7SEMI

ZED-F9P Dual-band GNSS RTK SMA Modem

Version 1.0

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1.Product Information

The **7Semi ZED-F9P Dual-band GNSS RTK SMA Modem Board** is a high-precision GNSS solution designed to deliver centimeter-level positioning accuracy. Built around the **u-blox ZED-F9P** module, this modem board offers seamless integration with multi-GNSS constellations and real-time kinematic (RTK) capabilities. Its versatile interfaces and compact design make it ideal for industrial, UAV, and IoT applications.

It key features:

- Centimeter-level positioning accuracy with RTK and PPP-RTK.
- Concurrent tracking of multiple GNSS constellations (GPS, GLONASS, Galileo, BeiDou).
- Supports RTK moving base for relative positioning in dynamic applications.
- Low power consumption and robust design for portable and embedded systems.
- Multiple communication interfaces, including USB, UART, SPI, and I²C.
- Compact and modular design for easy integration.

2.Description

The **7Semi ZED-F9P Board** integrates the **u-blox ZED-F9P GNSS module** with external SMA connectors, a USB interface, and multiple communication pins. It is optimized for high-performance GNSS applications requiring reliable and precise positioning under diverse environmental conditions.

Applications

UAV Navigation:

- Precise GNSS positioning enables drones to follow programmed flight paths or land on moving platforms. The RTK moving base feature enhances dynamic UAV operations.

Autonomous Vehicles:

- Provides high-precision navigation required for safety and reliability in self-driving cars, delivery robots, and other autonomous systems.

Precision Agriculture:

- Supports automated tractors and sprayers, enabling efficient and accurate field operations. RTK accuracy minimizes overlaps and missed areas during planting or harvesting.

Surveying and Mapping:

- Facilitates the collection of highly accurate geospatial data for construction, infrastructure planning, and environmental monitoring.

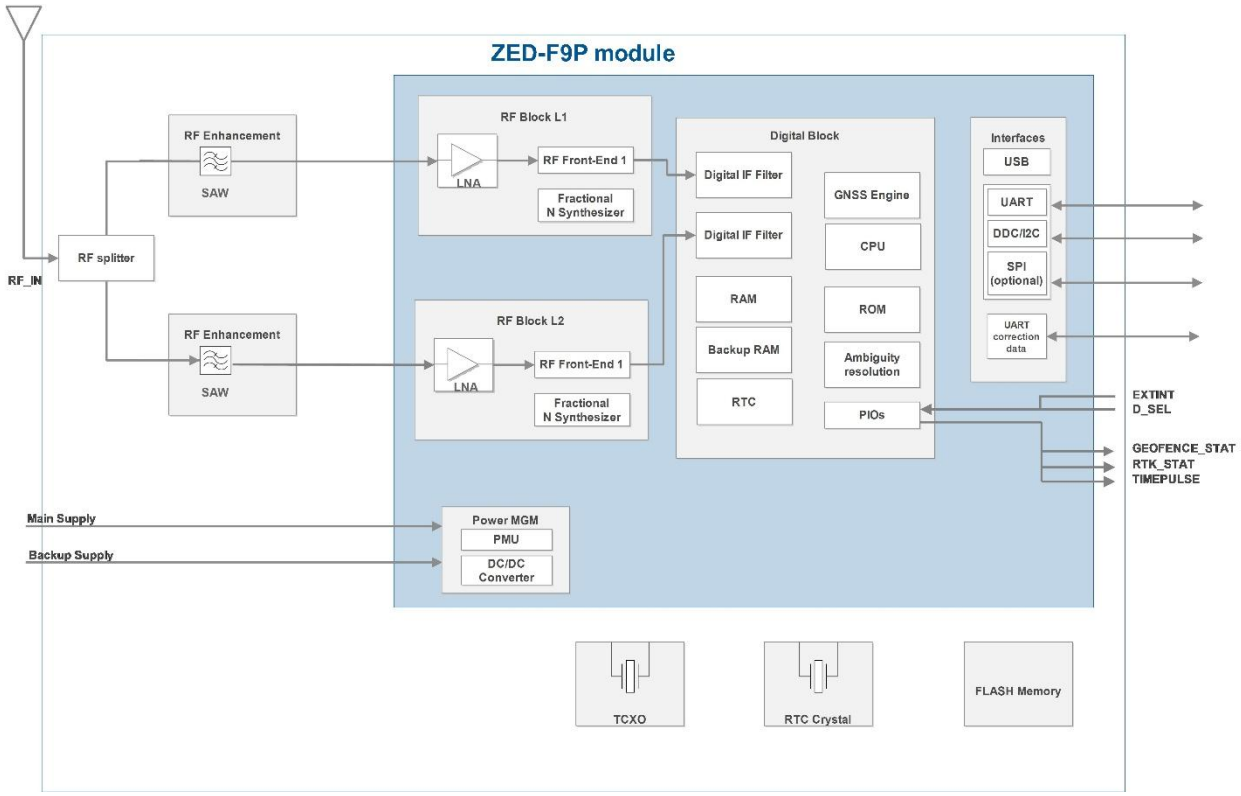
IoT and Smart Infrastructure:

- Integrates seamlessly with IoT platforms for real-time monitoring, geofencing, and analytics in smart cities, logistics, and asset tracking.

Robotics:

- Empowers autonomous robots with precise localization, enabling efficient navigation in both indoor and outdoor environments.

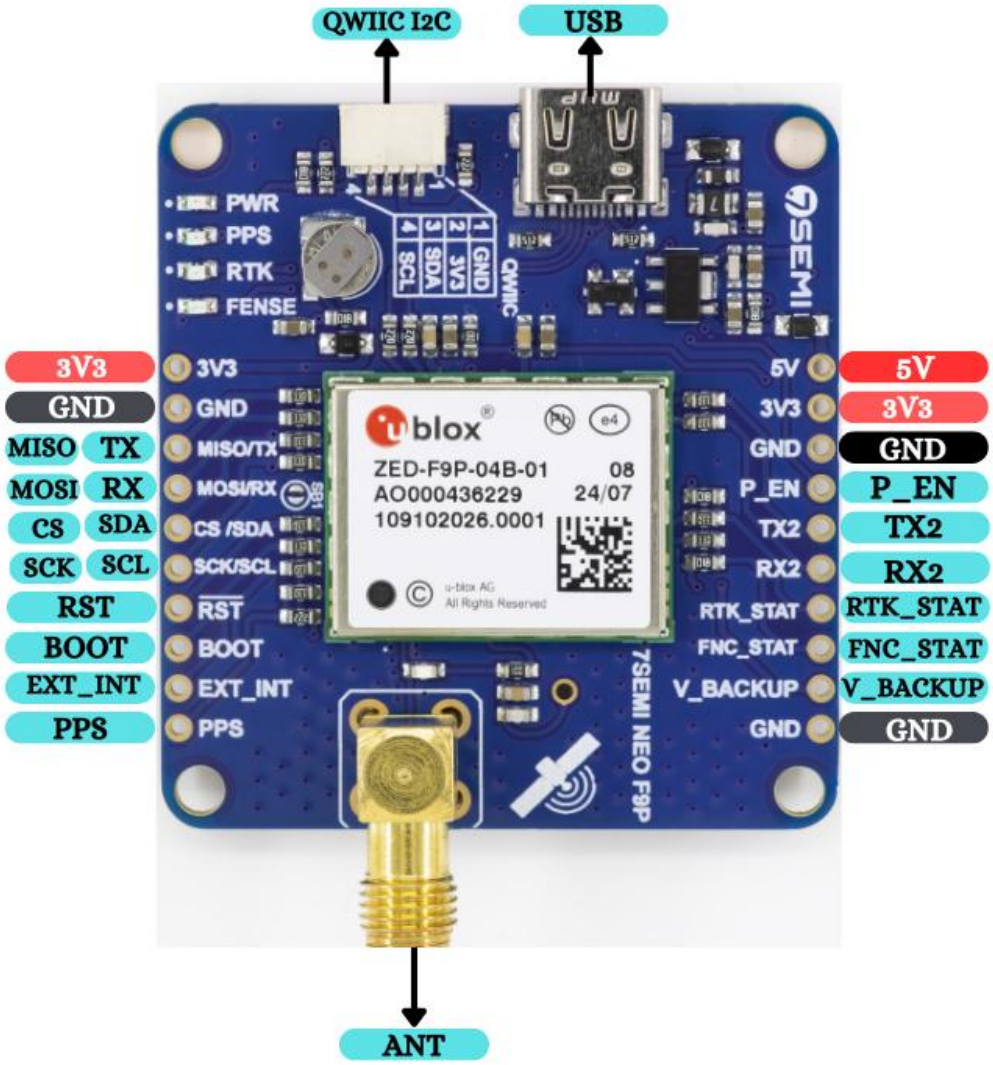
2.1 Block Diagram



The block diagram below illustrates the integration of the **u-blox ZED-F9P module** and the board's external interfaces:

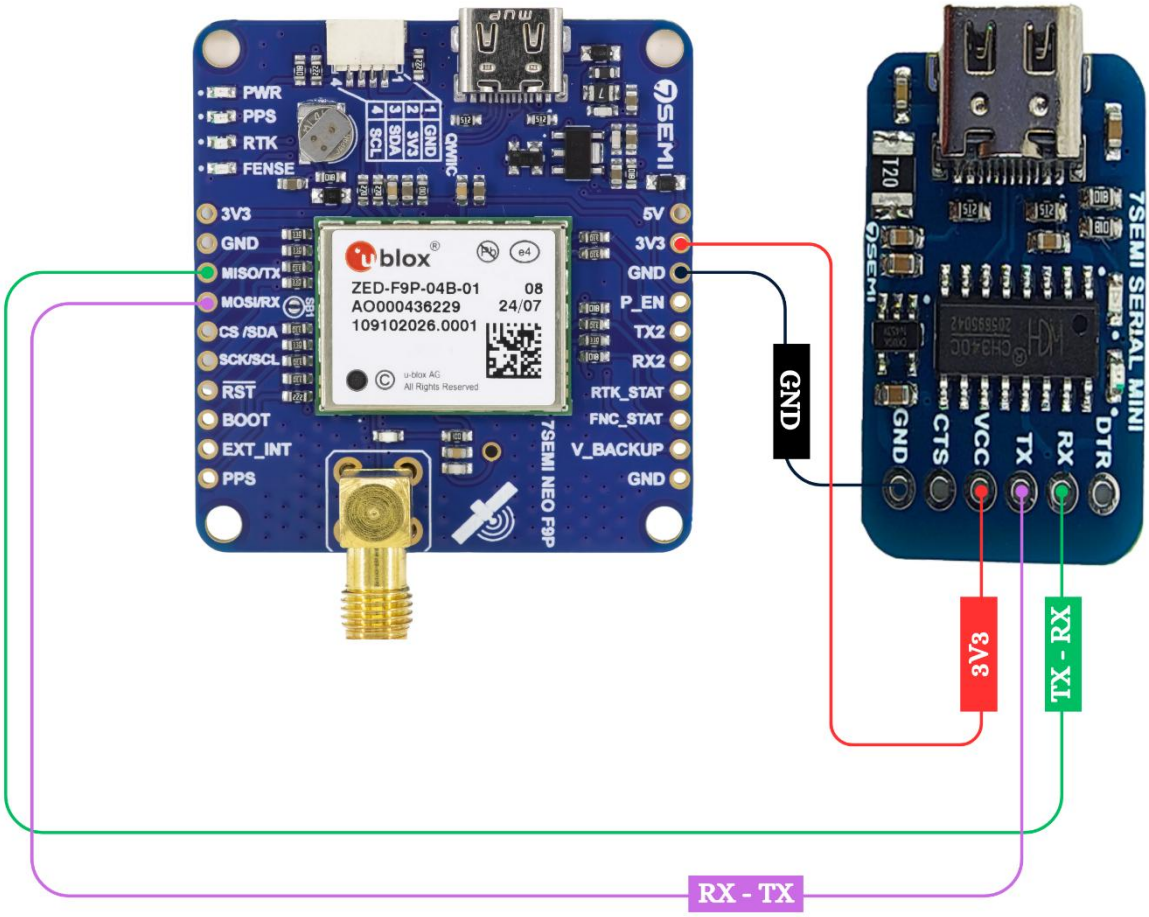
1. **GNSS Module**: The ZED-F9P provides multi-band GNSS reception and RTK functionality.
2. **Communication Interfaces**: Includes USB, UART, I²C, and SPI for versatile connectivity.
3. **SMA Connectors**: Enable connection with external GNSS antennas for enhanced accuracy.
4. **Power Supply**: Supports a wide voltage range for flexible power options.

