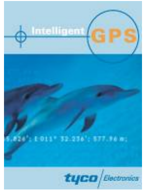

GPS Firmware A1029

A description of the standard GPS firmware provided on Tyco Electronics' GPS modules A1029-A and A1029-B

User's Manual

Version 3.0
Software Revision 103-xx

This page was intentionally left blank.

Revision History

Rev.	Date	Description
0.1	11-06-03	Preliminary version
0.2	11-18-03	Extended functionality, preliminary
0.3	11-25-03	Added latest release features
0.4	12-01-03	Format change
0.5	12-23-03	Minor format changes, incl. boot loader description
0.6	04-20-04	Included new GPS Flash description, minor format changes
1.0	06-25-04	Covers now additionally A1029-B, added comment to GSV, introduced INITDATIM, INITPOS, PARAMCL, BRATE, and SUPWR.
1.1	07-16-04	Introduced PARAMCL. Renamed “software” to “firmware”.
1.2	08-24-04	Format changes, reviewed for software release.
1.3	10-12-04	Minor format changes; release.
1.4	02-23-05	Introduced new contact details.
1.5	07-22-05	Corrected description of $PTYCINITPOS, minor format changes.
2.0	11-15-05	Added features of 103-xx release, SBAS support, serial number support, increased header
3.0	01-18-06	Features and Functions added: MH, Sunset, Julian Day, SW-Reset, Antenna status, GPS raw data
	mm-dd-yy	

Disclaimer

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF TYCO ELECTRONICS CORPORATION/POWER SYSTEMS (TYCO ELECTRONICS). IT MAY NOT BE COPIED OR TRANSMITTED BY ANY MEANS, PASSED TO OTHERS, OR STORED IN ANY RETRIEVAL SYSTEM OR MEDIA, WITHOUT PRIOR CONSENT OF TYCO ELECTRONICS OR ITS AUTHORIZED AGENTS.

THE INFORMATION IN THIS DOCUMENT IS, TO THE BEST OF OUR KNOWLEDGE, ENTIRELY CORRECT. HOWEVER, TYCO ELECTRONICS CAN NEITHER ACCEPT LIABILITY FOR ANY INACCURACIES, OR THE CONSEQUENCES THEREOF, NOR FOR ANY LIABILITY ARISING FROM THE USE OR APPLICATION OF ANY CIRCUIT, PRODUCT, OR EXAMPLE SHOWN IN THE DOCUMENT.

THE PRODUCT (HARD- AND SOFTWARE) DESCRIBED IN THIS DOCUMENTATION IS NOT AUTHORIZED FOR USE IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF TYCO ELECTRONICS.

THIS DOCUMENT MAY PROVIDE LINKS TO OTHER WORLD WIDE WEB SITES OR RESOURCES. BECAUSE TYCO ELECTRONICS HAS NO CONTROL OVER SUCH SITES AND RESOURCES, TYCO ELECTRONICS SHALL NOT BE RESPONSIBLE FOR THE AVAILABILITY OF SUCH EXTERNAL SITES OR RESOURCES, AND DOES NOT ENDORSE AND IS NOT RESPONSIBLE OR LIABLE FOR ANY CONTENT, ADVERTISING, PRODUCTS, OR OTHER MATERIALS ON OR AVAILABLE FROM SUCH SITES OR RESOURCES. TYCO ELECTRONICS SHALL NOT BE RESPONSIBLE OR LIABLE, DIRECTLY OR INDIRECTLY, FOR ANY DAMAGE OR LOSS CAUSED OR ALLEGED TO BE CAUSED BY OR IN CONNECTION WITH USE OF OR RELIANCE ON ANY SUCH CONTENT, GOODS OR SERVICES AVAILABLE ON OR THROUGH ANY SUCH SITE OR RESOURCE.

TYCO ELECTRONICS RESERVES THE RIGHT TO CHANGE, MODIFY, OR IMPROVE THIS DOCUMENT OR THE PRODUCT DESCRIBED HEREIN, AS SEEN FIT BY TYCO ELECTRONICS WITHOUT FURTHER NOTICE.

Table of Contents

This page was intentionally left blank.

1 Introduction

This document contains a detailed description of Tyco Electronics' standard GPS firmware used in the GPS modules A1029-A and A1029-B.

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 respectively on the serial USB port of the USB1029-A Demo Kit.
- 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.

- Debug information is sent to port 2 (pin Tx2 and Rx2) of the modules but only if explicitly turned on.
- The default configuration of this serial port is: 38400 baud, 8 data bits, no parity, 1 stop bit, no flow control!

1.2 LOCK Pin Control

The firmware controls the level of the LOCK pin (also P1.2 - see "Tyco Electronics GPS Receiver A1029"). A high level means that there's a valid position fix.

1.3 Saving a Configuration

In order to save a special configuration it is necessary to issue the command

- $PTYCSUPWR (**S**et-**UP** **WR**ite)

The command needs no parameters and is also described in "Appendix C: UART-Commands Reference". Without issuing this command, the configuration will fall back to the default configuration or the last configuration saved, respectively.

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: OFF)
- $GPRMC (default: ON)
- $GPGSA (default: ON)
- $GPGSV (default: ON)
- $GPZDA (default: OFF)

The sentences that are switched on are transmitted with an update rate of 1/s. This update rate can be changed down to 1/30s.

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,152145.000,4805.8193,N,01132.2317,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)	4805.8193	Latitude (48deg 05.8193min)
(4)	N	North (or S for south)
(5)	01132.2317	Longitude (011deg 32.2317min)
(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

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 2: 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 – 27th March 2002)
(11)	0.0	Magnetic variation, degrees
(12)	W	West (or E for east)
(13)	*7B	Checksum

Table 3: 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 1st satellite used for fix
(5)	20	ID of 2nd satellite used for fix
(6)	14	ID of 3rd satellite used for fix
(7)	31	ID of 4th satellite used for fix
(8)	<empty>	ID of 5th satellite used for fix
(9)	<empty>	ID of 6th satellite used for fix
(10)	<empty>	ID of 7th satellite used for fix
(11)	<empty>	ID of 8th satellite used for fix
(12)	<empty>	ID of 9th satellite used for fix
(13)	<empty>	ID of 10th satellite used for fix
(14)	<empty>	ID of 11th satellite used for fix
(15)	<empty>	ID of 12th 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

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 5: GSV example and description

2.2.6 ZDA – UTC Time / Date and Local Time Zone Offset

e.g. $GPZDA,145926.000,17,01,2006,,*58		
(1)	$GPZDA	Vendor and message identifier
(2)	145926.000	Universal time coordinated (14h 59m 26.000s)
(3)	17	Day (dd – 17)
(4)	01	Month (mm - 01)
(5)	2006	Year (yyyy - 2006)
(6)	<empty>	Deviation of local time from UTC (hours)
(7)	<empty>	Deviation of local time from UTC (minutes)
(8)	*7F	Checksum

Table 6: ZDA 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”.
- In the following “TYC” is used as manufacturer code for Tyco Electronics.
  This is approved by the NMEA.

3.2 Saving a Configuration

In order to save a configuration the command

- $PTYCSUPWR

needs to be issued. This will result in writing the current configuration to non-volatile memory. After reset the GPS modules will use the very same configuration as valid right before the last PTYCSUPWR command.

3.3 NMEA Sentence Handling

The following commands handle the configuration of NMEA outputs:

- $PTYCNMEAOFF: Switch off complete NMEA output
- $PTYCNMEAON: Switch on NMEA output using latest configuration
- $PTYCDEF: Return to default NMEA configuration and switch on NMEA output

- $PTYC[NMEA Sentence]: Toggle according NMEA sentence
- $PTYC[NMEA Sentence], 0: Switch output of according NMEA sentence OFF
- $PTYC[NMEA Sentence], 1: Switch output of according NMEA sentence ON

NMEA sentence can be GGA, GSA, GSV, RMC, or VTG. For example

- $PTYCGSV, 1

will switch on GSV sentence output.

3.4 Baud rate Set-up

The A1029 modules allow for setting up the baud rate of serial port 0. The following baud rates are allowed: 4800, 9600, 19200, 38400, 57600 baud.

The following command will change the baud rate configuration, but has no immediate effect:

- $PTYCBRATE,nn: change internal baud rate configuration

where nn is one of the above specified baud rates. In order to store this configuration, issue the command:

- $PTYCSUPWR

And finally, reset the module! Don't forget to change the baud rate on your host processor. For example, to set a baud rate of 19200 baud, use the following sequence:

- $PTYCBRATE,19200
- $PTYCSUPWR
- Reset the A1029 and adapt your baud rate

3.5 Start-up support

In order to improve the TTFF (Time To First Fix), it is recommended to support the RTC with a back-up battery when no system power is available. If this is not possible or if the GPS receiver is moved over a long distance without being aware of this (e.g. in a plane) the next start-up can be supported by providing a rough date/time and (if the receiver moved) 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 date and time has the following format:

- $PTYCINITDATIM,dd,mm,yyyy,hh,mm,ss

where dd is the day, mm the month, yyyy the year, hh the hour, mm the minute, and ss the second. For example to set the date to June 25, 2004, and the time to 1:05 p.m. the command will look like this:

- $PTYCINITDATIM,25,06,2004,13,05,00

To set the position the following syntax is valid:

- $PTYCINITPOS,xxxx.xxx,[N/S],yyyyy.yyy,[E/W],zzz.z

where xxxx.xxx stands for the latitude in degrees, minutes and fractions of minutes, [N/S] for either north or south, yyyyy.yyy for the longitude in degrees, minutes and fractions of minutes, [E/W] for either east or west, and zzz.z for the altitude. For example to set the position 48°4.250' north and 11°32.330' east with an altitude of 620m the command would look like this:

- $PTYCINITPOS,4804.250,N,01132.330,E,620.0

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.

In case, a receiver is moved over a long distance without power (travel in airplanes) or stored for a longer time and the new position is unknown or it is not possible to set a new time, date and position, it is useful to clear these data (either before switching off the receiver or immediately after a first power-on). This can be done with the following command:

- $PTYCPARAMCL

The command will clear date, time and last stored position.

3.6 Version information

A special command is implemented in order to return the version of ST GPS library and the version of the current release of Tyco Electronics GPS firmware:

- $PTYCHEAD: Return version information once

The version information will be returned in the following format (release 100-xx to 102-xx):

```
$PTYCVER,TYCO Electronics - 100-01 (12:00:00 Sep 01 2004)
$PSTMVER,GPS Version 4.11.2 ARM (13:31:23 Jul 29 2004)
$PSTMVER,Bootloader Version 2.00
```

Starting with version 103-xx, the version information is following this format:

```
$PTYCVER,TYCO Electronics - 103-02 (09:38:56 Jan 31 20056)
$PSTMVER,OS20_02.06.01 - Aug 26 2005 15:23:19
$PSTMVER,GPSLIB_04.23.04 ARM - Oct 20 2005 14:31:04
$PSTMVER,SBASLIB_01.05.00 - Oct 03 2005 09:28:49
$PTYCVER,Bootloader Version 2.00
```

This new header shows more information on the integrated software comprising the version of the underlying operating system and the version of the library supporting SBAS systems.

