



GPS Firmware A1037-A

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

User's Manual

**Version 2.0
Software Revision 4.30**

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Revision History

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|------|----------|---|
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| 1.2 | 11-02-06 | Valid for A1037-A working on GPS-LIB.: 4.30.3plus |
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1 Introduction

1.1 General

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.

1.2 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!

Using Pin P0.13 two different set of GPS NMEA out messages with two different baud rates can be selected.

| CONF (P0.13) | NMEA Messages Set | Default |
|--------------------------------------|---|---------|
| Leave unconnected / External pull-up | NMEA: GGA – VTG – GSA – GSV Baud rate: 4800 Transmit mode: on UTC second | X |
| External pull-down | NMEA: GGA – GSA – GSV - RMC – TG –TS - PA Baud rate: 57600 Transmit mode: on UTC second | |

Table 1: NMEA configuration

This pin will be read by the software during the GPS software start-up only. Any changes in the setting afterwards will not affect the configuration.

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.

2 Standard NMEA Sentences

2.1 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>

2.2 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.

2.2.1 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 2: GGA example and description

2.2.2 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 3: VTG example and description

2.2.3 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 4: RMC example and description

2.2.4 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 5: GSA example and description

2.2.5 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 6: GSV example and description

3 Proprietary Sentences

3.1 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".

3.2 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,<NMEAONCODE>

Configures NMEA

Arguments: NMEAONCODE 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 |
|-----------|----|
| GGA5 NMEA | 1 |
| GGA NMEA | 2 |
| GSA NMEA | 4 |
| GSV NMEA | 8 |
| VTG NMEA | 16 |
| RMC NMEA | 64 |

Table 7: NMEA sentences update part 2

3.3 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

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.

3.3.1 Avoiding Cold Start Behavior

A1037-A is a ROM based GPS receiver module. Powering 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 avoided by reading out the ephemeris / almanacs before powering down the module and reload it after powering up the module again.

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

3.3.1.1 Dump Ephemeris

- \$PSTMDUMPEPHEMS

This command sends out all ephemeris stored in the backup RAM in this format:

| 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 9: Ephemeris data output

3.3.1.2 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

3.3.1.3 Dump Almanacs

- \$PSTMDUMPALMANAC

This command sends out almanacs stored in the backup RAM in this format:

| 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

3.3.1.4 Load Almanacs

- \$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

3.3.2 Cold Start

- \$PSTMCOLD

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

3.3.3 Warm Start

- \$PSTMWARM

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

3.3.4 Hot Start

- \$PSTMHOT

This command reboots the system without erasing any data.

3.4 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
```

3.5 Support of SBAS (Satellite Based Augmentation Systems)

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 at 142.0° W  
PRN 134 - Inmarsat 3F3 POR at 178.0° E  
PRN 135 –Galaxy 15 PanAmSat at 133.0° W  
PRN 138 – Anik F1R at 107.3° W
```

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

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

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

```
PRN 129 - MTSAT 1 at 140.0° E  
PRN 137 - MTSAT 2 at 145.0° E
```

3.5.1 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:

3.5.2 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.

3.5.3 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.

3.6 SW-Reset

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

- \$PSTMGPSRESET

4 Related Information

4.1 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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4.2 Related Documents

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

5 List of Tables

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

Description: Load almanacs data into backup RAM

See also: 3.3.1.4 Load Almanacs

PSTMCOLD

\$PSTMCOLD

Perform COLD start

Arguments: none

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

See also: --

PSTMDUMPALMANAC

\$PSTMDUMPALMANAC

Dump almanacs

Arguments: None

Description: This command sends out all almanac data stored in the back up RAM.

See also: 3.3.1.3 Dump Almanacs

PSTMDUMPEPHEMS

\$PSTMDUMPEPHEMS

Dump ephemeris

Arguments: none

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

See also: 3.3.1.1 Dump Ephemeris

PSTMEPHEM

\$PSTMEPHEM,<ephemeris data> Load ephemeris data

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

Description: Load ephemeris data into backup RAM

See also: 3.3.1.2 Load Ephemeris

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:** ---

PSTMSTBY

\$PSTMSTBY,(T) Put the GPS engine in standby mode

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

Description: Put the system in Standby mode. If T is 0 then the system goes in standby mode for undefined time and can be waked up by hardware.

Response only if the input is incorrect:

\$PSTMSTBYERROR* <checksum>

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 ephemerides, stored in the backup RAM and then reboots the system.

No response!

See also: