

GNSS-SDRLIB Ver. 1.0



Contents

1. Overview	1
2. System Requirement.....	1
3. Installation	2
4. GUI/CLI Application Instructions.....	3
4.1 GUI AP	3
4.1.1 Settings.....	3
4.1.2 Debug mode	4
4.1.3 Spectrum analysis.....	5
4.2 CLI Application	6
4.2.1 Setting.....	6
5. Case Study.....	7
5.1 Real time Positioning using NSL STEREO v2 via RTKLIB	7
5.2 Real-time Positioning using SiGe GN3S v3 via RTKLIB	10
5.3 Post-Processing Analysis using IF Data	11

1. Overview

GNSS-SDRLIB is an open source program package for GNSS software defined radio (SDR) written in C/C++/CLI and consists of several application programs (APs). The features of GNSS-SDRLIB are:

- (1) Signal Acquisition, Signal Tracking, Pseudo-range generation, decoding Navigation data, Spectrum analysis and other GNSS signal processing.
- (2) Generation of GPS/QZSS L1CA, L1C, L2C, L5, GLONASS G1, G2, Galileo E1, E5a, E5b, BeiDou B1, QZSS LEX Ranging codes.
- (3) Signal Correlator using SIMD Operation (SSE2, AVX).
- (4) Real-time signal processing using Front End products on the market.
 - A) NSL STEREO v2 (<http://www.nsl.eu.com/primo.html>)
 - B) SiGe GN3S Sampler v3 (<https://www.sparkfun.com/products/10981>)
- (5) Post-processing GNSS signals using Intermediate Frequency (IF) data obtained by Front Ends.
- (6) GNSS signal processing via Command Line Interface (CLI) and/or Graphical User Interface (GUI) APs.
- (7) Real-time monitoring of GNSS signal correlation.
- (8) Real-time positioning using a GNSS Front End data and RTKLIB (<http://www.rtklib.com/>).
- (9) RINEX/RTCM format output of observation data (Pseudo-range, Phase, Doppler etc.).

2. System Requirement

Windows OS is required to execute GNSS-SDRLIB APs. It has been tested under the following environment:

- Windows 7 Professional 32/64bit

-

APs were built using the following environment:

- Microsoft Visual Studio Express 2012 for Windows Desktop (VS2012)
<http://www.microsoft.com/visualstudio/downloads#d-express-windows-desktop>

CPU supporting SSE2 command (after the Intel Pentium 4) is necessary to run the APs. Multi-core CPU (2nd generation Corei7/i5) is recommended for real-time processing.

Note: If you run the APs on a laptop PC, please set to "high performance mode" by clicking the battery icon on the taskbar.

3. Installation

There are 2 versions of GNSS-SDRLIB, 32bit and 64bit. Extract the program package **gnss-sdrlib_32bit.zip** or **gnss-sdrlib_64bit.zip** to appropriate directory. The GNSS-SDRLIB directory structure is as follows.

gnss-sdrlib_<32/64>bit

./bin	Executable APs for Windows
./gnss-sdrcli.exe	Real-time GNSS Signal Process AP (CLI)
./gnss-sdrcli.ini	Configuration File for CLI AP
./gnss-sdrgui.exe	Real-time GNSS Signal Process AP (GUI)
./cli	VS2012 project of CLI AP
./gui	VS2012 project of GUI AP
./src	Library source code
./lib	Source codes related to used library
./rcv	Source codes related to Front End
./sdr.h	Library header file
./sdracq.c	Function group related to Acquisition
./sdrcmn.c	Function group related to SIMD operation
./sdrcode.c	Function group related to generation of ranging code
./sdrinit.c	Function group related to initialization/end process
./sdrmain.c	Main function
./sdrnav.c	Function group related to navigation data
./sdrout.c	Function group related to RINEX/RTCM outputs
./sdrplot.c	Function group related to gnuplot graphic chart
./sdrrcv.c	Function group related to receiver/gaining data
./sdrspeg.c	Function group related to receiver/gaining data
./sdrtrk.c	Function group related to signal tracking
./test	Test data
./data	Test IF data
./output	Default RINEX output directory
./gnss-sdrcli_*.ini	Configuration for CLI AP