Note on beta versions: Beta versions will have an expiration date immediately after the version information you will see the following message format:

```
$PTYC,DROPDEAD on 20060128
```

For non readable ASCII characters the output will be replaced by "?".

3.7 Local Datum

This sentence reports the active datum.

e.g. $PTYCDAT,EUS*20		
(1)	$PTYCDAT	Proprietary sentence of Tyco Electronics for datum transformation
(2)	EUS	String for local datum in use (EUROPEAN 1979, Europe)
(3)	*20	Checksum

Table 7: PTYCDAT example and description

3.7.1 Introduction

In the following you find a few hints for the item called “(geodetic) Datum":

- The standard geodetic datum of most GPS-Modules is WGS84, as WGS84 is a global datum and therefore GPS positioning gives acceptable results worldwide.
- As there are maps with different datum, sometimes customers have the wish to change datum of the GPS module to meet the datum of their maps.
- Changing the datum does not improve accuracy of the positioning, see statement on NIMA website:

  http://164.214.2.59/GandG/datums/notice_8142002.html)
- Anyway, changing the datum allows easier comparison of co-ordinates between a GPS module and specific maps.
- Change in latitude and longitude is in the range of seconds, if the selected datum matches the region. It will increase if datum and region do not match!
- Local datums - in contradiction to global datums - are valid only locally. The module does not check if the selected datum makes any sense for the current region you are in! E.g. it does not make any sense to select a datum of North America if you are in Europe. It is up to the application to take care of this! Our recommendation is to stick to WGS84, as long as there is no good reason or need to change.
- Changing a datum from WGS84 to another datum requires a transformation of the latitude and longitude. This transformation is done using the so called “Standard Molodensky-Transformation” (there seem to be multiple spellings for Molodensky’s name). There are 5 transformation parameters: 3 parameters to factor in the delta in X, Y and Z and 2 additional parameters to compensate for different ellipsoid models. Height is not transformed!
- A good introduction into co-ordinate transformation is given on: http://kartoweb.itc.nl/geometrics/Coordinate%20transformations/coordtrans.html

3.7.2 Selecting a compatible Datum

There are more than 250 different datums. Some of them are global ones, most of them are only local ones. To pick a compatible datum for your region, please consult the map you want to use. If the map does not tell its datum and you want to change datum anyway, see Appendix A: Target#, Datum and Region. The different geodetic datums are in alphabetical order.
Sometimes datum for a region can be found by searching for the country's name (e.g. for Brazil there are 2 local datum: "COA" and "SAN-C"), sometimes a more global approach is necessary (e.g. for the US-state California "US-Western" can be used).

3.7.3 Configuring the GPS Module for a specific Datum

If the GPS module is powered up the first time, the selected datum is WGS84. The change to a different datum can be done like this:

1) Find the **Target#** of the desired local datum (e.g. "47" for "COA" or "217" for "SAN-C" or "169" for "US-Western") by looking it up in **Appendix A**.
2) Use a terminal program – or any other proper method - to communicate with the GPS module by UART commands.
3) Tell the GPS module by a special UART-Command on port 0 the desired "local datum". The syntax is:

   - $PTYCDAT,###: where ### is the Target# of the desire "local datum".

   For example to switch to "COA", enter:

   - $PTYCDAT,47

   or to switch to "US-Western", enter:

   - $PTYCDAT,169

Changing the datum to another datum than WGS84 will switch ON a proprietary sentence that tells the current datum on UART port 0 (e.g. $PTYCDAT,COA*2E" or "$PTYCDAT,NAS-B*50"). Changing the datum back to WGS84 using

- $PTYCDAT,0

will switch OFF the datum sentence.

If there is a need to have a datum sentence for WGS84 use

- $PTYCDAT,999

999 is not a valid Target#, therefore datum is changed back to WGS84 but datum sentence is still ON.

"WGE" is an alternative datum string for “WGS84”, the Target# is 256 (see Appendix A: Target#, Datum and Region)

Additional information:

- The module will read only a maximum of 3 digits for a Target#. If more than 3 digits are supplied the first 3 digits are read and interpreted, the other digits are ignored.

  E.g.: "***$PTYCDAT,12345***" -> "***$PTYCDAT,123***" -> change of datum to "LCF".
  E.g.: "***$PTYCDAT,047***" -> "***$PTYCDAT,47***" -> change of datum to "COA".

- A blank or tab between the comma after ***$PTYCDAT*** and the Target# is acceptable.

  E.g.: "***$PTYCDAT, 47***" -> "***$PTYCDAT,47***" -> change of datum to "COA".
  E.g. "***$PTYCDAT, 169***" -> "***$PTYCDAT,169***" -> change of datum to "NAS-B".

- If a Target# is supplied that is not valid, datum is switched to WGS84 and datum sentence is ON.

E.g.: "***$PTYCDAT,999***” -> change of datum to “WGS84”.

3.8 UTM Projection

This sentence contains information of the UTM.

e.g. $PTYCUTM,WGS84,32U,688912.0,5330240.9*7F (e.g. position of Munich, Germany):		
(1)	$PTYCUTM	Proprietary sentence of Tyco Electronics for UTM projection
(2)	WGS84	String for local datum is use
(3)	32U	UTM zone (1 …60 for longitude, C… X for latitude)
(4)	688912.0	Easting in meters (distance from central meridian)
(5)	5330240.9	Northing in meters (distance from equator)
(6)	7F	Checksum

Table 8: PTYCUTM example and description

3.8.1 Introduction

A map projection is an attempt to portray the surface of the earth or a portion of the earth onto a (flat) surface. The result of this process always shows some distortions of conformity, distance, direction, scale and area.

3.8.2 Universal Transverse Mercator Projection (UTM)

- The UTM projection is a conformal cylindrical projection (lines of latitude and longitude intersect at right angles).
- The globe is divided into 60 stripes (zones), each spanning 6 degrees of longitude. These stripes are divided into 20 rows. The limits of UTM projection is 80° S and 84° N. Starting at 80° S each row spans 8 degrees of latitude (the last one spans 12 degrees from 72° N to 84° N).
- This segmentation of the earth's surface results in 60 zones. Each zone can be identified clearly by a zone number and a zone character:
  The stripes are numbered from 1 to 60 (1 starting at 180° West, 60 ending at 180° East), the columns of each zone are marked by a character (starting with C at 80° South, ending with X at 84° North; there is no "I" and "O").
- The origin of each zone is its central meridian and the equator. To eliminate negative co-ordinates, the co-ordinates get a kind of offset, called false easting and false northing. I.e. the central meridian is set to 500,000 meters (called false easting). For zones in the northern hemisphere the false northing is 0 meters, for zones in the southern hemisphere the false northing is 10,000,000 meters.

A good introduction into projection is given on:
http://www.colorado.edu/geography/gcraft/notes/gps/gps_f.html
http://kartoweb.itc.nl/geometrics/Map%20projections/mappro.html

3.9 Interval of NMEA output

The default interval of the NMEA output is 1 second. If required this interval can be increased to up to 30 seconds by a simple proprietary command. The syntax is:

- $PTYCNMEAI,nn

where nn is the required interval in seconds.

E.g. to switch NMEA output to an interval of 5 seconds, enter "***$PTYCNMEAI,5***".

Note that the GPS receiver will continue with its normal operations (tracking satellites, etc.), only the UART output will enter a wait mode.

3.10 Support of SBAS (Satellite Based Augmentation Systems)

Starting with firmware version 103-xx, the A1029's support **S**atellite **B**ased **A**ugmentation **S**ystems (SBAS) systems. Three 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 (**W**ide **A**rea **A**ugmentation **S**ystem), EGNOS (**E**uropean **G**eostationary **N**avigation **O**verlay **S**ystem) and MSAS (***M****TSAT* [*M*ultifunctional *T*ransport *Sa*tellite *S*ystem] **S**pace-based **A**ugmentation **S**ystem):

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

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

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

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

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)

3.10.1 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:

- $PTYCSBAS,1

In recognition of the command the receiver will respond with one message:

- $PTYCSBAS,ON*30

The default satellite that will be used then is the EGNOS satellite with PRN 120. To select a different SBAS satellite, the command needs to be issued again with the satellite PRN, e.g.:

- $PTYCSBAS,126

The receiver will start searching for this satellite. In case of success and when the download of correctional data was done and is used for correcting the position, the GGA message will show this by changing the fix quality from 1 to 2, e.g.:

$GPGGA,105354.000,4804.2665,N,01139.0630,E,**2**,10,0.8,0547.8,M,47.5,M,,*68

In addition, the SBAS satellite will be added to the GSV information. In this message, the satellite number is calculated by deducting 87 from the real satellite PRN (minimum number is therefore 120 – 87 = 33). So an SBAS satellite can be recognized by a number higher than 32.

e.g. $GPGSV,3,3,10,30,63,87,00,37,33,166,43,,,,,,,,*71		
(1)	$GPGSV	Vendor and message identifier
(2)	3	Total numbers of messages – 3
(3)	3	Number of current message – 3
(4)	10	Satellites in view – 10
(5)	30	Satellite number of “normal” GPS satellite
(6)	63	Elevation in degrees of GPS satellite
(7)	87	Azimuth in degrees to true of GPS satellite
(8)	00	SNR in dB of GPS satellite
(9)	37	Satellite number (37 + 87 = 124)
(10)	33	Elevation in degrees of SBAS satellite
(11)	166	Azimuth in degrees to true of SBAS satellite
(12)	44	SNR in dB of SBAS satellite
...	,,,,,,,	empty fields
(20)	*70	Checksum

Table 9: GPGSV example and description with SBAS satellite

The same satellite is visible in the GSA message.

3.10.2 SBAS Satellite Message

In addition, information on the satellite in use can be displayed in an SBAS satellite message. Switching the message on or off follows the syntax of other NMEA sentences.

- $PTYCSBASSAT,1: switch SBAS satellite message on
- $PTYCSBASSAT,0: switch SBAS satellite message off
- $PTYCSBASSAT: toggle message

The SBAS satellite message follows this format:

e.g. $PTYCSBASSAT,1,124,33,166,41*45 (EGNOS satellite with PRN 124)		
(1)	$PTYCSBASSAT	Proprietary sentence of Tyco Electronics for SBAS satellites
(2)	1	SBAS in use (0: not in use)
(3)	124	PRN of satellite in use
(4)	33	Elevation in degrees
(5)	166	Azimuth in degrees
(6)	41	SNR in dB
(7)	45	Checksum

Table 10: PTYCSBASSAT example and description

In order to store your configuration (use of SBAS and choice of satellite), issue the command:

- $PTYCSUPWR

3.11 ODO measurement and calculation

TYCO Electronics' GPS firmware offers one of the most typical vehicle features, ODO measurement and calculation. This feature is calculating travelled distance and current speed by using GPS positioning. Therefore no additional odometer pulse is required. The lifetime odometer keeps a running total for all journey. Setting lifetime value is possible.

