Low-Cost MADOCA Receiver System
低コストのMADOCAレシーバーシステム

MAD-WIN, MAD-π and MADROID

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UTokyo/ICG GNSS Training
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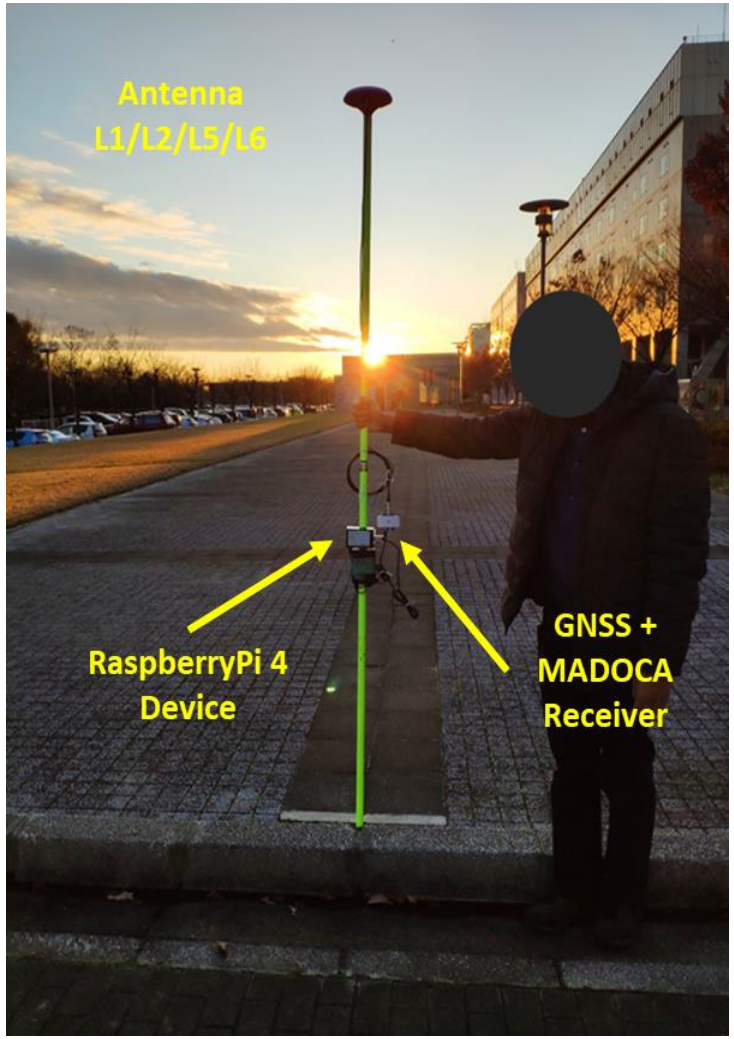
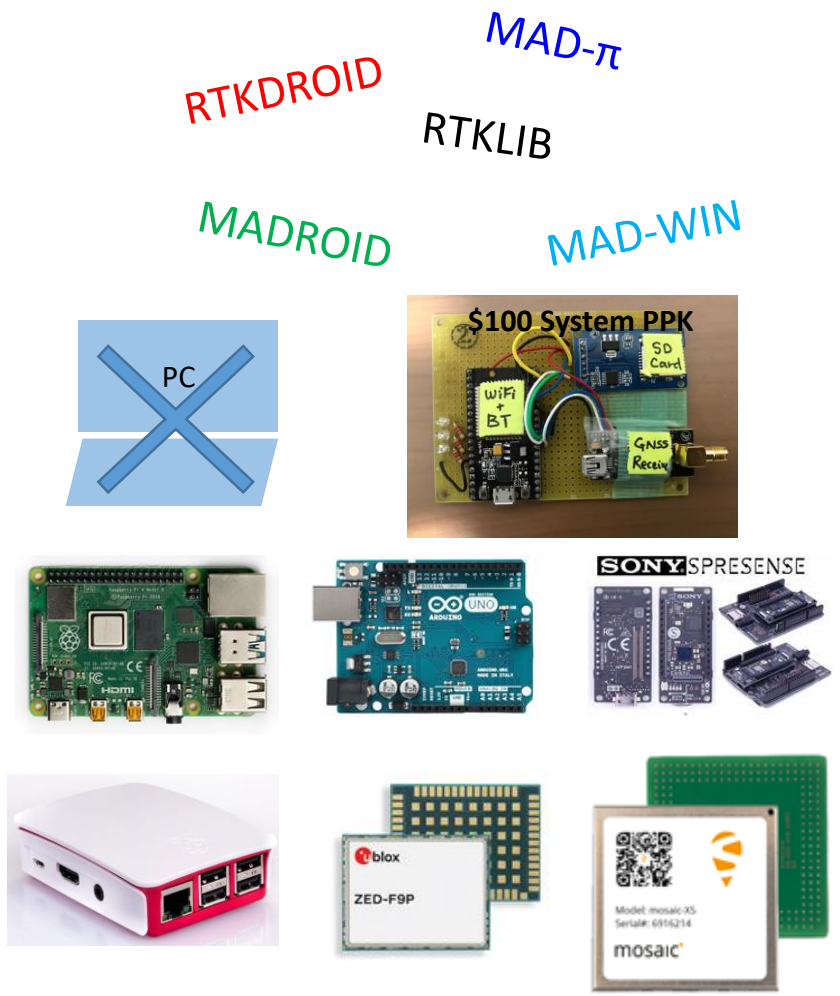


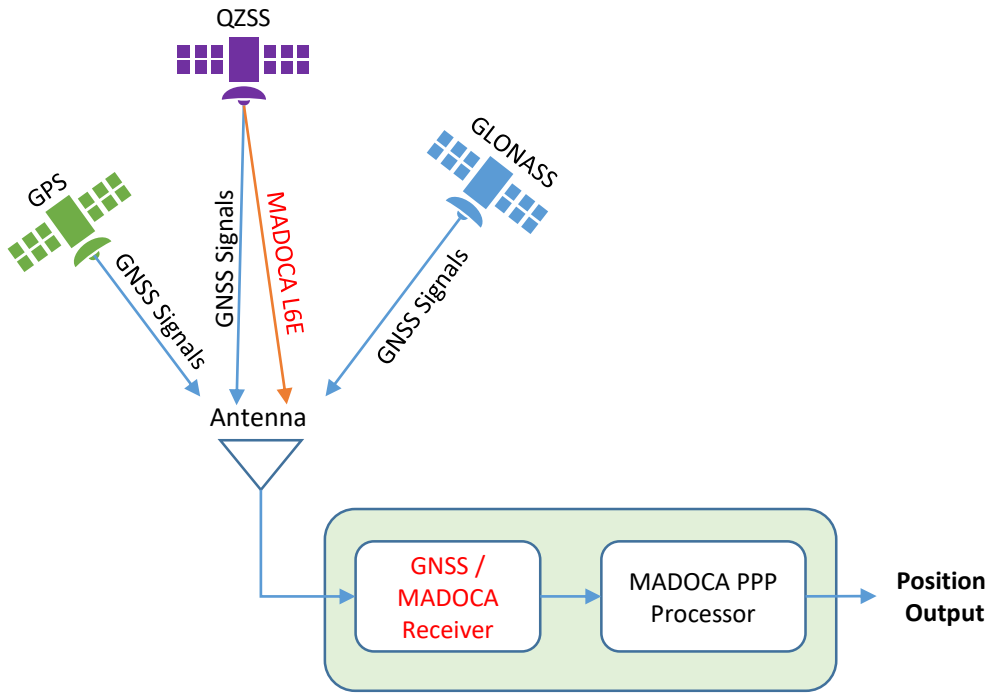
Objectives

- Develop Low-Cost High-Accuracy Positioning Systems (L-CHAPS)
  - System Integration of commercially available receiver or module
    - For RTK and MADOCA
  - Avoid use of computer to minimize the cost
    - Use Single Board Computer (SBC)
      - RaspberryPi, Arduino, Spresense
    - Use Tablet or Smart-Phone
      - Android devices are quite flexible and easier to use
- Develop Easy to Use System in Field
  - A user without GNSS knowledge shall be able to use
  - Self-understanding interface
  - Suitable for remote operation and data logging
  - Operate with mobile power-banks
- Promote GNSS and MADOCA Technologies Abroad through
  - Lectures, Trainings, Seminars, Workshops and Events
  - Joint Research and Joint Projects



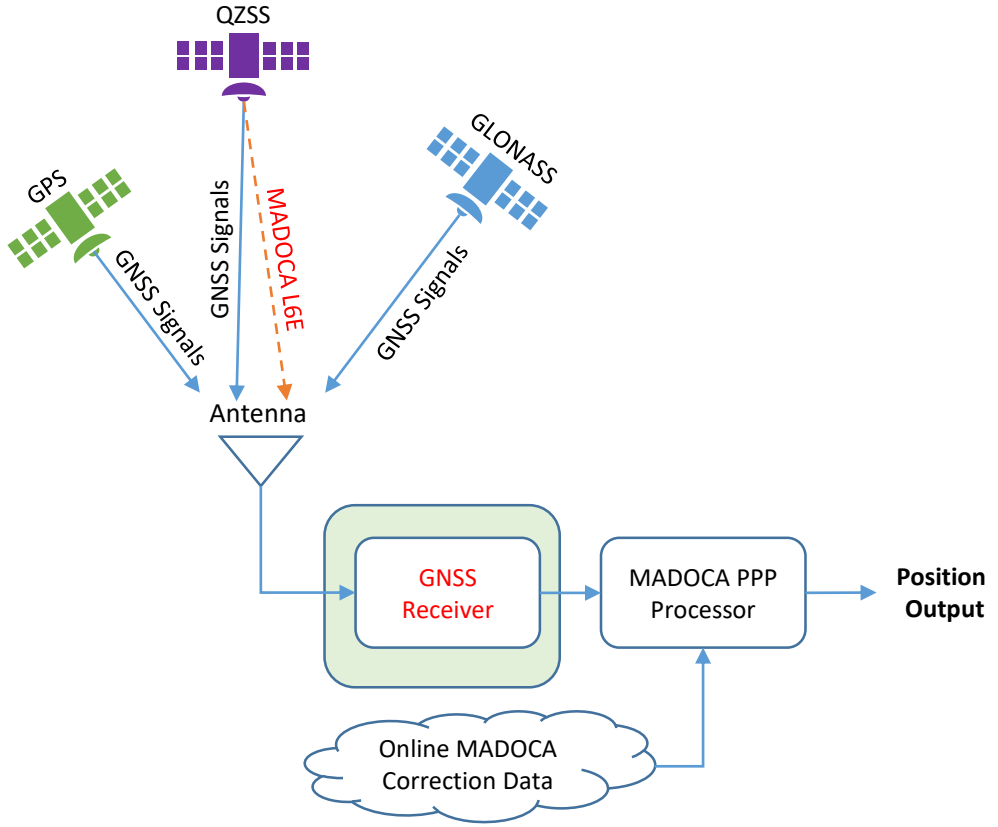
MADOCA System: Direct from QZSS or Online Correction Data

