GTR50

TIME & FREQUENCY TRANSFER RECEIVER

OPERATING INSTRUCTIONS

SEPTEMBER 2007

Contents

1. Introduction

The GTR50 is intended for time & frequency comparisons via GPS common views. The receiver supports both code and phase measurements. Thanks to large receiver bandwidth and advanced signal processing, even the code measurements provide sub-nanosecond accuracy. The double frequency version of the receiver provides additionally high accurate ionospheric delay measurement. Critical elements are placed in a thermostat box. The receiver can be directly connected to a local net/internet which allows remote control and output data download.

Operation

The operation is fully automatic. After the very first configuration, the receiver continuously collects and stores the measurement data. Several standard/proprietary output protocols can be generated from the collected data. The data processing can be started manually or by a scheduler which enables routine processing at given times (daily, weekly, ...). The resulting data files can be downloaded from the receiver or automatically uploaded to a server. A brief message is sent to an e-mail address after the processing is finished.

Remote control

The receiver can be controlled from any computer on the net. The User Interface has the form of a web page which can be accessed using a web browser. It enables control of the receiver, monitoring of the receiver operation, and download of the measurement data. Authorization is required to access the receiver.

Diagnostic system

The diagnostic system indicates several dozens of operational events and states. The diagnostic messages can be recorded in the log, displayed in the User Interface, and sent to an e-mail address.

Monitoring with graphical representation

History of operational parameters (time difference, temperature, satellite elevation/azimuth, …) is displayed in graphs in the User Interface.

2. Technical Specifications

Time Reference Input

Input signal:	1PPS (leading edge)
Input impedance:	50 Ω
Trigger level:	0 - 2 V adjustable
Max level:	< 5.5 V / 50 Ω
Min level:	> -0.1 V / 50 Ω

Precision

Code measurement:	< 1 ns rms (CGGTTS protocol, short-baseline common view)
Phase measurement:	< 80 ps rms (short-baseline common view)
Ionospheric delay:	< 2 ns rms (CGGTTS protocol)

Output Data Formats: CGGTTS (all tracks / all satellites in view, L1/L2 iono-delay)
RINEX (observation / navigation files)
RAW (proprietary format, both code and carrier phase data)
EL_MASK (CNR analysis and search for obstacles)
STAT (statistics of collected measurement data)
L3P_30s (standard P3 data, 30 s sampling period)
L3P_1s (P3 data, 1 s sampling period)

GPS Receiver

Frequency channels:	L1/L2
Type of measurement:	code / carrier phase referenced to the input time mark
Receiver bandwidth:	22 MHz

Time Interval Counter
Precision: < 50 ps rms

Thermostat: based on thermoelectric modules

Dimensions: 19"/2U standard chassis
Power Supply: 230 V AC
Operating Temperature: 0 to 50ºC

Antenna

Antenna supply:	5 V / up to 90 mA (plus on the inner contact of connector)
Recommended antenna:	Novatel GPS-702 (dual frequency)

3. Standards and Recommendations

Receiver operation, parameters, and output data formats comply with the following recommendations:

CGGTTS guidelines for manufacturers of GNSS receivers used for timing. Consultative Committee for Time and Frequency - Group on GNSS Time Transfer Standards (CGGTTS), June 2001.

Gurtner W.: RINEX The Receiver Independent Exchange Format, version 2.10. Astronomical Institute University of Berne 2000.

Allan D.W.; Thomas C.: Technical Directives for Standardization of GPS Time Receiver Software. Metrologia vol. 31 (1994), p.69-79.

4. Getting Started

4.1 Installation

1. Connect power supply 230 V AC to the connector on the rear panel.

2. Connect GPS antenna cable to the ANT connector on the front panel. The device provides the antenna supply +5 V (up to 90 mA) on the inner contact of the connector.

3. Connect 1PPS reference signal to the 1PPS connector on the front panel. The input impedance is 50 Ω. The mark is supposed to be referenced to the leading edge. The trigger level can be set from 0.0 to 2.5 V. The high level of the mark should not be higher than 5.5 V / 50 Ω.

4. Connect the net cable to the connector on the rear panel.

4.2 Net administration

Contact your net administrator and ask him or her to perform following configurations:

1. DHCP server configuration. The device expects automatic configuration of IP address and related settings from DHCP server. The IP address should be from the static pool.

