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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.

Another warning should be notified. GPS receiver modules should not be placed close to heat and fans. Drastic changes in temperature will degrade the signal receiving strength even when operating within the operation temperature. Crystal and crystal oscillator on PCB ASSY should be kept away from the cooling fan.

(Power)

If the impedance of the power terminal is too high (power cable too thin and over 10 cm long), then S/N will be degraded. Please insert condenser (above 47 μ F) into cable terminal to remove ripple.

(Operation)

Static electricity will destroy IC and erase backup data. Wear anti static electricity bundle while you are using the GPS Receive Module).

Besides static electricity, plugging in or out the connector while power on will cause initialization. Make sure this is performed under power-off condition.

(Antenna)

In order to strengthen the sensitivity for car navigation, GPS antenna is suggested to mount on a flat place around 80x80mm.

(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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(Environmental conditions)

The product should be suitably installed or shielded so that it should not be affected by high frequency (1575.42MHz± 10MHz) noises from other devices like CPUs. Don't allow the airflow from the cooling fan to come directly to the quartz crystal oscillator in the receiver module.

2.0 Absolute Ratings

Note: This module is not intended to operate under the conditions listed in Absolute Maximum Ratings. Continuous operation under these conditions or exceeding the maximum ratings may result in permanent damage to this device.

| Symbol | Parameter | Min | Max | Units |
|------------------------|---------------------------------------|--------------|------------------|-----------|
| DVDD | Module Supply Voltage, digital | - 0.3 | 3.6 | V |
| V_I | Input Voltage | - 0.3 | DVDD +0.3 | V |
| T_A | Ambient Temp. (Power applied) | - 30 | 85 | °C |
| T_{STG} | Storage Temp. | - 40 | 95 | °C |

3.0 Normal Operating Conditions

| Symbol | Parameter | Min | Typ | Max | Units |
|-------------|--|------------|------------|------------|-----------|
| AVDD | Supply Voltage, analogue | 2.7 | 3.0 | 3.3 | V |
| DVDD | Supply Voltage, digital | 2.7 | 3.0 | 3.3 | V |
| Top | Operational Temp. (Power applied) | -10 | | 70 | °C |

PRELIMINARY

| | | | | |
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4.0 Module Specification

| | | |
|------------------------|---------------------------|--|
| Dimensions | | 22.5*22.5*4.2mm |
| Satellite Tracking | | 12 Parallel channels |
| RF input | Center frequency | 1575.42MHz L1 band, C/A code |
| | Characteristics impedance | 50 ohm |
| | Signal sensitivity | -145 dBm (Searching Mode) -157 dBm (Tracking) |
| Positioning system | Default | WGS-84 |
| | Software Selectable | All major coordinate systems |
| Positioning accuracy | Position | 10 m CEP (50%) |
| | Velocity | 0.2m/s (50%) |
| Follow-up performance | Acceleration | 4g |
| Navigation Update Rate | | Default 1 second (see 13.2.5) |
| Operation Temperature | | -10° C to 70° C |
| Storage Temperature | | -40° C to 95° C |
| Operating voltage | | 2.7 V...3.3 V (typical 3.0V) |
| Antenna supply | | External supply (e.g. 5V) |
| Antenna | | External, passive or active |
| Power drain | | 45 mA, 135 mW @3.0V (Active antenna power not included) |
| I/O -port | | Dual asynchronous data ports 5 PINs GPIO 1PPS output |
| Flash memory memory | | 8 Mbits of on-board volatile (Module firmware used 4Mbits ,remainder 4Mbits for user define) |

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5.0 Time To First Fix (TTFF)

Typical Condition: 8 satellites in view + all previous conditions stand.