GNSS Receiver + MADOCA Decoder



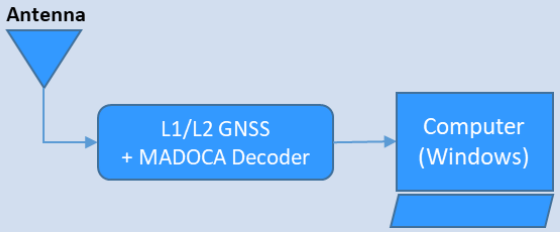
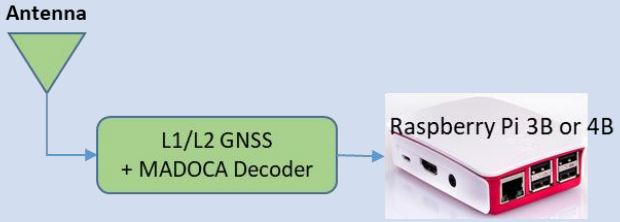
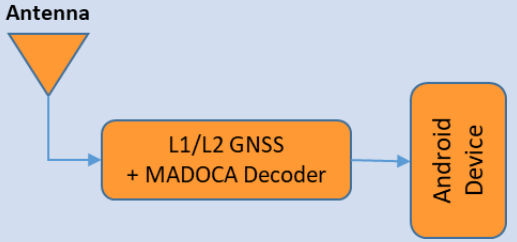
If QZSS is visible in your location and if you have MADOCA receiver

GNSS Receiver Only

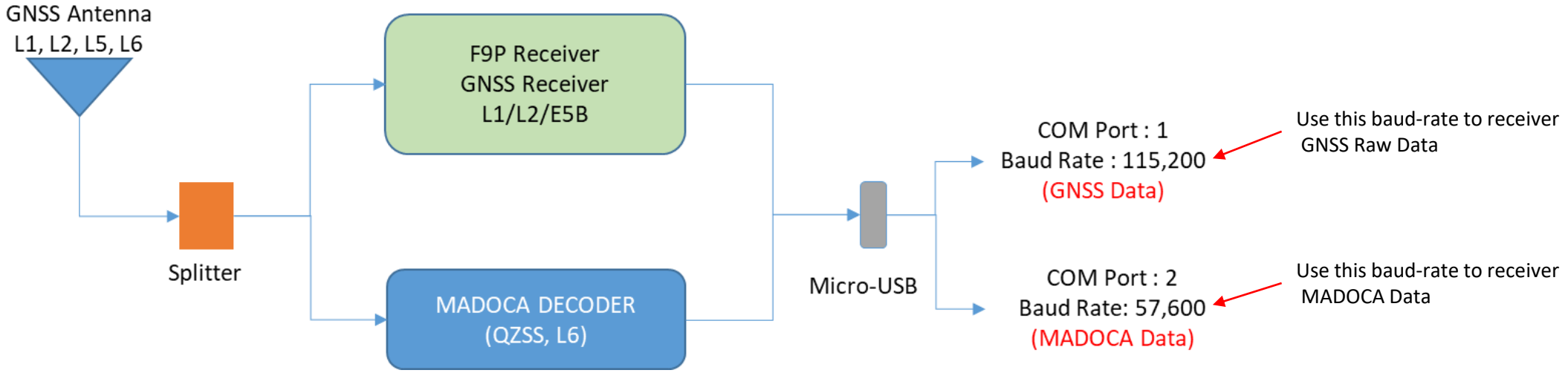


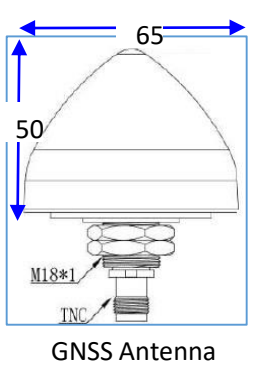
If you do not have MADOCA receiver

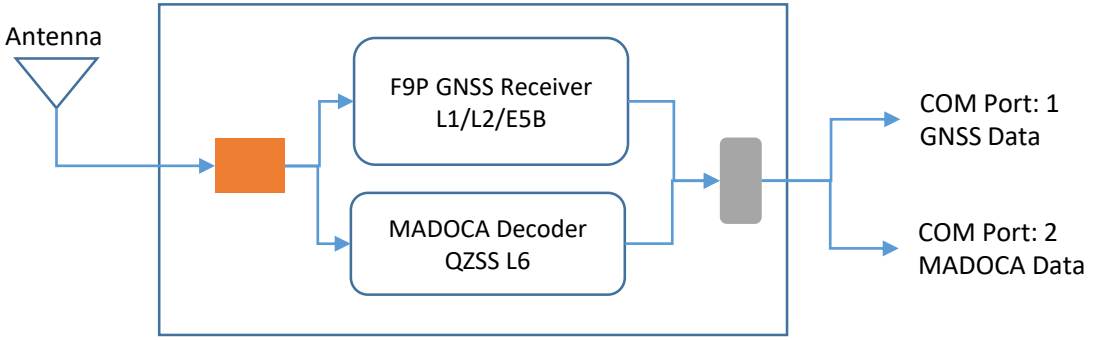
Low-Cost MADOCA Receiver Systems: Product Types

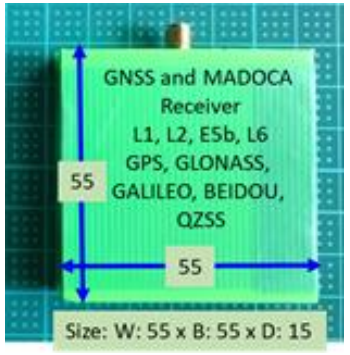
	MAD-WIN	MAD-π	MADROID
Platform / OS	Windows	RaspberryPi 3B or 4B	Android Device
GNSS Receiver	Default : u-blox F9P Other: Any dual-frequency Receiver	Default : u-blox F9P only	Default : u-blox F9P Other: Any dual-frequency Receiver
MADOCA Receiver	U-blox D9 only	U-blox D9 only	NA (MADOCA Online Correction Data only)
GNSS Receiver Data Format	UBX, SBF, RTCM3	UBX SBF, RTCM3 (For online GNSS data)	UBX
MADOCA Correction Data Format (Satellite)	UBX only	UBX only	NA
MADOCA Correction Data Format (Online)	Online Services from GPAS, UTokyo (Test Level) UBX or RTCM3	Online Services from GPAS, UTokyo (Test Level) Online Services UBX or RTCM3	GPAS Services, RTCM3 UTokyo Online Service in the next release
System Architecture			

