	N/A	-	Internally not connected
2	3.3Vaux	3.3Vaux	3.3Vaux	N/A	RAK833 supply input	Connect to 3.3 V
3	COEX1	NC	-	N/A	-	Internally not connected
4	GND	GND	GND	N/A	Ground	Connect to Ground
5	COEX2	NC	-	N/A	-	Internally not connected
6	1.5V	NC	-	N/A	-	Internally not connected
7	CLKREQ#	NC	-	N/A	-	Internally not connected
8	UIM_PWR	NC	-	N/A	-	Internally not connected
9	GND	GND	GND	N/A	Ground	Connect to Ground
10	UIM_DATA	NC	-	N/A	-	Internally not connected
11	REFCLK-	NC	-	N/A	-	Internally not connected
12	UIM_CLK	NC	-	N/A	-	Internally not connected
13	REFCLK+	NC	-	N/A	-	Internally not connected
14	UIM_RESET	NC	-	N/A	-	Internally not connected
15	GND	GND	GND	N/A	Ground	Connect to Ground
16	UIM_SPU	NC	-	N/A	-	Internally not connected
17	UIM_IC_ DM	SPDT_SEL	-	N/A	-	Internal 10K ohm pull-up
18	GND	GND	GND	N/A	Ground	Connect to Ground
19	GPS_PPS	GPS_PPS		N/A		Internal connection GPS_PPS for SX1301
20	W_DISABLE1#	NC	-	N/A	-	Internally not connected

No	Mini PCIEx PIN Rev. 2.0	RAK833 PIN	Power	I/O	Description	Remarks
21	GND	GND	GND	N/A	Ground	Connect to Ground
22	PERST#	RESET		I	RAK833 reset input	Active high(≥100ns) for SX1301
23	PERn0	NC		N/A		Internally not connected
24	3.3Vaux	3.3Vaux	3.3Vaux	I	RAK833 supply input	Connect to 3.3 V
25	PERp0	NC	-	N/A	-	Internally not connected
26	GND	GND	GND	N/A	Ground	Connect to Ground
27	GND	GND	GND	N/A	Ground	Connect to Ground
28	1.5V	NC	-	N/A	-	Internally not connected
29	GND	GND	GND	N/A	Ground	Connect to Ground
30	SMB_CLK	NC	-	N/A	-	Internally not connected
31	PETn0	NC	-	N/A	-	Internally not connected
32	SMB_DATA	NC	-	N/A	-	Internally not connected
33	PETp0	NC	-	N/A	-	Internally not connected
34	GND	GND	GND	N/A	Ground	Connect to Ground
35	GND	GND	GND	N/A	Ground	Connect to Ground
36	USB_D-	USB_D-	USB	I/O	USB Data Line D-	90-ohm nominal differential impedance. Pull-up, pull-down and series resistors as required by USB 2.0 specifications are part of the USB pin driver and need not be provided externally.
37	GND	GND	GND	N/A	Ground	Connect to Ground

No	Mini PCIEx PIN Rev. 2.0	RAK833 PIN	Power	I/O	Description	Remarks
38	USB_D+	USB_D+	USB	I/O	USB Data Line D+	90-ohm nominal differential impedance. Pull-up, pull-down and series resistors as required by USB 2.0 specifications are part of the USB pin driver and need not be provided externally.
39	3.3Vaux	3.3Vaux	3.3Vaux	I	RAK833 supply input	Connect to 3.3 V
40	GND	GND	GND	N/A	Ground	Connect to Ground
41	3.3Vaux	3.3Vaux	3.3Vaux	I	RAK833 supply input	Connect to 3.3 V
42	LED_WWAN#	NC	-	N/A	-	Internally not connected
43	GND	GND	GND	N/A	Ground	Connect to Ground
44	LED_WLAN#	NC	-	N/A	-	Internally not connected
45	Reserved	PCIe_SCK	-	I/O	Host SPI CLK	Max 10 MHz clock
46	LED_WPAN#	NC	-	N/A	-	Internally not connected
47	Reserved	PCIe_MISO	-	I/O	Host SPI MISO	-
48	1.5V	NC	-	N/A	-	Internally not connected
49	Reserved	PCIe_MOSI	-	I/O	Host SPI MOSI	-
50	GND	GND	GND	N/A	Ground	Connect to Ground
51	W_DISABLE2#	PCIe_CSN	-	I/O	Host SPI CS	-
52	3.3Vaux	3.3Vaux	3.3Vaux	I	RAK833 supply input	Connect to 3.3 V

RF Characteristics

The following table shows the typical sensitivity level of the RAK833 WisLink LPWAN Concentrator:

Signal Bandwidth (kHz)	Spreading Factor	Sensitivity (dBm)
125	12	-136.5
125	7	-124
250	12	-136
250	7	-123
500	12	-134
500	7	-120

Electrical Characteristics

Absolute Maximum Rating

Limiting values given below are in accordance with the Absolute Maximum Rating System (IEC 134).

