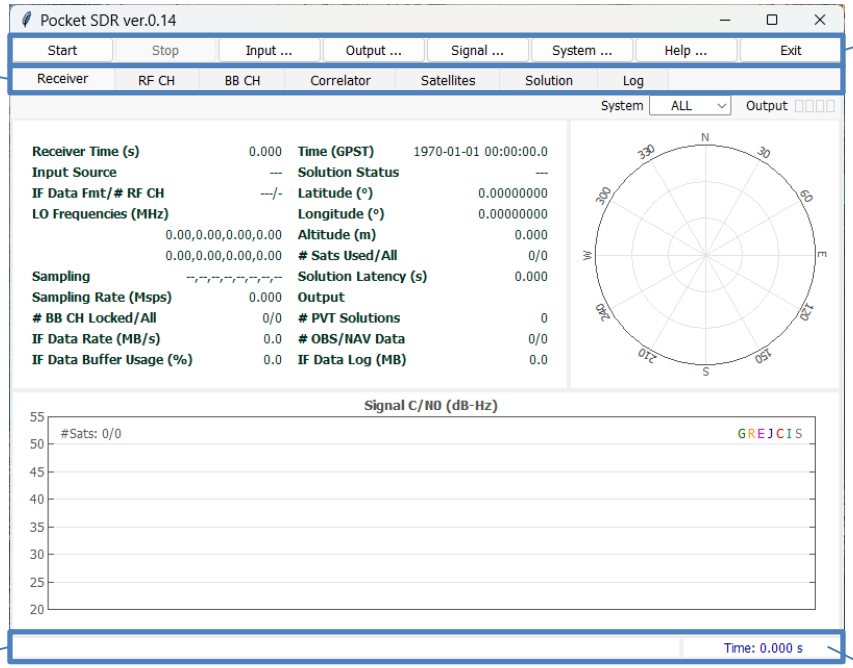
Initial Window of pocket_sdr.py



Page Tabs:
Tabs to switch current page

Command Buttons

Start	: Start the receiver
Stop	: Stop the receiver
Input...	: Show Input Options dialog
Output...	: Show Output Options dialog
Signal...	: Show Signal Options dialog
System...	: Show System Options dialog
Help	: Show Help dialog
Exit	: Exit the receiver

Status Bar:
Status info or error message for the receiver

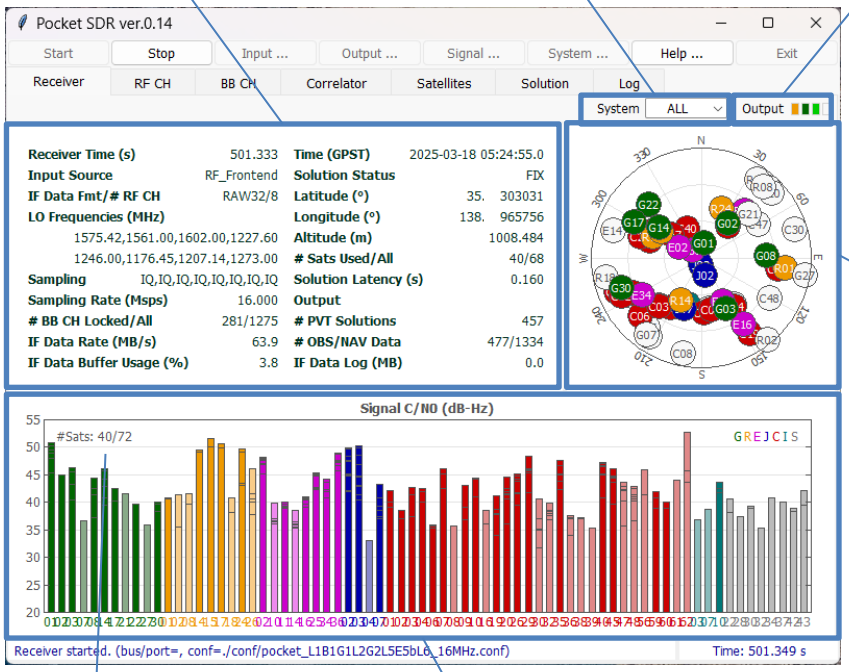
Receiver Time:
Elapsed time since the receiver started (s)

Receiver Page

Receiver Time:
Elapsed time since the receiver started
Input Source:
IF data source (RF_Frontend or IF_Data)
IF Data Fmt/# RF CH:
IF data format *3 and number of RF CHs
LO Frequencies:
Local oscillator frequencies for each RF CH (MHz)
Sampling:
IF data sampling type for each RF CH (I or IQ)
Sampling Rate:
IF data sampling rate (Msps)
 # BB CH Locked/All:
Number of BB CHs tracked and all
IF Data Rate:
IF data transfer rate (MB/s)
IF Data Buffer Usage:
Receiver internal IF data buffer usage rate (%)
Time (GPST):
PVT Solution time in GPST
Solution Status:
PVT Solution status (- or FIX)
Latitude, Longitude and Altitude:
PVT Solution latitude/ longitude (deg) and ellipsoidal height (m)
 # Sats Used / All:
Number of used satellites for PVT and all satellites with OBS data
Solution Latency:
PVT Solution latency (s)
 # PVT Solutions:
Total count of PVT solutions
 # OBS/NAV Data:
Total count of OBS and NAV data
IF Data Log:
Recorded size of IF Data log (MB)