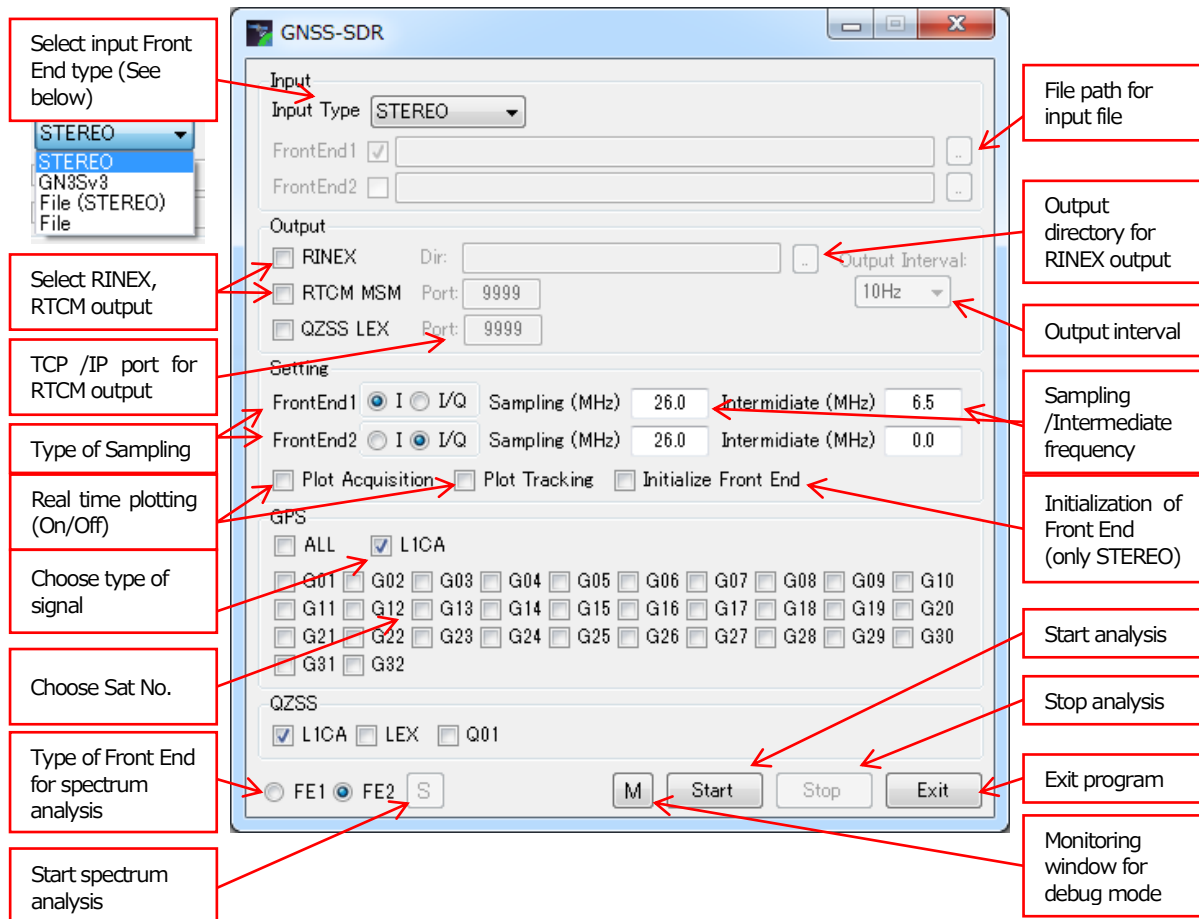
DLLs, which are /bin directory, are necessary for running the APs (gnss-sdrcli.exe/gnss-sdrgui.exe). Run the APs directly from /bin directory or make a shortcut of the APs.

4. GUI/CLI Application Instructions

4.1 GUI AP

4.1.1 Settings

Execute GUI AP file gnss-sdrgui.exe. You can see the main window of GNSS-SDR.



[Input]

Set Front End type or IF data

[Output]

Set On/Off of RINEX or RTCM output, Output Interval, port settings.