> ⚠ **WARNING**
>
> Stressing the device above one or more of the ratings listed in the Absolute Maximum Rating section may cause permanent damage. These are stress ratings only. Operating the module at these or at any conditions other than those specified in the Operating Conditions section of the specification should be avoided. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

Symbol	Description	Condition	Min	Max	Unit
3.3Vaux	Module supply voltage	Input DC voltage at 3.3Vaux pins	–0.3	3.6	V
USB	USB D+/D- pins	Input DC voltage at USB interface pins	-	3.6	V
SPDT_SEL	Port select	Input DC voltage at SPDT_SEL input pins	–0.3	3.6	V
RESET	RAK833 reset input	Input DC voltage at RESET input pin	–0.3	3.6	V
SPI	SPI interface	Input DC voltage at SPI interface pin	–0.3	3.6	V
GPS_PPS	GPS 1 pps input	Input DC voltage at GPS_PPS input pin	–0.3	3.6	V
Rho_ANT	Antenna ruggedness	Output RF load mismatch ruggedness at ANT1	-	10:1	VSWR
Tstg	Storage Temperature	-	–40	85	°C

> ⚠️ **WARNING**
>
> The product is not protected against over-voltage or reversed voltages. If necessary, voltage spikes exceeding the power supply voltage specification, given in table above, must be limited to values within the specified boundaries by using appropriate protection devices.

Maximum Electrostatic Discharge (ESD)

> 📝 **NOTE**
>
> RAK833 WisLink LPWAN Concentrator are Electrostatic Sensitive Devices and require special precautions when handling.

Parameter	Min	Typical	Max	Unit	Remarks
ESD sensitivity for all pins except ANT1	-	-	1000	V	Human Body Model according to JESD22-A114
ESD sensitivity for ANT1	-	-	1000	V	Human Body Model according to JESD22-A114
ESD immunity for ANT1	-	-	4000	V	Contact Discharge according to IEC 61000-4-2
-	-	-	8000	V	Air Discharge according to IEC 61000-4-2

Operating Conditions

Unless otherwise indicated, all operating condition specifications are at an ambient temperature of 25°C.

> ⚠️ **WARNING**
>
> Operation beyond the operating conditions is not recommended and extended exposure beyond them may affect device reliability.

Operating Temperature Range

Parameter	Min	Typical	Max	Unit	Remarks
Normal operating temperature	–20	+25	+65	°C	Normal operating temperature range (fully functional and meet 3GPP specifications)
Extended operating temperature	–40	-	+85	°C	Extended operating temperature range (RF performance may be affected outside normal operating range, though module is fully functional)

Supply/Power Pins

Input voltage at **3.3Vaux** must be above the normal operating range minimum limit to switch-on the module.

Symbol	Parameter	Min.	Typical	Max.	Unit
3.3Vaux	Module supply operating input voltage	3.00	3.30	3.60	V

Current Consumption

Mode	Condition	Min	Type	Max	Unit
Idle-Mode	All of the chip on the board enter idle mode or shutdown.	60	100	-	uA
Active-Mode (TX)	The power of TX channel is 23dBm and 3.3V supply.	-	TBD	-	mA
Active-Mode (RX)	TX disabled and shutdown PA.	-	TBD	-	mA

Mechanical Characteristics

RAK833 WisLink LPWAN Concentrator is fully compliant to the **52-pin PCI Express Full-Mini Card Type F2** form factor, with top-side and bottom-side keep-out areas, with 50.95 millimeter nominal length, 30 millimeter nominal width and all the other dimensions as defined by the PCI Express Mini Card Electromechanical Specification except for the card thickness with a nominal value of 3.7 millimeter. The weight of the RAK833 WisLink LPWAN Concentrator is about 9.7 grams.

