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1.0 Cautions

GPS (Global Positioning System) is a satellite-based navigation system. In an unobstructed clear view of the sky, GPS works anywhere in the world, 24 hours a day.

GPS is developed and operated by the government of United States. Under the policy of the government, the degradation in accuracy shall occur without prior warnings, and sometimes satellites don't transmit signal due to adjustment, test, and orbital revision.

Please be aware that the performance of the GPS receiver module does not warrant against the above factors.

(Position Accuracy)

Position data and position accuracy are affected or degraded by the satellite geometry, electric magnetic interference, and multipath.

(Equipment)

The high frequency noise will interfere with signal receiving. The high frequency noise within the receiver frequency band, 1575Mhz \pm 10MHz, will affect the receiver quality. Also, because of the mixer and modulation, the low frequency noise will be increased by several times. If this increased frequency drops into the 1575MHz \pm 10MHz band, it will also affect the receiver quality.

(Warranty)

If the product fails within one year after the date of delivery while it has been used properly it will be replaced or repaired free of charge.

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2.0 Absolute Maximum Ratings

Symbol	Parameter	Min	Typ	Max	Units
V_{dd}	Supply Voltage	4.5	5.0	5.5	V
V_I	Input Voltage	- 0.3		V_{dd}+0.3	V
V_O	Output Voltage	- 0.3		V_{dd}+0.3	V
T_A	Ambient Temp. (Power applied)	- 40		95	°C
T_{STG}	Storage Temp.	- 40		95	°C

3.0 Normal Operating Conditions

Symbol	Parameter	Min	Typ	Max	Units
V_{dd}	Voltage	4.5	5.0	5.5	V
V_{ddn}	Supply Voltage Noise			50	mV_{P-P}
P_w	Power Dissipation		350	400	mW
T_{op}	Operational Temp. (GPS)	-30		70	°C
	Operational Temp. (USB Cable)	-10		70	°C

4.0 Specification

Satellite Tracking		12 Parallel channels
RF input	Center frequency	1575.42MHz L1 band, C/A code
	Characteristics impedance	50 ohm
	Signal sensitivity	-145 dBm or less
Positioning system	Default	WGS-84
	Software Selectable	All major coordinate systems
Positioning accuracy	Position	10m CEP(50%)
	Velocity	0.2m/s (50%)
Positioning condition		A) DOP limit: 3D: PDOP < 12 2D: HDOP < 6 B) Elevation mask: 5°
Follow-up performance	Acceleration	4G
Navigation Update Rate		1second(Default)
Navigation method		All-In-View solution 2-Satelite solution
Operation Temperature(GPS)		-30°C to 70°C
Operation Temperature(USB Cable)		-10°C to 70°C
Storage Temperature		-40°C to 95°C

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5.0 Time To First Fix (TTFF)

Assumes previously listed navigation conditions and 8 satellites in view

TTFF	Typ	Units
Hot Start (time, position, valid ephemeris, and valid almanac)	12	seconds
Warm Start (time, position, no ephemeris, and valid almanac)	35	seconds
Cold Start (time, position, no ephemeris, and valid almanac)	50	seconds

The G-mouse has to establish location fix before accurate time information can be provided.

6.0 Interface

I/O connector (Power supply, serial data) USB

7.0 Communication Specification

Communication method
Transfer rate input/output

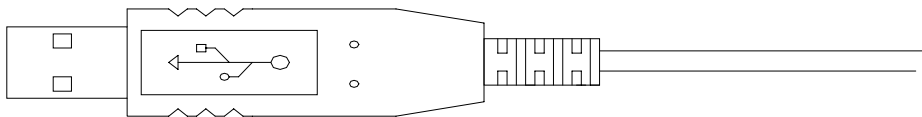
Start-stop synchronization
2400/4800/9600/19200/115200
bps NMEA (Default 4800)
TTL
ASCII
NMEA

Logic levels
I/O code
Communication format

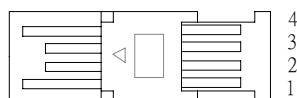
8.0 I/O Connector Pins

Pin Configuration

Pin No.	Symbol	I/O	Description
1	Vdd	-	Main power input.
2	USB_D+	O	TX
3	USB_D-	I	RX
4	GND	-	Ground