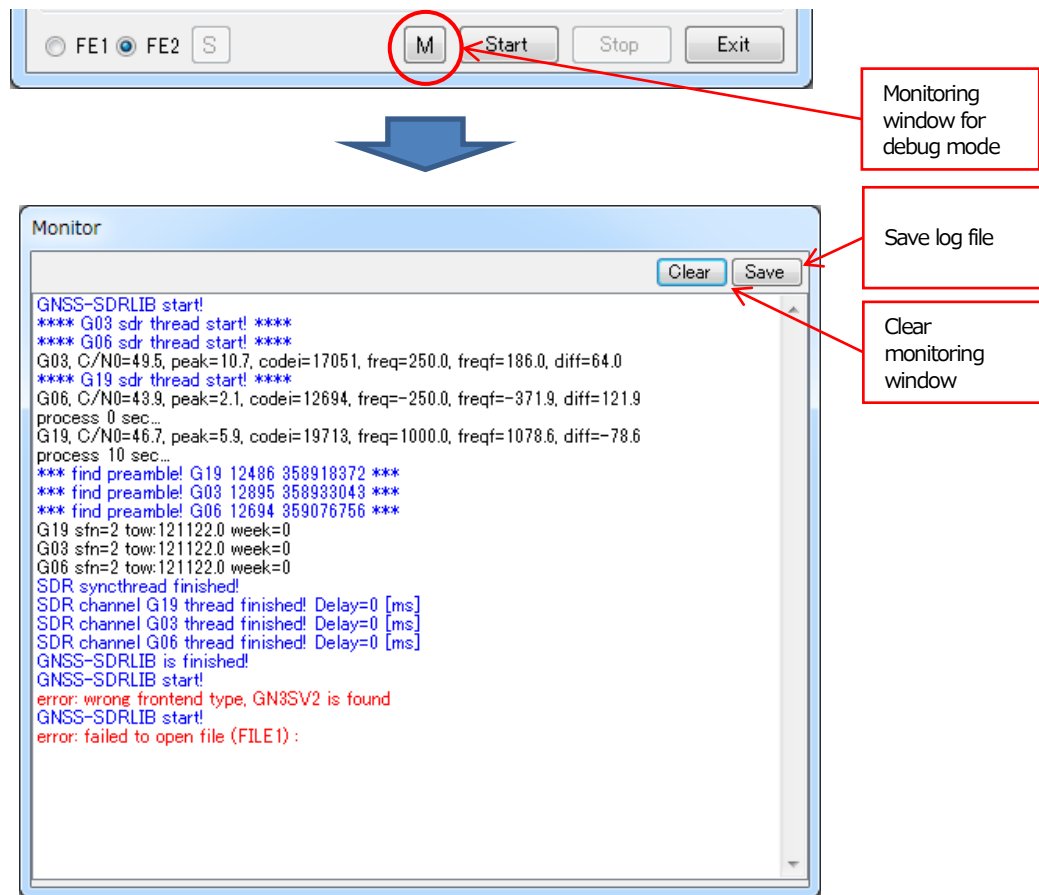
[Setting]

Set type of sampling, sampling and intermediate frequency.

[GPS/QZSS]

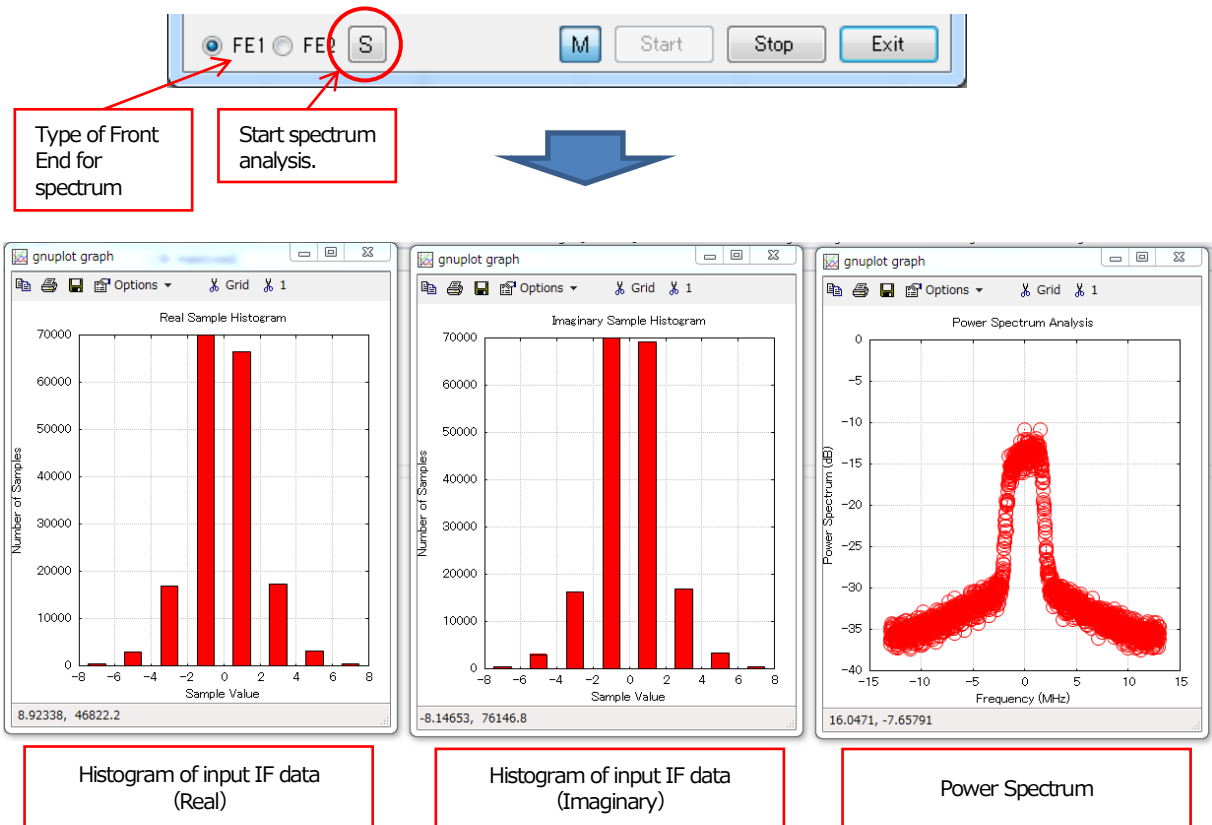
Set Sat No. for signal acquisition and tracking.