Receiver Status Panel

System Selection for Skyplot and C/N0 Plot



Output Status Indicators
for PVT solution, OBS/NAV data, receiver log and IF data log
Orange: waiting for connection
Green: data OK
Light-Green: data active
Red: error
White: no output

Satellite Positions in Skyplot *1 *2

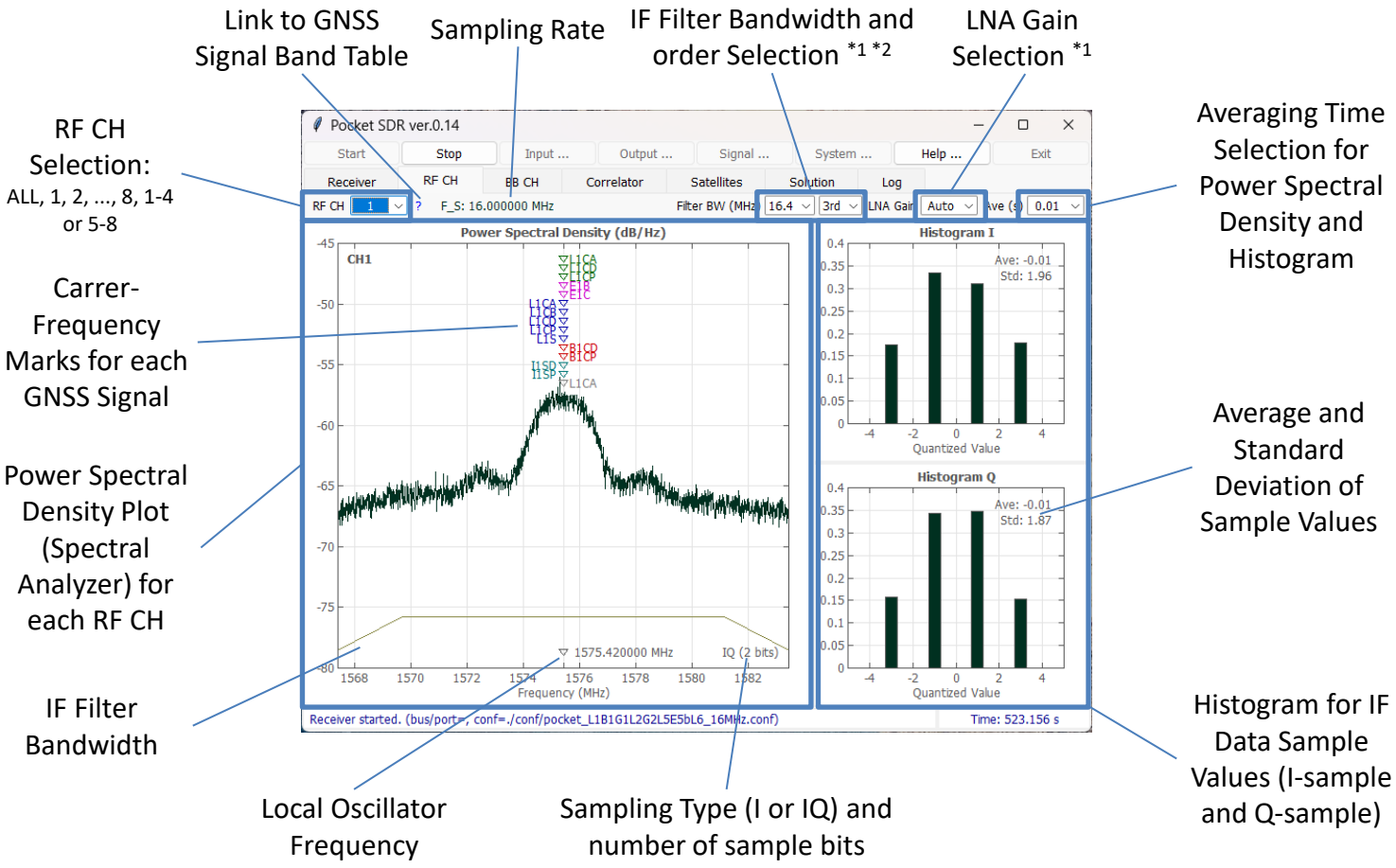
Number of used satellites and all satellites with OBS data

Signal C/N0 (dB-Hz) Plot for Each Satellite and Signals (stacked) *1 *2

*2 Satellite ID complies with RINEX convention
*3 INT8 (int8 I-sampling), INT8X2 (interleaved-int8 IQ-sampling), RAW8, RAW16 or RAW32 (Pocket SDR FE 2CH, 4CH or 8CH raw format)

* 1 GNSS System Color:
Green: GPS
Orange: GLONASS
Magenta: Galileo
Blue: QZSS
Red: BeiDou
Blue-Green: NavIC
Grey: SBAS
White or light-color: unused satellites for solution

RF CH Page



*1 Only valid for RF_Frontend Input, *2 Only valid for IQ-sampling

BB CH Page

RF CH Selection: ALL, 1, 2, ..., 8

GNSS System Selection: ALL, GPS, GLONASS, ...

