GR-901, RTK Centimeter-level L1/L2 Dual-band GNSS Smart Antenna as RTK Base or Rover

RoHS Compliant

Ardupilot

Overview

GR-901 is equipped with high-sensitivity, high precision engine of **u-blox ZED-F9P**, GNSS multi-band antenna, backup battery in a compact IP67 housing.

Mounted with wide-band antenna, this module supports dual band L1/L2 and multi-satellite systems GPS/GLONASS/BEIDOU/Galileo/QZSS simultaneously in one design.

This receiver exhibits fast RTK fix, reliable performance, high update rate for highly dynamic applications and centimeter accuracy in a small and energy-efficient way. It could be served as either an RTK rover or base.

This all-in-one smart antenna allows just plug and play, fast time to market with outstanding performance.

Applications

- UAV (RTK base, rover)
- Automatic farming (RTK base/rover/heading)
- Robotic guidance (RTK rover/heading)
- Pipeline/Asset/People positioning (RTK rover)
- Photogrammetry (RTK base/rover)

Features

- *Based on ZED-F9P high precision engine.*
- ***Plug and play cm-level smart antenna***
- *USB/RS232/UA*RT TTL options
- Built-in L1/L2 band antenna and circuits supporting multiple constellations simultaneously
  - GPS+Galileo+GLONASS+BeiDou
  - SBAS, QZSS
- DGNSS RTCM 10403.3 version 3 messages support for RTK fix.
- High sensitivity+:-167dBm tracking/-148dBm acquisition
- RTK convergence in 10 sec for multi-GNSS.
- Up to 8/ 10/ 15/ 20 Hz update rate for quad/ tri/ dual/ single-GNSS constellations
- **Spoofing detection / monitoring**
  - Multiple constellations should be enabled.
- **Jamming / interference indicator**
  - For continuous wave (narrow-band) jammers/interference only
- Magnet option available
  - Disk only, without magnet inside
  - Disk and pedestal with embedded magnet
- Pole support for acting as an RTK base
  - Quad-M3x8 screw holes for pole fixing
  - 5/8” survey-pole adapter option available
- Two GR-901s connected for moving baseline heading receiver available
  - Precise heading receiver w/o RTK calibration
  - And, precise RTK rover w/ RTK calibration
- Ardupilot/PX4-compliant
- Windows location sensor support
- OMA SUPL compliant A-GPS support
- SBAS (WAAS, EGNOS, MSAS, GAGAN) support
- Excellent EMI protection

Technical Specifications

Receiver Performance Data+

Supported GNSS Constellations	u-blox ZED-F9P GPS/SBAS/QZSS: (MHz) L1 C/A (1575.42), L2C (1227.60) GLONASS: (MHz) L1OF (1602+k*0.5625, k= -7,…,5,6), L2OF (1246+k*0.4375, k= -7,…,5,6), Galileo: (MHz) E1-B/C (1575.42), E5b (1207.140) BeiDou: (MHz) B1I (1561.098) B2I (1207.140)
Position Accuracy (RTK baseline up to 20km; 24 hours static)	Horizontal: RTK: 1 cm+1ppm CEP SBAS: 1 m CEP PVT: 1.5 m CEP Vertical: (result with 1km baseline) RTK: 1 cm+1ppm R50
Velocity Accuracy	<0.05 m/s (speed) <0.3° (heading) (50% @ 30 m/s for dynamic operation)
Time Pulse Signal	0.25Hz...10MHz3 RMS: 30ns, 99%: 60ns
Time To First Fix (TTFF) Hot start Aided start Cold start	Autonomous (All at -130dBm) 2sec (GPS+Glonass+Galileo+BeiDou) 2sec (GPS+Glonass+Galileo+BeiDou) 25sec (GPS+Glonass+Galileo+BeiDou)
Sensitivity	GPS+Glonass+Galileo+BeiDou Acquisition: -148 dBm Reacquisition: -160 dBm Tracking & navigation: -167 dBm
Max. Update Rate	a. GPS+Glonass+Galileo+BeiDou b. GPS+BeiDoui c. GPS RTK: 8Hz@a, 15Hz@b, 20Hz@c PVT: 10Hz@a, 25Hz@b, 25Hz@c RAW: 20Hz@a, 25Hz@b, 25Hz@c
RTK Convergence Time	<10s@a&b, <30s@c Depends on atmospheric conditions, baseline length, multipath conditions, satellite visibility and geometry
Moving Base RTK Performance	a. GPS+Glonass+Galileo+BeiDou b. GPS+BeiDoui c. GPS Max. update rate: 8Hz@a, 10Hz@b, 10Hz@c Heading accuracy: 0.4°@a,b,c
Max. Altitude	50,000 m
Max. Velocity	500 m/s
Protocol Support Default Settings	NMEA 0183 up to v 4.11, ASCII GGA, GLL, GSA, GSV, RMC, VTG UBX: u-blox proprietary, binary RTCM 3.3: binary UART1 & 2: 230400bps!, N-8-1 UART1: NMEA, UBX, RTCM 3.3 enabled Only NMEA output UART2: RTCM 3.3 enabled, No output, NMEA disabled, UBX not supported
Augmentation System Support	QZSS: Support L1S SLAS Correction data broadcasted on L1 SBAS: WAAS, EGNOS, MSAS, GAGAN DGNSS: RTCM 10403.3 ● Rover mode messages: (RTCM) 1001~1012, 1033, 1074, 1075, 1077, 1084, 1085, 1087,1094, 1095, 1097, 1124, 1125, 1127, 1230, 4072.0 ● Base mode messages: (RTCM)

