

GPS-200A SERIAL PROTOCOL SPECIFICATION

document version 1.4

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Introduction

Serial communication with the GPS-200A is accomplished by the exchange of messages. A command message is sent to the GPS-200A from the user application. A response message is returned to the user application from the GPS-200A. A response message will consist of a single response for query-type messages or multiple responses on some specified interval for mode-type commands.

A message will be defined as a group of bytes including a header, ID, data size, and data. The message header is used by both the GPS-200A and the user application to identify the message and message type. A message header consists of the hexadecimal byte sequence 0xFF 0xAC (255 172). A message ID will be one byte from the list of messages which the GPS-200A recognizes.

In this document all numbers are in decimal notation except for those preceded by '0x'. Such numbers are in hexadecimal notation.

Command messages - to the GPS-200A from the user application

The format for transmitting command messages to the GPS-200A is as follows:

```
<msg header><msg id>[<data bytes.....>]<checksum>
```

The data portion of a command message will vary depending on the type of message being sent. Some messages do not require any data to be transmitted so none should be sent. The GPS-200A knows the required number of data bytes for each command message. If a command message is transmitted without the appropriate number of data bytes it will be rejected.

A checksum is required for all messages sent to the GPS-200A. The checksum is calculated by exclusive-or'ing together the message id and all data bytes. The message header sequence (0xFF 0xAC) is not included in the checksum calculation. For command messages that contain no data bytes the message ID is sent (again) as the checksum.

Response messages - from the GPS-200A to the user application

The format for the response messages from the GPS-200A is as follows:

```
<msg header><msg id><data size><data bytes...><checksum>
```

The message ID indicates to which command message the response is directed. The data size specifies the number of response data bytes forthcoming, including the checksum. All response messages contain at least one data byte.

Mode-type message

Mode-type messages are enabled and disabled. When enabled they output on a given interval, usually once per second at the valid start of the second. Unless otherwise stated these messages, even when enabled, will not begin to transmit on their given intervals until the GPS receiver module begins outputting a pulse-per-second reference. All mode-type messages have an equivalent Query-type message from which a response can be obtained at any time.

Query-type messages

These messages return a one-time response.

Configuration-type messages

These messages cause the GPS-200A to alter operation in some way. These messages do not respond.

Firmware version notes

If your firmware version is not current some messages may not be supported. The 'Firmware' section for each message will indicate if that message has been added since firmware version 1.0. All user applications should send message ID 32 to verify that GPS-200A firmware version supports message(s) that the user application requires.

Physical connections to the GPS-200A

The GPS-200A has the following I/O connections for RS-232 communications on the rear DB-9 connector:

- pin 2 - receive (RX)
- pin 3 - transmit (TX)
- pin 5 - ground

For communications with the GPS-200A from a standard IBM PC or compatible computer a standard null-modem cable may be used. For communications with other types of hosts please observe the following requirements:

- All communications with the GPS-200A are at 9600 baud, 8 data bits, 1 stop bit, no parity.
- Connect the transmit (TX) line of the GPS-200A (pin 2 of the DB-9 connector) to the receive (RX) line of the host system.
- Connect the receive (RX) line of the GPS-200A (pin 3 of the DB-9 connector) to the transmit (TX) line of the host system.
- Connect the ground line of the GPS-200A (pin 5 of the DB-9 connector) to the ground of the host system.
- Be sure the host system is capable of communicating by standard RS-232 at 9600 baud, 8 data bits, 1 stop bit, no parity. The GPS-200A can not decode TTL-level serial communications at the DB-9 connector.
- Be sure that any cable you are using for communication with the GPS-200A is within RS-232 standard length and is a working cable. Check the cable connections with an ohmmeter if necessary.

Name: Auto-transmit GPS satellite acquisition/fix information
 ID: 0
 Type: Mode
 Firmware: 1.0

Description: Enable or disable automatic transmission of GPS fix acquisition information once per second at the valid start of the second. The GPS-200A must be receiving a pulse-per-second from the GPS receiver for this message to be output.