Turning the NMEA for ODO on is done by issuing the command

- $PTYCODO,1

Turning the NMEA for ODO off is done by simply issuing the command with the parameter 0:

- $PTYCODO,0

Alternatively, it is possible to toggle between on and off state of the ODO NMEA by issuing the command without a parameter:

- $PTYCODO

e.g. $PTYCODO,180106,095731.000,A,127000,23.0,0.167*32		
(1)	$PTYCODO	Proprietary sentence of Tyco Electronics for ODO
(2)	180106	Date (ddmmyy)
(3)	095731.000	Universal time coordinated (9h 57m 31.000s)
(4)	A	Valid fix (V: invalid)
(5)	127000	Odometer lifetime in m
(6)	23.0	Traveled distance in m
(7)	0.167	Current speed in m/s
(8)	*32	Checksum

Table 11: PTYCODO command description

Setting an odometer start value is done by issuing the command:

- $PTYCODOSET,x
    - x is the odometer lifetime value in km
    - Acceptable values are from 0 to 1000000.

After issuing a PTYCODOSET command with the correct syntax, the receiver will respond with an additional message:

- $PTYCODOSET, 388,OK*2F

Attention: It is not possible to reset the odometer lifetime to “0” or to reduce the odometer lifetime by issuing the ODOSET command with a lower value than the current odometer lifetime is showing. Increasing the lifetime is possible.

3.12 Module serial number

This firmware version offers the possibility to set a customized serial number to the module by issuing the command:

- $PTYCSERWR,x
    - x is the serial number
    - Acceptable values are within ASCII code 32 to 126 (please see ”Appendix B: ASCII code”)

After issuing a PTYCSERWR command with the correct syntax, the receiver will respond with an additional message:

- $PTYCSERWR,000000000001,OK*5A

Note: The serial number has to have 12 digits. Lower-case character will be transformed to capitals.

To activate the issued serial number use the command:

- $PTYCSUPWR

To read out the serial number, please use:

- $PTYCSERRD

Attention: Please make sure the issued serial number is correct. It is not possible to change the serial number after issuing the command $PTYCSUPWR.

3.13 SW-Reset

This command will reset the GPS module and the boot loader will be started also. The boot loader is checking the serial interface for incoming commands. This is essential for firmware update. The command is named:

- $PTYCRESET

3.14 Geo-fencing

Geo-fencing allows for the supervision of entering or leaving a certain territory. The territory is defined with a center and a distance (representing a circle). The command $PTYCGFC will turn on or off geo-fencing. Turning geo-fencing on can be done in two ways:

- By defining a radius (basic version)
- By defining a center and a radius (extended version)

e.g. $PTYCGFC,500		
(1)	$PTYCGFC	Proprietary sentence of Tyco Electronics for geo-fencing
(2)	500	Radius of circle in [m], minimum value 10, maximum value 1000000 (1 million m; 1.000 km)

Table 12: PTYCGFC command description (basic version)

This basic command will turn on geofencing around the current position.

e.g. $PTYCGFC,1000,4805.82,N,01132.23,E		
(1)	$PTYCGFC	Proprietary sentence of Tyco Electronics for geo-fencing
(2)	1000	Radius of circle in [m], minimum value 10, maximum value 1000000 (1 million m; 1.000 km)
(3)	4805.82	Latitude (48deg 05.82min), two digits for degrees are required, minutes in floating point representation
(4)	N	North (or S for south)
(5)	01132.23	Longitude (011deg 32.23min), three digits for degrees are required, minutes in floating point representation
(6)	E	East (or W for west)

Table 13: PTYCGFC command description (extended version)

This extended command will turn on geofencing around the defined position.

After issuing a PTYCGFC command with the correct syntax, the receiver will respond with an additional message:

e.g. $PTYCGFC,085901.000,A,300,4805.8200,N,01132.2300,E,288.8,8945,OUT*67		
(1)	$PTYCGFC	Proprietary sentence of Tyco Electronics for geo-fencing
(2)	085901.000	Universal time coordinated (15h 21m 45.000s)
(3)	A	Valid fix (V: invalid)
(4)	300	Radius of circle in [m]
(5)	4805.8200	Latitude (48deg 05.8200min), two digits for degrees, two digits for minutes, and 4 digits after decimal period
(6)	N	North (or S for south)
(7)	01132.2300	Longitude (011deg 32.2300min), three digits for degrees, two digits for minutes, and 4 digits after decimal period
(8)	E	East (or W for west)
	288.8	Bearing towards center in degrees (0° ≙ north)
(9)	8945	Distance in meters from current position to center of geo-fencing circle
(10)	OUT	outside defined radius around center (IN: within)
(11)	*67	Checksum

Table 14: PTYCGFC response description

Turning geo-fencing off is done by simply issuing the command with 0 radius

- $PTYCGFC,0

Note: Geofencing is always based on WGS84 coordinates, no matter what map datum has been turned on. The calculation for distance and direction is based on a sphere model of the earth and a great circle path on this. This will result in minor inaccuracies increasing with higher distance.

3.15 Bearing

The GPS receiver supports bearing, i.e. the pointing to a defined position including presentation of the distance and it's approaching towards the target or moving away from it. From any arbitrary position the $PTYCBR will turn on or off bearing functionality. Turning bearing on can be done in two ways:

- By issuing the command with parameter 1 (basic version)
- By defining a center and a radius (extended version)

e.g. $PTYCBR,1		
(1)	$PTYCBR	Proprietary sentence of Tyco Electronics for turning on bearing
(2)	1	Always 1 (0 will turn off bearing)

Table 15: PTYCBR command description (basic version)

This basic command will turn on bearing towards the current position. This is useful when the current position is left and needs to be found again.

e.g. $PTYCBR,4815.0,N,01130.05,E		
(1)	$PTYCBR	Proprietary sentence of Tyco Electronics for turning on bearing
(2)	4815.0	Latitude (48deg 15.0min), two digits for degrees are required, minutes in floating point representation
(3)	N	North (or S for south)
(4)	01130.05	Longitude (011deg 30.05min), three digits for degrees are required, minutes in floating point representation
(5)	E	East (or W for west)

Table 16: PTYCBR command description

After issuing a PTYCBR command with the correct syntax, the receiver will respond with an additional message:

e.g. $PTYCBR,152145.000,4815.0000,N,01130.0500,E,A,45.7,456,A,*38		
(1)	$PTYCBR	Proprietary sentence of Tyco Electronics for bearing
(2)	152145.000	Universal time coordinated (15h 21m 45.000s)
	A	Valid fix (V: invalid)
(3)	4815.0000	Latitude (48deg 15.0000min), two digits for degrees, two digits for minutes, and 4 digits after decimal period
(4)	N	North (or S for south)
(5)	01130.0500	Longitude (011deg 30.0500min), three digits for degrees, two digits for minutes, and 4 digits after decimal period
(6)	E	East (or W for west)
(8)	45.7	Bearing in degrees towards center (0° ≙ north)
(9)	456	Distance in [m]
(10)	A	Approaching (M: moving away, ? when bearing starts)
(11)	*38	Checksum

Table 17: PTYCBR response description

Turning bearing off is done by simply issuing the command with the parameter 0:

- $PTYCBR,0

Note: Bearing is always based on WGS84 coordinates, no matter what map datum has been turned on. The calculation for distance and direction is based on a sphere model of the earth and a great circle path on this. This will result in minor inaccuracies which will increase with higher distance.

3.16 Cross Track Distance

The GPS receiver supports the calculation of a cross track distance (XTD), i.e. the distance towards the optimum connection between two waypoints. The following picture explains the feature using a plane instead the (simplified) surface of the earth.

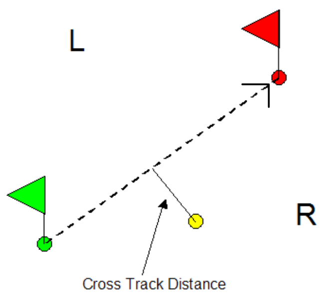

Figure 1: Cross Track Distance (XTD)

Turning the cross track distance NMEA on needs two "waypoints".

e.g. $PTYCXTD,4915.002,N,01136.088,E,4751.024,N,01135.636,E		
(1)	$PTYCXTD	Proprietary sentence of Tyco Electronics for turning on XTD
(2)	4915.002	Latitude (49deg 15.002min) of first waypoint, two digits for degrees are required, minutes in floating point representation
(3)	N	North (or S for south)
(4)	01136.088	Longitude (011deg 36.088min) of first waypoint, three digits for degrees are required, minutes in floating point representation
(5)	E	East (or W for west)
(6)	4751.024	Latitude (47deg 51.024min) of second waypoint, two digits for degrees are required, minutes in floating point representation
(7)	N	North (or S for south)
(8)	01135.636	Longitude (011deg 35.636min) of second waypoint, three digits for degrees are required, minutes in floating point representation
(9)	E	East (or W for west)

Table 18: PTYCXTD command description

The maximum distance between two waypoints shall not exceed 1,500,000m (1,500km).

After issuing a PTYCXTD command with the correct syntax, the receiver will respond with an additional message consisting of two lines:

e.g. $PTYCXTD,1,4915.0020,N,01136.0880,E,4751.0240,N,01135.6360,E*41		
(1)	$PTYCXTD	Proprietary sentence of Tyco Electronics for XTD
(2)	1	First line of XTD response
(3)	4915.0020	Latitude (49deg 15.002min) of first waypoint, two digits for degrees, two digits for minutes, and 4 digits after decimal period
(4)	N	North (or S for south)
(5)	01136.0880	Longitude (011deg 36.088min) of first waypoint, three digits for degrees, two digits for minutes, and 4 digits after decimal period
(6)	E	East (or W for west)
(7)	4751.0240	Latitude (47deg 51.024min) of second waypoint, two digits for degrees, two digits for minutes, and 4 digits after decimal period
(8)	N	North (or S for south)
(9)	01135.6360	Longitude (011deg 35.636min) of second waypoint, three digits for degrees, two digits for minutes, and 4 digits after decimal period
(10)	E	East (or W for west)
(11)	*41	Checksum

Table 19: PTYCXTD response description (first line)

e.g. $PTYCXTD,2,101716.000,A,4805.8044,N,01132.2398,E,4304,R,171.2,27745*65		
(1)	$PTYCXTD	Proprietary sentence of Tyco Electronics for XTD
(2)	2	Second line of XTD response
(3)	101716.000	Universal time coordinated (10h 17m 16.000s)
(4)	A	Valid fix (V: invalid)
(5)	4805.8044	Latitude (48deg 05.8044min) of current position, two digits for degrees, two digits for minutes, and 4 digits after decimal period
(6)	N	North (or S for south)
(7)	01132.2398	Longitude (011deg 32.2398min) of current position, three digits for degrees, two digits for minutes, and 4 digits after decimal period
(8)	E	East (or W for west)
(9)	4304	Cross Track Distance in meters
(10)	R	Right (or L for left) of track
(11)	171.2	Bearing in degrees towards second waypoint (0° ≙ north)
(12)	27745	Distance in meters towards second waypoint
(13)	*65	Checksum

Table 20: PTYCXTD response description (second line)

Turning cross track distance off is done by simply issuing the command with the parameter 0:

- $PTYCXTD,0

Note: Cross track distance is always based on WGS84 coordinates, no matter what map datum has been turned on. The calculation for distance and direction is based on a sphere model of the earth and a great circle path on this ignoring the actual height. This all will result in minor inaccuracies that are increasing with higher distance.

3.17 Maidenhead Grid Square

The Maidenhead grid locator system is used worldwide by over 500,000 amateur radio operators in their daily activities to describe their location. This grid system divides the earth's surface into 324 "fields" of 20 degrees of longitude times 10 degrees of latitude - identified by two letters (AA-RR). Each field is divided into 100 "squares" of 2 degrees of longitude times 1 degree of latitude - identified by two digits (00-99). Each square is finally divided into 576 "sub squares" of 5 minutes of longitude times 2.5 minutes of latitude - identified by two letters (aa-xx).

Turning the NMEA for Maidenhead grid on is done by issuing the command

- $PTYCMH,1

After issuing a PTYCMH command with the correct syntax, the receiver will respond with an additional message:

e.g. $PTYCMH,102253.000,A,4805.8152,N,01132.2451,E,210604,JN58sc*64		
(1)	$PTYCMH	Proprietary sentence of Tyco Electronics for Maidenhead grid
(2)	102253.000	Universal time coordinated (10h 22m 53.000s)
(3)	A	Valid fix (V: invalid)
(4)	4805.8152	Latitude (48deg 05.8152min) of current position, two digits for degrees, two digits for minutes, and 4 digits after decimal period
(5)	N	North (or S for south)
(6)	01132.2451	Longitude (011deg 32.2451min) of current position, three digits for degrees, two digits for minutes, and 4 digits after decimal period
(7)	E	East (or W for west)
(8)	210604	Current date (June 21, 2004) – format ddmmyy
(9)	JN58sc	Maidenhead grid
(10)	*64	Checksum

Table 21: PTYCMH response description

Turning the Maidenhead NMEA off is done by simply issuing the command with the parameter 0:

- $PTYCMH,0

Alternatively, it is possible to toggle between on and off state of the Maidenhead NMEA by issuing the command without a parameter:

- $PTYCMH

More details on the Maidenhead grid square can be found for example at:
http://www.colorado.edu/geography/gcraft/notes/coordsys/coordsys.html

3.18 Sunrise and Sunset

The module is capable of processing the sunrise and sunset times of its current position. There are different definitions of these times; therefore this is a short description on the method used within the Tyco GPS receiver module:

For computational purposes, sunrise or sunset are defined to occur when the geometric zenith distance of center of the sun is 90.8333 degrees. That is, the center of the sun is geometrically 50 arc minutes below a horizontal plane. For an observer at sea level with an even, unobstructed horizon, under average atmospheric conditions, the upper limb of the sun will then appear to be tangent to the horizon. The 50 arc minute geometric depression of the sun's center used for the computations is obtained by adding the average apparent radius of the Sun (16 arc minutes) to the average amount of atmospheric refraction at the horizon (34 arc minutes).

Turning the sunrise/sunset NMEA on is done by issuing the command

- $PTYCSUN,1

After issuing a PTYCSUN command with the correct syntax, the receiver will respond with an additional message:

e.g. $PTYCSUN,082752.000,A,4805.7988,N,01132.2128,E,170804,0,0416,0,1818*12		
(1)	$PTYCSUN	Proprietary sentence of Tyco Electronics for sunrise/sunset
(2)	082752.000	Universal time coordinated (08h 27m 52.000s)
(3)	A	Valid fix (V: invalid)
(4)	4805.7988	Latitude (48deg 05.7988min) of current position, two digits for degrees, two digits for minutes, and 4 digits after decimal period
(5)	N	North (or S for south)
(6)	01132.2138	Longitude (011deg 32.2138min) of current position, three digits for degrees, two digits for minutes, and 4 digits after decimal period
(7)	E	East (or W for west)
(8)	170804	Current date (August 17, 2004) – format ddmmyy
(9)	0	Overflow index for sunrise: -/0/+ yesterday/today/tomorrow
(10)	0416	Sunrise at 04:16UTC
(11)	0	Overflow index for sunset: -/0/+ yesterday/today/tomorrow
(12)	1818	Sunset at 18:18UTC
(13)	*64	Checksum

Table 22: PTYCSUN response description

Turning the sunrise/sunset NMEA off is done by simply issuing the command with the parameter 0:

- $PTYCSUN,0

Alternatively, it is possible to toggle between on and off state of the sunrise/sunset NMEA by issuing the command without a parameter:

- $PTYCSUN

3.19 Quality of the Fix

In order to monitor the quality of a GPS fix, the module can calculate the quality of the current fix. The quality is expressed in (horizontal) distances. The 50, 80 and 95% distances define the radius of a circle. The current fix will be within this circle with the according probability. E.g. if the 80% distance is 10m, then the current fix is within 10m of the real (generally accepted) position with a probability of 80%.

Turning the quality NMEA on is done by issuing the command

- $PTYCPRC,1

After issuing a PTYCPRC command with the correct syntax, the receiver will respond with an additional message:

e.g. $PTYCPRC,3,15.4,26.3,41.1*71		
(1)	$PTYCPRC	Proprietary sentence of Tyco Electronics for quality
(2)	3	Type of fix (3 = 3D, 2 = 2D, 1 = no fix)
(3)	15.4	Radius for the 50% probability
(4)	26.3	Radius for the 80% probability
(5)	41.1	Radius for the 95% probability
(6)	*71	Checksum

Table 23: PTYCPRC response description

Note that in case of a „1“ for the second parameter (meaning no fix), the additional values must be considered to be invalid.

Turning the quality NMEA off is done by simply issuing the command with the parameter 0:

- $PTYCPRC,0

Alternatively, it is possible to toggle between on and off state of the quality NMEA message by issuing the command without a parameter:

- $PTYCPRC

3.20 Julian Day

The module is capable of calculating and transmitting the current Julian Day. The Julian Day is routinely used by astronomers, geodesists, scientists, financiers, and even some historians. This dating convention, designed to facilitate simplified chronological calculations, numbers all days in consecutive fashion, beginning at a date sufficiently far into the past so as to precede the historical period. Julian Day Number is an integer counter of the days beginning at **noon** on January 1, 4713 B.C., which is Julian Day Number 0. The module not only calculates the integral but also the fractional part.

In contrary to most proprietary sentence commands, this command will result in a single response:

Requesting the Julian Day NMEA is done by issuing the command

- $PTYCJD

After issuing a PTYCJD command with the correct syntax, the receiver will respond with one message:

e.g. $PTYCJD,170804,094331.000,A,2453234.90522*6E		
(1)	$PTYCJD	Proprietary sentence of Tyco Electronics for Julian Day
(2)	170804	Current date (August 17, 2004) – format ddmmyy
(3)	094331.000	Universal time coordinated (09h 43m 31.000s)
(4)	A	Valid fix (V: invalid)
(5)	2453234. 90522	Julian Day 2453234 and 0.90522 (which is 21h 43' 31" – in respect to the fact that the JD starts at noon, this is 9am!)
(6)	*6E	Checksum

Table 24: PTYCJD response description

3.21 Antenna status

It is possible to check the status of the antenna connection. This check is based on the current consumption of the antenna. If the current consumption is within a certain range (please see the receiver description) the firmware will return an OK status. If the current consumption is outside this range (which could mean no antenna connected, short circuit or current just outside this value) the firmware will return an ERROR status.

- $PTYCANT

The command will result in a single response.

e.g. $PTYCANT,1*79		
(1)	$PTYCANT	Proprietary sentence of Tyco Electronics for antenna check
(2)	1	Connected: 1 (0 for not connected or current consumption in wrong range)
(3)	*79	Checksum

Table 25: PTYCANT response description

3.22 Raw GPS Parameters

The module supports the output of raw GPS parameters. The parameters are defined in the Interface Control Document (ICD) ICD-GPS-200C in different tables. The following paragraphs describe briefly on how to request and interpret the raw GPS data. In contrary to most proprietary sentence commands, these commands will result in a single response.

3.22.1 Raw UTC Data

Requesting the UTC raw data NMEA is done by issuing the command

- $PTYCUTCP

After issuing a PTYCUTCP command with the correct syntax, the receiver will respond with one message:

e.g. $PTYCUTCP,00000001,000006,0D,63,04,DE,05,0D*0E		
(1)	$PTYCUTCP	Proprietary sentence of Tyco Electronics for UTC raw data
(2)	00000001	Parameters according to ICD-GPS-200C table 20-IX in hexadecimal notation
…	…	
(9)	0D	
(10)	*6E	Checksum

Table 26: PTYCUTCP response description

3.22.2 Raw Ionospheric Data

Requesting the raw ionosphere data NMEA is done by issuing the command

- $PTYCIONP

After issuing a PTYCIONP command with the correct syntax, the receiver will respond with one message:

e.g. $PTYCIONP,0E,03,FF,FE,34,08,FF,FC*79		
(1)	$PTYCIONP	Proprietary sentence of Tyco Electronics for raw ionosphere data
(2)	0E	Parameters according to ICD-GPS-200C table 20-X in hexadecimal notation
…	…	
(9)	FC	
(10)	*79	Checksum

Table 27: PTYCIONP response description

3.22.3 Raw Almanac Data

Requesting the raw Almanac data NMEA is done by issuing the command

- $PTYCALMP

After issuing a PTYCALMP command with the correct syntax, the receiver will respond with one message. For each satellite visible, a separate line will be presented:

e.g. $PTYCALMP,04,369C,63,0A6F,FD32,A10D3B,E83682,FDA8D9,0BF8FC,6F2,7FC, 0504,0*17		
(1)	$PTYCALMP	Proprietary sentence of Tyco Electronics for raw Almanac data
(2)	04	Satellite number
(3)	369C	Parameters according to ICD-GPS-200C table 20-VI in hexadecimal notation
…	…	
(12)	7FC	
(13)	0504	GPS week
(14)	0	Health (0: good, 1: bad)
(15)	*79	Checksum