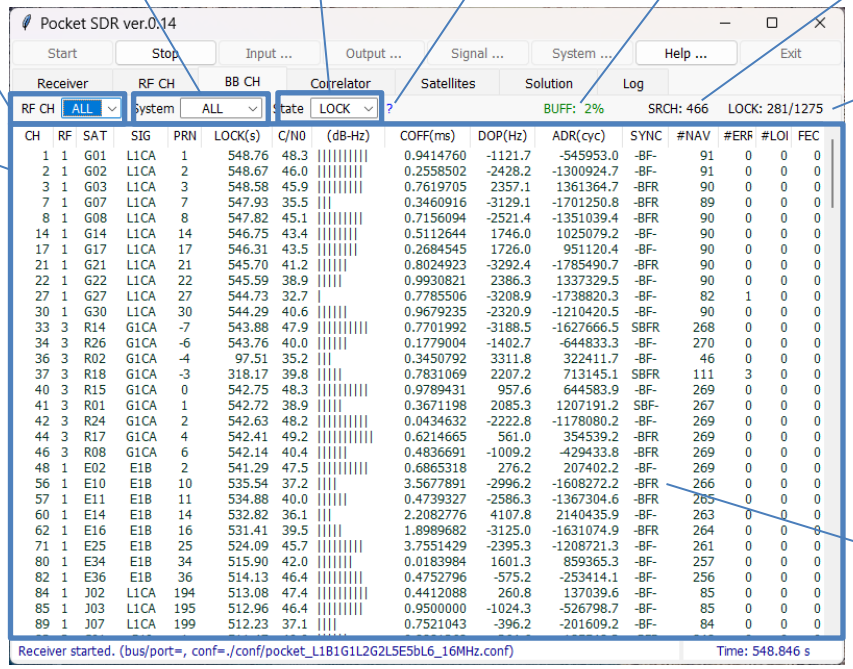
BB CH State Selection: LOCK or ALL

Link to GNSS Signal Table

Internal IF Data Buffer Usage Rate in %

BB CH No Searching Signal

Number of Locked and All BB CHs



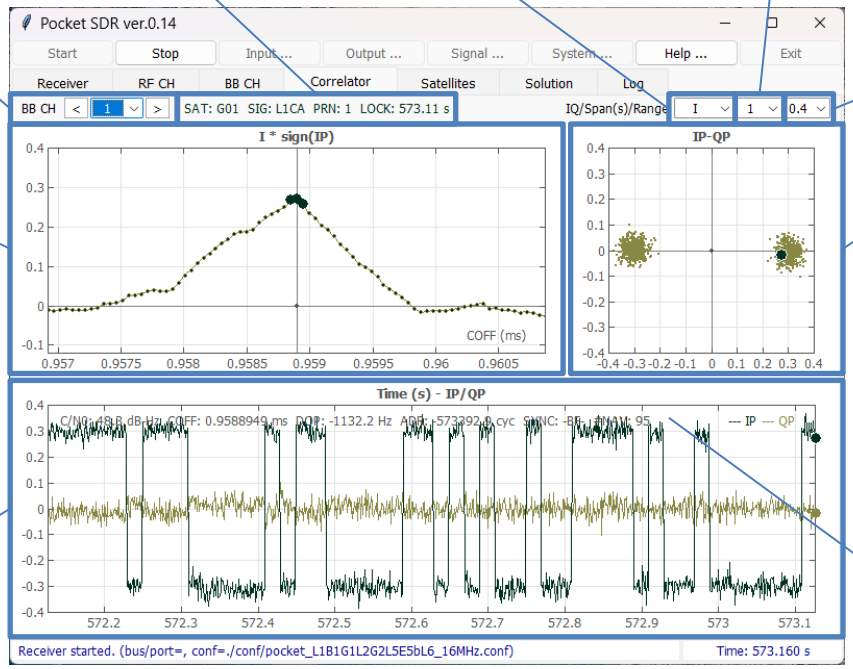
Status for each BB CH:

- CH : BB CH no
- RF : Assigned RF CH no for BB CH
- SAT : Satellite ID
- SIG : Signal ID
- PRN : PRN number or FCN for GLONASS FDMA signal
- LOCK : Continuous lock time (s)
- C/N0 : Signal C/N0 (dB-Hz)
- (dB-Hz) : Signal C/N0 Bar (20-50 dB-Hz)
- COFF : Code offset (ms)
- DOP : Doppler frequency (Hz)
- ADR : Accumulated Doppler range (cycle)
- SYNC : Synchronization status
- #NAV : Decoded subframe or message count
- #ERR : NAV data error count
- #LOL : Loss-of-lock count
- FEC : Number of error bits corrected by FEC (-1: correction unable)

Synchronization Status:

- S : Secondary code sync
- B : NAV symbol (bit) sync
- F : Subframe or message sync
- R : Polarity of subframe or message sync (R: reversed)

Correlator Page



BB CH Selection *1:
1, 2, 3, ...