Command format:

Byte	Value	Description
1	0xFF	message header
2	0xAC	“ “
3	0x00	command ID
4	0x??	0x01 to enable this mode, 0x00 to disable
5	0x??	checksum

Response format:

Byte	Value	Description
1	0xFF	message header
2	0xAC	“ “
3	0x00	response ID
4	0x10	response data size
5	0x??	Position fix quality. Possible position fix quality indications are: 0 = fix not available 1 = non-differential 2 = differential
6	0x??	Position fix type. Possible position fix indications are: 1 = not available 2 = 2-D 3 = 3-D
7	0x??	Satellites used in position fix
8	0x??	<i>reserved</i>
9	0x??	<i>reserved</i>
10	0x??	<i>reserved</i>
11	0x??	<i>reserved</i>
12	0x??	<i>reserved</i>
13	0x??	<i>reserved</i>
14	0x??	<i>reserved</i>
15	0x??	<i>reserved</i>
16	0x??	<i>reserved</i>
17	0x??	<i>reserved</i>
18	0x??	<i>reserved</i>
19	0x??	<i>reserved</i>
20	0x??	checksum

Name: Auto-transmit time information once/second
 ID: 1
 Type: Mode
 Firmware: 1.0

Description Enable or disable automatic transmission of GPS-200A UTC and generate (local) time once/second at the valid start of the second. The GPS-200A must be receiving a pulse-per-second from the GPS receiver for this message to be output.

Notes: User application must accommodate serial transmission delay times.

Command format:

Byte	Value	Description
1	0xFF	message header
2	0xAC	“ “
3	0x01	command ID
4	0x??	0x01 to enable this mode, 0x00 to disable
5	0x??	checksum

Response format:

Byte	Value	Description
1	0xFF	message header
2	0xAC	“ “
3	0x01	response ID
4	0x0D	response data size
5	0x??	UTC hour
6	0x??	UTC minute
7	0x??	UTC second
8	0x??	UTC month
9	0x??	UTC day
10	0x??	UTC year
11	0x??	generate hour
12	0x??	generate minute
13	0x??	generate second
14	0x??	generate month
15	0x??	generate day
16	0x??	generate year
17	0x??	checksum

Name: Auto-transmit time once/frame
ID: 2
Type: Mode
Firmware: 1.0 - Supports this mode only with SMPTE time code
 1.1 - Adds support of this mode for IRIG-B

Description Enable or disable automatic transmission of GPS-200A generate (local) time once/frame at the valid start of the frame.

Notes: The GPS-200A must be generating time code for this message to be output. User application must accomodate serial transmission delay times.

Command format:

Byte	Value	Description
1	0xFF	message header
2	0xAC	“ “
3	0x02	command ID
4	0x??	0x01 to enable this mode, 0x00 to disable
5	0x??	checksum

Response format:

Byte	Value	Description
1	0xFF	message header
2	0xAC	“ “
3	0x02	response ID
4	0x08	response data size
5	0x??	BCD generate hour ^{1 2}
6	0x??	BCD generate minute ^{1 2}
7	0x??	BCD generate second ^{1 2}
8	0x??	BCD generate frame ¹
9	0x??	BCD generate month ¹ / BCD day of year (tens and units) ²
10	0x??	BCD generate day ¹ / BCD day of year (hundreds) ²
11	0x??	BCD generate year ¹
12	0x??	checksum

¹ Available when the GPS-200A is configured to generate SMPTE-format time code

² Available when the GPS-200A is configured to generate IRIG-B(1) format time code

Name: Auto-transmit GPS-200A status
 ID: 3
 Type: Mode
 Firmware: 1.0

Description Enable or disable automatic transmission of GPS-200A operation status once/second at the valid start of the second.

Notes: The Garmin module status information (bytes 7 and 9, should only be considered valid if the most significant bit of byte 7 is set to 1.

