

GPS Firmware A1037-A

A description of the standard GPS firmware provided
on Tyco Electronics' GPS modules
A1037-A

User's Manual

Version 1.2
Software Revision 4.30

tyco

Electronics

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1 Introduction

This document contains a detailed description of Tyco Electronics' standard GPS firmware used in the GPS modules A1037-A.

The purpose of this paper is the explanation of the behavior of the "NMEA" interface, i.e. a description of the outputs coming from this interface, and a summary of the commands that can be issued to this interface. This will allow easy and full adjustment and control of the module.

1.1 Serial Port Configuration

The firmware supports the bi-directional serial interface of Tyco Electronics' GPS module. It is implemented by use of the full duplex UART (Universal Asynchronous Receiver Transmitter) interface of the GPS processor.

- For the communication with UART the use of a kind of terminal program or another appropriate method is necessary.
- UART communication is always on port 0 (pin Tx0 and Rx0) of the module
- The default configuration of this serial port is: 4800 baud, 8 data bits, no parity, 1 stop bit, no flow control!

This interface is bi-directional, i.e. on the one side the output of the GPS modules (NMEA sentences, etc.) is sent to the UART interface, on the other side the UART interface can be used to send commands to Tyco Electronics' GPS modules.



Standard NMEA Sentences

1.2 Introduction

The **N**ational **M**arine **E**lectronics **A**ssociation created a uniform interface standard for digital data exchange between different marine electronic products back in the early nineteen-eighties.

- NMEA information is transmitted from a 'vendor' in 'sentences' with a maximum length of 80 characters.
- The general format is:
"\$<vendor><message><parameters>*<checksum><CR><LF>".
- The combination of <vendor><message> is called address field.
- The vendor code for the Global Positioning System is "GP".
- In this document NMEA sentences refer to the NMEA 0183 Standard.

For details see:

<http://www.nmea.org>

<http://www.nmea.org/pub/index.html>

For an introduction into GPS NMEA sentences see:

<http://home.mira.net/~gnb/gps/nmea.html>

1.3 Supported NMEA Sentences

The Tyco Electronics' GPS firmware currently supports 6 NMEA sentences:

- \$GPGGA (default: ON)
- \$GPVTG (default: ON)
- \$GPRMC (default: OFF)
- \$GPGSA (default: ON)
- \$GPGSV (default: ON)

The sentences that are switched on are transmitted with an update rate of 1/s. The following paragraphs give an overview of NMEA messages with example strings and short explanation.

1.3.1 GGA - Global Positioning System Fix Data

e.g. \$GPGGA,152145.000,4805.81931,N,01132.23172,E,1,04,2.5,607.75,M,47.6,M,,*67

(1)	\$GPGGA	Vendor and message identifier
(2)	152145.000	Universal time coordinated (15h 21m 45.000s)
(3)	4805.81931	Latitude (48deg 05.81931min)
(4)	N	North (or S for south)
(5)	01132.23172	Longitude (011deg 32.23172min)
(6)	E	East (or W for west)
(7)	1	Fix quality: GPS fix valid (or 0 for fix not available or 2 for differential fix, also when SBAS data are used)
(8)	04	Four satellites in view (min 00, max 12)
(9)	2.5	Horizontal dilution of precision
(10)	0607.75	Antenna altitude above/below mean sea level (geoid)
(11)	M	Unit of antenna altitude: meters
(12)	47.6	Geoidal separation
(13)	M	Unit of geoidal separation: meters
(14)	<empty>	Age of differential GPS data, null field when DGPS is not used
(15)	<empty>	Differential reference station ID, null field when DGPS is not used
(16)	*67	Checksum

Table 1: GGA example and description

**List of Tables
and Figures**



1.3.2 VTG – Course Over Ground and Ground Speed

e.g. \$GPVTG,169.3,T,,M,0.3,N,0.5,K*6B

(1)	\$GPVTG	Vendor and message identifier
(2)	169.3	Track degrees
(3)	T	True
(4)	<empty>	Track degrees (not supported)
(5)	M	Magnetic (not supported)
(6)	0.3	Speed [knots]
(7)	N	Knots
(8)	0.5	Speed [kilometers per hour]
(9)	K	Kilometers per hour
(10)	*6B	Checksum

