



E106-915G27P

LoRa Gateway Mini PCIe modules with SPI and USB interface



Abstract

This is a technical data sheet of E106-915G27P LoRa gateway module. The module is a complete and cost efficient LoRa gateway solution offering up to 10 programmable parallel demodulation paths. It targeted at smart metering fixed networks and Internet of Things applications with up to 5000 nodes per km² in moderately interfered environment. The module has the industry standard PCI Express Mini Card form factor, which enables easy integration into an application board and is also ideal for manufacturing of small series.

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1. Functional description

1.1. Overview

E106-915G27P comprises complete and cost efficient LoRa gateway module in the industry standard PCI Express Mini Card form factor, which enables an easy integration into an application board and it is also ideal for manufacturing of small series.

E106-915G27P modules support 915MHz for North America over different regions.

E106-915G27P modules support up to -142 dBm sensitivity with SX1255/7 Tx/Rx front-end and max 27dBm TX power.

Typical applications are Smart Metering , Security Sensors Network, Agricultural Monitoring, Internet of Things (IoT) .



1.2. Product features

| Module | Frequency | SPI | GPS PPS |
|--------------|-----------|-----|---------|
| E106-915G27P | 915MHz | YES | YES |

Table 1: E106-915G27P main features summary

1.3. Block diagram

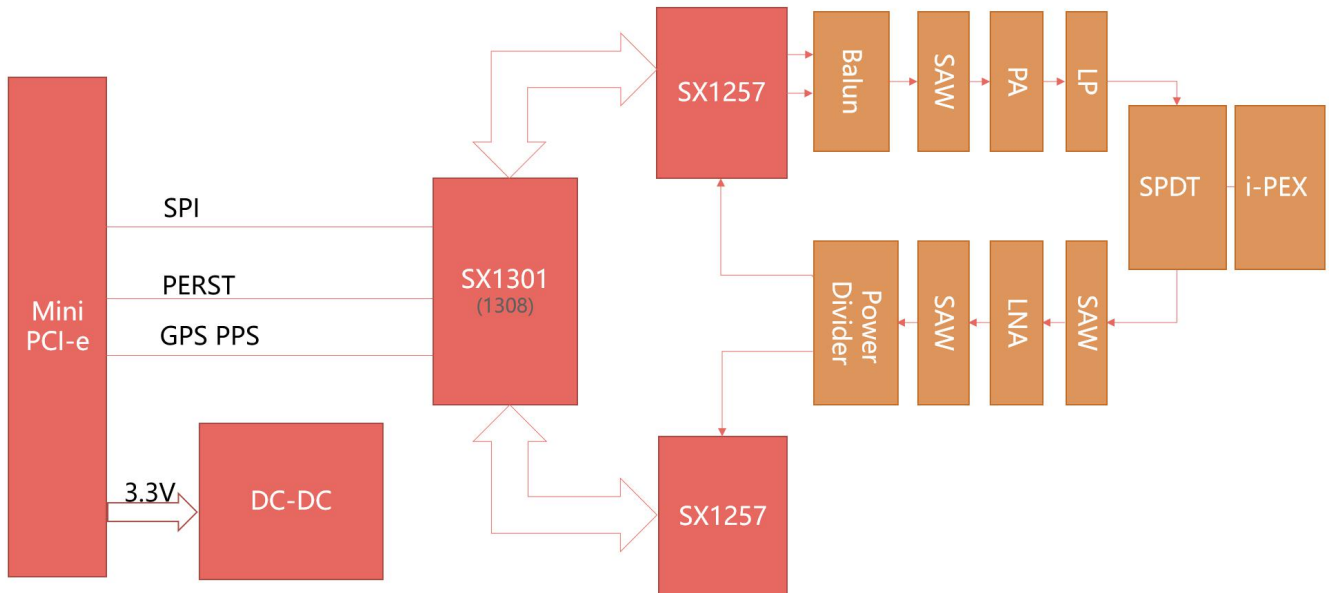


Figure 1: E106-915G27P block diagram

As described Figure 1, each E106-915G27P module integrates one SX1301 chip and two 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 easy antennas integration.

1.4. Product description

E106-915G27P module provides LoRa gateway multi-mode technology:

- E106-915G27P is mainly designed for operation in America and south-east Asia.

