

*Delivers centimeter level accuracy within seconds based on U-blox triple-band L1/L2/L5 **ZED-F20P** GNSS RTK module. Onboard **RM3100** magnetometer and **BMP581** barometric sensor.*

*Datasheet - In Production*



## Features

- 5V - 100mA power supply
- LEDs status: Power/RTK
- Timepulse & External Interrupt
- USB-C/I<sup>2</sup>C/SPI/UART interfaces
- Onboard Bosch BMP581 barometer
- Onboard PNI RM3100 compass
- 3.3V Active antenna input

## Applications

- Drones
- RTK Base
- Ground vehicles
- Precise navigation

## Description

The Siderion **Pioneer F20P** is an affordable, compact, and high-precision triple-band L1/L2/L5 GNSS RTK (Real-Time Kinematic) device.

Powered by the latest generation of u-blox **ZED-F20P** modules, the Pioneer F20P supports concurrent reception of GPS, Galileo, BeiDou, QZSS, and NavIC signals. Consequently, the device delivers reliable performance and fast convergence, achieving centimeter-level accuracy in seconds.

The onboard **BMP581** absolute barometric pressure sensor and the professional-grade **RM3100** compass enhance the overall performance of the Pioneer F20P.

Its JST-GH connectors make it ideal for integration with Pixhawk, ArduPilot or any other autopilot systems.

The Pioneer F20P operates across a temperature range from -40°C to +70°C.

Table 1. Device summary

| Order ref code            | Temperature [°C] | Product size [mm]  | Weight [g] |
|---------------------------|------------------|--------------------|------------|
| SID-GNSS-RTK-PIONEER_F20P | -40 to +70       | 51.0 x 33.0 x 13.4 | 17         |

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# 1. Block diagram and pin description

## 1.1 Block diagram

Figure 1. Pioneer F20P block diagram & connectivity

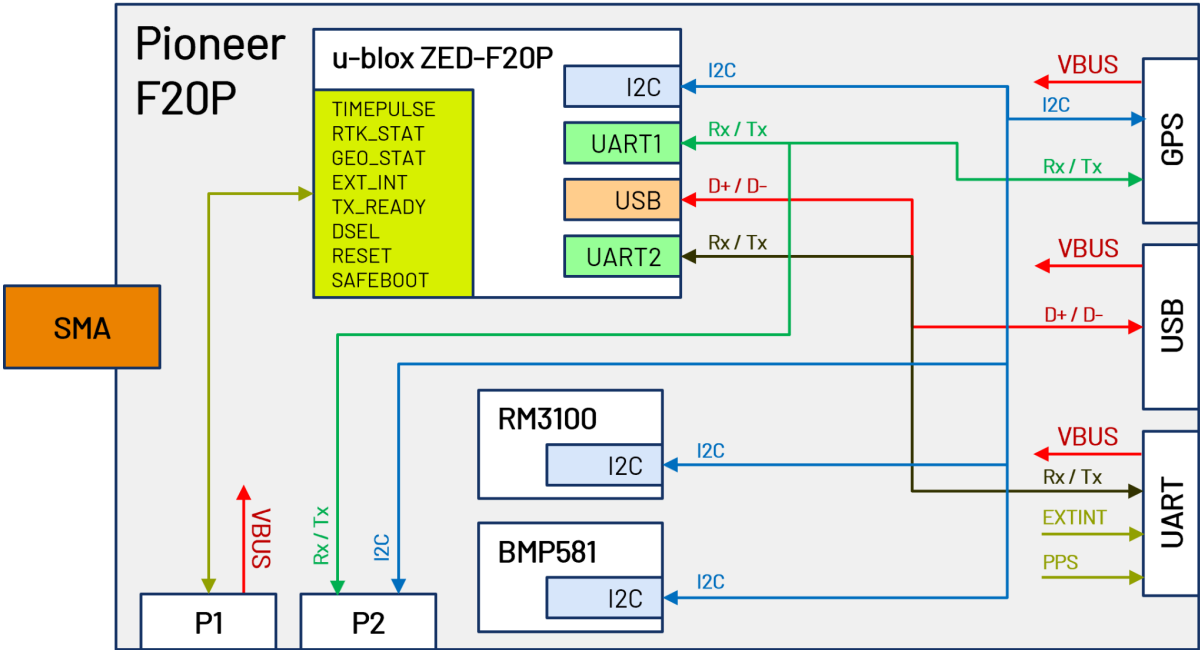
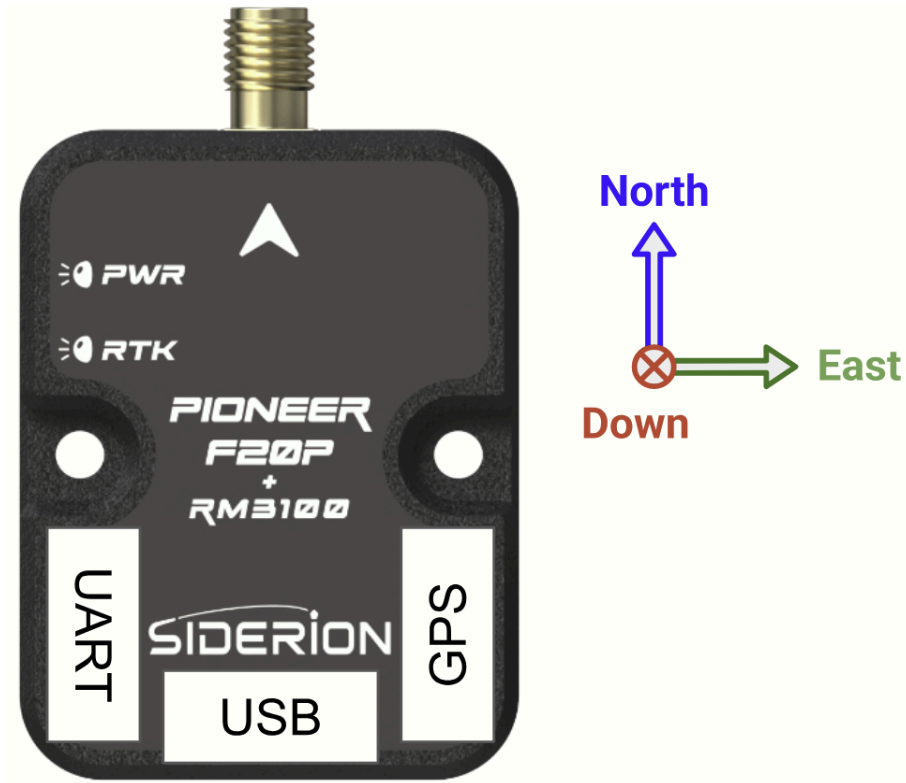