Hot Start (time, position, valid ephemeris, and valid almanac) 10 seconds

Warm Start (time, position, no ephemeris, and valid almanac) 35 seconds

Cold Start (no time & position, no ephemeris, and no almanac) 50 seconds

6.0 Module Interface

RF input connector

I/O connector (Power supply, serial data)

Board to board connection

through the RF board

7.0 Communication Specification

Communication method

Transfer rate input/output

Start-stop synchronization

2400/4800/9600/

19200/115200bps (Default

4800, see 13.2)

TTL compatible

ASCII

NMEA

Logic levels

I/O code

Communication format

| | | | | |
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8.0 I/O Connector Pins Pin Configuration

| Pin No. | Symbol | I/O | Description |
|---------|-----------|--------|---------------------------------------|
| 1 | Vbattery | I | Battery backup power |
| 2 | VANT | I | Antenna bias DC Power Supply |
| 3 | AVDD | I | Analogue Power Supply |
| 4 | DVDD | I | Digital Power Supply |
| 5 | TXD0 | O | UART Port 0, Transmit Data |
| 6 | RXD0 | I | UART Port 0, Receive Data |
| 7 | RESET | I | Module reset input |
| 8 | 1 PPS | O | 1 PPS signal output |
| 9 | GPIO [6] | I/O | General Purpose I/O |
| 10 | GND | Ground | Power and signal ground |
| 11 | GPIO [7] | I/O | General Purpose I/O |
| 12 | GPIO [8] | I/O | General Purpose I/O |
| 13 | GPIO [11] | I/O | External Wake-up, Interrupt input |
| 14 | GPIO [15] | I/O | Boot Mode Select, 1:FLASH, 0:UART/SPI |
| 15 | GND | Ground | Power and signal ground |
| 16 | GND | Ground | Power and signal ground |
| 17 | GND | Ground | Power and signal ground |
| 18 | RFIN | I | RF input |
| 19 | GND | Ground | Power and signal ground |
| 20 | GND | Ground | Power and signal ground |

9.0 Electrical Characteristics

| Item | Symbol | Parameter | Min | Typ | Max | Units |
|----------------|--------|------------------------------------|---------|-----|----------|-------|
| DVDD | | Module Supply Voltage, digital | 2.7 | 3.0 | 3.3 | V |
| Input Voltage | VIH | Input signal high level | .7xDVDD | | DVDD+0.3 | V |
| | VIL | Input signal low level | -0.3 | | 0.3xDVDD | V |
| Output Voltage | VOH | Output signal high level IOH = 1mA | .8xDVDD | | DVDD | V |
| | VOL | Output signal low level IOL = 1 mA | 0 | | .22xDVDD | V |

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10.0 Recommended Antenna Specification

Antenna

| | |
|------------------|---|
| Center frequency | L1 (1575.42MHz) |
| Polarization | Right-handed circular polarization |
| Gain | -5dBi or more ($5^\circ < \text{Angle of elevation}$) |
| Axis ratio | 3dB typical ($\text{Angle of elevation} = 90^\circ$) |