CN1



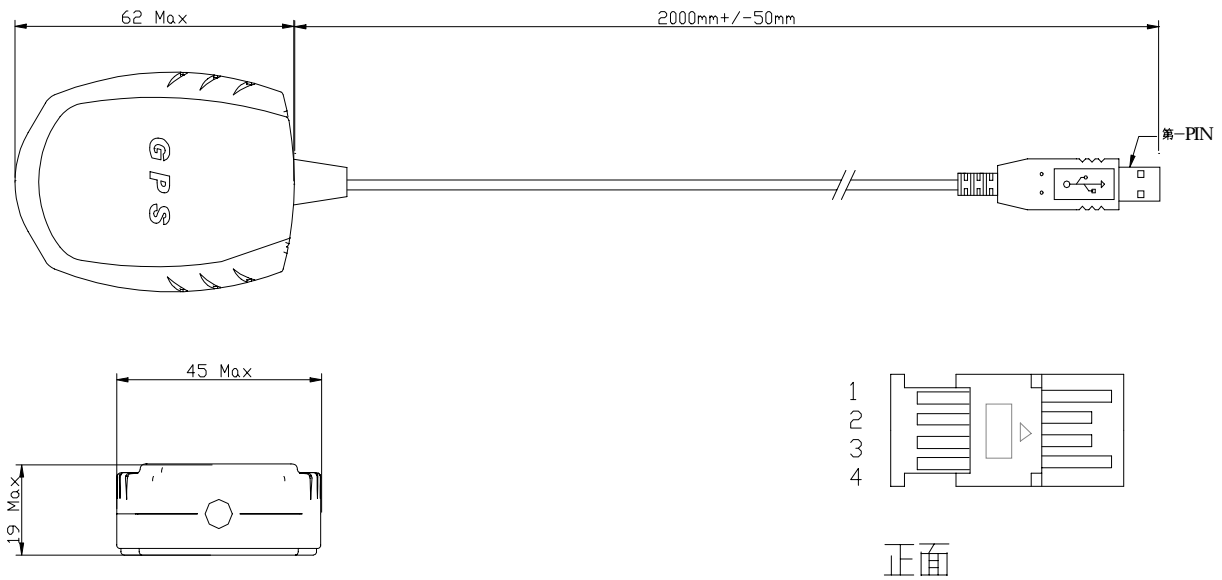
正面

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9.0 Electrical Characteristics **Vdd=5.0V**

Item	Symbol	Parameter	Min	Typ	Max	Units
Vdd		Condition Voltage		5.0		V
Input Voltage	V _{IH}	Input signal high level	0.7V _{dd}			V
	V _{IL}	Input signal low level			0.3V _{dd}	V
Output Voltage	V _{OH}	Output signal high level I _{OH} = -1.0mA	3.5			V
	V _{OL}	Output signal low level I _{OL} = 1.6mA			0.4	V
Schmitt Trigger Threshold Voltage	V _{t-}	Negative going	0.8			V
	V _{t+}	Positive going			2.0	V

10.0 Dimension



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11.0 NMEA Protocol

NMEA COMMANDS

This chapter describes the supported NMEA commands.

11.1 General NMEA commands

The following sections introduces the general-purpose NMEA commands the basic GM-42201 operations.

11.1.1 START – Start Navigation

Commands GM-42201 to start navigation. The command has no effect if called while GM-42201 is already navigating. After the start command has been given, it takes some time for GM-42201 to acquire satellites, gather data from the signal and calculate a first fix.

\$PFST,START,<startmode>

<i><Start mode></i>	<p>Navigation start modes:</p> <ul style="list-style-type: none"> 0=Auto start. Always uses the fastest possible start mode (1-4). Default value. 1=Force cold start. Module will behave as if no valid ephemeris or PVT data were available. 2=Request warm start. 3=Request hot start. Requires RTC time, valid ephemeris and PT data. Calculates a fix as soon as PS time is acquired from the GPS signal. 4=Request quick start. Requires RTC time and recent ephemeris. Assumes that RTC time is very accurate and doesn't wait for GPS time. <p>Notice that if the host requests faster start mode than possible (e.g. hot start when there is no ephemeris data available) start mode 0 will be used.</p> <p>RTC time is available if the module has already been navigating after the previous power-up, or if the time has been given by using the \$PFST, INITAID command.</p> <p>Valid ephemeris data is available if the module has been navigating within the last two hours and the navigation has been stopped properly by giving the \$PFST, STOP command.</p>
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11.1.2 STOP – Stop Navigation

Commands GM-42201 to stop navigating and enter the idle state. While in idle state, the GM-42201 receiver doesn't navigate but still accept commands., less power is consumed in the idle state than in the navigation state; however, remarkably more than in the power-down mode. This command also stores the "LastKnownGood" fix, ephemeris and almanac data in flash memory.

\$PFST,STOP,<1|0>

<1|0> 1 to save, 0 not to save "LastKnownGood" fix, ephemeris and almanac data to flash memory.

11.1.3 ODO - Odometer

This message displays the distance traveled by the receiver. The odometer distance is set to zero at module reset, and increasing as it moves.

\$PFST,ODO,<distance>

<Distance>	New odometer distance setting. If it is omitted, the odometer distance reading is displayed.
------------	--

11.1.4 SW – GM-42201 software revision

Shows the firmware revision of the GM-42201 module.