System Architecture

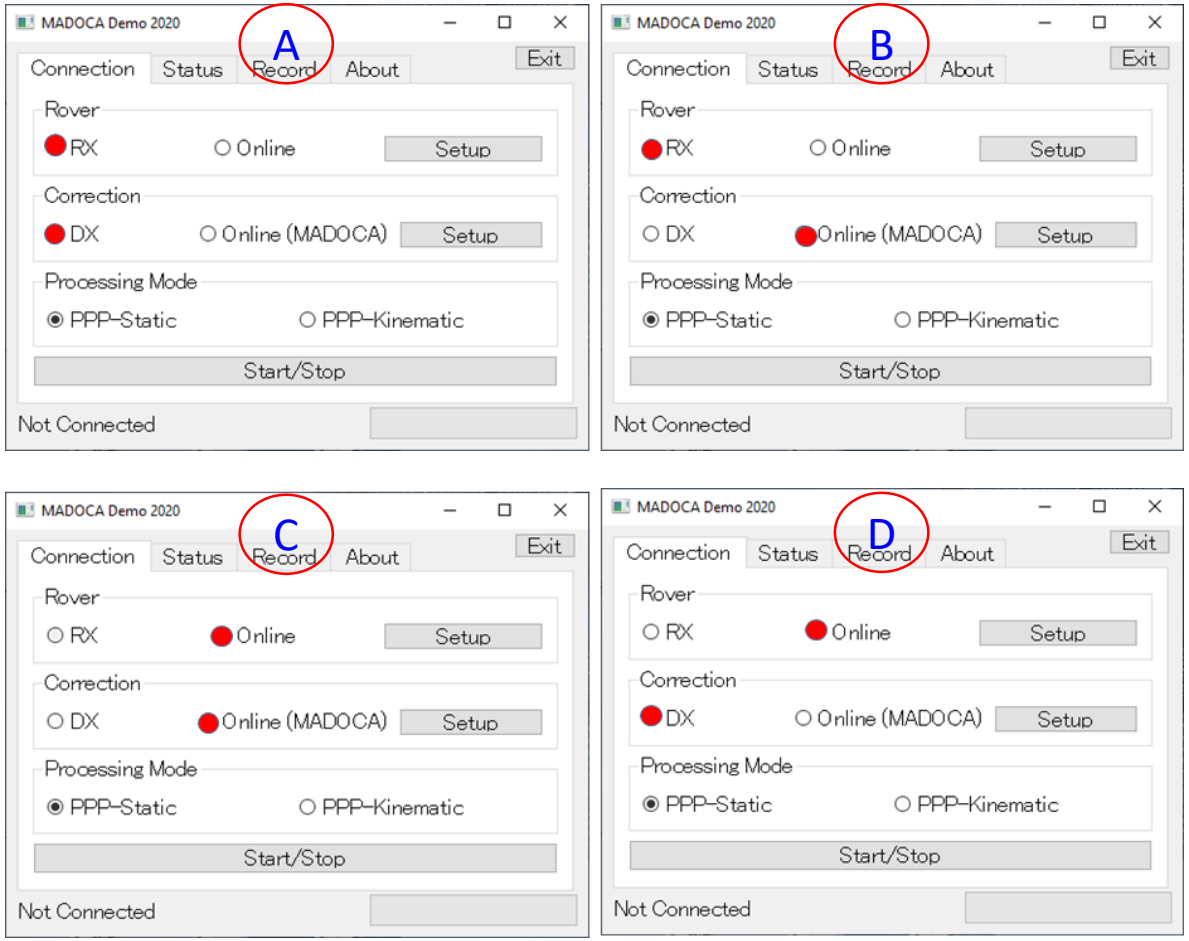






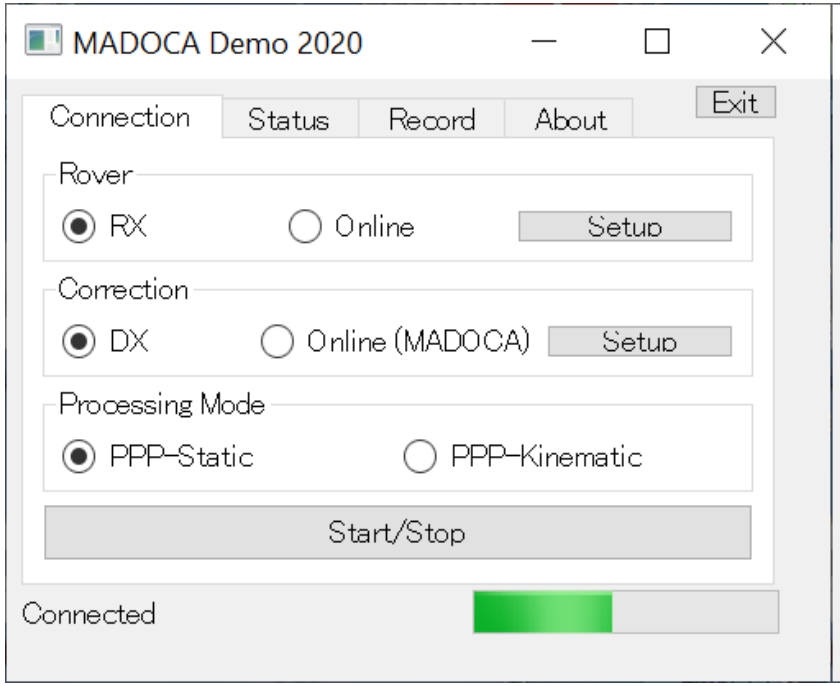


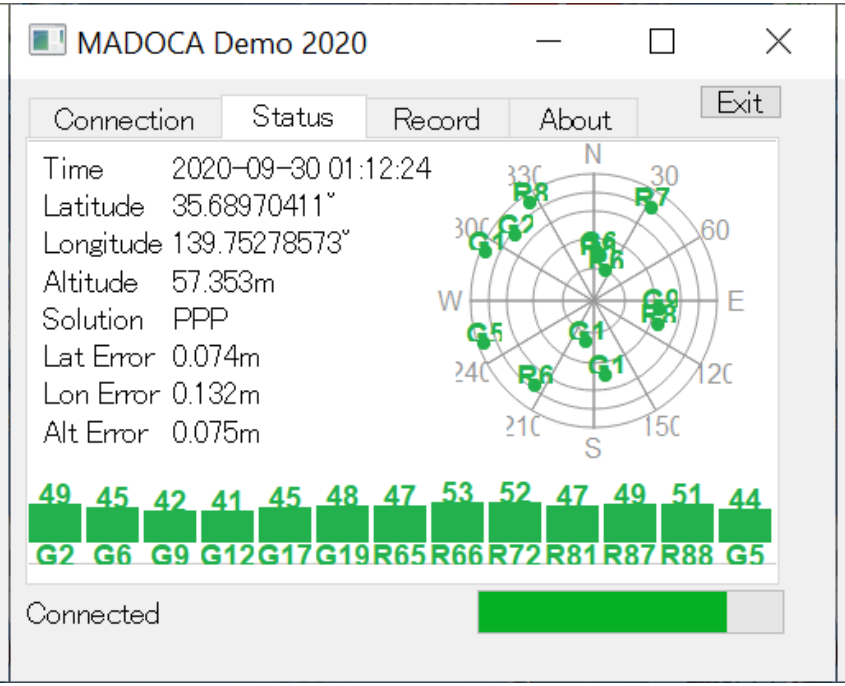
MAD-WIN / MAD-PI User Interface

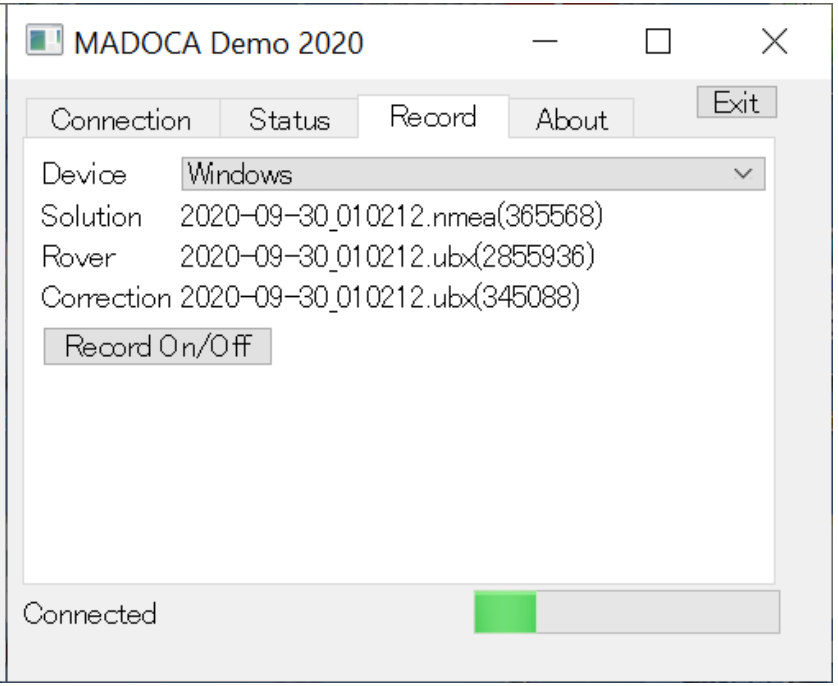


Cases	GNSS Receiver	MADOCA Correction Data	Selection Setting in the Program
Case A	Connect Receiver Directly	Connect MADOCA Receiver Directly	RX and DX
Case B	Connect Receiver Directly	Get MADOCA correction data through NTRIP	RX and Online (MADOCA)
Case C	Connect Receiver though NTRIP	Get MADOCA correction data through NTRIP	Online and Online (MADOCA)
Case D	Connect Receiver though NTRIP	Connect MADOCA Receiver Directly	Online and DX