1.5. Supported features

| Feature | Description |
|----------------|--|
| TRX Indication | Module has two on-board LEDs to indication the status of TX or RX, the LEDs are controlled by PA_EN and LNA_EN respectively. |
| Multichannel | 10 programmable parallel demodulation paths, up to 8 RX channel and 1 TX channel for 125K LoRa. |
| SPI Interface | The SPI interface gives access to the configuration register of SX1301 via a synchronous full-duplex protocol. |
| GPS PPS Input | GPS PPS input for received packets time-stamped. |

Table 2: Some of the main features supported by E106-915G27P module

2. Interfaces

2.1. Module supply input

E106-915G27P 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 SX1301 chip (see SX1301 DS).

2.2. Antenna RF interfaces

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

2.3. SPI interface

A 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.

2.4. RESET

E106-915G27P includes the RESET active-high input signal to reset the radio operations as specified by the SX1301 Specification.

2.5. GPS_PPS

E106-915G27P includes the GPS_PPS input for received packets time-stamped.

3. Pin definition

3.1. Pin assignment

| No | PCI Express Mini Card | E106-XXXG27P | Voltage domain | I/O | Description | Remarks |
|----|-----------------------|--------------|----------------|-----|-------------------|-----------------------------------|
| 1 | WAKE# | NC | | N/A | | Internally not connected |
| 2 | 3.3Vaux | 3.3Vaux | 3.3Vaux | I | MPCI supply input | Connect to external 3.3 V supply. |
| 3 | COEX1 | GPIO4 | | I/O | | Internally connect to SX1301 |
| 4 | GND | GND | GND | N/A | Ground | Internally not connected |
| 5 | COEX2 | GPIO3 | | N/A | | Internally connect to SX1301 |
| 6 | 1.5V | NC | | N/A | | Internally not connected |
| 7 | CLKREQ# | GPIO2 | | N/A | | Internally connect to SX1301 |
| 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 | GPIO1 | | N/A | | Internally connect to SX1301 |
| 17 | UIM_IC_DM | NC | | N/A | | Internally not connected |
| 18 | GND | GND | GND | N/A | Ground | Connect to ground |
| 19 | UIM_IC_DP | GPS_PPS | | N/A | | GPS 1 pps input |
| 20 | W_DISABLE1# | GPIO0 | | N/A | | Internally connect to SX1301 |
| 21 | GND | GND | GND | N/A | Ground | Connect to ground |
| 22 | RERST# | RESET | | I | MPCI reset input | Active high for SX1301 reset. |
| 23 | PERn0 | NC | | N/A | | Internally not connected |
| 24 | 3.3Vaux | 3.3Vaux | 3.3Vaux | I | MPCI supply input | Connect to external 3.3 V supply. |
| 25 | PERp0 | NC | | N/A | | Internally not connected |
| 26 | GND | GND | GND | N/A | Ground | Connect to ground |
| 27 | GND | GND | GND | N/A | | 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 |

| No | PCI Express Mini Card | E106-XXXG27P | Voltage domain | I/O | Description | Remarks |
|----|-----------------------|--------------|----------------|-----|--------------------|--|
| 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- | NC | | N/A | | Internally not connected |
| | | | | | | Pull-up, pull-down and series resistors as required by <i>USB 2.0 specifications</i> [6] are part of the USB pin driver and need not be provided externally. |
| 37 | GND | GND | GND | N/A | Ground | Connect to ground |
| 38 | USB_D+ | NC | | N/A | | Internally not connected |
| | | | | | | Pull-up, pull-down and series resistors as required by <i>USB 2.0 specifications</i> [6] are part of the USB pin driver and need not be provided externally. |
| 39 | 3.3Vaux | 3.3Vaux | 3.3Vaux | I | MPCI supply input | Connect to external 3.3 V supply. See 4.2.2 for detailed electrical specs. |
| 40 | GND | GND | GND | N/A | Ground | Connect to ground |
| 41 | 3.3Vaux | 3.3Vaux | 3.3Vaux | I | MPCI supply input | Connect to external 3.3 V supply. |
| 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 interface | Max 10MHz clock |
| 46 | LED_WPAN# | NC | | N/A | | Internally not connected |
| 47 | Reserved | PCIe_MISO | | I/O | Host SPI interface | |
| 48 | 1.5V | NC | | N/A | | Internally not connected |
| 49 | Reserved | PCIe_MOSI | | I/O | Host SPI interface | |
| 50 | GND | GND | GND | N/A | Ground | Connect to ground |
| 51 | W_DISABLE2# | PCIe_CSN | | I/O | Host SPI interface | |
| 52 | 3.3Vaux | 3.3Vaux | 3.3Vaux | I | MPCI supply input | Connect to external 3.3 V supply. |
| | | | | | | See 4.2.2 for detailed electrical specs. |

Table 3: E106-915G27P system connector pin assignment

4. Electrical specifications

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 sections (chapter 4.1) of the specification should be avoided. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

Operating condition ranges define those limits within which the functionality of the device is guaranteed.