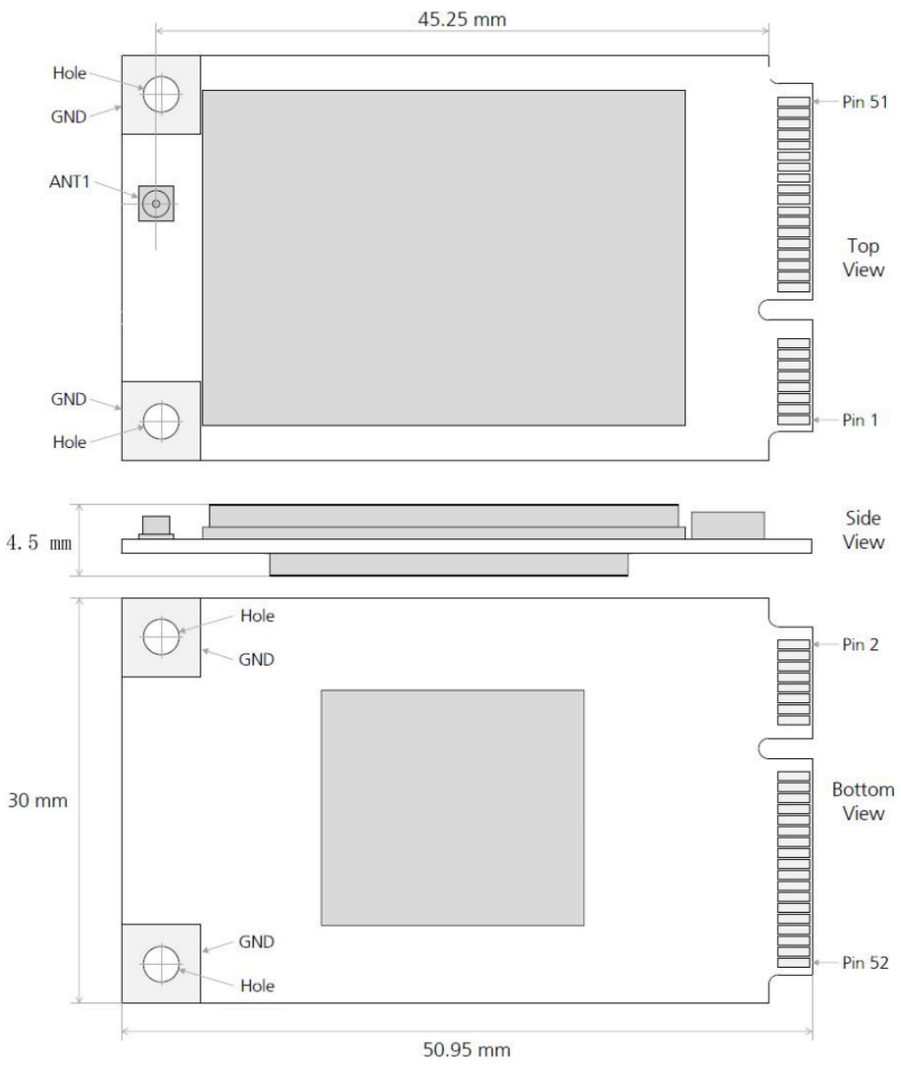

Figure 4: RAK833 WisLink LPWAN Concentrator Mechanical Characteristics

Schematic Diagrams

RAK833 WisLink LPWAN Concentrator refer Semtech's reference design of SX1301, and a 4 chancel SPDT to switch SPI of SX1301 to PCI edge connector or FT2232H which converts SPI to USB2.0 interface.