MAD-WIN / MAD-PI User Interface



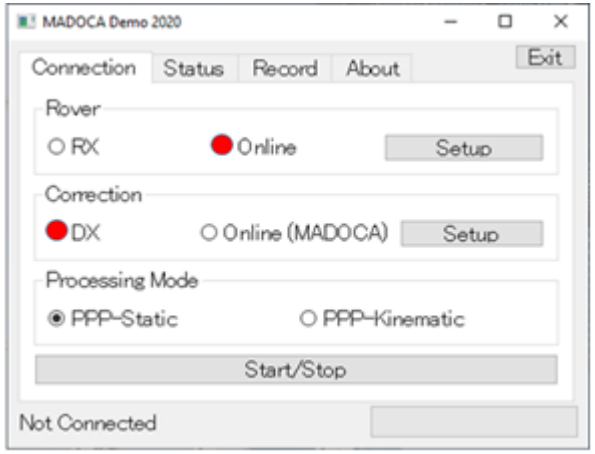


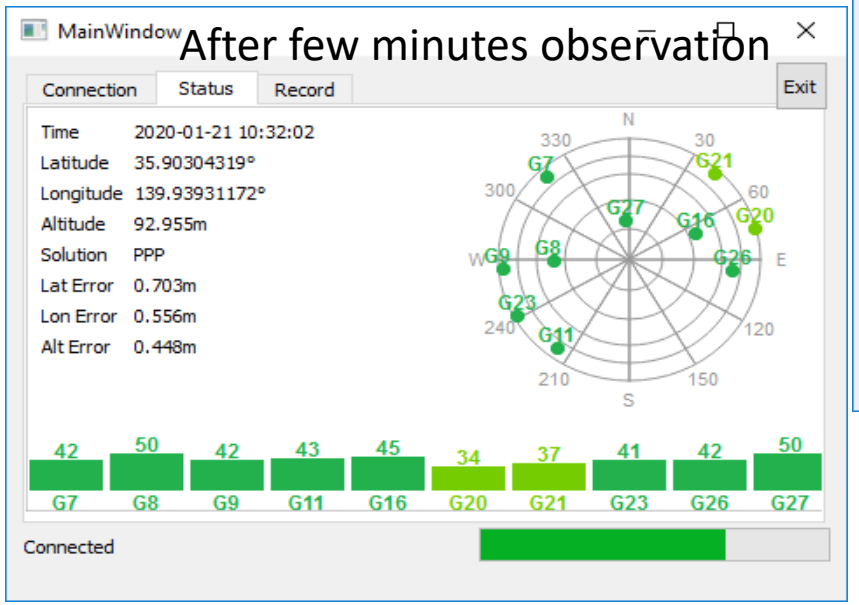


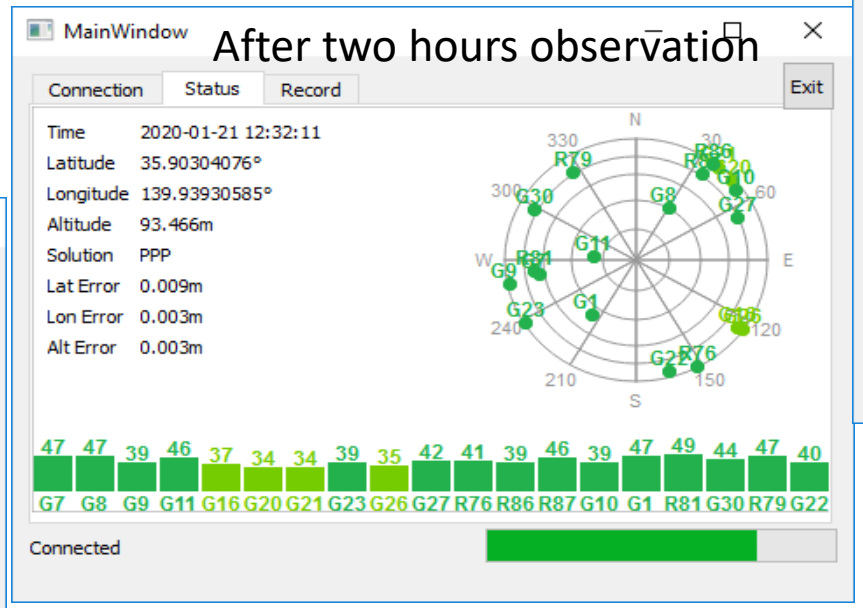
Log Files:
1. Solution: MADOCA PPP Solution in NEMA format
2. Rover: Rover RAW Data in receiver's proprietary format
Can be used for PPK (Post-Processing Kinematic) Solution or Post-Processing PPP
3. Correction: MADOCA PPP Correction Data in receiver's proprietary format
Can be used for Post-Processing MADOCA

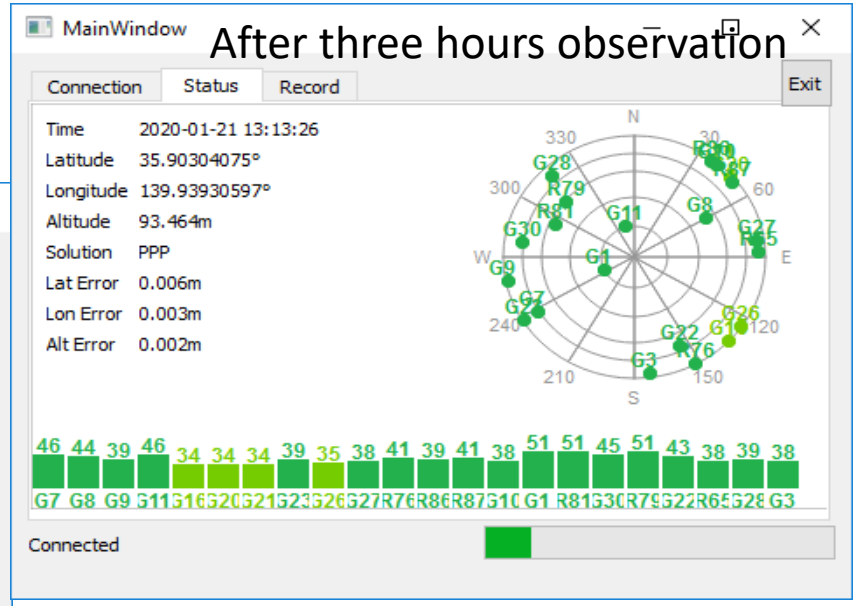
MAD-WIN Data Observation

Receiver: Online receiver access in Kashiwa / Correction Data: MADOCA Receiver in Bali



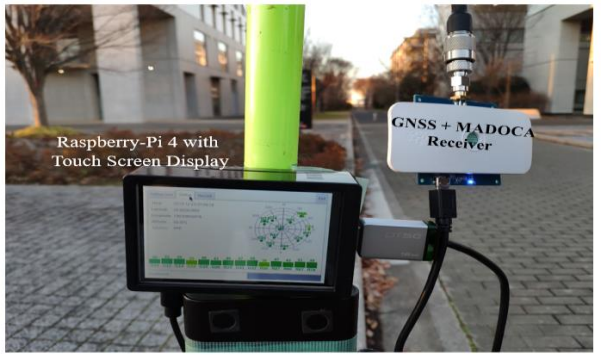


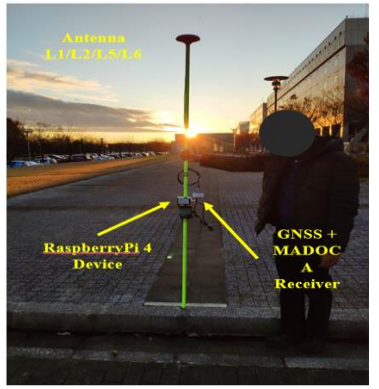


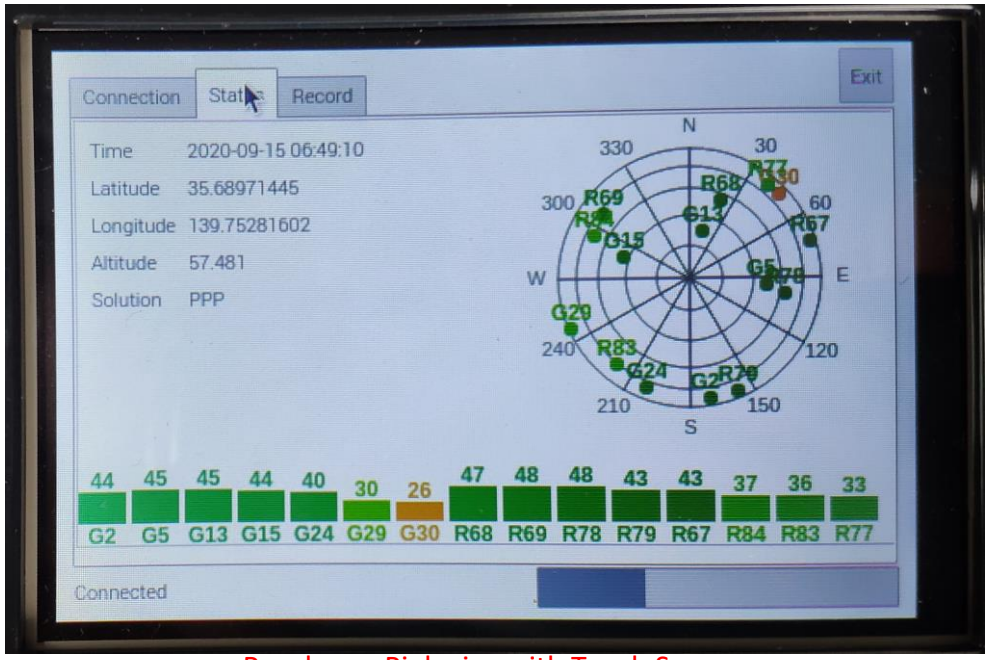


MAD-PI:MADOCA with RaspberryPi Device

- MAD-Pi has been tested with RaspberryPi-3B device
  - It also works with RaspberryPi-4B
  - If the device does not work, please try with a different USB port
- Do not remove and insert SD Card several times. It may get damaged.
- Observation data can be logged to an external USB memory disk. Memory drive of upto 64GB is supported.
  - Files are created at 6-hour interval with Date/Time based filename.
- Ras-Pi 4 device consumes more power than Ras-Pi 3 device. Continuous operation of the device will generate heat. Keep the device in well ventilated area
  - Do not keep the device in a closed box
- We have set both Ras-Pi 3 and Ras-Pi 4 devices with touch screens for easy operation.
  - Mouse and External keyboard can be connected either via BT or USB ports
- Ras-Pi device can be connected by an Android device using BT