Where application information is given, it is advisory only and does not form part of the specification.

4.1. Absolute maximum rating

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

| Symbol | Description | Condition | Min. | Max. | Unit |
|---------|-----------------------|--|------|------|------|
| 3.3Vaux | Module supply voltage | Input DC voltage at 3.3Vaux pins | -0.3 | 3.6 | V |
| RESET | MPCI 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 |
| ANT | Antenna ruggedness | Output RF load mismatch ruggedness at ANT1 | | 10:1 | VSWR |
| Tstg | Storage Temperature | | -40 | 85 | °C |

Table 4: Absolute maximum ratings

The product is not protected against overvoltage 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.

4.1.1. Maximum ESD

| 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- |
| ESD immunity for ANT1 | | | 4000 | V | Contact Discharge according to IEC 61000- |
| | | | 8000 | V | Air Discharge according to IEC 61000-4-2 |

Table 5: Maximum ESD ratings

E106-915G27P module is electrostatic sensitive devices and require special precautions when handling. See section 7.2 for ESD handling instructions.

4.2. Operating conditions

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.

4.2.1. 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) |

Table 6: Environmental conditions

4.2.2. Supply/power pins

| Symbol | Parameter | Min. | Typical | Max. | Unit |
|---------|---|------|---------|------|------|
| 3.3Vaux | Module supply operating input voltage ¹⁴ | 3.00 | 3.30 | 3.60 | V |

Table 7: Input characteristics of Supply/Power pins

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

4.2.3. Current consumption

| Mode | Condition | Min | Typ | 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 20dBm and 3.3V supply. | | 360 | | mA |
| Active-Mode (RX) | TX disabled and shutdown PA. | | 490 | | mA |

Table 9: Module 3.3Vaux supply current consumption

4.2.4. LoRa RF characteristics

E106-915G27P LoRa RF characteristics are specified in the *SX1255/7 series Data Sheet*.

5. Mechanical specifications

E106-915G27P module 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 mm nominal length, 30 mm nominal width and all the other dimensions as defined by the PCI Express Mini Card Electromechanical Specification [9] except for the card thickness (nominal value is 3.7 mm), as described in Figure 2. E106-915G27P module weight is about 9.7 g.

