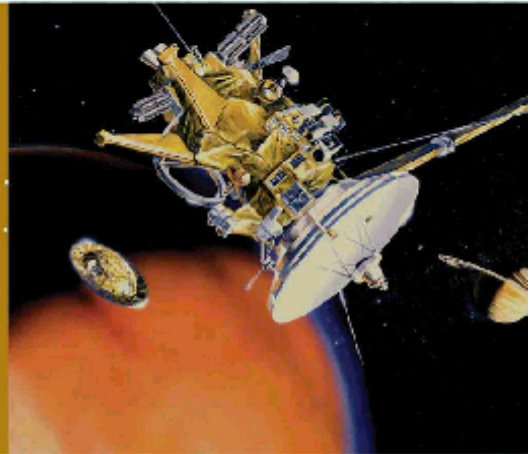




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REV 1.0

GPS Receiver/CT-5510 Application Note Memory System (NMEA Commands)

This document describes the overall memory system structure of the CT5510, it's logging system, and the applications using NMEA commands.

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Overview

The data logging capability of CT5510 enables the storage of time and location information in the built-in flash memory, while the module is navigating.

When logging, the receiver periodically stores new “log points”, which consist of the current navigation information. There may be several different logs in the module’s memory at the same time, so that different routes can be stored. The user may upload the logged data from the module to a PC or other host devices for observation and processing.

Users may choose how much information is stored along each point, affecting the number of log points stored in the available memory. Each log point may contain the following navigation information or a subset of them:

- Latitude+longitude coordinates with a resolution of 0.0000001 degrees (about 1 cm on earth surface).
- Altitude with a resolution of 1 meter.
- Time with a resolution of 1 second.
- Horizontal and vertical velocity with a resolution of 0.01 m/s, direction of movement with a resolution of 0.01 degrees.
- Fix quality information like the number of satellites used in a fix, 2D/3D fix indication, HDOP value with a resolution of 0.1 units.

User may also set various conditions for how often new data points are added to the log:

- Minimum and maximum time may elapse between logging points.
- Minimum and maximum distance the receiver may move between logging points.

Depending on the logging settings, between 14000 to 39000 log points can fit into the memory of a standard CT5510 module with 8Mbits of flash memory.

The logging capability is not available in CT5510 modules with 4Mbit flash memory.

QUICK START

This chapter describes the quick steps to start using the logging system.

During these steps, users may use either the NMEA protocol to communicate with the CT5510 module.

Step 1: Logging settings

The logging filter settings define how often new points are added to the log and how much information is saved at each log point.

The default settings are that a new point is added to the log if the receiver has moved at least 15 meters AND at least 5 seconds have elapsed since the previous point was added to the log. According to the default settings, CT5510 stores time and latitude & longitude coordinates at each point.

Step 2: Logging start mode

By default, logging is disabled.

To activate logging, set the logging start mode to “3”. In this mode, a new log is created and logging is started each time when navigation is started. The old logs are stored in the memory.

Using NMEA protocol

The logging start mode is set to “3” with the following command:

```
$PFST,LOGMODE,3<CR><LF>
```

NOTES:

- When using NMEA, navigation has to be stopped before setting the logging start mode.
- In the logging start mode “3”, logging is started each time when navigation is started. To disable logging, the start mode has to be set to zero (see step 6 below)
- The logging settings are stored in flash memory and can thus persist resetting the module and switching off the power.

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Step 3: Start navigation

When the logging settings have been configured as described in the previous sections, logging starts automatically as navigation is started.

Navigation is started by:

- Giving the NMEA command *\$PFST,START<CR><LF>*
- Resetting the CT5510 module (assuming that the auto-start after power-up is enabled [on by default]).

Step 4: Downloading logged data

After the CT5510 has been navigating and logged, the logged data can be downloaded to PC in the following ways:

Using NMEA protocol

1. Stop navigation to finish the logging session.
2. Read the number of logs that are in CT5510's memory, as new logs are created each time when logging is started with the given settings. The number of logs can be displayed with the *\$PFST,LOGNUM* command, e.g.
\$PFST,LOGNUM<CR><LF>
The system responds with a message containing the number of logs, e.g. *\$PFST,LOGNUM,1*32*
This shows that there is one log currently in the memory.
3. The logged data can be outputted using the command "*\$PFST,LOGGET,<N>*", where *<N>* is the log number of interest. This command outputs the logged data in standard NMEA format.