2. DNS server configuration. Name of the device must be associated to the IP address.

3. Firewall configuration. If the device should be accessible through a firewall, it must be transparent for following protocols: HTTP, SMTP, FTP, SSH.

The Ethernet HW address and a name of the device are necessary for the configurations. The Ethernet HW address is written on a label on the rear panel. Choice of the device name is up to the user.

4.3 Switching on

Press the power button on the front panel.

4.4 LEDs

Two LEDs provide the very basic information about the GTR50 operation.

GPS LED

When the receiver is on and no satellites are tracked, the GPS LED is red. Instead, this LED blinks as follows:

- a green blink for each GPS satellite being tracked,

- a pause if at least one satellite has CNR> 48 dBHz or red blink if no satellite has CNR> 48 dBHz.

For example, if 8 satellites are being tracked, the LED repeatedly blinks 8 greens between pauses or red blinks.

Trigger LED

When measurement is running, the LED blinks after every 1PPS mark trigger. Instead, it does not blink.

4.5 User Interface

The GTR50 can be controlled and its operation monitored using a User Interface which has the form of a web page and can be accessed using a web browser. The User Interface is described in detail in the chapter *GTR50 User Interface*.

4.6 Startup

1. After the login field of the User Interface appears, enter your user name and password. (Factory default: User = user, Password = user)

2. Press the **Maintenance** button in the menu.

3. Press the **Start** button in the main frame.

4. Press **Show Receiver Status** button at the bottom.

5. Wait till the **IDLE** state is indicated (15 minutes approximately).

6. Press the **Measurement** button in the menu.

7. Press the **Start Measurement** button in the main frame.

Now the measurement is running and the measurement data being collected on the HD in hourly files (GM*).

4.7 Monitoring of operation

You can monitor the device operation using the **Display** functions: **Time Difference, Diagnostics**, **Satellites**, **Temperature**, **Position**, and **Log**. The functions are selectable from the menu.

4.8 Measurement data processing

1. Press the **Control / Processing** button in the menu.

2. Select desired type of processing:

   RINEX_O generates a RINEX observation file. The observation data are related to the input 1PPS reference signal.

   RINEX_ON generates RINEX observation and navigation files.

   CGGTTS generates a CGGTTS file (all tracks / all satellites in view).

   RAW generates a proprietary format file which includes both the code and phase measurements.

   EL_MASK analyzes the dependence of the signal-to-noise ratio on azimuth and elevation and searches for obstacles around the antenna.

   STAT provides statistics of available measurement data.

   L3P_30s generates standard P3 data based on measurements taken with 30 s sampling period.

   L3P_1s generates nonstandard P3 data based on measurements taken with 1 s sampling period. The fit algorithm is identical to the algorithm used in the classical CGGTTS protocol.

3. Select date and time of the first observation to be processed (MJD or date in ISO format, UTC or GPS time),

4. Select length of the observation to be processed.

5. Select period of observation (only for RINEX, RAW, and EL_MASK).

6. Select satellites to be processed. All satellites are processed in default.

7. An e-mail message at the end of the processing can be allowed.

8. Press the **Start Processing** button.

9. Check the processing parameters and confirm the start of the processing.

List of running processes is shown at the top of the page. A sequence number (0..99) which serves for identification of the resulting data, is assigned to every process. The processes can be stopped by the **Kill All** button.

Resulting files can be downloaded at the **Control / Get File** page. Only files from last five processes are kept. Older files are automatically deleted. In the case of RINEX, CGGTTS, L3P, and EL_MASK processes, a copy of the resulting data file with standard generic name is also generated. These files are not automatically deleted.

4.9 Shutdown

1. Press the **Maintenance** button in the menu.

2. Press the **GTR50 shutdown** button in the main frame.

Wait until the device switches off.

5. GTR50 User Interface

The User Interface enables remote control and monitoring of the device operation. It has the form of a web page which can be accessed using a web browser.

5.1 Access to User Interface

1. Enter URL of your GTR50 to the web browser (URL = <host name>/GTR50).

2. After the login field appears, enter your user name and password. (Factory default: User = user, Password = user)

We recommend using the Mozilla Firefox browser ([www.mozilla.com)](www.mozilla.com), but no problems have been observed using other browsers.

5.2 Appearance of User Interface page

The User Interface page consists of four frames:

- heading frame at the top,
- status frame at the bottom,
- menu frame on the left,
- main frame on the right.