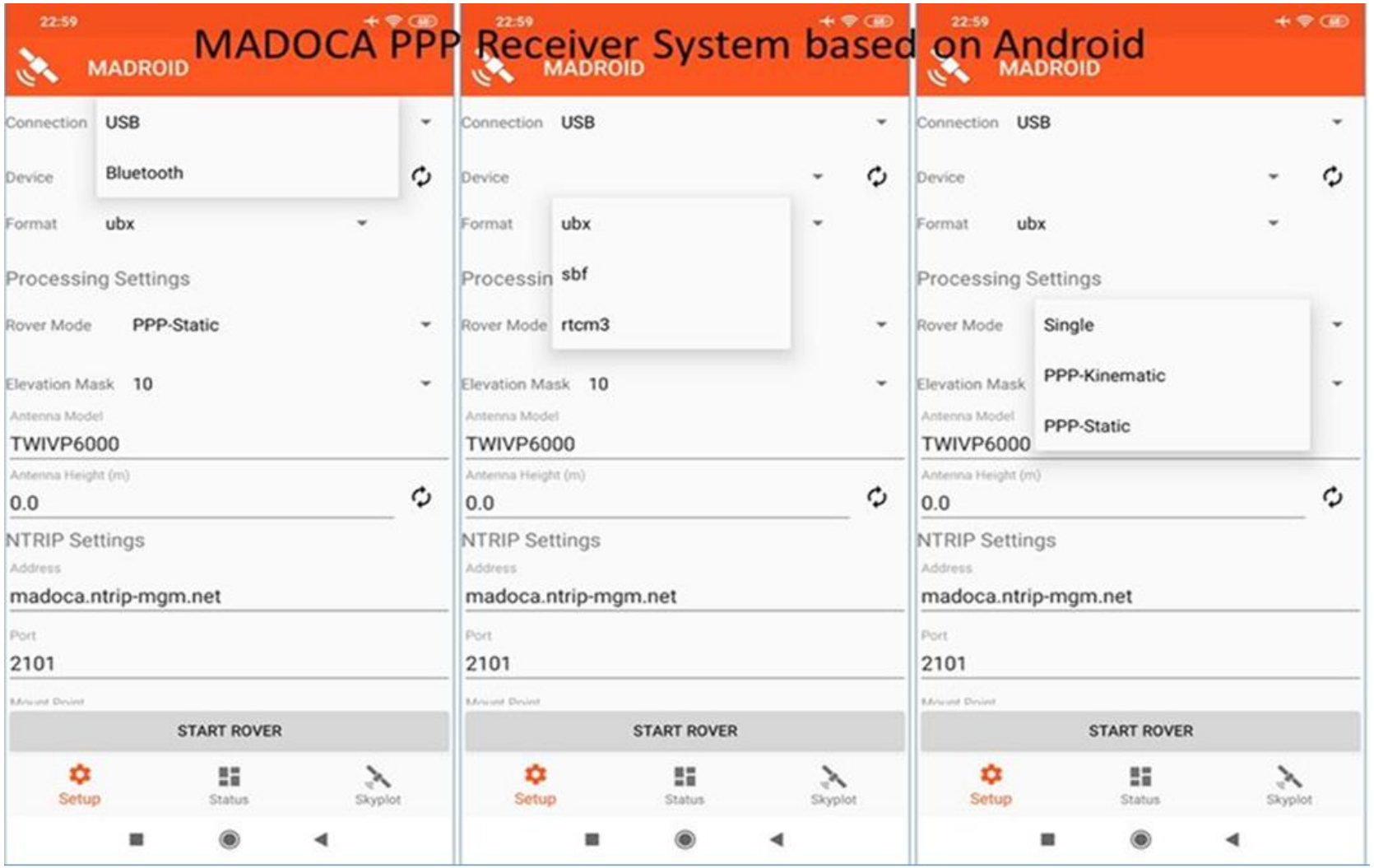






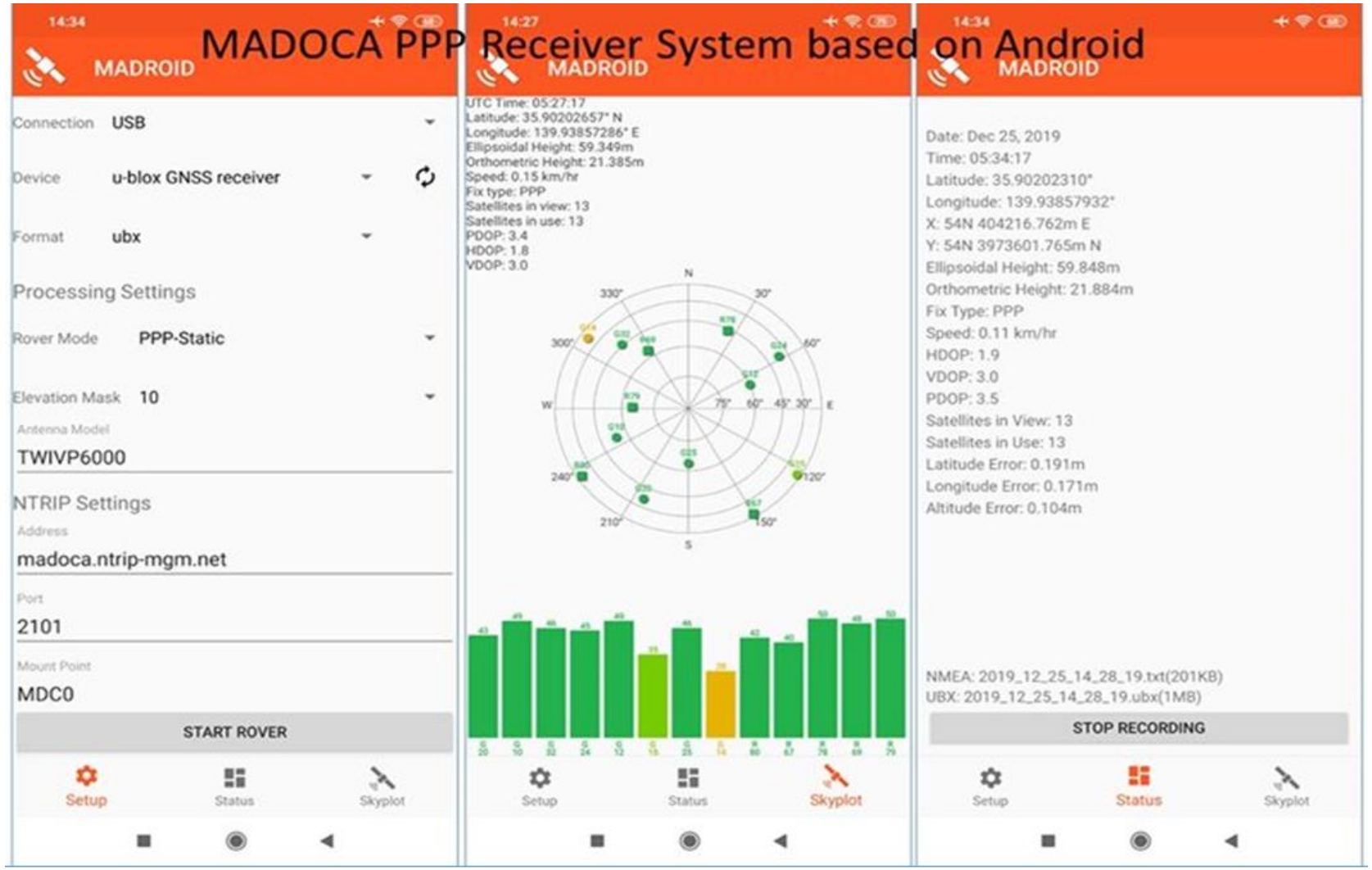
Raspberry-Pi device with Touch Screen

MADROID: MADOCA with Android Device

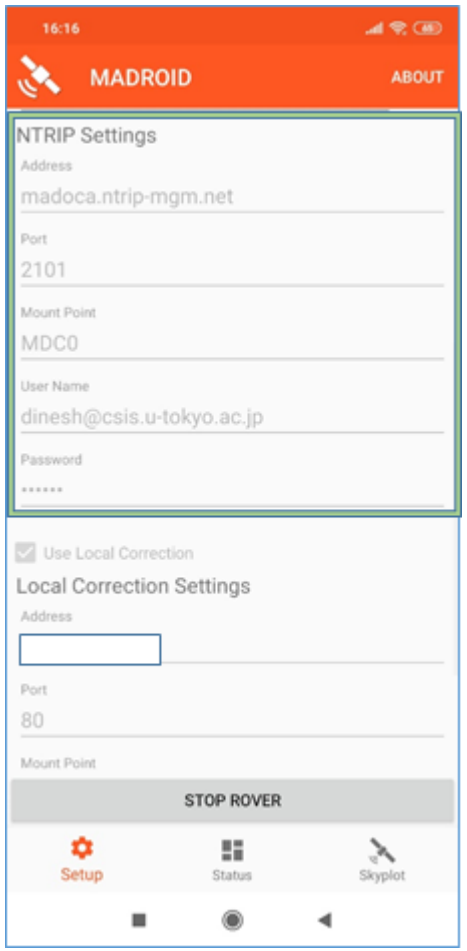


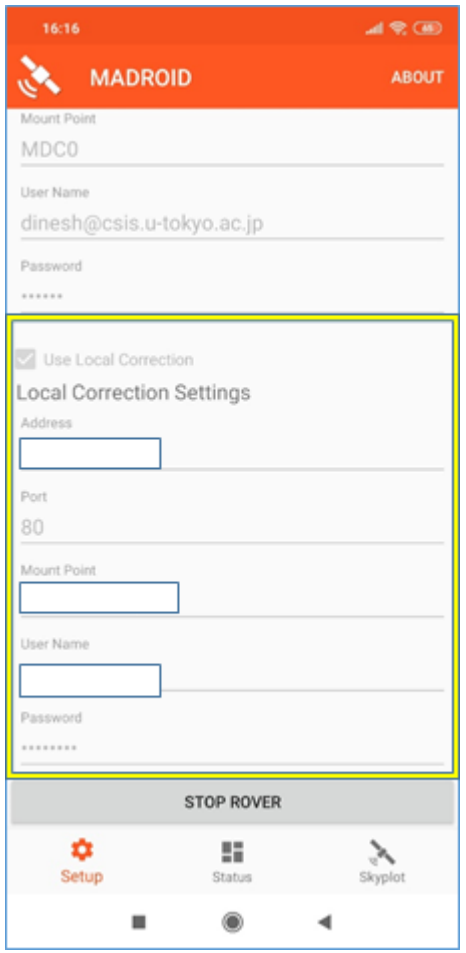
MADROID: MADOCA with Android Device

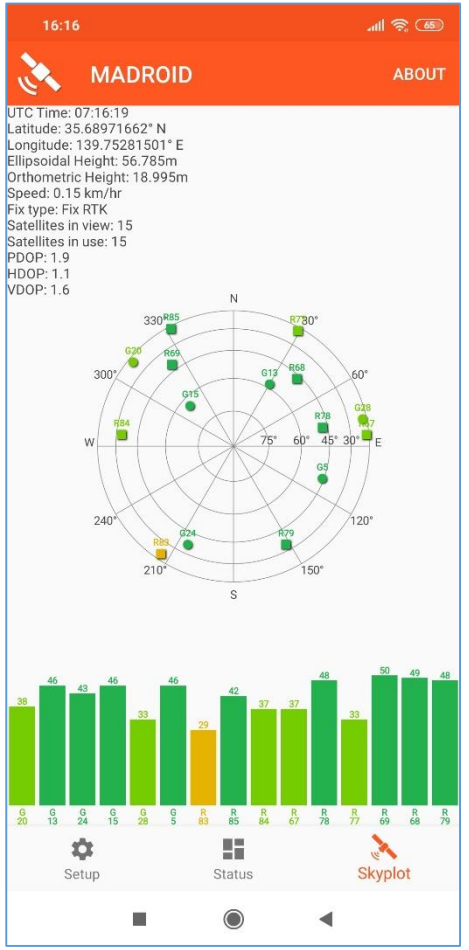
MADOCA PPP Receiver System based on Android