Command format:

Byte	Value	Description
1	0xFF	message header
2	0xAC	“ ”
3	0x03	command ID
4	0x??	0x01 to enable this mode, 0x00 to disable
5	0x??	checksum

Response format:

Byte	Value	Description
1	0xFF	message header
2	0xAC	“ ”
3	0x03	response ID
4	0x07	response data size
5	0x??	GPS-200A operation status bits. A bit set indicates the given condition is on/true/active: bit 0 = freewheeling bit 1 = time simulation bit 2 = time code generation status bit 3 = daylight time applied to generate time bit 4 = GPS fix valid for critical timing bit 5 = 1Hz clock is converging with Garmin PPS bit 6 = last reset cause (1=power-on, 0=other source) bit 7 = GPS receiver operation (1=normal, 0=reset in progress)
6	0x??	time code type. Possible time code type indications are: 0 = SMPTE (30 frames/second, non-drop frame) 1 = SMPTE (25 frames/second) 2 = SMPTE (24 frames/second) 3 = IRIG-B(1)
7	0x??	<i>reserved</i>
8	0x??	Garmin GPS receiver status bits. ROM checksum test (1=pass, 0=fail) Receiver failure discrete (1=pass, 0=fail) Stored data lost (1=retained, 0=lost) Real time clock lost (1=retained, 0=lost) Oscillator drift discrete (1=pass, 0=excessive drift) Data collection discrete (1=collecting, 0=not collecting) Board configuration data (1=retained, 0=lost) Garmin status bits status (1=valid, 0=invalid)
9	0x??	<i>reserved</i>
10	0x??	Garmin GPS receiver board temperature (°C)
11	0x??	checksum

Name: Set GPS-200A time zone configuration
ID: 16
Type: Configuration
Firmware: 1.0

Description Configure time zone information the GPS-200A applies to UTC time to derive generate (local) time.

Notes: A take is performed on the new time zone configuration at the next pulse-per-second event. This configuration overrides on-board switch bank settings only until the next GPS-200A reset or power cycle.

Command format:

Byte	Value	Description
1	0xFF	message header
2	0xAC	“ “
3	0x10	command ID
4	0x??	local time bias (in seconds) (LSB) ¹
5	0x??	local time bias (in seconds) ¹
6	0x??	local time bias (in seconds) (MSB) ¹
7	0x??	bias sign (0=positive bias, 1=negative bias)
8	0x??	checksum

¹The local time bias value is a 24-bit word transmitted as its three 8-bit components with byte 7 as a sign (+/-) indication. The GPS-200A uses the following formula to determine local time: UTC + bias = local time

Name: Set GPS-200A daylight savings time configuration
 ID: 17
 Type: Configuration
 Firmware: 1.0

Description Configure the daylight savings time window and bias that the GPS-200A applies to local time for time code generation.

Notes: A take is performed on the new configuration at the next pulse-per-second event. This configuration overrides on-board switch bank settings only until the next GPS-200A reset or power cycle. This message can accommodate a greater variety of daylight savings time configurations than can the on-board switch bank selections. Specifying a new daylight savings time configuration does not disable or alter the previous time zone configuration.

Daylight time encoding

When 'dyltype' is set to 0ffh daylight savings time encoding is disabled and the system assumes that 'stdtype' is also set to 0ffh.

When 'dsttype' is set to 1-5 daylight saving time begins on the...

- 1 = first week
- 2 = second week
- 3 = third week
- 4 = fourth week
- 5 = last week

...of the month specified in 'dstmon' and the day of the week specified in 'dstday' for the current year and at the time specified in 'dsthr/dstmin/dstsec'. Day of week is encoded as (0=Sunday, etc.)

When 'dsttype' is set to 0 daylight savings time begins on an absolute time/date for the current year. 'dstmon' specifies start month, 'dstday' specifies start day of month and 'dsthr/dstmin/dstsec' specifies start time.