The heading frame shows the device type and the firmware version. The status frame provides the basic information on the device operation. It can be refreshed automatically. The menu frame includes a field of buttons for switching subpages assigned to different functions. The selected subpage is then shown in the main frame. The main frame is refreshed only after the press of a button.

5.3 Receiver Status

After you press the **Show Receiver Status** button, the status information is being refreshed every 3 seconds till you press the **Stop Status Refresh** button.

The frame includes the following data:

Last Status Update - GPS date and time of last update.

State - Receiver state according to the state diagram in the attachment I.

C/A # of Sats - Number of satellites being received (C/A signal at L1).

C/A Max CNR - Maximum of signal-to-noise ratio over all satellites (C/A signal at L1).

P1 # of Sats - Number of satellites being received (P signal at L1).

P1 Max CNR - Maximum of signal-to-noise ratio over all satellites (P signal at L1).

P2 # of Sats - Number of satellites being received (P signal at L2).

P2 Max CNR - Maximum of signal-to-noise ratio over all satellites (P signal at L2).

Diagnostics - Indication of diagnostic alerts/warnings. Detailed diagnostic information is available at **Display / Diagnostics** and **Display / Log** pages.

5.4 Menu

- control,
- display,
- settings.

The control functions enable control of the device operation such as start/stop of measurement and processing of the measurement data. The display functions allow detailed monitoring of the device operation and the graphical representation of the output data. The setting functions set operational parameters to desired values.

5.5 Control functions

Measurement

The measurement can be started and stopped from this page.

Scheduler

The scheduler starts a processing task at a given time. Repeated data processing (daily, weekly, ...) is also possible. Five types of processing can be started from the scheduler:

CGGTTS_1_week generates a CGGTTS file from all observations from the last seven days.

CGGTTS_1_day generates a CGGTTS file from all observations from the last day.

RINEX_1_day generates an observation RINEX file with 30 s observation period from the last day.

L3P_1_week generates a standard P3 data file from all observations from the last seven days.

L3P_1_day generates a standard P3 data file from all observations from the last day.

The resulting data files can be downloaded at page **Control / Get File** or automatically uploaded to a server. A brief message can be sent to an e-mail address after the processing is finished. The e-mail and ftp addresses can be set at the **Settings / Communication** page.

Processing

A processing task can be started from this page. The following types of processing can be selected:

RINEX_O generates a RINEX observation file. The observation data are related to the input 1PPS reference signal. All calibration corrections (receiver chain delay, P1-P2, P1-C1) are applied on the data to keep them consistent with other results.

RINEX_ON generates RINEX observation and navigation files.

CGGTTS generates a CGGTTS file (all tracks / all satellites in view).

RAW generates a proprietary format file which includes both the code and phase measurements.

EL_MASK analyzes the dependence of the signal-to-noise ratio on azimuth and elevation and searches for obstacles around the antenna.

STAT provides statistics of available measurement data.

L3P_30s generates standard P3 data based on measurements taken with 30 s sampling period.

L3P_1s generates nonstandard P3 data based on measurements taken with 1 s sampling period. The fit algorithm is identical to the algorithm used in the classical CGGTTS protocol.

Prior to the start of the processing select:

- desired type of processing,
- date and time of the first observation to be processed (MJD or date in ISO format, UTC or GPS time),
- length of observation to be processed,
- period of observation (only for RINEX, RAW, and EL_MASK),
- satellites to be processed.

An e-mail announcement can be sent after the processing finishes. The e-mail address is to be set at the **Settings / Communication** page.

List of running processes is shown at the top of the page. A sequence number (0..99) which serves for identification of the resulting data, is assigned to every process. The processes can be stopped by the **Kill All** button. Resulting files can be downloaded at the **Control / Get File** page.

Get File

Resulting data files can be downloaded from this page. Every process generates a data file and a log file which includes a brief description of the process. Both files are identified by the process sequence number. Only files from last five processes are kept. Older files are automatically deleted.

In the case of RINEX, CGGTTS, L3P, and EL_MASK processes, a copy of the resulting data file with standard generic name is also generated. These files are not automatically deleted.

A copy of the latest CGGTTS file is also kept in the last_cggtts file. A copy of the latest L3P file is in the last_l3p file.

All files in the folder can be deleted using **Maintenance / Delete output data** button.

Maintenance

Field of buttons at this page enables one to start and stop the measurement firmware, set all the device settings to default values, delete all measurement data, delete all output data, delete the log file, and shut down the device. Once the device has been shut down, it can be turned on again only by the HW button on the front panel.

5.6 Display functions

Time Difference

This page displays the results of one-way measurement of the (Reference Time - GPS Time) difference.

The following data are displayed:

Time Difference - Graph of the last history of the time difference.

Current Time Difference - Last measured time difference.

Mean Time Difference - Average of time difference over history shown in the graph.

Linear Fit / Slope - Slope of the time difference estimated from linear fit over the last 24 hours.

Linear Fit / Current Time Difference - Current time difference estimated from linear fit over the last 24 hours.

Scale of the graph can be set at **Settings/ Device/ Graphs**.

CGGTTS Data

This page displays the latest CGGTTS and L3P files.

The following data are displayed:

Last CGGTTS Processing - Graph of the CGGTTS REFGPS data.

Last L3P Processing - Graph of the L3P REFGPS data.

Last Time Difference - Latest observed time difference.

Mean Time Difference - Average of time difference over history shown in the graph.

Linear Fit / Slope – Slope of the time difference estimated from linear fit over the history shown in the graph.

Linear Fit / Last Time Difference - Last time difference estimated from linear fit over the history shown in the graph.

Scale of the graphs can be set at **Settings/ Device/ Graphs**.

Diagnostics

This page displays the current diagnostic states and five last reported diagnostic events. Only the states and events tagged at **Settings / Device / Diagnostics / UI Ind.** are displayed. Each message consists of its importance category (I: information, W: warning, A: alert), time of the occurrence, and a brief description.

Satellites

Information about the satellites is displayed in the table. Satellites currently being received are marked as green. When only the C/A-code is being received, the satellite is marked as yellow. The "health" flag is indicated by red. Clicking on a table item opens a new window with a graph of the 1-day history of the parameter.

The following data are displayed:

PRN - Satellite number.

EL - Satellite elevation.

AZ - Satellite azimuth.

CNR C/A - Signal-to-noise ratio (C/A at L1).

CNR P1 - Signal-to-noise ratio (P at L1).

CNR P2 - Signal-to-noise ratio (P at L2).

Scale of the CNR graphs can be set at **Settings/ Device/ Graphs**.

Temperature

This page displays temperature in the receiver box and the thermostat heating power including graphs of their 1-day history:

Temperature - Temperature in the receiver box.

Heating - Percentage of the full heating of the thermostat.

Scale of graphs can be set at **Settings/ Device/ Graphs**.

Position

The page displays the currently measured X, Y, Z antenna position referenced to WGS-84 frame, as a result of autonomous (not differential) measurement.

Log

This page enables access to the log of diagnostic messages. Only the states and events tagged at **Settings / Device / Diagnostics / Log Entry** are recorded. The time order of the records shown in the log can be selected. The records can be filtered by a keyword.

Every diagnostic message consists of date/time of the event, category of importance (I – information, W – warning, A - alert), time of the occurrence, and a brief description. A message indicating the start or end of a state contains the letter S or E in addition.

5.7 Settings functions

Changes in settings are possible while the measurement is not running (states IDLE or WARM UP).

Site & Time Reference

This page allows all settings associated to the site and the time reference.

Site:

Site	- Identification of Site & Time Reference settings data.
Lab	- Laboratory name for CGGTTS file header (LAB) and RINEX file header (RUN BY, AGENCY).
Observer	- Observer name for RINEX file header (OBSERVER).
Marker	- Marker name for RINEX file header (MARKER NAME).
Marker #	- Marker number for RINEX file header (MARKER NUMBER).
Position	- Antenna position XYZ [m]. If not known, enter 0, 0, 0.
Frame	- Reference frame for CGGTTS file header (FRAME).
Elv. Mask	- Elevation mask in dependence on azimuth. Only measurements with elevation higher than the elevation mask are processed. EL_MASK processing function can be used to determine the elevation mask.

Input time reference:

Time Reference	- Time reference name for CGGTTS file header (REF).
Cable Delay	- Cable delay for CGGTTS file header (CAB DLY).

CGGTTS and L3P files:

File Name	- The laboratory code and the receiver identification (4 characters). The full CGGTTS file name consists of the letters 'GM' followed by these 4 characters, the first 2 digits of MJD of the start of the observation, dot, and the last 3 digits of the MJD. The full

L3P file name consists of the letters 'GZ' followed by these 4 characters, the first 2 digits of MJD of the start of the observation, dot, and the last 3 digits of the MJD.