Table 2: VTG example and description

1.3.3 RMC - Recommended Minimum Specific GPS Data

e.g. \$GPRMC,092516.000,A,4805.8021,N,01132.2243,E,1.9,183.8,270302,0.0,W*7B

(1)	\$GPRMC	Vendor and message identifier
(2)	092516.000	UTC - Universal Time Coordinated (09h 25m 16.000s)
(3)	A	Fix valid (or V for invalid or no fix)
(4)	4805.8021	Latitude (48deg 05.8021min)
(5)	N	North (or S for south)
(6)	01132.2243	Longitude (011deg 32.2243min)
(7)	E	East (or W for west)
(8)	1.9	Speed over ground in knots
(9)	183.8	Track made good, degrees true
(10)	270302	Date (ddmmyy – 27 th March 2002)
(11)	0.0	Magnetic variation, degrees
(12)	W	West (or E for east)
(13)	*7B	Checksum

Table 3: RMC example and description

**List of Tables
and Figures**



1.3.4 GSA - GPS DOP and Active Satellites

e.g. \$GPGSA,A,3,03,20,14,31,,,,,,,,,3.7,2.5,2.8*3D

(1)	\$GPGSA	Vendor and message identifier
(2)	A	Selection mode
(3)	3	Mode
(4)	03	ID of 1 st satellite used for fix
(5)	20	ID of 2 nd satellite used for fix
(6)	14	ID of 3 rd satellite used for fix
(7)	31	ID of 4 th satellite used for fix
(8)	<empty>	ID of 5 th satellite used for fix
(9)	<empty>	ID of 6 th satellite used for fix
(10)	<empty>	ID of 7 th satellite used for fix
(11)	<empty>	ID of 8 th satellite used for fix
(12)	<empty>	ID of 9 th satellite used for fix
(13)	<empty>	ID of 10 th satellite used for fix
(14)	<empty>	ID of 11 th satellite used for fix
(15)	<empty>	ID of 12 th satellite used for fix
(16)	3.7	PDOP in meters
(17)	2.5	HDOP in meters
(18)	2.8	VDOP in meters
(19)	*3D	Checksum

Table 4: GSA example and description

1.3.5 GSV – GPS Satellites in View

e.g. \$GPGSV,1,1,04,03,27,159,45,14,43,095,48,20,17,231,40,31,60,190,42*7F		
(1)	\$GPGSV	Vendor and message identifier
(2)	1	Total numbers of messages
(3)	1	Number of current message
(4)	04	Satellites in view
(5)	03	Satellite number
(6)	27	Elevation in degrees
(7)	159	Azimuth in degrees to true
(8)	45	SNR in dB
(9)	14	Satellite number
(10)	43	Elevation in degrees
(11)	095	Azimuth in degrees to true
(12)	48	SNR in dB
(13)	20	Satellite number
(14)	17	Elevation in degrees
(15)	231	Azimuth in degrees to true
(16)	40	SNR in dB
(17)	31	Satellite number
(18)	60	Elevation in degrees
(19)	190	Azimuth in degrees to true
(20)	42	SNR in dB
(21)	*7F	Checksum

Table 5: GSV example and description



2 Proprietary Sentences

2.1 Introduction

Device manufacturer define extensions of the standard NMEA protocol or sentences thereof.

- The general format is:
"\$<vendor><message><parameters><CR><LF>".
Note that a checksum is NOT required!
- The combination of <vendor><message> is called address field.
- The general format of the address field (vendor + message identifier) is:
"P<manufacturer code><message code> with "P" for proprietary".

2.2 NMEA Sentence Handling and Baud rate Set-up

The following commands handle the configuration of NMEA outputs.

- **\$PSTMNMEAONOFF**: Toggle NMEA sentences
- **\$PSTMRMC**: Toggle RMC sentence

\$PSTMNMEACONFIG,<NMEACONCODE>

Configures NMEA

Arguments: **NMEACONCODE** Code for NMEA output sentences configuration, syntax:

0,xxxxxxx,yyyy,z

xxxxxxx UART baud rate

yyyy Output message list (see below)

z 0 to transmit on UTC second

1 to transmit after FIX

Description: This command configures baud rate, message list and transmit mode of NMEA output sentences.

No response!

See also: ---

Table 6: NMEA sentences update part 1

Message list:

The message list is the sum of the IDs of each message included to the list.

Example: to have GSA and GSV output messages the message list must be 12.

Available NMEA output messages, message IDs:

Message	ID
GGA NMEA	1
GSA NMEA	4
GSV NMEA	8
VTG NMEA	16
RMC NMEA	64

Table 7: NMEA sentences update part 2

2.3 Start-up support

In order to improve the TTFF (Time to First Fix) after the receiver module was switched off the start up can be supported by providing a rough time and position information. The date/time provided should be exact to a few minutes, while for the position information a very rough estimation will help already. Tests did show positive results even with uncertainties of 1,000km.