\$PFST,SW, < revision>

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11.2 Configuration commands

The following sections introduce the commands used for controlling the behavior of GM-42201.

11.2.1 NMEA – NMEA Serial Communication

Sets the NMEA message mask and NMEA serial port communication speed. This message mask defines which of the NMEA messages are being outputted.

\$PFST,NMEA,<mask>,<speed>

<Mask>	<p>NMEA messaging mask bitmap in hexadecimal notation. If it's desired to change only the speed while keeping the old message mask, this parameter may be omitted and use “,” instead.</p> <p>Mask bits for message are defined as follows:</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Message</th> <th>bit</th> </tr> </thead> <tbody> <tr><td>GSV</td><td>0x0001</td></tr> <tr><td>GSA</td><td>0x0002</td></tr> <tr><td>ZDA</td><td>0x0004</td></tr> <tr><td>PPS</td><td>0x0010</td></tr> <tr><td>FOM</td><td>0x0020</td></tr> <tr><td>Reserved*</td><td>0x0040</td></tr> <tr><td>GLL</td><td>0x1000</td></tr> <tr><td>GGA</td><td>0x2000</td></tr> <tr><td>VTG</td><td>0x4000</td></tr> <tr><td>RMC</td><td>0x8000</td></tr> </tbody> </table> <p>I.e. to allow GLL and RMC messages one would set mask as $0x1000 + 0x8000 = 0x9000$. See examples below.</p> <p>Note that hexadecimal digits A, B, C, D, E and F must be in capital letters.!</p> <p>* Enables a message used for special purposes.</p>	Message	bit	GSV	0x0001	GSA	0x0002	ZDA	0x0004	PPS	0x0010	FOM	0x0020	Reserved*	0x0040	GLL	0x1000	GGA	0x2000	VTG	0x4000	RMC	0x8000
Message	bit																						
GSV	0x0001																						
GSA	0x0002																						
ZDA	0x0004																						
PPS	0x0010																						
FOM	0x0020																						
Reserved*	0x0040																						
GLL	0x1000																						
GGA	0x2000																						
VTG	0x4000																						
RMC	0x8000																						
<SPEED>	Communication speed. Either 1200, 2400, 4800, 9600,19200, 57600 or 115200.																						

NOTE:

Using message mask FFFF (command *\$PFST,NMEA,FFFF*) is not recommended. Although it may be used to turn on all messages, the side effect of this would be that all new messages in future GM-42201 versions will also be turned on. The following messages are enabled by default: GGA, RMC, GSA, GSV.

NOTE:

NMEA Serial port settings other than speed cannot be changed. The settings for the port are:

- Default speed 4800 bps
- No parity (cannot be changed)
- 8 data bits (cannot be changed)
- 1 stop bit (cannot be changed)

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NOTE:

In order to preserve this setting after reset or power-up, the new setting has to be stored in flash memory by using the \$PFST,STORE command (only GM-42201 modules).

11.2.2 AUTOSTART – Set Autostart Mode

Defines if GM-42201 automatically starts navigation when power is turned on or GM-42201 is reset.

\$PFST,AUTOSTART,<1/0>

<1/0>	1 to enable, 0 to disable autostart.
-------	--------------------------------------

NOTE: In order for this message to have an effect, the new setting has to be stored in flash memory by using the \$PFST,STORE command.

NOTE: Since GM-42201 doesn't save parameters in non-volatile memory, AUTOSTART command has no effect in GM-42201.

11.2.3 CONF – Set configuration parameters

This command is used for setting the configuration parameters of GM-42201.

\$PFST,CONF,<ID>,<VALUE>

<ID>	Configuration parameter ID number. See the table below for possible values.
<VALUE>	New value for the parameter. If omitted, the command shows the current value of the configuration parameter.

Available configuration parameter ID's are:

Param ID	Param. Type	Default value	Description
1	BOOL	1	Position pinning on/off (1=on)
3	BOOL	1	Velocity smoothing on/off
4	BOOL	1	Position smoothing on/off
10	BOOL	1	Carrier smoothing on/off
17	BOOL	0	Route nav- & msg-task messages to host (enables calculating the navigation fix in host)
45	WORD	12	Number of receiver channels
47	BOOL	0	Disable fast search (=> uses slower but more sensitive search mode)
48	WORD	7000	Acq search window width (Hz, from middle of the window)
50	DOUBLE	5	Timeout for resetting the post filters
51	DOUBLE	0.4	Coefficient for position smoothing, high
52	DOUBLE	0.12	Coefficient for position smoothing, low
53	DOUBLE	0.0001	Velocity filter coefficient, low limit
54	DOUBLE	0.5	Velocity filter coefficient, high limit

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55	DOUBLE	3.0	Pinning lag criteria (meters). In pinning mode, the position may lag behind the actual position by this amount.
59	DOUBLE	1.0	Pinning velocity limit. Goes to pinning mode if velocity is below this limit.
70	DOUBLE	50	FOM limit. Fix is marked invalid if FOM is larger than this value.
71	DOUBLE	22	HDOP limit. Fix is marked invalid if HDOP is larger than this value.

