# Application Note AN0003

# Binary Messages

# Of

# cyber i-tech V 6 GPS Module

**Ver. 4.13**


GPS Modules

www.cyberitech.com

## Binary Message Protocol

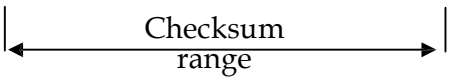
The Cyber i-tech binary message protocol manual provides the detailed descriptions on the Skytraq V6 chipset binary protocol serving as a communicating interface between Cyber i-tech GPS receivers and an external host such as PC, Notebook and mobile personal device. It is a standard protocol used by all Cyber i-tech devices and provides users a satisfactory control over the GPS receivers.

The Cyber i-tech GPS receiver outputs standard NMEA messages during normal operation. This NMEA messages may be a scheduled output at a specified rate subject to user's requests. The Cyber i-tech binary message protocol is designed with cares on reliable transmissions of data, ease & efficiency of implement, and payload independence mechanism which ensure users to retrieve data in a most effective & flexible way. The overall binary protocol messages can be categorized as input and output messages. Input messages provide the functionality to users to control the behavior of the GPS receiver and to retrieve the detailed information of the GPS status in real-time. Output messages, on the other hand, are information strings that GPS receiver responses to requests from hosts and can optionally periodically reports the Position, Velocity and Time (PVT) via NMEA or binary messages.

## BINARY MESSAGE STRUCTURE

### Message Format

The following picture shows the structure of a binary message.




| Start of Sequence | Payload Length (PL) | Payload | | Checksum (CS) | End of Sequence |
|---|---|---|---|---|---|
| | | Message ID | Message Body | | |
| 0xA0, 0xA1 | Two bytes | Message ID: 1 bytes; Payload up to 65535 bytes | | One byte | 0x0D, 0x0A |

The syntax of the message is shown below.

<0xA0,0xA1><PL><Message ID><Message Body><CS><0x0D,0x0A>

### Start of Sequence

This field contains two bytes of values 0xA0, 0xA1 which indicate start of Messages.

### Payload Length

The payload length (PL) field contains 16 bits of value which indicates the length of payload.

### Payload

The payload field consists of 2 sub-fields, Message ID and Message Body. Message ID field defines the message ID.

| Sub-Field | Values |
|---|---|
| Message ID | 0x01~0xFF |
| Message Body | Data Bytes |

### Checksum

Checksum (CS) field is transmitted in all messages. The checksum field is the last field in a message before the end of sequence field. The checksum is the 8-bit exclusive OR of only the payload bytes which start from Message ID until the last byte prior to the checksum byte. A reference to the calculation of CS is provided

below,

CS = 0, N=PL;

For n = 0 to N

CS = CS ^ <Payload Byte # n>

## End of Sequence

This field contains two bytes of values 0x0D, 0x0A which indicate end of Messages.

## Data Byte Ordering

All payloads in binary protocol are transferred in little-endian format. The low order byte is transmitted first followed by the high order byte for data size larger than a byte (e.g. UINT32, DPFP).

## Data Type Definition

| | |
|---|---|
| UINT8 | 8 bit unsigned integer |
| UINT16 | 16 bit unsigned integer |
| UINT32 | 32 bit unsigned integer |
| SINT8 | 8 bit signed integer |
| SINT16 | 16 bit signed integer |
| SINT32 | 32 bit signed integer |
| SPFP | 32 bit single precision floating point number |
| DPFP | 64 bit double precision floating point number |

## MESSAGE FLOW

Host can perform actions to GPS receiver by issuing a request or a set message. The message flow between Host and GPS receiver is designed under the considerations of certain reliable transmission. Cyber i-tech binary message protocol requires an ACK response from the GPS receiver upon receiving a successful input message and on the other hand, requires a NACK response from the receiver to a failed input message. Figure 1 shows a message flow that a host requests information from GPS receiver and the GPS receiver responses with an ACK and information respectively. Figure 2 shows a message flow with un-successful input message. Therefore, all requests (input messages) will have a corresponding ACK or NACK to be related with. However, output messages will not require
the host to confirm by an ACK or NACK back in current design.

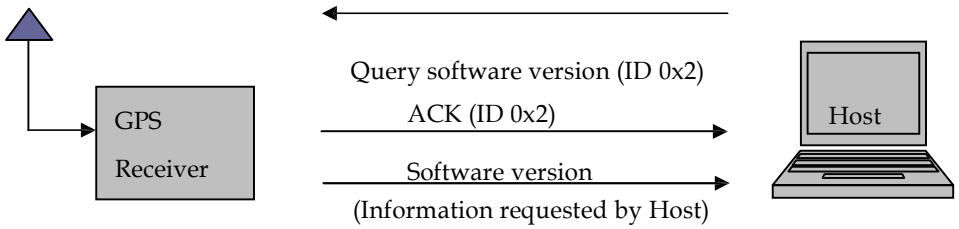



Figure 1

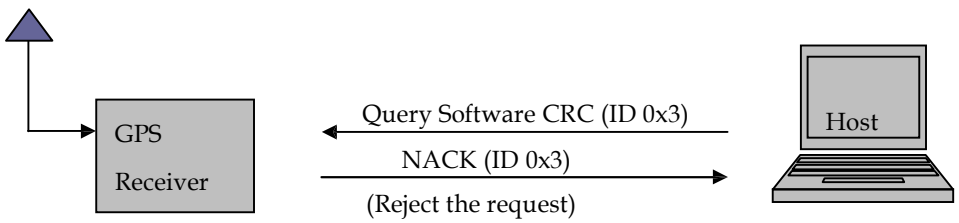



Figure 2

## MESSAGE LIST

This section provides brief information about available Cyber i-tech binary input and output messages shown in a tabular list. All the messages are listed by Message ID. Full descriptions of input and output messages will be described in later Sections.

| Input System Messages | | | | |
|---|---|---|---|---|
| ID(Hex) | ID(Decimal) | Attribute | Name | Descriptions |
| 0x1 | 1 | Input | System Restart | Force system to restart |
| 0x2 | 2 | Input | Query Software version | Query revision information of software |
| 0x3 | 3 | Input | Query Software CRC | Query the CRC of the software |
| 0x4 | 4 | Input | Set Factory Defaults | Set system to factory default values |
| 0x5 | 5 | Input | Configure Serial Port | Set up serial port COM, baud rate, data bits, stop bits and parity |
| 0x6 | 6 | Input | Reserved | Reserved |
| 0x7 | 7 | Input | Reserved | Reserved |
| 0x8 | 8 | Input | Configure NMEA | Configure NMEA output message |
| 0x9 | 9 | Input | Configure Output Message Format | Configure the output message format from GPS receiver |
| 0xC | 12 | Input | Configure Power Mode | Set system power mode |
| 0xE | 14 | Input | Configure position update rate | Configure the position update rate of GPS system |
| 0x10 | 16 | Input | Query position update rate | Query the position update rate of GPS system |
| Input GPS Messages | | | | |
| ID(Hex) | ID(Decimal) | Attribute | Name | Descriptions |
| 0x29 | 41 | Input | Configure Datum | Configure Datum of the GPS receiver |
| 0x2D | 45 | Input | Query Datum | Query datum used by the GPS receiver |
| 0x30 | 48 | Input | Get ephemeris | Retrieve ephemeris data of the GPS receiver |
| 0x31 | 49 | Input | Set ephemeris | Set ephemeris data to the GPS receiver |
| 0x37 | 55 | Input | Configure WAAS | Configure the enable or disable of WAAS |
| 0x38 | 56 | Input | Query WAAS status | Query WAAS status of GPS receiver |
| 0x39 | 57 | Input | Configure position pinning | Enable or disable position pinning of GPS receiver |
| 0x3A | 58 | Input | Query position pinning | Query position pinning status of the GPS receiver |
| 0x3B | 59 | Input | Configure position pinning parameters | Set position pinning parameters of GPS receiver |

| | | | | |
|---|---|---|---|---|
| 0x3C | 60 | Input | Configuration navigation mode | Configure the navigation mode of GPS system |
| 0x3D | 61 | Input | Query navigation mode | Query the navigation mode of GPS receiver |
| 0x3E | 62 | Input | Configure 1PPS mode | Set 1PPS mode to the GPS receiver |
| 0x3F | 63 | Input | Query 1PPS mode | Query 1PPS mode of the GPS receiver |
| Output System Messages | | | | |
| ID(Hex) | ID(Decimal) | Attribute | Name | Descriptions |
| 0x80 | 128 | Output | Software version | Software revision of the receiver |
| 0x81 | 129 | Output | Software CRC | Software CRC of the receiver |
| 0x82 | 130 | Output | Reserved | Reserved |
| 0x83 | 131 | Output | ACK | ACK to a successful input message |
| 0x84 | 132 | Output | NACK | Response to an unsuccessful input message |
| 0x86 | 134 | Output | Position update rate | Position update rate of GPS system |
| Output GPS Messages | | | | |
| ID(Hex) | ID(Decimal) | Attribute | Name | Descriptions |
| 0xAE | 174 | Output | GPS Datum | Datum used by the GPS receiver |
| 0xB3 | 179 | Output | GPS WAAS status | WAAS status of the GPS receiver |
| 0xB4 | 180 | Output | GPS Position pinning status | Position pinning status of the GPS receiver |
| 0xB5 | 181 | Output | GPS navigation mode | Navigation mode of the GPS receiver |
| 0xB6 | 182 | Output | GPS 1PPS mode | 1PPS mode of GPS receiver |
| | | | | |

## INPUT MESSAGES

***SYSTEM RESTART – Force System to restart (0x1)***

This is a request message which will reset and restart the GPS receiver. This command is issued from the host to GPS receiver and GPS receiver should respond with an ACK or NACK. The payload length is 15 bytes.

Structure:

<0xA0,0xA1>< PL><01>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 0F 01 01 07 D8 0B 0E 08 2E 03 09 C4 30 70 00 64 16 0D 0A

1 2 3 4 5 6 7 8 9 10 11 1213 14 15

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 01 | | UINT8 | - |
| 2 | Start Mode | 01 | 00 = Reserved<br>01 = System Reset, Hot start<br>02 = System Reset, Warm start<br>03 = System Reset, Cold start<br>04 = Reserved | UINT8 | |
| 3-4 | UTC Year | 07D8 | >= 1980 | UINT16 | |
| 5 | UTC Month | 0B | 1 ~ 12 | UINT8 | |
| 6 | UTC Day | 0E | 1 ~ 31 | UINT8 | |
| 7 | UTC Hour | 08 | 0 ~ 23 | UINT8 | |
| 8 | UTC Minute | 2E | 0 ~ 59 | UINT8 | |
| 9 | UTC Second | 03 | 0 ~ 59 | UINT8 | |
| 10-11 | Latitude | 09C4 | Between – 9000 and 9000<br>> 0: North Hemisphere<br>< 0: South Hemisphere | SINT16 | 1/100 degree |
| 12-13 | Longitude | 3070 | Between – 18000 and 18000<br>> 0: East Hemisphere<br>< 0: West Hemisphere | SINT16 | 1/100 degree |
| 14-15 | Altitude | 0064 | Between –1000 and 18300 | SINT16 | Meter |
| Payload Length : 15 bytes | | | | | |

***QUERY SOFTWARE VERSION – Query revision information of loaded software (0x2)***

This is a request message which is issued from the host to GPS receiver to retrieve loaded software version. The GPS receiver should respond with an ACK along with information on software version when succeeded and should respond with an NACK when failed. The payload length is 2 bytes.

Structure:

<0xA0,0xA1>< PL><02>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 02 02 00 02 0D 0A

1 2

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 02 | | UINT8 | |
| 2 | Software Type | 00 | 00 = Reserved<br>01 = System code | UINT8 | |
| Payload Length : 2 bytes | | | | | |

***QUERY SOFTWARE CRC – Query CRC information of loaded software (0x3)***

This is a request message which is issued from the host to GPS receiver to retrieve loaded software CRC. The GPS receiver should respond with an ACK along with information on software version when succeeded and should respond with an NACK when failed. The payload length is 2 bytes.

Structure:

<0xA0,0xA1>< PL><03>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 02 03 00 03 0D 0A

1 2

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 03 | | UINT8 | |
| 2 | Software Type | 00 | 00 = Reserved<br>01 = System code | UINT8 | |
| Payload Length : 2 bytes | | | | | |

***SET FACTORY DEFAULTS – Set the system to factory default values (0x4)***

This is a request message which is issued from the host to GPS receiver. It will reset the GPS receiver's internal parameters to factory default values. The GPS receiver should respond with an ACK when succeeded and should respond with an NACK when failed. The user data will be erased and filled with factory default values. The payload length is 2 bytes.

Structure:

<0xA0,0xA1>< PL><04>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 02 04 00 04 0D 0A

1 2

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 04 | | UINT8 | |
| 2 | Type | 00 | 00 = Reserved<br>01 = reboot after setting to factory defaults | UINT8 | |
| Payload Length : 2 bytes | | | | | |

*CONFIGURE SERIAL PORT – Set up serial port property (0x5)*

This is a request message which will configure the serial COM port, baud rate. This command is issued from the host to GPS receiver and GPS receiver should respond with an ACK or NACK. The payload length is 4 bytes.

Structure:

<0xA0,0xA1>< PL><05>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 04 05 00 00 00 05 0D 0A

1 2 3 4

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 05 | | UINT8 | |
| 2 | COM port | 00 | 00 = COM 1 | UINT8 | |
| 3 | Baud Rate | 00 | 0: 4800<br>1: 9600<br>2: 19200<br>3: 38400<br>4: 57600<br>5: 115200 | UINT8 | |
| 4 | Attributes | 00 | 0: update to SRAM<br>1: update to both SRAM & FLASH | UINT8 | |
| Payload Length : 4 bytes | | | | | |

***CONFIGURE NMEA MESSAGE – Configure NMEA message interval (0x8)***

This is a request message which will set NMEA message configuration. This command is issued from the host to GPS receiver and GPS receiver should respond with an ACK or NACK. The payload length is 9 bytes.

Structure:

<0xA0,0xA1>< PL><08>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 09 08 01 01 01 00 01 00 00 00 08 0D 0A

1 2 3 45 6 7 8 9

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 08 | | UINT8 | |
| 2 | GGA Interval | 01 | 0 ~255, 0: disable | UINT8 | Second |
| 3 | GSA Interval | 01 | 0 ~255, 0: disable | UINT8 | Second |
| 4 | GSV Interval | 01 | 0 ~255, 0: disable | UINT8 | Second |
| 5 | GLL Interval | 00 | 0 ~255, 0: disable | UINT8 | Second |
| 6 | RMC Interval | 01 | 0 ~255, 0: disable | UINT8 | Second |
| 7 | VTG Interval | 00 | 0 ~255, 0: disable | UINT8 | Second |
| 8 | ZDA Interval | 00 | 0 ~255, 0: disable | UINT8 | Second |
| 9 | Attributes | 00 | 0: update to SRAM<br>1: update to both SRAM & FLASH | UINT8 | |
| Payload Length : 9 bytes | | | | | |

***CONFIGURE MESSAGE TYPE – Configure and select output message type (0x9)***

This is a request message which will change the GPS receiver output message type. This command is issued from the host to GPS receiver and GPS receiver should respond with an ACK or NACK. The payload length is 2 bytes.

Structure:

<0xA0,0xA1>< PL><09>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 03 09 00 09 0D 0A

1 2

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 09 | | UINT8 | |
| 2 | Type | 00 | 00 : No output<br>01 : NMEA message<br>02 : Binary Message | UINT8 | |
| Payload Length : 2 bytes | | | | | |

***CONFIGURE SYSTEM POWER MODE –Set the power mode of GPS system (0xC)***

This is a request message which is issued from the host to GPS receiver to configure the system power mode. The GPS receiver should respond with an ACK when succeeded and should respond with an NACK when failed. The payload length is 3 bytes.

Structure:

<0xA0,0xA1>< PL><0C>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 03 0C 00 00 0C 0D 0A

1 2 3

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 0C | | UINT8 | |
| 2 | Mode | 00 | 00 = Normal (disable)<br>01 = Power Save (enable) | UINT8 | |
| 3 | Attributes | 00 | 0: update to SRAM<br>1: update to both SRAM & FLASH<br>2: temporarily enabled | UINT8 | |
| Payload Length : 3 bytes | | | | | |

***CONFIGURE SYSTEM POSITION RATE – Configure the position update rate of GPS system (0xE)***

This is a request message which is issued from the host to GPS receiver to configure the system position update rate. Receivers with position rate 4 or higher needs to configure baud rate to 38400 or higher value.The GPS receiver should respond with an ACK when succeeded and should respond with an NACK when failed. The payload length is 3 bytes.

Structure:

<0xA0,0xA1>< PL><0E>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 03 0E 01 00 0F 0D 0A

1 2 3

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 0E | | UINT8 | |
| 2 | Rate | 01 | Value with 1, 2, 4, 5, 8 or 10<br>01: 1Hz update rate<br>Note: value with 4 or higher should work with baud rate 38400 or higher | UINT8 | |
| 3 | Attributes | 00 | 0: update to SRAM<br>1: update to both SRAM & FLASH | UINT8 | |
| Payload Length : 3 bytes | | | | | |

***QUERY POSITION UPDATE RATE – Query the position update rate of GPS system (0x10)***

This is a request message which is issued from the host to GPS receiver to query position update rate. The GPS receiver should respond with an ACK along with information on software version when succeeded and should respond with an NACK when failed. The payload length is 1 byte.

Structure:

<0xA0,0xA1>< PL><10>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 01 10 10 0D 0A

1

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 10 | | UINT8 | |
| Payload Length : 1 byte | | | | | |

***CONFIGURE DATUM – Configure datum used for GPS position transformation (0x29)***

This is a request message which will setup parameters used for GPS position transformation. This command is issued from the host to GPS receiver and GPS receiver should respond with an ACK or NACK. The payload length is 19 bytes.

Structure:

<0xA0,0xA1>< PL><29>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 13 29 00 13 07 FF 7A FF 97 FE D9 00 7D DF 39 00 46 F4 10 00 CE 0D 0A

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 29 | | UINT8 | |
| 2-3 | index | 0013 | Refer to Appendix B for available Datum | UINT16 | |
| 4 | Ellip idx | 07 | Refer to Appendix A for available Value | UINT8 | |
| 5-6 | Delta X | FF7A | Refer to Appendix A and B for available Delta X | SINT16 | Meter |
| 7-8 | Delta Y | FF97 | Refer to Appendix A and B for available Delta Y | SINT16 | Meter |
| 9-10 | Delta Z | FED9 | Refer to Appendix A and B for available Delta Z | SINT16 | Meter |
| 11-14 | Semi-major axis | 007DDF39 | Refer to Appendix A | UINT32 | |
| 15-18 | Inversed Flattening | 0046F410 | Refer to Appendix A | UINT32 | |
| 19 | Attributes | 00 | 0: update to SRAM<br>1: update to both SRAM & FLASH | UINT8 | |
| Payload Length : 19 bytes | | | | | |

1. In order to reduce number of bytes to send in the configure datum command, the Semi-Major Axis is to be deducted by 6,370,000, with the result multiplied by 1,000.
   Thus if converting 6,378,249.145 the result would be: 6,378,249.145 – 6,370,000 equals 8,249.145 And converting 8,249.145 x 1000 to hex is 007DDF39.
2. Same as for Inversed Flattening which is to be deducted by 293; with the result multiplied by 10,000,000 then converted to hex.
3. The exception is: the Inversed Flattening for Ellipsoid index 20 and 23 will lose precision after deducting by 293, multiply by 10,000,000 and convert to hex. Therefore, upon receiving the configure datum command, our firmware will use the internal hardcoded inversed flattening values for of 20 and 23, regardless of what is sent in the set datum command.

***QUERY DATUM – Query datum used by the GPS receiver (0x2D)***

This is a request message which is issued from the host to GPS receiver to retrieve used datum information. The GPS receiver should respond with an ACK along with the datum information when succeeded and should respond with an NACK when failed. The payload length is 1 byte.

Structure:

<0xA0,0xA1>< PL><2D>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 01 2D 2D 0D 0A

1

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 2D | | UINT8 | |
| Payload Length : 1 byte | | | | | |

***Get Ephemeris – Get ephemeris used of firmware (0x30)***

This is a request message which is issued from the host to GPS receiver to retrieve ephemeris data. The GPS receiver should respond with an ACK along with information on ephemeris when succeeded and should respond with an NACK when failed. The payload length is 2 bytes.

Structure:

<0xA0,0xA1>< PL><30>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 02 30 00 30 0D 0A

1 2

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 30 | | UINT8 | |
| 2 | SV # | 00 | 0: means all SVs<br>1~32 : mean for the particular SV | UINT8 | |
| Payload Length : 2 bytes | | | | | |

***Set Ephemeris – Set ephemeris to GPS firmware (0x31)***

This is a request message which is issued from the host to GPS receiver to set ephemeris data (open an ephemeris file) to GPS receiver. The GPS receiver should respond with an ACK when succeeded and should respond with an NACK when failed. The payload length is 87 bytes.

Structure:

<0xA0,0xA1>< PL><31>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 57 31 00 02 00 77 88 04 61 10 00 00 00 00 00 00 00 00 00 00 00 00 DB DF 59 A6 00 00 1E 0A

1 2 3 …… 28 29

47 7C 00 77 88 88 DF FD 2E 35 A9 CD B0 F0 9F FD A7 04 8E CC A8 10 2C A1 0E 22 31 59 A6 74 00 77

30 31 . ……... 62 63

89 0C FF A3 59 86 C7 77 FF F8 26 97 E3 B9 1C 60 59 C3 07 44 FF A6 37 DF F0 B0 5E 0D 0A

64 65 ……. 86 87

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 31 | | UINT8 | |
| 2-3 | SV id | 0x1 | Satellite id | UINT16 | |
| 4 | SubFrameData[0][0] | 00 | Eph data subframe 1 | UINT8 | |
| 5 | SubFrameData[0][1] | 00 | Eph data subframe 1 | UINT8 | |
| 6 | SubFrameData[0][2] | 00 | Eph data subframe 1 | UINT8 | |
| 7 | SubFrameData[0][3] | 00 | Eph data subframe 1 | UINT8 | |
| 8 | SubFrameData[0][4] | 00 | Eph data subframe 1 | UINT8 | |
| 9 | SubFrameData[0][5] | 00 | Eph data subframe 1 | UINT8 | |
| 10 | SubFrameData[0][6] | 00 | Eph data subframe 1 | UINT8 | |
| 11 | SubFrameData[0][7] | 00 | Eph data subframe 1 | UINT8 | |
| 12 | SubFrameData[0][8] | 00 | Eph data subframe 1 | UINT8 | |
| 13 | SubFrameData[0][9] | 00 | Eph data subframe 1 | UINT8 | |
| 14 | SubFrameData[0][10] | 00 | Eph data subframe 1 | UINT8 | |
| 15 | SubFrameData[0][11] | 00 | Eph data subframe 1 | UINT8 | |
| 16 | SubFrameData[0][12] | 00 | Eph data subframe 1 | UINT8 | |
| 17 | SubFrameData[0][13] | 00 | Eph data subframe 1 | UINT8 | |
| 18 | SubFrameData[0][14] | 00 | Eph data subframe 1 | UINT8 | |
| 19 | SubFrameData[0][15] | 00 | Eph data subframe 1 | UINT8 | |
| 20 | SubFrameData[0][16] | 00 | Eph data subframe 1 | UINT8 | |
| 21 | SubFrameData[0][17] | 00 | Eph data subframe 1 | UINT8 | |
| 22 | SubFrameData[0][18] | 00 | Eph data subframe 1 | UINT8 | |
| 23 | SubFrameData[0][19] | 00 | Eph data subframe 1 | UINT8 | |

| | | | | | |
|---|---|---|---|---|---|
| 24 | SubFrameData[0][20] | 00 | Eph data subframe 1 | UINT8 | |
| 25 | SubFrameData[0][21] | 00 | Eph data subframe 1 | UINT8 | |
| 26 | SubFrameData[0][22] | 00 | Eph data subframe 1 | UINT8 | |
| 27 | SubFrameData[0][23] | 00 | Eph data subframe 1 | UINT8 | |
| 28 | SubFrameData[0][24] | 00 | Eph data subframe 1 | UINT8 | |
| 29 | SubFrameData[0][25] | 00 | Eph data subframe 1 | UINT8 | |
| 30 | SubFrameData[0][26] | 00 | Eph data subframe 1 | UINT8 | |
| 31 | SubFrameData[0][27] | 00 | Eph data subframe 1 | UINT8 | |
| 32~59 | SubFrameData[1][0~27] | 00 | Eph data subframe 2, same as field 4-31 | UINT8 | |
| 60-87 | SubFrameData[2][0~27] | 00 | Eph data subframe 3, same as field 4-31 | UINT8 | |
| Payload Length : 87 bytes | | | | | |

***CONFIGURE WAAS – Configure the enable or disable of WAAS (0x37)***

This is a request message which is issued from the host to GPS receiver to enable or disable WAAS. The GPS receiver should respond with an ACK when succeeded and should respond with an NACK when failed. The payload length is 3 bytes.

Structure:

<0xA0,0xA1>< PL><37>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 03 37 01 00 36 0D 0A

1 2 3

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 37 | | UINT8 | |
| 2 | enable | 1 | 0: disable<br>1: enable | UINT8 | |
| 3 | Attributes | 00 | 0: update to SRAM<br>1: update to both SRAM & FLASH | UINT8 | |
| Payload Length : 3 bytes | | | | | |

*QUERY WAAS STATUS – Query WAAS status of GPS receiver (0x38)*

This is a request message which is issued from the host to GPS receiver to query WAAS status. The GPS receiver should respond with an ACK along with AGPS aiding status when succeeded and should respond with an NACK when failed. The payload length is 1 byte.

Structure:

<0xA0,0xA1>< PL><38>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 01 38 38 0D 0A

1

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 38 | | UINT8 | |
| Payload Length : 1 byte | | | | | |

*CONFIGURE POSITION PINNING – Enable or disable position pinning of GPS receiver (0x39)*

This is a request message which is issued from the host to GPS receiver to configure the system position pinning. The GPS receiver should respond with an ACK when succeeded and should respond with an NACK when failed.

The payload length is 2 bytes.

Structure:

<0xA0,0xA1>< PL><39>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 02 39 01 38 0D 0A

1 2

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 39 | | UINT8 | |
| 2 | Position pinning | 01 | 0: disable (default)<br>1: enable | UINT8 | |
| Payload Length : 2 bytes | | | | | |

*QUERY POSITION PINNING – Query position pinning status of GPS receiver (0x3A)*

This is a request message which is issued from the host to GPS receiver to query position pinning status. The GPS receiver should respond with an ACK along with position pinning status when succeeded and should respond with an NACK when failed. The payload length is 1 byte.

Structure:

<0xA0,0xA1>< PL><3A>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 01 3A 3A 0D 0A

1

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 3A | | UINT8 | |
| Payload Length : 1 byte | | | | | |

***CONFIGURE POSITION PINNING PARAMETERS –Set position pinning parameters of GPS receiver (0x3B)***

This is a request message which is issued from the host to GPS receiver to configure the system position pinning parameters. The GPS receiver should respond with an ACK when succeeded and should respond with an NACK when failed. The payload length is 11 bytes.

Structure:

<0xA0,0xA1>< PL><3B>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 0B 3B 00 02 00 0A 00 08 00 2D 01 F4 E3 0D 0A

1 2 3 4 5 6 7 8 9 10 11

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 3B | | UINT8 | |
| 2-3 | Pinning speed | 0002 | | UINT16 | Km/Hr |
| 4-5 | Pinning cnt | 000A | | UINT16 | Second |
| 6-7 | Unpinning speed | 0008 | | UINT16 | Km/Hr |
| 8-9 | Unpinning cnt | 002D | | UINT16 | Second |
| 10-11 | Unpinning distance | 01F4 | | UINT16 | Meter |
| Payload Length : 11 bytes | | | | | |

***CONFIGURE NAVIGATION MODE – Configure the navigation mode of GPS system (0x3C)***

This is a request message which is issued from the host to GPS receiver to configure the system navigation mode. The GPS receiver should respond with an ACK when succeeded and should respond with an NACK when failed.

The payload length is 3 bytes.

Structure:

<0xA0,0xA1>< PL><3C>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 03 3C 00 00 3C 0D 0A

1 2 3

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 3C | | UINT8 | |
| 2 | Navigation mode | 00 | 0: car<br>1: pedestrian | UINT8 | |
| 3 | Attributes | 00 | 0: update to SRAM<br>1: update to both SRAM & FLASH | UINT8 | |
| Payload Length : 3 bytes | | | | | |

*QUERY NAVIGATION MODE – Query the navigation mode of GPS receiver (0x3D)*

This is a request message which is issued from the host to GPS receiver to query navigation mode. The GPS receiver should respond with an ACK along with navigation mode when succeeded and should respond with an NACK when failed. The payload length is 1 byte.

Structure:

<0xA0,0xA1>< PL><3D>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 01 3D 3D 0D 0A

1

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 3D | | UINT8 | |
| Payload Length : 1 byte | | | | | |

***CONFIGURE 1PPS MODE –Set 1PPS mode to the GPS receiver (0x3E)***

This is a request message which is issued from the host to GPS receiver to configure the system 1PPS mode. The GPS receiver should respond with an ACK when succeeded and should respond with an NACK when failed. The payload length is 3 bytes.

Structure:

<0xA0,0xA1>< PL><3E>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 03 3E 00 00 3E 0D 0A

1 2 3

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 3E | | UINT8 | |
| 2 | 1PPS mode | 00 | 0: off<br>1: on when 3D fix<br>2: on when 1 SV | UINT8 | |
| 3 | Attributes | 00 | 0: update to SRAM<br>1: update to both SRAM & FLASH | UINT8 | |
| Payload Length : 3 bytes | | | | | |

***QUERY 1PPS MODE – Query 1PPS mode of the GPS receiver (0x3F)***

This is a request message which is issued from the host to GPS receiver to query 1PPS mode. The GPS receiver should respond with an ACK along with 1PPS mode when succeeded and should respond with an NACK when failed. The payload length is 1 byte.

Structure:

<0xA0,0xA1>< PL><3F>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 01 3F 3F 0D 0A

1

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 3F | | UINT8 | |
| Payload Length : 1 byte | | | | | |

# OUTPUT MESSAGES

***SOFTWARE VERSION – Software version of the GPS receiver (0x80)***

This is a response message which provides the software version of the GPS receiver. This message is sent from the GPS receiver to host. The example below output the Cyber i-tech software version as 01.01.01-01.03.14-07.01.18 on System image. The payload length is 14 bytes.

Structure:

<0xA0,0xA1>< PL><80>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 0E 80 01 00 01 01 01 00 01 03 0E 00 07 01 12 98 0D 0A

1 2 3 4 5 6 7 8 9 10 11 12 13 14

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 80 | | UINT8 | |
| 2 | Software Type | 00 | 0: Reserved<br>1: System code | UINT8 | |
| 3-6 | Kernel Version | 00010001 | X1.Y1.Z1 = Cyber i-tech Kernel Version<br>Ex. X1=01, Y1=00, Z1=01 (1.0.1) | UINT32 | |
| 7-10 | ODM version | 00010307 | X1.Y1.Z1 = Cyber i-tech Version<br>Ex. X1=01, Y1=03, Z1=01 (1.3.1) | UINT32 | |
| 11-14 | Revision | 00060C0F | YYMMDD = Cyber i-tech Revision<br>Ex. YY=06, MM=01, DD=10 (060110) | UINT32 | |
| Payload Length : 14 bytes | | | | | |

*SOFTWARE CRC – Software CRC of the GPS receiver (0x81)*

This is a response message which provides the software CRC of the GPS receiver. This message is sent from the GPS receiver to host. The payload length is 4 bytes.

Structure:

<0xA0,0xA1>< PL><81>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 04 81 01 98 76 6E 0D 0A

1 2 3 4

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 81 | | UINT8 | |
| 2 | Software Type | 00 | 0: Reserved<br>1: System code | UINT8 | |
| 3-4 | CRC | 9876 | CRC value | UINT16 | |
| Payload Length : 4 bytes | | | | | |

***ACK – Acknowledgement to a Request Message (0x83)***

This is a response message which is an acknowledgement to a request message. The payload length is 2 bytes

Structure:

<0xA0,0xA1>< PL><83>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 02 83 02 81 0D 0A

1 2

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 83 | | UINT8 | |
| 2 | ACK ID | 02 | Message ID of the request message | UINT8 | |
| Payload Length : 2 bytes | | | | | |

***NACK – Response to an unsuccessful request message (0x84)***

This is a response message which is a response to an unsuccessful request message. This is used to notify the Host that the request message has been rejected. The payload length is 2 bytes

Structure:

<0xA0,0xA1>< PL><84>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 02 84 01 82 0D 0A

1 2

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 84 | | UINT8 | |
| 2 | ACK ID | 01 | Message ID of the request message | UINT8 | |
| Payload Length : 2 bytes | | | | | |

***POSITON UPDATE RATE – Position Update rate of the GPS system (0x86)***

This is a response message to ***QUERY POSITION UPDATE RATE*** which provides the position update rate of the GPS receiver. This message is sent from the GPS receiver to host. The payload length is 2 bytes.

Structure:

<0xA0,0xA1>< PL><86>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 02 86 01 87 0D 0A

1 2

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | 86 | | UINT8 | |
| 2 | Update Rate | 01 | 01: 1Hz | UINT8 | |
| Payload Length : 2 bytes | | | | | |

***GPS Ephemeris data – ephemeris data of the GPS receiver (0xB1)***

This is a response message which provides the Ephemeris Data of the GPS receiver to Host. The Host will save the ephemeris data as an ephemeris file. This message is sent from the GPS receiver to host. The payload length is 87 bytes.

Structure:

<0xA0,0xA1>< PL><B1>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 57 B1 00 02 00 77 88 04 61 10 00 00 00 00 00 00 00 00 00 00 00 00 DB DF 59 A6 00 00 1E 0A

1 2 3 …… 28 29

47 7C 00 77 88 88 DF FD 2E 35 A9 CD B0 F0 9F FD A7 04 8E CC A8 10 2C A1 0E 22 31 59 A6 74 00 77

30 31 . ……... 62 63

89 0C FF A3 59 86 C7 77 FF F8 26 97 E3 B9 1C 60 59 C3 07 44 FF A6 37 DF F0 B0 5E 0D 0A

64 65 ……. 86 87

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | B1 | | UINT8 | |
| 2-3 | SV id | 0x1 | Satellite id | UINT16 | |
| 4 | SubFrameData[0][0] | 00 | Eph data subframe 1 | UINT8 | |
| 5 | SubFrameData[0][1] | 00 | Eph data subframe 1 | UINT8 | |
| 6 | SubFrameData[0][2] | 00 | Eph data subframe 1 | UINT8 | |
| 7 | SubFrameData[0][3] | 00 | Eph data subframe 1 | UINT8 | |
| 8 | SubFrameData[0][4] | 00 | Eph data subframe 1 | UINT8 | |
| 9 | SubFrameData[0][5] | 00 | Eph data subframe 1 | UINT8 | |
| 10 | SubFrameData[0][6] | 00 | Eph data subframe 1 | UINT8 | |
| 11 | SubFrameData[0][7] | 00 | Eph data subframe 1 | UINT8 | |
| 12 | SubFrameData[0][8] | 00 | Eph data subframe 1 | UINT8 | |
| 13 | SubFrameData[0][9] | 00 | Eph data subframe 1 | UINT8 | |
| 14 | SubFrameData[0][10] | 00 | Eph data subframe 1 | UINT8 | |
| 15 | SubFrameData[0][11] | 00 | Eph data subframe 1 | UINT8 | |
| 16 | SubFrameData[0][12] | 00 | Eph data subframe 1 | UINT8 | |
| 17 | SubFrameData[0][13] | 00 | Eph data subframe 1 | UINT8 | |
| 18 | SubFrameData[0][14] | 00 | Eph data subframe 1 | UINT8 | |
| 19 | SubFrameData[0][15] | 00 | Eph data subframe 1 | UINT8 | |
| 20 | SubFrameData[0][16] | 00 | Eph data subframe 1 | UINT8 | |
| 21 | SubFrameData[0][17] | 00 | Eph data subframe 1 | UINT8 | |
| 22 | SubFrameData[0][18] | 00 | Eph data subframe 1 | UINT8 | |
| 23 | SubFrameData[0][19] | 00 | Eph data subframe 1 | UINT8 | |

| | | | | | |
|---|---|---|---|---|---|
| 24 | SubFrameData[0][20] | 00 | Eph data subframe 1 | UINT8 | |
| 25 | SubFrameData[0][21] | 00 | Eph data subframe 1 | UINT8 | |
| 26 | SubFrameData[0][22] | 00 | Eph data subframe 1 | UINT8 | |
| 27 | SubFrameData[0][23] | 00 | Eph data subframe 1 | UINT8 | |
| 28 | SubFrameData[0][24] | 00 | Eph data subframe 1 | UINT8 | |
| 29 | SubFrameData[0][25] | 00 | Eph data subframe 1 | UINT8 | |
| 30 | SubFrameData[0][26] | 00 | Eph data subframe 1 | UINT8 | |
| 31 | SubFrameData[0][27] | 00 | Eph data subframe 1 | UINT8 | |
| 32~59 | SubFrameData[1][0~27] | 00 | Eph data subframe 2, same as field 4-31 | UINT8 | |
| 60-87 | SubFrameData[2][0~27] | 00 | Eph data subframe 3, same as field 4-31 | UINT8 | |
| Payload Length : 87 bytes | | | | | |

***GPS DATUM – datum used by the GPS receiver (0xAE)***

This is a response message which provides the datum information of the GPS receiver. This message is sent from the GPS receiver to host. The payload length is 3 bytes.

Structure:

<0xA0,0xA1>< PL><AE>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 03 AE 00 13 BD 0D 0A

1 2 3

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | AE | | UINT8 | |
| 2-3 | Datum Index | 0013 | Datum index<br>Refer to Appendix A & B | UINT16 | |
| Payload Length : 3 bytes | | | | | |

***GPS WAAS STATUS – WAAS status of the GPS receiver (0xB3)***

This is a response message which provides the status of the WAAS receiver. This message is sent from the GPS receiver to host. The payload length is 2 bytes.

Structure:

<0xA0,0xA1>< PL><B3>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 02 B3 00 B3 0D 0A

1 2

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | B3 | | UINT8 | |
| 2 | WAAS status | 00 | 0: disable<br>1: enable | UINT8 | |
| Payload Length : 2 bytes | | | | | |

*GPS POSITON PINNING STATUS – Position pinning status of the GPS receiver (0xB4)*

This is a response message to ***QUERY POSITION PINNING*** which provides the position pinning status of the GPS receiver. This message is sent from the GPS receiver to host. The payload length is 2 bytes.

Structure:

<0xA0,0xA1>< PL><B4>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 02 B4 00 B4 0D 0A

1 2

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | B4 | | UINT8 | |
| 2 | status | 00 | 0: disable<br>1: enable | UINT8 | |
| Payload Length : 2 bytes | | | | | |

***GPS NAVIGATION MODE – Navigation mode of the GPS receiver (0xB5)***

This is a response message to ***QUERY NAVIGATION MODE*** which provides the navigation mode of the GPS receiver. This message is sent from the GPS receiver to host. The payload length is 2 bytes.

Structure:

<0xA0,0xA1>< PL><B5>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 02 B5 00 B5 0D 0A

1 2

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | B5 | | UINT8 | |
| 2 | Navigation mode | 00 | 0: car<br>1: pedestrian | UINT8 | |
| Payload Length : 2 bytes | | | | | |

***GPS 1PPS MODE – 1PPS mode of the GPS receiver (0xB6)***

This is a response message to ***QUERY 1PPS MODE*** which provides the 1PPS mode of the GPS receiver. This message is sent from the GPS receiver to host. The payload length is 2 bytes.

Structure:

<0xA0,0xA1>< PL><B6>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 02 B6 00 B6 0D 0A

1 2

| Field | Name | Example(hex) | Description | Type | Unit |
|---|---|---|---|---|---|
| 1 | Message ID | B6 | | UINT8 | |
| 2 | 1PPS mode | 01 | 0: off<br>1: on | UINT8 | |
| Payload Length : 2 bytes | | | | | |

**A. Ellipsoid List**

| Ellipsoid Index | Ellipsoid | Semi-major axis (a) | Inversed Flattening (1/f) |
|---|---|---|---|
| 1 | Airy 1830 | 6377563.396 | 299.3249646 |
| 2 | Modified Airy | 6377340.189 | 299.3249646 |
| 3 | Australian National | 6378160 | 298.25 |
| 4 | Bessel 1841 (Namibia) | 6377483.865 | 299.1528128 |
| 5 | Bessel 1841 | 6377397.155 | 299.1528128 |
| 6 | Clarke 1866 | 6378206.4 | 294.9786982 |
| 7 | Clarke 1880 | 6378249.145 | 293.465 |
| 8 | Everest (India 1830) | 6377276.345 | 300.8017 |
| 9 | Everest (Sabah Sarawak) | 6377298.556 | 300.8017 |
| 10 | Everest (India 1956) | 6377301.243 | 300.8017 |
| 11 | Everest (Malaysia 1969) | 6377295.664 | 300.8017 |
| 12 | Everest (Malay. & Sing) | 6377304.063 | 300.8017 |
| 13 | Everest (Pakistan) | 6377309.613 | 300.8017 |
| 14 | Modified Fischer 1960 | 6378155 | 298.3 |
| 15 | Helmert 1906 | 6378200 | 298.3 |
| 16 | Hough 1960 | 6378270 | 297 |
| 17 | Indonesian 1974 | 6378160 | 298.247 |
| 18 | International 1924 | 6378388 | 297 |
| 19 | Krassovsky 1940 | 6378245 | 298.3 |
| 20 | GRS 80 | 6378137 | 298.257222101 |
| 21 | South American 1969 | 6378160 | 298.25 |
| 22 | WGS 72 | 6378135 | 298.26 |
| 23 | WGS 84 | 6378137 | 298.257223563 |

**B. Datum Reference List**

| Datum index | Datum Name | Delta X | Delta Y | Delta Z | Ellipsoid | Ellipsoid Index | Region of Use |
|---|---|---|---|---|---|---|---|
| 0 | WGS-84 | 0 | 0 | 0 | WGS 84 | 23 | Global |
| 1 | Adinda | -118 | -14 | 218 | Clarke 1880 | 7 | Burkina Faso |
| 2 | Adinda | -134 | -2 | 210 | Clarke 1880 | 7 | Cameroon |
| 3 | Adinda | -165 | -11 | 206 | Clarke 1880 | 7 | Ethiopia |
| 4 | Adinda | -123 | -20 | 220 | Clarke 1880 | 7 | Mal |
| 5 | Adinda | -166 | -15 | 204 | Clarke 1880 | 7 | MEAN FOR Ethiopia; Sudan |
| 6 | Adinda | -128 | -18 | 224 | Clarke 1880 | 7 | Senegal |
| 7 | Adinda | -161 | -14 | 205 | Clarke 1880 | 7 | Sudan |
| 8 | Afgooye | -43 | -163 | 45 | Krassovsky 1940 | 19 | Somalia |
| 9 | Ain el Abd 1970 | -150 | -250 | -1 | International 1924 | 18 | Bahrain |
| 10 | Ain el Abd 1970 | -143 | -236 | 7 | International 1924 | 18 | Saudi Arabia |
| 11 | American Samoa 1962 | -115 | 118 | 426 | Clarke 1866 | 6 | American Samoa Islands |
| 12 | Anna 1 Astro 1965 | -491 | -22 | 435 | Australian National | 3 | Cocos Islands |
| 13 | Antigua Island Astro 1943 | -270 | 13 | 62 | Clarke 1880 | 7 | Antigua (Leeward Islands) |
| 14 | Arc 1950 | -138 | -105 | -289 | Clarke 1880 | 7 | Botswana |
| 15 | Arc 1950 | -153 | -5 | -292 | Clarke 1880 | 7 | Burund |
| 16 | Arc 1950 | -125 | -108 | -295 | Clarke 1880 | 7 | Lesotho |
| 17 | Arc 1950 | -161 | -73 | -317 | Clarke 1880 | 7 | Malaw |
| 18 | Arc 1950 | -143 | -90 | -294 | Clarke 1880 | 7 | MEAN FOR Botswana; Lesotho; Malawi; Swaziland; Zaire; Zambia; Zimbabwe |
| 19 | Arc 1950 | -134 | -105 | -295 | Clarke 1880 | 7 | Swaziland |
| 20 | Arc 1950 | -169 | -19 | -278 | Clarke 1880 | 7 | Zaire |
| 21 | Arc 1950 | -147 | -74 | -283 | Clarke 1880 | 7 | Zambia |
| 22 | Arc 1950 | -142 | -96 | -293 | Clarke 1880 | 7 | Zimbabwe |
| 23 | Arc 1960 | -160 | -6 | -302 | Clarke 1880 | 7 | MEAN FOR Kenya; Tanzania |
| 24 | Arc 1960 | -157 | -2 | -299 | Clarke 1880 | 7 | Kenya |
| 25 | Arc 1960 | -175 | -23 | -303 | Clarke 1880 | 7 | Taanzania |
| 26 | Ascension Island 1958 | -205 | 107 | 53 | International 1924 | 18 | Ascension Island |
| 27 | Astro Beacon E 1945 | 145 | 75 | -272 | International 1924 | 18 | Iwo Jima |
| 28 | Astro DOS 71/4 | -320 | 550 | -494 | International 1924 | 18 | St Helena Island |
| 29 | Astro Tern Island (FRIG) 1961 | 114 | -116 | -333 | International 1924 | 18 | Tern Island |
| 30 | Astronomical Station 1952 | 124 | -234 | -25 | International 1924 | 18 | Marcus Island |
| 31 | Australian Geodetic 1966 | -133 | -48 | 148 | Australian National | 3 | Australia; Tasmania |
| 32 | Australian Geodetic 1984 | -134 | -48 | 149 | Australian National | 3 | Australia; Tasmania |
| 33 | Ayabelle Lighthouse | -79 | -129 | 145 | Clarke 1880 | 7 | Djibout |
| 34 | Bellevue (IGN) | -127 | -769 | 472 | International 1924 | 18 | Efate & Erromango Islands |
| 35 | Bermuda 1957 | -73 | 213 | 296 | Clarke 1866 | 6 | Bermuda |
| 36 | Bissau | -173 | 253 | 27 | International 1924 | 18 | Guinea-Bissau |
| 37 | Bogota Observatory | 307 | 304 | -318 | International 1924 | 18 | Colombia |
| 38 | Bukit Rimpah | -384 | 664 | -48 | Bessel 1841 | 5 | Indonesia (Bangka & Belitung Ids) |
| 39 | Camp Area Astro | -104 | -129 | 239 | International 1924 | 18 | Antarctica (McMurdo Camp Area) |
| 40 | Campo Inchauspe | -148 | 136 | 90 | International 1924 | 18 | Argentina |
| 41 | Canton Astro 1966 | 298 | -304 | -375 | International 1924 | 18 | Phoenix Islands |
| 42 | Cape | -136 | -108 | -292 | Clarke 1880 | 7 | South Africa |
| 43 | Cape Canaveral | -2 | 151 | 181 | Clarke 1866 | 6 | Bahamas; Florida |
| 44 | Carthage | -263 | 6 | 431 | Clarke 1880 | 7 | Tunisia |
| 45 | Chatham Island Astro 1971 | 175 | -38 | 113 | International 1924 | 18 | New Zealand (Chatham Island) |
| 46 | Chua Astro | -134 | 229 | -29 | International 1924 | 18 | Paraguay |
| 47 | Corrego Alegre | -206 | 172 | -6 | International 1924 | 18 | Brazil |
| 48 | Dabola | -83 | 37 | 124 | Clarke 1880 | 7 | Guinea |
| 49 | Deception Island | 260 | 12 | -147 | Clarke 1880 | 7 | Deception Island; Antarctia |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 50 | Djakarta (Batavia) | -377 | 681 | -50 | Bessel 1841 | 5 | Indonesia (Sumatra) |
| 51 | DOS 1968 | 230 | -199 | -752 | International 1924 | 18 | New Georgia Islands (Gizo Island) |
| 52 | Easter Island 1967 | 211 | 147 | 111 | International 1924 | 18 | Easter Island |
| 53 | Estonia; Coordinate System 1937 | 374 | 150 | 588 | Bessel 1841 | 5 | Estonia |
| 54 | European 1950 | -104 | -101 | -140 | International 1924 | 18 | Cyprus |
| 55 | European 1950 | -130 | -117 | -151 | International 1924 | 18 | Egypt |
| 56 | European 1950 | -86 | -96 | -120 | International 1924 | 18 | England; Channel Islands; Scotland; Shetland Islands |
| 57 | European 1950 | -86 | -96 | -120 | International 1924 | 18 | England; Ireland; Scotland; Shetland Islands |
| 58 | European 1950 | -87 | -95 | -120 | International 1924 | 18 | Finland; Norway |
| 59 | European 1950 | -84 | -95 | -130 | International 1924 | 18 | Greece |
| 60 | European 1950 | -117 | -132 | -164 | International 1924 | 18 | Iran |
| 61 | European 1950 | -97 | -103 | -120 | International 1924 | 18 | Italy (Sardinia) |
| 62 | European 1950 | -97 | -88 | -135 | International 1924 | 18 | Italy (Sicily) |
| 63 | European 1950 | -107 | -88 | -149 | International 1924 | 18 | Malta |
| 64 | European 1950 | -87 | -98 | -121 | International 1924 | 18 | MEAN FOR Austria; Belgium; Denmark; Finland; France; W Germany; Gibraltar; Greece; Italy; Luxembourg; Netherlands; Norway; Portugal; Spain; Sweden; Switzerland |
| 65 | European 1950 | -87 | -96 | -120 | International 1924 | 18 | MEAN FOR Austria; Denmark; France; W Germany; Netherlands; Switzerland |
| 66 | European 1950 | -103 | -106 | -141 | International 1924 | 18 | MEAN FOR Iraq; Israel; Jordan; Lebanon; Kuwait; Saudi Arabia; Syria |
| 67 | European 1950 | -84 | -107 | -120 | International 1924 | 18 | Portugal; Spain |
| 68 | European 1950 | -112 | -77 | -145 | International 1924 | 18 | Tunisia |
| 69 | European 1979 | -86 | -98 | -119 | International 1924 | 18 | MEAN FOR Austria; Finland; Netherlands; Norway; Spain; Sweden; Switzerland |
| 70 | Fort Thomas 1955 | -7 | 215 | 225 | Clarke 1880 | 7 | Nevis; St. Kitts (Leeward Islands) |
| 71 | Gan 1970 | -133 | -321 | 50 | International 1924 | 18 | Republic of Maldives |
| 72 | Geodetic Datum 1949 | 84 | -22 | 209 | International 1924 | 18 | New Zealand |
| 73 | Graciosa Base SW 1948 | -104 | 167 | -38 | International 1924 | 18 | Azores (Faial; Graciosa; Pico; Sao Jorge; Terceira) |
| 74 | Guam 1963 | -100 | -248 | 259 | Clarke 1866 | 6 | Guam |
| 75 | Gunung Segara | -403 | 684 | 41 | Bessel 1841 | 5 | Indonesia (Kalimantan) |
| 76 | GUX 1 Astro | 252 | -209 | -751 | International 1924 | 18 | Guadalcanal Island |
| 77 | Herat North | -333 | -222 | 114 | International 1924 | 18 | Afghanistan |
| 78 | Hermannskogel Datum | 653 | -212 | 449 | Bessel 1841 (Namibia) | 4 | Croatia -Serbia, Bosnia-Herzegovina |
| 79 | Hjorsey 1955 | -73 | 46 | -86 | International 1924 | 18 | Iceland |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 80 | Hong Kong 1963 | -156 | -271 | -189 | International 1924 | 18 | Hong Kong |
| 81 | Hu-Tzu-Shan | -637 | -549 | -203 | International 1924 | 18 | Taiwan |
| 82 | Indian | 282 | 726 | 254 | Everest (India 1830) | 8 | Bangladesh |
| 83 | Indian | 295 | 736 | 257 | Everest (India 1956) | 10 | India; Nepal |
| 84 | Indian | 283 | 682 | 231 | Everest (Pakistan) | 13 | Pakistan |
| 85 | Indian 1954 | 217 | 823 | 299 | Everest (India 1830) | 8 | Thailand |
| 86 | Indian 1960 | 182 | 915 | 344 | Everest (India 1830) | 8 | Vietnam (Con Son Island) |
| 87 | Indian 1960 | 198 | 881 | 317 | Everest (India 1830) | 8 | Vietnam (Near 16øN)) |
| 88 | Indian 1975 | 210 | 814 | 289 | Everest (India 1830) | 8 | Thailand |
| 89 | Indonesian 1974 | -24 | -15 | 5 | Indonesian 1974 | 17 | Indonesia |
| 90 | Ireland 1965 | 506 | -122 | 611 | Modified Airy | 2 | Ireland |
| 91 | ISTS 061 Astro 1968 | -794 | 119 | -298 | International 1924 | 18 | South Georgia Islands |
| 92 | ISTS 073 Astro 1969 | 208 | -435 | -229 | International 1924 | 18 | Diego Garcia |
| 93 | Johnston Island 1961 | 189 | -79 | -202 | International 1924 | 18 | Johnston Island |
| 94 | Kandawala | -97 | 787 | 86 | Everest (India 1830) | 8 | Sri Lanka |
| 95 | Kerguelen Island 1949 | 145 | -187 | 103 | International 1924 | 18 | Kerguelen Island |
| 96 | Kertau 1948 | -11 | 851 | 5 | Everest (Malay. & Sing) | 12 | West Malaysia & Singapore |
| 97 | Kusaie Astro 1951 | 647 | 1777 | -1124 | International 1924 | 18 | Caroline Islands |
| 98 | Korean Geodetic System | 0 | 0 | 0 | GRS 80 | 20 | South Korea |
| 99 | L. C. 5 Astro 1961 | 42 | 124 | 147 | Clarke 1866 | 6 | Cayman Brac Island |
| 100 | Leigon | -130 | 29 | 364 | Clarke 1880 | 7 | Ghana |
| 101 | Liberia 1964 | -90 | 40 | 88 | Clarke 1880 | 7 | Liberia |
| 102 | Luzon | -133 | -77 | -51 | Clarke 1866 | 6 | Philippines (Excluding Mindanao) |
| 103 | Luzon | -133 | -79 | -72 | Clarke 1866 | 6 | Philippines (Mindanao) |
| 104 | M'Poraloko | -74 | -130 | 42 | Clarke 1880 | 7 | Gabon |
| 105 | Mahe 1971 | 41 | -220 | -134 | Clarke 1880 | 7 | Mahe Island |
| 106 | Massawa | 639 | 405 | 60 | Bessel 1841 | 5 | Ethiopia (Eritrea) |
| 107 | Merchich | 31 | 146 | 47 | Clarke 1880 | 7 | Morocco |
| 108 | Midway Astro 1961 | 912 | -58 | 1227 | International 1924 | 18 | Midway Islands |
| 109 | Minna | -81 | -84 | 115 | Clarke 1880 | 7 | Cameroon |
| 110 | Minna | -92 | -93 | 122 | Clarke 1880 | 7 | Nigeria |
| 111 | Montserrat Island Astro 1958 | 174 | 359 | 365 | Clarke 1880 | 7 | Montserrat (Leeward Islands) |
| 112 | Nahrwan | -247 | -148 | 369 | Clarke 1880 | 7 | Oman (Masirah Island) |
| 113 | Nahrwan | -243 | -192 | 477 | Clarke 1880 | 7 | Saudi Arabia |
| 114 | Nahrwan | -249 | -156 | 381 | Clarke 1880 | 7 | United Arab Emirates |
| 115 | Naparima BWI | -10 | 375 | 165 | International 1924 | 18 | Trinidad & Tobago |
| 116 | North American 1927 | -5 | 135 | 172 | Clarke 1866 | 6 | Alaska (Excluding Aleutian Ids) |
| 117 | North American 1927 | -2 | 152 | 149 | Clarke 1866 | 6 | Alaska (Aleutian Ids East of 180øW) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 118 | North American 1927 | 2 | 204 | 105 | Clarke 1866 | 6 | Alaska (Aleutian Ids West of 180øW) |
| 119 | North American 1927 | -4 | 154 | 178 | Clarke 1866 | 6 | Bahamas (Except San Salvador Id) |
| 120 | North American 1927 | 1 | 140 | 165 | Clarke 1866 | 6 | Bahamas (San Salvador Island) |
| 121 | North American 1927 | -7 | 162 | 188 | Clarke 1866 | 6 | Canada (Alberta; British Columbia) |
| 122 | North American 1927 | -9 | 157 | 184 | Clarke 1866 | 6 | Canada (Manitoba; Ontario) |
| 123 | North American 1927 | -22 | 160 | 190 | Clarke 1866 | 6 | Canada (New Brunswick; Newfoundland; Nova Scotia; Quebec) |
| 124 | North American 1927 | 4 | 159 | 188 | Clarke 1866 | 6 | Canada (Northwest Territories; Saskatchewan) |
| 125 | North American 1927 | -7 | 139 | 181 | Clarke 1866 | 6 | Canada (Yukon) |
| 126 | North American 1927 | 0 | 125 | 201 | Clarke 1866 | 6 | Canal Zone |
| 127 | North American 1927 | -9 | 152 | 178 | Clarke 1866 | 6 | Cuba |
| 128 | North American 1927 | 11 | 114 | 195 | Clarke 1866 | 6 | Greenland (Hayes Peninsula) |
| 129 | North American 1927 | -3 | 142 | 183 | Clarke 1866 | 6 | MEAN FOR Antigua; Barbados; Barbuda; Caicos Islands; Cuba; Dominican Republic; Grand Cayman; Jamaica; Turks Islands |
| 130 | North American 1927 | 0 | 125 | 194 | Clarke 1866 | 6 | MEAN FOR Belize; Costa Rica; El Salvador; Guatemala; Honduras; Nicaragua |
| 131 | North American 1927 | -10 | 158 | 187 | Clarke 1866 | 6 | MEAN FOR Canada |
| 132 | North American 1927 | -8 | 160 | 176 | Clarke 1866 | 6 | MEAN FOR CONUS |
| 133 | North American 1927 | -9 | 161 | 179 | Clarke 1866 | 6 | MEAN FOR CONUS (East of Mississippi; River Including Louisiana; Missouri; Minnesota) |
| 134 | North American 1927 | -8 | 159 | 175 | Clarke 1866 | 6 | MEAN FOR CONUS (West of Mississippi; River Excluding Louisiana; Minnesota; Missouri) |
| 135 | North American 1927 | -12 | 130 | 190 | Clarke 1866 | 6 | Mexico |
| 136 | North American 1983 | 0 | 0 | 0 | GRS 80 | 20 | Alaska (Excluding Aleutian Ids) |
| 137 | North American 1983 | -2 | 0 | 4 | GRS 80 | 20 | Aleutian Ids |
| 138 | North American 1983 | 0 | 0 | 0 | GRS 80 | 20 | Canada |
| 139 | North American 1983 | 0 | 0 | 0 | GRS 80 | 20 | CONUS |
| 140 | North American 1983 | 1 | 1 | -1 | GRS 80 | 20 | Hawai |
| 141 | North American 1983 | 0 | 0 | 0 | GRS 80 | 20 | Mexico; Central America |
| 142 | North Sahara 1959 | -186 | -93 | 310 | Clarke 1880 | 7 | Algeria |
| 143 | Observatorio Meteorologico 1939 | -425 | -169 | 81 | International 1924 | 18 | Azores (Corvo & Flores Islands) |
| 144 | Old Egyptian 1907 | -130 | 110 | -13 | Helmert 1906 | 15 | Egypt |
| 145 | Old Hawaiian | 89 | -279 | -183 | Clarke 1866 | 6 | Hawai |
| 146 | Old Hawaiian | 45 | -290 | -172 | Clarke 1866 | 6 | Kauai |
| 147 | Old Hawaiian | 65 | -290 | -190 | Clarke 1866 | 6 | Maui |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 148 | Old Hawaiian | 61 | -285 | -181 | Clarke 1866 | 6 | MEAN FOR Hawaii; Kauai; Maui; Oahu |
| 149 | Old Hawaiian | 58 | -283 | -182 | Clarke 1866 | 6 | Oahu |
| 150 | Oman | -346 | -1 | 224 | Clarke 1880 | 7 | Oman |
| 151 | Ordnance Survey Great Britain 1936 | 371 | -112 | 434 | Airy 1830 | 1 | England |
| 152 | Ordnance Survey Great Britain 1936 | 371 | -111 | 434 | Airy 1830 | 1 | England; Isle of Man; Wales |
| 153 | Ordnance Survey Great Britain 1936 | 375 | -111 | 431 | Airy 1830 | 1 | MEAN FOR England; Isle of Man; Scotland; Shetland Islands; Wales |
| 154 | Ordnance Survey Great Britain 1936 | 384 | -111 | 425 | Airy 1830 | 1 | Scotland; Shetland Islands |
| 155 | Ordnance Survey Great Britain 1936 | 370 | -108 | 434 | Airy 1830 | 1 | Wales |
| 156 | Pico de las Nieves | -307 | -92 | 127 | International 1924 | 18 | Canary Islands |
| 157 | Pitcairn Astro 1967 | 185 | 165 | 42 | International 1924 | 18 | Pitcairn Island |
| 158 | Point 58 | -106 | -129 | 165 | Clarke 1880 | 7 | MEAN FOR Burkina Faso & |
| 159 | Pointe Noire 1948 | -148 | 51 | -291 | Clarke 1880 | 7 | Congo |
| 160 | Porto Santo 1936 | -499 | -249 | 314 | International 1924 | 18 | Porto Santo; Madeira Islands |
| 161 | Provisional South American 1956 | -270 | 188 | -388 | International 1924 | 18 | Bolivia |
| 162 | Provisional South American 1956 | -270 | 183 | -390 | International 1924 | 18 | Chile (Northern; Near 19 øS) |
| 163 | Provisional South American 1956 | -305 | 243 | -442 | International 1924 | 18 | Chile (Southern; Near 43 øS) |
| 164 | Provisional South American 1956 | -282 | 169 | -371 | International 1924 | 18 | Colombia |
| 165 | Provisional South American 1956 | -278 | 171 | -367 | International 1924 | 18 | Ecuador |
| 166 | Provisional South American 1956 | -298 | 159 | -369 | International 1924 | 18 | Guyana |
| 167 | Provisional South American 1956 | -288 | 175 | -376 | International 1924 | 18 | MEAN FOR Bolivia; Chile; Colombia; Ecuador; Guyana; Peru; Venezuela |
| 168 | Provisional South American 1956 | -279 | 175 | -379 | International 1924 | 18 | Peru |
| 169 | Provisional South American 1956 | -295 | 173 | -371 | International 1924 | 18 | Venezuela |
| 170 | Provisional South Chilean 1963 | 16 | 196 | 93 | International 1924 | 18 | Chile (Near 53 øS) (Hito XVIII |
| 171 | Puerto Rico | 11 | 72 | -101 | Clarke 1866 | 6 | Puerto Rico; Virgin Islands |
| 172 | Pulkovo 1942 | 28 | -130 | -95 | Krassovsky 1940 | 19 | Russia |
| 173 | Qatar National | -128 | -283 | 22 | International 1924 | 18 | Qatar |
| 174 | Qornoq | 164 | 138 | -189 | International 1924 | 18 | Greenland (South) |
| 175 | Reunion | 94 | -948 | -1262 | International 1924 | 18 | Mascarene Islands |
| 176 | Rome 1940 | -225 | -65 | 9 | International 1924 | 18 | Italy (Sardinia) |
| 177 | S-42 (Pulkovo 1942) | 28 | -121 | -77 | Krassovsky 1940 | 19 | Hungary |
| 178 | S-42 (Pulkovo 1942) | 23 | -124 | -82 | Krassovsky 1940 | 19 | Poland |
| 179 | S-42 (Pulkovo 1942) | 26 | -121 | -78 | Krassovsky 1940 | 19 | Czechoslavakia |
| 180 | S-42 (Pulkovo 1942) | 24 | -124 | -82 | Krassovsky 1940 | 19 | Latvia |
| 181 | S-42 (Pulkovo 1942) | 15 | -130 | -84 | Krassovsky 1940 | 19 | Kazakhstan |
| 182 | S-42 (Pulkovo 1942) | 24 | -130 | -92 | Krassovsky 1940 | 19 | Albania |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 183 | S-42 (Pulkovo 1942) | 28 | -121 | -77 | Krassovsky 1940 | 19 | Romania |
| 184 | S-JTSK | 589 | 76 | 480 | Bessel 1841 | 5 | Czechoslavakia (Prior 1 JAN 1993) |
| 185 | Santo (DOS) 1965 | 170 | 42 | 84 | International 1924 | 18 | Espirito Santo Island |
| 186 | Sao Braz | -203 | 141 | 53 | International 1924 | 18 | Azores (Sao Miguel; Santa Maria Ids) |
| 187 | Sapper Hill 1943 | -355 | 21 | 72 | International 1924 | 18 | East Falkland Island |
| 188 | Schwarzeck | 616 | 97 | -251 | Bessel 1841 (Namibia) | 4 | Namibia |
| 189 | Selvagem Grande 1938 | -289 | -124 | 60 | International 1924 | 18 | Salvage Islands |
| 190 | Sierra Leone 1960 | -88 | 4 | 101 | Clarke 1880 | 7 | Sierra Leone |
| 191 | South American 1969 | -62 | -1 | -37 | South American 1969 | 21 | Argentina |
| 192 | South American 1969, | -61 | 2 | -48 | South American 1969 | 21 | Bolivia |
| 193 | South American 1969, | -60 | -2 | -41 | South American 1969 | 21 | Brazil |
| 194 | South American 1969, | -75 | -1 | -44 | South American 1969 | 21 | Chile |
| 195 | South American 1969, | -44 | 6 | -36 | South American 1969 | 21 | Colombia |
| 196 | South American 1969, | -48 | 3 | -44 | South American 1969 | 21 | Ecuador |
| 197 | South American 1969, | -47 | 26 | -42 | South American 1969 | 21 | Ecuador (Baltra; Galapagos) |
| 198 | South American 1969, | -53 | 3 | -47 | South American 1969 | 21 | Guyana |
| 199 | South American 1969, | -57 | 1 | -41 | South American 1969 | 21 | MEAN FOR Argentina; Bolivia; Brazil; Chile; Colombia; Ecuador; Guyana; Paraguay; Peru; Trinidad & Tobago; Venezuela |
| 200 | South American 1969, | -61 | 2 | -33 | South American 1969 | 21 | Paraguay |
| 201 | South American 1969, | -58 | 0 | -44 | South American 1969 | 21 | Peru |
| 202 | South American 1969, | -45 | 12 | -33 | South American 1969 | 21 | Trinidad & Tobago |
| 203 | South American 1969, | -45 | 8 | -33 | South American 1969 | 21 | Venezuela |
| 204 | South Asia | 7 | -10 | -26 | Modified Fischer 1960 | 14 | Singapore |
| 205 | Tananarive Observatory 1925 | -189 | -242 | -91 | International 1924 | 18 | Madagascar |
| 206 | Timbalai 1948 | -679 | 669 | -48 | Everest (Sabah Sarawak) | 9 | Brunei; E. Malaysia (Sabah Sarawak) |
| 207 | Tokyo | -148 | 507 | 685 | Bessel 1841 | 5 | Japan |
| 208 | Tokyo | -148 | 507 | 685 | Bessel 1841 | 5 | MEAN FOR Japan; South Korea; Okinawa |
| 209 | Tokyo | -158 | 507 | 676 | Bessel 1841 | 5 | Okinawa |
| 210 | Tokyo | -147 | 506 | 687 | Bessel 1841 | 5 | South Korea |
| 211 | Tristan Astro 1968 | -632 | 438 | -609 | International 1924 | 18 | Tristan da Cunha |
| 212 | Viti Levu 1916 | 51 | 391 | -36 | Clarke 1880 | 7 | Fiji (Viti Levu Island) |
| 213 | Voirol 1960 | -123 | -206 | 219 | Clarke 1880 | 7 | Algeria |
| 214 | Wake Island Astro 1952 | 276 | -57 | 149 | International 1924 | 18 | Wake Atoll |
| 215 | Wake-Eniwetok 1960 | 102 | 52 | -38 | Hough 1960 | 16 | Marshall Islands |
| 216 | WGS 1972 | 0 | 0 | 0 | WGS 72 | 22 | Global Definition |
| 217 | Yacare | -155 | 171 | 37 | International 1924 | 18 | Uruguay |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 218 | Zanderij | -265 | 120 | -358 | International 1924 | 18 | Suriname |