Pre-amplifier

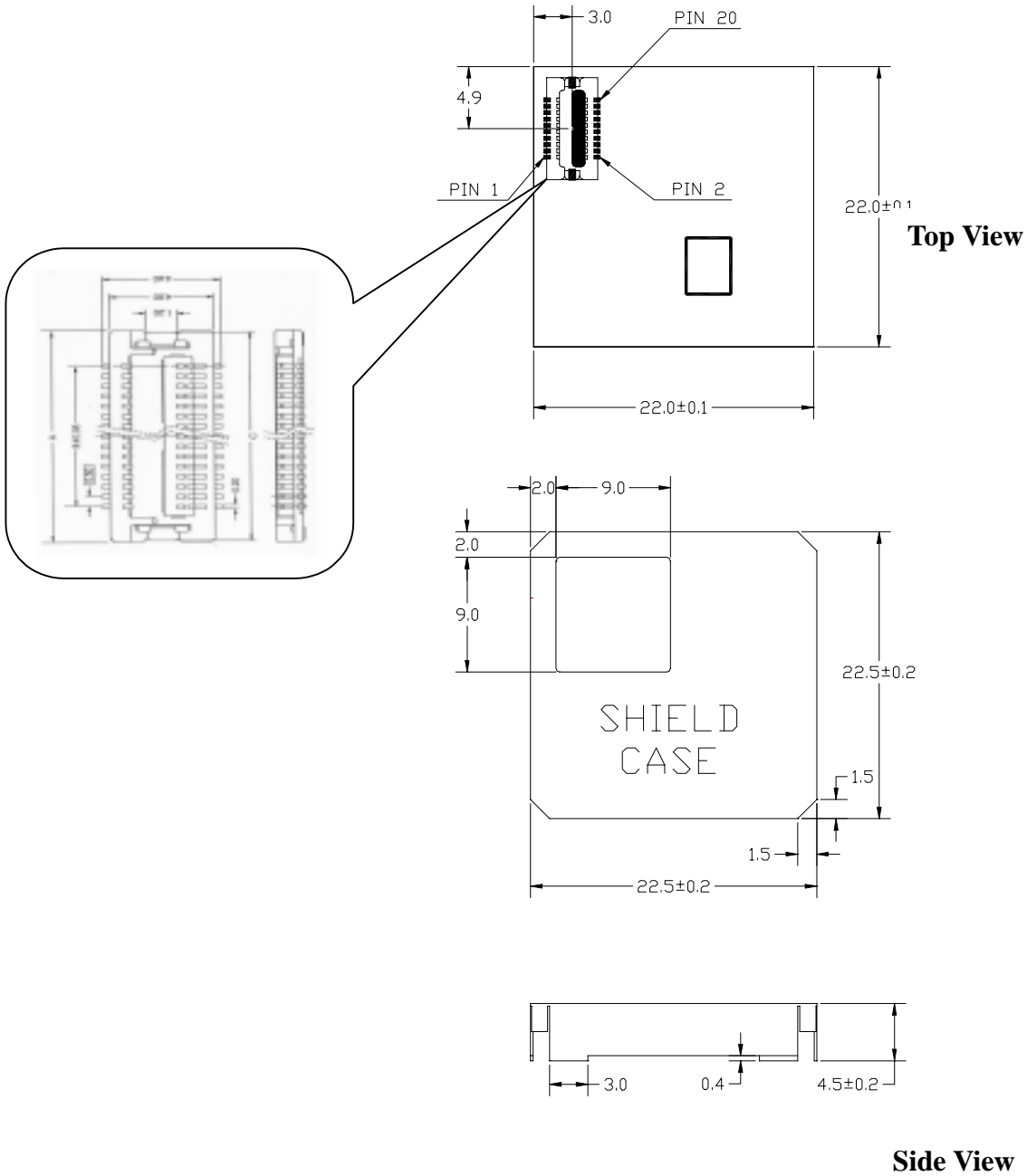
| | |
|-------------------|---------------------------------------|
| Gain | 15~25dB (included antenna cable loss) |
| Noise figure (NF) | 2.5dB or less |

Overall Specification

| | |
|-----------------------------|--|
| Gain | 17dBi or more ($\text{Angle of elevation} = 90^\circ$) |
| Output impedance | 50 ohms |
| Output VSWR | 2.0 or less |
| Supply voltage | External supply, according to antenna requirement |
| Maximum Current consumption | 30mA |