The command for setting time and position has the following format:

- \$PSTMINITGPS,<position&time>

To set <position&time> the following syntax is valid:

position&timecode Code for setting new position and time, syntax:

```

xxxx.xxx,[N/S],yyyyy.yyy,[E/W],zzzz,DD,MM,YYYY,HH,MM,SS
xxxx.xxx: latitude in degrees, minutes and fractions of minutes
[N/S]: north or south
yyyyy.yyy: longitude in degrees, minutes and fractions of
minutes
[E/W]: east or west
zzzz: altitude in meters
DD: day of month
MM: month
YYYY: year
HH: hour
MM: minute
SS: second

```

Table 8: GPS start up support

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For example to set the date to March 25, 2006, the time to 1:05 p.m. and the location is closed to Munich, Germany the command will look like this:

- `$PSTMINITGPS,4804.000,N,01139.000,E,0500,25,03,2006,13,05,00`

Please note that the position is accepted only, if the number of digits before and after the decimal point is correct. For the latitude 4 digits before and 3 digits after the decimal point are required, for the longitude 5 digits before and again 3 digits after, respectively.

2.3.1 Providing cold start behavior

A1037-A is a ROM based GPS receiver module. Power down the module will delete all ephemeris and almanac data in the GPS engine and will end in a cold start next time the module will be powered on again.

This can be provided by reading out the ephemeris / almanacs before power down to module and reload it after power up the module again.

Please note: Ephemeris data are valid for 4 hours
Almanac data are valid for 3 month

2.3.1.1 Dump ephemeris

- `$PSTMDUMPEPHEMS`

This command sends out all ephemeris stored in the backup RAM

Result:

e.g. <code>\$PSTMEPHEM,1,3,<byte1>,<byte2>,...,<byteN>*7F</code>		
(1)	<code>\$PSTMEPHEM</code>	Vendor and message identifier
(2)	1	Satellite ID
(3)	3	Number of the ephemeris data bytes
(4)	<code><byte1></code>	First byte of ephemeris data
(5)	<code><byte2></code>	Second byte of ephemeris data
(6)	<code><byteN></code>	Last byte of ephemeris data
(7)	<code>*7F</code>	Checksum

Table 9: Ephemeris data output

2.3.1.2 Load ephemeris

- **\$PSTMEPHEM**

This command load ephemeris data into backup RAM. This will end up in hot start.

e.g. \$PSTMEPHEM,1,3,<byte1>,<byte2>,...,<byteN>*7F

(1)	\$PSTMEPHEM	Vendor and message identifier
(2)	1	Satellite ID
(3)	3	Number of the ephemeris data bytes
(4)	<byte1>	First byte of ephemeris data
(5)	<byte2>	Second byte of ephemeris data
(6)	<byteN>	Last byte of ephemeris data
(7)	*7F	Checksum

Table 10: Load ephemeris data

2.3.1.3 Dump almanacs

- **\$PSTMDUMPALMANAC**

This command sends out almanacs stored in the backup RAM.

Result:

e.g. \$PSTMALMANAC,1,3,<byte1>,<byte2>,...,<byteN>*7F

(1)	\$PSTMALMANAC	Vendor and message identifier
(2)	1	Satellite ID
(3)	3	Number of the almanac data bytes
(4)	<byte1>	First byte of almanac data
(5)	<byte2>	Second byte of almanac data
(6)	<byteN>	Last byte of almanac data
(7)	*7F	Checksum

Table 11: Almanac data output

2.3.1.4 Load almanac



- **\$PSTMALMANAC**

This command load almanac data into backup RAM. This will end up in warm start.

e.g. \$PSTMALMANAC,1,3,<byte1>,<byte2>,...,<byteN>*7F

(1)	\$PSTMEPHEM	Vendor and message identifier
(2)	1	Satellite ID
(3)	3	Number of the almanac data bytes
(4)	<byte1>	First byte of almanac data
(5)	<byte2>	Second byte of almanac data
(6)	<byteN>	Last byte of almanac data
(7)	*7F	Checksum

Table 12: Load almanac data

2.3.2 Cold Start

- **\$PSTMCOLD**

This command erases all the almanacs and ephemerics, stored in the backup RAM and then reboots the system.

2.3.3 Warm Start

- **\$PSTMWARM**

This command erases all ephemerics, stored in the backup RAM and then reboots the system

2.3.4 Hot Start

- **\$PSTMHOT**

This command reboots the system without erasing any datas.

2.4 Version information

A special command is implemented in order to return the serial number of ST GPS engine.