Table 28: PTYCALMP response description

3.22.4 Raw Ephemeris Data

Requesting the raw Ephemeris data NMEA is done by issuing the command

- $PTYCEPHP

After issuing a PTYCEPHP command with the correct syntax, the receiver will respond with one message. For each satellite visible, three separate lines will be presented:

e.g. $PTYCEPHP,1,04,27,27,FA5F,3548,A5C66718,FAD8,0368412E,1154,A10DA762, 34BC*24		
(1)	$PTYCEPHP	Proprietary sentence of Tyco Electronics for raw Almanac data
(2)	1	First line
(3)	04	Satellite number
(4)	27	Parameters according to ICD-GPS-200C table 20-III in hexadecimal format
…	…	
(13)	34BC	
(14)	*24	Checksum

Table 29: PTYCEPHP response description (first line)

e.g. $PTYCEPHP,2,04,FFD1,E8470510,FFB5,270E1353,1BDE,FDB0E0BF,FFA71F, 3AFE,0504,0*1B		
(1)	$PTYCEPHP	Proprietary sentence of Tyco Electronics for raw Almanac data
(2)	2	Second line
(3)	04	Satellite number
(4)	FFD1	
…	…	Parameters according to ICD-GPS-200C table 20-III
(11)	3AFE	
(12)	0504	GPS week
(13)	0	Health (0: good, 1: bad)
(14)	*1B	Checksum

Table 30: PTYCEPHP response description (second line)

e.g. $PTYCEPHP,3,04,F3,027,34BC,00,FF7B,37A5B7*12		
(1)	$PTYCEPHP	Proprietary sentence of Tyco Electronics for raw Almanac data
(2)	3	Third line
(3)	04	Satellite number
(4)	F3	T_{GD} acc. to ICD-GPS-200C table 20-I
(5)	027	IODC acc. to ICD-GPS-200C table 20-I
(6)	34BC	t_{oc} acc. to ICD-GPS-200C table 20-I
(7)	00	a_{f2} acc. to ICD-GPS-200C table 20-I
(8)	FF7B	a_{f1} acc. to ICD-GPS-200C table 20-I
(9)	37A5B7	a_{f0} acc. to ICD-GPS-200C table 20-I
(10)	*12	Checksum

Table 31: PTYCEPHP response description (third line)

4 Specific Features

4.1 Demo Kit

Tyco Electronics' GPS firmware is available for 3 targets: For the GPS modules A1029-A, A1029-B and for the TYCO Electronics Demo Kit USB1029-A including a module. The Demo Kit USB1029A features the standard module A1029-A including standard firmware. For details please refer to the according document.

4.2 Firmware update and upgrades

Tyco Electronics' GPS firmware is stored in the flash memory of the A1029 and usually does not require any changes. Anyhow, in case of updates or upgrades, the A1029 provides a user-friendly method with its integrated boot loader. This boot loader allows an easy update of the GPS firmware using the serial I/O port. For this process a counter part on a PC – or an according application in an embedded system - is required. The following paragraphs describe the procedure of updating the GPS application using Tyco Electronics' flashing tool "GPS Flash Tool A1029".

4.2.1 Installing "GPS Flash Tool A1029"

This tool is either available through your local distributor or by sending a request to gps@tycoelectronics.com.

The software consists of two files, the executable "*GFT.exe*" and the help file "*GFTA1029.hlp*". Both files need to be copied into one directory, e.g. named "GPS Flash Tool A1029". The application is usually started by a double click. The tool uses the following icon.

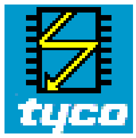

Figure 2: GPS Flash Tool A1029 icon

4.2.2 The download process

- Connect serial port 0 to your PC. Please apply necessary signal conversion (the A1029 comes with TTL level interfaces).
- If you use the Demo Kit, the serial port 0 is routed through the USB link. The "GPS Flash Tool A1029" supports serial channels (COM ports) 1 through 10 only, so in rare cases you might need to change the settings using the device manager. In section "interfaces" check for the assigned serial port and change this within the properties of the USB serial device.
- Start Tyco Electronics "GPS Flash Tool A1029"
- When started the "GPS Flash Tool A1029" will display "NOT CONNECTED" and the message "Please Reset the Target" in the status window.

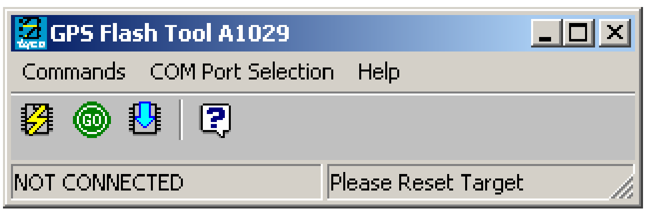

Figure 3: GFT main window

- By default the "GPS Flash Tool A1029" will connect to the target via COM1, however you may change the COM port by selecting the "COM Port Selection" menu.

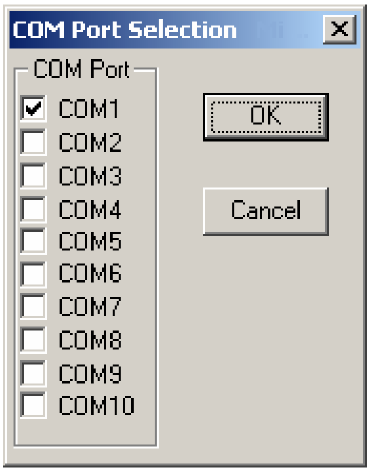

Figure 4: GFT COM port selection

- In order for the “GPS Flash Tool A1029” to successfully connect to the target, the user has to reset the target. Once the target starts out of reset and the “GPS Flash Tool A1029” has successfully connected to it, the status window will now display "CONNECTED" along with the COM port that is currently used for the connection. Other communication parameters, such as Baud Rate, Parity, Stop Bits, and Data bits are also displayed.

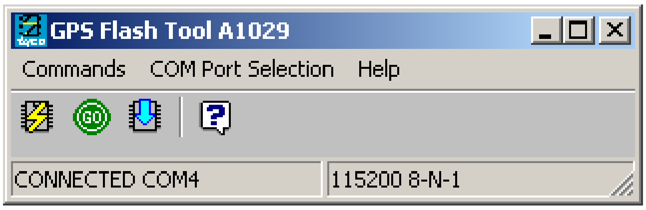

Figure 5: GFT main window - connected

- The “GPS Flash Tool A1029” is capable of upgrading the target with new application firmware and new boot loader firmware, selectable via the “Flash Programming Options”. It is recommended to leave the settings in their original state.
- To initiate the programming operation the user must select either the "Program Target" option from the "Commands" menu or the appropriate tool bar button.

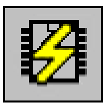

Figure 6: GFT program target button

- In order for the “GPS Flash Tool A1029” to perform the upgrade, it must be able to access a HEX file containing the upgrade firmware. When you select to program the target they will be presented with the “Open Hex File” dialog window from which you may select the appropriate hex file for downloading to the target.

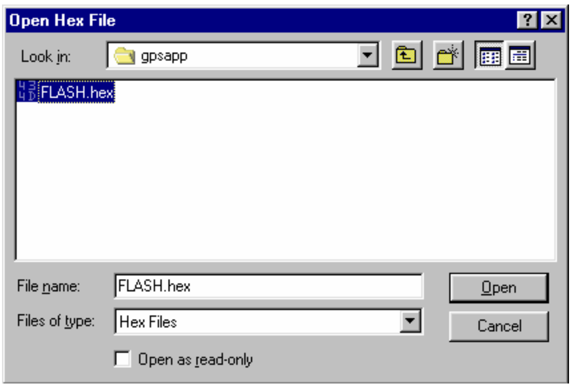

Figure 7: GFT open HEX file window

- Whilst the programming operation is taking place a progress bar will be presented to you.

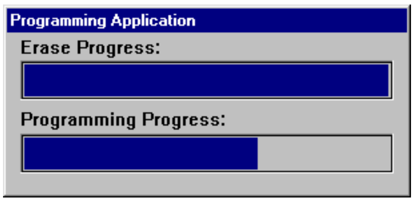

Figure 8: GFT erase and programming process

- For other features of the tool, please refer to the online help menu.

4.3 Prepared for Differential GPS

Differential GPS can increase accuracy of the GPS position. For that purpose corrections are broadcasted from reference stations at known locations. They can be received by a special hardware and need to be forwarded to the GPS receiver. TYCO Electronics’ GPS firmware can handle these RTCM (Radio Technical Commission For Maritime Services) data if they are provided at port 1 @ 4800 baud. As soon as RTCM data are detected at this port, the firmware will start to exploit these data to increase accuracy.

Pls. refer to RTCM Paper 194-93/SC104-STD: “RTCM Recommended Standards For Differential Navstar GPS Service, Version 2.1”

5 Related Information

5.1 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.

Tyco Electronics
Power Systems
Finsinger Feld 1
85521 Ottobrunn, Germany
Tel.: +49 89 6089 838
Fax: +49 89 6089 835
gps@tycoelectronics.com.
www.tycoelectronics.com/gps.

Further contact addresses:
Info.gps@tycoelectronics.com.
support.gps@tycoelectronics.com.
sales.gps@tycoelectronics.com.

5.2 Related Documents

- Manual: T.E. GPS Receivers A1029 (TYCO)
- Manual: T.E. GPS Firmware DR A1029 (TYCO)
- Manual: T.E. GPS Demo Kit USB1029-A (TYCO)
- Manual: T.E. GPS Evaluation Kit EVA1029-A (TYCO)
- Manual: T.E. GPS Demo Kit DKS1029-B (TYCO)
- Manual: T.E. GPS Boot loader A1029 (TYCO)

6 List of Tables

7 List of Figures

Appendix A: Target#, Datum and Region

Datum and Region according to NATO document on NIMA websites
http://www.nima.mil and http://164.214.2.59/GandG/datums/natodt.html