4.1.2 Debug mode



Press “M” button to open monitoring window for debug mode. Window will show statics of the program. Press “M” button to close window. Error message will show up in red.

4.1.3 Spectrum analysis

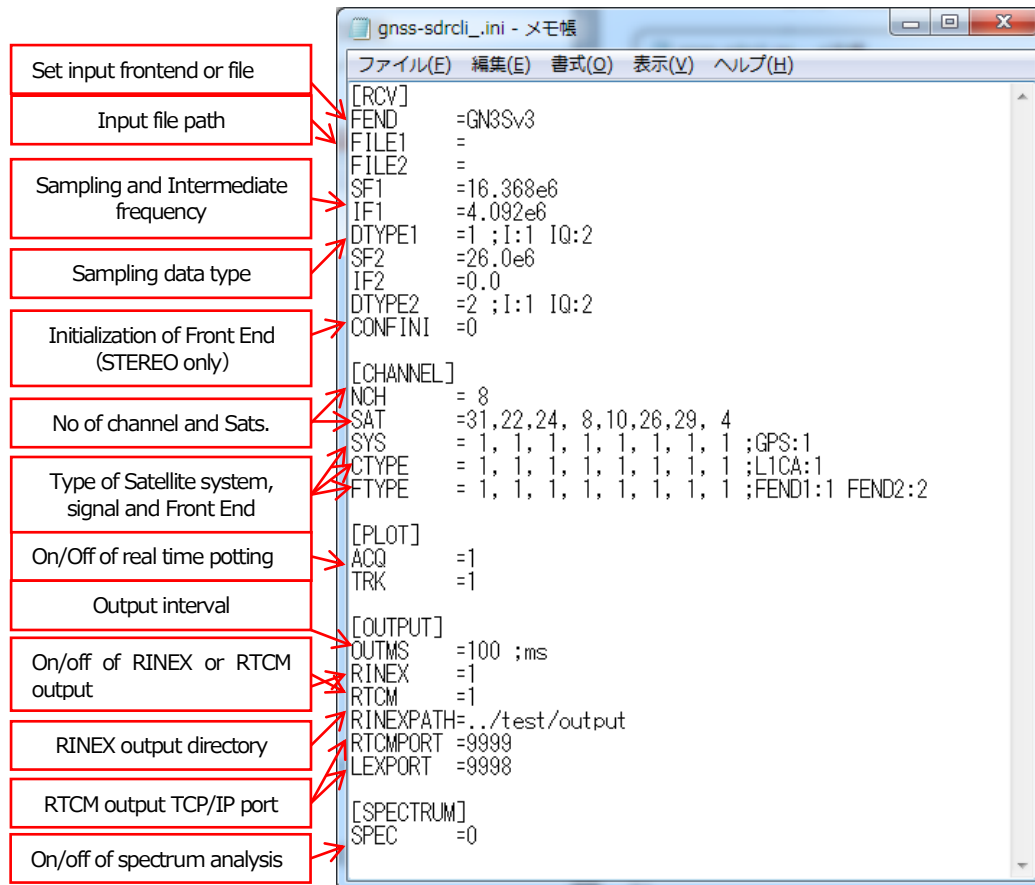


After starting the analysis, by pressing the “S” button, spectrum analysis will begin. Specify the Front End for spectrum analysis (FE1 or FE2). Spectrum analysis will run by the setting of the chosen Front End. Press “S” Button to close window.

4.2 CLI Application

4.2.1 Setting

Configuration of CLI AP (gnss-sdrcli.exe) is done by setting the .ini file. AP will read the **gnss-sdrcli.ini** file from the same directory when running.



[RCV]

Settings for the Front End. Set either [STEREO, GN3Sv3, FILESTEREO, FILE] in FEND=<type>.

[CHANNEL]

Settings for the number of channels(NCH) for SDR Signal Acquisition and tracking. NCH and the number of parameters must be the same.

[PLT]

On/off of Real time plotting using gnuplot.

[OUTPUT]

Settings for RINEX or RTCM output.