2.2 Pinouts


QWIIC I2C
USB
PWR
PPS
RTK
FENSE
GND
3V3
SDA
SCL
QWIIC
3V3
GND
MISO
TX
MOSI
RX
CS
SDA
SCK
SCL
RST
BOOT
EXT_INT
PPS
3V3
GND
MISO/TX
MOSI/RX
CS /SDA
SCK/SCL
RST
BOOT
EXT_INT
PPS
ublox
ZED-F9P-04B-01
08
AO000436229
24/07
109102026.0001
5V
3V3
GND
P_EN
TX2
RX2
RTK_STAT
FNC_STAT
V_BACKUP
GND
5V
3V3
GND
P_EN
TX2
RX2
RTK_STAT
FNC_STAT
V_BACKUP
GND
7SEMI NEO F9P
ANT

PINOUT	FUNCTION
TX1	Transmits data to external devices.
RX1	Receives data from external devices.
TX2/RX2	Secondary UART communication for RTK corrections
USB	Configures the board and transmits GNSS data
PPS	Pulse-per-second output for synchronization
RTK_STAT	Displays RTK status (fixed, floating, or no corrections)
QWIIC I2C	Dedicated I2C connection
GND	Ground pin; connect to the system's ground.
3V3/5V	Power input; connect to a 3.3V/5V DC supply.
MISO	SPI interface - Master In, Slave Out pin.
MOSI:	SPI interface - Master Out, Slave In pin.
CS:	SPI Chip Select pin.
SCK	SPI Clock pin.
RST:	Reset pin to restart the module.
BOOT:	Safe boot pin used for firmware updates.
EXT_INT:	External interrupt pin for triggering events.
PPS:	Pulse Per Second output for precise timing and synchronization.
V_BACKUP:	Backup power supply input to maintain GNSS data during power loss.

2.3Default interface settings



UART1 output

- 38400 baud, 8 bits, no parity bit, 1 stop bit.
- NMEA protocol with GGA, GLL, GSA, GSV, RMC, VTG, TXT messages are output by default.
- UBX and RTCM 3.4 protocols are enabled by default but no output messages are enabled by default.

UART1 input

- UBX, NMEA and RTCM 3.4 input protocols are enabled by default.
- SPARTN input protocol is enabled by default.

UART2 output

- 38400 baud, 8 bits, no parity bit, 1 stop bit.
- UBX protocol is disabled by default.
- RTCM 3.4 protocol is enabled by default but no output messages are enabled by default.
- NMEA protocol is disabled by default.

UART2 input

- 38400 baud, 8 bits, no parity bit, 1 stop bit.
- UBX protocol is enabled by default.
- RTCM 3.4 protocol is enabled by default.
- SPARTN protocol is enabled by default.
- NMEA protocol is disabled by default.

USB

- Default messages activated as in UART1. Input/output protocols available as in UART1.