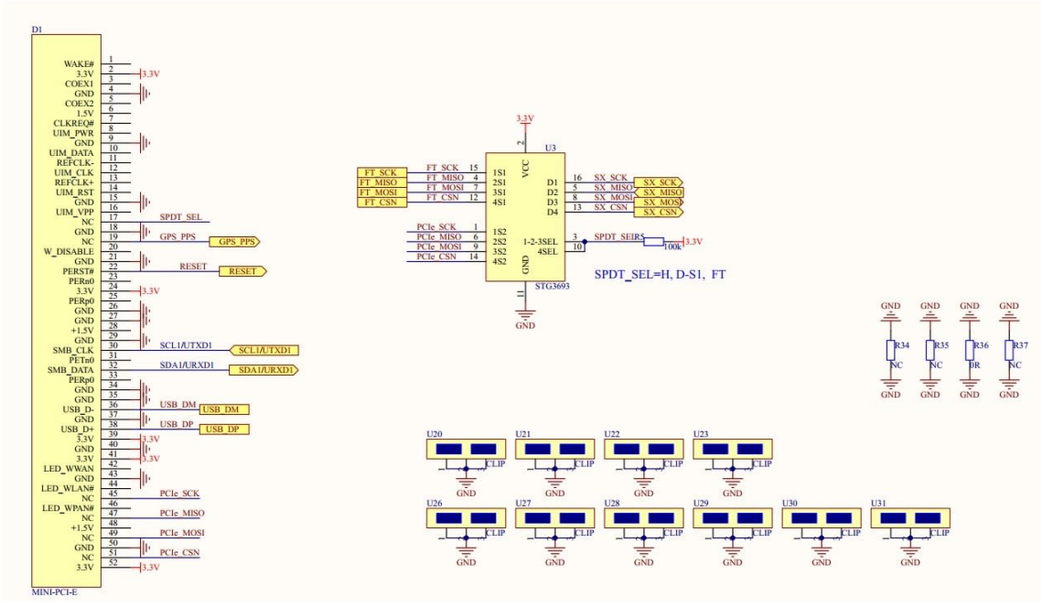

Figure 5: RAK833 WisLink LPWAN Concentrator Mechanical Characteristics

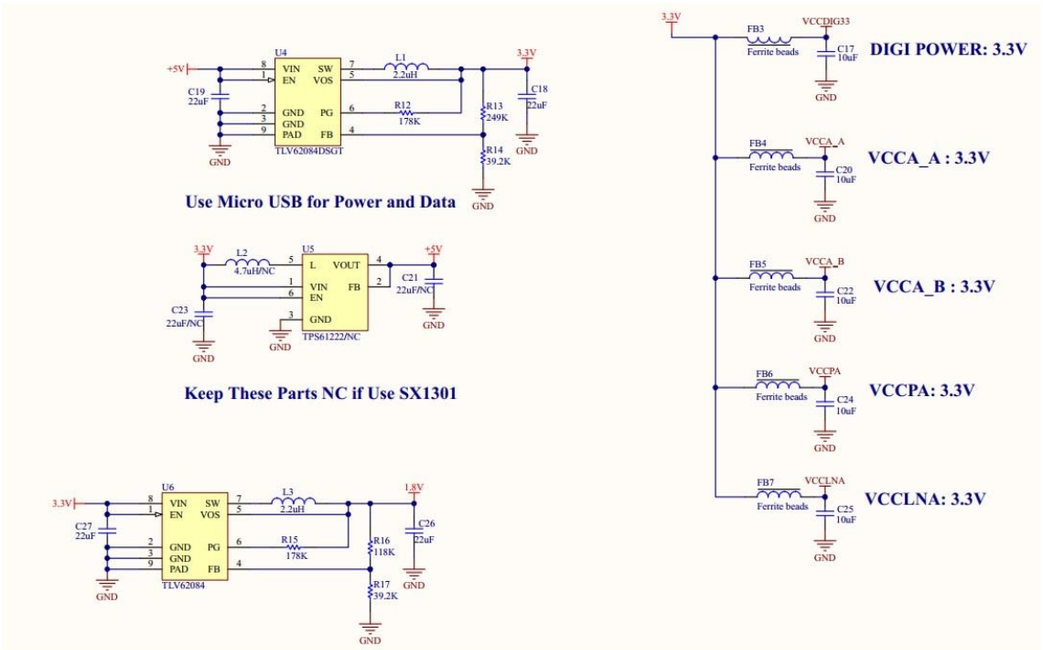

Figure 6: Power Source Schematic Diagram

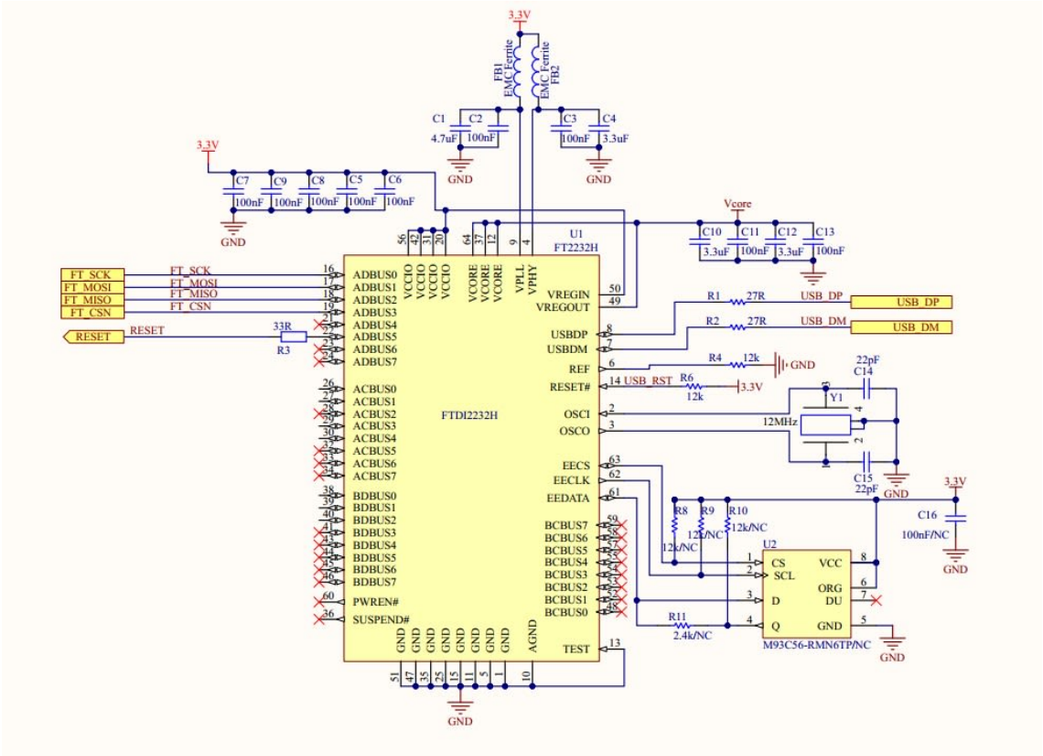

Figure 7: FT22323 IC Schematic Diagram

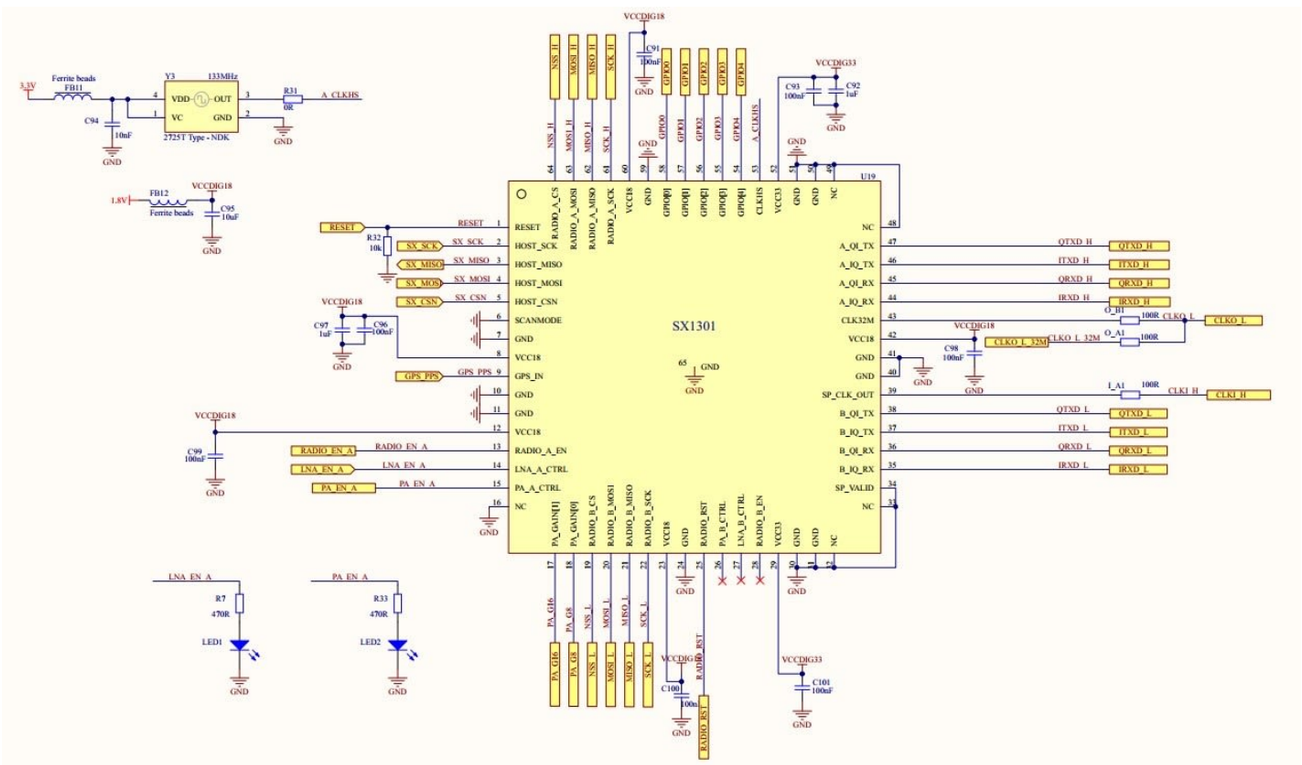

Figure 8: Semtech - SX1301 Schematic Diagram