	1005, 1074, 1077, 1084, 1087, 1094, 1097, 1124, 1127, 1230, 4072.0, 4072.1
Dynamics	< 4g

+ Note. According to IC Spec

! Higher update rate usually leads to higher performance. In case high update rate was adopted, higher baud rate and/or less NMEA sentences are required to allow bigger baud rate to accommodate the data traffic.

Electrical Data

Power Supply	3.3 ~ 5.5 VDC, ≥ 3.5V suggested
Power Consumption (10Hz update rate)	118mA/average tracking (USB) # of SVs tracked: L1: 37, L2: 27

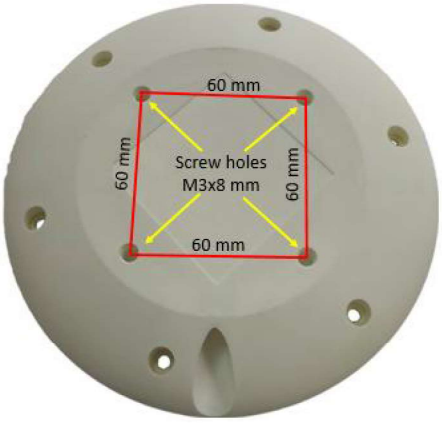
Environmental Data

Operating temperature	-40 ~ 85℃ except battery: -20~60℃
Storage temperature	-40 ~ 85℃ except battery: -20~60℃
Waterproof	IPX7
Operating humidity	5% ~ 95% non-condensing

Mechanical Data:

- Φ116*24.6 (mm) for disk without pedestal
- Φ116*56.8 (mm) for disk with pedestal

- Quad-fixing screw holes, bottom of disk:

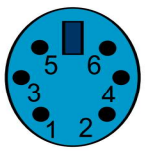
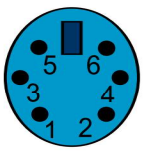


5/8”-11 Pole Adapter

Other Data

Cable Length (default, customizable)	1.5 m for GR-901U, GR-901V 3 m for GR-901R, GR-901Q 1 m for GR-901T, GR-901S

Interfaces

	GR-901T_S	GR-901R_Q	GR-901U_V
!			
Pin	Mini-Din 6-pin PS/2 Male Plug	Mini-Din 6-pin PS/2 Male Plug	USB A type Male Plug
1	GND	GND	VDD 5V
2	VCC	VCC	D-
3	TXD-TTL	TX-RS232	D+
4	RXD-TTL	RX-RS232	GND
5	$PPS	$:PPS	-
6	-	-	-

!:Connector, cable length; baud rate, update rate, NMEA sentence customization available..

$:TTL signal level.

LED Indication

Green LED for GNSS fix	**ON**, position not fixed, **Blinking**, position fixed, **OFF**, power is OFF
Orange LED for RTK fix	**ON**, RTK fixed **Blinking**, RTK under fixing **OFF**, not in RTK mode, i.e. RTCM correction data is not available.