NOTE: In order to preserve this setting after reset or power-up, the new setting has to be stored to flash memory by using the *\$PFST,STORE* command (only GM-42201 modules).

11.2.4 DATUM – Set Local Coordinate System

Selects the local coordinate system. After this command, the GM-42201 will return positions in the selected coordinate system.

\$PFST,DATUM,<datum_id>

<Datum_id>	Coordinate system id. See appendix for supported DATUM id's.
-------------------------	--

NOTE: In order to preserve this setting after reset or power-up, the new setting has to be stored to flash memory by using the *\$PFST,STORE* command (only GM-42201 modules).

11.2.5 FIXRATE – Set Fixrate

Defines how often GM-42201 should acquire navigation fix and thus output the NMEA messages.

\$PFST,FIXRATE,<fixrate>

<Fixrate>	Number of seconds to between navigation fixes
------------------------	---

NOTE: In order to preserve this setting after reset or power-up, the new setting has to be stored to flash memory by using the *\$PFST,STORE* command (only GM-42201 modules).

11.2.6 SYNCMODE – synchronous NMEA output mode

Enables or disables the synchronous NMEA output mode. In the synchronous output mode, all the enabled NMEA navigation messages are outputted approx. once per second, regardless of the availability of a valid navigation fix. The synchronous mode is enabled by default.

\$PFST,SYNCMODE,<mode>

<Mode>	Set synchronous mode on or off, 0 = off, 1 = on (default).
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NOTE: In order to preserve this setting after reset or power-up, the new setting has to be stored to flash memory by using the *\$PFST,STORE* command (only GM-42201 modules).

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11.2.7 STORE – Store Current Parameter Set

Stores the current parameter set in GM-42201's flash memory. These parameters include those that are defined by the commands, ALTAID, AUTOSTART, CONF, CABLEDEL, DATUM, FIXRATE, NMEA, PPSMODE, PULSEPOL, PULSELEN, SETLIMIT, SURVEYLEN, and SYNCMODE.

\$PFST,STORE

NOTE: Navigation has to be stopped before giving this command.

NOTE: GM-42201 doesn't store configuration parameters in flash memory, and thus this command doesn't have any effects on the GM-42201 modules. For GM-42201, the preferred way is to set parameters each time, when the module is reset or switched on.

11.2.8 RESETDATA

Erases the navigation data stored in the flash memory, i.e. erases the last good known navigation fix, ephemeris, almanac and UTC/Ionosphere model data. The module has to be reset after this command to abandon all the above data; otherwise, some of the data may still reside in RAM memory.

\$PFST,RESETDATA

NOTE: Navigation has to be stopped before giving this command.

NOTE: This command doesn't affect logged data. Log data is cleared with *\$PFST,LOGCLEAR* command.

11.2.9 RESTORE – Restores Default Parameter Set

Restores factory default parameter set.

\$PFST,RESTORE

NOTE: Navigation has to be stopped before giving this command.

NOTE: GM-42201 doesn't store configuration parameters to flash memory, and thus this command is irrelevant with GM-42201 module.

NOTE: This command doesn't affect the last good navigation fix, ephemeris, UTC/ionosphere model data or log data. Navigation, ephemeris and model data is erased with the *\$PFST,RESETDATA* command. Log data is cleared with the *\$PFST,LOGCLEAR* command.

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11.3 Navigation Aiding Commands

The following sections introduce the commands that provide the GM-42201 receiver with additional data, which may be helpful for starting and during navigations.

11.3.1 INITAID – Initial position and time aiding

Gives the GM-42201 module the current position and time information for aiding the navigation startup. Setting this information before navigation starts with the *\$PFST,START* command reduces the time required for finding the satellites, and receiving the first valid navigation fix.

If the position isn't known, the initial time may also be given alone by omitting the position parameters, i.e. using the command with only the two first parameters. The altitude information is not critical and can be set to zero (i.e. mean sea level) if not known.

NOTE: Even when INITAID is being used, the GM-42201 module reports navigation data of the previous actual navigation fix until a new fix is acquired, not the position and time data given in the INITAID command.