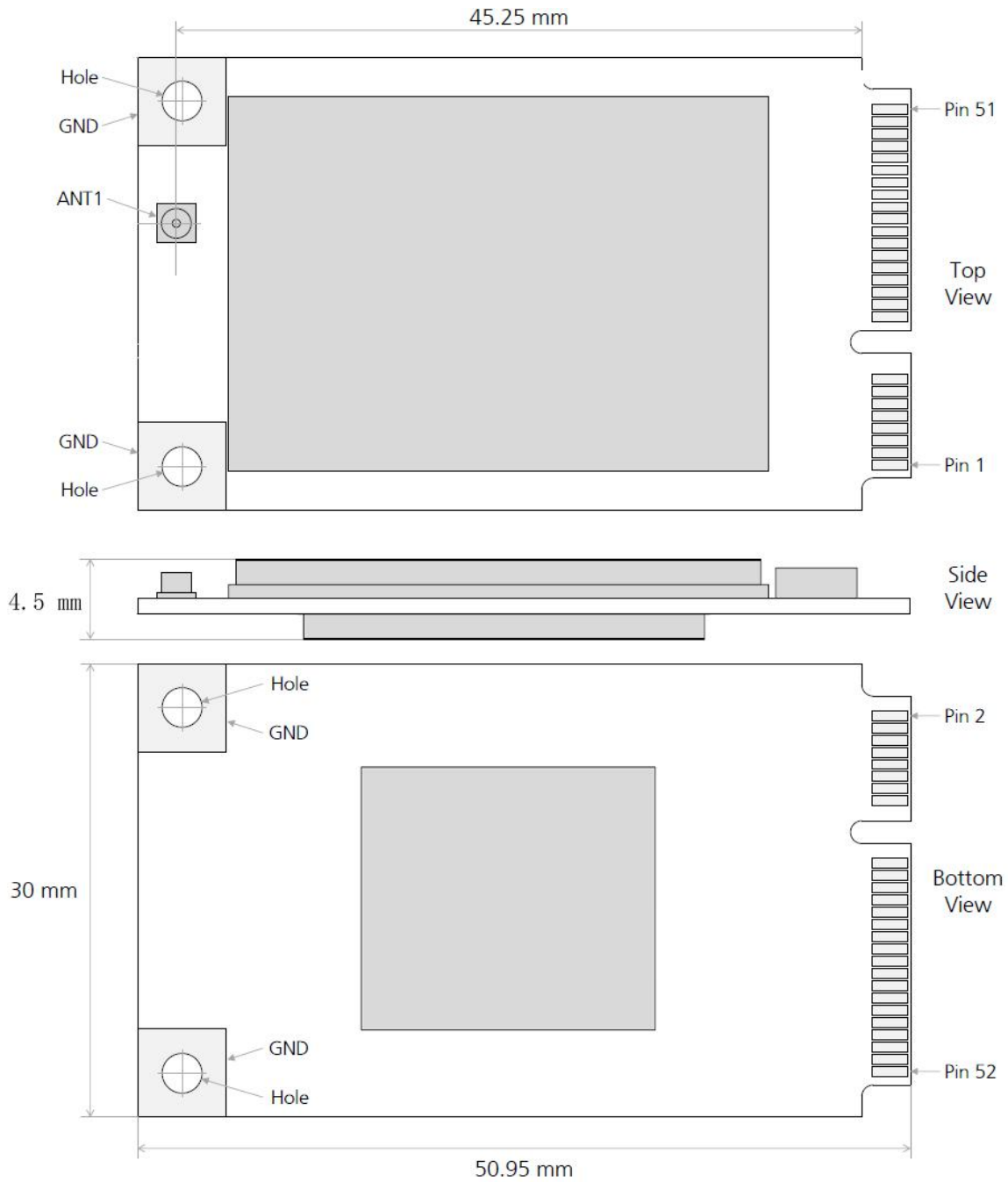


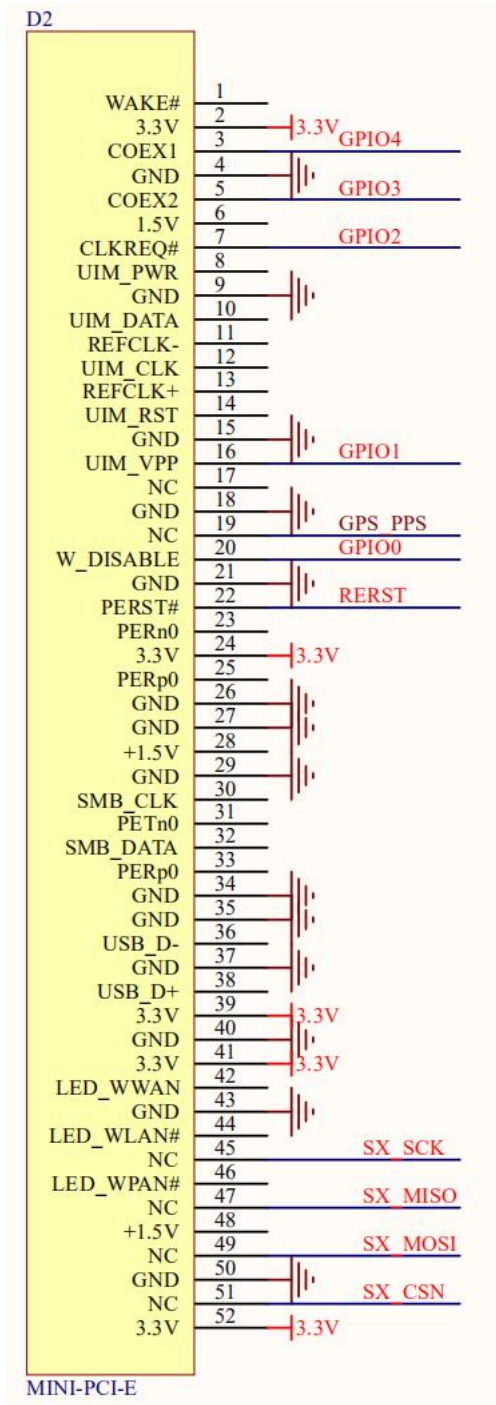
Figure 2: E106-915G27P mechanical dimensions (top view, side view, bottom view)



For further details regarding mechanical specifications see the *PCI Express Mini Card Electromechanical Specification* [9].

6. Inner schematic

E106-915G27P module refer Semtech’s reference design of SX1301, add a 4 channel SPDT to switch SPI of SX1301 to PCI edge connector or FT2232H, which convert SPI to USB2.0 interface.