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11.0 Dimension

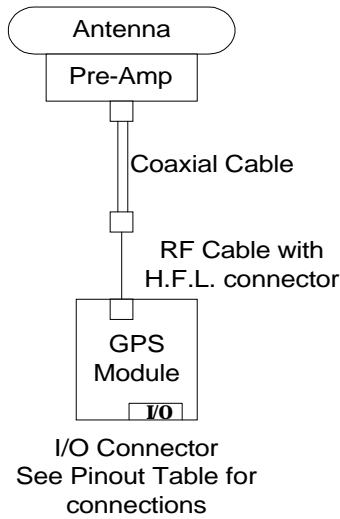


Error of measurement: ± 0.1 mm
Units of measurement: mm

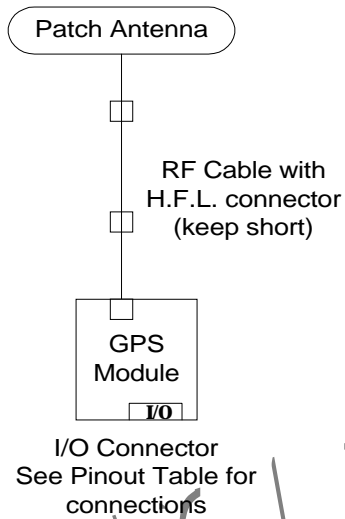
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12.0 GPS Receiver Module Configuration

12.1 Configuration with Active Antenna

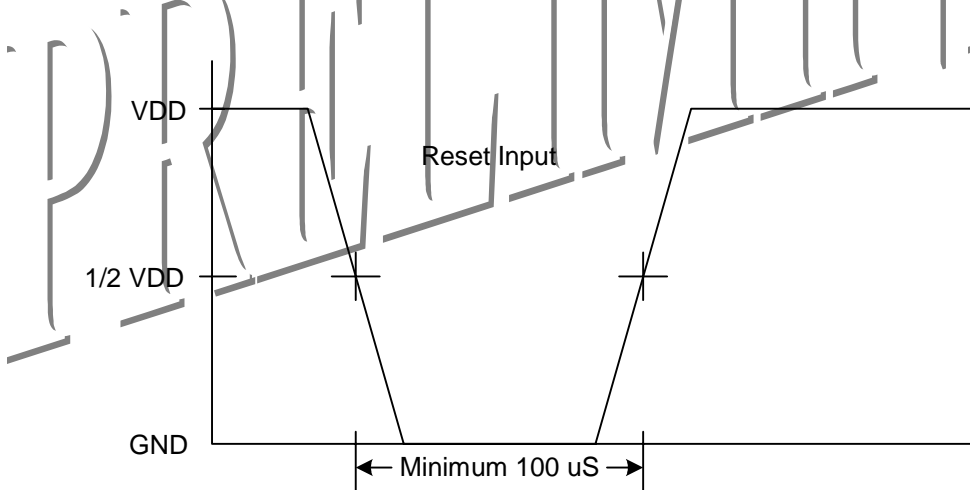


Configuration with Passive Antenna



12.2 Reset During Operation

$V_{DD} = 2.7$ to $3.3V$, temperature = -40 to $+85^{\circ}C$



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13.0 NMEA Protocol

NMEA COMMANDS

This chapter describes the supported NMEA commands.

13.1 General NMEA commands

The following sections introduces the general-purpose NMEA commands the basic CT5530 operations.

13.1.1 START – Start Navigation

Commands CT5530 to start navigation. The command has no effect if called while CT5530 is already navigating. After the start command has been given, it takes some time for CT5530 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=Autostart. 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 <i>\$PFST,INITAID</i> 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 <i>\$PFST,STOP</i> command.</p> |
|---------------------------|--|

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13.1.2 STOP – Stop Navigation

Commands CT5530 to stop navigating and enter the idle state. While in idle state, the CT5530 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.

13.1.3 PWRDOWN – CT5530 Sleep Mode

Commands CT5530 to sleep mode.

Using the sleep mode is recommended when navigation isn't needed. CT5530 consumes remarkably little power in the sleep mode and still re-acquires the navigation fix quickly after waking up.

CT5530 wakes up from the sleep mode when the timeout has expired or the GPIO pin 11 state is toggled. If the receiver was navigating when the PWRDOWN command was given, navigation will restart automatically after waking up from the sleep mode.

\$PFST,PWRDOWN,<hours>,<minutes>,<seconds>

or

\$PFST,PWRDOWN

| | |
|-----------|------------------|
| <hours> | Sleeping hours |
| <minutes> | Sleeping minutes |
| <seconds> | Sleeping seconds |

13.1.4 SW – CT5530 software revision

Shows the firmware revision of the CT5530 module.