\$PFST,INITAID,<time>,<date>,<lat>,<N/S>,<long>,<E/W>,<altitude>

<Time>	UTC time in “hhmmss.dd” format, hh = hours (2 digits), mm = minutes (2 digits), ss.dd = seconds with two decimals (2+2 digits).
<Date>	UTC date in “ddmmyy” format, dd = day (2 digits), mm = month (2 digits), yy = year (2 digits).
<Lat>	Latitude in degrees and minutes in “xxmm.dddd” format, xx = degrees (1-2 digits), mm.dddd = minutes with four decimals (2+4 digits).
<N/S>	Either a character N or S (N = north, S = south).
<Long>	Longitude in degrees and minutes in “yyymm.dddd” format, yyy = degrees (1-3 digits), mm.dddd = minutes with four decimals (2+4 digits).
<E/W>	Either a character E or W (E = east, W = west).
<Altitude>	Altitude from the sea level in meters (1-5 digits).

11.3.2 ALTAID – Set the altitude aiding mode

Sets or disables the altitude aiding mode, where the navigation is assisted by using the given altitude value or an altitude value from a previous fix. Altitude aiding enables a navigation fix with fewer than four satellites, and as a matter of fact altitude aiding is used only if there are four or less satellites visible. Note that the aided altitude is used as an additional observation and the altitude is still calculated, not fixed to the given or aided altitude.

Altitude aiding commands can be given before starting or during the navigation. The altitude aiding mode is reset to “no altitude aiding” when navigation is stopped.

By default, the altitude aiding mode is disabled.

\$PFST,ALTAID,<mode>,<altitude>

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<Mode>	A numeric value indicating the new altitude aiding mode: 0: No altitude aiding (default) 1: Altitude hold mode: Use an altitude from the previous fix 2: External altitude mode: Use constant altitude given in the <altitude> parameter.
<Altitude>	Constant altitude in meters above the sea level, used in altitude aiding mode 2. This parameter is ignored in other modes. The constant altitude is subject to the altitude limits as defined in the command <i>\$PFST, SETLIMITS</i>

11.3.3 SETLIMIT – Set limits for altitude, velocity and acceleration

Sets the upper limits for altitude, velocity and acceleration parameters that the GM-42201 navigation subsystem accepts for a valid fix. Setting realistic, lower-than-default limits for these parameters hastens finding a valid navigation fix.

\$PFST,SETLIMIT,<altitude>,<velocity>,<acceleration>

<Altitude>	Maximum value for altitude (meters).
<Velocity>	Maximum value for velocity (m/s).
<Acceleration>	Maximum value for acceleration (m/s ²).

The GM-42201 module checks the given parameters values against fixed upper limits for each of these parameters (same as the factory defaults, see below), thus the user cannot set the parameters beyond these values.

If necessary, the <altitude>, <velocity> and <acceleration> parameters may be omitted. If all the three parameters are omitted, the command displays the current maximum limit values.

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11.4 Logging Commands

The following sections introduce commands related to the CT5501 logging system.

11.4.1 LOGCLEAR – Clear log data

Erases logs in CT5501's memory.

\$PFST,LOGCLEAR,<MODE>

<MODE>	<p>“Clear” operation.</p> <p>0 - Reclaim the flash file system only. Doesn't delete any logged data, only frees up data clusters that have been deleted but not freed yet.</p> <p>1 - Delete log data (default). Deletes logged data but keeps the current logging settings.</p> <p>2 - Format the flash file system. Formats the file system used by the logging system. Not recommended for normal use, useable only for recovering from an extreme system disaster.</p>
--------	--

11.4.2 LOGFREE – Amount of free space for log data

Calculates how much space is available for log data.

\$PFST,LOGFREE

This command outputs the amount of free space in the reply message:

*\$PFST,LOGFREE,<WORDS>,<ITEMS>*hh*

Where <WORDS> is the amount of free space in 16bit words and <ITEMS> is how many log items fit into the free space with the current logging settings.

11.4.3 LOGGET – Output logged data

Output logged data items. This command outputs the logged data in standard NMEA format messages according to the current NMEA settings.

\$PFST,LOGGET,<LOGNUM>,<FIRSTITEM>,<NUMITEMS>

<LOGNUM>	Log number.
<FIRSTITEM>	(optional) The first item that is outputted. If omitted, starts from the first item of the log.
<NUMITEMS>	(optional) The amount of items being outputted. If omitted, outputs all items until the end of the log.

11.4.4 LOGINFO – Show log information

Show log information, including log name, how many items have been stored to the log and what data level has been used.

\$PFST,LOGINFO,<L LOGNUM> OGNUM>

<LOGNUM>	Number of the log of interest.
----------	--------------------------------

The log information is displayed on the reply message:

*\$PFST,LOGINFO,<LOGNUM>,<NAME>,<ITEMS>,<DATALEVEL>*hh*

Where <NAME> is name of the log, <ITEMS> is the amount of items (data points) that are in the log and <DATALEVEL> is the data level setting.

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11.4.5 LOGMODE – Set logging start mode

Set logging start mode.