Comment - Comment for the file header (COMMENTS). The maximum length is 60 characters.

RINEX files:

File Name - First four letters of RINEX file name. The full RINEX file name consists of these 4 letters, day of the year of the start of the observation, a file sequence number within the day, dot, year (last 2 digits), and the letter O or N for the observation or navigation file, respectively. If the file contains all existing observations of the day, the file sequence number is 0.

Comment - Comment for the file header (COMMENT). The maximum length is 60 characters.

Device

This page allows settings of the device operational parameters.

Device:

Device Name - Name of the device for identification of e-mail messages.

Trigger Level - Trigger level at the 1PPS input [V]. It can be any value from 0.0 to 2.5 V.

Monitoring:

Sampling Period - Sampling period of the monitoring.

Graphs:

Min Temperature - Minimum temperature in the graph at **Display / Temperature**.

Max Temperature - Maximum temperature in the graph at **Display / Temperature**.

Min Time Diff. - Minimum time difference in the graph at **Display / Time Difference**.

Max Time Diff. - Maximum time difference in the graph at **Display / Time Difference**.

Min CNR - Minimum CNR in the graph at **Display / Satellites**.

Max CNR - Maximum CNR in the graph at **display / Satellites**.

Diagnostics:

Events Configuration - List of diagnostic events is in the attachment II. Each event is processed depending on the following settings.

Cat - Category of importance (I - information, W - warning, A - alert) to be displayed in the event message.

UI Ind - If allowed, the event message is displayed in the User Interface.

Log Entry - If allowed, the event is recorded in the diagnostic log.

E-mail - If allowed, the event message is sent to the e-mail address.

States Configuration - List of diagnostic states is in the attachment III. Each state is determined by two events – the start and the end of the state. These two events are processed in dependence on the settings. The following must be set in addition to the above:

Start Delay - Minimum duration to start the state indication.

Stop Delay - Minimum duration to stop the state indication.

Parameters Configuration - List of diagnostic parameters is in the attachment IV. All these parameters are continuously monitored. When value of a parameter is out of the range, it is indicated like a state. The following must be set in addition to the above:

Lower Trsh - Lower bound of the parameter range.

Upper Trsh - Upper bound of the parameter range.

Communication

This page allows the settings of the e-mail address where messages will be sent to and the connection parameters for the connection to the servers where the files resulting from scheduler-started processing will be uploaded.

E-mail:

> **E-mail** – The address where all e-mail messages will be sent.

CGGTTS Data Storage:

The server to which the CGGTTS files resulting from a scheduler-started processing are uploaded.

> **Protocol** – The ftp, ftps, sftp, or fish protocol can be selected.
>
> **Host** – URL of the server including the path to the destination folder. For example:
>
> ftp.anyserver.org/path/destination.
>
> **User** – User name. Not mandatory.
>
> **Password** – Access password. Not mandatory.

RINEX Data Storage:

The server to which the RINEX files resulting from a scheduler-started processing are uploaded.

> **Protocol** – The ftp, ftps, sftp, or fish protocol can be selected.
>
> **Host** – URL of the server including the path to the destination folder. For example:
>
> ftp.anyserver.org/path/destination.
>
> **User** – User name. Not mandatory.
>
> **Password** – Access password. Not mandatory.

L3P Data Storage:

The server to which the L3P files resulting from a scheduler-started processing are uploaded.

> **Protocol** – The ftp, ftps, sftp, or fish protocol can be selected.
>
> **Host** – URL of the server including the path to the destination folder. For example:
>
> ftp.anyserver.org/path/destination.
>
> **User** – User name. Not mandatory.
>
> **Password** – Access password. Not mandatory.

6. Administration and access to data

The GTR50 application SW run under Linux operating system. If required, the output data can be accessed from a local console (when a keyboard and a display are connected) or remotely via SSH or SCP instead of the web based User Interface. A card with the factory default user name and password is attached. We recommend using the WinSCP client (www.winscp.com).

6.1 Output data

All the output data can be found in the folder: /opt/GTR50/data/user

Every measurement data processing generates a data file and a log file which includes a brief description of the process. Both files are identified by the process sequence number. Only files from last five processes are kept. Older files are automatically deleted. If you want to keep any of them, it must be copied outside the GTR50 or its name must be changed.