## NMEA protocol

The serial interface protocol is based on the National Marine Electronics Association's NMEA 0183 ASCII interface specification. This standard is fully define in "NMEA 0183, Version 3.01" The standard may be obtained from NMEA, www.nmea.org

## GGA-GLOBAL POSITIONING SYSTEM FIX DATA

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

### Structure:

$GPGGA,hhmmss.sss,ddmm.mmmm,a,dddmm.mmmm,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh<CR><LF>

1 2 3 4 5 6 7 8 9 10 11 12 13

### Example:

$GPGGA,060932.448,2447.0959,N,12100.5204, E,1,08,1.1,108.7,M,,,,0000*0E<CR><LF>

| Field | Name | Example | Description |
|---|---|---|---|
| 1 | UTC Time | 060932.448 | UTC of position in hhmmss.sss format, (000000.00 ~ 235959.99) |
| 2 | Latitude | 2447.0959 | Latitude in ddmm.mmmm format<br>Leading zeros transmitted |
| 3 | N/S Indicator | N | Latitude hemisphere indicator, 'N' = North, 'S' = South |
| 4 | Longitude | 12100.5204 | Longitude in dddmm.mmmm format<br>Leading zeros transmitted |
| 5 | E/W Indicator | E | Longitude hemisphere indicator, 'E' = East, 'W' = West |
| 6 | GPS quality indicator | 1 | GPS quality indicator<br>0: position fix unavailable<br>1: valid position fix, SPS mode<br>2: valid position fix, differential GPS mode<br>3: GPS PPS Mode, fix valid<br>4: Real Time Kinematic. System used in RTK mode with fixed integers<br>5: Float RTK. Satellite system used in RTK mode. Floatin g integers<br>6: Estimated (dead reckoning) Mode<br>7: Manual Input Mode<br>8: Simulator Mode |
| 7 | Satellites Used | 08 | Number of satellites in use, (00 ~ 12) |
| 8 | HDOP | 1.1 | Horizontal dilution of precision, (00.0 ~ 99.9) |
| 9 | Altitude | 108.7 | mean sea level (geoid), (-9999.9 ~ 17999.9) |

| | | | |
|---|---|---|---|
| 10 | Geoid Separation | | Geoid separation in meters according to WGS-84 ellipsoid<br>(-999.9 ~ 9999.9) |
| 11 | DGPS Age | | Age of DGPS data since last valid RTCM transmission in xxx format (seconds)<br>NULL when DGPS not used |
| 12 | DGPS Station ID | 0000 | Differential reference station ID, 0000 ~ 1023<br>NULL when DGPS not used |
| 13 | Checksum | 0E | |

**Note:** The checksum field starts with a '*' and consists of 2 characters representing a hex number. The checksum is the exclusive OR of all characters between '$' and '*'.

# GLL - LATITUDE AND LONGITUDE, WITH TIME OF POSITION FIX AND STATUS

Latitude and longitude of current position, time, and status.

## Structure:

$GPGLL,ddmm.mmmm,a,dddmm.mmmm,a,hhmmss.sss,A,a*hh<CR><LF>

1 2 3 4 5 6 7 8

## Example:

$GPGLL,4250.5589,S,14718.5084,E,092204.999,A,A*2D<CR><LF>

| Field | Name | Example | Description |
|---|---|---|---|
| 1 | Latitude | 4250.5589 | Latitude in ddmm.mmmm format<br>Leading zeros transmitted |
| 2 | N/S Indicator | S | Latitude hemisphere indicator<br>'N' = North<br>'S' = South |
| 3 | Longitude | 14718.5084 | Longitude in dddmm.mmmm format<br>Leading zeros transmitted |
| 4 | E/W Indicator | E | Longitude hemisphere indicator<br>'E' = East<br>'W' = West |
| 5 | UTC Time | 092204.999 | UTC time in hhmmss.sss format (000000.00 ~ 235959.99) |
| 6 | Status | A | Status, 'A' = Data valid, 'V' = Data not valid |
| 7 | Mode Indicator | A | Mode indicator<br>'N' = Data not valid<br>'A' = Autonomous mode<br>'D' = Differential mode<br>'E' = Estimated (dead reckoning) mode<br>'M' = Manual input mode<br>'S' = Simulator mode |
| 8 | Checksum | 2D | |

## GSA - GPS DOP AND ACTIVE SATELLITES

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

### Structure:

$GPGSA,A,x,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,x.x,x.x,x.x*hh<CR><LF>

1 2 3 3 3 3 3 3 3 3 3 3 3 3 4 5 6 7

### Example:

$GPGSA,A,3,01,20,19,13,,,,,,,,40.4,24.4,32.2*0A<CR><LF>

| Field | Name | Example | Description |
|---|---|---|---|
| 1 | Mode | A | Mode<br>'M' = Manual, forced to operate in 2D or 3D mode<br>'A' = Automatic, allowed to automatically switch 2D/3D |
| 2 | Mode | 3 | Fix type<br>1 = Fix not available<br>2 = 2D<br>3 = 3D |
| 3 | Satellite used 1~12 | 01,20,19,13,,,,,,,, | Satellite ID number, 01 to 32, of satellite used in solution, up to 12 transmitted |
| 4 | PDOP | 40.4 | Position dilution of precision (00.0 to 99.9) |
| 5 | HDOP | 24.4 | Horizontal dilution of precision (00.0 to 99.9) |
| 6 | VDOP | 32.2 | Vertical dilution of precision (00.0 to 99.9) |
| 7 | Checksum | 0A | |

## GSV - GPS SATELLITE IN VIEW

Numbers of satellites in view, PRN number, elevation angle, azim uth angle, and C/No. Four satellites details are transmitted per message. Additional satellite in view information is send in subsequent GSV messages.

### Structure:

$GPGSV,x,x,xx,xx,xx,xxx,xx,…,xx,xx,xxx,xx *hh<CR><LF>

1 2 3 4 5 6 7 4 5 6 7 8

### Example:

$GPGSV,3,1,09,28,81,225,41,24,66,323,44,20,48,066,43,17,45,336,41*78<CR><LF>

$GPGSV,3,2,09,07,36,321,45,04,36,257,39,11,20,050,41,08,18,208,43*77<CR><LF>

| Field | NaME | Example | Description |
|---|---|---|---|
| 1 | Number of message | 3 | Total number of GSV messages to be transmitted (1-3) |
| 2 | Sequence number | 1 | Sequence number of current GSV message |
| 3 | Satellites in view | 09 | Total number of satellites in view (00 ~ 12) |
| 4 | Satellite ID | 28 | Satellite ID number, GPS: 01 ~ 32, SBAS: 33 ~ 64 (33 = PRN120) |
| 5 | Elevation | 81 | Satellite elevation in degrees, (00 ~ 90) |
| 6 | Azimuth | 225 | Satellite azimuth angle in degrees, (000 ~ 359 ) |
| 7 | SNR | 41 | C/No in dB (00 ~ 99)<br>Null when not tracking |
| 8 | Checksum | 78 | |

## RMC - RECOMMANDED MINIMUM SPECIFIC GPS/TRANSIT DATA

Time, date, position, course and speed data provided by a GNSS navigation module.

### Structure:

$GPRMC,hhmmss.sss,A,dddmm.mmmm,a,dddmm.mmmm,a,x.x,x.x,ddmmyy,x.x,a,a*hh<CR><LF>

1 2 3 4 5 6 7 8 9 10 11 12 13

### Example:

$GPRMC,092204.999,A,4250.5589,S,14718.5084,E,0.00,89.68,211200,,A*25<CR><LF>

| Field | NaME | Example | Description |
|---|---|---|---|
| 1 | UTC time | 092204.999 | UTC time in hhmmss.sss format (000000.00 ~ 235959.999) |
| 2 | Status | A | Status<br>'V' = Navigation module warning<br>'A' = Data Valid |
| 3 | Latitude | 4250.5589 | Latitude in dddmm.mmmm format<br>Leading zeros transmitted |
| 4 | N/S indicator | S | Latitude hemisphere indicator<br>'N' = North<br>'S' = South |
| 5 | Longitude | 14718.5084 | Longitude in dddmm.mmmm format<br>Leading zeros transmitted |
| 6 | E/W Indicator | E | Longitude hemisphere indicator<br>'E' = East<br>'W' = West |
| 7 | Speed over ground | 000.0 | Speed over ground in knots (000.0 ~ 999.9) |
| 8 | Course over ground | 000.0 | Course over ground in degrees (000.0 ~ 359.9) |
| 9 | UTC Date | 211200 | UTC date of position fix, ddmmyy format |
| 10 | Magnetic variation | | Magnetic variation in degrees (000.0 ~ 180.0) |
| 11 | Magnetic Variation | | Magnetic variation direction<br>'E' = East<br>'W' = West |
| 12 | Mode indicator | A | Mode indicator<br>'N' = Data not valid<br>'A' = Autonomous mode<br>'D' = Differential mode<br>'E' = Estimated (dead reckoning) mode<br>'M' = Manual input mode<br>'S' = Simulator mode |
| 13 | checksum | 25 | |

## VTG - COURSE OVER GROUND AND GROUND SPEED

The Actual course and speed relative to the ground.

### Structure:

GPVTG,x.x,T,x.x,M,x.x,N,x.x,K,a*hh<CR><LF>

1 2 3 4 5 6

### Example:

$GPVTG,89.68,T,,M,0.00,N,0.0,K,A*5F<CR><LF>

| Field | Name | Example | Description |
|---|---|---|---|
| 1 | Course | 89.68 | True course over ground in degrees (000.0 ~ 359.9) |
| 2 | Course | | Magnetic course over ground in degrees (000.0 ~ 359.9) |
| 3 | Speed | 0.00 | Speed over ground in knots (000.0 ~ 999.9) |
| 4 | Speed | 0.00 | Speed over ground in kilometers per hour (0000.0 ~ 1800.0) |
| 5 | Mode | A | Mode indicator<br>'N' = not valid<br>'A' = Autonomous mode<br>'D' = Differential mode<br>'E' = Estimated (dead reckoning) mode<br>'M' = Manual input mode<br>'S' = Simulator mode |
| 6 | Checksum | 5F | |

## ZDA- TIME AND DATE

### Structure:

$GPRMC,hhmmss.sss,dd,mm.yyyy, , ,xxx<CR><LF>

1 2 3 4 5 6 7

### Example:

$GPZDA,104548.04,25,03,2004,,*6C <CR><LF>

| Field | Name | Example | Description |
|---|---|---|---|
| 1 | UTC time | 104548.04 | UTC time in hhmmss.ss format, 000000.00 ~ 235959.99 |
| 2 | UTC time: day | 25 | UTC time day (01 ... 31) |
| 3 | UTC time: month | 03 | UTC time: month (01 ... 12) |
| 4 | UTC time: year | 2004 | UTC time: year (4 digit year) |
| 5 | | | Local zone hour<br>Not being output by the module (NULL) |
| 6 | | | Local zone minutes<br>Not being output by the module (NULL) |
| 7 | 6C | 6C | Checksum |

## Contact Information

We hope this datasheet will be helpful to the user to get the most out of the GPS mo dule, furthermore feedback inputs about errors or mistakable verbalizations and comments or proposals to **Cyber i-Technologies Co., Ltd.**. for further improvements are highly appreciated.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