\$PFST,LOGMODE,<MODE>

<MODE>	Log start mode. May be one of the following: 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 consecutive navigation starts, logging won't be used after that. 2 -The previous log is continued once when navigation is started for the next time. On the consecutive navigation starts, logging won't be used after that. 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. 4 -The previous log is continued each time when navigation is started. Logging is active until user changes the start mode again.
--------	--

11.4.6 LOGNAME – Set log name

Set log name. This name concatenated with the log number is displayed in the log information.

\$PFST,LOGNAME,<NAME>

<NAME>	New name to be used with new logs. If omitted, displays the current name.
--------	---

11.4.7 LOGNUM – Get number of logs

Show how many logs are currently stored in the memory.

\$PFST,LOGNUM

The number of logs <NUM> is displayed on the reply message:

*\$PFST,LOGNUM,<NUM>*hh*

11.4.8 LOGSETTING - Set logging settings

Sets the logging settings.

\$PFST,LOGSETTING,<LEVEL>,<MININT>,<MINMOVE>,<MAXINT>,<MAXMOVE>

<LEVEL>	How much information is saved along each log item, may have values between 1..6
<MININT>	Minimum interval time (seconds): A new point won't be added to a log if the time elapsed is less the set value since the previous log point. An exception is that if the maximum movement limit is exceeded, then a new point is logged.
<MINMOVE>	Minimum movement (meters): A new point won't be added to a log if the distance traveled 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.
<MAXINT>	(optional) Maximum interval time (seconds): If this time or longer has elapsed since the previous log point, a new point is logged. If omitted or set to zero, the maximum limit isn't used.
<MAXMOVE>	(optional) Maximum movement (meters): If distance from the previous

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	log point is this distance or more, a new point is logged. If omitted or set to zero, the maximum limit isn't used.
--	---

If all parameters are omitted, the command shows the current settings in the reply message.

11.4.9 LOGSTOP – Stop Logging

This command can be used to stop logging while navigating without stopping navigation at the same time.

When navigation is started next time, logging is started in a normal fashion as defined by the logging start mode.

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12.0 NMEA MESSAGES

This chapter describes the supported NMEA output messages.

12.1 GGA – Global Positioning System Fix Data

Time, position and fix related data for a GPS receiver.

*\$GPGGA,hhmmss.dd,xxmm.dddd,<N|S>,yyymm.dddd,<E|W>,v,ss,d,d,h,h,M,g,g,M,a,a,xxxx*hh<CR><LF>*

hhmmss.dd	UTC time hh = hours mm = minutes ss = seconds dd = decimal part of seconds
xxmm.dddd	Latitude xx = degrees mm = minutes dddd = decimal part of minutes
<N S>	Either character N or character S, (N = North, S = South)
yyymm.dddd	Longitude yyy = degrees mm = minutes dddd = decimal part of minutes
<E W>	Either character E or character W, E = East, W = West
V	Fix valid indicator 0=Fix not valid 1=Fix valid
Ss	Number of satellites used in position fix, 00-12. Fixed length
d.d	HDOP – Horizontal Dilution Of Precision
h.h	Altitude (mean-sea-level, geoid)
M	letter M
g.g	Difference between the WGS-84 reference ellipsoid surface and the mean-sea-level altitude.
M	letter M
a.a	NULL (missing)
Xxxx	NULL (missing).

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12.2 GLL – Geographic Position – Latitude/Longitude

Latitude and Longitude, UTC time of fix and status.

*\$GPGLL,xxmm.dddd,<N|S>,yyymm.dddd,<E|W>,hhmmss.dd,S,M*hh<CR><LF>*

xxmm.dddd	Latitude xx = degrees mm = minutes dddd = decimal part of minutes
<N S>	Either character N or character S, (N = North, S = South)
yyymm.dddd	Longitude yyy = degrees mm = minutes dddd = decimal part of minutes
<E W>	Either character E or character W, E = East, W = West
hhmmss.dd	UTC time hh = hours mm = minutes ss = seconds dd = decimal part of seconds
S	Status indicator A = valid V = invalid
M	Mode indicator A=autonomous N=data not valid

12.3 GSA – DOP and Active Satellites

GPS receiver operating mode, satellites used in the navigation solution reported by the GGA sentence, and DOP values.

*\$GPGSA,a,b,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,p,p,h,h,v,v*hh<CR><LF>*

A	Mode: M = Manual, forced to operate in 2D or 3D mode. A= Automatic, allowed to automatically switch 2D/3D.
B	Mode: 1 = Fix not available, 2 = 2D, 3 = 3D
xx	ID (PRN) numbers of GPS satellites used in solution
p.p	PDOP
h.h	HDOP
v.v	VDOP

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12.4 GSV – Satellites in view

Number of satellites in view, satellite ID (PRN) numbers, elevation, azimuth, and SNR value. The maximum information for each message is four satellites. Additional messages up to a maximum of eight is sent as needed. The satellites are in the PRN number order.