Figure 2. Pioneer F20P North-East-Down (NED) orientation (top view)



## 1.2 LED description

Table 2. Pioneer F20P LED sequence status

| LED name   | Color | Light sequence                                                                    | Comment                        |
|------------|-------|-----------------------------------------------------------------------------------|--------------------------------|
| Power      | Blue  |  | Solid blue LED when powered ON |
| RTK Status | Green |  | 3D fix mode / No RTK fix       |
|            |       |  | RTK fix but no FIXED RTK fix   |
|            |       |  | FIXED RTK fix                  |

## 1.3 Pin description

Figure 3. Pioneer F20P pinout (top view & side views)

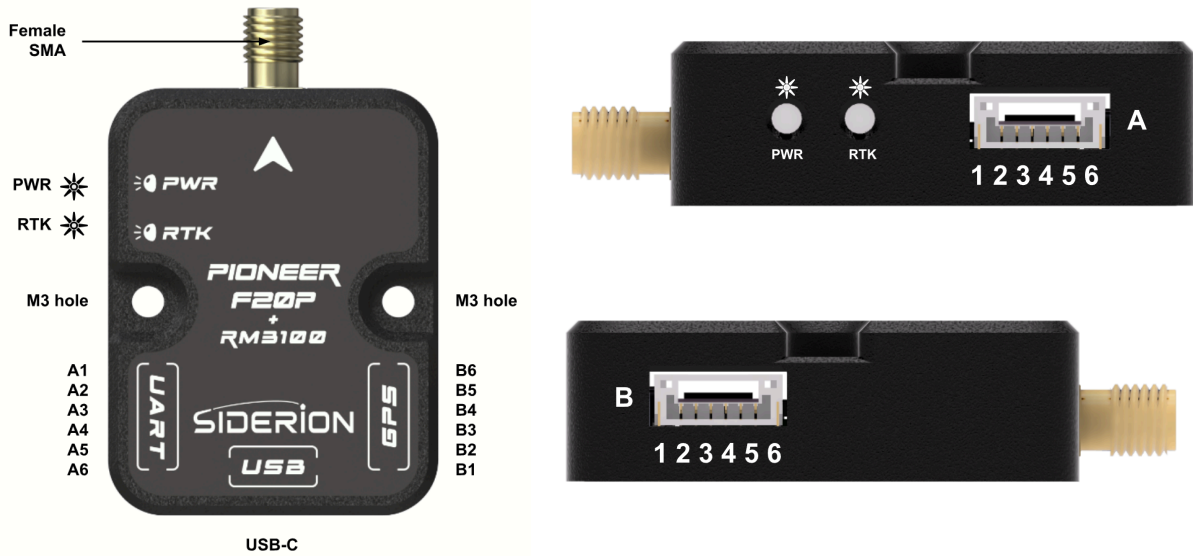


Table 3. Pinout configuration

|      | Pin | Name                 | Type | Function                           |
|------|-----|----------------------|------|------------------------------------|
| UART | A1  | 5V IN                | P    | 5V input                           |
|      | A2  | UART2 TXD            | O    | UART2 transmit                     |
|      | A3  | UART2 RXD            | I    | UART2 receive                      |
|      | A4  | EXTINT               | I    | External Interrupt                 |
|      | A5  | TIMEPULSE            | O    | Timepulse output                   |
|      | A6  | GND                  | P    | Ground reference                   |
| GPS  | B1  | 5V IN                | P    | 5V input                           |
|      | B2  | UART1 RXD / SPI MOSI | I    | UART1 receive <b>OR</b> SPI MOSI   |
|      | B3  | UART1 TXD / SPI MISO | O    | UART1 transmit <b>OR</b> SPI MISO  |
|      | B4  | I2C SCL / SPI SCLK   | I    | I2C clock <b>OR</b> SPI clock      |