Satellite ID, Signal ID and Lock Time of BB CH

Correlation Plot Type Selection

Time Span Selection for Correlation History or Constellation Plot

Y-axis Range Selection

Correlation Plot

X-axis: code offset (ms)
Y-axis: correlations
(I * sign(IP), sqrt($I^2 + Q^2$) or sqrt(sum($I^2 + Q^2$))) *2
Large dots:
correlator positions for VE, E, P, L and VL *3

Constellation Plot

X-axis: IP-correlation
Y-axis: QP-correlation
Large dot:
current correlation

Correlation History Plot

X-axis: receiver time (s)
Y-axis: IP or QP-correlation

C/N0, code offset, Doppler Frequency, accumulated Doppler range, synchronization status, decoded subframe or message count

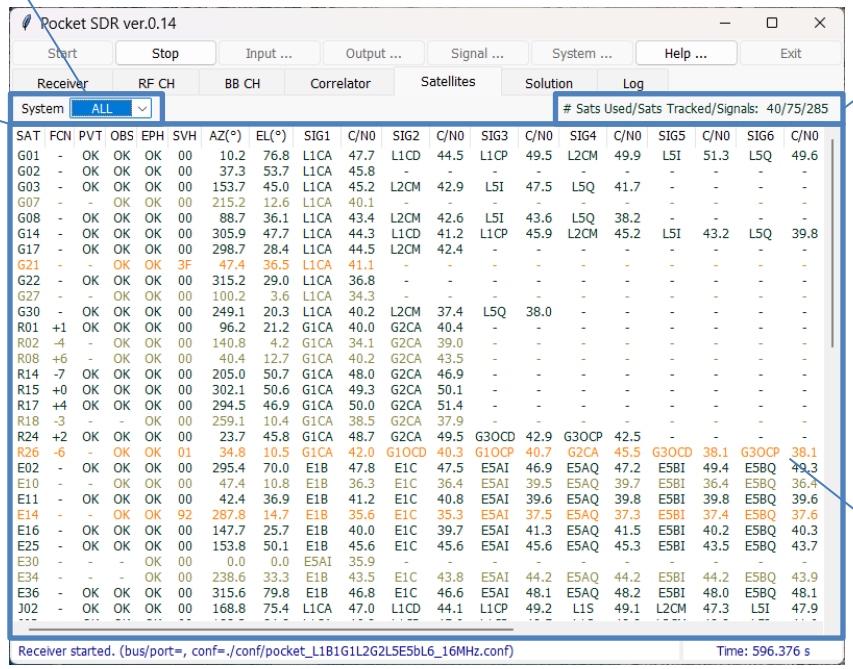
*1 BB CH can be selected by clicking BB CH Status row in BB CH Page
*2 Integration time is based on non-coherent integration time for DLL
*3 VE and VL are only shown in case of BOC-modulation and Bump-Jump enabled

Satellites Page

System Selection

Status for each Satellite:

Number of satellites used for PVT solution, number of satellites tracked, number of all tracked signals



Orange: unhealthy satellite
Grey: unused satellite for PVT solution

SAT : Satellite ID
FCN : Frequency channel no (FCN) for GLONASS FDMA signals
PVT : Satellite used in PVT solution or not
OBS : Satellite L1 OBS data availability
EPH : Satellite ephemeris availability
SVH : Satellite health flag in ephemeris (HEX)
AZ : Azimuth angle (deg)
EL : Elevation angle (deg)
SIG1 : Signal 1 ID
C/N0 : C/N0 of signal 1 (dB-Hz)
SIG2 : Signal 2 ID
C/N0 : C/N0 for signal 2 (dB-Hz)
SIG3 : Signal 3 ID
C/N0 : C/N0 for signal 3 (dB-Hz)
... ...