Only the SNR (signal to noise ratio) value is available until a position fix is attained. The elevation and azimuth angles are also added after a fix. Note that there CAN be “theoretical” satellites in the GSV message. These are the satellites with known angles (elevation, azimuth), but for some reason, e.g. due to an obstruction, have not been found by GM-42201. The SNR value for these satellites are set to zero.

Please notice that as all viewable satellites are reported, the amount of satellites may occasionally be exceed the number of receiver tracking channels, 12.

*\$GPGSV,n,m,ss,xx,ee,aaa,cn,.....,xx,e ee,aaa,cn*hh<CR><LF>*

N	Total number of messages, 1 to 9
M	Message number, 1 to 9
Ss	Total number of satellites in view
Xx	Satellite ID (PRN) number
Ee	Satellite elevation, degrees 90 max
Aaa	Satellite azimuth, degrees True, 000 to 359
Cn	SNR (C/No) 00-99 dB-Hz. zero when not tracking

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12.5 RMC – Recommended Minimum Specific GNSS Data

Time, date, position, course and speed data.

*\$GPRMC,hhmmss.dd,S,xxmm.dddd,<N|S>,yyymm.dddd,<E|W>,s.s,h.h,ddmmyy,d.d,<E|W>,M*hh<CR><LF>*

hhmmss.dd	UTC time hh = hours mm = minutes ss = seconds dd = decimal part of seconds
S	Status indicator A = valid V = invalid
xxmm.dddd	Latitude xx = degrees mm = minutes dddd = decimal part of minutes
<N S>	Either character N or character S, (N = North, S = South)
yyymm.dddd	Longitude yyy = degrees mm = minutes dddd = decimal part of minutes
<E W>	Either character E or character W, E = East, W = West
s.s	Speed, knots.
h.h	Heading
ddmmyy	Date dd – date mm = month yy = year
d.d	Magnetic variation. This value is available if magnetic model data has been stored to the flash memory (available since firmware rev. 1.08)
<E W>	Declination. Either character E or character W, E = East, W = West
M	Mode indicator A=autonomous N=data not valid

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12.6VTG – Course Over Ground and Ground Speed

Course and speed

*\$GPVTG,h.h,T,m.m,M,s.s,N,s.s,K,M*hh<CR><LF>*

h.h	Heading
T	Degrees (heading units).
m.m	Magnetic heading. This value is available if magnetic model data has been stored to the flash memory (available since firmware rev. 1.08)
M	Degrees. Magnetic heading units.
s.s	Speed, knots.
N	Knots (Speed unit)
s.s	Speed, km/h.
K	km/h (Speed units).
M	Mode indicator A=autonomous N=data not valid

12.7 ZDA – Time and Date

Outputs the current UTC time and date. Unlike other messages, the time outputted by this message is bound to GM-42201's internal realtime clock (RTC) and thus it is updated even when navigation fix is unavailable. The RTC time is maintained also while the module is in sleep mode.

*\$GPZDA,hhmmss.dd,ddmmyyyy,xx,yy*hh*

hhmmss.dd	UTC time in hours, minutes, seconds and fractions of a second.
ddmmyyyy	UTC data in day-month-year format
Xx	Local zone hours. Not implemented, 00 outputted always.
Yy	Local zone minutes. Not implemented, 00 outputted always.

12.8 PFST,FOM – Position figure of merit

Figure of merit (FOM) value for the position fix. Indicates the accuracy of the position in meters. The FOM value cannot be calculated before at least one fix has been made with more than four observations (five satellites, or four satellites and an altitude aid); before that a value of "-1" is reported, indicating that FOM is not available yet. After this the FOM value is always available. The only exception being the altitude aiding modes, when a fix has been calculated using three satellites.

*\$PFST,FOM,n*hh<CR><LF>*

N	Position FOM value, i.e. the position accuracy in meters.
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13.0 APPENDIX: DATUM IDS

Table below defines all coordinate systems that CT-5501 supports with appropriate datum ids .