|      | B5  | I2C SDA / SPI CS     | I/O  | I2C data <b>OR</b> SPI chip select |
|      | B6  | GND                  | P    | Ground reference                   |

P : Power / I : Input / O : Output

**Note:** The SPI port is available only when the D\_SEL pin is pulled LOW.

Figure 4. Pioneer F20P bottom connectors pinout (bottom view)

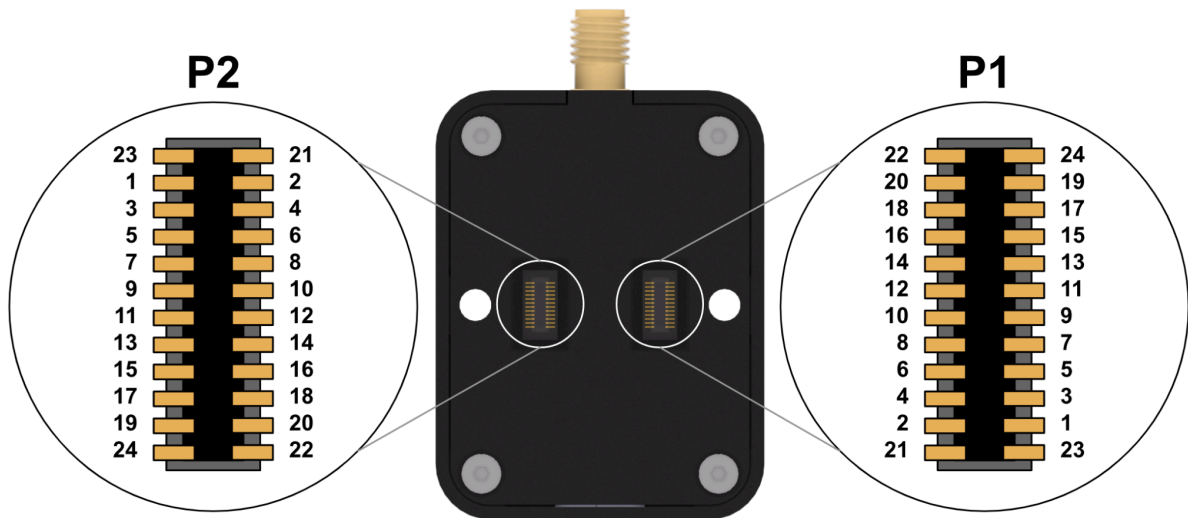


Table 4. DF40C-20DP-0.4V(51) HIROSE ELECTRIC pinout configuration

|    | Pin | Name     | Pin | Name      | Pin | Name     | Pin | Name |
|----|-----|----------|-----|-----------|-----|----------|-----|------|
| P2 | 1   | VUSB     | 7   | I2C SDA   | 13  | UART1 RX | 19  | VUSB |
|    | 2   | VUSB     | 8   | GND       | 14  | GND      | 20  | VUSB |
|    | 3   | GND      | 9   | I2C SCL   | 15  | GND      | 21  | GND  |
|    | 4   | GND      | 10  | GND       | 16  | GND      | 22  | GND  |
|    | 5   | GND      | 11  | UART1 TX  | 17  | GND      | 23  | GND  |
|    | 6   | GND      | 12  | GND       | 18  | GND      | 24  | GND  |
| P1 | 1   | NC       | 7   | TIMEPULSE | 13  | GND      | 19  | NC   |
|    | 2   | NC       | 8   | GEO_STAT  | 14  | RESET    | 20  | NC   |
|    | 3   | GND      | 9   | EXT_INT   | 15  | GND      | 21  | GND  |
|    | 4   | GND      | 10  | TX_READY  | 16  | SAFEBOOT | 22  | GND  |
|    | 5   | GND      | 11  | GND       | 17  | GND      | 23  | GND  |
|    | 6   | RTK_STAT | 12  | D_SEL     | 18  | GND      | 24  | GND  |

**Note:** The SPI port is available only when the **D\_SEL** pin is pulled LOW.

## 2. Absolute maximum ratings

Stresses above those listed as “absolute maximum ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device under these conditions is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