- **\$PSTMINFOREAD**: Initiates serial number output

The version information will be returned in the following format:

```
$PSTMVER, GPSLIB_04.23.05PAL ARM – DEC 02 2005 11:14:50,SW  
COMMANDS rel 1.0 (Dec 02 2005 12:22:53)*47
```

2.5 Support of SBAS (Satellite Based Augmentation Systems)

Current X1037-A is an engineering sample of the A1037-A. This version does not support SBAS. Mass production units A1037-A will support SBAS.

Starting with firmware version 4.30.00, the A1037 will support **Satellite Based Augmentation Systems (SBAS)** systems. Two systems around the world transmit signals that can be interpreted by the receiver. As normal GPS satellites, the geostationary satellites that are used for the transmission of the information are identified by a unique PRN (Pseudo Random Noise number), a satellite ID. This is the PRN ID information for WAAS (**Wide Area Augmentation System**) and EGNOS (**European Geostationary Navigation Overlay System**);

The following PRNs have been allocated to the WAAS system (region: USA, Canada and Mexico):

```
PRN 122 - Inmarsat 3F4 AOR-W 54.0° W  
PRN 134 - Inmarsat 3F3 POR 178.0° E
```

The following PRNs have been allocated to the EGNOS system (region: Europe, Africa and Venezuela):

```
PRN 120 - Inmarsat 3F2 AOR-E 15.5° W  
PRN 124 - Artemis 21.5° E  
PRN 126 - Inmarsat 3F5 IOR-W 25.0° E  
PRN 131 - Inmarsat 3F1 IOR-E 64.0° E
```

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The following PRNs have been allocated to the MSAS system (region: Japan, Australia and Hawaii):

PRN 129 - MTSAT 1 140.0° E

PRN 137 - MTSAT 2 (to be launched yet, replacement of MTSAT 1)

2.5.1 Enabling SBAS support

By default, SBAS support is switched off. To switch on SBAS support one needs to issue the following command to the receiver:

- `$PSTMSBASSTART`

In recognition of the command the receiver will respond with SBAS version information:

- `$PTYCSBAS,ON*30`

2.5.2 Toggle SBAS support

- `$PSTMSBASONOFF`

This command will toggle the SBAS support. If the SBAS was active, this command will stop SBAS support and vice versa.

2.5.3 Choose SBAS satellite

- `$PSTMSBASSAT,120`

After issuing this command the GPS engine will start to track the SBAS Satellite 120. If the parameter is "0" the system automatically searches for the SBAS satellite which is available in the user region.

2.6 SW-Reset

This command will reset the GPS engine. The command is named:

- \$PSTMGPSRESET



3 Related Information

3.1 Contact

This manual was created with due diligence. We hope that it will be helpful to the user to get the most out of the GPS module.

Anyway, inputs about errors or mistakable verbalizations and comments or proposals to TYCO Electronics, Power Systems in Munich, Germany, for further improvements are highly appreciated.

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3.2 Related Documents

- Manual: T.E. GPS Receivers A1037 (TYCO)
- Manual: T.E. GPS Evaluation Kit EVA1037-A (TYCO)

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Appendix C: UART-Commands Reference

The following is an explanation of all UART commands (in alphabetical order) that will be recognized by the module with the current firmware revision.

The following notation is used:

<i>(option)</i>	optional parameters <i>option</i>
<i><position></i>	placeholder <i>position</i>
<i>[a,b,c]</i>	selection of <i>a</i> or <i>b</i> or <i>c</i>

Example 1:

```
$PSTMNMEACONFIG,0,4800,65,1
```

This command will output RMC and GGA NMEA sentences with 4800 baud after getting a fix.

PSTMALMANAC

\$PSTMALMANC,<almanacs data> Load Almanacs data

Arguments: Almanacs Code for loading ephemeris:
data <sat ID>,<N>,<byte1>,<byte2>,...,<byteN>*7F

Description: Load almanacs data into backup RAM

See also: Page 19, Table 12



PSTMCOLD

\$PSTMCOLD

Perform COLD start

Arguments: none

Description: Perform COLD Start. This command erases all the almanacs and ephemerics, stored in the backup RAM and then reboots the system.

No response!

See also:

PSTMDUMPALMANAC

\$PSTMDUMPALMANAC

Dump almanacs

Arguments: None

Description: This command send out all almanacs data stored in the back up RAM

See also:



PSTMDUMPEPHEMS

\$PSTMDUMPEPHEMS

Dump ephemeris

Arguments: none

Description: This command send out all ephemeris data stored in the back up RAM

See also:

PSTMEPHEM

\$PSTMEPHEM,<ephemeris data> Load ephemeris data

Arguments: Ephemeris Code for loading ephemeris:
data <sat ID>,<N>,<byte1>,<byte2>,...,<byteN>*7F

Description: Load ephemeris data into backup RAM

See also: Page 18, Table 10



PSTMGPSRESET

\$PSTMGPSRESET

Reset the GPS engine

Arguments: None

Description: This command resets the GPS module.
No response!