Standard time encoding

Encoded exactly as 'Daylight time' with the following exceptions:

- uses standard ... command message members
- indicates when standard time begins (daylight time ends)

Command format:

Byte	Value	Description
1	0xFF	message header
2	0xAC	“ “
3	0x11	command ID
4	0x??	daylight time bias in seconds (LSB) ¹
5	0x??	daylight time bias in seconds ¹
6	0x??	daylight time bias in seconds (MSB) ¹
7	0x??	bias sign (0=positive bias, 1=negative bias)
8	0x??	daylight encoding type
9	0x??	daylight month
10	0x??	daylight day
11	0x??	daylight hour
12	0x??	daylight minute
13	0x??	daylight second
14	0x??	standard encoding type

15	0x??	standard month
16	0x??	standard day
17	0x??	standard hour
18	0x??	standard minute
19	0x??	standard second
20	0x??	checksum

¹The daylight bias value is a 24-bit word transmitted as its three 8-bit components with byte 7 as a sign (+/-) indication.

Name: Simulate Time
ID: 31
Type: Configuration
Firmware: 1.0

Description Enables or disables time simulation. The time set with this configuration is treated as UTC-referenced and must be between January 1, 1980 and December 31, 2079. The GPS-200A will apply current time zone and daylight time biases to the simulation time sent.

Notes: Once set, simulation persists until specifically disabled by this message or a power cycle on the GPS-200A. When possible, simulation time clocks to the UTC change of the second (synchronized to UTC and GPS).

Command format:

Byte	Value	Description
1	0xFF	message header
2	0xAC	“ “
3	0x1F	command ID
4	0x??	0x01 to enable this configuration, 0x00 to disable
5	0x??	UTC hour (0 - 23)
6	0x??	UTC minute (0-59)
7	0x??	UTC second (0-59)
8	0x??	UTC month (1-12)
9	0x??	UTC day (1-31)
10	0x??	UTC year (0-99) ¹
11	0x??	checksum

¹The year sent as 80-99 will be in the 20th century (1980-1999). The year sent as 00-79 will be in the 21st century (2000-2079).

Name: Request GPS-200A product information
ID: 32
Type: Query
Firmware: 1.0

Description: Responds with GPS-200A production information.

Notes: This information is available at any time after the GPS-200A has completed initialization.

Command format:

Byte	Value	Description
1	0xFF	message header
2	0xAC	“ “
3	0x20	command ID
5	0x20	checksum

Response format:

Byte	Value	Description
1	0xFF	message header
2	0xAC	“ “
3	0x20	response ID
4	0x23	response data size
5	0x??	GPS-200A firmware version (major)
6	0x??	GPS-200A firmware version (minor)
7	0x??	<i>reserved</i>
8	0x??	<i>reserved</i>
9	0x??	Garmin GPS receiver version string
10	0x??	“ “
..	0x??	“ “
38	0x??	“ “
39	0x??	checksum

Name: Request GPS-200A generate time
ID: 33
Type: Query
Firmware: 1.0

Description Responds with a one-time transmission of GPS-200A generate time information

Notes: The GPS-200A must be generating time code for this message to be output. User application must accomodate serial transmission delay times.

Command format:

Byte	Value	Description
1	0xFF	message header
2	0xAC	“ ”
3	0x21	command ID
5	0x21	checksum

Response format:

Byte	Value	Description
1	0xFF	message header
2	0xAC	“ ”
3	0x02	response ID
4	0x08	response data size
5	0x??	BCD generate hour ^{1 2}
6	0x??	BCD generate minute ^{1 2}
7	0x??	BCD generate second ^{1 2}
8	0x??	BCD generate frame ¹
9	0x??	BCD generate month ¹ / BCD day of year (tens and units) ²
10	0x??	BCD generate day ¹ / BCD day of year (hundreds) ²
11	0x??	BCD generate year ¹
12	0x??	checksum

¹ Available when the GPS-200A is configured to generate SMPTE-format time code

² Available when the GPS-200A is configured to generate IRIG-B(1) format time code

Name: Request GPS-200A status
 ID: 34
 Type: Query
 Firmware: 1.0

Description: Responds with one-time transmission of GPS-200A operation status information.

Notes: The Garmin module status information (bytes 7 and 9, should only be considered valid if the most significant bit of byte 7 is set to 1.