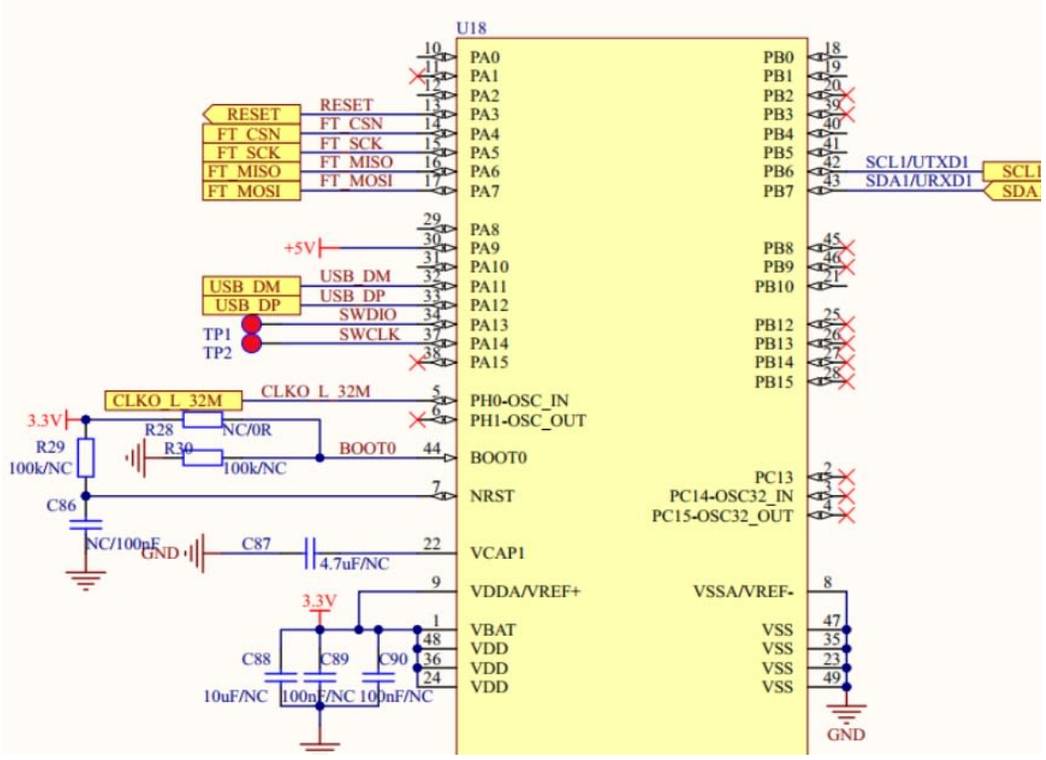

Figure 9: STM32F401CDU6 Schematic Diagram

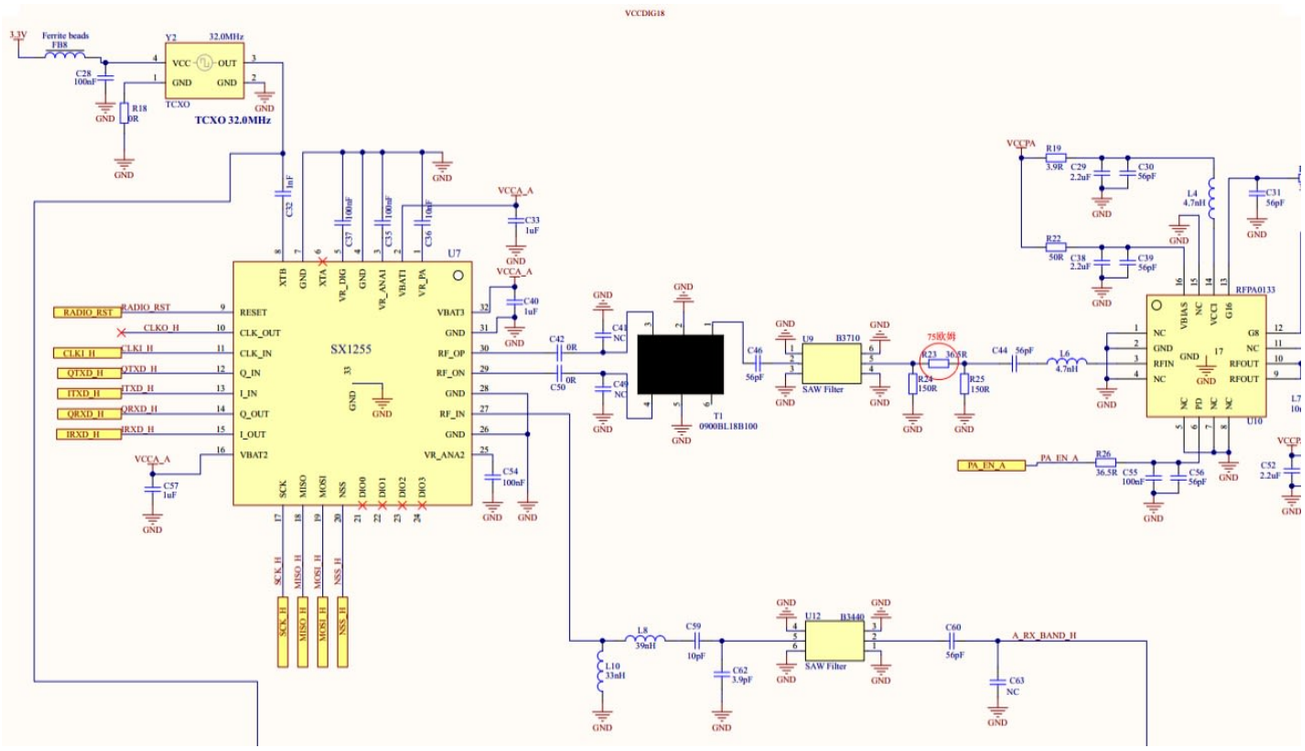

Figure 10: RF Part-1 Schematic Diagram

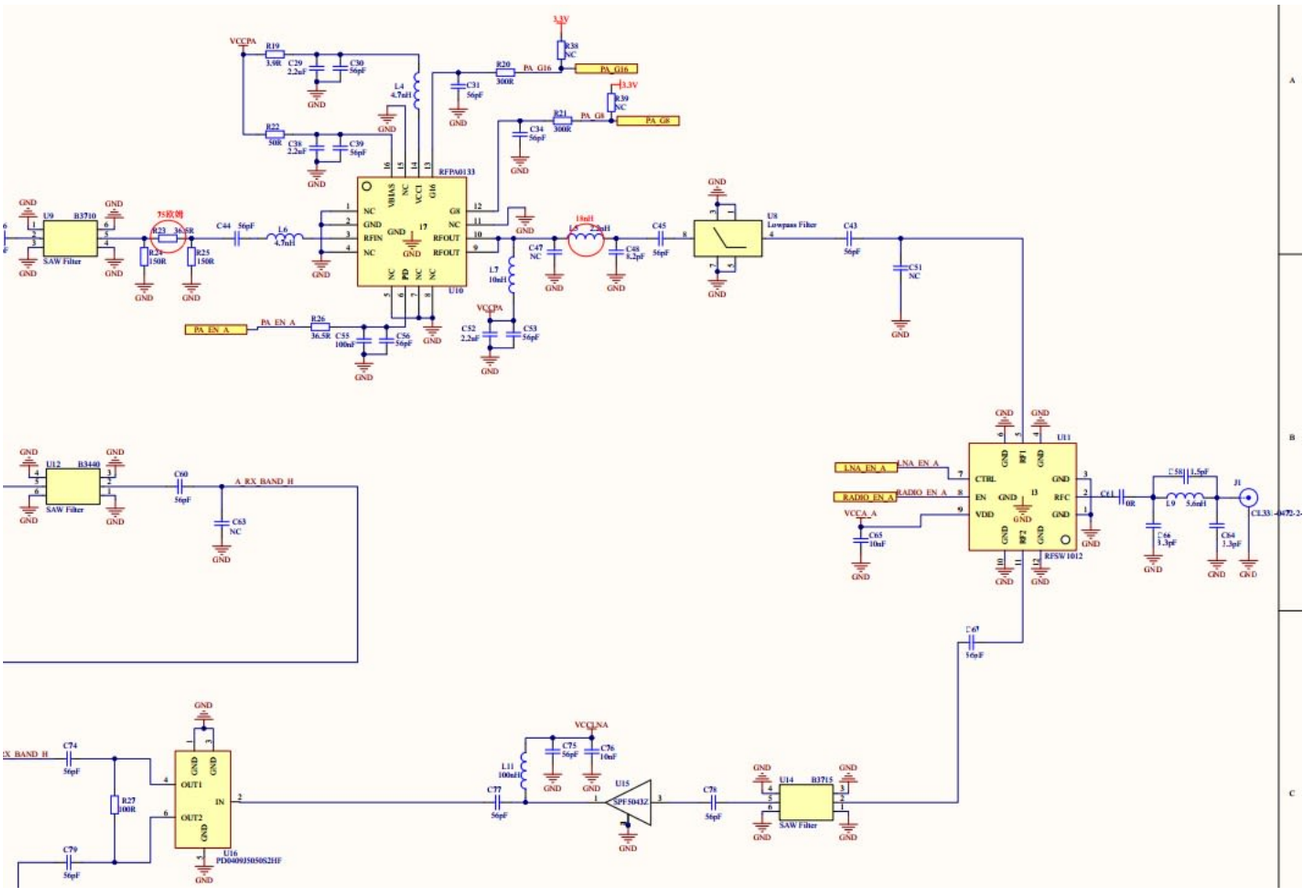

Figure 11: RF Part-2 Schematic Diagram

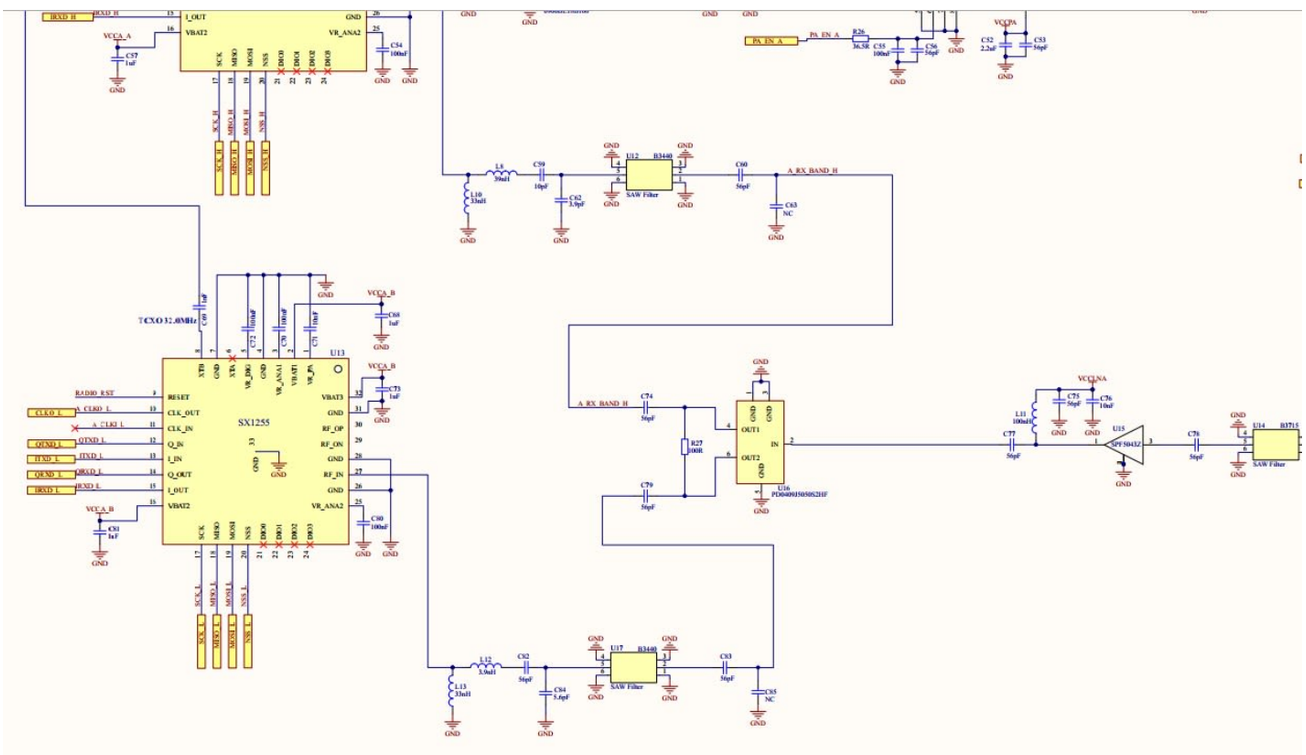

Figure 12: RF Part-3 Schematic Diagram

