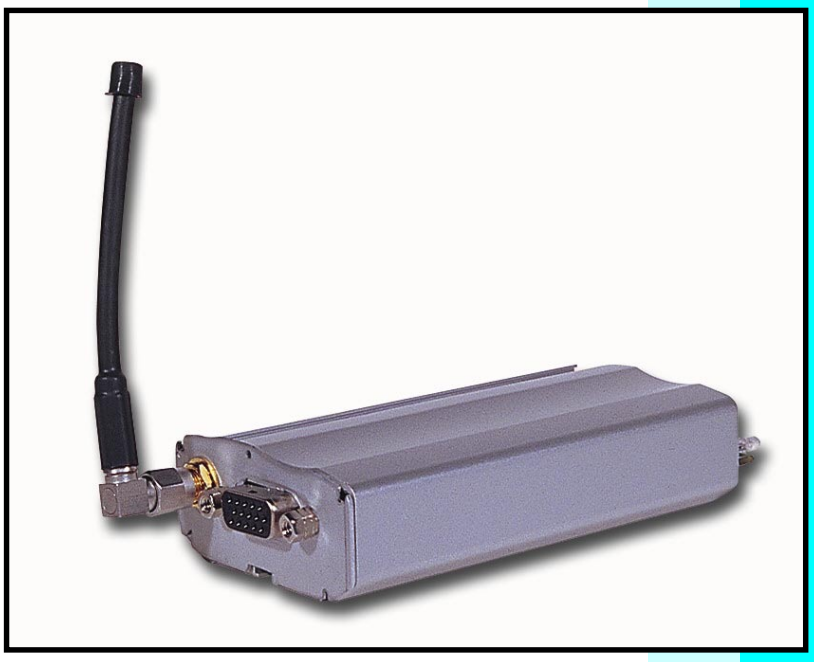
SENA
GPS



MODEM GPS AMIGO

OPERATOR'S MANUAL

MU-AMI-035-SN

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1 INTRODUCTION

The *Amigo* GPS modem is a terminal supporting fax, data transmission, SMS short messages mobile originated or terminated, and voice calls. Hence, in a fixed or mobile installation, it allows communication establishment for instant localization and time control, and permits transmitting orders and data between the modem and its GSM control center.

This document objective is to describe the commands and protocols available from the terminal.

The *Amigo* 15-pin sub-D connector is to connect the modem to a computer or a data terminal. Once correctly connected, the user may use this port to:

- Use it like a GSM modem.
- Configure the parameters
- Test the functionalities
- Diagnostic problems

Once connected to the modem, the user can use a complete set of AT commands to control all the modem functionalities.

This document is a complement to the "AT COMMANDS MANUAL", referenced WCOM/GSM/SW/SII015, edited by Wavecom, and available on the web: http://www.wavecom.com. This document describes the personalized commands for its use as a GPS positioning and time control device.

The *Amigo* is basically made of a Wavecom modem, and an Albatros GPS receiver from SENA GPS.

2 QUICK START

This chapter describes how to set up an Amigo. For more information about used commands, refer to the corresponding chapters (3: USER INTERFACE, on page 3.1).

2.1 PHYSICAL INSTALLATION

The steps to install physically the Amigo (cable connexions, etc) are described in the Amigo User's manual (ref MU-AMI-034-SN)

2.2 CONFIGURATION

2.2.1 Power-up the Amigo

Connect the data cable to a terminal (PC with hyperterminal for example). The terminal configuration must be 9600,8,N,1.

On power-up the modem prints a welcome message (software version, etc). The Amigo start up in AT mode, i.e. it only accepts AT commands.

Note: all the configuration parameters are stored in the SIM module (node number, etc). For a correct behavior of the modem, it is necessary to wait the GSM module to set-up completely, which can need al least 30 seconds. To check if the Amigo is ready, send the AT <CR> command, until it answers OK. While answering ERROR, the Amigo is not ready. (note: <CR> is the Enter key).

2.2.2 Switch to maintenance mode

Although it is possible to completely configure the Amigo with AT commands, the maintenance mode offers a more convivial interface. To switch to maintenance mode, enter the AT+SNGPSMANT <CR> command.

The Amigo prints information about the mode switching, and a prompt (“>”).

2.2.3 Configuring the node number

The Amigo behaves as a standard GSM modem. It is possible to make voice, fax and data calls, and send short messages.

However, the node number (0 by default) must be configured for any automatic communication (see corresponding chapter 4: EXTERNAL COMMUNICATIONS, on page 4.1)

Example: configure the node number 123456:

NODO 123456 <CR>

The node number has a maximum of 8 digits.

2.2.4 Configuring the control center

To send and receive binary orders, it is necessary to configure the control center identification.

Example: configure the control center node to 2, and its phone number is: +34 123 456 789 (always international number):

TELEFONO 2 34123456789 <CR>

The control center node number has a maximum of 8 digits.

3 USER INTERFACE

3.1 INTRODUCTION

The user interface to communicate with the modem is provided by the serial port on the sub-D connector. The user may connect a text terminal, or a computer with a Procomm-like terminal emulator (HyperTerminal for example), to be able to type and send orders, and receive the modem answers.

The *Amigo* GPS modem has five user interface modes:

- Maintenance mode: compatible with the PROTEUS GPS (from SENA GPS) maintenance mode. The available commands are listed in the chapter MAINTENANCE MODE on page 3.2.
- Modem mode: this is the default mode. It allows direct access to the GSM modem. Report to chapter MODEM MODE on page 3.13 for more details.
- SiRF mode: fully compatible with the SiRF GPS protocol.
- NMEA mode: fully compatible with the format NMEA-0183 defined by the National Marine Electronics Association, Standard for Interfacing Marine Electronic Devices, version 2.20, 01-01-1997.
- DockStation mode: this mode is automatically activated when the modem is inserted in its programming dock station. This mode only exists when the modem is in handheld configuration. The dock station fulfils a double mission: recharge the GPS accumulators, and configure user GPS parameters. In DockStation mode, the protocol is considerably reduced to match the dock station capabilities: numeric only keyboard, and LCD screen (2 16-characters alphanumeric lines).

3.2 MAINTENANCE MODE

The maintenance mode communication parameters are the followings:

- 9600 bauds
- 8 data bits, no parity
- 1 stop bit

Any ASCII terminal can communicate with the modem.

Most terminal emulation options should be disabled:

- Local echo must be disabled
- CR translation must not be enabled (do not translate to CR LF)

The commands may be typed in uppercase or lowercase.

The Backspace key erases the last character typed.

The modem indicates it is ready to receive orders sending the prompt: “>”

Due to the internal initialization of the modem, some commands are available only after a few seconds. The Amigo notifies when it is ready to process all commands sending “GSM init done”.

3.2.1 Help command: ?

Description: Prints all available commands in maintenance mode.

Parameters: N/A.

Example:

```
>?
AMIGO commands :
                ? -- Show help
          VERSION -- Software version
             TEST -- Test hardware
             NODO -- Node configuration
             NODE -- Node configuration
               CM -- SMS center config
         TELEFONO -- GSM base configuration
             BASE -- GSM base configuration
            RADIO -- Radius configuration
           RADIUS -- Radius configuration
           CICLOS -- Cycles configuration
           CYCLES -- Cycles configuration
           TIEMPO -- Max allowed time alarm
          MAXTIME -- Max allowed time alarm
             HORA -- Local time config.
          LOCTIME -- Local time config.
              POS -- Current GPS posicion
          CANALES -- Tracking canals
         CHANNELS -- Tracking canals
              MAP -- Satellites map
             SIRF -- Switch to SiRF protocol
             NMEA -- Switch to NMEA protocol
            POWER -- Power saving mode
           ECOTFN -- Phone line spy
            RESET -- Reset GPS
Standard AT commands are also available
Type AT+SNGPS? for help on extended GPS AT commands
>
```

3.2.2 VERSION command

Description: Print the actual software version.

Parameters: N/A.

Example:

```
>version
AMIGO R1 Version 002c beta
Current mode: mantenimiento
Press '?' for help on available commands
>
```

3.2.3 TEST command

Description: This command is used for factory testing. It needs a specific test board and is useless without this board.

3.2.4 NODE command

Description: Configuration of the modem's node number.

Parameters: 1: New node number.

If no parameter is provided, the modem will print the actual configuration.

Example:

```
>node
Actual node number: 0
To update the configuration :
   node new_node_number

>node 2
New node number: 2

>
```

3.2.5 BASE command

Description: Configuration of the authorized control center.

Parameters: 1: New base (GSM control center) node number. See chapter 4.4 TEXT MESSAGES on page 4.2 for more information about reserved values.

2: Base new phone number. This number must be entered in international format (34 for Spain), without the "+" sign (international prefix).

If no parameter is provided, the modem will print the actual configuration.

Example:

```
>base
Base Id : 0
Base phone number:
To update the configuration :
   base BaseId BasePhoneNumber
```

```
>base 2 34609123456
New base Id: 2
New base phone number: 34609123456

>
```

3.2.6 RADIUS command

Description: Alarm radius configuration.

Parameters: 1: New radius, in meters (250 m minimum); "off" do disable the alarm radius.

2: Alarm circle center latitude, in degrees.

3: Alarm circle center longitude, in degrees.

If no parameter is provided, the modem will print the actual configuration.

Example:

```
>radius
The radius alarm is currently disabled
To update the configuration :
   radius radius_in_meters center_latitude center_longitude
To disable radius alarm:
   radius off

>radius 2000 41.0589 -3.65148
New radius : 2000 meters
New center : Lat=41.058900, Lon=-3.651480

>radius off
Radius alarm disabled

>
```

3.2.7 CYCLES command

Description: Autoresponding cycles configuration.

Parameters: 1: New autoresponding time, in seconds (30 s. minimum, 0 to disable autoresponding feature).

If no parameter is provided, the modem will print the actual configuration.

Example:

```
>cycles
Current autoresponding time: 0 s
Next autoresponding cycle in 0 s
To update the configuration :
```

```
    cycles new_time
(new_time in seconds, 30 s minimo, 0 to disable )

>cycles 300
New autoresponding time: 300 s

>cycles 0
Autoresponding cycles disabled

>
```

3.2.8 MAXTIME command

Description: Authorized absence time configuration. The *Amigo* GPS modem automatically counts the elapsed time out of the DockStation, and send an alarm if the modem remains too long out of its base.

Parameters: 1: New time, in hours (0 to disable time alarm).

If no parameter is provided, the modem will print the actual configuration.

Example:

```
>maxtime
The time alarm is disabled
To update the configuration:
   maxtime authorized_hours_out_of_the_dockstation
To disable the time alarm:
    tiempo 0

>maxtime 8
New authorized time out of the DockStation: 8

>maxtime 0
Time alarm disabled

>
```

Note: There is another modem version, which configures the absence time differently. The time limit out of the DockStation is absolute, and not relative: the modem must be back in its base at HH:MM (local time).

3.2.9 LOCTIME command

Description: Local time configuration vs. GPS time.

Parameters: 1: Number of minutes that must be added to GPS time (UTC) to compute local time (for example: +60 min for Spain in winter). This value can be negative.

If no parameter is provided, the modem will print the actual configuration.

Note: This command onlv exists in the software version working with absolute time (see 3.2.8 MAXTIME command)

3.2.10 POS command

Description: Prints the current GPS position, GPS time, used satellites, DOPs (Dilution Of Precision), navigation mode, and velocity.

Parameters: N/A

Example:

```
>pos
Current position :
LAT =  40.513984
LON =  -3.657461
ALT = 767.246648
Velocity: 0.200 km/h    Angle: 72.049
6 satellites used in navigation : 15 22 17 6 18 30
GDOP:3.487, HDOP:2.011, PDOP:2.919, TDOP:1.908, VDOP:2.116
GPS Time : Week = 89, TOW = 28939891
UTC Time: 09/05/2001 08:23:05
Navigation mode : 04

>
```

3.2.11 CHANNELS command

Description: Shows the GPS canals states.

Parameters: N/A.

Example:

```
>canales
Channel  SV  Azim Elev  State C/No
    1 :   1   315    7  -----  0
    2 :  30    90   41  CCBFE  36
    3 :   3   246    8  -----  0
    4 :  25   240   62  -----  0
    5 :  17   140   48  -----  0
    6 :  22   301   33  -----  0
    7 :  Channel free
    8 :  Channel free
    9 :   6    46   61  CCBFE  36
   10 :  Channel free
   11 :   5   101   12  CCBF-  32
   12 :  29   218    9  -----  0

>
```

Fields description:

- Channel: GPS channel number
- SV: satellite number
- Azim: satellite azimuth, in degrees (0=north, 90=east)
- Elev: satellite elevation, in degrees (0=horizon, 90=vertical)
- State: satellite communication state:
  - C: Carrier sync
  - C: Code sync
  - B: Byte sync
  - F: Frame sync
  - E: Ephemeris available
- C/No: signal strength (en dBHz)

3.2.12 MAP command

Description: Gives a satellite graphic map

Parameters: N/A.

Example:

```
>map
                  ---N---                    Channel  SV  Azim Elev  State C/No
                         |                       A :  21   308   21  -----  0
                         |                       B :   9   327   68  CCBFE  41
                         |                       C :  Channel free
                         |                  d    D :   2    50    9  -----  0
         a               |                       E :  26   142   51  CCBFE  35
                         |                       F :  30   225   13  CCBFE  40
                         |              K        G :  Channel free
|                 B      |                       H :   5   225   49  CCBFE  32
|                        |                       I :  18   264   36  -----  0
W--------------------+--------------------E      J :  Channel free
|        i               |                       K :   7    67   29  CCBFE  38
|                        |                       L :  23   225   32  -----  0
               H        E
            l           |
                        |
         F              |
                        |
                        |
                        |
                  ---S---

>
```

Fields description: see channels command

3.2.13 SIRF command

Description: Switch to SiRF protocol.

Parameters: N/A.

This command switch the modem to SiRF protocol, with the following characteristics:

- 38400 bauds
- 8 data bits, no parity
- 1 stop bit

After receiving this command, the modem will only accept SiRF frames, and will ignore any other data.

There are three ways to switch back to maintenance mode:

- Insert the modem in its DockStation, and remove it.
- Erase completely the SRAM memory

- Send a SiRF order frame to switch back to the named USER1 protocol.

In the actual software version, the Poll SW Version SiRF frame causes the modem to switch to maintenance protocol. Hence the modem will not answer the Poll SW Version command.

Note: It is possible to switch directly to the NMEA protocol from SiRF protocol sending a Change To NMEA Protocol frame.

3.2.14 NMEA command

Description: Switch to NMEA protocol.

Parameters: N/A.

This command switch the modem to NMEA protocol, with the following characteristics:

- 4800 bauds
- 8 data bits, no parity
- 1 stop bit

After receiving this command, the modem will only accept NMEA frames, and will ignore any other data.

There are five ways to switch back to maintenance mode:

- Insert the modem in its DockStation, and remove it.
- Erase completely the SRAM memory
- Send an AT command. The command will not be interpreted, but the Amigo will switch back to AT mode (9600 bauds).

- Send a NMEA frame to switch back to the named USER1 protocol.

- Switch to SiRF protocol (with the appropriate NMEA frame), and then switch to maintenance (USER1) protocol (see 3.2.13 SIRF command on page. 3.9).

3.2.15 POWER command

Description: Configure the power saving modes.

Parameters: 1: Power saving type:

- 0: Power saving disabled.
- 1: TricklePower mode activated (ratio 200/1000).
- 2: Push To Fix mode activated.

If no parameter is provided, the modem will print the actual configuration.

Example:

```
>power
Power saving currently disabled
To update the configuration :
   power 0 : disable power saving modes
   power 1 : enable Trickle Power (200/1000)
   power 2 : enable Push To Fix

>power 1
Trickle Power mode enabled

>power 0
Power saving modes disabled

>
```

3.2.16 ECOTFN command

Description: Debug of the communication messages with the GSM module

Parameters: 1: Debug mode:

- 0: Debug disabled.

- 1: Debug of outgoing messages.
- 2: Debug of incoming messages.
- 3: Debug of all the messages.

If no parameter is provided, the modem will print the actual configuration.

Example:

```
>ecotfn
Ecotfn value: 0
To update the configuration :
   Ecotfn 0 : ecotfn disabled
   Ecotfn 1 : trace outgoing messages
   Ecotfn 2 : trace incoming messages
   Ecotfn 3 : trace all messages

>ecotfn 3
New ecotfn value: 3

>
```

3.2.17 RESET command

Description: Software reset of the module. SRAM is erased and the GPS module will execute a cold start.

Parameters: N/A.

3.2.18 AT command – access to the modem mode

Description: Send an AT order to the GSM modem, and switch to modem mode.

This is a special command. After receiving any order beginning by "AT" (example: AT+CMGF=1, AT+CSQ, ATE1, etc), the module switch to modem mode. See the corresponding chapter: MODEM MODE, on page 3.13.

3.3 MODEM MODE

3.3.1 Introduction

The modem mode uses the same physical layer as the maintenance mode (same velocity, etc). Any ASCII terminal can be used to connect to the module.

In this mode, the *Amigo* GPS module will act as if it were a true Wavecom modem, except for the differences given below.

While in maintenance mode, the module will automatically enter modem mode as it receives any AT command (even erroneous commands).

Note: In this mode, only UPPERCASE commands will be recognized, and concatenated commands are forbidden (e.g: AT+CMGF=1;+CMGR=2).

3.3.2 Partially or not supported commands

3.3.2.1 Turn modem OFF: AT+CPOF or AT+CFUN=0

This command is prohibited. The modem will answer ERROR.

3.3.2.2 Dial command: ATD or ATDL or AT%D1

These commands are fully supported, for all type of calls (voice, data, except multiple calls).

3.3.2.3 Call waiting, multiparty call, etc

The CCWA, CLCC and CHLD are not yet supported

3.3.2.4 Answer command: ATA or ATS0

The actual version only allows the ATA command. ATS command (automatic answer) is not supported.

3.3.2.5 PIN Code: AT+CPIN=

Note: To ensure correct operation of the module while in modem mode, the PIN code of the SIM card must be disabled.

The actual version does not support SIM con PIN code activated. However, the PIN commands remain available.

3.3.2.6 PIN configuration: AT+CLCC="SC" or AT+CPWD="SC"

The actual version does not accept PIN code. Thus it is strongly recommended not to validate it with the AT+CLCC="SC" command, or change it with the AT+CPWD="SC" command. The modem would get out of order until the PIN code is removed.

3.3.2.7 Phonebook commands

All the phonebook commands are available (except AT+WAIP), but the entries 5 to 20 are reserved for the *Amigo* internal use (configuration storage). Any modification of these entries can alter normal modem operation.

The *Amigo* GPS module can erase and write these entries at any moment to save its configuration.

The Amigo needs the phonebook to store its configuration. Thus the command AT+WAIP is prohibited.

Note: It is strictlv forbidden to alter the entries 5 to 20 of the phonebook.

3.3.2.8 SMS commands

All SMS commands are available. It is possible to save and restore the configuration with AT+CSAS and AT+CRES. See the Table 3.b : parameters storage on page 3.37 for more information about parameters storage in non volatile memory.

The AT+CNMA command is not supported.

3.3.2.9 Data modes

The *Amigo* GPS module provides support for data communication. However, Fax modes have not been tested yet.

3.3.2.10 Communication format and speed

The modem only communicates at the same speed as the maintenance protocol (currently 9600,8,N,1).

The Autobauding is not recognized.

The AT+IPR command can be used with the limitations indicated above.

The AT+ICF command is prohibited.

3.3.2.11 Handshaking

The hardware handshaking (RTS/CTS) is fully supported. The modem detects automatically the presence of RTS (like a standard Wavecom modem) to automatically enable hardware handshaking on startup.

3.3.2.12 DCD, DTR and DSR

The AT&D and AT&S commands are fully supported. However, the AT&C command is forbidden and the DCD line will behave like in the command AT&C1 (current carrier state).

3.3.2.13 Registering unsolicited codes: AT+CREG=1

The AT+CREG=1 command is not yet supported.

3.3.2.14 Return codes suppression: ATQ

The ATQ command is prohibited.

3.3.2.15 Return codes format: ATV

The ATV command is prohibited.

3.3.2.16 Modem Reset: ATZ

ATZ command is supported. When the modem is reset, the values stored in non volatile memory will be loaded, as described in the Table 3.b : parameters storage on page 3.37.

After sending ATZ command, a delay of 5 seconds must be observed after the command (before 5 seconds the modem can answer ERROR or CME ERROR: 515 to the command).

3.3.2.17 Save configuration: AT&W

The AT&W command is supported. The parameters will be stored in non volatile memory, as described in the Table 3.b : parameters storage on page 3.37.

3.3.2.18 Restore configuration: AT&F

AT&F command is supported. The values stored in non volatile memory will be loaded, as described in the Table 3.b : parameters storage on page 3.37.

After sending AT&F command, a delay of 5 seconds must be observed after the command (before 5 seconds the modem can answer ERROR or CME ERROR: 515 to the command).

3.3.2.19 Show actual configuration: AT&V

This command is supported. However, the actual software version will always show CMEE status = 1 and CRC status = 1, even if the user changes the configuration with AT+CMEE=0 or AT+CRC=0 (that are fully supported commands). On the same manner, AT&D value will always be shown as 0, and IFC value will be 2,2.

3.3.2.20 General indications: AT+WIND

The AT+WIND command is supported, with the following differences:

- The unsolicited codes +WIND: 0 and +WIND: 1 (SIM presence notification) are not transmitted. However, the user can know if the SIM is present with the unsolicited result code +SNGPSERROR: 602 (no SIM). The unsolicited code +WIND: 4 guarantees that a valid SIM is present.
- The +WIND: 3 code is sent when the Amigo is ready to receive a reduced set of AT commands. The commands allowed before receiving +WIND: 4 code are the following: AT, AT+WSTR, AT+SNGPS?, AT+SNGPSPOS, AT+SNGPSVEL, AT+SNGPSTIME, AT+SNGPSUTC, AT+SNGPSMODE, AT+SNGPSCH, AT+SNGPSSV, AT+SNGPSDOPS, AT+SNGPSINIT, AT+SNGPSVER, y AT+SNGPSMANT.
  Any other command will answer ERROR.

The +WIND: 4 code notifies when the Amigo is ready to process any valid AT command.

3.3.2.21 Wavecom downloading: AT+WDWL

The actual software version does not support the AT+WDWL command

3.3.3 Supplementary commands

The *Amigo* GPS module provides more GPS specific commands given below.

3.3.3.1 AT+SNGPS?: Modem mode help

This command prints the GPS specific command list. This command is subject to change without notice, and is only implemented for user help.

Syntax: AT+SNGPS?<CR>

Response:

```
Extended GPS AT commands :
     AT+SNGPS?          -- Show help on AT cmds
     AT+SNGPSPOS        -- Show current position
     AT+SNGPSVEL        -- Show current velocity
     AT+SNGPSTIME       -- Show current GPS time
     AT+SNGPSUTC        -- Show current UTC time
     AT+SNGPSMODE       -- Show navigation mode
     AT+SNGPSCH         -- Show tracked satellites
     AT+SNGPSSV         -- Show used satellites
     AT+SNGPSDOPS       -- Show current DOPs
     AT+SNGPSDATUM      -- Datum configuration
     AT+SNGPSMASK       -- Navigation masks config
     AT+SNGPSINIT       -- Init GPS
     AT+SNGPSVER        -- Show SW/HW version
     AT+SNGPSNODE       -- Node configuration
     AT+SNGPSBASE       -- GSM base configuration
     AT+SNGPSRADIUS     -- Radius configuration
     AT+SNGPSCYCLES     -- Cycles configuration
     AT+SNGPSDISC       -- Discrete I/O
     AT+SNGPSERR        -- Error messages +SNGPS
     AT+SNGPSALARM      -- Alarm configuration
     AT+SNGPSMANT       -- Switch to mantenim mode
OK
```

3.3.3.2 AT+SNGPSMANT: Switch to maintenance mode

This command will switch the module to maintenance mode. The prompt ">" will be displayed.

Syntax: AT+SNGPSMANT<CR>

Response:

```
OK

<NAME> version <X.XX>
<Comment about the version>
Actual mode : mantenimiento
```

```
Enter '?' for help on available commands

>
```

To switch back to modem mode, send any AT command.

3.3.3.3 AT+SNGPSVER: HW/SW version

This command will poll the software and hardware version of the GPS module.

This command can be remotely called (see 4.4 TEXT MESSAGES on page 4.2)

Syntax: AT+SNGPSVER<CR>

Response: HW_VERSION SW_VERSION<CRLF>
OK<CRLF>

Notes:

- The hardware version is an alphanumeric string without spaces.
- A single space separates the HW and the SW version
- The software version is an alphanumeric string without spaces.

3.3.3.4 AT+SNGPSPOS: GPS position

This command outputs the last computed GPS position, in the current DATUM.

This command can be remotely called (see 4.4 TEXT MESSAGES on page 4.2)

Syntax: AT+SNGPSPOS<CR>

Response:

+SNGPSPOS: Q,S,AAAA.AAAA,BBBBB.BBBB,CCC.CCC<CRLF>
OK<CRLF>

Description:

- Q quality indicator:

- √ 0: Fix not available or invalid
- √ 1: "Not full 3D" solution (3D fixed alt, 2D, dead reckon, etc).
- √ 2: full 3D solution.

- S is the number of satellites used in the navigation solution (1 or 2 digits).
- AAAA.AAAA is the current latitude, in degrees, minutes, decimals of minute, with 4 decimals. The enter part length is variable. The decimal separator is the point, between minutes and decimals of minute. In case of negative latitude (south of the equator), a minus sign will be present before the value.
- BBBBB.BBBB is the current longitude, in degrees, minutes decimals of minute, with 4 decimals. The enter part length is variable. The decimal separator is the point, between minutes and decimals of minute. In case of negative latitude (west from 0º meridian), a minus sign will be present before the value.
- CCC.CCC is the altitude, in meters, with 3 decimals, relative to the current DATUM's reference ellipsoid. The decimal separator is the point, and the integer part length is variable. In case of negative altitude, a minus sign will be present before the value.

Note:

- The DOPs state (Dilution of precision) should be checked to validate a position.

3.3.3.5 AT+SNGPSVEL: GPS velocity

This command outputs the last computed GPS speed.

This command can be remotely called (see 4.4 TEXT MESSAGES on page 4.2)

Syntax: AT+SNGPSVEL<CR>

Response: +SNGPSVEL: VVV.VVVVVV,AAA.AAA<CRLF>
OK<CRLF>

Description:

- VVV.VVVVVV is the horizontal velocity (Course over Ground), in kilometers by hour, with 6 decimals. The decimal separator is the point, and the integer part length is variable (1 to 3 digits).
- AAA.AAA is the true bearing, with reference to the geographical north (not the magnetic north), 90º is east. The value is in degrees, with 3 decimals. The decimal separator is the point, and the integer part length is variable (1 to 3 digits, from 0 to 359).

3.3.3.6 AT+SNGPSTIME: GPS time

This command outputs the GPS time.

This command can be remotely called (see 4.4 TEXT MESSAGES on page 4.2)

Syntax: AT+SNGPSTIME<CR>

Response: +SNGPSTIME: AAAA,BBBBBBBB<CRLF>
OK<CRLF>

Description:

- AAAA (4 digits) is the extended GPS week number (e.g. not modulo 1024).
- BBBBBBBB (1 to 10 digits) is the TOW (time of week) in 100s of seconds.

3.3.3.7 AT+SNGPSUTC: UTC time

This command outputs UTC time (with leap seconds correction if available).

This command can be remotely called (see 4.4 TEXT MESSAGES on page 4.2)

Syntax: AT+SNGPSUTC<CR>

Response: +SNGPSUTC: YYYY,MM,DD,hh,mm,ss<CRLF>
OK<CRLF>

Description:

- YYYY (4 digits): year.
- MM (2 digits): month.
- DD (2 digits): day.
- hh (2 digits): UTC time (not the local time !).
- mm (2 digits): minutes.
- ss (2 digits): seconds.

3.3.3.8 AT+SNGPSCH: GPS tracking channels

This command outputs the list of tracked satellites.

Syntax: AT+SNGPSCH<CR>

Response: +SNGPSCH: XX1,AA1,EE1,SR1<CRLF>
+SNGPSCH: XX2,AA2,EE2,SR2<CRLF>
+SNGPSCH: XX3,AA3,EE3,SR3<CRLF>
...
+SNGPSCH: XXn,AAn,EEn,SRn<CRLF>
OK<CRLF>

Description:

- Only appear the active channels (12 max).
- Each field is of variable length, separated by commas, without space.
- XXi is the satellite number (1 to 32).

- AAi is the satellite azimuth (0 a 359 degrees, 1 to 3 digits, north = 0, East = 90).
- EEi is the satellite elevation (0 to 90 degrees, 1 to 2 digits, horizon = 0, vertical = 90).
- SR is the Noise/Signal ratio, in dB-Hz (1 to 2 digits).

3.3.3.9 AT+SNGPSSV: used satellites in the navigation

This command outputs the list of used satellites in the navigation solution.

This command can be remotely called (see 4.4 TEXT MESSAGES on page 4.2)

Syntax: AT+SNGPSSV<CR>

Response: +SNGPSSV: N,S_1,S_2, ... ,S_N <CRLF>

OK<CRLF>

Description:

- Only appear the satellites used in the navigation solution (12 max).
- N is the number of satellites in the response.
- S_i is the satellite number (1 to 32).
- The satellites can be in any order.
- The list may be empty (N = 0).

3.3.3.10 AT+SNGPSMODE: Navigation mode

This command outputs the navigation mode like it is defined in the SiRF protocol.

This command can be remotely called (see 4.4 TEXT MESSAGES on page 4.2)

Syntax: AT+SNGPSMODE<CR>

Response: +SNGPSMODE: XX<CRLF>

OK<CRLF>

Description:

- XX is the navigation mode (hexadecimal, 1 to 2 digits). See the SiRF documentation for more details).

3.3.3.11 AT+SNGPSDOPS: Dilution of precision

This command outputs the DOP of the actual solution.

This command can be remotely called (see 4.4 TEXT MESSAGES on page 4.2)

Syntax: `AT+SNGPSDOPS<CR>`

Response:

`+SNGPSDOPS: G.GGGG,H.HHHH,P.PPPP,T.TTTT,V.VVVV<CRLF>`
`OK<CRLF>`

Description:

- GG.GGGG is the GDOP (Geometric Dilution of Precision).
- HH.HHHH is the HDOP (Horizontal Dilution of Precision).
- PP.PPPP is the PDOP (Position Dilution of Precision).
- TT.TTTT is the TDOP (Time Dilution of Precision).
- VV.VVVV is the VDOP (Vertical Dilution of Precision).
- Each value has 4 decimals, and a variable integer part length (1 or 2 digits). The decimal separator is the point.

3.3.3.12 AT+SNGPSDATUM: DATUM configuration

This command allows reading and selecting the DATUM configuration.

Syntax: `AT+SNGPSDATUM?<CR>`: To read the actual DATUM.

`AT+SNGPSDATUM=XXX<CR>`: To select the DATUM to use, (XXX is the new DATUM number, 1 to 3 digits).

Response: `+SNGPSDATUM: XXX<CRLF>` (only in case of DATUM reading).

OK<CRLF>

Description:

- Currently supported DATUMS:
  - 1: WGS84.
  - 2: Ethiopia, Mali, Senegal, Sudan.
  - 3: Botswana, Lesotho, Malawi, Zaire, Zambia, Zimbabwe
  - 4: Australia and Tasmania.
  - 5: Bukit Rimpah (Indonesia).
  - 6: Camp Area Astro (Antarctic).
  - 7: Djakarta (Sumatra Island).
  - 8: European 1950.
  - 9: Geodetic Datum '49 (New Zealand).
  - 10: Ghana (WGS84).
  - 11: Great Britain '36 (England, Isle of Man, Shetland Isles, Wales).
  - 12: Guam 1963.
  - 13: Gunung Segara (S.E.Borneo).
  - 14: Gunung Serindung (S.W.Borneo).
  - 15: Herat North (Afghanistan).
  - 16: Hjorsey 1955 (Iceland).
  - 17: Hu-Tzu-Shan (Taiwan).
  - 18: India, Thailand, Nepal, Vietnam, Bangladesh.
  - 19: Ireland 1965.
  - 20: Kertau (Malayan Rev'd Triangulation) West Malaysia and Singapore.

- 21: Liberia 1964.
- 22: WGS84.
- 23: Luzon (Philippines excluding Mindanao).
- 24: Merchich (Morocco).
- 25: Montjong Lowe (Celebes Island).
- 26: Nigeria.
- 27: North Am 1927 (CONUS) (NAD-27).
- 28: North Am 1927 (Alaska/Canada).
- 29: Old HA, Maui.
- 30: Old HA, Oahu.
- 31: Old HA, Kauai.
- 32: Qornoq (S.Greenland).
- 33: SierraLeone '60.
- 34: S.Am: Provisional'56 (Bolivia, Chile, Colombia, Ecuador, Guyana, Peru, Venezuela).
- 35: S.Am: Corrego Alegre (Brazil).
- 36: S.Am: Campo Inchauspe (Argentina).
- 37: S.Am: Chua Astro (Paraguay).
- 38: S.Am: Yacare (Uruguay).
- 39: Tananarive Observatory '25 (Madagascar).
- 40: Timbalai '48 (Brunei and E.Malaysia-- Sarawak and Saba).
- 41: Tokyo (Japan, Korea, Okinawa).
- 42: Voirol (Algeria and Tunisia).
- 43: Indian special.

- 44: Luzon special.
- 45: Tokyo special.
- 46: WGS84.
- 47: WGS72.
- 178: Tokyo mean.
- 179: Tokyo Japan.
- 180: Tokyo Korea.
- 181: Tokyo Okinawa.

- Any other DATUM value will be interpreted as WGS84.

3.3.3.13 AT+SNGPSMASK: Read/configure nav masks

This command allows reading and configuring the navigation masks: DOP Mask, Elevation Mask, and Power Mask

Syntax: `AT+SNGPSMASK?`<CR>: To read the actual configuration.
`AT+SNGPSMASK=EN,ET,PN,PT,DM,GD,PD,HD`
<CR>: To set new mask values.

Response: `+SNGPSMASK: EN,ET,PN,PT,DM,GD,PD,HD`<CRLF>
`OK`<CRLF>

Description:

- EN (1 to 3 digits): Is the elevation limit for a satellite to be used in a navigation solution. Any satellite below this elevation will not be used in a navigation solution. Unit: 1/10 of degrees.
- ET (1 to 3 digits): Is the elevation limit for a satellite to be tracked. Any satellite below this elevation will not be tracked. Unit: 1/10 of degrees.
- PN (1 to 2 digits): Is the signal power limit for a satellite to be used in a navigation solution. Any satellite below this mask will not be used in a navigation solution. Unit: dB-Hz.

- PT (1 to 2 digits): Is the signal power limit for a satellite to be tracked. Any satellite below this mask will not be tracked. Unit: dB-Hz.
- DM (1 digit): Is the DOP mask type to use:
  - √ 0= Auto PDOP/HDOP.
  - √ 1= PDOP.
  - √ 2= HDOP.
  - √ 3= GDOP.
  - √ 4= Do not use DOP mask.
- GD (1 to 3 digits): Is the GDOP limit.
- PD (1 to 3 digits): Is the PDOP limit.
- HD (1 to 3 digits): Is the HDOP limit.
- Any parameter can be omitted. In this case, its value will not be altered. If the last parameters are omitted, the corresponding remaining commas can also be omitted.

3.3.3.14 AT+SNGPSINIT: GPS initialization

This command allows the user to init the GPS engine (cold, warm or hot start, reset factory settings).

This command can be remotely called (see 4.4 TEXT MESSAGES on page 4.2)

Syntax: `AT+SNGPSINIT=MODE,WNO,TOW,POSX,POSY,POSZ,CLK <CR>`

Response: `OK<CRLF>`

```
<NAME> version <X.XX>
<Comment about the version>
Actual mode : Wavecom Modem (AT commands)
Enter AT+SNGPSMANT to switch to mantenim mode
```

Description:

- MODE (1 digit): Start mode:
  - √ 1: Hot start.

- √ 2: Warm start. Any ephemeris data is lost.
- √ 4: Cold start. Any almanac data is lost.
- √ 8: Factory reset. Any GPS data is lost.

- WNO: Is the extended GPS week number (extended value: NOT the modulo 1024 value).
- TOW: Is the Time Of Week (number of seconds elapsed from the beginning of the current GPS week).
- POSX, POSY and POSZ: Are the estimated ECEF coordinates of the GPS Receiver position (in meters).
- CLK: Is the "Clock OFFSET" (in Hertz).
- Any parameter can be omitted. In this case, its value will not be altered. If the last parameters are omitted, the corresponding remaining commas can also be omitted. It the first parameter is missing, a cold start will be done by default.
- The Amigo will reset only if MODE is equal to 8. For other values, it will only answer OK.

3.3.3.15 AT+SNGPSNODE: Node number configuration

This command allows reading and configuring the node number.

Syntax: `AT+SNGPSNODE?`<CR>: To read the actual configuration.

`AT+SNGPSNODE=NNN`<CR>: To set a new node number.

Response: `+SNGPSNODE: NNN`<CRLF> (only in case of reading)

`OK`<CRLF>

Description:

- NNN: Is the node number (1 to 9 digits, 0 not allowed).

3.3.3.16 AT+SNGPSBASE: GSM control center configuration

This command allows reading and setting the GSM control center (base) configuration. This control center is used for remote configuration of the modem, and to receive and centralize data from the GPS module.

Syntax: `AT+SNGPSBASE?<CR>`: To read the actual configuration.

`AT+SNGPSBASE=NNN,TTTTTTT<CR>`: To change the actual configuration.

Response: `+SNGPSNODE: NNN,TTTTTTT<CRLF>` (only in case of reading)

`OK<CRLF>`

Description:

- NNN: Is the new GSM base node number (1 to 9 digits, 0 not allowed). See the chapter 4.4 TEXT MESSAGES on page 4.2 for more information about reserved base numbers.
- TTTTTTT: Is the GSM base phone number. This number must be entered with the international prefix (34 for Spain), and can be preceded by the "+" sign. However, in the read command, the "+" sign will never appear.
- Any parameter can be omitted. In this case, its value will not be altered. If the last parameters are omitted, the corresponding remaining commas can also be omitted.

3.3.3.17 AT+SNGPSRADIUS: Radius alarm configuration

This command allows reading and setting the radius alarm configuration.

This command can be remotely called (see 4.4 TEXT MESSAGES on page 4.2)

Syntax: AT+SNGPSRADIUS?<CR>: To read the actual configuration.

AT+SNGPSRADIUS=RRRR,AAAA,BBBB<CR>: To set a new radius configuration.

Response: +SNGPSRADIUS: RRRR,AAAA,BBBB<CRLF> (only in case of reading)
OK<CRLF>

Description:

- RRRR: Is the new radius, in meters (250m minimum). "0" will disable the radius alarm. Any value between 1 and 249 meters will return an error.
- AAAA and BBBB: Are respectively the latitude and the longitude of the circle center, in degrees. The decimal separator is the point. The read values are given with 6 decimals, but it is possible to set values with up to 9 decimals.
- The radius type is always the same: the alarm will occur if the GPS module gets out of the defined circle.
- Any parameter can be omitted. In this case, its value will not be altered. If the last parameters are omitted, the corresponding remaining commas can also be omitted.

3.3.3.18 AT+SNGPSCYCLES: Modem cycles configuration

This command allows reading and setting the cycle's configuration.

Syntax: AT+SNGPSCYCLES?<CR>: To read the actual configuration.

AT+SNGPSCYCLES=TA,TP,TV,TT,TU,TS,TM,TD<CR>
To set a new configuration

Response: +SNGPSCYCLES: TA,TP,TV,TT,TU,TS,TM,TD<CRLF> (only in case of reading)
OK<CRLF>

Description:

- TA: Is the Autoresponding time, in seconds (30s minimum, 60000s maximum). 0 will disable autoresponding cycles. Immediately after receiving a new valid configuration setting, the GPS module will send its first position to the GSM control center.

- TP,TV,TT,TU,TS,TM and TD: Control respectively the output periodicity of position, velocity, time, UTC, satellites, navigation mode, and navigation DOPs. For each value:

  √ The output periodicity is given in seconds (1 minimum, 255 maximum, 0 to disable the corresponding output). This time should not be used by the user as a time base, since the periodicity accuracy is not warranted.

  √ The periodicity activation/modification automatically reloads a "timer" that periodically sends the requested message.

  √ The periodic messages output format is exactly the same as the commands format: AT+SNGPSPOS, AT+SNGPSVEL, AT+SNGPSTIME, AT+SNGPSUTC, AT+SNGPSSV, AT+SNGPSMODE, and AT+SNGPSDOPS.

  √ The periodic messages output is suspended while the user is waiting for the answer of a GSM user command (e.g. dial, SMS reading, etc).

- Any parameter can be omitted. In this case, its value will not be altered. If the last parameters are omitted, the corresponding remaining commas can also be omitted.

3.3.3.19 AT+SNGPSMAXCYCLES: Cycles limitation

This command allows reading and setting the autoresponding cycles limitation.

Syntax: `AT+SNGPSMAXCYCLES?`<CR>: To read the actual configuration.

`AT+SNGPSMAXCYCLES=N`<CR>
To set a new configuration

Response: `+SNGPSMAXCYCLES: N`<CRLF> (only in case of reading)

OK<CRLF>

Description:

- N is the maximum number of autoresponding cycles. After N autoresponding cycles sent, the autoresponding cycles configuration will be erased (time set to 0). The value must be between 1 and 99999. The default value is 250.
- The new value is automatically stored in non volatile memory.
- Resetting the Amigo will also reset the internal autoresponding cycles counter to 0.

3.3.3.20 AT+SNGPSDISC: Discrete I/O

This command allows reading the discrete input, and writing the discrete output.

This command can be remotely called (see 4.4 TEXT MESSAGES on page 4.2)

Syntax: AT+SNGPSDISC?<CR>: To read the discrete input.

AT+SNGPSDISC=X<CR>: To set the discrete output state (**0** to **activate** it: set the level to 0V, **1** to **deactivate** it: let the open drain port floating).

Response: +SNGPSDISC: 1<CRLF> (only when reading the discrete input. 1 means a high level (> 3V), 0 a low level (< 1V)).

OK<CRLF>

Description:

- The Amigo-W has one discrete input (isolated by an optocoupler), and a discrete output (open drain).
- The discrete input accepts levels from 0 to 12V. The entry impedance value is 1000 ohms. Any level inferior at 1V will be interpreted as 0, any level superior at 3V will interpreted as 1.

- The discrete output is an open drain (50mA max, 12Vmax). **It is considered active at 0V**

3.3.3.21 AT+SNGPSERR: Internal error codes

This command allows the user to enable or disable unsolicited error codes from the Amigo.

Syntax: `AT+SNGPSERR?`<CR>: To read the actual state (if the unsolicited error codes are enabled or not, and to get the last error number).

`AT+SNGPSERR=X`<CR>: To enable or disable unsolicited error codes. 0 to disable, 1 to enable (default value).

Response: `+SNGPSERR: X,YYY`<CRLF> : only when reading the state. X is 0 or 1 (0: unsolicited error codes disabled, 1: enabled). YYY (1 to 3 digits) is the last occurred error code.

`OK`<CRLF>

Description:

- By default, the Amigo sends unsolicited error codes if it encounters an internal problem (internal failure, SIM card failure, etc). This command allows the user to enable or disable these unsolicited messages.
- The unsolicited error message format is the following:
  `+SNGPSERROR: XXX`<CRLF>
  (where XXX is a 1 to 3 digits error code)
- The error codes list is in the Table 3.a: Amigo error codes.

Table 3.a: Amigo error codes

Code	Signification
600	Internal error
601	The GSM phone does not answer. May be absent or broken

602	No SIM inserted in the SIM connector, or connector failure
603	SIM failure
604	The SIM card needs PIN, PIN2, PUK o PUK2 code
605	Unassigned number: the Amigo internally intented to send a message to an unassigned number
606	The network barred a call (any call): check SIM
607	The network barred a specific call
608	A SMS message was rejected
609	Unidentified subscriber: check SIM
610	Facility rejected: check SIM
611	Unknown subscriber: check SIM
612	Facility not subscribed: check SIM
613	Facility not implemented: check la SIM and operator
614	ME SMS service reserved: check SIM
615	SC address unknown: message center not configured.
616	Failed to send a message. Check message center address or SIM card.
617	Internal error during phone initialization.

3.3.3.22 AT+SNGPSALARM: discrete alarm configuration

This command allows reading and setting the discrete alarm configuration.

Syntax: `AT+SNGPSALARM?`<CR>: To read the actual configuration.

`AT+SNGPSALARM=T,LLLLL`<CR>: To set a new alarm configuration.

Response: `+SNGPSALARM: T,LLLLL<CRLF>` (only in case of reading)
`OK<CRLF>`

Description:

- T: Is the alarm type :
  0: No alarm
  1: Alarm when the input is high
  2: Alarm when the input is low
  3: Alarm when low to high transition on the input
  4: Alarm when high to low transition on the input

- LLLLL (up to 5 digits: 99 seconds): Latency time, in milliseconds (approximate).
  If the alarm is by state (T=1 or 2), the input must remain active al least LLLLL ms to trigger the alarm.
  If the alarm is by transition (T=3 or 4), the input must remain LLLLL ms in inactive state, and then LLLL ms in active state to trigger the alarm.

- Note: if the alarm is by level (T=1 or 2), the alarm will only be sent once, until the input gets inactive during LLLLL ms.

- The discrete input is sampled at 200ms rate. Then the latency time precision will be 200ms. The configuration value will be rounded up to the next 200ms.
  Example 1: the commands AT+SNGPSALARM=1,0 and AT+SNGPSALARM=1,200 have the same effect: the alarm will be sent when the discrete input will be sampled one time at high level.
  Example 2: the commands AT+SNGPSALARM=1,201 and AT+SNGPSALARM=1,400 will send an alarm when the discrete input is sampled twice at high level.

- The alarm detection only starts when the GSM is ready (+WIND: 4 unsolicited code sent if AT+WIND is correctly configured).

3.3.3.23 AT+SNGPSNMEA: switch to NMEA protocol

This command switches the Amigo to NMEA protocol (4800 bauds).

Syntax: `AT+SNGPSNMEA<CR>`

Response: OK<CRLF>

The Amigo then resets and switches to NMEA protocol (4800 buads).

Description:

This command switches the Amigo to the NMEA protocol (4800 bauds). To switch back to AT mode, enter an AT command.

3.3.4 Parameters storage in non volatile memory

The Amigo can store most of its configuration in non volatile memory. Some parameters will be stored in the SIM module, others directly in the modem The Table 3.b : parameters storage shows how parameters are stored in non volatile memory.

Table 3.b : parameters storage

Command	AT&W	AT+CSAS	AT&F	Default value
+CMEE	SIM		X	0
+CSCS	AMIGO		X	PCCP437
ATS0				0 (fixed)
+CICB	AMIGO		X	2
+VGR	AMIGO		X	64 (all speakers)
+VGT	AMIGO		X	64 (all microphones)
+SPEAKER			RESET	1 (see notes)
+SIDET	AMIGO		X	1,1
+CREG				0 (fixed)
+WAIP				0 (fixed)
+CMGF	SIM		X	1
+CSDH	AMIGO		X	0
+CNMI		SIM	X	2,1,0,0,0
+CSMP		AMIGO	X	1,167,0,0
+CSCA		SIM	RESET	Depends on SIM card (phase2)
+CCWA	AMIGO		X	0 (fixed)
+CLIP	AMIGO		X	0
+COLP	AMIGO		X	0

+CBST	AMIGO		X	0,0,1
+CRLP	AMIGO		X	61,61,48,6,0
+CR	AMIGO		X	0
+CRC	SIM		X	0
+IPR				9600 (fixed)
+IFC	SIM		X	2,2
+ICF				3,4 (fixed)
E	SIM		X	1
&C				1 (fixed)
&D	SIM		X	1
&S	SIM		X	1
Q				0 (fixed)
V				1 (fixed)
+DOPT	AMIGO		X	1.1
%C	AMIGO		X	2
\N	AMIGO		X	0
+DS	AMIGO		X	3,0,4096,20
+DR	AMIGO		X	0
+FDC, +FIDS	AMIGO		X	0,5,0,0,2,0,0,0,0
+FCQ	AMIGO		X	0
+FCR	AMIGO		X	1
+FPHCTO	AMIGO		X	30
+FBOR	AMIGO		X	0
+ECHO	AMIGO		X	0,255,1000,5,500,63 (echo cancel) 0,0,3,10,7,0 (switch attenuation)
+WIND	AMIGO (see notes)		X	0
+SNGPSERR	SIM		X	1
+SNGPSALARM	SIM		X	0,2000
+SNGPSCYCLES	SIM (see notes)		X (see notes)	0,0,0,0,0,0,0,0
+SNGPSMAXCYCLES	SIM (see notes)			250

Notes:

- X: The corresponding parameter is loaded with AT&F command.

- Reset: The parameter will only be loaded on hardware reset, or when the corresponding command is executed to update the configuration.

- Amigo: the parameter is stored in the Amigo.

- SIM: the parameter is stored in the SIM card.

- AT+SPEAKER command: this command allows to choose the current microphone and speaker for voice calls. The default parameter (1) corresponds to the only speaker and microphone supported by the Amigo. Therefore it is normally useless to change the configuration.

- The parameters stored in the SIM card need a few seconds to load, when the Amigo is powered-up. The +WIND: 4 unsolicited code can be used to detect when the modem is ready with all updated parameters.

- The AT+WIND command automatically stores its settings in non volatile memory. AT&F resets the value to 0.

- The AT+SNGPSCYCLES command is divided in two parts:
  > The first parameter (autoresponding time) is automatically stored in non volatile memory when the configuration command is executed.
  > The other parameters are stored with the AT&W command.
  The commands ATZ and AT&F do not alter the autoresponding time.

- The AT+SNGPSMAXCYCLES command automatically stores its value in the SIM card. The default value will only be used when a new SIM is inserted. The commands ATZ and AT&F do no alter the parameter.

3.4 SIRF MODE

The SiRF mode communication parameters are the followings:

- 38400 bauds
- 8 data bits, no parity
- 1 stop bit

This SiRF protocol is fully compatible with the SiRF specifications, except for the Poll SW Version frame, that currently switch the module to maintenance protocol.

3.4.1 SiRF Binary Protocol

The SiRF Binary Protocol is the standard interface protocol used by the modem *Amigo* GPS Receiver and other SENA GPS and SiRF products.

This serial communication protocol is designed to include:

- Reliable transport of messages
- Ease of implementation
- Efficient implementation
- Independence from payload

3.4.2 Protocol Layers

Transport Message

Start Sequence	Payload Length	Payload	Message Checksum	End Sequence
0xA0[1] 0xA2	Two-bytes (15-bits)	Up to 2 10^{-1} (<1023)	Two-bytes (15-bits)	0xB0, 0xB3,

1. 0xYY denotes a hexadecimal byte value. 0xA0 equals 160.

Transport

The transport layer of the protocol encapsulates a GPS message in two start characters and two stop characters. The values are chosen to be easily identifiable and unlikely to occur frequently in the data. In addition, the transport layer prefixes the message with a two-byte (15-bit) message length and a two-byte (15-bit) check sum. The values of the start and stop characters and the choice of a 15-bit value for length and check sum ensure message length and check sum can not alias with either the stop or start code.

Message Validation

The validation layer is of part of the transport, but operates independently. The byte count refers to the payload byte length. The check sum is a sum on the payload.

3.4.3 Payload Length

The payload length is transmitted high order byte first followed by the low byte.

High Byte	Low Byte
< 0x7F	Any value

Even though the protocol has a maximum length of (2 15 -1) bytes, practical considerations require the Albatros GPS module implementation to limit this value to a smaller number.

3.4.4 Payload Data

The payload data follows the payload length. It contains the number of bytes specified by the payload length. The payload data may contain any 8-bit value.

Where multi-byte values are in the payload data neither the alignment nor the byte order are defined as part of the transport although SiRF payloads will use the big-endian order.

3.4.5 Checksum

The check sum is transmitted high order byte first followed by the low byte. This is the so-called big-endian order.

High Byte	Low Byte
< 0x7F	Any value

The checksum is 15-bit checksum of the bytes in the payload data. The following pseudo code defines the algorithm used.

Let message to be the array of bytes to be sent by the transport.

Let msgLen be the number of bytes in the message array to be transmitted.

Index = first

checkSum = 0

while index < msgLen

checkSum = checkSum + message[index]

checkSum = checkSum AND (2^15 -1).

3.4.6 Input Messages for SiRF Binary Protocol

Note: All input messages are sent in **BINARY** format.

Table 2-4-6-a lists the message list for the SiRF input messages.

Table 2-4-6-a SiRF Messages - Input Message List

Hex	ASCII	Name
0 x 80	128	Initialize Data Source
0 x 81	129	Switch to NMEA Protocol
0 x 82	130	Set Almanac (upload)
0 x 84	132	Software Version (Poll)
0 x 85	133	DGPS Source Control
0 x 86	134	Set Main Serial Port
0 x 87	135	Set Protocol
0 x 88	136	Mode Control
0 x 89	137	DOP Mask Control
0 x 8A	138	DGPS Mode
0 x 8B	139	Elevation Mask
0 x 8C	140	Power Mask
0 x 8D	141	Editing Residual
0 x 8E	142	Steady-State Detection - Not Used
0 x 8F	143	Static Navigation
0 x 90	144	Clock Status (Poll)
0 x 91	145	Set DGPS Serial Port
0 x 92	146	Almanac (Poll)
0 x 93	147	Ephemeris (Poll)
0 x 95	149	Set Ephemeris (upload)
0 x 96	150	Switch Operating Mode
0 x 97	151	Set Low Power operation
0 x 98	152	Navigation Parameters (Poll)
0 x A7	167	Low Power Acquisition Parameters

3.4.6.1 Initialize Data Source - Message I.D. 128

Table 2-4-6-1-a contains the input values for the following example:

Warm start the receiver with the following initialization data: ECEF XYZ (-2686727 m, -4304282 m, 3851642 m), Clock Offset (75,000 Hz), Time of Week (86,400 s), Week Number (924), and Channels (12). Raw track data enabled, Debug data enabled.

Example: A0A20019—Start Sequence and Payload Length

80FFD700F9FFBE5266003AC57A000124F80083D600039C0C33—Payload

0A91B0B3—Message Checksum and End Sequence

Table 2-4-6-1-a Initialize Data Source

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		80		ASCII 128
ECEF X	4		FFD700F9	meters	
ECEF Y	4		FFBE5266	meters	
ECEF Z	4		003AC57A	meters	
Clock Offset	4		000124F8	Hz	
Time of Week	4	*100	0083D600	seconds	
Week Number	2		039C		
Channels	1		0C		Range 1-12
Reset Config.	1		01		See Table 2-4-6-1-b

Payload Length: 25 bytes

Table 2-4-6-1-b Reset Configuration Bitmap

Bit	Description
0	Data valid flag—set warm/hot start
1	Clear ephemeris—set warm start
2	Clear memory—set cold start
3	Factory Reset
4	Enable debug output data for navigation library (YES=1, NO=0)
5	Enable debug data for SiRF binary protocol (YES=1, NO=0)
6	Enable debug data for NMEA protocol (YES=1, NO=0)
7	Reserved (must be 0).

Note: If Nav Lib data is ENABLED then the resulting messages are enabled. Clock Status (MID 7), 50 BPS (MID 8), Raw DGPS (17), NL Measurement Data (MID 28), DGPS Data (MID 29), SV State Data (MID 30), and NL Initialize Data (MID 31). All messages are sent at 1 Hz and the baud rate will be automatically set to 57600.

3.4.6.2 Switch To NMEA Protocol - Message I.D. 129

Table 2-4-6-2-a contains the input values for the following example:

Request the following NMEA data at 4800 baud:

GGA – ON at 1 sec, GLL – OFF, GSA - ON at 5 sec, GSV – ON at 5 sec, RMC-OFF, VTG-OFF

Example:

A0A20018—Start Sequence and Payload Length

810201010001050105010001000100010001000 1000112C0—Payload

016AB0B3—Message Checksum and End Sequence

Table 2-4-6-2-a Switch To NMEA Protocol

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		81		ASCII 129
Mode	1		02	1/s	Always 0x02 to switch to NMEA mode
GGA Message[1]	1		01		See Appendix A for format
Checksum[2]	1		01		
GLL Message	1		00	1/s	See Appendix A for format
Checksum	1		01		
GSA Message	1		05	1/s	See Appendix A for format
Checksum	1		01		
GSV Message	1		05	1/s	See Appendix A for format
Checksum	1		01		
MSS Message	1		00	1/s	Should always be 0 (DGPS not available)
Checksum	1		01		
RMC Message	1		00	1/s	See Appendix A for format.
Checksum	1		01		
VTG Message	1		00	1/s	See Appendix A for format.
Checksum	1		01		
Unused Field	1		00		Recommended value

Unused Field	1		01		Recommended value
Unused Field	1		00		Recommended value
Unused Field	1		01		Recommended value
Unused Field	1		00		Recommended value
Unused Field	1		01		Recommended value
Unused Field	1		00		Recommended value
Unused Field	1		01		Recommended value
Baud Rate	2		12C0		38400,19200,9600,4800,2400

Payload Length: 24 bytes.

1. A value of 0x00 implies NOT to send message, otherwise data is sent at 1 message every X seconds requested (e.g. to request a message to be sent every 5 seconds, request the message using a value of 0x05.) Maximum rate is 1/255s.

2. A value of 0x00 implies the checksum NOT transmitted with the message (not recommended). A value of 0x01 will have a checksum calculated and transmitted as part of the message (recommended).

Note: In Trickle Power mode, update rate is specified by the user. When you switch to NMEA protocol, message update rate is also required. The resulting update rate is the product of the Trickle Power Update rate and the NMEA update rate (e.g. Trickle Power update rate = 2 seconds, NMEA update rate = 5 seconds, resulting update rate is every 10 seconds, (2 X 5)

3.4.6.3 Set Almanac – Message I.D. 130

This command enables the user to upload an almanac file to the modem *Amigo* GPS Receiver.

3.4.6.4 Software Version – Message I.D. 132

Table 2-4-6-4-a contains the input values for the following example:

Poll the software version

Example:

A0A20002—Start Sequence and Payload Length

8400—Payload

0084B0B3—Message Checksum and End Sequence

Table 2-4-6-4-a Software Version

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		84		ASCII 132
TBD	1		00		Reserved

Payload Length: 2 bytes

Current version of the receiver software will be returned in response to this message, in a zero-terminated string format.

Note: In the actual version, the Poll SW Version command turns the GPS receiver in Maintenance/Modem mode. Therefore, the module will not answer to this command.

3.4.6.5 DGPS Source - Message I.D. 133

The *Amigo* GPS receiver does not support differential corrections. Therefore, this command should not be used.

3.4.6.6 Set Main Serial Port - Message I.D. 134

Table 2-4-6-6-a contains the input values for the following example:

Set Main Serial port to 9600,n,8,1.

Example:

A0A20009—Start Sequence and Payload Length

860000258008010000—Payload

0134B0B3—Message Checksum and End Sequence

Table 2-4-6-6-a Set Main Serial Port

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		86		decimal 134
Baud	4		00002580		38400,19200,9600,4800,2400,1200
Data Bits	1		08		8,7
Stop Bit	1		01		0,1
Parity	1		00		None=0, Odd=1, Even=2
Pad	1		00		Reserved

Payload Length: 9 bytes

3.4.6.7 Set Protocol - Message I.D. 135

This message sets the protocol to specified parameters. After reception of this message, the module will restart with the new protocol. Selection will be preserved in SRAM.

Table 2-4-6-7-a contains the input values for the following example:

Set Protocol to maintenance/modem

Example:

A0A20002—Start Sequence and Payload Length

8704—Payload

008BB0B3—Message Checksum and End Sequence

Table 2-4-6-7-a Set Main Serial Port

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		87		decimal 135
New protocol[1]	1		04		Switch to maintenance/modem protocol

Payload Length: 2 bytes

1. Values for protocol selection:
   - 0: SiRF protocol
   - 1: NMEA protocol
   - 4: Maintenance/modem protocol (9600 bauds, 8,N,1)

   Do not use any other value.

3.4.6.8 Mode Control - Message I.D. 136

Table 2-4-6-8-a contains the input values for the following example:

3D Mode = Always, Alt Constraining = Yes, Degraded Mode = clock then direction, TBD=1, DR Mode = Yes, Altitude = 0, Alt Hold Mode = Auto, Alt Source =Last Computed, Coast Time Out = 20, Degraded Time Out=5, DR Time Out = 2, Track Smoothing = Yes

Example: A0A2000E—Start Sequence and Payload Length

88010101010100000002140501—Payload

00A9B0B3—Message Checksum and End Sequence

Table 2-4-6-8-a Mode Control

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		88		ASCII 136
3D Mode	1		01		1 (always true=1)
Alt Constraint					Not Used
Degraded Mode	1		01		See Table 2-4-6-8-b
TBD	1		01		Reserved
DR Mode	1		01		YES=1, NO=0
Altitude	2		0000	meters	range -1,000 to 10,000
Alt Hold Mode	1		00		Auto=0, Always=1,Disable=2
Alt Source	1		02		Last Computed=0,Fixed to=1
Coast Time Out					Not Used
Degraded Time Out	1		05	seconds	0 to 120
DR Time Out	1		01	seconds	0 = disabled. 1 to 120 otherwise
Track Smoothing	1		01		YES=1, NO=0

Payload Length: 14 bytes

Table 2-4-6-8-b Degraded Mode Byte Value

Byte Value	Description
0	Use Direction then Clock Hold
1	Use Clock then Direction Hold
2	Direction (Curb) Hold Only
3	Clock (Time) Hold Only
4	Disable Degraded Modes.

3.4.6.9 DOP Mask Control - Message I.D. 137

Table 2-4-6-9-acontains the input values for the following example:

Auto Pdop/Hdop, Gdop =8 (default), Pdop=8,Hdop=8

Example: A0A20005—Start Sequence and Payload Length

8900080808—Payload

00A1B0B3—Message Checksum and End Sequence

Table 2-4-6-9-a DOP Mask Control

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		89		ASCII 137
DOP Selection	1		00		See Table 2-4-6-9-b
GDOP Value	1		08		Range 1 to 50
PDOP Value	1		08		Range 1 to 50
HDOP Value	1		08		Range 1 to 50

Payload Length: 5 bytes

Table 2-4-6-9-b DOP Selection

Byte Value	Description
0	Auto PDOP/HDOP
1	PDOP
2	HDOP
3	GDOP
4	Do Not Use.

3.4.6.10 DGPS Control - Message I.D. 138

The *Amigo* GPS receiver does not support differential corrections. Therefore, this command should not be used.

3.4.6.11 Elevation Mask – Message I.D. 139

Table 2-4-6-11-a contains the input values for the following example:

Set Navigation Mask to 15.5 degrees (Tracking Mask is defaulted to 5 degrees).

Example: A0A20005—Start Sequence and Payload Length

8B0032009B—Payload

0158B0B3—Message Checksum and End Sequence

Table 2-4-6-11-a Elevation Mask

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		8B		ASCII 139
Tracking Mask	2	*10	0032	degrees	Not currently used
Navigation Mask	2	*10	009B	degrees	Range -20.0 to 90.0

Payload Length: 5 bytes

3.4.6.12 Power Mask - Message I.D. 140

Table 2-4-6-12-a contains the input values for the following example:

Navigation mask to 33 dBHz (tracking default value of 28)

Example: A0A20003—Start Sequence and Payload Length

8C1C21—Payload

00C9B0B3—Message Checksum and End Sequence

Table 2-4-6-12-a Power Mask

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		8C		ASCII 140
Tracking Mask	1		1C	dBHz	Not currentlv implemented
Navigation Mask	1		21	dBHz	Range 28 to 50.

Payload Length: 3 bytes

3.4.6.13 Editing Residual– Message I.D. 141

Note: Not implemented

3.4.6.14 Steady State Detection - Message I.D. 142

Note: Not implemented

3.4.6.15 Static Navigation– Message I.D. 143

Note: Not supported

3.4.6.16 Poll Clock Status – Message I.D. 144

Clock status message will be returned in response to this message.

Table 2-4-6-16-a contains the input values for the following example:

Poll the clock status.

Example: A0A20002—Start Sequence and Payload Length

9000—Payload

0090B0B3—Message Checksum and End Sequence

Table 2-4-6-16-a Clock Status

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		90		ASCII 144
TBD	1		00		Reserved

Payload Length: 2 bytes

3.4.6.17 Set DGPS Serial Port - Message I.D. 145

The *Amigo* GPS receiver does not support differential corrections. Therefore, this command should not be used.

3.4.6.18 Poll Almanac - Message I.D. 146

In response to this message receiver will return 32 almanac data packets, one for each SVID available.

Table 2-4-6-18-a contains the input values for the following example:

Poll for the Almanac.

Example: A0A20002—Start Sequence and Payload Length

9200—Payload

0092B0B3—Message Checksum and End Sequence

Table 2-4-6-18-a Almanac

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		92		ASCII 146
TBD	1		00		Reserved

Payload Length: 2 bytes

3.4.6.19 Poll Ephemeris - Message I.D. 147

In response to this message, the receiver will return a MID_Ephemeris message with the ephemeris data for the requested SV. SV numbers range from 1-32 inclusive. If SVID 0 is requested, the module will respond by sending ephemeris data for all SV's.

Table 2-4-6-19-a contains the input values for the following example:

Poll for Ephemeris Data for all satellites.

Example: A0A20003—Start Sequence and Payload Length

930000—Payload

0092B0B3—Message Checksum and End Sequence

Table 2-4-6-19-a Ephemeris

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		93		ASCII 147
Sv I.D[1]	1		00		Range 0 to 32
TBD	1		00		Reserved

Payload Length: 3 bytes

1. A value of 0 requests all available ephemeris records; otherwise the ephemeris of the Sv I.D. is requested.

3.4.6.20 Switch Operating Modes - Message I.D. 150

This command is reserved for manufacturing testing purposes only.

3.4.6.21 Set TricklePower Parameters - Message I.D. 151

Table 2-4-6-21-a contains the input values for the following example:

Sets the receiver into low power Modes.

Example: Set receiver into Trickle Power at 1 Hz update and 200 ms On Time.

A0A20009—Start Sequence and Payload Length

97000000C8000000C8—Payload

0227B0B3—Message Checksum and End Sequence

Table 2-4-6-21-a Set Trickle Power Parameters

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		97		ASCII 151
Push To Fix Mode	2		0000		ON = 1, OFF = 0
Duty Cycle	2	*10	00C8	%	% Time ON
Milli Seconds On Time	4		000000C8	ms	range 200 - 900 ms

Payload Length: 9 bytes

If an update rate of 1 second is selected, then the on-time greater than 600ms is invalid.

3.4.6.22 Computation of Duty Cycle and On Time

The Duty Cycle is the desired time to be spent tracking. The On Time is the duration of each tracking period (range is 200 - 900 ms). To calculate the TricklePower update rate as a function of Duty Cycle and On Time, use the following formula:

$$\text{Off Time} = \text{On Time} - \frac{(\text{Duty Cycle} * \text{On Time})}{\text{Duty Cycle}}$$

$$\text{Update rate} = \text{Off Time} + \text{On Time}$$

Note: On Time inputs of > 900 ms will default to 1000 ms.

Following are some examples of selections:

Table 2-4-6-22-a Example of Selections for Trickle Power Mode of Operation

Mode	On Time (ms)	Duty Cycle (%)	Update Rate (1/Hz)
Continuous	1000	100	1
Trickle Power	200	20	1
Trickle Power	200	10	2
Trickle Power	300	10	3
Trickle Power	500	5	10

Note: To confirm the receiver is performing at the specified duty cycle and ms On Time, see "The 12-Channel Signal Level View Screen" The C/No data bins will be fully populated at 100% duty and only a single C/No data bin populated at 20% duty cycle. Your position should be updated at the computed update rate.

Table B-26 Trickle Power Mode Support

On Time (ms)	Update Rate (sec)									
	1	2	3	4	5	6	7	8	9	10
200	Y[1]	Y	Y	Y	Y	Y	Y	Y	Y	Y
300	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
400	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
500	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
600	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
700	N[2]	Y	Y	Y	Y	Y	Y	Y	Y	Y
800	N[2]	Y	Y	Y	Y	Y	Y	Y	Y	Y
900	N[2]	Y	Y	Y	Y	Y	Y	Y	Y	Y

1. Y = Yes (Mode supported)
2. 2. N = No (Duty cycle >50% = FP)

3.4.6.23 Push-to-Fix

In this mode the receiver will turn on every 30 minutes to perform a system update consisting of a RTC calibration and satellite ephemeris data collection if required (e.g. a new satellite has become visible) as well as all software tasks to support Snap Start in the event of an NMI. Ephemeris collection time in general takes 18 to 30 seconds. If ephemeris data is not required then the system will re-calibrate and shut down. In either case, the amount of time the receiver remains off will be in proportion to how long it stayed on:

$$\text{Off period} = \frac{\text{On Period}*(1-\text{Duty Cycle})}{\text{Duty Cycle}}$$

Off Period is limited to 30 minutes. The duty cycle will not be less than approximately On Period/1800, or about 1%. Push-to-Fix keeps the ephemeris for all visible satellites up to date so position/velocity fixes can generally be computed within Snap Start times (when requested by the user) on the order of 3 seconds.

3.4.6.24 Poll Navigation Parameters - Message I.D. 152

Table 2-4-6-21-a contains the input values for the following example:

Example: Poll receiver for current navigation parameters.

A0A20002—Start Sequence and Payload Length

9800—Payload

0098B0B3—Message Checksum and End Sequence

Table 2-4-6-24-a Poll Receiver for Navigation Parameters

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		98		ASCII 152
Reserved	1		00		Reserved

Payload Length: 2 bytes

3.4.6.25 Low Power Acquisition - Message I.D. 167

Table 2-4-6-25-a contains the input values for the following example:

Set maximum off and search times for re-acquisition while receiver is in low power.

Example: A0A20019—Start Sequence and Payload Length

A7000075300001D4C00000000000000000000000000000000—Payload

02E1B0B3—Message Checksum and End Sequence

Table 2-4-6-25-a Set Low Power Acquisition Parameters

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		A7		Decimal 167
Max Off Time	4		00007530	ms	Maximum time for sleep mode
Max Search Time	4		0001D4C0	ms	Max. satellite search time
TBD	4		00000000		Reserved
TBD	4		00000000		Reserved
TBD	4		00000000		Reserved
TBD	4		00000000		Reserved

Payload Length: 25 bytes

3.4.7 Output Messages for SiRF Binary Protocol

Table 2-4-7-a lists the message list for the SiRF output messages.

Table 2-4-7-a SiRF Messages - Output Message List

Hex	ASCII	Name	Description
0 x 02	2	Measured Navigation Data	Position, velocity, and time
0 x 03	3	True Tracker Data	Not Implemented
0 x 04	4	Measured Tracking Data	Satellite and C/No information.
0 x 05	5	Raw Track Data	Raw measurement data
0 x 06	6	SW Version	Receiver software
0 x 07	7	Clock Status	Current clock status
0 x 08	8	50 BPS Subframe Data	Standard ICD format
0 x 09	9	Throughput	Navigation complete data
0 x 0A	10	Error ID	Error coding for message failure

0 x 0B	11	Command Acknowledgment	Successful request
0 x 0C	12	Command NAcknowledgment	Unsuccessful request
0 x 0D	13	Visible List	Auto Output
0 x 0E	14	Almanac Data	Response to Poll
0 x 0F	15	Ephemeris Data	Response to Poll
0 x 10	16	Test Mode Data	For use with test [1]
0 x 11	17	Differential Corrections	Received from DGPS broadcast
0 x 12	18	OkToSend	CPU ON / OFF (Trickle Power)
0 x 13	19	Navigation Parameters	Response to Poll
0 x 1C	28	Nav. Lib	Measurement Data Measurement Data
0 x 1D	29	Nav. Lib	DGPS Data Differential GPS Data
0 x 1E	30	Nav. Lib	SV State Data Satellite State Data
0 x 1F	31	Nav. Lib.	Initialization Data Initialization Data
0 x FF	255	Development Data	Various status messages

1. Test is production testing software tool.

3.4.7.1 Measured Navigation Data Out - Message I.D. 2

Output Rate: 1 Hz

Table 2-4-7-1-a lists the binary and ASCII message data format for the measured navigation data.

Example: A0A20029—Start Sequence and Payload Length

02FFD6F78CFFBE536E003AC00400030104A00036B039780E3

0612190E160F04000000000000—Payload

09BBB0B3—Message Checksum and End Sequence

Table 2-4-7-1-a Measured Navigation Data Out - Binary & ASCII Message Data Format

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		02			2
X-position	4		FFD6F78C	m		-2689140
Y-position	4		FFBE536E	m		-4304018
Z-position	4		003AC004	m		3850244
X-velocity	2	*8	00	m/s	Vx%8	0
Y-velocity	2	*8	03	m/s	Vx%8	0.375
Z-velocity	2	*8	01	m/s	Vx%8	0.125
Mode[1]	1		04	Bitmap[1]		4
DOP[2]	1	*5	A		/5	2.0
Mode[2]	1		00	Bitmap[3]		0
GPS Week	2		036B			875
GPS TOW	4	*100	039780E3	seconds	¸/100	602605.79
SVs in Fix	1		06			6
CH 1	1		12			18
CH 2	1		19			25
CH 3	1		0E			14
CH 4	1		16			22
CH 5	1		0F			15
CH 6	1		04			04
CH 7	1		00			00
CH 8	1		00			00
CH 9	1		00			00
CH 10	1		00			00
CH 11	1		00			00
CH 12	1		00			00

Payload Length: 41 bytes.

1. For further information, go to Table 2-4-7-1-b.
2. Dilution of precision (DOP) field contains the HDOP value only.
3. For further information, go to Table 2-4-7-1-c.

Note: Binary units scaled to integer values need to be divided by the scale value to receive true decimal value (e.g. decimal X_{vel} = binary $X_{vel}/8$).

Table 2-4-7-1-b Mode 1

Mode 1		Description
Hex	ASCII	
0 x 00	0	No Navigation Solution
0 x 01	1	1 Satellite Solution
0 x 02	2	2 Satellite Solution
0 x 03	3	3 Satellite Solution (2D)
0 x 04	4	>=4 Satellite Solution (3D)
0 x 05	5	2D Point Solution (Least Square)
0 x 06	6	3D Point Solution (Least Square)
0 x 07	7	Dead Reckoning
0 x 08	8	Trickle Power Position
0 x 10	16	Altitude Used From Filter
0 x 20	32	Altitude Used From User
0 x 30	48	Forced Altitude (From User)
0 x 40	64	DOP Mask Exceeded
0 x 80	128	DGPS Position

Example: A value of 0 x 84 (132) is a DGPS >4 Satellite Solution (3D).

Table 2-4-7-1-c Mode 2

Mode 2		Description
Hex	ASCII	
0 x 00	0	Sensor Data
0 x 01	1	Validated (1), Unvalidated (0)
0 x 02	2	if set, Dead Reckoning (Time Out)
0 x 03	3	if set, Output Edited by UI (e.g. DOP Mask exceeded)
0 x 04	4	Reserved
0 x 05	5	Reserved
0 x 06	6	Reserved
0 x 07	7	Reserved

3.4.7.2 Measured Tracker Data Out - Message I.D. 4

Output Rate: 1 Hz

Table B-39 lists the binary and ASCII message data format for the measured tracker data.

Example:

A0A200BC—Start Sequence and Payload Length

04036C0000937F0C0EAB46003F1A1E1D1D191D 1A1A1D1F1D59423F1A1A...—Payload

....B0B3—Message Checksum and End Sequence

Table 2-4-7-2-a Measured Tracker Data Out

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		04	None		4
GPS Week	2		036C			876
GPS TOW	4	s*100	0000937F	s	S/100	37759
Chans	1		0C			12
1st SVid	1		0E			14
Azimuth	1	Az*[2/3]	AB	deg	/[2/3]	256.5
Elev	1	El*2	46	deg	/2	35
State	2		003F	Bitmap[1]		0 x 3F
C/No 1	1		1A			26
C/No 2	1		1E			30
C/No 3	1		1D			29
C/No 4	1		1D			29
C/No 5	1		19			25
C/No 6	1		1D			29
C/No 7	1		1A			26
C/No 8	1		1A			26
C/No 9	1		1D			29
C/No 10	1		1F			31
2nd SVid	1		1D			29
Azimuth	1	Az*[2/3]	59	deg	/[2/3]	89
Elev	1	El*2	42	deg	/2	66
State	2		3F	Bitmap 1		63
C/No 1	1		1A			26
C/No 2	1		1A			63
....						

Payload Length: 188 bytes.

1. For further information, go to Table 2-4-7-2-b.

Note: Message length is fixed to 188 bytes with nontracking channels reporting zero values.

Table 2-4-7-2-b TrktoNAVStruct.trk_status Field Definition

Field Definition	Hex Value	Description
ACQ_SUCCESS	0x0001	Set, if acq/reacq is done successfully
DELTA_CARPHASE_VALID	0x0002	Set, Integrated carrier phase is valid
BIT_SYNC_DONE	0x0004	Set, Bit sync completed flag
SUBFRAME_SYNC_DONE	0x0008	Set, Subframe sync has been done
CARRIER_PULLIN_DONE	0x0010	Set, Carrier pullin done
CODE_LOCKED	0x0020	Set, Code locked
ACQ_FAILED	0x0040	Set, Failed to acquire S/V
GOT_EPHEMERIS	0x0080	Set, Ephemeris data available

Note: When a channel is fully locked and all data is valid, the status shown is 0 x BF.

3.4.7.3 Raw Tracker Data Out - Message I.D. 5

GPS Pseudo-Range and Integrated Carrier Phase Computations Using SiRF Binary Protocol

This section describes the necessary steps to compute the GPS pseudo-range, pseudo-range rate, and integrated carrier phase data that can be used for post processing applications such as alternative navigation filters. This data enables the use of third party software to calculate and apply differential corrections based on the SiRF binary protocol.

SiRF Binary Data Messages

The Albatros GPS provides a series of output messages as described in this Guide.

This is the raw data message required to compute the pseudo-range and carrier data. The ephemeris data can be polled by the user or requested at specific intervals with customized software. Currently, there is no support for the automatic saving of the ephemeris when an update ephemeris is decoded.

Output Rate: 1 Hz

Table 2-4-7-3-a lists the binary and ASCII message data format for the raw tracker data.

Example:

A0A20033—Start Sequence and Payload Length

0500000070013003F00EA1BD4000D039200009
783000DF45E

000105B5FF90F5C2000024282727232724242729
0500000070013003F—Payload

0B2DB0B3—Message Checksum and End Sequence

Note: The data that is sent from the modem *Amigo* GPS Receiver is in binary format. Albatros converts the data to ASCII for the log file. Data is NOT output in ASCII format.

Table 2-4-7-3-a Raw Tracker Data Out

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		05			5
Channel	4		00000007			7
SVid	2		0013			19
State	2		003F	Bitmap[1]		0 x 3F
Bit Number	4		00EA1BD4	bit		15342548
Millisecond Number	2		000D	ms		13
Chip Number	2		0392	chip		914
Code Phase	4	2 16	00009783	chip	/2 16	38787
Carrier Doppler	4	2 10	000DF45E	radians/2 ms	/2 10	914526
Receiver Time Tag	4		000105B5	ms		66997
Delta Carrier 2	4	2 10	FF90F5C2	cycles	/2 10	-7277118
Search Count	2		0000			0
C/No 1	1		24	dBHz		36
C/No 2	1		28	dBHz		40
C/No 3	1		27	dBHz		39
C/No 4	1		27	dBHz		39
C/No 5	1		23	dBHz		35
C/No 6	1		27	dBHz		39
C/No 7	1		24	dBHz		36
C/No 8	1		27	dBHz		36
C/No 9	1		29	dBHz		39
C/No 10	1		29	dBHz		41
Power Bad Count	1		05			5
Phase Bad Count	1		07			7
Accumulation Time	2		0013	ms		19
Track Loop Time	2		003F			63

Payload Length: 51 bytes.

1. For further information, go to Table 2-4-7-2-b.
2. Multiply by (1000 / 4pi) /□2 ^{16} to convert to Hz.

Note: The status is reflected by the value of all bits as the receiver goes through each stage of satellite acquisition. The status will have a 0xBF value when a channel is fully locked and all data is valid.

Message ID: Each SiRF binary message is defined based on the ID.

Channel: Receiver channel where data was measured (range 1-12).

SVID: PRN number of the satellite on current channel.

State: Current channel tracking state (see Table 2-4-7-2-b).

Bit Number: Number of GPS bits transmitted since Sat-Sun midnight (in Greenwich) at a 50 bps rate.

Millisecond Number: Number of milliseconds of elapsed time since the last received bit (20 ms between bits).

Chip Number: Current C/A code symbol being transmitted (range 0 to 1023 chips; 1023 chips = 1 ms).

Code Phase: Fractional chip of the C/A code symbol at the time of sampling (scaled by 2 -16 , = 1/65536).

Carrier Doppler: The current value of the carrier frequency as maintained by the tracking loops.

Note: The Bit Number, Millisecond Number, Chip Number, Code Phase, and Carrier Doppler are all sampled at the same receiver time.

Receiver Time Tag: This is the count of the millisecond interrupts from the start of the receiver (power on) until the measurement sample is taken.

The ms interrupts are generated by the receiver clock.

Delta Carrier Phase: The difference between the carrier phase (current) and the carrier phase (previous). Units are in carrier cycles with the LSB = 0.00185 carrier cycles. The delta time for the accumulation must be known.

Note: Carrier phase measurements are not necessarily in sync with code phase measurement for each measurement epoch.

Search Count: This is the number of times the tracking software has completed full satellite signal searches.

C/No: Ten measurements of carrier to noise ratio (C/No) values in dBHz at input to the receiver. Each value represents 100 ms of tracker data and its sampling time is not necessarily in sync with the code phase measurement.

Power Loss Count: The number of times the power detectors fell below the threshold between the present code phase sample and the previous code phase sample. This task is performed every 20 ms (max count is 50).

Phase Loss Count: The number of times the phase lock fell below the threshold between the present code phase sample and the previous code phase sample. This task is performed every 20 ms (max count is 50).

Integration Interval: The time in ms for carrier phase accumulation. This is the time difference (as calculated by the user clock) between the Carrier Phase (current) and the Carrier Phase (previous).

Track Loop Iteration: The tracking Loops are run at 2 ms and 10 ms intervals. Extrapolation values for each interval is 1 ms and 5 ms for range computations.

3.4.7.4 Software Version String - Message I.D. 6

Output Rate: Response to polling message

Example:

A0A20015—Start Sequence and Payload Length

0606312E322E30444B495431313920534D0000000000—Payload

0382B0B3—Message Checksum and End Sequence

*Table 2-4-7-4-a*Software Version String

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		06			6
Character	20		1			2

Payload Length: 21 bytes.

1. 06312E322E30444B495431313920534D0000000000
2. 1.2.0DKit119 SM

Note: Convert to symbol to assemble message (e.g. 0 x 4E is 'N'). These are low priority task and are not necessarily output at constant intervals.

Note: The actual version of the SW does not send this message: the Poll SW version command is interpreted as a protocol switch (to maintenance/modem)

3.4.7.5 Response: Clock Status Data - Message I.D. 7

Output Rate: 1 Hz or response to polling message

Example:

A0A20014—Start Sequence and Payload Length

0703BD02154924082231 7923DAEF—Payload

0598B0B3—Message Checksum and End Sequence

Table 2-4-7-4-a Clock Status Data Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		07			7
GPS Week	2		03BD			957
GPS TOW	4	*100	02154924	s	/100	349494.12
Svs	1		08			8
Clock Drift	4		2231	Hz		74289
Clock Bias	4		7923	nano s		128743715
Estimated GPS Time	4		DAEF	milli s		349493999

Payload Length: 20 bytes

3.4.7.6 50 BPS Data – Message I.D. 8

Output Rate: As available (12.5 minute download time)

Example:

A0A2002B—Start Sequence and Payload Length

08001900C0342A9B688AB0113FDE2D714FA0A7F FFACC5540157EFFEEDFFFA

80365A867FC67708BEB5860F4—Payload

15AAB0B3—Message Checksum and End Sequence

Table 2-4-7-6-a 50 BPS Data

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		08			8
Channel	1		00			0
Sv I.D	1		19			25
Word[10]	40.					

Payload Length: 43 bytes per subframe (5 subframes per page)

Note: Data is logged in ICD format (available from www.navcen.uscg.mil). The ICD specification is 30-bit words. The output above has been stripped of parity to give a 240-bit frame instead of 300 bits.

3.4.7.7 CPU Throughput – Message I.D. 9

Output Rate: 1 Hz

Example: A0A20009—Start Sequence and Payload Length

09003B0011001601E5—Payload

0151B0B3—Message Checksum and End Sequence

Table 2-4-7-7-a CPU Throughput

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		09			9
SegStatMax	2	*186	003B	milli s	/186	.3172
SegStatLat	2	*186	0011	milli s	/186	.0914
AveTrkTime	2	*186	0016	milli s	/186	.1183
Last MS	2		01E5	milli s		485

Payload Length: 9 bytes

3.4.7.8 Command Acknowledgment – Message I.D. 11

Output Rate: Response to successful input message

This is successful almanac (message ID 0x92) request **example:**

A0A20002—Start Sequence and Payload Length

0B92—Payload

009DB0B3—Message Checksum and End Sequence

Table 2-4-7-8-a Command Acknowledgment

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0B			11
Ack. I.D	1		92			146

Payload Length: 2 bytes

3.4.7.9 Command NAcknowledgment – Message I.D. 12

Output Rate: Response to rejected input message

This is an unsuccessful almanac (message ID 0x92) request **example:**

A0A20002—Start Sequence and Payload Length

0C92—Payload

009EB0B3—Message Checksum and End Sequence

Table 2-4-7-9-a Command Nacknowledgment

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0C			12
NAck. I.D.	1		92			146

Payload Length: 2 bytes

3.4.7.10 Visible List – Message I.D. 13

Output Rate: Updated approximately every 2 minutes

Note: This is a variable length message. Only the number of visible satellites is reported (as defined by Visible Svs in Table 2-4-7-10-a). Maximum is 12 satellites.

Example: A0A2002A—Start Sequence and Payload Length

0D081D002A00320F009C0032....—Payload

....B0B3—Message Checksum and End Sequence

Table 2-4-7-10-a Visible List

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0D			13
Visible Svs	1		08			8
CH 1 - Sv I.D.	1		10			16
CH 1 - Sv Azimuth	2		002A	degrees		42
CH 1 - Sv Elevation	2		0032	degrees		50
CH 2 - Sv I.D.	1		0F			15
CH 2 - Sv Azimuth	2		009C	degrees		156
CH 2 - Sv Elevation	2		0032	degrees		50
.....						

3.4.7.11 Almanac Data - Message I.D. 14

Output Rate: Response to poll

Example: A0A203A1—Start Sequence and Payload Length

0E01....—Payload

....B0B3—Message Checksum and End Sequence

Table 2-4-7-11-a Almanac Data

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0E			14
Sv I.D	1		01			1
AlmanacData[14][2]	28					

Payload Length: 30 bytes

Note: Each almanac entry is output in a single message.

3.4.7.12 Ephemeris Data – Message I.D. 15

The ephemeris data that is polled from the receiver is in a special SiRF format based on the ICD- GPS -200 format for ephemeris data.

3.4.7.13 OkToSend - Message I.D. 18

Output Rate: Trickle Power CPU on/off indicator

Example:

A0A20002—Start Sequence and Payload Length

1200—Payload

0012B0B3—Message Checksum and End Sequence

Table 2-4-7-13-a OkToSend parameters

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		12			18
Send Indicator[1]	1		00			00

Payload Length: 2 bytes.

1. 0 implies that CPU is about to go OFF, OkToSend==NO, 1 implies CPU has just come ON, OkToSend==YES

3.4.7.14 Navigation Parameters – Message I.D. 19

Output Rate: 1 Response to Poll

Example:

A0A20018—Start Sequence and Payload Length

13010000000011E3C0104001E004B1E0000050 0016400C8—Payload

022DB0B3—Message Checksum and End Sequence

Table 2-4-7-14-a Navigation Parameters

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		13			19
Reserved	4					
Altitude Hold Mode	1		00			0
Altitude Hold Source	1		00			0
Altitude Source Input	2		0000	meters		0
Degraded Mode[1]	1		01			1

Degraded Timeout	1		1E	seconds		30
DR Timeout	1		3C	seconds		60
Track Smooth Mode	1		01			1
Static Navigation	1					
3SV Least Squares	1					
Reserved	4					
DOP Mask Mode[2]	1		04			4
Navigation Elevation Mask	2					
Navigation Power Mask	1					
Reserved	4					
DGPS Source[3]	1					
DGPS Mode[3]	1		00			0
DGPS Timeout[3]	1		1E	seconds		30
Reserved	4					
LP Push-to-Fix	1					
LP On-time	4					
LP Interval	4					
LP User Tasks Enabled	1					
LP User Task Interval	4					
LP Power Cycling Enabled	1					
LP Max. Acq. Search Time	4					
LP Max. Off Time	4					
Reserved	4					
Reserved	4					

Payload Length: 65 bytes.

1. See Table 2-4-6-8-a.
2. See Table 2-4-6-9-a.
3. Do not use

3.4.7.15 Navigation Measurement Data - Message I.D. 28

Output Rate: Every measurement cycle (full power / continuous: 1Hz)

Example:

A0A20038—Start Sequence and Payload Length

1C00000660D015F143F62C4113F42FF3FBE95E4
17B235C468C6964B8FBC5824

15CF1C375301734.....03E801F400000000—
Payload

1533B0B3—Message Checksum and End Sequence

Table 2-4-7-15-a Measurement Data

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		1C			28
Channel	1		00			
Time Tag	4		000660D0	ms		
Satellite ID	1		15			
GPS Software Time	8		F143F62C4113F42F	ms		
Pseudo-range	8		F3FBE95E417B235C	m		
Carrier Frequency	4		468C6964			
Carrier Phase	8		B8FBC582415CF1C3			
Time in Track	2		7530	ms		
Sync Flags	1		17			
C/No 1	1	34				

C/No 2	1					
C/No 3	1					
C/No 4	1					
C/No 5	1					
C/No 6	1					
C/No 7	1					
C/No 8	1					
C/No 9	1					
C/No 10	1					
Delta Range Interval	2		03E801F4	m		
Mean Delta Range Time	2		01F4	ms		
Extrapolation Time	2		0000	ms		
Phase Error Count	1		00			
Low Power Count	1		00			

Payload Length: 56 bytes.

3.4.7.16 Navigation Library DGPS Data - Message I.D. 29

Output Rate: Every measurement cycle (full power / continuous: 1Hz)

Example:

A0A2001A—Start Sequence and Payload Length

1D000F00B501BFC97C673CAAAAAB3FBFFE1240A0000040A00000—Payload

0956B0B3—Message Checksum and End Sequence

Table 2-4-7-16-a Measurement Data

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		1D			29
Satellite ID	2		000F			15
IOD	2		00B5			181
Source[1]	1		01			1
Pseudo-range Correction	4		BFC97C67	m		3217652839
Pseudo-range rate Correction	4		3CAAAAAB	m/s		1017817771
Correction Age	4		3FBFFE12	s		1069547026
Reserved	4					
Reserved	4					

Payload Length: 26 bytes.

1. 0 = Use no corrections, 1 = Use WAAS channel, 2 = Use external source, 3 = Use Internal Beacon, 4 = Set DGPS Corrections

3.4.7.17 Navigation SV State Data - Message I.D. 30

Output Rate: Every measurement cycle (full power / continuous: 1Hz)

Example:

A0A20053—Start Sequence and Payload Length

1E15....2C64E99D01....408906C8—Payload

2360B0B3—Message Checksum and End Sequence

Table 2-4-7-17-a SV State Data

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		1E			30
Satellite ID	1		15			21
GPS Time	8			s		
Position X	8			m		
Position Y	8			m		
Position Z	8			m		
Velocity X	8			m/s		
Velocity Y	8			m/s		
Velocity Z	8			m/s		
Clock Bias	8			s		
Clock Drift	4		2C64E99D	s/s		744810909
Ephemeris Flag[1]	1		01			1
Reserved	8					
Ionospheric Delay	4		408906C8	m		1082721992

Payload Length: 83 bytes

1. 0 = no valid SV state, 1 = SV state calculated from ephemeris, 2 = Satellite state calculated from almanac

3.4.7.18 Navigation Initialization Data - Message I.D. 31

Output Rate: Every measurement cycle (full power / continuous: 1Hz)

Example:

A0A20054—Start Sequence and Payload Length

1F....00000000000001001E000F....00....0000000
00F....00....02....043402....

....02—Payload

0E27B0B3—Message Checksum and End Sequence

Table 2-4-7-18-a Measurement Data

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		1F			31
Reserved	1					
Altitude Mode [1]	1		00			0
Altitude Source	1		00			0
Altitude	4		00000000			0
Degraded Mode[2]	1		01			1
Degraded Timeout	2		001E			30
Dead-reckoning Timeout	2		000F			15
Reserved	2					
Track Smoothing Mode[3]	1		00			0
Reserved	1					
Reserved	2					
Reserved	2					
Reserved	2					

DGPS Selection [4]	1		00			0
DGPS Timeout	2		0000			0
Elevation Nav. Mask	2		000F			15
Reserved	2					
Reserved	1					
Reserved	2					
Reserved	1					
Reserved	2					
Static Nav. Mode[5]	1		00			0
Reserved	2					
Position X	8					
Position Y	8					
Position Z	8					
Position Init. Source[6]	1		02			2
GPS Time	8					
GPS Week	2		0434			1076
Time Init. Source[7]	1		02			2
Drift	8					
Drift Init. Source[8]	1		02			2

Payload Length: 84 bytes

1. 0 = Use last know altitude 1 = Use user input altitude 2 = Use dynamic input from external source
2. 0 = Use direction hold and then time hold 1 = Use time hold and then direction hold 2 = Only use direction hold 3 = Only use time hold 4 = Degraded mode is disabled
3. 0 = True 1 = False
4. 0 = Use DGPS if available 1 = Only navigate if DGPS corrections are available 2 = Never use DGPS corrections
5. 0 = True 1 = False
6. 0 = ROM position 1 = User position 2 = SRAM position 3 = Network assisted position
7. 0 = ROM time 1 = User time 2 = SRAM time 3 = RTC time 4 = Network assisted time
8. 0 = ROM clock 1 = User clock 2 = SRAM clock 3 = Calibration clock 4 = Network assisted clock

3.4.7.19 Development Data – Message I.D. 255

Output Rate: Receiver generated

Example:

A0A2....—Start Sequence and Payload Length

FF....—Payload

....B0B3—Message Checksum and End Sequence

Table 2-4-7-19-a Development Data

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		FF			255

Payload Length: Variable

Note: MID 255 is output when SiRF binary is selected and development data is enabled. The data output using MID 255 is essential for SiRF assisted troubleshooting support.

3.5 NMEA MODE

The NMEA mode is fully compatible with the NMEA-0183 format defined by the National Marine Electronics Association, Standard for Interfacing Marine Electronic Devices, version 2.20, 01/01/1997.

3.5.1 NMEA Output Messages

Table 2-5-1-a lists each of the NMEA output messages supported by the modem *Amigo* GPS Receiver and a brief description.

Table 2-5-1-a NMEA Output Messages

Option	Description
GGA	Time, position and fix type data.
GLL	Latitude, longitude, UTC time of position fix and status.
GSA	GPS receiver operating mode, satellites used in the position solution, and DOP values.
GSV	The number of GPS satellites in view satellite ID numbers, elevation, azimuth, and SNR values.
MSS	Signal-to-noise ratio, signal strength, frequency, and bit rate from a radio-beacon receiver.
RMC	Time, date, position, course and speed data.
VTG	Course and speed information relative to the ground.

The next sections of this chapter provide a full description and definition of the listed NMEA messages.

3.5.1.1 GGA —Global Positioning System Fixed Data

Table 2-5-1-1-a contains the values for the following example:

$GPGGA,161229.487,3723.2475,N,12158.3416,W,1,07,1.0,9.0,M, , , ,0000*18

Table 2-5-1-1-a GGA Data Format

Name	Example	Units	Description
Message ID	$GPGGA		GGA protocol header
UTC Time	161229.487		hhmmss.sss
Latitude	3723.2475		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.3416		dddmm.mmmm
E/W Indicator	W		E=east or W=west
Position Fix Indicator	1		See Table 2-5-1-1-b
Satellites Used	07		Range 0 to 12
HDOP	1.0		Horizontal Dilution of Precision
MSL Altitude 1	9.0	meters	
Units	M	meters	
Geoid Separation[1]		meters	
Units	M	meters	
Age of Diff. Corr		second	Null fields when DGPS is not used
Diff. Ref. Station ID	0000		
Checksum	*18		
<CR> <LF>			End of message termination

1. Albatros GPS Receiver does not support geoid corrections. Values are WGS84 ellipsoid heights.

Table 2-5-1-1-b Position Fix Indicator

Value	Description
0	Fix not available or invalid
1	GPS SPS Mode, fix valid
2	Differential GPS, SPS Mode, fix valid
3	GPS PPS Mode, fix valid.

3.5.1.2 GLL—Geographic Position - Latitude/Longitude

Table 2-5-1-2-a contains the values for the following example:

$GPGLL,3723.2475,N,12158.3416,W,161229.487,A*2C

Table 2-5-1-2-a GLL Data Format

Name	Example	Units	Description
Message ID	$GPGLL		GLL protocol header
Latitude	3723.2475		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.3416		dddmm.mmmm
E/W Indicator	W		E=east or W=west
UTC Position	161229.487		hhmmss.sss
Status	A		A=data valid or V=data not valid
Checksum	*2C		
<CR> <LF>			End of message termination

3.5.1.3 GSA—GNSS DOP and Active Satellites

Table 2-5-1-3-a contains the values for the following example:

$GPGSA,A,3,07,02,26,27,09,04,15, , , , , ,1.8,1.0,1.5*33

Table 2-5-1-3-a GSA Data Format

Name	Example	Units	Description
Message ID	$GPGSA		GSA protocol header
Mode 1	A		See Table 2-5-1-3-b
Mode 2	3		See Table 2-5-1-3-c
Satellite Used[1]	07		Sv on Channel 1
Satellite Used[1]	02		Sv on Channel 2
....	....		
Satellite Used[1]			Sv on Channel 12
PDOP	1.8		Position Dilution of Precision
HDOP	1.0		Horizontal Dilution of Precision
VDOP	1.5		Vertical Dilution of Precision
Checksum	*33		
<CR> <LF>			End of message termination

1. Satellite used in solution.

Table 2-5-1-3-b Mode 1

Value	Description
M	Manual—forced to operate in 2D or 3D mode
A	2DAutomatic—allowed to automaticallv switch 2D/3D

Table 2-5-1-3-c Mode 2

Value	Description
1	Fix Not Available
2	2D
3	3D

3.5.1.4 GSV—GNSS Satellites in View

Table 2-5-1-4-a contains the values for the following example:

$GPGSV,2,1,07,07,79,048,42,02,51,062,43,26,36,256,42,27,27,138,42*71

$GPGSV,2,2,07,09,23,313,42,04,19,159,41,15,12,041,42*41

Table 2-5-1-4-a GSV Data Format

Name	Example	Units	Description
Message ID	$GPGSV		GSV protocol header
Number of Messages[1]	2		Range 1 to 3
Message Number[1]	1		Range 1 to 3
Satellites in View	07		
Satellite ID	07		Channel 1 (Range 1 to 32)
Elevation	79	degrees	Channel 1 (Maximum 90)
Azimuth	048	degrees	Channel 1 (True, Range 0 to 359)
SNR (C/No)	42	dBHz	Range 0 to 99, null when not tracking
....	....	....	....
Satellite ID	27		Channel 4 (Range 1 to 32)
Elevation	27	degrees	Channel 4 (Maximum 90)
Azimuth	138	degrees	Channel 4 (True, Range 0 to 359)
SNR (C/No)	42	dBHz	Range 0 to 99, null when not tracking
Checksum	*71		
<CR> <LF>			End of message termination

1. Depending on the number of satellites tracked multiple messages of GSV data may be required.

3.5.1.5 MSS—MSK Receiver Signal

Differential corrections are not available in the *Amigo* GPS Receiver. Therefore, this message should not be used.

3.5.1.6 RMC—Recommended Minimum Specific GNSS Data

Table 2-5-1-6-a contains the values for the following example:

$GPRMC,161229.487,A,3723.2475,N,12158.3416,W,0.13,309.62,120598, ,*10

Table 2-5-1-6-a RMC Data Format

Name	Example	Units	Description
Message ID	$GPRMC		RMC protocol header
UTC Time	161229.487		hhmmss.sss
Status	A		A=data valid or V=data not valid
Latitude	3723.2475		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.3416		dddmm.mmmm
E/W Indicator	W		E=east or W=west
Speed Over Ground	0.13		knots
Course Over Ground	309.62	degrees	True
Date	120598		ddmmyy
Magnetic Variation[1]		degrees	E=east or W=west
Checksum	*10		
<CR> <LF>			End of message termination

1. Albatros GPS receiver does not support magnetic declination. All "course over ground" data are geodetic WGS84 directions.

3.5.1.7 VTG—Course Over Ground and Ground Speed

Table 2-5-1-7-a contains the values for the following example:

$GPVTG,309.62,T, ,M,0.13,N,0.2,K*6E

Table 2-5-1-7-a VTG Data Format

Name	Example	Units	Description
Message ID	$GPVTG		VTG protocol header
Course	309.62	degrees	Measured heading
Reference	T		True
Course degrees			Measured heading
Reference	M		Magnetic 1
Speed	0.13		knots Measured horizontal speed
Units	N		Knots
Speed	0.2	km/hr	Measured horizontal speed
Units	K		Kilometers per hour
Checksum	*6E		
<CR> <LF>			End of message termination.

1. Albatros GPS receiver does not support magnetic declination. All "course over ground" data are geodetic WGS84 directions.

3.5.2 NMEA Input Messages

NMEA input messages are provided to allow you to control the modem *Amigo* while in NMEA protocol mode. The GPS Receiver may be put into NMEA mode by sending the SiRF Binary protocol message "Switch To NMEA Protocol - Message I.D. 129" using a user program and selecting Switch to NMEA Protocol from the Action menu. If the receiver is in SiRF Binary mode, all NMEA input messages are ignored. Once the receiver is put into NMEA mode, the following messages may be used to command the module.

Transport Message

Start Sequence	Payload	Checksum	End Sequence
$PSRF<MID>[1]	Data[2]	*CKSUM[3]	<CR> <LF>[4]

1. Message Identifier consisting of three numeric characters. Input messages begin at MID 100.
2. Message specific data. Refer to a specific message section for <data>...<data> definition.
3. CKSUM is a two-hex character checksum as defined in the NMEA specification. Use of checksums is required on all input messages.
4. Each message is terminated using Carriage Return (CR) Line Feed (LF), which is \r\n, which is hex 0D 0A. Because \r\n are not printable ASCII characters, they are omitted from the example strings, but must be sent to terminate the message and cause the receiver to process that input message.

Note: All fields in all proprietary NMEA messages are required, none are optional. All NMEA messages are comma delimited.

NMEA Input Messages

Message	MID[1]	Description
SetSerialPort	100	Set PORT A parameters and protocol
NavigationInitialization	101	Parameters required for start using X/Y/Z[2]
SetDGPSPort	102	Set PORT B parameters for DGPS input
Query/Rate Control	103	Query standard NMEA message and/or set output rate
LLANavigationInitialization	104	Parameters required for start using Lat/Lon/Alt[3]
Development Data On/Off	105	Development Data messages On/Off
MSK Receiver Interface	MSK	Command message to a MSK radio-beacon receiver.

1. Message Identification (MID).
2. Input coordinates must be WGS84.
3. Input coordinates must be WGS84.

Note: NMEA input messages 100 to 105 are SiRF proprietary NMEA messages. The MSK NMEA string is as defined by the NMEA 0183 standard.

3.5.2.1 100—SetSerialPort

This command message is used to set the protocol (SiRF Binary or NMEA) and/or the communication parameters (baud, data bits, stop bits, parity). Generally, this command is used to switch the module back to SiRF Binary protocol mode where a more extensive command message set is available. When a valid message is received, the parameters are stored in battery-backed SRAM and then the modem *Amigo* GPS Receiver restarts using the saved parameters.

Table 2-5-2-1-a contains the input values for the following example:

Switch to SiRF Binary protocol at 9600,8,N,1

$PSRF100,0,9600,8,1,0*0C

Table 2-5-2-1-a Set Serial Port Data Format

Name	Example	Units	Description
Message ID	$PSRF100		PSRF100 protocol header
Protocol	0		0=SiRF Binary, 1=NMEA, 4=maintenance/modem
Baud[1]	9600		4800, 9600, 19200, 38400
DataBits[2]	8		8,7
StopBits	1		0,1
Parity	0		0=None, 1=Odd, 2=Even
Checksum	*0C		
<CR> <LF>			End of message termination.

1. Maintenance/modem protocol should be 9600,8,N,1.
2. SiRF protocol is only valid for 8 data bits, 1stop bit, and no parity.

3.5.2.2 101—Navigation Initialization

This command is used to initialize the modem *Amigo* GPS Receiver by providing current position (in X, Y, Z coordinates), clock offset, and time. This enables the modem *Amigo* GPS Receiver to search for the correct satellite signals at the correct signal parameters. Correct initialization parameters enable the modem *Amigo* GPS Receiver to acquire signals quickly.

Table 2-5-2-2-a contains the input values for the following example:

Start using known position and time.

$PSRF101,-2686700,-4304200,3851624,96000,497260,921,12,3*1C

Table 2-5-2-2-a Navigation Initialization Data Format

Name	Example	Units	Description
Message ID	$PSRF101		PSRF101 protocol header
ECEF X	-2686700	meters	X coordinate position
ECEF Y	-4304200	meters	Y coordinate position
ECEF Z	3851624	meters	Z coordinate position
ClkOffse t	96000	Hz	Clock Offset of the Albatros GPS[1]
TimeOfWeek	497260	seconds	GPS Time Of Week
WeekNo	921		GPS Week Number
ChannelCount	12		Range 1 to 12
ResetCfg	3		See Table 2-5-2-2-b
Checksum	*1C		
<CR> <LF>			End of message termination

1. Use 0 for last saved value if available. If this is unavailable, a default value of 96,000 will be used.

Table 2-5-2-2-b Reset Configuration

Hex	Description
0x01	Hot Start— All data valid
0x02	Warm Start—Ephemeris cleared
0x03	Warm Start (with Init)—Ephemeris cleared, initialization data loaded
0x04	Cold Start—Clears all data in memory
0x08	Clear Memory—Clears all data in memory and resets receiver back to factory defaults.

3.5.2.3 102—SetDGPSPort

Differential corrections are not available in the *Amigo* GPS Receiver. Therefore, this message should not be used.

3.5.2.4 103—Query/Rate Control

This command is used to control the output of standard NMEA messages GGA, GLL, GSA, GSV, RMC, and VTG. Using this command message, standard NMEA messages may be polled once, or setup for periodic output. Checksums may also be enabled or disabled depending on the needs of the receiving program. NMEA message settings are saved in battery-backed memory for each entry when the message is accepted.

Table 2-5-2-4-a contains the input values for the following examples:

1. Query the GGA message with checksum enabled

   $PSRF103,00,01,00,01*25

2. Enable VTG message for a 1 Hz constant output with checksum enabled

   $PSRF103,05,00,01,01*20

3. Disable VTG message

   $PSRF103,05,00,00,01*21

Table 2-5-2-4-a Query/Rate Control Data Format (See example 1.)

Name	Example	Units	Description
Message ID	$PSRF103		PSRF103 protocol header
Msg	00		See Table 2-5-2-4-b
Mode	01		0=SetRate, 1=Query
Rate	00	seconds	Output—off=0, max=255
CksumEnable	01		0=Disable Checksum. 1=Enable Checksum
Checksum	*25		
<CR> <LF>			End of message termination

Table 2-5-2-4-b Messages

Value	Description
0	GGA
1	GLL
2	GSA
3	GSV
4	RMC
5	VTG

Note: In TricklePower mode, update rate is specified by the user. When you switch to NMEA protocol, message update rate is also required. The resulting update rate is the product of the TricklePower Update rate and the NMEA update rate (e.g. TricklePower update rate = 2 seconds, NMEA update rate = 5 seconds, resulting update rate is every 10 seconds, (2 X 5 = 10).

3.5.2.5 104—LLA Navigation Initialization

This command is used to initialize the modem *Amigo* GPS Receiver by providing current position (in latitude, longitude, and altitude coordinates), clock offset, and time. This enables the receiver to search for the correct satellite signals at the correct signal parameters. Correct initialization parameters enable the receiver to acquire signals quickly.

Table 2-5-2-5-a contains the input values for the following example:

Start using known position and time.

$PSRF104,37.3875111,-121.97232,0,96000,237759,1946,12,1*07

Table 2-5-2-5-a LLA Navigation Initialization Data Format

Name	Example	Units	Description
Message ID	$PSRF104		PSRF104 protocol header
Lat	37.3875111	degrees	Latitude position (Range 90 to -90)
Lon	-121.97232	degrees	Longitude position (Range 180 to -180)
Alt	0	meters	Altitude position
ClkOffset	96000	Hz	Clock Offset of the modem Amigo GPS[1]
TimeOfWeek	237759	seconds	GPS Time Of Week
WeekNo	1946		Extended GPS Week Number (1024 added)
ChannelCount	12		Range 1 to 12
ResetCfg	1		See Table 2-5-2-5-b
Checksum	*07		
<CR> <LF>			End of message termination

1. Use 0 for last saved value if available. If this is unavailable, a default value of 96,000 will be used.

Table 2-5-2-5-b Reset Configuration

Hex	Description
0x01	Hot Start— All data valid
0x02	Warm Start—Ephemeris cleared
0x03	Warm Start (with Init)—Ephemeris cleared, initialization data loaded
0x04	Cold Start—Clears all data in memory
0x08	Clear Memory—Clears all data in memory and resets receiver back to factory defaults.

3.5.2.6 105—Development Data On/Off

Use this command to enable development data information if you are having trouble getting commands accepted. Invalid commands generate debug information that enables the user to determine the source of the command rejection. Common reasons for input command rejection are invalid checksum or parameter out of specified range.

Table 2.5.2.6-a contains the input values for the following examples:

1. Debug On

   $PSRF105,1*3E

2. Debug Off

   $PSRF105,0*3F

Table 2.5.2.6-a Development Data On/Off Data Format

Name	Example	Units	Description
Message ID	$PSRF105		PSRF105 protocol header
Debug	1		0=Off, 1=On
Checksum	*3E		
<CR> <LF>			End of message termination

3.5.2.7 MSK—MSK Receiver Interface

Differential corrections are not available in the *Amigo* GPS Receiver. Therefore, this message should not be used.

3.6 DOCKSTATION MODE

3.6.1 Introduction

The DockStation mode communication parameters are the followings:

- 9600 bauds
- 8 data bits, no parity
- 1 stop bit

This mode is designed for the use of a specific DockStation which characteristics are the followings:

- Numeric keypad: 10 numeric keys, "#" and "*". Pressing any key will send one byte to the GPS module: numeric keys: 0x30 to 0x39, "#" key: 0x7F, "*" key: 0x0D.
- LCD 2x16 characters screen. Recognizes the following sequences:
  - √ "\x1B\x5B\x32\x4A": clear the whole screen, and move the cursor to the beginning of the first line.
  - √ "\x1B\x5B\x45": move the cursor to the beginning of the second line.
  - √ "\x1B\x5B\x31\x3B\x31\x48": move the cursor to the beginning of the current line.
  - √ "\x13\x5B\x31\x58": erase the character to the left of the cursor.
  - √ Other: prints the corresponding character.

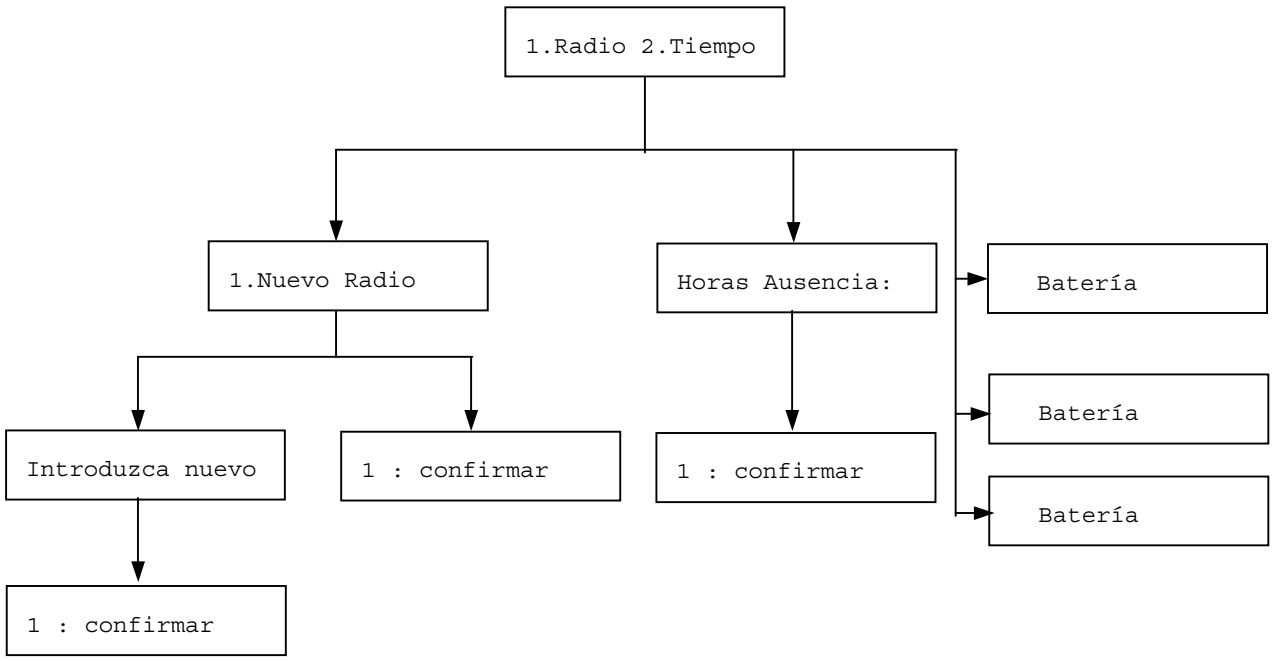
- Battery charger: sending "\x1B\x5B\x55" to the DockStation will ask for a battery charging status. The DockStation will send back one byte:
  - √ 0x61: battery currently charging.
  - √ 0x62: battery charged
  - √ 0x63: battery error

Inserting the modem into its DockStation automatically changes the current protocol to the DockStation mode, even if the modem was in SiRF or NMEA mode.

Removing the modem from its DockStation will put it automatically to model or maintenance mode (depending of the previously selected mode).

3.6.2 DockStation menu

In DockStation mode, AT and maintenance commands are not valid. The GPS module uses a reduced specific user menu to allow changing its configuration:



Note: In the software version with absolute time, the menu "Horas ausencia" is converted to "Hora limite de ausencia: __:__"

4 EXTERNAL COMMUNICATIONS

4.1 INTRODUCTION

The *Amigo* GPS modem is designed to be used inside a fleet control system. In this case, the GSM modem is used to communicate with the fleet control center (GSM control center).

The specific communication protocol is defined in the document ICD-GPS-004-SN, edited by SENA GPS.

The GPS modem is able to send and receive secured communication frames.

The following chapter lists the supported frames in the *Amigo* GPS modem.

4.2 INCOMING FRAMES

- Frame 3B (generic request): Ask for the modem's GPS position via an extended position frame, or for the actual modem configuration. The GPS modem will answer this with the requested frame.
- Frame 3F (Remote configuration): Allows to program the, periodicity and maximum number of autoresponding cycles, alarm radius, latitude and longitude of the alarm circle center, absence time, local time offset, discrete output state.
  Note: in case of discrete output configuration, remind that the ACTIVE state of the output (ON state) is 0V, and the INACTIVE state (OFF state) is open drain.

4.3 OUTGOING FRAMES

- Frame 4D (Extended position): With the following reasons:
  - Answer to an extended position request.

- Autoresponding cycle.
- Radius alarm.
- Time limit alarm.
- Discrete input alarm. The command AT+SNGPSALARM can be used to configure the alarm type (level, transition, etc).

Frame 78: Modem's actual configuration. Contains the same fields as the 3F frame.

4.4 TEXT MESSAGES

The *Amigo* GPS modem can also receive text messages, sent from a mobile phone. If the text message is considered as valid (as described in the following chapters), the *Amigo* will execute the corresponding order.

Some base numbers have a special signification:

- The base number 99999999 means that the base DOES NOT support binary messages: only text messages sent from the base phone number will be recognized.
  The alarms and autoresponding cycles are converted to text position messages (See 4.4.2 Alarms with text messages on page 4.4), sent to the base phone number.
  Only text messages from the authorized phone number will be accepted.
- The base number 99999998 means that the base DOES NOT support binary messages: only text messages (sent from ANY phone number) will be recognized.
  The alarms and autoresponding cycles are converted to text position messages (See 4.4.2 Alarms with text messages on page 4.4), sent to the base phone number.
  The answer to text orders (position request, etc) will be sent

to the phone number that sent the order. Any phone number will be accepted.

- Any other base number means that the base accepts both types of messages (text and binary), but only from and to the authorized phone number (the base phone number). Alarms and autoresponding cycles will be sent in binary format.

4.4.1 Text order format

The text message must be sent in 7 bit format (default when sent from a mobile phone). The format is the following:

XXXXXXXXYYYYYYY

- XXXXXXXX is the Amigo's node number (8 digit)
- YYYYYYY is a GPS order: The GPS orders are obtained from the AT+SNGPS orders, removing the "AT+SNGPS" prefix. Not all orders are available remotely (for security reasons). See the corresponding documentation for each GPS command to know if it is remotely available.

The Amigo will always answer a correct order.

- If the order is a query-type order (position request for example), the answer will be sent to the phone number that sent the order.
- If the order does not waits for a specific answer, the modem will answer with the text message: "AMIGO OK".
- If the order fails (parameter error, etc), the modem will answer with the text message: "AMIGO ERROR".
- If the order is not recognized (syntax error, incorrect node number, etc), the modem will not answer. The incoming text message will be delivered to the user (to the maintenance port).

Example 1: the text message 00000002POS is sent to the Amigo with node number 2. It will answer:

+SNGPSPOS: 2,4,0.70710951,-0.06383870,990.258

Example 2: the text message 00000002DISC=0 is sent to the Amigo with node number 2. It will activate its discrete output (0 means "activate", or "set to 0V"), and will answer with the text message:

AMIGO OK

Example 3: the text message 00000003POS is sent to the Amigo with node number 2. The Amigo will not answer (incorrect node number: rejected message), and will send to the maintenance port a incoming message indication.

4.4.2 Alarms with text messages

In binary mode (communication with a control center) the alarms and autoresponding cycles use extended position frames.

In text mode, alarms are notified with text messages similar to the AT+SNGPSPOS order, but with a different header:

+ALARM???: M,N,Lat,Lon,Alt

- M: Navigation mode (No nav, 2D, 3D)
- N: Satellites number
- Lat, Lon in degrees, minutes, decimals of minutes.
- Alt in meters.

(see AT+SNGPSPOS command for more information)

??? represents the Alarm reason (3 characters). The possible value are the following:

- "X02": autoresponding cycle
- "XD1": radius alarm
- "X80": time limit alarm

- “X81”: discrete input alarm

5 CYCLES

5.1 INTRODUCTION

The GPS modem is able to manage time cycles. These time cycles can be programmed via the maintenance serial port, or via a configuration frame (3F frame).

5.2 AUTORESPONDING CYCLES

The GPS modem can send periodically 4D frames, with "Autoresponding cycle" reason, accordingly to the cycle's configuration.

If the Amigo is configured to work only with text messages, alarm text messages will be sent instead of 4D binary frames. See chapter 4.4.2 Alarms with text messages on page 4.4 for more information.

The maximum number of autoresponding frames is limited. Th limit value (default: 250) can be configured with AT+SNGPSMAXCYCLES: Cycles limitation, on page 3.32, or with a remote configuration frame from a control center.