Datum-String	Target#	Datum	Region
„WGS84“	“0”	WORLD GEODETIC SYSTEM 1984	Global
“ADI-E”	“1”	ADINDAN	Burkina Faso
“ADI-F”	“2”	ADINDAN	Cameroon
“ADI-A”	“3”	ADINDAN	Ethiopia
“ADI-C”	“4”	ADINDAN	Mali
“ADI-M”	“5”	ADINDAN	Mean
“ADI-D”	“6”	ADINDAN	Senegal
“ADI-B”	“7”	ADINDAN	Sudan
“AIA”	“8”	ANTIGUA ISLAND ASTRO 1943	Antigua
« AIN-A »	“9”	AIN EL ABD 1970	Bahrain
« AIN-B »	“10”	AIN EL ABD 1970	Saudi Arabia
“AMA”	“11”	AMERICAN SAMOA 1962	Samoa Islands
“AME-7”	“12”	RD, AMERSFOORT	Netherlands
“ANO”	“13”	ANNA 1 ASTRO 1965	Cocos Islands
“ARF-M”	“14”	ARC 1950	Southern Africa
“ARF-A”	“15”	ARC 1950	Botswana
„ARF-H“	“16”	ARC 1950	Burundi
„ARF-B“	“17”	ARC 1950	Lesotho
“ARF-C”	“18”	ARC 1950	Malawi
“ARF-D”	“19”	ARC 1950	Swaziland
“ARF-E”	“20”	ARC 1950	Zaire
„ARF-F“	“21”	ARC 1950	Zambia
“ARF-7”	“22”	ARC 1950	Zimbabwe
“ARS-7”	“23”	ARC 1960	Kenya
“ARS-B”	“24”	ARC 1960	Tanzania
“ASC”	“25”	ASCENSION ISLAND 1958	Ascension
“ASM”	“26”	MONTSERRAT IS. ASTRO 1958	Montserrat
“ASQ”	“27”	ASTRO STATION 1952	Marcus Islands
“ATF”	“28”	ASTRO BEACON E 1845	Iwo Jima
“AUA”	“29”	AUSTRALIAN GEODETIC 1966	Australia
“AUG-7”	“30”	AUSTRALIAN GEODETIC 1984	Australia
“BAT”	“31”	DJAKARTA	Indonesia
“BER”	“32”	BERMUDA 1957	Bermuda
“BID”	“33”	BISSAU	Guinea Bissau
“BOO”	“34”	BOGOTA OBSERVATORY	Colombia
“BRE”	“35”	BERNE (1898)	Switzerland
„BUR“	“36”	BUKIT RIMPAH	Indonesia
“CAC”	“37”	CAPE CANAVERAL	Florida & Bahamas
“CAI”	“38”	CAMPO INCHAUSPE 1969	Argentina
“CAO”	“39”	CANTON ASTRO 1966	Phoenix Islands
“CAP”	“40”	CAPE	South Africa

Table 32: Datum (1)

Datum-String	Target#	Datum	Region
“CAZ”	**“41”**	CAMP AREA ASTRO	Antarctica
“CCD-7”	**“42”**	S-JTSK	Czech Republic
“CCD-7”	**“43”**	S-JTSK	Slovakia
“CHI”	**“44”**	CHATHAM ISLAND ASTRO 1971	New Zealand
“CHU”	**“45”**	CHUA ASTRO	Paraguay
“CHW-7“	**“46”**	CH1903+	Switzerland
“COA”	**“47”**	CORREGO ALEGRE	Brazil
“CPR-7”	**“48”**	OBSERVATOROI	Mozambique South
“CSE”	**“49”**	ESTONIA 1937	Estonia
“DAL”	**“50”**	DABOLA	Guinea
“DID”	**“51”**	DECEPTION ISLAND	Antarctica
“DOB”	**“52”**	GUX 1 ASTRO	Guadalcanal Island
“EAS”	**“53”**	EASTER ISLAND 1967	Easter Island
“ENW“	**“54”**	WAKE-ENIWETOK 1960	Marshall Islands
“EUR-M“	**“55”**	EUROPEAN DATUM 1950	Europe
“EUR-A“	**“56”**	EUROPEAN DATUM 1950	Western Europe
“EUR-C“	**“57”**	EUROPEAN DATUM 1950	Norway & Finland
”EUR-7“	**“58”**	EUROPEAN DATUM 1950	Denmark
“EUR“	**“59”**	EUROPEAN DATUM 1950	Channel Islands
“EUR-D“	**“60”**	EUROPEAN DATUM 1950	Portugal and Spain
“EUR“	**“61”**	EUROPEAN DATUM 1950	Portugal
“EUR-7“	**“62”**	EUROPEAN DATUM 1950	Balearic Islands
“EUR-7“	**“63”**	EUROPEAN DATUM 1950	Spain (except NW)
“EUR-7“	**“64”**	EUROPEAN DATUM 1950	Spain NW
“EUR“	**“65”**	EUROPEAN DATUM 1950	Gibraltar
“EUR-I”	**“66”**	EUROPEAN DATUM 1950	Italy – Sardinia
“EUR-J”	**“67”**	EUROPEAN DATUM 1950	Italy – Sicily
“EUR-L”	**“68”**	EUROPEAN DATUM 1950	Malta
“EUR”	**“69”**	EUROPEAN DATUM 1950	Former Yugoslavia N
„EUR-B“	**“70”**	EUROPEAN DATUM 1950	Greece
“EUR-7“	**“71”**	EUROPEAN DATUM 1950	Cyprus
“EUR-7“	**“72”**	EUROPEAN DATUM 1950	Turkey
“EUR-7“	**“73”**	EUROPEAN DATUM 1950	Algeria
“EUR-T“	**“74”**	EUROPEAN DATUM 1950	Tunisia
“EUR-F“	**“75”**	EUROPEAN DATUM 1950	Egypt
“EUR-7“	**“76”**	EUROPEAN DATUM 1950	Lebanon
“EUR-H“	**“77”**	EUROPEAN DATUM 1950	Iran
“EUR-S”	**“78”**	EUROPEAN DATUM 1950	Middle East
“EUR-7“	**“79”**	EUROPEAN DATUM 1950	Oman
“EUS”	**“80”**	EUROPEAN 1979	Europe
“EUS”	**“81”**	EUROPEAN 1979	Portugal
“EUT“	**“82”**	ETRF89	Europe
“FAH-7”	**“83”**	FAHUD	Oman
“FLO”	**“84”**	OBSERVATORIO MET. 1939	Flores
“FOT”	**“85”**	FORT THOMAS 1955	St Kitts-Nevis

Table 33: Datum (2)

Datum-String	Target#	Datum	Region
“GAA”	**“86”**	GAN 1970	Rep. Of Maldives
“GDS”	**“87”**	GEOCENTRIC DATUM AUSTRALIA	Australia
“GEO-7”	**“88”**	GEODETIC DATUM 1949	New Zealand
“GIZ“	**“89”**	DOS 1968	Gizo Islands
“GRA”	**“90”**	GRACIOSA BASE SW 1948	Azores
“GRX”	**“91”**	GGRS87	Greece
“GSE”	**“92”**	GUNUNG SEGARA	Indonesia
“GUA”	**“93”**	GUAM 1963	Guam
“HEL-7”	**“94”**	HELSINKI, KALLIO CHURCH	Finland
“HEN”	**“95”**	HERAT NORTH	Afghanistan
”HER-7“	**“96”**	MGI DATUM / HERMANNSKOGEL	Austria
“HER-7”	**“97”**	HERMANNSKOGEL	Former Yugoslavia
“HIT”	**“98”**	HITO XVIII 1963	Chile
“HJO”	**“99”**	HJORSEY 1955	Iceland
“HKD”	**“100”**	HONG KONG 1963	Hong Kong
“HKE“	**“101”**	HONG KONG 1980	Hong Kong
“HTN“	**“102”**	HU-TZU-SHAN	Taiwan
“IBE”	**“103”**	BELLEVUE (IGN)	Efate Island
“IDN”	**“104”**	INDONESIAN 1974	Indonesia
“IKB”	**“105”**	IRAQ-KUWAIT BOUNDARY 1992	Iraq/ Kuwait
“IND-7“	**“106”**	INDIAN	Bangladesh
“IND-I”	**“107”**	INDIAN	India & Nepal
“IND-P”	**“108”**	INDIAN	Pakistan
“INF-A”	**“109”**	INDIAN 1954	Thailand
“ING-B”	**“110”**	INDIAN 1960	Con Son Island
“ING-A”	**“111”**	INDIAN 1960	Vietnam
“INH-A1”	**“112”**	1 INDIAN 1975	Thailand
“IRL-7”	**“113”**	IRELAND 1965	Ireland
“ISG”	**“114”**	ISTS 061 ASTRO 1968	South Georgia
“IST”	**“115”**	ISTS 073 Astro 1969	Diego Garcia
“JOH”	**“116”**	JOHNSTON ISLAND 1961	Johnston Island
“KAN-7”	**“117”**	KANDAWALA JACKSON?	Sri Lanka
“KEA-7“	**“118”**	KERTAU 1948	Malaysia W & Sing.
“KEG“	**“119”**	KERGUELEN ISLAND 1949	Kerguelen Island
“KGS“	**“120”**	KOREAN GEODETIC SYSTEM 1995	South Korea
“KKX-7”	**“121”**	KKJ	Finland
“KUS“	**“122”**	KUSAIE ASTRO 1951	Caroline Island
“LCF”	**“123”**	LC5 ASTRO 1961	Cayman Brac
“LEH-7“	**“124”**	LEIGON	Ghana
“LIB”	**“125”**	LIBERIA 1964	Liberia
“LIS-7”	**“126”**	LISBON (Castelo di Sao Jorge) D73	Portugal
“LTH”	**“127”**	LKS94	Lithuania
“LUZ-B”	**“128”**	LUZON	Philippines – Mindanao
“LUZ-A”	**“129”**	LUZON	Philippines
“MAS”	**“130”**	MASSAWA	Eritrea

Table 34: Datum (3)

Datum-String	Target#	Datum	Region
“MER”	**“131”**	MERCHICH	Morocco
“MID”	**“132”**	MIDWAY ASTRO 1961	Midway Islands
“MIK”	**“133”**	MAHE 1971	Seychelles – Mahe Is.
“MIN-A”	**“134”**	MINNA	Cameroon
“MIN-B”	**“135”**	MINNA	Nigeria
“MOD-7”	**“136”**	ROME 1940	Italy mainland
“MOD-7”	**“137”**	ROME 1940	Italy – Sardinia
“MOD-7”	**“138”**	ROME 1940	Italy – Sicily
“MPO”	**“139”**	M’PORALOKO	Gabon
“MVS”	**“140”**	VITI LEVU 1916	Fiji – Viti Levu
“NAH-A“	**“141”**	NAHRWAN	Oman – Masirah Island
“NAH-C“	**“142”**	NAHRWAN	Saudi Arabia
“NAH-B”	**“143”**	NAHRWAN	United Arab Emirates
“NAP”	**“144”**	NAPARIMA	Trinidad & Tobago
“NAR-A”	**“145”**	NORTH AMERICAN 1983	US – Alaska
“NAR-E”	**“146”**	NORTH AMERICAN 1983	US – Aleutian
“NAR-B”	**“147”**	NORTH AMERICAN 1983	Canada
“NAR-C“	**“148”**	NORTH AMERICAN 1983	US – CONUS
“NAR-H”	**“149”**	NORTH AMERICAN 1983	US – Hawaii
“NAR-D”	**“150”**	NORTH AMERICAN 1983	Mexico
“NAS-D”	**“151”**	NORTH AMERICAN 1927	US – Alaska
“NAS-E“	**“152”**	NORTH AMERICAN 1927	Canada
“NAS-F”	**“153”**	NORTH AMERICAN 1927	Canada – Alberta/British Col.
“NAS-V”	**“154”**	NORTH AMERICAN 1927	US – Aleutian East
“NAS-W”	**“155”**	NORTH AMERICAN 1927	US – Aleutian West
“NAS-Q”	**“156”**	NORTH AMERICAN 1927	Bahamas
“NAS-O”	**“157”**	NORTH AMERICAN 1927	Canal Zone
“NAS-P”	**“158”**	NORTH AMERICAN 1927	Caribbean
“NAS-N”	**“159”**	NORTH AMERICAN 1927	Central America
“NAS-C”	**“160”**	NORTH AMERICAN 1927	US – CONUS
“NAS-T”	**“161”**	NORTH AMERICAN 1927	Cuba
“NAS-G”	**“162”**	NORTH AMERICAN 1927	Canada East
“NAS-A”	**“163”**	NORTH AMERICAN 1927	US – Eastern
“NAS-U”	**“164”**	NORTH AMERICAN 1927	Greenland
“NAS-H”	**“165”**	NORTH AMERICAN 1927	“Canada – Manitoba/Ontario”
“NAS-L”	**“166”**	NORTH AMERICAN 1927	Mexico
“NAS-I”	**“167”**	NORTH AMERICAN 1927	Canada – NW Territory
“NAS-R”	**“168”**	NORTH AMERICAN 1927	San Salvador
“NAS-B”	**“169”**	NORTH AMERICAN 1927	US – Western
“NAS-J”	**“170”**	NORTH AMERICAN 1927	Canada – Yukon
“NSD”	**“171”**	NORTH SAHARA 1959	Algeria
“ODU-7“	**“172”**	BELGIUM DATUM 1972	Belgium
“OEG”	**“173”**	OLD EGYPTIAN 1907	Egypt
“OGB-7”	**“174”**	ORDNANCE GB 1936	GB – Great Britain
“OHA-M”	**“175”**	OLD HAWAI’IAN	US – Hawaii Mean

Table 35: Datum (4)

Datum-String	Target#	Datum	Region
”OHA-A“	**“176”**	OLD HAWAI’IAN	US – Hawaii
“OHA-B”	**“177”**	OLD HAWAI’IAN	US – Kauai
“OHA-C”	**“178”**	OLD HAWAI’IAN	US – Maui
“OHA-D”	**“179”**	OLD HAWAI’IAN	US – Oahu
“OHI-M”	**“180”**	OLD HAWAI’IAN	US – Hawaii
“OHI-A”	**“181”**	OLD HAWAI’IAN	US – Hawaii
“OHI-B”	**“182”**	OLD HAWAI’IAN	US – Kauai
“OHI-C”	**“183”**	OLD HAWAI’IAN	US – Maui
“OHI-D”	**“184”**	OLD HAWAI’IAN	US – Oahu
“PHA”	**“185”**	AYABELLA LIGHTHOUSE	Djibouti
“PIT”	**“186”**	PITCAIRN ASTRO 1967	Pitcairn Island
“PLN”	**“187”**	PICO DE LAS NIEVES.	Spain – Canary Islands
“POS”	**“188”**	PORTO SANTO 1936.	Portugal – Madeira
“PRP-A”	**“189”**	PROV. S AMERICAN 1956	Bolivia
“PRP-D”	**“190”**	PROV. S AMERICAN 1956	Colombia
“PRP-E”	**“191”**	PROV. S AMERICAN 1956	Ecuador
“PRP-F”	**“192”**	PROV. S AMERICAN 1956	Guyana
“PRP-B”	**“193”**	PROV. S AMERICAN 1956	Chile North
“PRP-G”	**“194”**	PROV. S AMERICAN 1956	Peru
“PRP-M“	**“195”**	PROV. S AMERICAN 1956	South America
“PRP-C”	**“196”**	PROV. S AMERICAN 1956	Chile South
“PRP-7”	**“197”**	PROV. S AMERICAN 1956	Venezuela
“PTB”	**“198”**	POINT 58	Burkina Faso & Niger
“PTN”	**“199”**	POINT NOIRE 1948	Congo
“PUK”	**“200”**	PULKOVO 1942	Russia
“PUK-7”	**“201”**	PULKOVO 1942	Germany
“PUK-7”	**“202”**	PULKOVO 1942	Estonia
“PUR”	**“203”**	PUERTO RICO & Virgin Is.	“Puerto Rico & Virgin Islands”
“QAT-7”	**“204”**	QATAR NATIONAL 1974	Qatar
“QAR-7”	**“205”**	QATAR NATIONAL 1995	Qatar
“QUO”	**“206”**	QORNOQ	Greenland South
“RAU-7”	**“207”**	DHDN (RAUENBERG)	Germany
“REU”	**“208”**	REUNION	Mascarene Islands
“RTS-7”	**“209”**	RT90	Sweden
“SAE”	**“210”**	SANTO (DOS) 1965	Vanuatu – Espirito Santo
“SAN-A”	**“211”**	SOUTH AMERICAN 1969	Argentina
“SAN-J”	**“212”**	SOUTH AMERICAN 1969	Galapagos
“SAN-B”	**“213”**	SOUTH AMERICAN 1969	Bolivia
“SAN-C”	**“214”**	SOUTH AMERICAN 1969	Brazil
“SAN-D”	**“215”**	SOUTH AMERICAN 1969	Chile
“SAN-E”	**“216”**	SOUTH AMERICAN 1969	Colombia
“SAN-F”	**“217”**	SOUTH AMERICAN 1969	Ecuador
“SAN-G”	**“218”**	SOUTH AMERICAN 1969	Guyana
“SAN-H”	**“219”**	SOUTH AMERICAN 1969	Paraguay
“SAN-I”	**“220”**	SOUTH AMERICAN 1969	Peru

Table 36: Datum (5)

Datum-String	Target#	Datum	Region
"SAN-M"	"221"	SOUTH AMERICAN 1969	South America
"SAN-K"	"222"	SOUTH AMERICAN 1969	Trinidad
"SAN-L"	"223"	SOUTH AMERICAN 1969	Venezuela
"SAO"	"224"	SAO BRAZ	Santa Maria Islands
"SAP-7"	"225"	SAPPER HILL 1943 (2000 adj)	Falkland Islands
"SCK"	"226"	SCHWARZECK	Namibia
"SEI-7"	"227"	SOUTH EAST ISLAND	Seychelles
"SGM"	"228"	SELVAGEM GRANDE 1938	Salvage Island
"SHB"	"229"	ASTRO DOS 71/4	St Helena
"SIB"	"230"	SIERRA LEONE DATUM 1960	Sierra Leone
"SIR"	"231"	SIRGAS	South America
"SOA"	"232"	SOUTH ASIA	Singapore
"SPK-F"	"233"	S-42 (PULKOVO 1942)	Albania
"SPK-C"	"234"	S-42 (PK42)	Czechoslovakia
"SPK-A"	"235"	S-42 (PULKOVO 1942)	Hungary
"SPK-D"	"236"	S-42 (PULKOVO 1942)	Latvia
"SPK-E"	"237"	S-42 (PK 1942)	Kazakhstan
"SPK-7"	"238"	SYSTEM 1942/58 (PULKOVO 1942)	Poland
"SPK-B"	"239"	S-42 (PULKOVO 1942)	Poland
"SPK-G"	"240"	S-42 (PULKOVO 1942)	Romania
"SPK"	"241"	S-42 (PULKOVO 1942)	Romania
"SPK"	"242"	S-42 (PULKOVO 1942)	Afghanistan
"TAN-7"	"243"	"TANANARIVE OBSERVATORY 1925"	Madagascar
"TDC"	"244"	TRISTAN ASTRO 1968	Tristan da Cunha
"TEC-7"	"245"	TETE	Mozambique
"TIL-7"	"246"	TIMBALAI 1948 (Everest)	Malaysia E & Brunei
"TIM-7"	"247"	TIMBALAI 1968, Adj of 1948	Malaysia E & Brunei
"TIN-7"	"248"	TIMBALAI 1968, Adj of 1948	Malaysia E & Brunei
"TIV-7"	"249"	TIMBALAI 1948 (Bessel)	Malaysia E & Brunei
"TOY-A"	"250"	TOKYO	Japan
"TOY-B1"	"251"	TOKYO	South Korea
"TOY-C"	"252"	TOKYO	Japan - Okinawa
"TRN"	"253"	ASTRO TERN ISLAND (FRIG) 1961	Antarctica
"WAK"	"254"	WAKE ISLAND ASTRO 1952	Wake Island
"WGC-7"	"255"	WORLD GEODETIC SYSTEM 1972	World
"WGE"	"256"	WORLD GEODETIC SYSTEM 1984	World
"YAC"	"257"	YACARE	Uruguay
"ZAN"	"258"	ZANDERIJ	Suriname

Table 37: Datum (6)

Appendix B: ASCII code

Dec.	Hex.	Character	Dec.	Hex.	Character	Dec.	Hex.	Character
32	20		64	40	@	96	60	‘
33	21	!	65	41	A	97	61	a
34	22	“	66	42	B	98	62	B
35	23	#	67	43	C	99	63	c
36	24	$	68	44	D	100	64	d
37	25	%	69	45	E	101	65	e
38	26	&	70	46	F	102	66	f
39	27	‘	71	47	G	103	67	g
40	28	(	72	48	H	104	68	h
41	29	)	73	49	I	105	69	i
42	2A	*	74	4A	J	106	6A	j
43	2B	+	75	4B	K	107	6B	k
44	2C	,	76	4C	L	108	6C	l
45	2D	-	77	4D	M	109	6D	m
46	2E	.	78	4E	N	110	6E	n
47	2F	/	79	4F	O	111	6F	o
48	30	0	80	50	P	112	70	p
49	31	1	81	51	Q	113	71	q
50	32	2	82	52	R	114	72	r
51	33	3	83	53	S	115	73	s
52	34	4	84	54	T	116	74	t
53	35	5	85	55	U	117	75	u
54	36	6	86	56	V	118	76	v
55	37	7	87	57	W	119	77	w
56	38	8	88	58	X	120	78	x
57	39	9	89	59	Y	121	79	y
58	3A	:	90	5A	Z	122	7A	z
59	3B	;	91	5B	[	123	7B	{
60	3C	<	92	5C	\	124	7C	|
61	3D	=	93	5D	]	125	7D	}
62	3E	>	94	5E	^	126	7E	~
63	3F	?	95	5F	_			

Table 38: ASCII code

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:

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

Example 1:

$PTYCGGA(,[0,1]) allows these commands

$PTYCGGA
$PTYCGGA,0
$PTYCGGA,1

Example 2:

$PTYCIOC,[<*pin*,*dirpin*>,<*port*,*dirport*>,<*dirport*,*dirport*>] allows these command:

$PTYCIOC,*pin*,*dirpin*
$PTYCIOC,*port*,*dirport*
$PTYCIOC,*dirport*,*dirport*

pin, dirpin, port, dirport are then explained separately.

PTYCALMP

$PTYCALMP Activates raw Almanac data output

Arguments: none

Description: Activates raw Almanac data output. Only one response!

See also: ---

PTYCANT

$PTYCANT Checks antenna status

Arguments: none

Description: Checks if the antenna is connected or not

See also: ---

PTYCBR

$PTYCBR,[<pos>,1,0] Controls bearing

Arguments:	pos	Turns bearing towards given position on.
	1	Turns bearing towards current position on.
	0	Turns bearing off.