Table 5. Pioneer F20P absolute maximum ratings

| Symbol | Parameter               | Maximum value   | Units |
|--------|-------------------------|-----------------|-------|
| Vusb   | USB supply voltage      | -0.3 to +6      | V     |
| Vdd    | Internal supply voltage | -0.5 to +3.6    | V     |
| Vdd_IO | I/O pins supply voltage | -0.5 to Vdd+0.1 | V     |
| Icc_RF | RF output current       | 300             | mA    |
| Prfin  | Input power at RF_IN    | 10              | dBm   |
| W      | Product weight          | 17              | g     |
| TOP    | Operating temperature   | -40 to +70      | °C    |
| TSTG   | Storage temperature     | -40 to +80      | °C    |



This device is sensitive to electrostatic discharge (ESD), improper handling can cause permanent damage to the part.

## 3. Specifications

### 3.1 Ublox ZED-F20P specifications

Table 6. ZED-F20P mechanical and electrical specifications

| Symbol | Parameter                             | Test conditions    | Min.    | Typ.    | Max.     | Units |
|--------|---------------------------------------|--------------------|---------|---------|----------|-------|
| Vusb   | USB supply voltage                    |                    | 4.5     | 5.0     | 5.5      | V     |
| Vdd    | Internal supply voltage               |                    |         | 3.3     |          | V     |
| Vdd_IO | Supply voltage for I/O                |                    |         | 3.3     |          | V     |
| Idd    | Current consumption                   | w/o active antenna |         | 50      |          | mA    |
|        |                                       | w/ active antenna  |         | 130     |          | mA    |
| Vdd_RF | Output RF voltage                     |                    |         | Vdd-0.1 |          | V     |
| Idd_RF | Output RF current                     |                    |         | 50      |          | mA    |
| Vil    | IO pin low lvl input volt             |                    | 0       |         | 0.8      | V     |
| Vih    | IO pin high level input voltage       |                    | 2       |         | Vdd +0.3 | V     |
| Vol    | IO pin low level output voltage       | Iol = 1mA          |         |         | 0.4      | V     |
| Voh    | IO pin high level output voltage      | Ioh = 1mA          | Vdd-0.4 |         |          | V     |
| Top    | Operating temperature                 |                    | -40     |         | +70      | °C    |
| I2Cadd | Default 7bit I <sup>2</sup> C address | 0b0100010 (0x42)   |         |         |          |       |

Table 7. ZED-F20P general performance

| Parameter              | Specifications                   | Value                       |
|------------------------|----------------------------------|-----------------------------|
| Receiver type          | Multi-band GNSS high precision   |                             |
| Accuracy of Timepulse  | RMS                              | 30 ns                       |
| Frequency of Timepulse |                                  | 0.25 Hz to 10 MHz           |
| Operational limits     | Dynamics<br>Altitude<br>Velocity | < 4g<br>80,000 m<br>500 m/s |
| Velocity accuracy      |                                  | 0.03 m/s                    |



Table 8. ZED-F20P performance in different GNSS mode

| GNSS                     | Parameter                                                   | GPS+GAL+BDS                                  | GPS+BDS | GPS+GAL | GPS |
|--------------------------|-------------------------------------------------------------|----------------------------------------------|---------|---------|-----|
| Acquisition              | Cold start<br>Hot start<br>Aided start                      | 25 s<br>2 s<br>2 s                           | -       | -       | -   |
| Update rate              | RTK<br>PVT<br>RAW                                           | 25 Hz<br>25 Hz<br>25 Hz                      | -       | -       | -   |
| Convergence time         | RTK                                                         | < 7 s                                        | -       | -       | -   |
| Horizontal pos. accuracy | PVT<br>RTK                                                  | 1.2 m CEP<br>0.006 m +<br>1ppm CEP           | -       | -       | -   |
| Vertical pos. accuracy   | RTK                                                         | 0.01 m +<br>1ppm CEP                         | -       | -       | -   |
| Sensitivity              | Tracking & Nav.<br>Reacquisition<br>Cold start<br>Hot start | -167 dBm<br>-160 dBm<br>-148 dBm<br>-158 dBm | -       | -       | -   |

Table 9. ZED-F20P supported GNSS constellations and signals

| System  | Signal                    | Frequency                                    |
|---------|---------------------------|----------------------------------------------|
| GPS     | L1C/A<br>L2C<br>L5        | 1575.420 MHz<br>1227.600 MHz<br>1176.450 MHz |
| Galileo | E1-B/C<br>E5a             | 1575.420 MHz<br>1176.450 MHz                 |
| BeiDou  | B1I<br>B1C<br>B2a         | 1561.098 MHz<br>1575.420 MHz<br>1176.450 MHz |
| QZSS    | L1C/A, L1C/B<br>L2C<br>L5 | 1575.420 MHz<br>1227.600 MHz<br>1176.450 MHz |
| NavIC   | L1-SPS Data<br>L5-SPS     | 1575.420 MHz<br>1176.450 MHz                 |

## 3.2 PNI RM3100 specifications

Table 10. RM3100 electrical specifications

| Symbol     | Parameter                                                    | Test conditions | Min.     | Typ. | Max.     | Units |
|------------|--------------------------------------------------------------|-----------------|----------|------|----------|-------|
| Vdd        | Internal supply voltage                                      |                 | 2.0      | 3.0  | 3.6      | V     |
| Vdd_IO     | Supply voltage for I/O                                       |                 | 2.0      | 3.0  | 3.6      | V     |
| Vdd_Ripple | Vdd ripple voltage                                           |                 |          |      | 0.05     | Vpp   |
| Idd        | Current consumption                                          |                 |          |      | 1        | mA    |
| Vil        | IO pin low level input voltage                               |                 | 0        |      | 0.3* Vdd | V     |
| Vih        | IO pin high level input voltage                              |                 | 0.7* Vdd |      | Vdd      | V     |
| Iidle      | Idle Mode Current                                            |                 |          |      | 1        | μA    |
| Ileak      | Leakage Current @ DVDD pin<br>(AVDD=AVSS=DVSS=0V, DVDD=3.6V) |                 |          |      | 100      | nA    |
| Top        | Operating temperature                                        |                 | -20      |      | +85      | °C    |
| I2Cadd     | 7bit I2C address                                             | 0b0100000       |          |      |          |       |

Table 11. RM3100 Geomagnetic Sensor Performance

| Parameter                                    | Cycle counts |     |     | Units  |
|----------------------------------------------|--------------|-----|-----|--------|
|                                              | 50           | 100 | 200 |        |
| Field Measurement Range                      | -800 to +800 |     |     | μT     |
| Gain                                         | 20           | 38  | 75  | LSB/μT |
| Sensitivity                                  | 50           | 26  | 13  | nT     |
| Noise                                        | 30           | 20  | 15  | nT     |
| Noise Density @ Max. Single-Axis Sample Rate | 1.2          |     |     | nT/√Hz |
| Repeatability over ±200 μT                   | 15           | 8   | 8   | nT     |
| Hysteresis over ±200 μT                      | 15           |     |     | nT     |

|                                                                               |      |     |     |                  |
|-------------------------------------------------------------------------------|------|-----|-----|------------------|
| Linearity over $\pm 200 \mu\text{T}$                                          | 0.5  |     |     | %                |
| Maximum Single-Axis Sample Rate<br>(divide by 3 for max. 3-axis sample rate)  | 1600 | 850 | 440 | Hz               |
| Single-Axis Average Current @ 24 Hz Sample Rate (equivalent to 3-axis @ 8 Hz) | 70   | 135 | 260 | $\mu\text{A}$    |
| Bias Resistor, $R_b$                                                          | 121  |     |     | $\Omega$         |
| Ext. Timing Resistor for Clock, $R_{EXT}$                                     | 33   |     |     | $\text{K}\Omega$ |
| Circuit Oscillation Frequency                                                 | 180  |     |     | kHz              |

### 3.3 Bosch Sensortech BMP581 specifications

Table 12. BM581 electrical specifications

| Symbol   | Parameter                           | Test conditions                | Min. | Typ.      | Max.        | Units         |
|----------|-------------------------------------|--------------------------------|------|-----------|-------------|---------------|
| Type     | Absolute barometric pressure sensor |                                |      |           |             |               |
| Pres     | Pressure Range                      |                                | 30   |           | 125         | kPa           |
| Vdd      | Supply Voltage (VDD)                |                                | 1.65 |           | 3.6         | V             |
| Idd      | Current Consumption                 | Peak<br>Deep standby           |      |           | 260<br>0.55 | $\mu\text{A}$ |
| Abac     | Absolute Accuracy                   | -5°C to 65°C                   |      | $\pm 30$  |             | Pa            |
| Reac     | Relative Accuracy                   | 700 to 1100 hPa                |      | $\pm 6$   |             | Pa            |
| Reac     | Relative Accuracy                   | 900 to 1100 hPa                |      | $\pm 0.4$ |             | Pa            |
| Noise    | Noise (Lowest Bandwidth)            |                                |      | 0.08      |             | Pa            |
| Temp_off | Temperature Coefficient Offset      |                                |      | $\pm 0.5$ |             | Pa            |
| ltd      | Long-term Drift (12 months)         |                                |      | $\pm 0.1$ |             | Pa            |
| Sd       | Solder Drift                        |                                |      | $\pm 30$  |             | Pa            |
| ODR      | Output Data Rate                    | continuous mode<br>normal mode |      |           | 480<br>240  | Hz<br>Hz      |
| Int      | Interfaces                          | I <sup>2</sup> C               |      |           | 1           | MHz           |
| Temp     | Temperature Range                   |                                | -40  |           | 85          | °C            |

|        |                  |           |  |  |  |  |
|--------|------------------|-----------|--|--|--|--|
| I2Cadd | 7bit I2C address | 0b1000110 |  |  |  |  |
|--------|------------------|-----------|--|--|--|--|

## 4. Applications

### 4.1 Standalone configuration

Figure 5. U-blox ANN-MB2 GNSS antenna attached to the Pioneer F20P



|                                                                                     |                                                                                      |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|  |  |
| Pioneer F20P + SA275                                                                | Pioneer F20P + SA435                                                                 |

## 5. Communication interfaces

There are several communications interfaces including UART, SPI, I2C and USB. All the inputs have internal pull-up resistors in normal operation and can be left open if not used. All the PIOs are supplied by VCC, therefore all the voltage levels of the PIO pins are related to Vdd supply voltage.

### 5.1 UART Interface

There are two UART interfaces: UART1 and UART2. UART1 and UART2 operate up to and including a speed of 8 Mbaud. No hardware flow control on UART1 and UART2 is supported. UART1 is enabled by default if D\_SEL is not tied to ground.

Figure 6. UART chronogram specifications

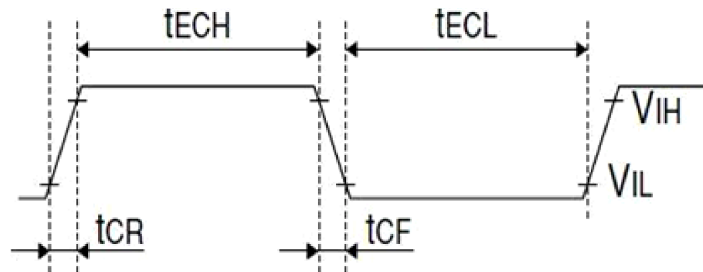


Table 13. ZED-F20P serial UART timing specifications

| Symbol | Parameter                          | Min.    | Max.    | Units |
|--------|------------------------------------|---------|---------|-------|
| Vil    | LOW-LEVEL input voltage            | 0       | 0.2xVdd | V     |
| Vih    | HIGH-LEVEL input voltage           | 0.7xVdd | Vdd+0.3 | V     |
| tECH   | HIGH period of external data input | 0       | 0.4     | μs    |
| tECL   | LOW period of external data input  | TBA     | TBA     | μs    |
| Ru     | Baudrate                           | 4800    | 8       | Mbps  |
| tCR    | Rise time of data                  |         | 5       | ns    |
| tCF    | Fall time of data                  |         | 5       | ns    |

## 5.2 SPI interface

The Pioneer F20P has an SPI slave interface that can be selected by tying the **D\_SEL** input pin to ground. The SPI slave interface is shared with UART1. The SPI pins available are: SPI\_MISO (TXD), SPI\_MOSI (RXD), SPI\_CS\_N, SPI\_CLK. The SPI interface is designed to allow communication to a host CPU. The interface can be operated in slave mode only. Note that SPI is not available in the default configuration because its pins are shared with the UART and I2C interfaces. The maximum transfer rate using SPI is 950 kB/s and the maximum SPI clock frequency is 12.8 MHz.

This section provides SPI timing values for the ZED-F20P slave operation. The following tables present timing values under different capacitive loading conditions. Default SPI configuration is CPOL = 0 and CPHA = 0.