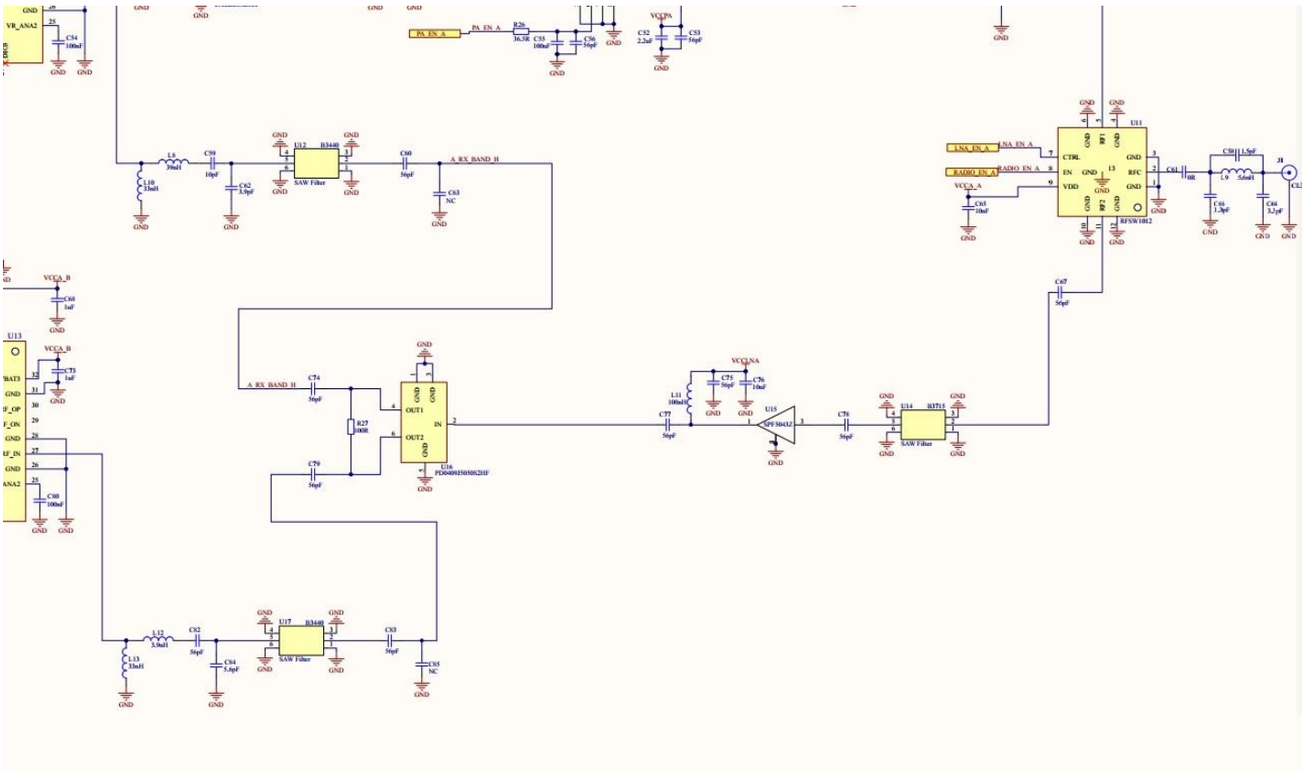

Figure 13: RF Part-4 Schematic Diagram

Reference Applications

The figure below shows the minimum application schematic of the RAK833 WisLink LPWAN Concentrator which uses at least **3.3V/1A DC power source**. It can either connect through the SPI interface or USB interface to the main processor. If