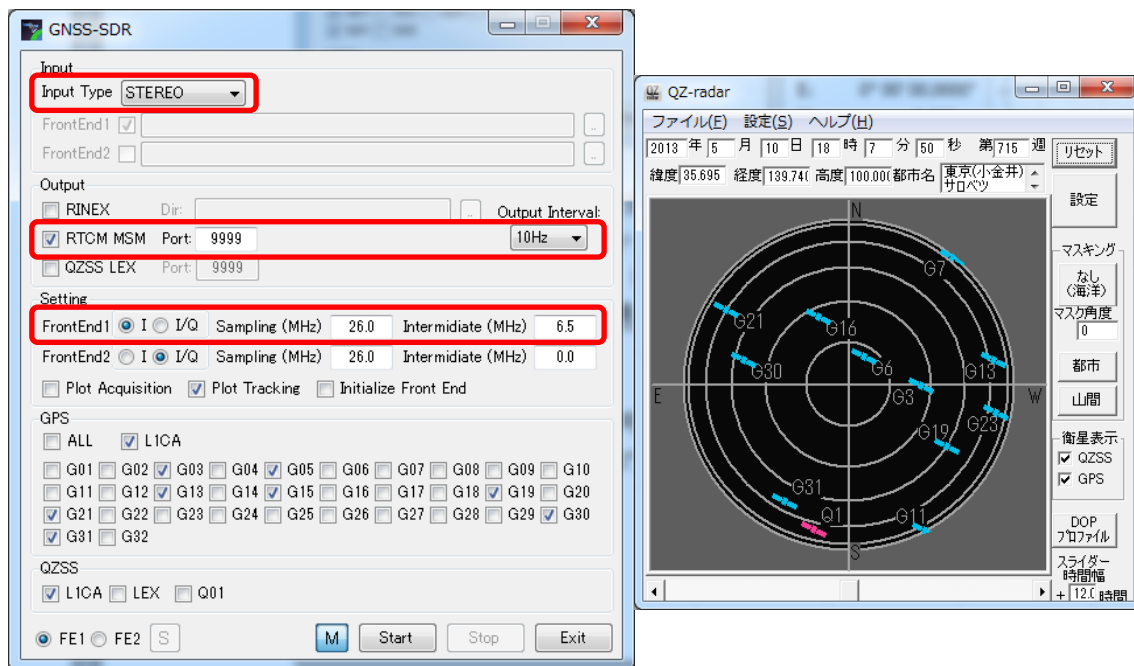
[SPECTRUM]

On/off of Spectrum Analysis.

5. Case Study

5.1 Real time Positioning using NSL STEREO v2 via RTKLIB

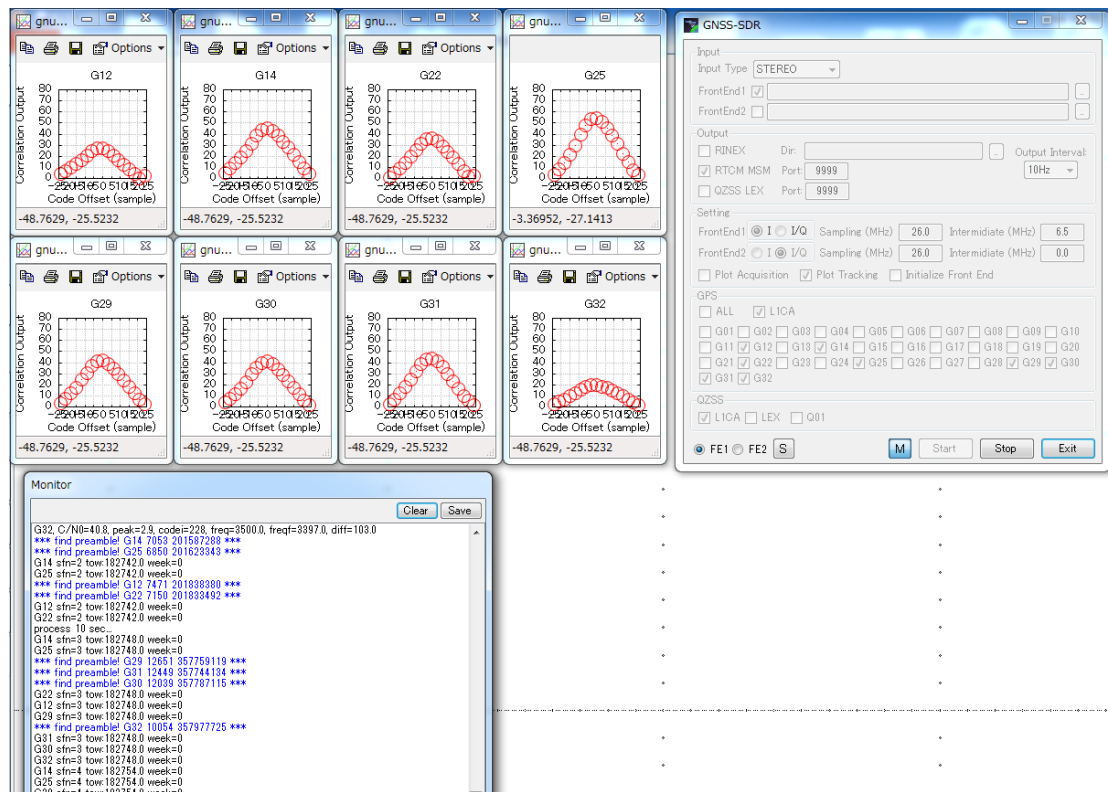
- (1) Extract RTKIB 2.4.2 (<http://www.rtklib.com/>) to appropriate directory.
- (2) Connect NSL STEREO v2 to PC and install the original driver software.
- (3) Run the device configuration attached to NSL STEREO v2. If the setting is default, run by “stereo_app.exe -e”.
- (4) Set and run gnss-sdrgui.exe as follows.