Solution Page

PVT Solution Plot Selection:
Pos ENU or Pos Horiz

Show Ref Pos Dialog Button

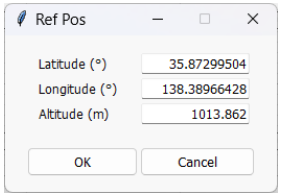
PVT Solution Clear Button

Time Span and Y-axis Range Selections

Current Solution and Number of Used/All Satellites

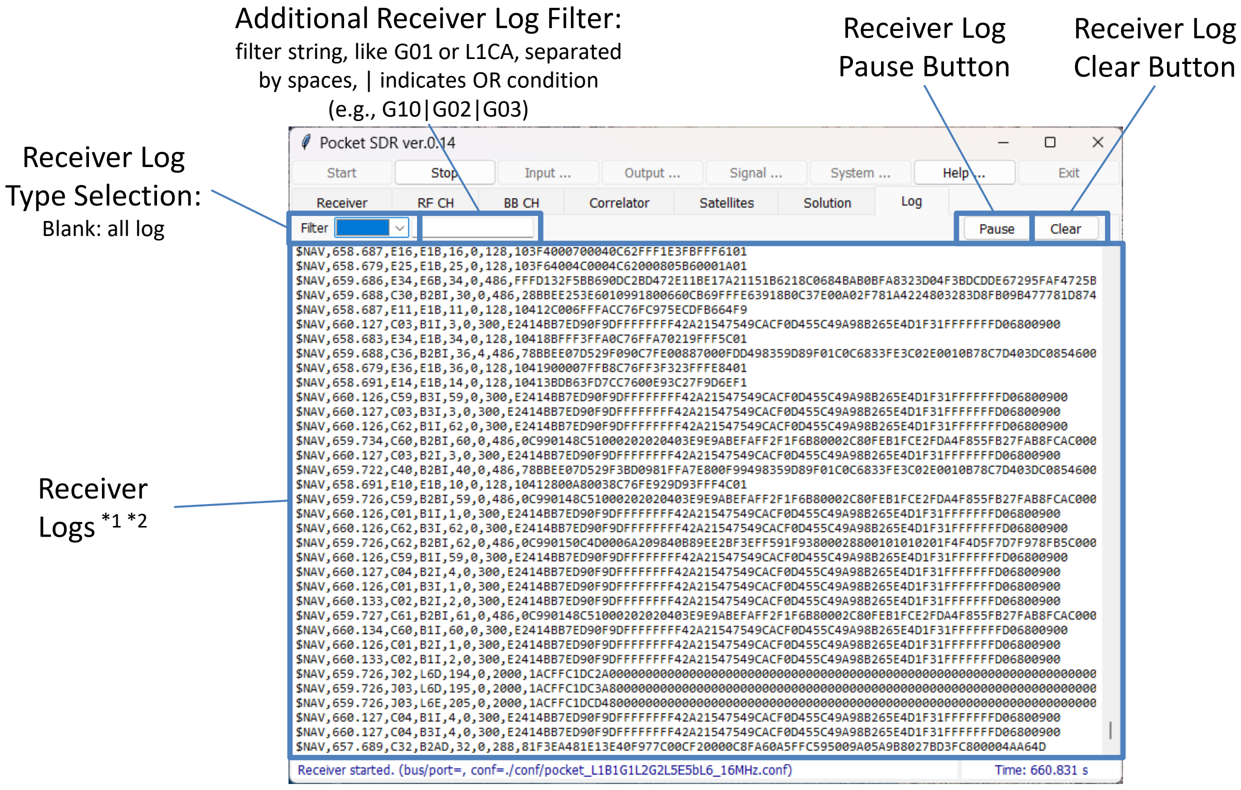
PVT Solution Plot:
Pos E, N, U: position errors east-west, north-south, up-down *1,
Sats: Number of used/all satellites
or
Position error horizontal *1 (east-west and north-west, horizontal scatter plot)

Ref Pos Dialog



*1 The reference position is automatically selected from the first epoch solution.
It can be modified by using Ref Pos Dialog

Log Page



*1 Refer p.14 for the receiver log formats

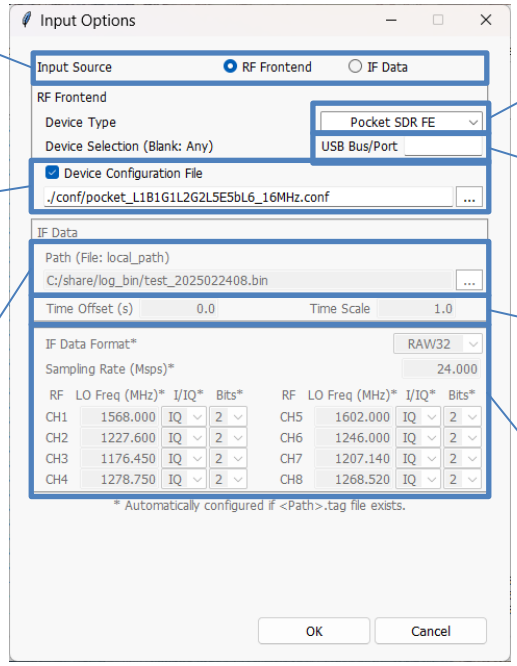
*2 To copy the logs to Clip-board, push Pause button, select the logs and push Ctrl-C of the keyboard

Input Options Dialog

Input Source Selection:
RF Frontend or IF Data

Device Configuration File:
RF Frontend configuration (MAX2771 register settings for Pocket SDR FE) to be loaded at the receiver started. Check Device Configuration File and fill the file path. If unchecked, the current configuration for the device is used.

IF Data File *1:
IF data file path, if IF Data selected as the input source. The IF data can be captured by pocket_dump or as IF data log of the receiver with tag files.



RF Frontend Type Selection:
Currently, only Pocket SDR FE is selectable

USB Bus/Port:
To select device in case of multiple devices connected. If blank, the device is automatically selected.

Time Offset and Scale:
Start time offset and time scale to playback the IF Data.

IF Data File Property *1:
IF Data Format, Sampling Rate, LO frequency, Sampling Type (I or IQ), Number of sample bits for each RF CH. If the tag file exist for the IF data file, these are automatically configured according to the tag file.

*1 Refer p.13 for the IF data file formats

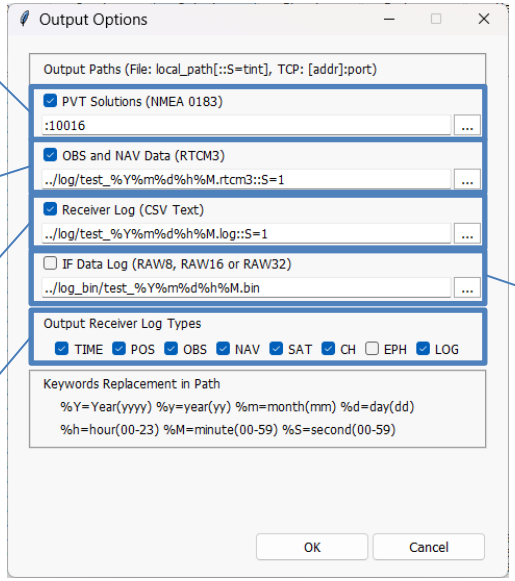
Output Options Dialog

PVT Solution Output Path:
PVT Solution (NMEA 0183 GNRMC, GNGGA, GNGSA, GxGSV) path *1.