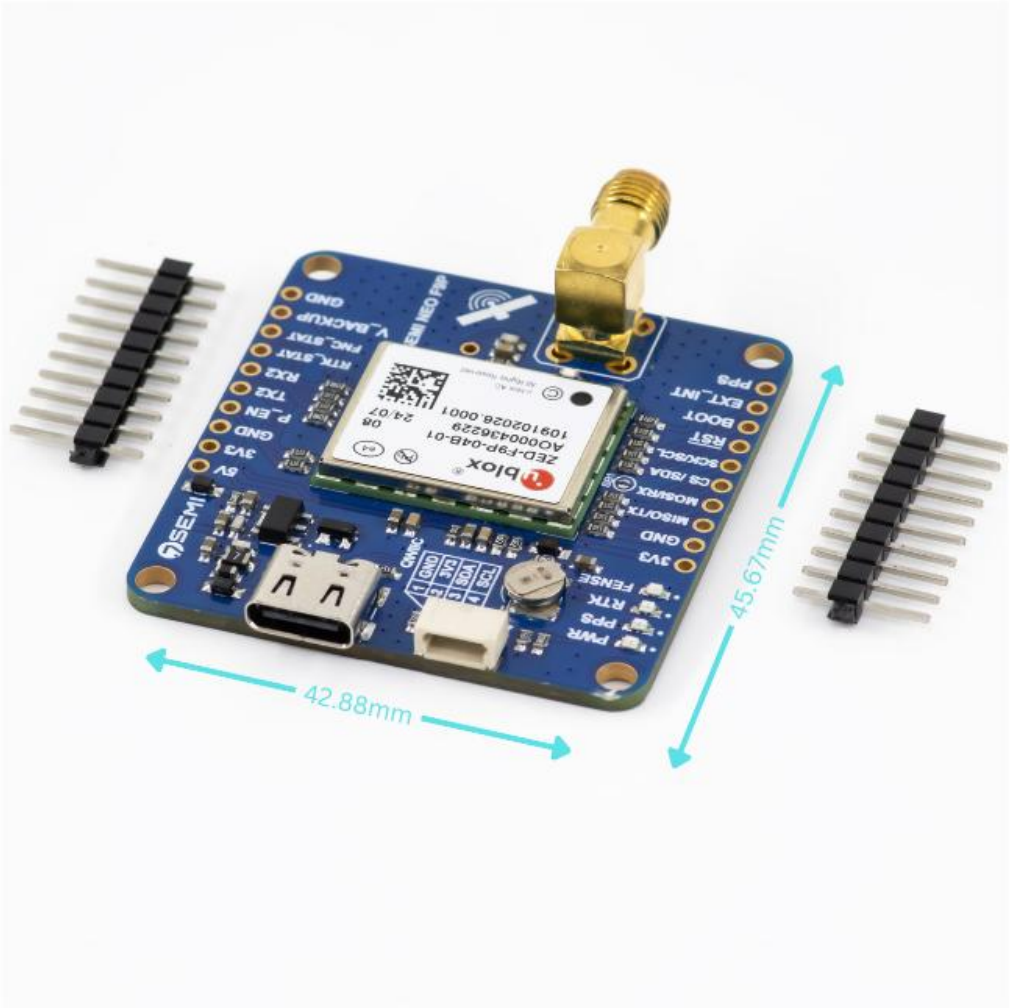
I2C

- Available for communication in the Fast-mode with an external host CPU in peripheral mode only. Default messages activated as in UART1.
- Input/output protocols available as in UART1. Maximum bit rate 400 kb/s.