Figure 7. SPI chronogram specifications

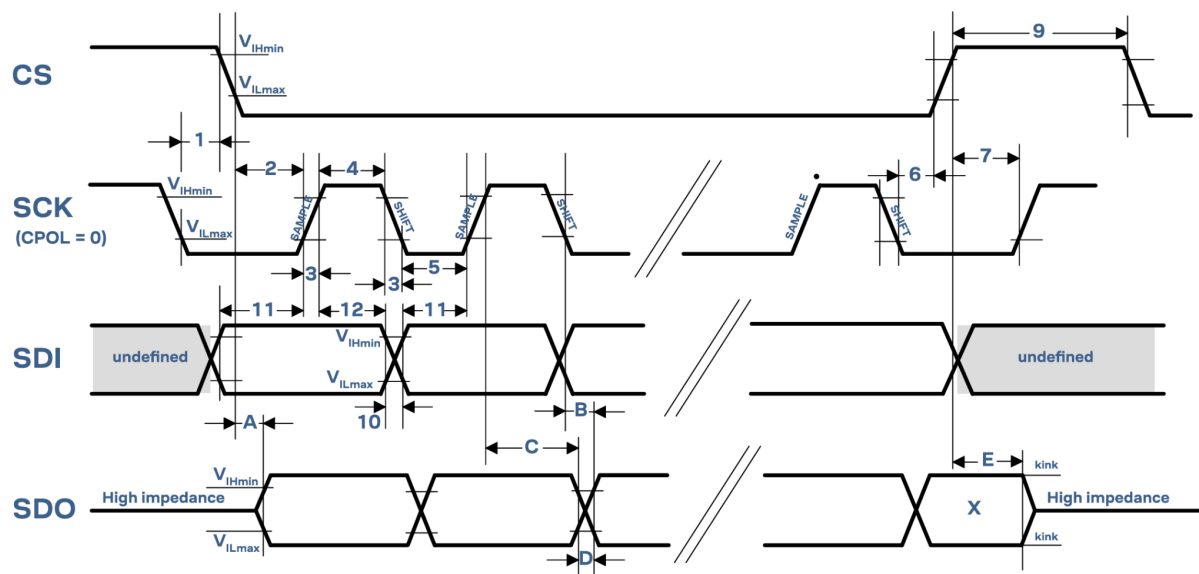


Table 14. ZED-F20P SPI timing specifications

| Timing value @ 20pF load                          | Min [ns] | Max [ns] |
|---------------------------------------------------|----------|----------|
| "A" - MISO data valid time (CS)                   | 17       | 42       |
| "B" - MISO data valid time (SCK) weak driver mode | 16       | 39       |
| "C" - MISO data hold time                         | 52       | 88       |
| "D" - MISO rise/fall time, weak driver mode       | 2        | 21       |
| "E" - MISO data disable lag time                  | 7        | 20       |

## 5.3 Slave I2C interface

An I2C compliant interface is available for communication with an external host CPU. The interface can be operated in slave mode only. It is fully compatible with Fast-Mode-Plus of the I2C industry standard. Since the maximum SCL clock frequency is 1 MHz (in Fast-Mode-Plus), the maximum bit rate is 1 Mbit/s. The interface stretches the clock when slowed down while serving interrupts, therefore the real bit rates may be slightly lower.

**Note :** The I2C interface is only available with the UART default mode. If the SPI interface is selected by tying the **D\_SEL** input to ground, the I2C is not available.

