SmartElex Allband GNSS RTK Breakout - ZED-X20P

❖ Introduction –

The **SmartElex Allband GNSS RTK Breakout (ZED-X20P)** is a high-precision positioning module built around the **u-blox ZED-X20P GNSS module**. It is designed for applications that require accurate location tracking, such as robotics, surveying, autonomous systems, and drones.

This module supports multiple satellite constellations (GPS, Galileo, BeiDou, QZSS, NavIC) and multi-frequency signals, enabling reliable positioning even in challenging environments. With RTK (Real-Time Kinematic) capability, it can achieve **centimeter-level accuracy** when correction data is available.

It offers flexible connectivity options including **USB, UART, I2C, and SPI**, making it easy to integrate with PCs or microcontrollers. The board also includes features like a built-in backup battery, PPS timing output, and advanced interference detection.

❖ Specifications –

Parameter	Specification
Module Core	u-blox ZED-X20P GNSS module
GNSS Constellations	GPS, Galileo, BeiDou, QZSS, NavIC
Supported Bands	L1, L2, L5 + L-band
SBAS Support	WAAS, EGNOS, MSAS, GAGAN, BDSBAS
Position Accuracy	RTK: ~0.6 cm + 1 ppm
Standard Accuracy	~1.2 m (GPS), ~0.6 m (SBAS)
PPP Accuracy	<10 cm
Velocity Accuracy	0.03 m/s
Heading Accuracy	0.3°
Time Pulse Accuracy	60 ns
Sensitivity (Tracking)	-167 dBm
Cold Start Time	~25 sec
Hot Start Time	~2 sec
RTK Convergence Time	<7 sec
Update Rate	Up to 25 Hz

Parameter	Specification
Max Altitude	80,000 m
Max Velocity	300 m/s
Operating Voltage	2.7V – 3.6V
Interfaces	USB, UART (x2–3), I2C, SPI
Protocols Supported	NMEA, UBX, RTCM, SPARTN
Antenna Connector	SMA / U.F.L (active antenna supported)
Operating Temperature	-40°C to +85°C
LED Indicators	PWR, PPS, RTK, Geofence
Special Features	RTK, PPP-RTK, L-band correction, anti-jamming, spoofing detection
Services Supported	AssistNow, PointPerfect
Backup Feature	Built-in backup battery

❖ Features –

- U-blox ZED-X20P Allband, GNSS module
  - GNSS Constellations
    - GPS (USA)
    - Galileo (EU)
    - BDS (China)
    - QZSS (Japan)
    - NavIC (India)
  - SBAS Systems:
    - WASS (USA)
    - EGNOS (EU)
    - BDSBAS (China)
    - MSAS (Japan)
    - GAGAN (India)
- Connections:
  - 19 PTH Pins
  - 4-pin JST connector (x2)
  - UART interfaces (x3)
    - USB-C connector
    - 6 PTH pins (BlueSMiRF/Serial-to-UART)
    - 4-pin locking JST connector
- LEDs:
  - PWR - Red 3.3V power indicator
  - PPS - Yellow Pulse-Per-Second indicator
  - RTK - White RTK correction indicator
  - FENCE - Blue Geofence status indicator
- Backup battery

ZED-X20P General Features-

- Supply voltage: 2.7V to 3.6V
- GNSS Support:
  - GPS: L1C/A, L2C, L5
  - Galileo: E1B/C, E5a, E6
  - BeiDou: B1I, B1C, B2a, B3I

    - QZSS: L1C/A, L1C/B*, L2C, L5, L6
    - NavIC: L1*, L5
    - SBAS: L1C/A
- Interfaces:
    - UART x2
    - SPI
    - I2C
- Features:
    - Programmable flash memory
    - Carrier phase output
    - Jamming detection
    - Galileo OSNMA
    - Secure boot

❖ Hardware Overview –

➢ Interfaces-

- I2C (JST – default communication)
- UART1, UART2
- USB
- SPI (enabled via jumper)

➢ Key Pins-

Below are the **most important pins you will use in design/testing**:

Pin Name	Type	Function
VCC (3.3V)	Power	Main supply input
GND	Power	Ground reference
EN	Input	Enables 3.3V regulator (active HIGH)
RST	Input	Reset (LOW → cold restart)
TX1 / RX1	UART	Primary communication (UART1)
TX2 / RX2	UART	Secondary UART
SDA / SCL	I2C	JST interface (Address: 0x42)
SPI Pins	SPI	Enabled via jumper
TIMEPULSE (PPS)	Output	Timing pulse (1Hz default)
EXTINT (EVENT)	Input	External interrupt / wake-up
RTK_STAT	Output	RTK status indication

Notes:

- UART1 is used for **firmware updates**
- PPS pin used for **precise timing applications**