Command format:

Byte	Value	Description
1	0xFF	message header
2	0xAC	“ “
3	0x22	command ID
4	0x22	checksum

Response format:

Byte	Value	Description
1	0xFF	message header
2	0xAC	“ “
3	0x03	response ID
4	0x07	response data size
5	0x??	GPS-200A operation status bits. A bit set indicates the given condition is on/true/active: bit 0 = freewheeling bit 1 = time simulation bit 2 = time code generation status bit 3 = daylight time applied to generate time bit 4 = GPS fix valid for critical timing bit 5 = 1Hz clock is converging with Garmin PPS bit 6 = last reset cause (1=power-on, 0=other source) bit 7 = free-running time code generator
6	0x??	time code type. Possible time code type indications are: 0 = SMPTE (30 frames/second, non-drop frame) 1 = SMPTE (25 frames/second) 2 = SMPTE (24 frames/second) 3 = IRIG-B(1)
7	0x??	<i>reserved</i>
8	0x??	Garmin GPS receiver status bits. ROM checksum test (1=pass, 0=fail) Receiver failure discrete (1=pass, 0=fail) Stored data lost (1=retained, 0=lost) Real time clock lost (1=retained, 0=lost) Oscillator drift discrete (1=pass, 0=excessive drift) Data collection discrete (1=collecting, 0=not collecting) Board configuration data (1=retained, 0=lost) Garmin status bits status (1=valid, 0=invalid)
9	0x??	<i>reserved</i>
10	0x??	Garmin GPS receiver board temperature (°C)
11	0x??	checksum

Name: Request GPS-200A satellite acquisition/fix information
ID: 35
Type: Query
Firmware: 1.0

Description: Responds with one-time transmission of GPS fix acquisition information.

Notes: This information is available at any time after the GPS-200A has completed initialization.

Command format:

Byte	Value	Description
1	0xFF	message header
2	0xAC	“ “
3	0x23	command ID
5	0x23	checksum

Response format:

Byte	Value	Description
1	0xFF	message header
2	0xAC	“ “
3	0x23	response ID
4	0x10	response data size
5	0x??	Position fix quality. Possible position fix quality indications are: 0 = fix not available 1 = non-differential 2 = differential
6	0x??	Position fix type. Possible position fix indications are: 1 = not available 2 = 2-D 3 = 3-D
7	0x??	Satellites used in position fix
8	0x??	<i>reserved</i>
9	0x??	<i>reserved</i>
10	0x??	<i>reserved</i>
11	0x??	<i>reserved</i>
12	0x??	<i>reserved</i>
13	0x??	<i>reserved</i>
14	0x??	<i>reserved</i>
15	0x??	<i>reserved</i>
16	0x??	<i>reserved</i>
17	0x??	<i>reserved</i>
18	0x??	<i>reserved</i>
19	0x??	<i>reserved</i>
20	0x??	checksum

Name: Simulate GPS Outage
ID: 50
Type: Configuration (diagnostic only)
Firmware: 3.0

Description: Forces the GPS-200A to treat the GPS fix information as invalid, which disengages the software oscillator from GPS disciplining and the system enters freewheeling mode. The

requested behavior will persist until turned off again by this message.

Command format:

Byte	Value	Description
1	0xFF	message header
2	0xAC	“ “
3	0x32	command ID
4	0xAA	diagnostic “passcode”
5	0xBB	diagnostic “passcode”
6	0x??	simulation behavior, one of: 0 = normal operation 1 = GPS fix outage 2 = sporadic GPS fix outage
7	0x??	checksum

Name: Adjust Software Oscillator Frequency
ID: 51
Type: Configuration (diagnostic only)
Firmware: 3.0

Description: Manually adjusts software oscillator frequency by the specified number of ticks (1 tick = 166.67ns). Note that this command has no effect unless system is in (normal or forced) freewheeling mode.

Command format:

Byte	Value	Description
1	0xFF	message header
2	0xAC	“ “
3	0x33	command ID
4	0xAA	diagnostic “passcode”
5	0xBB	diagnostic “passcode”
6	0x??	adjustment ¹ (LSB)
7	0x??	adjustment ¹ (MSB)
8	0x??	checksum

¹ Adjustment is a signed 16-bit number

Name: Enable/Disable Debugging Diagnostics
ID: 52
Type: Configuration (diagnostic only)
Firmware: 3.0

Description: Enables output of debugging diagnostic messages (currently 251-253).