\$PFST,SW,<customer id>,<major revision>,<minor revision>,<build number>

| | |
|------------------|--|
| <customer id> | Customer identifier, if the module has a customer-modified firmware. Value "0" means the original Cirocomm releases. |
| <major revision> | Major firmware revision. This number together with the following two defines the firmware release. |
| <minor revision> | Minor firmware revision. |
| <build number> | Firmware build number. |

13.1.5 HW – CT5530 hardware revision

Shows the Bill-Of-Material date (year, month, day) of the CT5530 module.

\$PFST,HW,<BOM date>

| | | | | |
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13.2 Configuration commands

The following sections introduce the commands used for controlling the behavior of CT5530.

13.2.1 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 1:

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 CT5530 versions will also be turned on. The following messages are enabled by default: GGA, RMC, GSA, GSV.

NOTE 2:

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)

NOTE 3:

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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.

13.2.2 AUTOSTART – Set Autostart Mode

Defines if CT5530 automatically starts navigation when power is turned on or CT5530 is reset.

\$PFST,AUTOSTART,<I/O>

| | |
|-------|--------------------------------------|
| <I/O> | 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 CT5530 doesn't save parameters in non-volatile memory, AUTOSTART command has no effect in CT5530.

13.2.3 CONF – Set configuration parameters

This command is used for setting the configuration parameters of CT5530.

\$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 |
| 55 | DOUBLE | 3.0 | Pinning lag criteria (meters). In pinning mode, the position may lag behind the actual position by this amount. |

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|----|--------|-----|---|
| 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.

13.2.4 DATUM – Set Local Coordinate System

Selects the local coordinate system. After this command, the CT5530 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.

13.2.5 FIXRATE – Set Fixrate

Defines how often CT5530 should acquire navigation fix and thus output the NMEA messages.

\$PFST,FXRATE,<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.

13.2.6 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). |
|--------|--|

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.

| | | | | |
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13.2.7 STORE – Store Current Parameter Set

Stores the current parameter set in CT5530'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: CT5530 doesn't store configuration parameters in flash memory, and thus this command doesn't have any effects on the CT5530 modules. For CT5530, the preferred way is to set parameters each time, when the module is reset or switched on.

13.2.8 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.

13.2.9 RESTORE – Restores Default Parameter Set

Restores factory default parameter set.

\$PFST,RESTORE

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

NOTE: CT5530 doesn't store configuration parameters to flash memory, and thus this command is irrelevant with CT5530 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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13.3 Navigation Aiding Commands

The following sections introduce the commands that provide the CT5530 receiver with additional data, which may be helpful for starting and during navigations.

13.3.1 INITAID – Initial position and time aiding

Gives the CT5530 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 CT5530 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). |

13.3.2 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> |

13.3.3 SETLIMIT – Set limits for altitude, velocity and acceleration

Sets the upper limits for altitude, velocity and acceleration parameters that the CT5530 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 CT5530 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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13.4 Logging Commands

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

13.4.1 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> |
|--------|--|

13.4.2 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.

13.4.3 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. |

13.4.4 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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13.4.5 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. |
|--------|--|

13.4.6 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. |
|--------|---|

13.4.7 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*

13.4.8 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.

13.4.9 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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14.0 NMEA MESSAGES

This chapter describes the supported NMEA output messages.

14.1 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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14.2 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 |

14.3 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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14.4 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 CT5530. 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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14.5 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.ddd d | 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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14.6 VTG – 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 |

14.7 ZDA – Time and Date

Outputs the current UTC time and date. Unlike other messages, the time outputted by this message is bound to CT5530'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. |

14.8 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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14.9 PFST,PPS – PPS signal

The pulse per second message. Indicates the parameters of the PPS pulse that will shortly be outputted. Outputs the current GPS time and timing correction term for the coming PPS pulse.