See also: ---

PSTMGPSRESTART

\$PSTMGPSRESTART

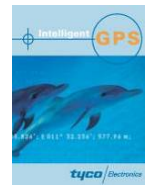
Restarts the GPS engine

Arguments: None

Description: This command restarts the GPS module.

No response!

See also: ---



PSTMHOT

\$PSTMHOT

Perform HOT start

Arguments: none

Description: Perform HOT Start. This command reboots the system without erasing any backup data.

No response!

See also:

PSTMINFOREAD

\$PSTMINFOREAD Initiates serial number output

Arguments: none

Description: Initiates serial number output

Issuing this command leads to a one time output of the module serial number

See also: ---



PSTMINITGPS

\$PSTMINITGPS,<position&timecode> Initialize GPS position and time

Arguments: **position&** Code for setting new position and time, syntax:
timecode xxxx.xxx,[N/S],yyyyy.yyy,[E/W],zzzz,DD,MM,YYYY,HH,MM,SS

xxxx.xxx: latitude in degrees, minutes and fractions of minutes
[N/S]: north or south
yyyyy.yyy: longitude in degrees, minutes and fractions of minutes
[E/W]: east or west
zzzz: altitude in meters
DD: day of month
MM: month
YYYY: year
HH: hour
MM: minute
SS: second

Description: Initialize GPS position and time. This additional information will help to speed-up the starting time under certain circumstances.
No response!

See also: ---

PSTMNEACONFIG

\$PSTMNMEACONFIG,<NMEACONCODE>

Configures NMEA

Arguments: **NMEACONCODE** Code for NMEA output sentences configuration, syntax:

0,xxxxxxx,yyyy,z

xxxxxxx UART baud rate

yyyy Output message list (see below)

z 0 to transmit on UTC second

 1 to transmit after FIX

Description: This command configures baud rate, message list and transmit mode of NMEA output sentences.

No response!

See also: ---

Message list:

The message list is the sum of the IDs of each message included to the list.

Example: to have GSA and GSV output messages the message list must be 12.

Available NMEA output messages, message IDs:

Message	ID
GGA NMEA	1
GSA NMEA	4
GSV NMEA	8
VTG NMEA	16
RMC NMEA	64



PSTMNMEAONOFF

\$PSTMNMEAONOFF Toggle NMEA output message

Arguments: None

Description: Controls NMEA output sentences
Toggle the NMEA output message. If it has been switched ON before it becomes switched OFF and vice versa.

See also:

PSTMRMC

\$PSTMRMC

Toggle RMC message

Arguments: none

Description: Controls NMEA sentence \$GPRMC

Toggle the NMEA output message. If it has been switched ON before it becomes switched OFF and vice versa.

See also:



PSTMSBASONOFF

\$PSTMSBASONOFF

Toggle SBAS support

Arguments: none

Description: This command will toggle the SBAS support. If the SBAS was active, this command will stop SBAS support and vice versa.

No Response:

See also:

PSTMSBASSAT

\$PSTMSBASSAT<SBAS ID>

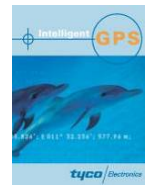
Change SBAS satellite

Arguments: SBAS ID Number of SBAS satellite

Description: After issuing this command the GPS engine will start to track the dedicated SBAS Satellite. If the parameter is "0" the system automatically searches for the SBAS satellite which is available in the user region.

No Response:

See also:



PSTMSBASSTART

\$PSTMSBASSTART

Start SBAS support

Arguments: none

Description: SBAS support will be started

Response: output of SBAS version information

See also:

PSTMSRR

\$PSTMSRR

Reset of the GPS Software

Arguments: None

Description: This command reset the Software running on the GPS engine.

No response!

See also: ---

PSTMSTOP

\$PSTMSTOP,(T)

Stop the GPS engine

Arguments: T Stop period (seconds);
Acceptable values are from 0 to 99999

Description: Stop the GPS engine for a T time. After the defined time frame the system will be reset.

Response only if the input is incorrect:

\$PSTMSTOPERROR*<checksum>

See also:



PSTMWARM

\$PSTMWARM

Perform WARM start

Arguments: none

Description: Perform WARM Start. This command erases all the ephemerics, stored in the backup RAM and then reboots the system.

No response!

See also:

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