OBS and NAV Data Output Path:
OBS and NAV Data (RTCM 3.4 MSM (MT1077, 1087, 1097, 1117, 1127, 1137 and 1107) with extension and EPH (MT1019, 1020, 1045, 1046, 1044, 1042 and 1041) path *1 *2

Receiver Log Output Path:
Receiver Log Path *1 *3

Receiver Log Type Selections *3



IF Data Log Output Path:
IF Data Log Path *1 *4, It is only valid for RF Frontend selected as the input source

*1 The output path should be one of the followings.
(1) <local path>: A local file path <local path>. It can contain time keywords replaced by the log start time. Optionally, it can include the file swapping order "::S=<tint>" by the specified interval <tint> (H).
(2) :<port>: TCP server with the port number <port>. The TCP server waits for and accepts the external TCP connection at the port and output data
(3) <addr>:<port>: TCP client with the address <addr> and the port number <port>. The TCP client connects the external TCP server and output data
*2 The output RTCM 3.4 MSM (with extensions) and EPH can be converted to RINEX OBS and NAV by CONVBIN utility included in the Pocket SDR package
*3 Refer p.14 for the receiver log format. The receiver log can be plotted by the Log Viewer pocket_plot.py in the Pocket SDR package
*4 Refer p.13 for the IF data log format. The output format is automatically selected according to the RF Frontend (RAW8, RAW16 or RAW32). The tag file is also generated.

Signal Options Dialog

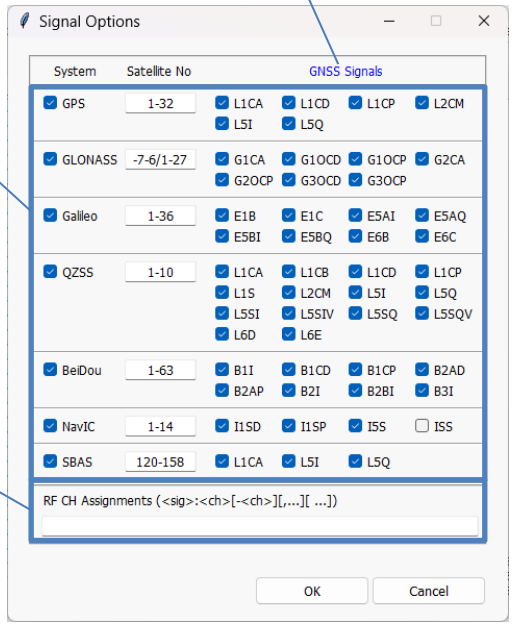
Link to Detailed GNSS Signal Table

GNSS System and Signal Selections:

System: GNSS System,
Satellite No: Satellite number or number range (n-m) separated by , *1
GNSS Signals: Signal IDs to be tracked

RF CH Assignment Options:

RF CH is automatically assigned for signals. To assign signals to specific RF CH(s) manually, use the option as the format <sig>:<ch_list> separated by spaces, where, <sig> is signal ID and <ch_list> is RF CH number list like 1,3,5-7. Additionally, SRCH:<ch_list> can be used to specify signal search CH(s) to shorten the acquisition time.



*1 For GPS, Galileo, BeiDou, NavIC and SBAS, these satellite numbers are the same as the signal PRN numbers. For GLONASS, use the frequency channel number (FCN) for FDMA signals and satellite slot number for CDMA signals instead separated by /. For QZSS, which has complicated satellite numbering, use SV IDs (1-5, 8, 9) or non-standard code numbers (6, 10) instead as the satellite numbers.