➢ LED Indications-

LED	Color	Meaning
PWR	Red	Power ON
PPS	Green	Time pulse (1Hz)
RTK	White	RTK status

LED	Color	Meaning
FENCE	Blue	Geofence status

- Cut jumper → LED OFF (for low power)

➢ **Jumper Configuration-**

Jumper	Function
I2C	Enables/disables pull-up resistors
SPI (D_SEL)	Enables SPI mode (replaces UART/I2C pins)
VSEL	Select voltage (3.3V / 5V for JST connector)
SHLD	Disconnect USB shield from ground

- **RF Jumper (Important)-**
  - Controls antenna routing:
    - Default → SMA connector active
    - Modified → U.F.L connector active
  - You must **change this jumper** if using U.F.L antenna

➢ **Antenna Connection-**

- **Available Options-**The board supports **two antenna connectors**:
- **SMA Connector (Default)-**
  - Main antenna interface
  - Direct connection
  - Best for testing & field use
- **U.F.L Connector-**
  - Compact connection
  - Requires: U.F.L to SMA cable
  - Needs **RF jumper modification**

❖ Testing Procedure-

- Connect antenna and place in open sky.
- Connect USB to PC and verify power LED.
- Check COM port in Device Manager.
- Open u-center software and connect to module.
- Verify NMEA data output.
- Check satellite detection (10+ satellites expected).
- Confirm 3D position fix.
- Observe PPS LED blinking every second.
- Optional: Test RTK using correction data.

1. Basic Testing Setup-

Required items-

- ZED-X20P board (your module)
- Dual-band GNSS antenna (UFL/SMA)
- USB-to-UART / direct USB board
- PC / Laptop

Connection (simple way)-

Option 1: USB board (best)-

- Plug USB → PC

Option 2: UART-

- VCC → 3.3V
- GND → GND
- TX → RX (ESP32/USB converter)
- RX → TX

2. Software for Testing-

Use official tool: u-center (u-blox software)

This lets you:

- View satellites
- Check GPS lock
- See RTK status
- Configure module

3. First Test (Standalone GPS)-

Steps:

1. Connect antenna
2. Power ON
3. Open u-center
4. Select COM port
5. Wait 30–60 sec

You should see:

- Latitude / Longitude
- Satellites visible

4. RTK Testing (Important)-

To get **cm accuracy**, you need:

Option A: Base + Rover

- 2 modules needed
- One = Base station
- One = Rover

Option B: NTRIP (internet)

- Use RTK correction server
- ESP32 / PC internet required

Without RTK correction → only normal GPS (~1m accuracy)

5. How to Check if RTK is Working-

In u-center:

- FIX type:
  - NO FIX
  - 3D FIX (normal GPS)
  - RTK FLOAT
  - RTK FIX (best)

Only **RTK FIX = centimetre accuracy**

❖ I2C Connection (Arduino ↔ ZED-F9P)

ZED-F9P	Arduino UNO / Nano
VCC	3.3V
GND	GND
SDA	A4
SCL	A5

Important-

- ZED-F9P is **3.3V device**
- If using UNO (5V), better use **logic level shifter**
- ESP32 = safe (3.3V)

1. Install Library-

Use Arduino Library Manager:
Install: **SparkFun u-blox GNSS Arduino Library.**

2. Basic I2C Test Code-

```
#include <Wire.h>
#include <SparkFun_u-blox_GNSS_Arduino_Library.h>

SFE_UBLOX_GNSS myGPS;
void setup()
{
  Serial.begin(115200);
  Wire.begin();
  Serial.println("ZED-F9P I2C Test");
  if (myGPS.begin() == false) // I2C default address 0x42
{
  Serial.println("GPS not detected. Check wiring!");
  while (1);
 }
  Serial.println("GPS detected!");
}
void loop()
{
   long latitude = myGPS.getLatitude();
   long longitude = myGPS.getLongitude();
   long altitude = myGPS.getAltitude();
   Serial.print("Lat: ");
   Serial.print(latitude / 10000000.0, 7);
   Serial.print(" | Lon: ");
   Serial.print(longitude / 10000000.0, 7);
   Serial.print(" | Alt: ");
   Serial.print(altitude / 1000.0);
   Serial.println(" m");
```

```
    delay(1000);
}
```

3. What you should see In Serial Monitor-

GPS detected!
Lat: 18.xxxxxxx | Lon: 73.xxxxxxx | Alt: xxx m

First fix may take **30–60 sec (outdoor only)**

❖ Important Notes-

- Must have **clear sky view** (no indoor use)
- Needs **continuous correction data**
- Antenna quality affects accuracy

❖ Applications –

- Autonomous robots & drones
- Precision agriculture
- Surveying & mapping
- GIS data collection
- Navigation systems
- Asset tracking