For example, the following command will display all data in log 1:

\$PFST,LOGGET,1<CR><LF>

NOTE: If there are plenty of data in the log, it may take some time to output all the data as NMEA messages. To speed-up the operation, it is advised to increase the NMEA port speed or disable some of the NMEA messages.

Step 5:Erasing logs

CT5510's logging system doesn't automatically delete old log data but always creates new logs or appends data to the previous log. While it's often advantageous to have several logging sessions in memory at the same time, eventually the memory will be filled up if old log data isn't erased.

Using NMEA protocol

The log data is deleted with the following command:

```
$PFST,LOGCLEAR<CR><LF>
```

Step 6:Disable logging

When the logging system is configured as described above, a new log is created each time when navigation is started. To stop using the logging capability, the logging can be disabled by setting the start mode to zero.

Using NMEA protocol

The logging start mode is set to zero with the following command:

```
$PFST,LOGMODE,0<CR><LF>
```

Summary

This chapter describes the quick steps for using the CT5510 logging system.

1. [No action needed at first step if the default logging settings are ok.]

2. Set logging start mode to "3",

```
NMEA      : $PFST,LOGMODE,3<CR><LF>
```

3. Start navigation,

```
$PFST,START<CR><LF>
```

4. Download logged data,

```
NMEA      : $PFST,LOGGET,1<CR><LF>
```

5. Erase log data,

```
NMEA      : $PFST,LOGCLEAR<CR><LF>
```

6. Disable logging,

```
NMEA      : $PFST,LOGMODE,0<CR><LF>
```

LOGGING SETTINGS

This chapter describes the settings that affect the logging system. These settings can be configured by using the NMEA protocol.

The log settings are stored in flash memory and thus they will stay valid until the user reconfigures them.

- **Logging filters**

Logging filters control how often and the amount of time that is stored into the log. Users may affect the amount of data, and span of time or distance that can fit into the available memory by using these settings.

- **Position and interval limits**

Users may define the minimum and maximum time intervals, as well as the movement limits between the storing points:

- *Minimum interval time (seconds)*: A new point won't be added to a log if the time elapsed since the previous log point is less than the minimum interval time set. An exception is that if the maximum movement limit is exceeded, then a new point is logged.
- *Maximum interval time (seconds)*: If the time elapsed since the previous log point is longer than the maximum interval time set, a new point is then logged. The maximum limit is ignored if it's set to zero.
- *Minimum movement (meters)*: A new point won't be added to a log if the distance travelled from the previous log point is less than this limit. An exception is that, if the maximum interval time from the previous log point is exceeded, then a new point is logged.
- *Maximum movement (meters)*: If the distance travelled from the previous log point is equal to or more than the maximum value set, a new point is logged. If the maximum value is set to zero, the maximum limit isn't used.

In pseudo-code, the limit rules are evaluated as follows:

```
if ((time >= min_interval) and (distance >= min_move)) then
    log;
else if ((time >= max_interval) or (distance >= max_move))
then
    log;
else
    dont_log;
```

Default settings for the filter limit are as follows:

```
min.interval    = 5
max.interval    = 0 (max. limit not used)
min.move        = 15
max.move        = 0 (max. limit not used)
```

According to these default settings, a new point is logged when at least 5 seconds has elapsed from the previous point and the distance from the previous point is at least 15 meters.

Example:

Assume that the limit settings are defined as follows:

```
min.interval    = 5
max.interval    = 60
min.move        = 15
max.move        = 100
```

In this case a new point is logged when at least 5 seconds has elapsed from the previous point and the distance from the previous point is at least 15 meters. A new point is also logged when at least 60 seconds has elapsed since the previous point or the distance from the previous point is 100 meters or more.

■ Logging data level

Logging data level controls how much information is stored at each log point. The data level directly affects how much space each log point requires, and consequently how many log points can fit in memory.