Id	Description	Id	Description	Id	Description
-1	WGS84	034	Old Egypt	069	Estonia
000	Ethiopian+Sudan	035	Burkina Faso and Niger	070	Europe 1950
001	Burkina Faso	036	Congo	071	Western Europe(1950)
002	Cameroon	037	Namibia	072	Cyprus
003	Ethiopia	038	Sierra Leone	073	England, Channel Islands
004	Mali	039	Algeria	074	England, Ireland
005	Senegal	040	Bahrain Island	075	Greece
006	Sudan	041	Saudi Arabia	076	Italy(Sardinia)
007	Somalia	042	Sumatra (Indonesia)	077	Italy(Sicily)
008	Botswana	043	Iran	078	Malta
009	Burundi	044	Hong Kong	079	Finland and Norway
010	Lesotho	045	Taiwan	080	Portugal and Spain
011	Malawi	046	Bangladesh	081	European 1979
012	Swaziland	047	India and Nepal	082	Iceland
013	Zaire	048	Thailand	083	Ireland
014	Zambia	049	Vietnam	084	England, Isle of Man,
015	Zimbabwe	050	Con Son Island	085	England
016	Kenya+Tanzania	051	Thailand(1997)	086	England, Wales
017	Kenya	052	Indonesia	087	Scotland, Shetland Islands
018	Tanzania	053	Sri Lanka	088	Wales
019	Djibouti	054	West Malaysia ,Singapore	089	Sardinia
020	Guinea-Bissau	055	Korean Geodetic System	090	Hungary
021	South Africa	056	Masirah Island	091	Poland
022	Tunisia	057	United Arab Emirates	092	Czechoslovakia
023	Guinea-Bissau	058	Saudi Arabia	093	Latvia
024	Egypt	059	Oman	094	Kazakhstan
025	Tunisia	060	Qatar	095	Albania
026	Ghana	061	Singapore	096	Romania
027	Liberia	062	East Malaysia	097	Czechoslovakia
028	Eritrea	063	Japan, Korea	098	Florida and Bahamas
029	Morocco	064	Japan	099	CONUS
030	Cameroon	065	Okinawa	100	Western USA
031	Nigeria	066	South Korea	101	Eastern USA
032	Gabon	067	Australia 1966	102	Alaska(excluding Aleutian Islands)
033	Algeria	068	Australia 1984	103	Aleutian Isle (East of 180° W)

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104	Aleutian Isle (West of 180° W)
105	Bahamas
106	San Salvador Island
107	Canada Mean Solution
108	Alberta and British Columbia
109	Eastern Canada
110	Manitoba and Ontario
111	NW Territories and Saskatchewan
112	Yukon
113	Canal Zone
114	Caribbean
115	Central America
116	Cuba
117	Greenland (Hayes Peninsula)
118	Mexico
119	Alaska (excluding Aleutian Islands)
120	Aleutian Islands
121	Canada
122	CONUS
123	Hawaii
124	Mexico and Central America
125	Colombia
126	Argentina
127	Paraguay
128	Brazil
129	Bolivia, Chile, Colombia, Ecuador, Guyana, Peru and Venezuela
130	Bolivia
131	Northern Chile
132	Southern Chile
133	Colombia
134	Ecuador
135	Guyana
136	Peru
137	Venezuela
138	Southern Chile
139	Mean Solution
140	Argentina
141	Bolivia
142	Brazil

143	Chile
144	Colombia
145	Ecuador (excluding Galapagos Islands)
146	Baltra, Galapagos Islands
147	Guyana
148	Paraguay
149	Peru
150	Trinidad and Tobago
151	Venezuela
152	Suriname
153	Antigua, Leeward Islands
154	Ascension Island
155	St. Helena Island
156	Bermuda Island
157	Deception Island, Antarctica
158	Nevis, St. Kitts, Leeward Island
159	Pico, Sao Jorge
160	South Georgia Island
161	Cayman Brac Island
162	Montserrat, Leeward Islands
163	Trinidad and Tobago
164	Corvo and Flores Islands
165	Cayman Island
166	Porto Santo and Madeira Islands
167	Puerto Rico and Virgin Islands
168	South Greenland
169	Sao Miguel
170	East Falkland Island
171	Salvage Islands
172	Tristan da Cunha
173	Cocos Islands
174	Republic of Maldives
175	Diego Garcia
176	Kerguelen Island
177	Mahe Island
178	Mascarene Island
179	American Samoa Island
180	Iwo Jima
181	Tern Island

182	Marcus Island
183	Efate and Erromango Islands
184	Phoenix Islands
185	Chatham Island New Zealand
186	Gizo Island
187	Easter Island
188	New Zealand
189	Guam
190	Guadalcanal Island
191	Johnston Island
192	Caroline Island, Fed. States of Micronesia
193	Philippines
194	Mindanao Island
195	Midway Islands
196	old Hawaiian
197	Hawaii
198	Kauai
199	Maui
200	Oahu
201	Pitcairn Island
202	Espirito Santo Island
203	Viti Levu Island (Fiji Islands)
204	Marshall Islands
205	Wake Atoll
206	Bankga and Belitung Islands (Indonesia)
207	Camp McMurdo Area, Antarctica
208	Iraq, Israel, Jordan, Lebanon, S. Arabia and Syria
209	Kalimantan (Indonesia)
210	Afghanistan
211	former Yugoslavia
212	Pakistan
213	Russia
214	Madagascar
215	Tunisia/Algeria
216	Tunisia/Algeria
217	Uruguay
300	Kartta Koordinaatio Jarjestelma, Finland