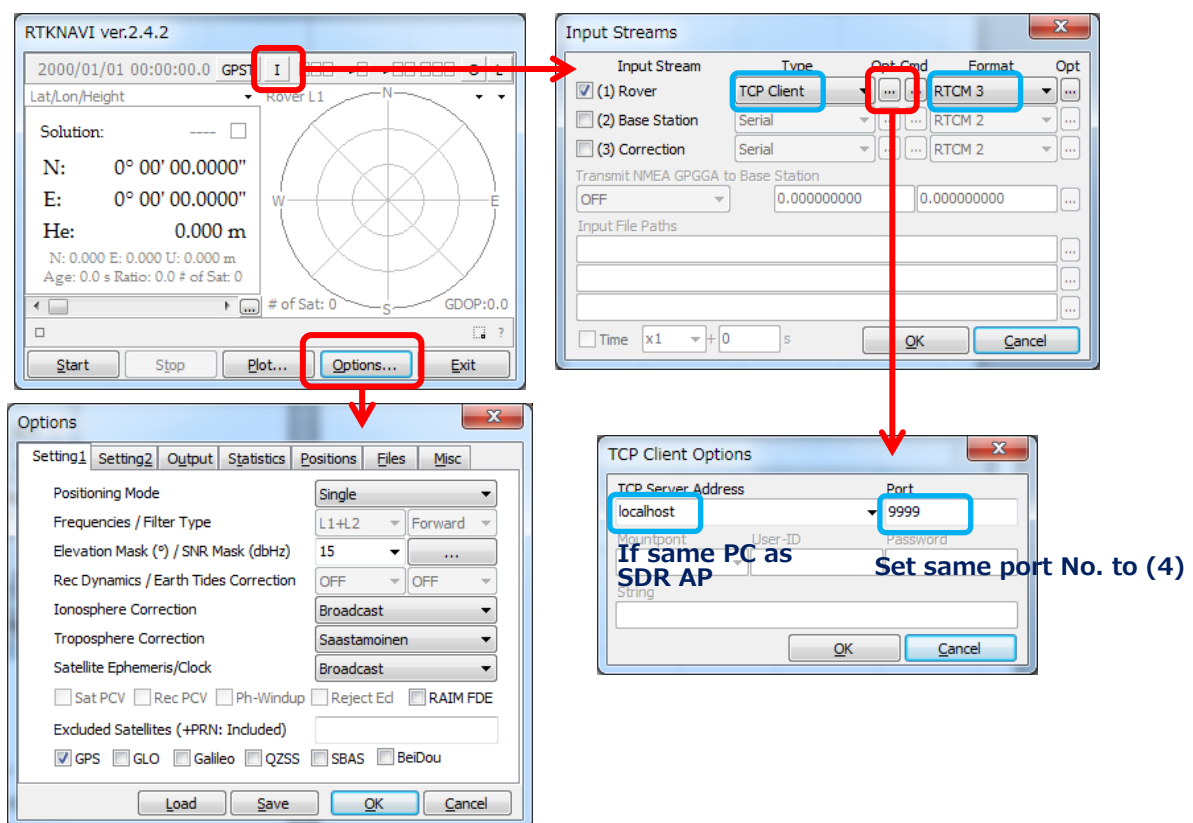
Specify satellites for the acquisition and tracking. In this example, satellites G3, G6, G16, G19, G21, G30, and G31 are visible and are checked. QZ-radar is used for identification. (http://qz-vision.jaxa.jp/USE/ja/qz_radar)

Note: In some environments, the program may be unstable if too many satellites are chosen.