For further details regarding schematic please refer "SX1301DVK_e286v02a_sch_layout" from Semtech.

7. Reference application

Figure 4 shows the minimum application schematic of E106-915G27P module. Uses at least 3.3V/1A DC power, connect SPI interface or USB interface to the main processor. If uses SPI interface SPDT_SEL should be tied to GND otherwise just let this pin open.

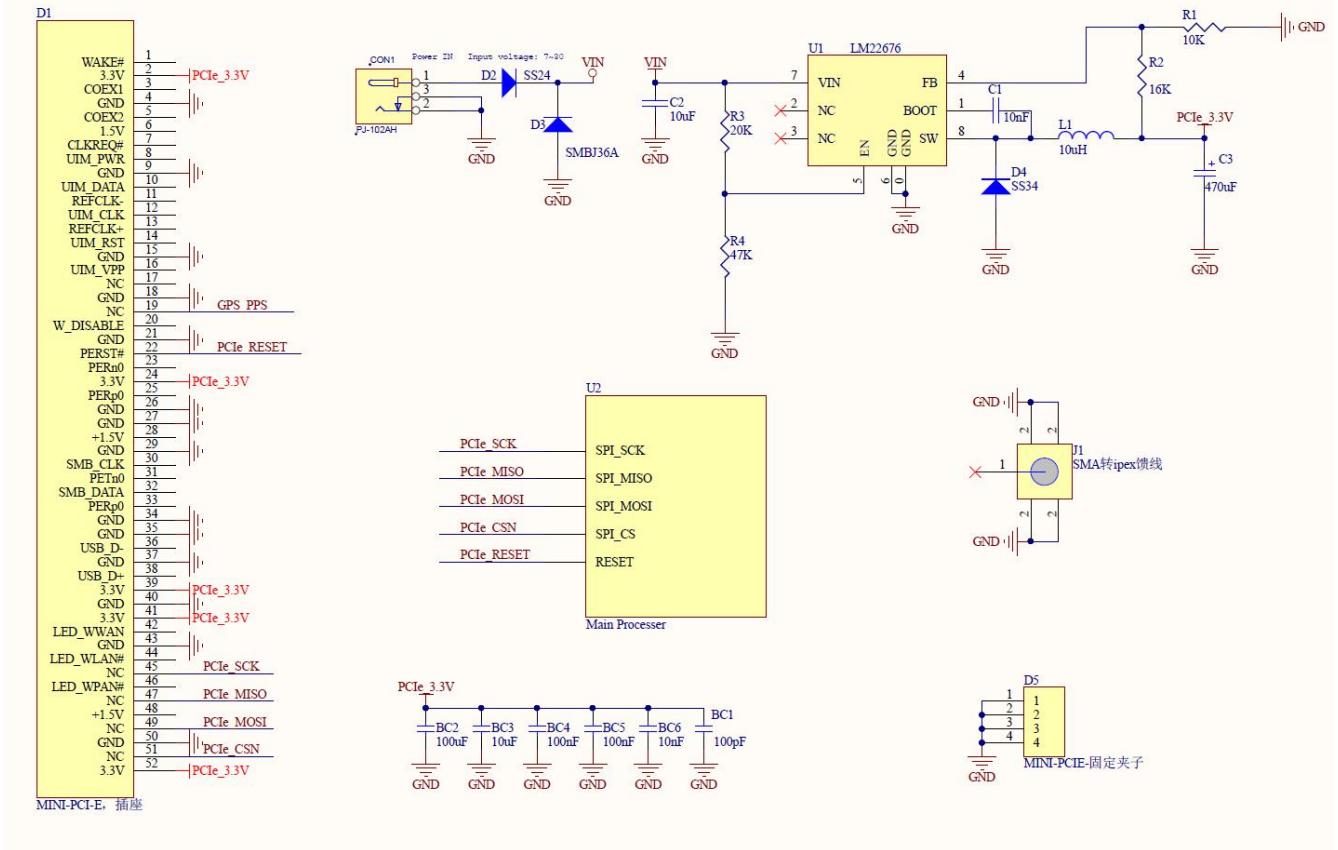


Figure 4: E106-915G27P reference minimum schematic.

8. Revision history

| Version | Date | Description | Issued by |
|---------|-----------|-----------------|------------|
| 1.00 | 2019/5/31 | Initial version | Liyangling |
| 1.10 | 2019/9/6 | version update | Liyangling |

9. About us

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