Road Test (For Indicative Reference Only)

- Fix two GR-901Vs 84-cm apart on car roof.
- Drive a round-trip along a city road.

  - Around 24.7817339,121.0416466
- Calculate the distance for all (4324) position pairs and analyze its variations.
- Result
  - Average: 83.5-cm, 1-sigma = 0.926cm
  - 1-sigma: 68.8%, 2-sigma: 93.27%, 3-sigma: 99.72%,

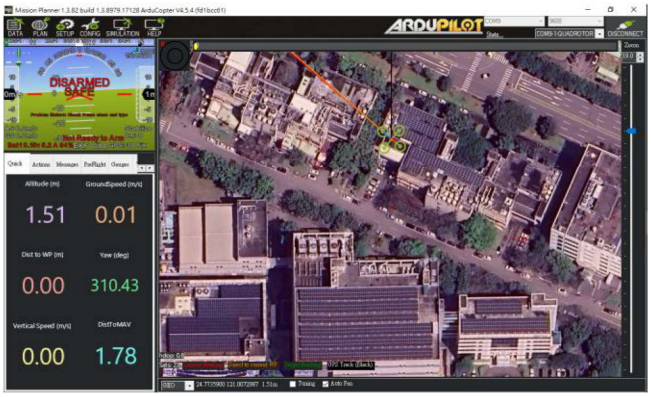
Road Test (Moving Baseline)

- Fix two GR-901Vs 30-cm apart on car roof. One configured as moving baseline (back), another as rover (front).
- Drive a round-trip along a city road.

  - Around 24.7817339,121.0416466
- Check all the relative data for the validity.
- Result
  - Average relative distance is 30.06cm,
  - 1-sigma 0.339cm, 3-sigma 97.1%.
  - All the relative distance and heading shown by u-blox protocol are all valid
- It shows good validity for moving baseline of as short as 30cm.

Mission Planner/ Ardupilot

- Serving as an RTK Rover



- Serving as an RTK Base

Ordering Information

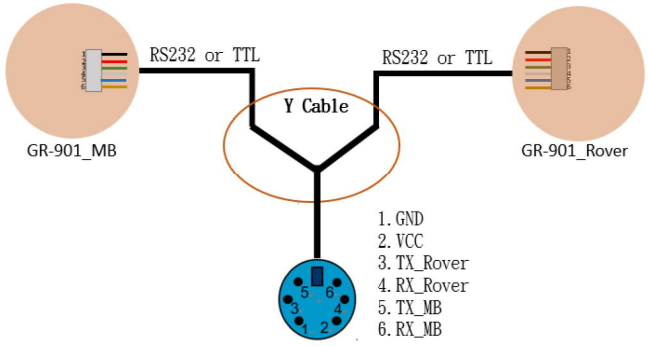
GR-901X:

\ X \	RS-232	TTL	USB
Disk Only (w/o magnet)	R	-	-
	-	T	-
	-	-	U
Disk + Pedestal (w/ magnet)	Q	-	-
	-	S	-
	-	-	V

Firmware Options

Option	Settings
Rover	Baud: 230400bps, Update Rate: 10Hz NMEA Output: GGA, RMC, GLL, VTG, GSA, GSV RTCM3 Input, accepting: 1077, 1087, 1127, 1230, 4072.0, 4072.1
Base	Baud: 230400bps, Update Rate: 1Hz NMEA Output: GGA, RMC, GLL, VTG, GSA, GSV RTCM3 Output: 1074, 1077, 1084, 1087, 1124, 1127, 1230, 4072.1

Variant GR-9012 for Moving Baseline Application:
Two GR-901s are configured and connected by a Y-cable to provide moving baseline heading function as following:



- One GR-901 is configured as a moving baseline, another as a rover. Both perform the configured role automatically when they are powered on.
- Read the position, heading and all other information from pin 3, TX_Rover. Pin 6, RX_MB, is used only if there is external RTCM calibration data input to have accurate position
- Cable length of each segment of Y-cable, connector other than PS2, RS232 or TTL, w/ pedestal or not could be customized. Please specify when ordering.

*This document is subject to change without notice.