SPI

- Allow communication to a host CPU, operated in peripheral mode only.
- Default messages activated as in UART1.
- Input/output protocols available as in UART1.
- SPI is not available unless D_SEL pin is set to low (see section D_SEL interface in Integration manual

3.Mechanical Specification



4.Hardware Setup

4.1 Sample Serial Output

Sample output Image of TTL :

```
07:44:51  $GLGSV,2,1,05,71,23,267,,72,07,313,,74,10,319,,83,54,060,,0*7D
07:44:51  $GLGSV,2,2,05,84,41,174,,0*47
07:44:51  $GAGSV,1,1,00,0*74
07:44:51  $GBGSV,2,1,08,06,45,125,32,07,48,034,39,09,59,112,27,10,60,021,35,1*7B
07:44:51  $GBGSV,2,2,08,28,42,048,35,40,38,030,31,56,,,42,58,,,40,1*7A
07:44:51  $GBGSV,1,1,01,06,45,125,08,B*3D
07:44:51  $GQGSV,1,1,03,02,18,067,36,03,23,071,26,07,26,103,24,1*5E
07:44:51  $GNGLL,1903.26574,N,07300.97367,E,074451.00,A,A*75
07:44:52  $GNRMC,074452.00,A,1903.26559,N,07300.97352,E,0.576,,310125,,,A,V*1C
07:44:52  $GNVTG,,T,,M,0.576,N,1.067,K,A*39
07:44:52  $GNGGA,074452.00,1903.26559,N,07300.97352,E,1,12,2.19,42.7,M,-65.9,M,,*55
07:44:52  $GNGSA,A,3,02,01,07,30,,,,,,,,,3.36,2.19,2.56,1*0B
07:44:52  $GNGSA,A,3,82,73,80,,,,,,,,,,3.36,2.19,2.56,2*09
07:44:52  $GNGSA,A,3,,,,,,,,,,,,,3.36,2.19,2.56,3*0E
07:44:52  $GNGSA,A,3,06,07,09,10,40,28,,,,,,,3.36,2.19,2.56,4*0E
07:44:52  $GNGSA,A,3,02,03,,,,,,,,,,,3.36,2.19,2.56,5*09
07:44:52  $GPGSV,2,1,06,01,24,067,39,02,24,056,38,07,45,119,37,13,,,30,1*5B
07:44:52  $GPGSV,2,2,06,14,,,30,30,75,064,38,1*5C
07:44:52  $GLGSV,1,1,04,70,10,308,19,73,35,358,31,80,28,065,28,82,17,031,38,1*79
07:44:52  $GLGSV,2,1,05,71,23,267,,72,07,313,,74,10,319,,83,54,060,,0*7D
07:44:52  $GLGSV,2,2,05,84,41,174,,0*47
07:44:52  $GAGSV,1,1,00,0*74
07:44:52  $GBGSV,2,1,08,06,45,125,32,07,48,034,40,09,59,112,27,10,60,021,35,1*75
07:44:52  $GBGSV,2,2,08,28,42,048,35,40,38,030,32,56,,,42,58,,,40,1*79
07:44:52  $GBGSV,1,1,01,06,45,125,08,B*3D
07:44:52  $GQGSV,1,1,03,02,18,067,36,03,23,071,27,07,26,103,25,1*5E
07:44:52  $GNGLL,1903.26559,N,07300.97352,E,074452.00,A,A*7F
07:44:53  $GNRMC,074453.00,A,1903.26547,N,07300.97346,E,0.759,63.57,310125,,,A,V*31
07:44:53  $GNVTG,63.57,T,,M,0.759,N,1.406,K,A*1C
07:44:53  $GNGGA,074453.00,1903.26547,N,07300.97346,E,1,12,2.19,42.4,M,-65.9,M,,*5D
07:44:53  $GNGSA,A,3,02,01,07,30,,,,,,,,,3.36,2.19,2.56,1*0B
07:44:53  $GNGSA,A,3,82,73,80,,,,,,,,,,3.36,2.19,2.56,2*09
07:44:53  $GNGSA,A,3,,,,,,,,,,,,,3.36,2.19,2.56,3*0E
07:44:53  $GNGSA,A,3,06,07,09,10,40,28,,,,,,,3.36,2.19,2.56,4*0E
07:44:53  $GNGSA,A,3,02,03,,,,,,,,,,,3.36,2.19,2.56,5*09
07:44:53  $GPGSV,2,1,06,01,24,067,30,02,24,056,29,07,45,119,29,13,,,23,1*5F
07:44:53  $GPGSV,2,2,06,14,,,22,30,75,064,32,1*55
```

Serial Monitor Output Explanation

The given serial monitor output displays **NMEA (National Marine Electronics Association)** sentences, which are standard messages used in GNSS/GPS communication. These messages provide positioning, satellite information, and navigation data from the **7Semi ZED-F9P Dual-band GNSS RTK SMA Modem Board.**

Understanding the NMEA Sentences in the Serial Monitor Output

Each line represents an NMEA sentence, starting with a "$" symbol, followed by different identifiers that describe the type of data. Below is an explanation of the most relevant NMEA sentences found in the image.