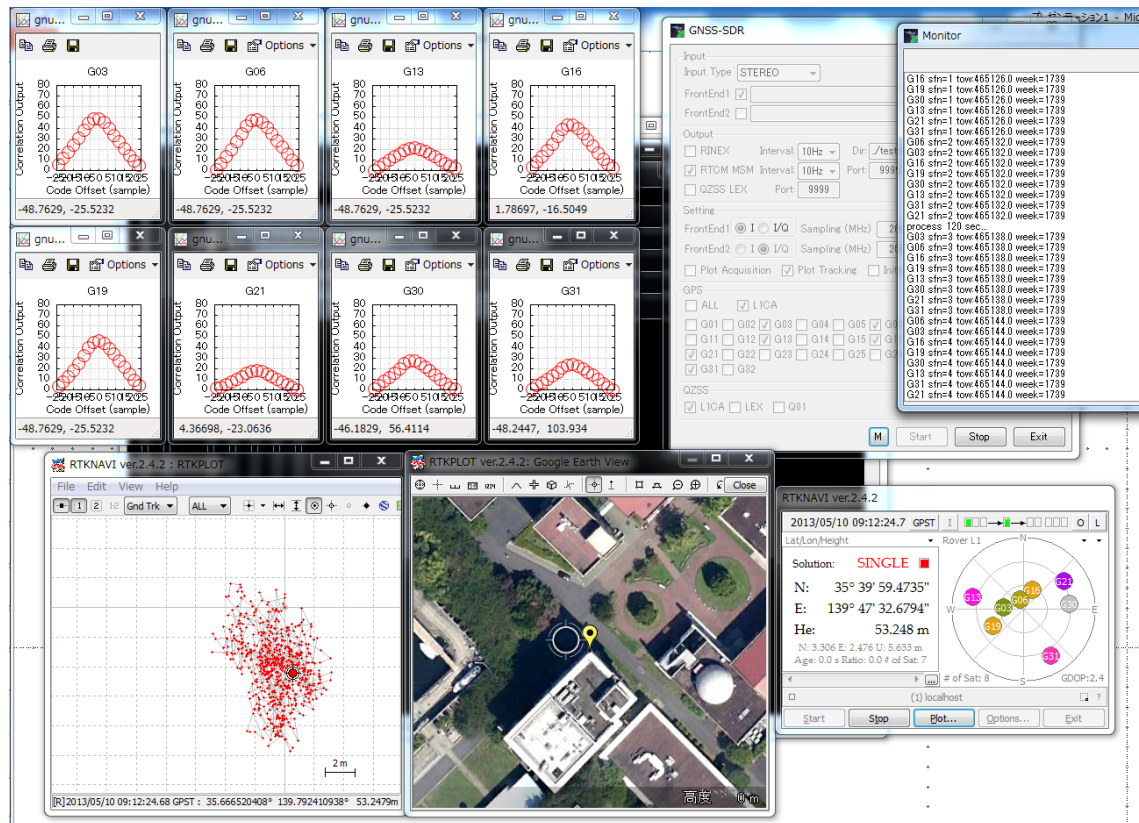
- (5) Press Start button. If the plot tracking is checked, windows should appear as below.



(6) Set and run rtknavi.exe as follows.



(7) Start RTKNAVI.



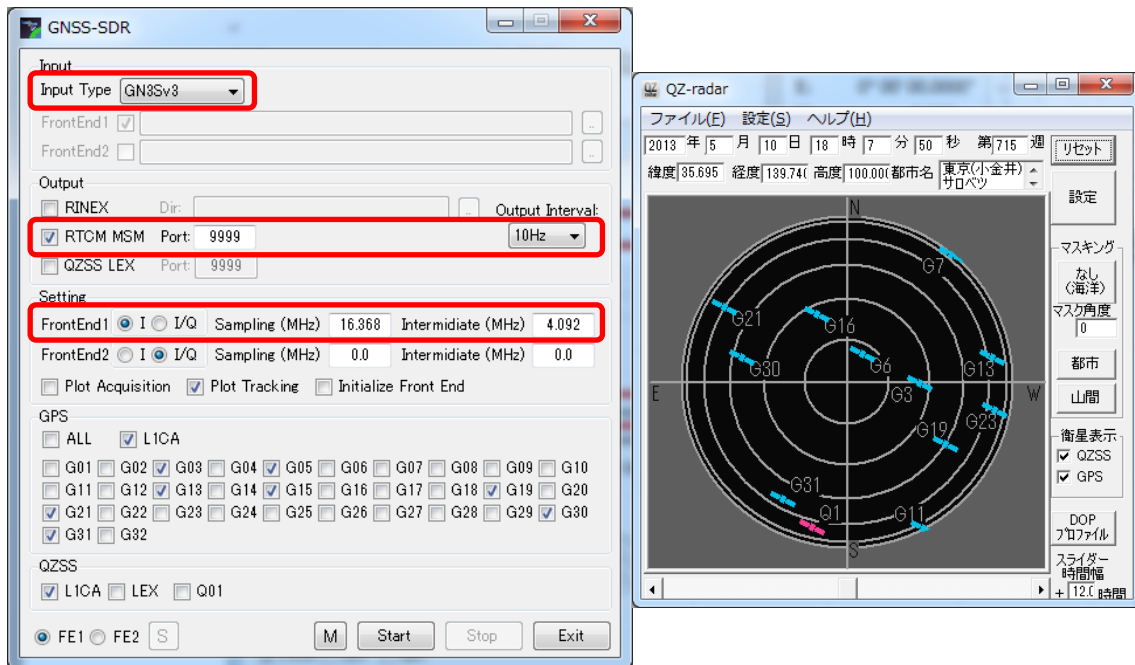
Note1: Navigation data will only be output when decoded for the first time or when updated. If rtknavi is not connected from the beginning, it may not position (lack of navigation data).