Command format:

Byte	Value	Description
1	0xFF	message header
2	0xAC	“ “
3	0x34	command ID
4	0xAA	diagnostic “passcode”
5	0xBB	diagnostic “passcode”
6	0x??	1 = enable, 0 = disable
7	0x??	checksum

Name: Calibration/Disciplining Diagnostic
ID: 251
Type: Response-only
Firmware: 3.0

Description: Diagnostic output of various calibration/disciplining values.

Response format:

Byte	Value	Description
1	0xFF	message header
2	0xAC	“ “
3	0xFB	response ID
4	0x08	response data size
5	0x??	time code generator calibration value (LSB)
6	0x??	time code generator calibration value (MSB)
7	0x??	original calibrated oscillator reload value (LSB)
8	0x??	original calibrated oscillator reload value (MSB)
9	0x??	current calibrated oscillator reload value (LSB)
10	0x??	current calibrated oscillator reload value (MSB)
11	0x??	current calibrated oscillator interval counter
12	0x??	checksum

Name: Monitor Oscillator Disciplining
ID: 252
Type: Response-only
Firmware: 3.0

Description: Transmits information relating to the ongoing software oscillator disciplining that occurs during normal operation when GPS fix is present. Diagnostics only.

Response format:

Byte	Value	Description
1	0xFF	message header
2	0xAC	“ “
3	0xFC	response ID
4	0x0A	response data size
6	0x??	differential ¹ (LSB)
7	0x??	differential ¹
8	0x??	differential ¹ (MSB)
9	0x??	reload constant (LSB)
10	0x??	reload constant (MSB)
11	0x??	current timer 2 pass counter max
12	0x??	current reload (LSB)
13	0x??	current reload (MSB)
14	0x??	frequency adjustment stage (6/3 = far, 5/2 = medium, 4/1 = near)
15	0x??	checksum

¹Differential is a signed 24-bit number

Name: Monitor Oscillator Calibration
ID: 253
Type: Response-only

Firmware: 3.0

Description: Transmits information relating to the software oscillator calibration that occurs at power-up. Diagnostics only.

Response format:

Byte	Value	Description
1	0xFF	message header
2	0xAC	“ ”
3	0xFD	response ID
4	0x07	response data size
6	0x??	differential ¹ (LSB)
7	0x??	differential ¹
8	0x??	differential ¹ (MSB)
9	0x??	proposed reload constant (LSB)
10	0x??	proposed reload constant (MSB)
11	0x??	stabilization counter
12	0x??	checksum

¹Differential is a signed 24-bit number

Name: Startup Message
ID: 254
Type: Response-only
Firmware: 1.1

Description: One-time transmission GPS-200A “initialization complete” message. Sent after a power cycle and successful initialization of the GPS-200A unit.

Response format:

Byte	Value	Description
1	0xFF	message header
2	0xAC	“ ”
3	0xFE	response ID
4	0x06	response data size
6	0x??	GPS-200A status bits
7	0x??	On-board switch bank settings (1-8)
8	0x??	On-board switch bank settings (9-10)
9	0x??	<i>reserved</i>
10	0x??	<i>reserved</i>
11	0x??	<i>reserved</i>
20	0x??	checksum

Name: Error Messages
ID: 255
Type: Response-only
Firmware: 1.0

Description: Indicates that an RS-232 command message has been rejected. The error code and extended error code fields in the response indicate why the message was rejected.

Response format:

Byte	Value	Description
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1	0xFF	message header
2	0xAC	“ “
3	0xFF	response ID
4	0x04	response data size
6	0x??	ID of message which was rejected (if in response to invalid message, otherwise 0xff)
7	0x??	error code ¹
8	0x??	extended error code ²
9	0x??	checksum

¹ Possible error codes are:

- 1 = serial message rejected
- 2 = invalid request for current GPS-200A operation mode
- 3 = system-induced reset
 - extended 1 = reset flag bits
- 4 = stack waterline failure

² Extended error codes are message dependent.