1. $GNGGA - Global Positioning System Fix Data

```
$GNGGA,074452.00,1903.2659,N,07300.97352,E,2,11,1.2,19.2,M,-
65.9,M,,*55
```

Explanation:

- 074452.00 → UTC time (07:44:52)
- 1903.2659,N → Latitude (19°03.2659' N)
- 07300.97352,E → Longitude (73°00.97352' E)
- 2 → Fix quality (2 = DGPS fix, 1 = Standard GPS, 4 = RTK fixed)
- 11 → Number of satellites in use
- 1.2 → Horizontal dilution of precision (HDOP)
- 19.2,M → Altitude above mean sea level (19.2 meters)
- -65.9,M → Geoid separation
- **Checksum (55)* → Ensures data integrity

2. $GNGSA - GNSS DOP and Active Satellites

```
$GNGSA,A,3,02,01,07,30,,,,,,,,,3.6,2.19,2.56*09
```

Explanation:

- A → Auto-selection of GNSS mode
- 3 → Fix mode (1 = No fix, 2 = 2D fix, 3 = 3D fix)
- 02,01,07,30,... → PRN (satellite numbers) in use
- 3.6 → Position dilution of precision (PDOP)
- 2.19 → Horizontal dilution of precision (HDOP)
- 2.56 → Vertical dilution of precision (VDOP)
- **Checksum (09)* → Data integrity check

3. $GNRMC - Recommended Minimum Specific GPS Data

```
$GNRMC,074452.00,A,1903.2659,N,07300.97352,E,0.576,310.25, ,
,A,V*1C
```

Explanation:

- 074452.00 → UTC Time (07:44:52)
- A → Status (A = Valid, V = Invalid)
- 1903.2659,N → Latitude (19°03.2659' N)
- 07300.97352,E → Longitude (73°00.97352' E)
- 0.576 → Speed over ground (0.576 knots)
- 310.25 → Track angle in degrees (310.25°)
- **Checksum (1C)* → Data integrity verification

4. $GPGSV & $GLGSV - GNSS Satellites in View

```
$GPGSV,2,1,08,06,45,125,32,07,48,034,39,09,59,112,27,10,60,021,3
5,1*75

$GLGSV,2,1,05,71,23,267,,72,07,313,,74,10,319,,83,54,060,,0*7D
```

Explanation:

- 2 → Total number of GSV sentences
- 1 → Sentence number (this is the 1st part of 2 sentences)
- 08 → Total satellites in view
- 06,45,125,32 → Satellite PRN (06), elevation (45°), azimuth (125°), SNR (32 dB)
- **Checksum (75)* → Data integrity verification

The GPGSV sentence lists the GPS satellites, while GLGSV lists GLONASS satellites.

5. $GPTXT - Text Transmission Sentence

```
$GPTXT,01,01,02,ANTSTATUS=OK*3B
```

Explanation:

- ANTSTATUS=OK → Antenna status message, indicating that the antenna is working correctly.
- **Checksum (3B)* → Ensures data integrity.

4.2 More Circuit Connections & Updates

For additional circuit connections, setup guides, and the latest updates on the **7Semi ZED-F9P Dual-band GNSS RTK SMA Modem Board**, visit the official **7Semi Wiki page**:

🔗 **7Semi Wiki - Circuit Connections & Updates**

This page contains detailed documentation, troubleshooting tips, firmware updates, and integration examples to help you get the most out of your GNSS module.