*Note2: Check RINEX and specify directory to output RINEX data format, RINEX file will be saved as **yyyymmddhhmmss.obs** and **yyyymmddhhmmss.nav** in output directory.*

Note3: Ver. 1.0 does not support QZSS observation data nor decoding of L1SAIF and LEX message.

5.2 Real-time Positioning using SiGe GN3S v3 via RTKLIB

- (1) Extract RTKLIB 2.4.2 (<http://www.rtklib.com/>) to appropriate directory.
- (2) Connect SiGe GN3S v3 to PC and install the original driver software.
- (3) Set and run gnss-sdrgui.exe as follows.

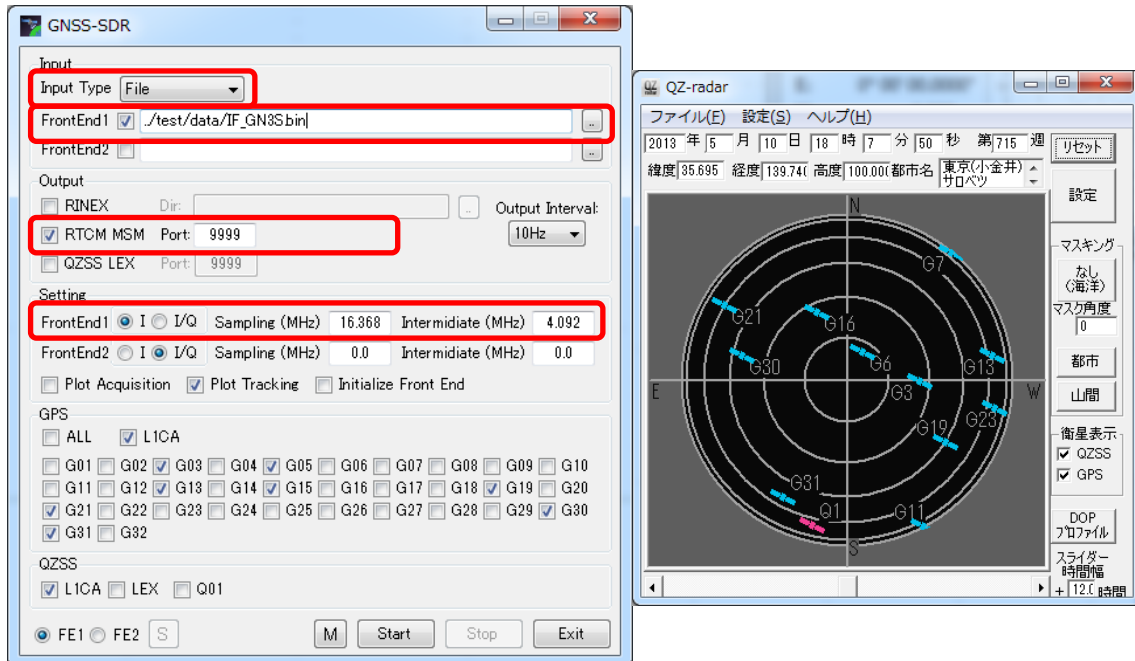


Default settings of SiGe GNSS Sampler v3 are [Sampling data type: I], [Sampling rate: 16.368MHz], and [IF: 4.092MHz].

- (4) Press Start to run the signal acquisition and tracking. Settings for RTKNAVI is the same to 5.1(6)~(7).

5.3 Post-Processing Analysis using IF Data

(1) Set and run gnss-sdrgui.exe as follows.



Sampling data type, sampling frequency and Intermediate frequency must match the IF data. Input IF data must be 8bit integer type binary file. If I/Q sampling is used, 8bit integer data must alternate as I Q I Q I Q

(2) Press Start for signal acquisition and tracking.

Note: RTKNAVI can be used for positioning by playing back the IF data. When doing so, the clock inside the PC and the time of IF data gathering must be roughly the same (RTKNAVI uses the PC clock). The settings of RTKNAVI follows 5.1 (6)~(7).