*2 QZSS L5S verification mode signals

*3 Pocket SDR FE currently does not support S-band signals

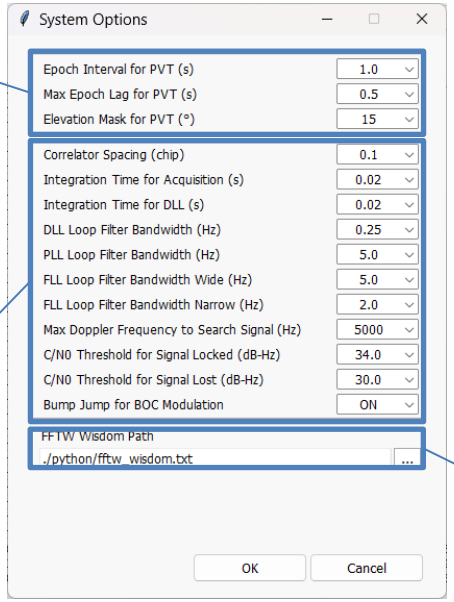
Pocket SDR Signal ID Table

System	Signal	Signal ID	System	Signal	Signal ID
GPS	L1C/A	L1CA	BeiDou	B1I	B1I
	L1C-D	L1CD		B1C-D	B1CD
	L1C-P	L1CP		B1C-P	B1CP
	L2C-M	L2CM		B2a-D	B2AD
	L5-I	L5I		B2a-P	B2AP
	L5-Q	L5Q		B2I	B2I
GLONASS	L1C/A	G1CA		B2b-I	B2BI
	L1OCd	G1OCD		B3I	B3I
	L1OCp	G1OCP	NavIC	L1-SPS-D	I1SD
	L1C/A	G2CA		L1-SPS-P	I1SP
	L2OCp	G2OCP		L5-SPS	I5S
	L3OCd	G3OCD		S-SPS	ISS*3
	L3OCp	G3OCP	SBAS	L1C/A	L1CA
Galileo	E1-B	E1B		L5-I	L5I
	E1-C	E1C		L5-Q	L5Q
	E5a-I	E5AI			
	E5a-Q	E5AQ			
	E5b-I	E5BI			
	E5b-Q	E5BQ			
	E6-B	E6B			
	E6-C	E6C			
QZSS	L1C/A	L1CA			
	L1C/B	L1CB			
	L1C-D	L1CD			
	L1C-P	L1CP			
	L2C-M	L2CM			
	L5-I	L5I			
	L5Q	L5Q			
	L5S-I	L5SI			
		L5SIV*2			
	L5S-Q	L5SQ			
		L5SQV*2			
	L6D	L6D			
	L6E	L6E			

System Options Dialog

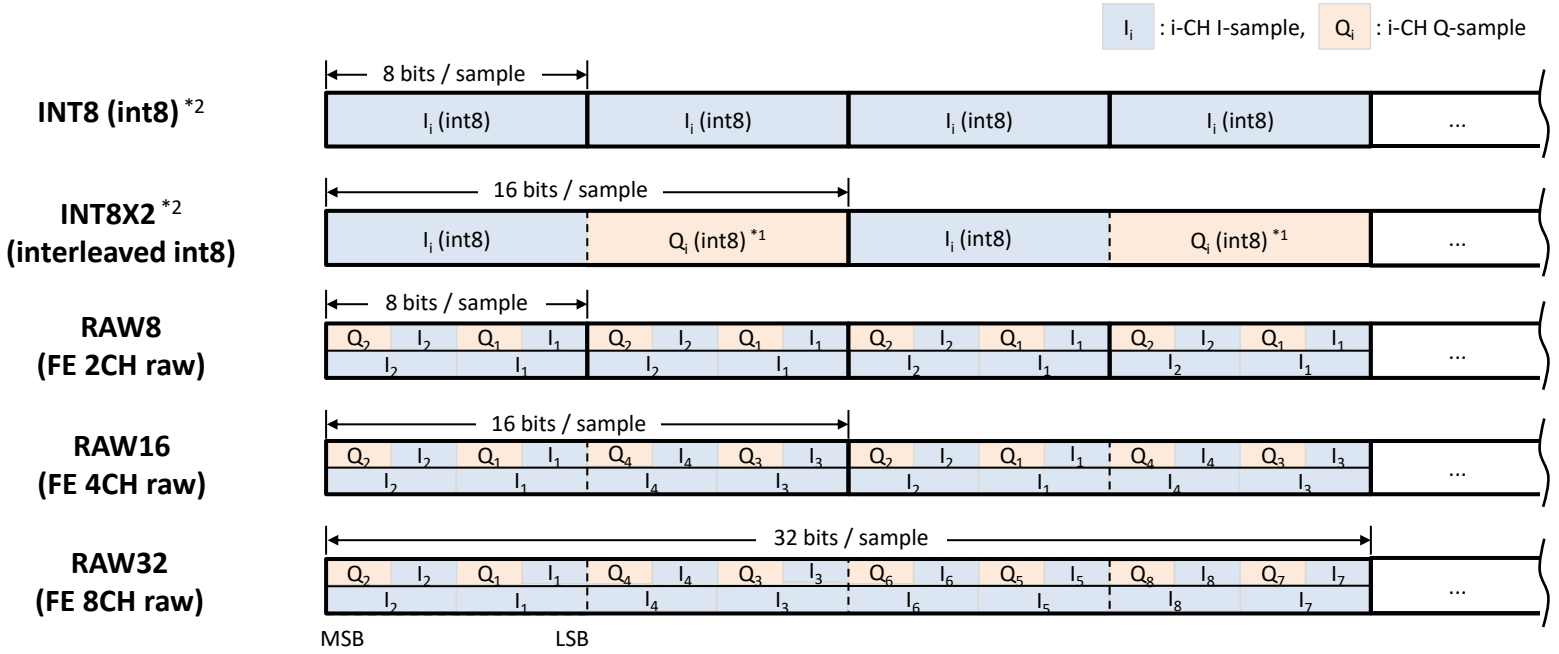
PVT Options Selection:
Epoch Interval (s), Max Epoch Lag (s) and Elevation angle Mask (deg)

Signal Acquisition and Tracking Options Selection:
Correlation Spacing (chip), Non-coherent Integration Time for Acquisition (s), Non-coherent Integration Time for DLL (s), Loop filter bandwidth for DLL, PLL, FLL (wide-band) and FLL (narrow-band) (Hz), Max Doppler Frequency search range (Hz), C/N0 thresholds for signal-lock or signal-lost decision (dB-Hz), Bump-Jump for BOC modulation enabled or disabled.



FFTW Wisdom Path:
FFTW wisdom file path to shorten the signal acquisition time. The file can be generated by the utility fftw_wisdom in the Pocket SDR package.