In the case of RINEX, CGGTTS, L3P, and EL_MASK processes, a copy of the resulting data files with standard names is also generated. These files are not automatically deleted. They can be manually deleted after they are archived.

A copy of the latest CGGTTS file is also kept in the last_cggtts file. A copy of the latest L3P file is in the last_l3p file.

6.2 Measurement data

All measurement data can be found in the folder: /opt/GTR50/data .

The measurement data are collected in hourly binary files with names GM*yymmddhh* where *yy* is year, *mm* is month, *dd* is day, and *hh* is hour of start of the measurement.

All collected GM files are kept till size of the measurement data is higher than allowed. The oldest GM files are being deleted after that. If required, the measurement data can be archived outside of the GTR50 for later processing.

6.3 User Interface access administration

The factory default username and password are as follows:
User = user, Password = user

New user or change of password: htpasswd /etc/gtr50passwd <user_name>

Delete of a user: Delete <user_name> line in /etc/gtr50passwd

7. Calibration of receiver

Following data are to be determined during the receiver calibration:

- correction of receiver chain delay,

- delay of antenna cable,

- P1-P2 and P1-C1 differential delays (only for double frequency receiver).

The calibration data are saved in the file: /opt/GTR50/data/config_lck. Their names are: Int_dly0, Cab_dly, Dif_dly, and AMR_cor. All the data are in nanoseconds.

7.1 Correction of receiver chain delay

The correction Int_dly0 is added to all measurement data. It is negative. The correction includes delay of the antenna, the antenna cable, and the receiver. It can be determined from comparison with a reference receiver. We recommend using of CGGTTS data from 1-day or longer measurement for the purpose. The standard ionospheric correction should be removed from the REFGPS data before they are used for the calibration.
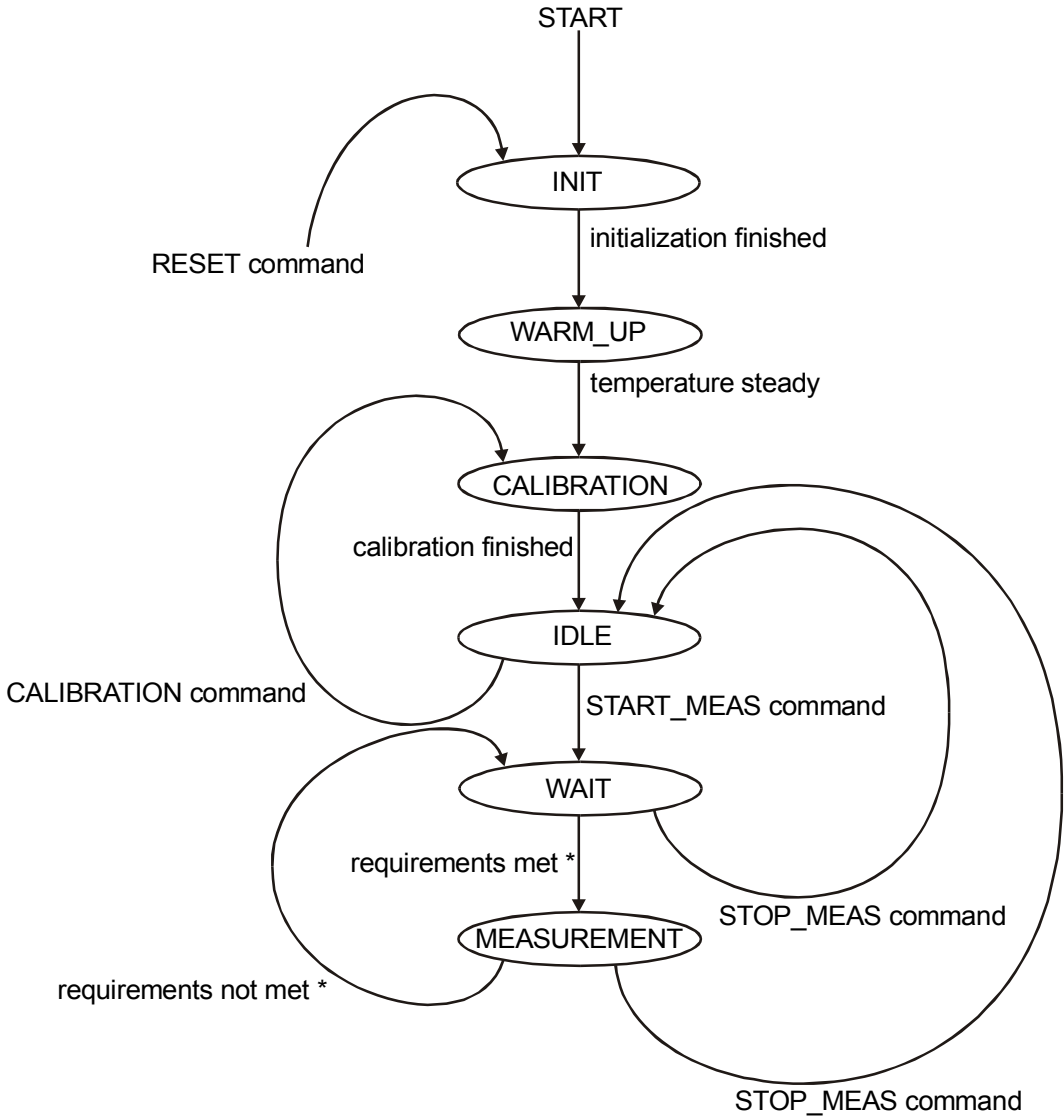
7.2 Cable delay

The antenna cable delay Cab_dly is used only in the CGGTTS file header. It has no influence on the resulting measurement data. The value is always positive.

7.3 Differential delays

The P1-P2 and the P1-C1 differential delays of the receiver must be determined. The Dif_dly reflects the P1-P2 differential delay. It is subtracted from all L1/L2 iono-delay measurements. The AMR_cor correction reflects the P1-C1 differential delay. It is used to keep consistent the L3P and the CGGTTS double frequency data. Both the corrections are also applied on the RINEX data to keep them consistent with other results. We recommend asking the manufacturer for support about calibration of these parameters at the address:
support@dicom.mesit.cz.

Attachment I: State diagram of the GTR50 operation

START

INIT

RESET command

initialization finished

WARM_UP

temperature steady

CALIBRATION

calibration finished

CALIBRATION command

IDLE

START_MEAS command

WAIT

requirements met *

STOP_MEAS command

MEASUREMENT

requirements not met *

STOP_MEAS command

* Requirements to start / continue measurement:
1. Appropriate input signals are connected.
2. The GPS receiver is in positioning mode for last 30 seconds.

Attachment II: List of diagnostic events

Event 1

Associated message: Initialization finished.

Description: The transition from the INIT state to the WARM_UP state.

Event 2

Associated message: Warm up finished.

Description: The transition from the WARM_UP state to the CALIBRATION state.

Event 3

Associated message: Calibration finished.

Description: The transition from the CALIBRATION state to the IDLE state after the Interval Measurement Unit passed the test. Results of the IMU test are added to the log entry:

Offset = DC offset at ADC input,
ADC_s = Standard deviation of noise at ADC input,
ADC_min = Minimum of noise at ADC input,
ADC_max = Maximum of noise at ADC input,
R_min = Minimum of the response at ADC input,
R_max = Maximum of the response at ADC input,
R_r = Standard deviation of noise in response at ADC input.

Event 4

Associated message: Calibration finished.

Description: The transition from the CALIBRATION state to the IDLE state after the Interval Measurement Unit has failed the test. The above results of the IMU test are added to the log entry.

Event 5

Associated message: Measurement request.

Description: The transition from the IDLE state to the WAIT state.

Event 6

Associated message: Start of calibration.

Description: The transition from the IDLE state to the CALIBRATION state.

Event 7

Associated message: Start of measurement.

Description: The transition from the WAIT state to the MEASUREMENT state.

Event 8

Associated message: Waiting for measurement has stopped.

Description: The transition from the WAIT state to the IDLE state.

Event 9

Associated message: Measurement interrupt.

Description: The transition from the MEASUREMENT state to the WAIT state. The measurement cannot continue any more.

Possible reasons:
The 1PPS input signal is not connected.
The GPS receiver does not provide continuously the positioning and timing data.

Event 10

Associated message: Measurement stopped.

Description: The transition from the MEASUREMENT state to the IDLE state.

Event 11

Associated message: Site parameters setting.

Description: Update of parameters from Settings / Site & Time Reference.

Event 12

Associated message: Device parameters setting.

Description: Update of parameters from Settings / Device.

Event 13

Reserved

Event 14

Reserved

Event 15

Associated message: Reset command, forced init.

Description: The transition to the INIT state caused by RESET command.

Event 16

Associated message: No response from IMU/0, forced init.

Description: The transition to the INIT state caused by watchdog.

Event 17

Associated message: No response from IMU/1, forced init.

Description: The transition from the CALIBRATION state to the INIT state caused by watchdog.

Event 18

Associated message: No response from IMU/1, forced init.

Description: The transition from the MEASUREMENT state to the INIT state caused by watchdog.

Event 19

Associated message: IMU measured wrong data.

Description: The transition from the MEASUREMENT state to the INIT state caused by reception of wrong data from the Interval Measurement Unit.

Event 20

Associated message: Frequency deviation, measurement interrupt.

Description: The transition from the MEASUREMENT state to the WAIT state caused by large frequency deviation of the Interval Measurement Unit internal reference oscillator.

Event 21

Associated message: Frequency jump, measurement interrupt.

Description: The transition from the MEASUREMENT state to the WAIT state caused by jump in frequency of the Interval Measurement Unit internal reference oscillator.

Attachment III: List of diagnostic states

State 1

Associated message: Antenna not connected.

Description: The DC supply current into the antenna is lower than 5 mA.

Possible reason: The antenna is not connected or the antenna cable is broken.

Note: This diagnostic state is not supported in current version.

State 2

Associated message: Antenna overcurrent.

Description: The DC supply current into the antenna is higher than 90 mA.

Possible reason: Short on the antenna cable.

Note: This diagnostic state is not supported in current version.

State 3

Associated message: Positioning not possible.

Description: The GPS receiver is not able to provide positioning and timing data.

Possible reasons:
The receiver has not received all necessary data yet.
Low number of satellites being received (<4).
The antenna is not connected or the cable is broken.

State 4

Associated message: 1PPS not connected.

Description: The device is waiting for measurement (WAIT state) and the 1PPS input signal is not present.

Possible reason: The 1PPS signal is not connected.

State 5

Associated message: 5/10 MHz not connected.

Description: The device is waiting for measurement (WAIT state) and the 5/10 MHz input signal is not present.

Possible reason: The 5/10 MHz signal is not connected.

State 6

Associated message: Temperature out of allowed range.

Description: Thermostat temperature is out of the range from 10 to 50°C. Operation of the thermostat is suspended.

Possible reasons:
Too high or low ambient temperature.
Malfunction of the thermostat.

Attachment IV: List of diagnostic parameters

Parameter 1

Associated message: Temperature deviation out of range.

Description: Deviation from the nominal temperature of the thermostat.

Unit: degree of Celsius.

Possible reasons:
The thermostat is not in steady state yet.
The ambient temperature is too high or too low.

Parameter 2

Associated message: Low number of sats for C/A measurement.

Description: Number of satellites available for C/A measurement.

Parameter 3

Associated message: Low CNR of C/A signal.

Description: CNR of the strongest C/A signal.

Unit: dBHz

Parameter 4

Associated message: Low number of sats for P1 measurement.

Description: Number of satellites available for P1 measurement.

Parameter 5

Associated message: Low CNR of P1 signal.

Description: CNR of the strongest P1 signal.

Unit: dBHz

Parameter 6

Associated message: Low number of sats for P2 measurement.

Description: Number of satellites available for P2 measurement.

Parameter 7

Associated message: Low CNR of P2 signal.

Description: CNR of the strongest P2 signal.

Unit: dBHz

Parameter 8

Associated message: Time difference out of allowed range.

Description: Measured time difference referenced to GPS time.

Unit: nanosecond

Attachment V: RAW data format

ITEM	DESCRIPTION	UNIT	COMMENT
PRN	Satellite number	-	
MJD	MJD of measurement	day	
UTC	UTC of measurement	hhmmss	
EL	Satellite elevation	deg	
AZ	Satellite azimuth	deg	
CNR	Signal-to-noise ratio	dBHz	
IOE	Issue of Ephemeris data	-	
REF-GPS code	Time deviation from code measurement	ns	1)
REF-GPS phase	Time deviation from phase measurement	ns	1), 2)
SV_COR	Satellite clock correction	ns	
TROPO	Tropo-delay	ns	
IONO	Iono-delay	ns	

Comments:

1) (Reference time – GPS time) difference measured through specific satellite. Satellite clock correction and tropo/iono delay corrections are included.

2) Phase measurement ambiguity is not solved.