$\$PFST,PPS,wwww,ttttt,n,xxxx*hh <CR><LF>$

| | |
|-------|---|
| wwww | GPS Week (i.e. number of full weeks elapsed since midnight 5-6 January 1980). |
| ttttt | Time of Week (seconds from the beginning of the current GPS week). |
| n | Number of satellites used when calculating the solution. |
| xxxx | Short-time pulse offset of the physical PPS pulse signal (units of 0.01 ns, in range of approx. -15.3 .. 15.3 ns). The correct pulse time can be calculated by subtracting this offset from the physical PPS pulse instant. |

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15.0 APPENDIX: DATUM IDS

Table below defines all coordinate systems that CT-5530 supports with appropriate datum ids .

| Id | Description | Id | Description | Id | Description |
|-----------|--------------------|-----------|--------------------------|-----------|------------------------------------|
| -1 | WGS84 | 034 | Old Egypt | 070 | Europe 1950 |
| 000 | Ethiopian+Sudan | 035 | Burkina Faso and Niger | 071 | Western Europe(1950) |
| 001 | Burkina Faso | 036 | Congo | 072 | Cyprus |
| 002 | Cameroon | 037 | Namibia | 073 | England, Channel Islands |
| 003 | Ethiopia | 038 | Sierra Leone | 074 | England, Ireland |
| 004 | Mali | 039 | Algeria | 075 | Greece |
| 005 | Senegal | 040 | Bahrain Island | 076 | Italy(Sardinia) |
| 006 | Sudan | 041 | Saudi Arabia | 077 | Italy(Sicily) |
| 007 | Somalia | 042 | Sumatra (Indonesia) | 078 | Malta |
| 008 | Botswana | 043 | Iran | 079 | Finland and Norway |
| 009 | Burundi | 044 | Hong Kong | 080 | Portugal and Spain |
| 010 | Lesotho | 045 | Taiwan | 081 | European 1979 |
| 011 | Malawi | 046 | Bangladesh | 082 | Iceland |
| 012 | Swaziland | 047 | India and Nepal | 083 | Ireland |
| 013 | Zaire | 048 | Thailand | 084 | England, Isle of Man, |
| 014 | Zambia | 049 | Vietnam | 085 | England |
| 015 | Zimbabwe | 050 | Con Son Island | 086 | England, Wales |
| 016 | Kenya+Tanzania | 051 | Thailand(1997) | 087 | Scotland, Shetland Islands |
| 017 | Kenya | 052 | Indonesia | 088 | Wales |
| 018 | Tanzania | 053 | Sri Lanka | 089 | Sardinia |
| 019 | Djibouti | 054 | West Malaysia ,Singapore | 090 | Hungary |
| 020 | Guinea-Bissau | 055 | Korean Geodetic System | 091 | Poland |
| 021 | South Africa | 056 | Masirah Island | 092 | Czechoslovakia |
| 022 | Tunisia | 057 | United Arab Emirates | 093 | Latvia |
| 023 | Guinea-Bissau | 058 | Saudi Arabia | 094 | Kazakhstan |
| 024 | Egypt | 059 | Oman | 095 | Albania |
| 025 | Tunisia | 060 | Qatar | 096 | Romania |
| 026 | Ghana | 061 | Singapore | 097 | Czechoslovakia |
| 027 | Liberia | 062 | East Malaysia | 098 | Florida and Bahamas |
| 028 | Eritrea | 063 | Japan, Korea | 099 | CONUS |
| 029 | Morocco | 064 | Japan | 100 | Western USA |
| 030 | Cameroon | 065 | Okinawa | 101 | Eastern USA |
| 031 | Nigeria | 066 | South Korea | 102 | Alaska(excluding Aleutian Islands) |
| 032 | Gabon | 067 | Australia 1966 | 103 | Aleutian Isle (East of 180° W) |
| 033 | Algeria | 068 | Australia 1984 | 104 | Aleutian Isle (West of 180° W) |
| Id | Description | Id | Description | 105 | Bahamas |
| | | 069 | Estonia | 106 | San Salvador Island |



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| | |
|-----|---|
| 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) |

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| 146 | Balra, 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 |

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| 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 | Banka 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 |