the SPI interface is chosen, **SPDT_SEL** should be connected to the ground (GND) otherwise, leave the pin open.

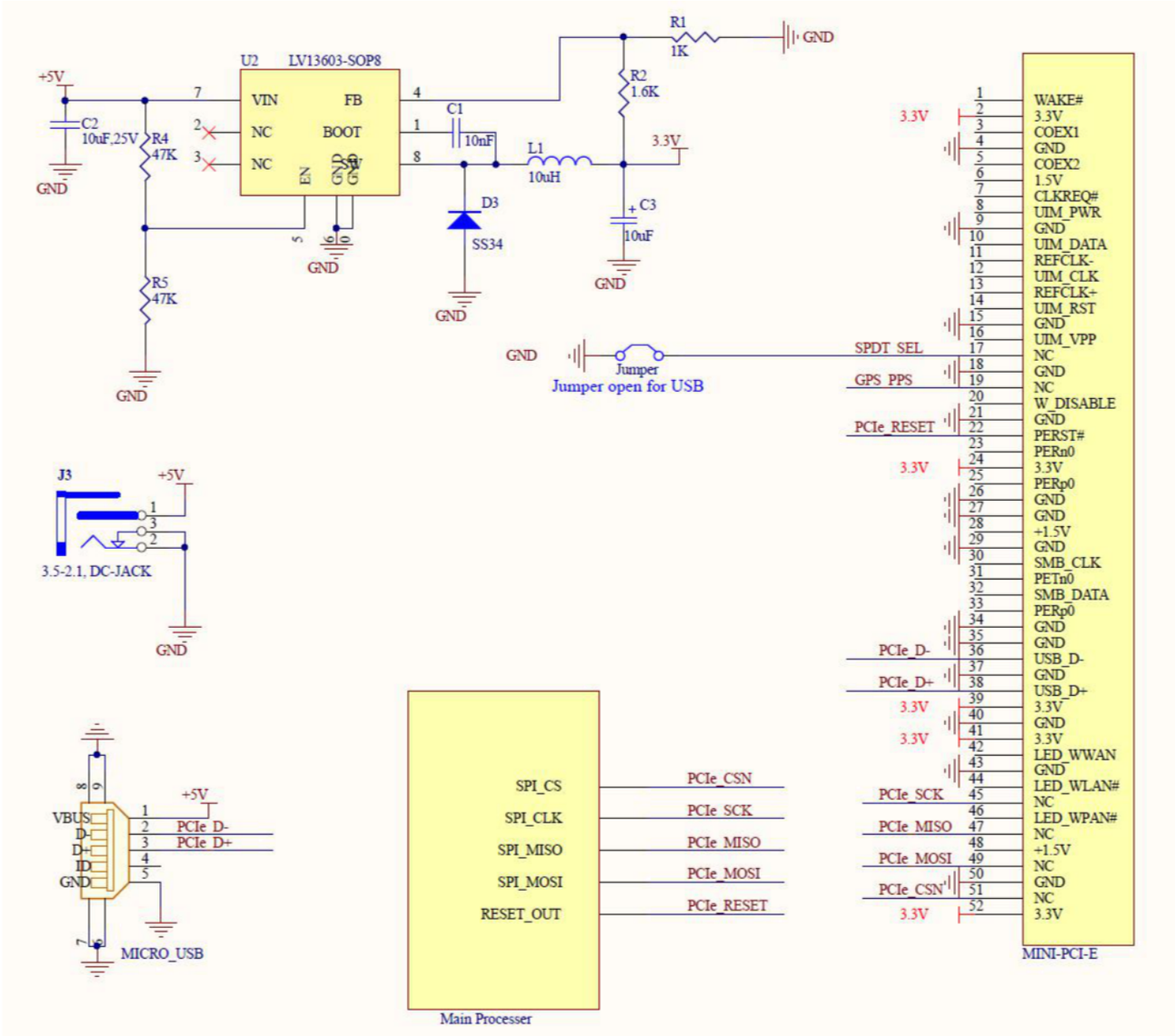

Figure 14: Reference Minimum Schematic

Software

Download the latest version of RAK833 in the table provided below.

Firmware

Model	Raspberry Pi Board	Firmware Version	Source
RAK833 - SPI	Raspberry Pi 3B+, 4	V4.1.0	Download
RAK833 - USB	Raspberry Pi 3B+, 4	V4.1.0	Download

Models / Bundles

Ordering Information

Part Number	Description
RAK833-SPI/USB-915	USB and SPI, 902MHz-928 MHz
RAK833-SPI/USB-868	USB and SPI, 863MHz-870 MHz
RAK833-SPI-915	SPI, 902MHz-928 MHz
RAK833-SPI-868	SPI, 863MHz-870 MHz

Last Updated: 7/28/2021, 5:13:12 AM