Figure 8. I2C chronogram specifications

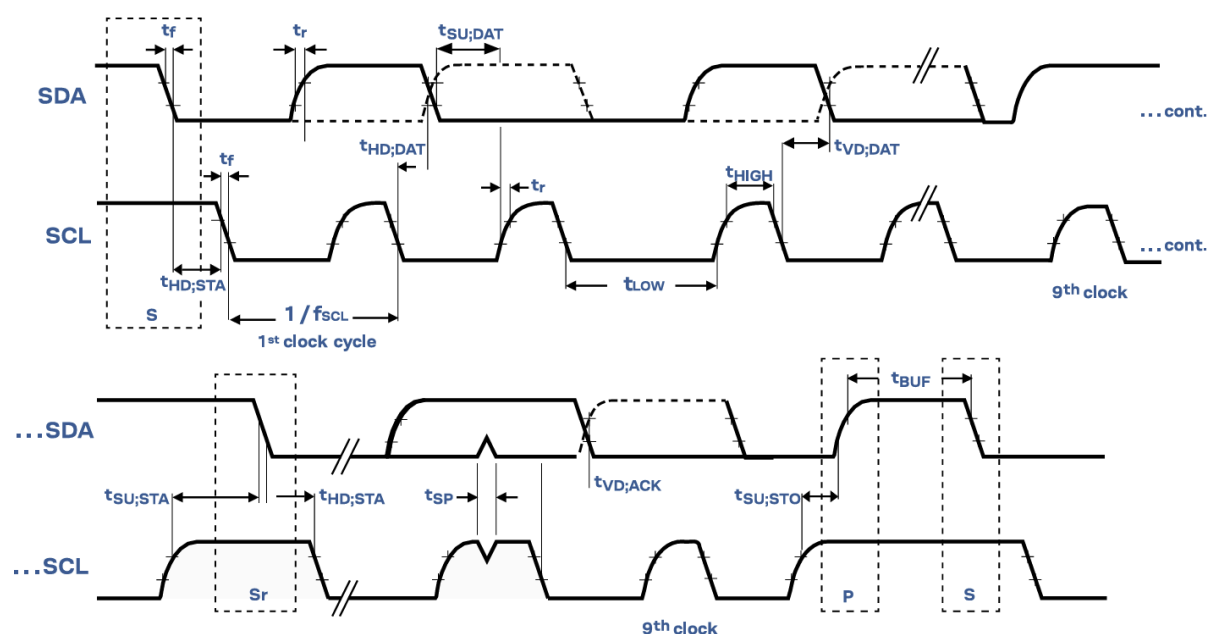


Table 15. Pioneer F20P I2C timing specifications

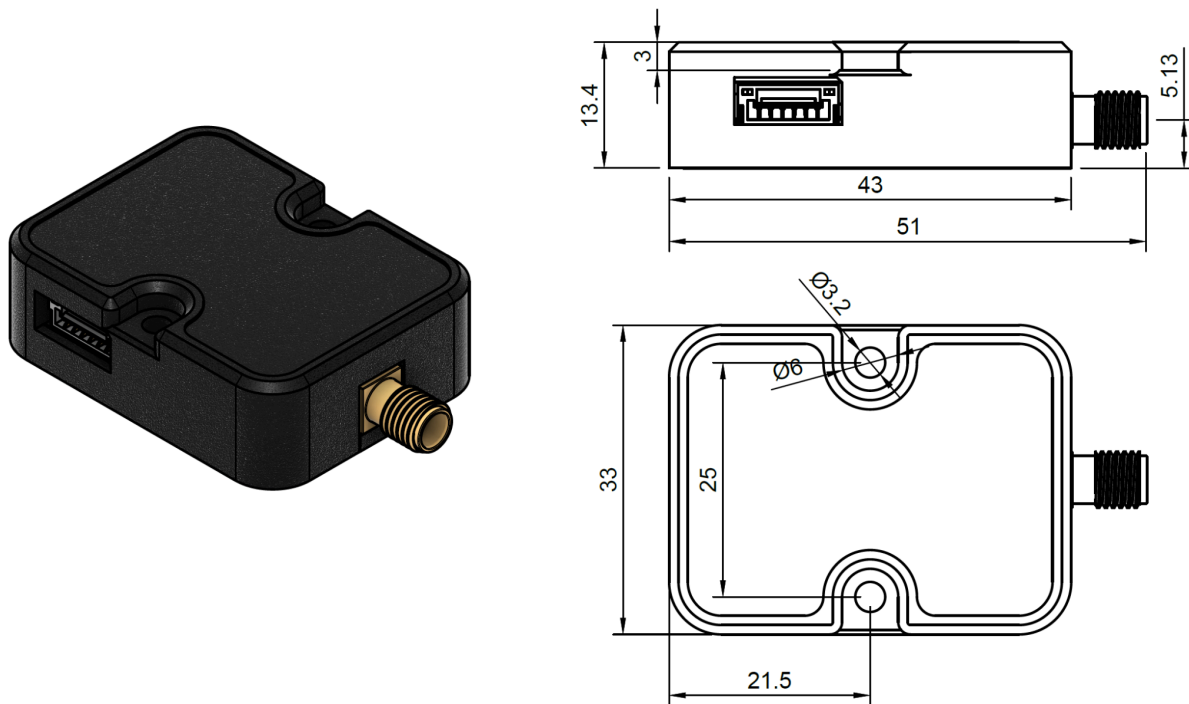
| Symbol | Parameter                         | Min                            | Max                     | Units |
|--------|-----------------------------------|--------------------------------|-------------------------|-------|
| Vil    | LOW-LEVEL input voltage           | Vss-0.3                        | 0.3xVdd                 | V     |
| Vih    | HIGH-LEVEL input voltage          | 0.7xVdd                        | Vdd+0.3                 | V     |
| Cb     | Capacitive load for each bus line | 400<br>(standard & fast modes) | 550<br>(fast mode plus) | pF    |
| Fscl   | SCL clock frequency               | 0                              | 1                       | MHz   |

## 5.4 USB interface

A USB interface, which is compatible with USB version 2.0 FS (Full Speed, 12 Mbit/s), can be used for communication as an alternative to the UART.

## 6. Mechanical drawings

Figure 9. Pioneer F20P v1.0 mechanical drawings



The recommended mating connector is the **HIROSE ELECTRIC DF40HC(3.5)-20DS-0.4V**  
 Datasheet: [\[DF40\] Series Catalog](#)

Manufacturer:

[DF40HC\(3.5\)-30DS-0.4V\(51\) - HIROSE Electric Group \[Connector\]](#)

Supplier's list:

- [DF40HC\(3.5\)-20DS-0.4V\(51\) Hirose Electric Co Ltd | Connectors, Interconnects | DigiKey](#)
- [DF40HC\(3.5\)-80DS-0.4V\(51\) Hirose Connector | Mouser](#)
- [DF40HC\(3.5\)-30DS-0.4V\(51\) in Reel by Hirose Electric | Rectangular Connectors | Future Electronics](#)



## 7. Revision history

Table 16. Document revision history

| Date        | Revision | Changes                                    |
|-------------|----------|--------------------------------------------|
| 02-Sep-2025 | 1.0      | SiderionDoc_Pioneer_F20P / Initial release |
| 26-May-2026 | 1.1      | Figure 1 - Block Diagram added             |

## 8. Appendix

U-blox ZED-F20P datasheet: [ZED-F20P-00B Data sheet](#)

U-blox ZED-F20P integration manual: [ZED-F20P Integration manual](#)

U-blox ZED-F20P interface description: [u-blox F20 HPG 2.02 Interface description](#)

Siderion user's guide:

Siderion tutorials:

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