IF Data File Formats



2 bits IQ-sampling

bits	00	01	10	11
I	+1	+3	-1	-3
Q *1	-1	-3	+1	+3

2 bits I-sampling

bits	**00	**01	**10	**11
I	+1	+3	-1	-3

3 bits I-sampling

bits	0000	1000	0001	1001	0010	1010	0011	1011
I	+1	+3	+5	+7	-1	-3	-5	-7

*1 Polarity inverted due to MAX2771 convention
*2 Quantized values only supported in the range [-7 ... +7]

IF Data Tag File (<path>.tag)

```
PROG = Pocket SDR
TIME = 2024/11/01 20:48:00.776     (Start Time GPST)
FMT  = RAW16                       (Format)
F_S  = 24                          (Sampling Freq. MHz)
F_LO = 1568,1237.8,1176.45,1278.75 (LO Freq. MHz)
IQ   = 2,2,2,2                     (Sampling, 1:I, 2:IQ)
BITS = 2,2,2,2                     (Sampling Bits)
```

Receiver Logs

$TIME,time,year,mon,day,hour,min,sec,tsys (time info)
$OBS,time,year,month,day,hour,min,sec,sat,code,cn0,pr,cp,dop,lli,fcn (OBS data)
$NAV,time,sat,sig,nerr,size,data (raw NAV data)
$POS,time,year,month,day,hour,min,sec,lat,lon,hgt,Q,ns,stdn,stde,stdu,dtr (position solution)
$SAT,time,year,month,day,hour,min,sec,sat,pvt,obs,cn0,az,el,res (satellite info)
$EPH,time,sat,sig,IODE,IODC,SVA,SVH,Toe,Toc,Ttr,A,e,i0,OMEGA0,omega,M0,delta-n,OMEGAdot,Idot,Crc,Crs,Cuc,Cus,Cic,Cis,Toes,Fit,Af0,Af1,Af2, TGD,code,flag (GPS/Galileo/QZSS/BeiDou/NavIC decoded ephemeris)
$EPH,time,sat,sig,tb,fcn,SVH,SVA,age,Toe,Tof,pos-x,pos-y,pos-z,vel-x,vel-y,vel-z,acc-x,acc-y,acc-z,tau-n,gamma-n,delta-tau-n (GLONASS decoded ephemeris)
$CH,time,ch,rfch,sat,sig,prn,lock,cn0,coff,dop,adr,ssync,bsync,fsync,rev,srev,err_phas,err_code,tow_v,tow,week,type,nnav,nerr,nlol,nfec (receiver channel info)
$LOG,time,message (error, warning, general info message)

$TIME

time	receiver time (s)
year	year (2000-2099)
mon	month (1-12)
day	day (1-31)
hour	hour (0-23)
min	minute (0-59)
sec	second (0.000-59.999)
tsys	time system (GPST or UTC)

$OBS

time	receiver time (s)
year,month,day	obs data day (GPST)
hour,min,sec	obs data time (GPST)
sat	satellite ID
code	RINEX obs code
cn0	C/N0 (dB-Hz)
pr	pseudorange (m)
cp	carrier phase (cyc)
dop	Doppler frequency (Hz)
lli	loss-of-lock indicator
fcn	frequency channel number for GLONASS FDMA signals

$NAV

time	receiver time (s)
sat	satellite ID
sig	signal ID
nerr	number of corrected error bits
size	raw NAV data size (bits)
data	raw NAV data HEX dump

$POS

time	receiver time (s)
year,month,day	solution day (GPST)
hour,min,sec	solution time (GPST)
lat	solution latitude (deg,+:north,-:south)
lon	solution longitude (deg,+:east,-:west)
hgt	solution ellipsoidal height (m)
Q	quality flag (=5: single)
ns	number of valid satellites
stdn	solution standard-dev north (m)
stde	solution standard-dev east (m)
stdu	solution standard-dev up (m)
dtr	receiver clock bias (s)

$SAT

time	receiver time (s)
year,month,day	solution day (GPST)
hour,min,sec	solution time (GPST)
sat	satellite ID
pvt	PVT status (0:not used,1:used)
obs	L1 obs data status (0:unavailable,1:available)
cn0	L1 signal C/N0 (dB-Hz)
az	azimuth angle (deg)
el	elavation angle (deg)
res	L1 pseudorange residual (m)

$EPH

time	receiver time (s)
sat	satellite ID
sig	signal ID
...	decoded ephemeris parameters

$LOG

time	receiver time (s)
message	error, warning or general info message

$CH

time	receiver time (s)
ch	receiver channel number
rfch	RF channel number
sat	satellite ID
sig	signal ID
prn	PRN number
lock	lock time (s)
cn0	C/N0 (dB-Hz)
coff	code offset (ms)
dop	Doppler frequency (Hz)
adr	accumlated Doppler range (cyc)
ssync	secondary code sync flag(0:async,1:sync)
bsync	symbol/bit sync flag (0:async,1:sync)
fsync	frame sync flag (0:async,1:sync)
rev	primary code polarity (0:normal,1:reversed)
srev	secondary code polarity (0:normal,1:reversed)
err_phas	phase error (cyc)
err_code	code error (10^-6 s)
tow_v	tow valid flag (0:invalid,1:valid, 2:ambiguity unresolved)
tow	time of week (ms)
week	week number (week)
type	navigation subframe or message type
nnav	navigation subframe/message count
nerr	error subframe/message count
nlol	loss-of-lock count
nfec	number of error corrected (bits)