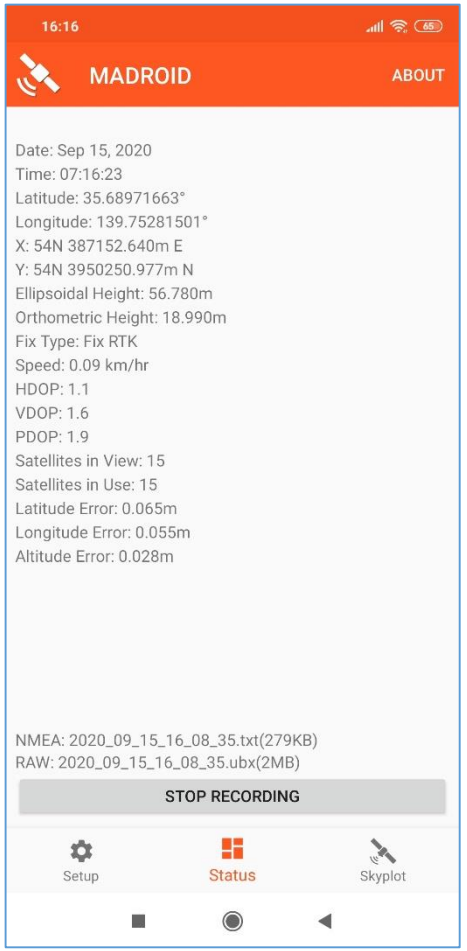


MADROID: PPP-RTK Test



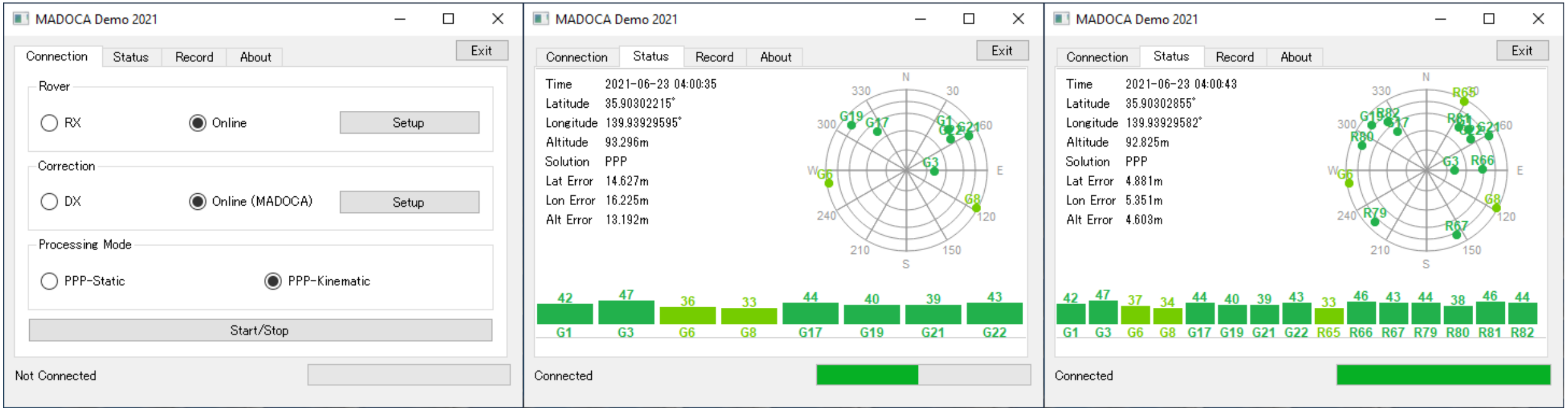




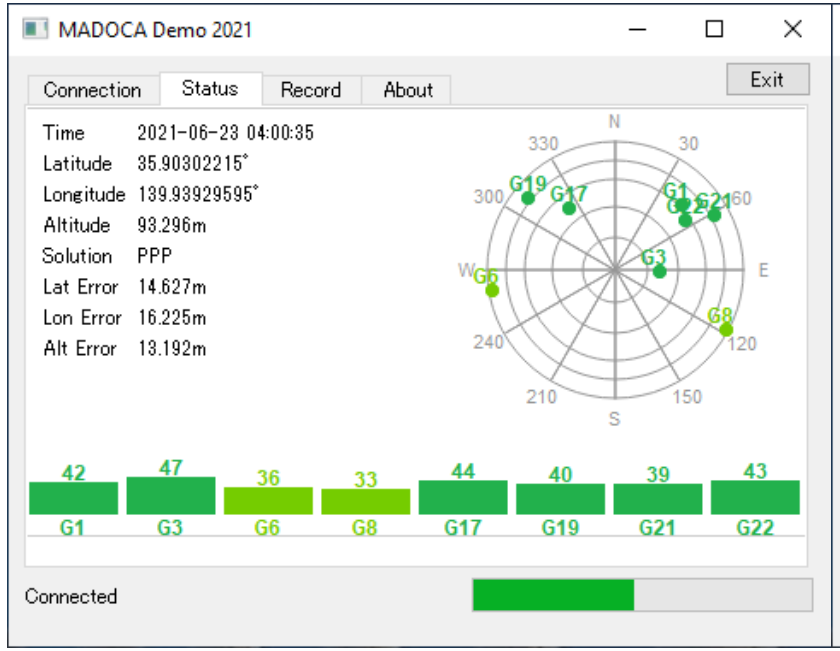


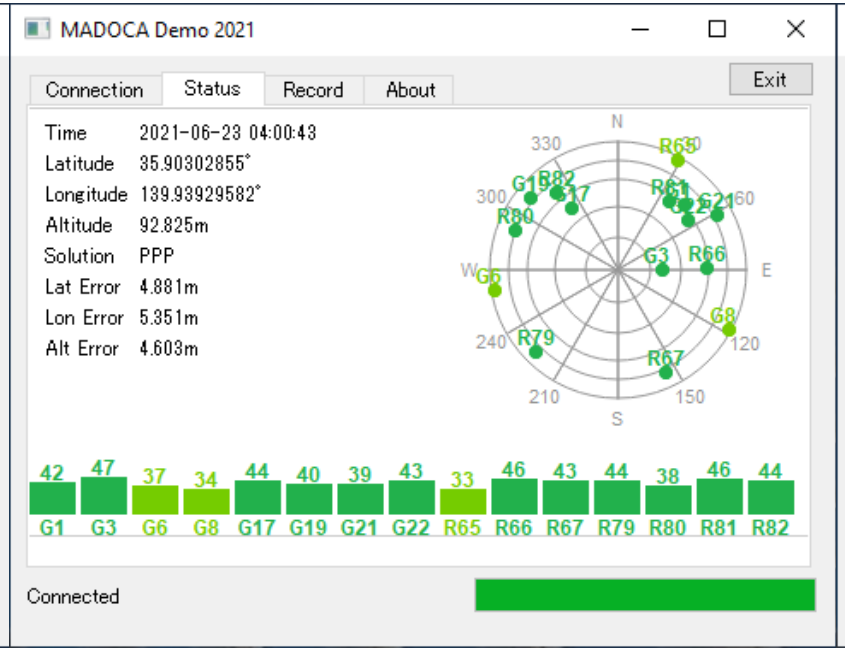
MADOCA Data Observation

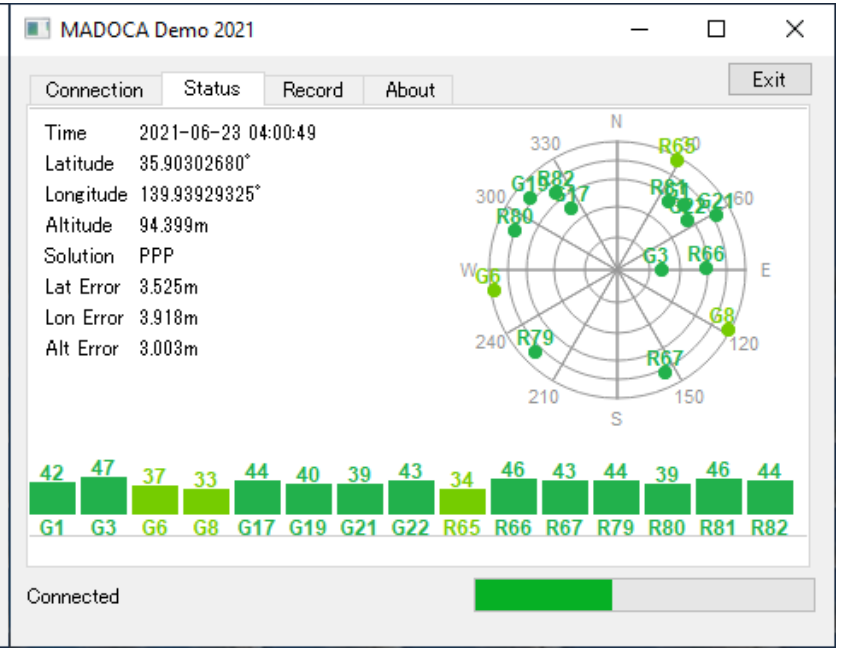
MADOCA PPP Test Results



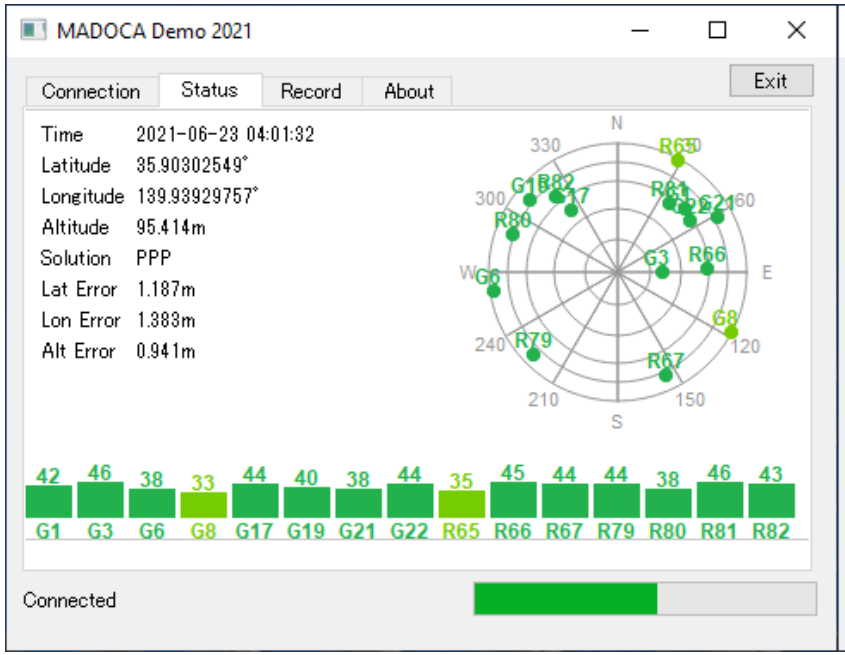
MADOCA PPP Test Results

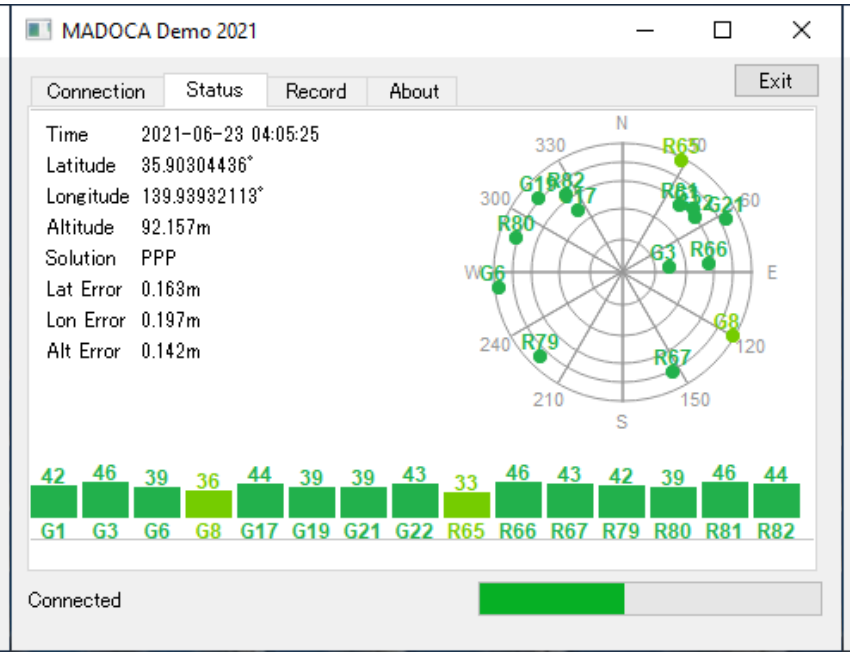


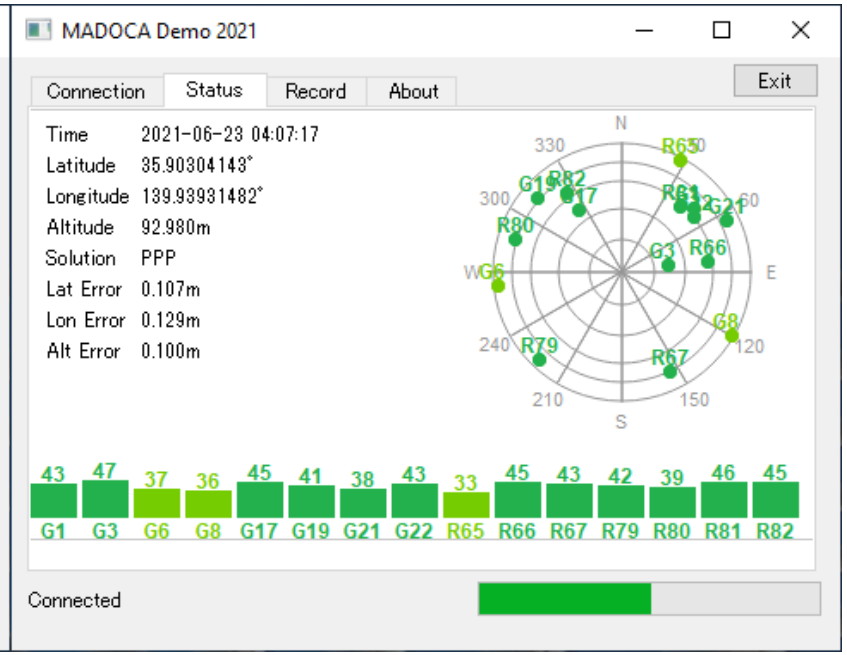




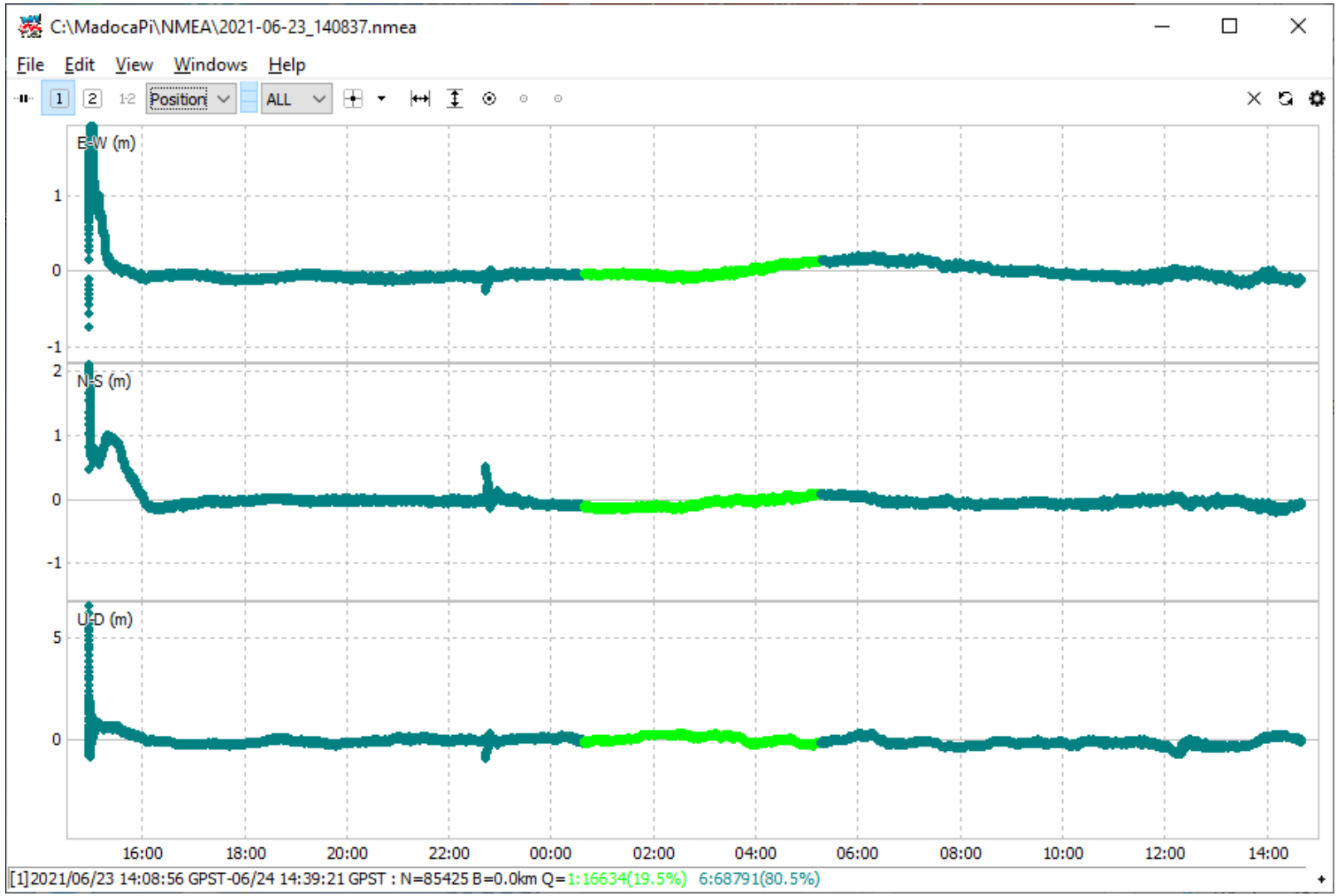
MADOCA PPP Test Results



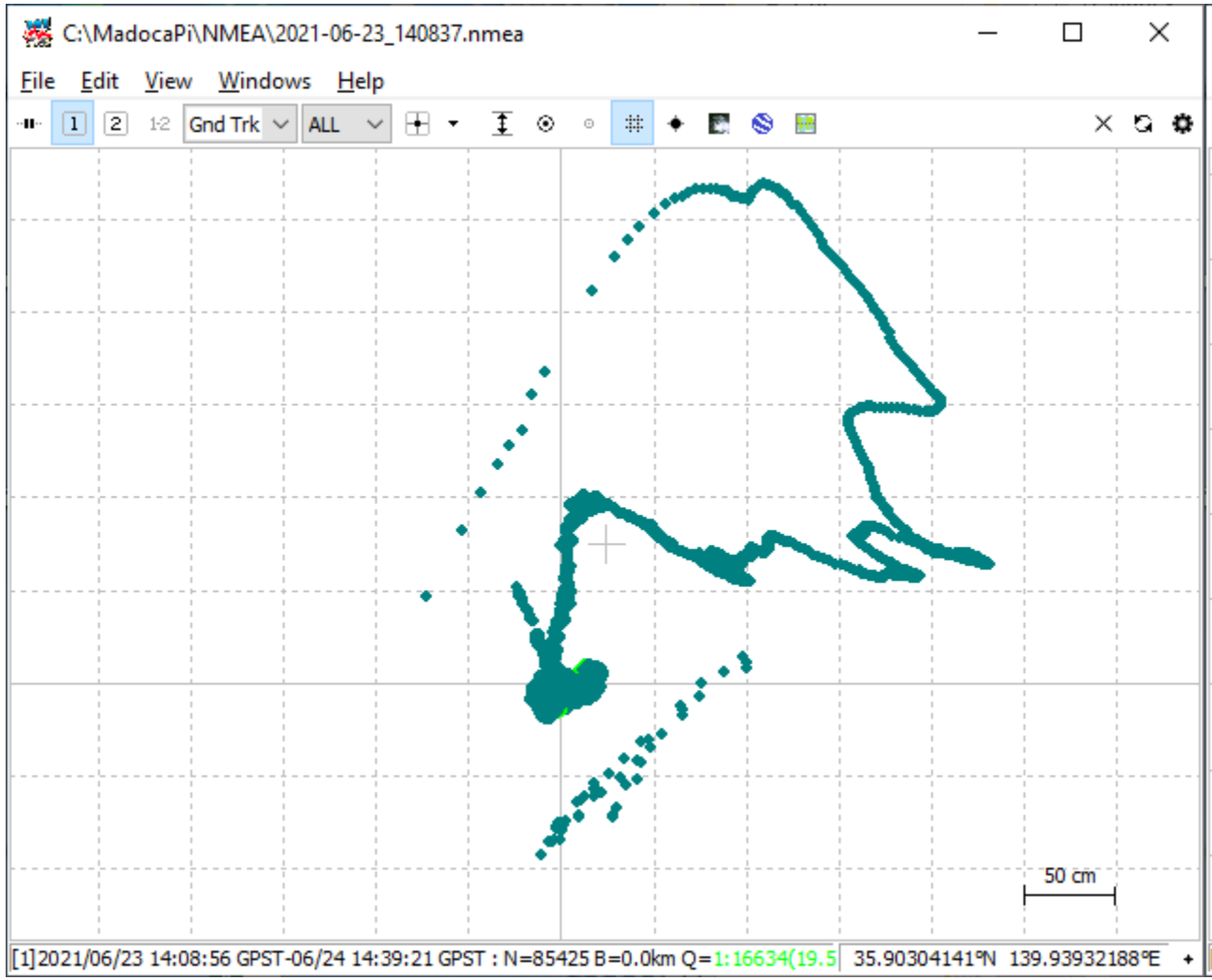


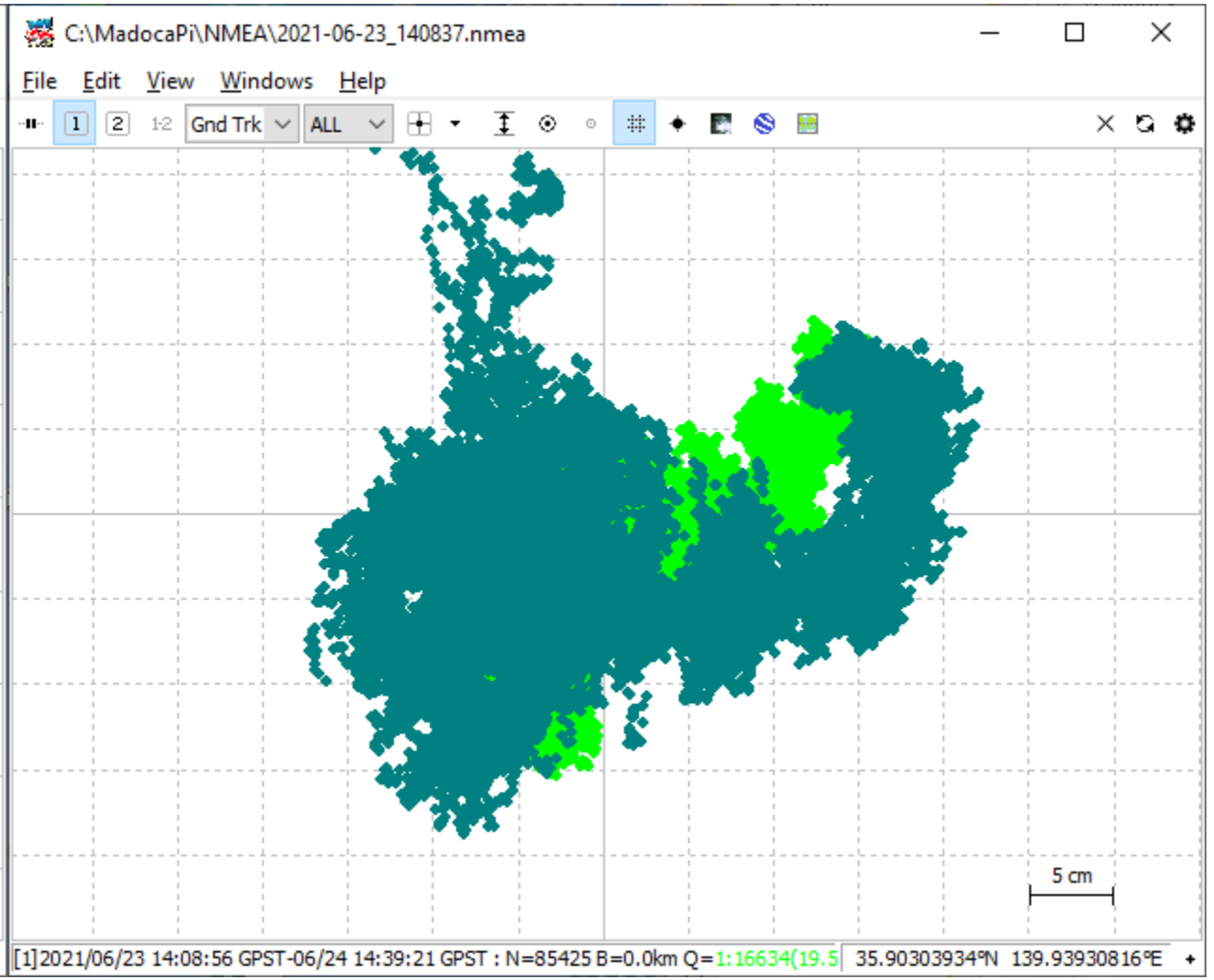


MADOCA PPP Test Results (24 hours)



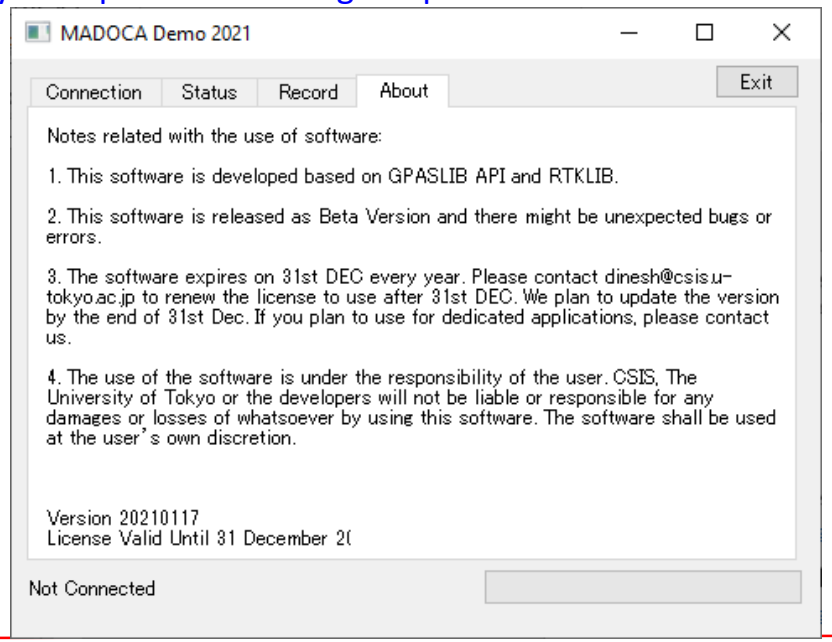
MADOCA PPP Test Results (24 hours)





Request for HW/SW

- MADOCA Receiver Systems are distributed to overseas universities for joint research and pilot projects
  - Includes HW and SW
  - Signing of MTA (Material Transfer Agreement) Document is necessary for HW
  - If only SW is required, please send request through
    - https://home.csis.u-tokyo.ac.jp/~dinesh/LCHAR.htm
  - SW is provided under the understanding that the recipients provide feedbacks and some sample data