Data-Level	Size per point (16-bit words)	Information stored per point
1	4	Latitude & Longitude coordinates
2	6	Lat&Lon + GPS Time
3	7	Lat&Lon + Time + Altitude
4	8	Lat&Lon + Time + Alt + Fix information (i.e. number of satellites used for fix, 2D/3D fix indicator, HDOP value)
5	10	Lat&Lon + Time + Alt + FixInfo +Horizontal Velocity + Direction of movement
6	11	Lat&Lon + Time + Alt + FixInfo + HVel +Dir + Vertical velocity

Configuring the filter settings

Using NMEA: Filter settings are configured with the command *\$PFST,LOGSETTING*.

Start modes

Logging start mode controls if and how CT5510 should start logging when GPS navigation is started. Depending on the start mode, the system may create a new log each time when logging is started or continue using the old log so that new log points are appended after the old points.

The start mode also controls if logging starts only once, at the next time when navigation starts, or continuously so that logging always starts when navigation starts (until again disabled by user).

Available start modes are described in the following table:

Start Mode	Description
0	Logging disabled (default).
1	Logging is started so that a new log is created once when navigation is started for the next time. On the consecutive navigation starts after that logging won't be used.
2	The previous log is continued once when navigation is started for the next time. On the consecutive navigation starts after that logging won't be used.
3	Logging is started so that a new log is created each time when navigation is started. Logging is active until user changes the start mode again.

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4	The previous log is continued each time when navigation is started. Logging is active until user changes the start mode again.
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Using NMEA, logging start mode is configured with the command *\$PFST,LOGMODE*.

dLog name

The system stores a log name which has a user-given log name text string and the index number of the log. The default log name is “Log”.

Using NMEA, log names can be configured with the command *\$PFST,LOGNAME*.

DOWNLOADING LOGGED DATA TO HOST

The logged data can be downloaded to the host device using one of these alternative approaches:

- Using the NMEA protocol. In this approach, the CT5510 outputs the logged data to the NMEA serial port as standard NMEA messages.
- Using the iTalk protocol. The binary iTalk protocol offers an efficient way for downloading the logged data to applications.

Downloading log-data using NMEA

CT5510 can output the log-data through the NMEA serial port in standard NMEA message format. The users may then capture and parse the outputted messages from the serial port by his/her own means.

Depending on the data level settings that were used when logging the data, it may be possible that, not all the data required for generating complete NMEA messages are available; in such case, the missing data fields are replaced with zeros.

The output is activated with the NMEA command *\$PFST,LOGGET*

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NMEA PROTOCOL SUPPORT

CT5510 has a set of NMEA commands that can be used to control the logging system. On the table below is a summary of the available NMEA logging commands.

Command	Description
LOGCLEAR	Erase log data from CT5510's memory
LOGFREE	Calculate how much space is left for log data
LOGGET	Output logged data as standard NMEA messages
LOGINFO	Show log information
LOGMODE	Set logging start mode
LOGNAME	Set log name
LOGNUM	Show how many logs are currently stored in the memory
LOGSETTING	Sets the logging settings
LOGSTOP	Stop logging without stopping navigation

USAGE CONSIDERATIONS

1.1 Sleep mode

Sleep mode (power-down mode) doesn't affect the logging system. If logging is active when going to sleep mode, logging is resumed as the module wakes up and first valid fixes are received.

1.2 Power-down

The CT5510's logging system can sustain sudden power losses without major affects; however, it's suggested to stop navigation properly prior to switching off the power or otherwise some of the most recently logged data may be lost and as CT5510's logging system performs automatic recovery checks due to the power loss, the next power-up time may be longer.

It's also possible that CT5510's logging system may occasionally unable to continue the previous log (logging start modes 2 and 4) after sudden power-losses. In such cases, the logging system creates a new log and continues using that one as usual.

1.3 Memory full

CT5510's logging system automatically ceases from logging shortly before the flash memory gets totally full. It's thus quite normal for the logging to stop while enough flash space for several dozen more logs seems to be available.

This early stopping is implemented to prevent problems with logging settings and book-keeping information due to the lack of available memory.