  - Feedbacks are necessary to improve and debug the products



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Low-Cost High-Accuracy Receiver Systems

Receiver Systems: Type A, Type B, Type C, Type D

Note: APKs can be downloaded from the following links:
Please send e-mail to dinesh{@}csis.u-tokyo.ac.jp for password.
Following information are necessary:
1. Name
2. Affiliation (Organization Name)
3. Purpose (Optional)

	APK Name	Description
1	RTKDROID (click to download) - Register for Password and Updates	**RTK based on RTKLIB 2.4.3** Receiver Type: Single or Dual Frequency Receiver Receiver and Data Compatibility: u-blox: M8T, M8P, F9P in UBX Format Septentrio in SBF Format Other Receivers in RTCM3 Format Connection: (1) USB using OTG cable with Android Device (2) Bluetooth
2	MADROID We will provide software for joint research and pilot projects based on MADOCA. Please contact me if your institute or organization is interested. Register here for MADOCA PPP Software	**PPP with MADOCA Correction Data** Receiver Type: Dual Frequency Receiver Receiver and Data Compatibility: u-blox: F9P in UBX Format Septentrio in SBF Format Other Receivers in RTCM3 Format Connection: USB using OTG cable with Android Device Download Presentation File

Summary and Future Plans

- Three types of Low-Cost MADOCA receiver systems are developed.
  - MAD-WIN, MAD-PI and MADROID
- MAD-PI will be improved for remote data logging.
- MADROID will be improved for using MADOCA data directly.
- Integration of current system with other systems
  - Traffic monitoring, EWS Application, GIS data collection tool, ……..
- Detail field tests will be conducted in this fiscal year.
- Trainings, Seminars, Workshops and Joint Projects with foreign universities will be conducted
  - With support from MELCO, GPAS, TUMSAT and CAO

References

- Main Page
  - https://home.csis.u-tokyo.ac.jp/~dinesh/
- Request for Low-Cost Receiver System
  - https://home.csis.u-tokyo.ac.jp/~dinesh/LCHAR.htm
- Other Training Materials
  - https://home.csis.u-tokyo.ac.jp/~dinesh/GNSS_Train.htm
- Webinar Links
  - https://home.csis.u-tokyo.ac.jp/~dinesh/WEBINAR.htm
- Link to MADOCA Information at GPAS
  - https://www.gpas.co.jp/service_madoca.php
- QZSS Main Page
  - https://qzss.go.jp/en/