Description: Calculates direction and distance towards a position.

See also: ---

PTYCBRATE

$PTYCBRATE,<baud_rate> Pre-configures baud rate of serial interface

Arguments: baud_rate Baud rate to be used for serial interface, allow values are: 4800, 9200,19200,38400

Description: Pre-configures the baud rate of the serial interface. In order to switch to the new baud rate, it is necessary to save this configuration using $PTYCSUPWR and to reset the module. For more details see paragraph "Baud rate Set-up".

See also: ---

PTYCDAT

$PTYCDAT,<target#> Sets geodetic datum

Arguments: target# To get the correct target# consult **"**Appendix A: Target#, Datum and Region**"**.

Description: Sets local datum to specified geodetic datum.
If target# is unequal to "0" the proprietary sentence $PTYCDAT is switched on and tells the current datum as a string.

For more details see paragraph "Local Datum".

See also: ---

PTYCDEF

$PTYCDEF Switches on default NMEA messages

Arguments: none

Description: Switches NMEA output to default setting ($GPGGA, $GPGSA, $GPGSV, $GPRMC).

This command has no effect on GPVTG, Datum and UTM.

See also: $PTYCGGA
$PTYCGSA
$PTYCGSV
$PTYCRMC

PTYCEPHP

$PTYCEPHP Activates raw Ephemeris data output

Arguments: none

Description: Activates raw Ephemeris data. Response only once.

See also: ---

PTYCGFC

$PTYCGFC,[<rad>,<rad,pos>,0] Starts or stops geofencing

Arguments:	rad	Starts geofencing around current position.
	rad,pos	Starts geofencing around given position.
	0	Stops geofencing

Description: Initiates geofencing, i.e. the receiver will control, if the current position is within a certain radius around a given or the original position.

See also: ---

PTYCGGA

$PTYCGGA(,[1,0]) Controls GGA sentence

Arguments:	1	Sets the NMEA sentence ON.
	0	Sets the NMEA sentence OFF.

Description: Controls NMEA sentence $GPGGA

Without the optional code the NMEA sentence is toggled (if it has been switched ON before it becomes switched OFF and vice versa).

If the optional code is 0, the NMEA sentence becomes switched OFF, no matter what it has been before.

If the optional code is 1, the NMEA sentence becomes switched ON, no matter what it has been before.

For more details about GGA sentence see paragraph "GGA - Global Positioning System Fix Data".

See also: $PTYCDEF

PTYCGSA

$PTYCGSA(,[1,0]) Controls GSA sentence

Arguments: 1 Sets the NMEA sentence ON.
0 Sets the NMEA sentence OFF.

Description: Controls NMEA sentence $GPGSA

Without the optional code the NMEA sentence is toggled (if it has been switched ON before it becomes switched OFF and vice versa).

If the optional code is 0, the NMEA sentence becomes switched OFF, no matter what it has been before.

If the optional code is 1, the NMEA sentence becomes switched ON, no matter what it has been before.

For more details about GSA sentence see paragraph
"GSA - GPS DOP and Active Satellites".

See also: $PTYCDEF

PTYCGSV

$PTYCGSV(,[1,0]) Controls GSV sentence

Arguments: 1 Sets the NMEA sentence ON.
0 Sets the NMEA sentence OFF.

Description: Controls NMEA sentence $GPGSV

Without the optional code the NMEA sentence is toggled (if it has been switched ON before it becomes switched OFF and vice versa).

If the optional code is 0, the NMEA sentence becomes switched OFF, no matter what it has been before.

If the optional code is 1, the NMEA sentence becomes switched ON, no matter what it has been before.

For more details about GSV sentence see paragraph "GSV – GPS Satellites in View".

See also: $PTYCDEF

PTYCHEAD

$PTYCHEAD Initiates version output

Arguments: none

Description: Initiates version (ST library and Tyco Electronics' firmware) output

Issuing this command leads to a one time output of the current version of the ST library and the Tyco Electronics' firmware.

For more details see paragraph "Version information".

See also: ---

PTYCINITDATIM

$PTYCINITDATIM,<datimcode> Sets new datum and time

Arguments: datimcode Code for setting datum and time, syntax:
dd,mm,yyyy,hh,mm,ss

dd: day of month, e.g. 13
mm: month, e.g. 06 for June
yyyy: year, e.g. 2004
hh: hour of the day (24h notation), e.g. 14 for 2 p.m.
mm: minute, e.g. 25
ss: second (usually 00)

Description: Sets a new datum and time information to the GPS receiver. After setting the information, the internal GPS engine will be restarted. This additional information will help to speed-up the starting time under certain circumstances.

For more details see paragraph "Start-up support".

See also: $PTYCINITPOS

PTYCINITPOS

$PTYCINITPOS,<positioncode> Sets new position

Arguments: positioncode Code for setting a new position, syntax:
xxxx.xxx,[N/S],yyyyy.yyy,[E/W],zzz.z

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
zzz.z: altitude in meters

Description: Sets new position information to the GPS receiver. After setting the information, the internal GPS engine will be restarted. This additional information will help to speed-up the starting time under certain circumstances.

For more details see paragraph “Start-up support”.

See also: $PTYCINITDATIM

PTYCIONP

$PTYCIONP Activates raw ionosphere data output

Arguments: none

Description: Activates raw ionosphere data output. Response only once.

See also: ---

PTYCJD

$PTYCJD Activates Julian Day output

Arguments: none

Description: Activates Julian Day output. Response only once.

See also: ---

PTYCMH

$PTYCMH(,[1,0]) Controls Maidenhead Square output

Arguments:	1	Sets the NMEA sentence ON.
	0	Sets the NMEA sentence OFF.

Description: Controls NMEA sentence for Maidenhead Grid Square

Without the optional code the NMEA sentence is toggled (if it has been switched ON before it becomes switched OFF and vice versa).

If the optional code is 0, the NMEA sentence becomes switched OFF, no matter what it has been before.

If the optional code is 1, the NMEA sentence becomes switched ON, no matter what it has been before.

See also: ---

PTYCNMEAI

$PTYCNMEAI,<nmea_interval> Sets interval for NMEA output

Arguments: nmea_interval Interval of NMEA output in seconds (integer). Acceptable values are from 1 to 30.

Description: Sets interval of NMEA output.

NMEAs will be sent to UART every <nmea_interval> seconds.

The GPS receiver will continue to track satellites in the meantime; therefore power consumption will not be reduced!

ATTENTION:
Please check carefully the impact of this command on the concurrent use of low power mode!

For more details see paragraph "Interval of NMEA output".

See also: ---

PTYCNMEAOFF

$PTYCNMEAOFF Switches all NMEA sentences OFF

Arguments: none

Description: Switches all active NMEA sentences to OFF

See also: $PTYCDEF

PTYCNMEAON

$PTYCNMEAON Switches NMEA sentences ON

Arguments: none

Description: Switches all active NMEA sentences to ON, i.e. all sentences that have been configured to ON before.

See also: $PTYCDEF

PTYCODO

$PTYCODO(,[1,0]) Controls ODO output

Arguments:	1	Sets the NMEA sentence ON.
	0	Sets the NMEA sentence OFF.

Description: Controls NMEA sentence for ODO

Without the optional code the NMEA sentence is toggled (if it has been switched ON before it becomes switched OFF and vice versa).

If the optional code is 0, the NMEA sentence becomes switched OFF, no matter what it has been before.

If the optional code is 1, the NMEA sentence becomes switched ON, no matter what it has been before.

See also: ---

PTYCODOSET

$PTYCODOSET,<odometer lifetime>	Sets odometer lifetime value

Arguments:	Odometer lifetime	odometer lifetime value in km; acceptable values are from 0 to 1000000.

Description: Sets the start value of odometer lifetime.

Reset to “0” is not possible after setting odometer lifetime once. It is also not possible to decrease the lifetime value.

See also: ---

PTYCPARAMCL

$PTYCPARAMCL Clears position and time parameters

Arguments: none

Description: Clears the parameters position, time and data stored in non-volatile memory. Supports therefore a faster start-up time after a receiver has been moved over a long distance or has been stored over a longer period.

See also: ---

PTYCPRC

$PTYCPRC(,[1,0]) Controls PRC sentence

Arguments:	1	Sets the NMEA sentence ON.
	0	Sets the NMEA sentence OFF.

Description: Controls NMEA sentence $PTYCPRC

Without the optional code the NMEA sentence is toggled (if it has been switched ON before it becomes switched OFF and vice versa).

If the optional code is 0, the NMEA sentence becomes switched OFF, no matter what it has been before.

If the optional code is 1, the NMEA sentence becomes switched ON, no matter what it has been before.

See also: ---

PTYCRESET

$PTYCRESET Reset the GPS module

Arguments: None

Description: This command resets the GPS module. The boot loader will be started first.

See also: ---

PTYCRMC

$PTYCRMC(,[1,0]) Controls RMC sentence

Arguments: 1 Sets the NMEA sentence ON.
0 Sets the NMEA sentence OFF.

Description: Controls NMEA sentence $GPRMC

Without the optional code the NMEA sentence is toggled (if it has been switched ON before it becomes switched OFF and vice versa).

If the optional code is 0, the NMEA sentence becomes switched OFF, no matter what it has been before.

If the optional code is 1, the NMEA sentence becomes switched ON, no matter what it has been before.

For more details about RMC sentence see paragraph "RMC - Recommended Minimum Specific GPS Data".

See also: $PTYCDEF

PTYCSBAS

$PTYCSBAS,[1,0,PRN] Controls use of SBAS information

Arguments:	1	Sets the use of SBAS to ON.
	0	Sets the use of SBAS to OFF
	PRN	Defines PRN of satellite to use (real PRN)

Description: Controls use of SBAS and selection of satellite

Within the factory setting, SBAS is disabled. This command can be used to switch on or off the use of SBAS and to select the corresponding SBAS satellite. The actual configuration can be stored using $PTYCSUPWR.

If the code is 0, the use of SBAS becomes switched OFF, no matter what it has been before.

If the code is 1, the use of SBAS becomes switched ON, no matter what it has been before.

To select an SBAS satellite, the PRN of the satellite needs to be used as the parameter, e.g. $PTYCSBAS,120.

For more details about SBAS sentence see paragraph "Support of SBAS (Satellite Based Augmentation Systems)".

See also: $PTYCSBASSAT

PTYCSBASSAT

$PTYCSBASSAT(,[1,0]) Controls SBASSAT sentence

Arguments:

	1	Sets the NMEA sentence ON.
	0	Sets the NMEA sentence OFF.

Description: Controls NMEA sentence $GPRMC

Without the optional code the NMEA sentence is toggled (if it has been switched ON before it becomes switched OFF and vice versa).

If the optional code is 0, the NMEA sentence becomes switched OFF, no matter what it has been before.

If the optional code is 1, the NMEA sentence becomes switched ON, no matter what it has been before.

For more details about SBASSAT sentence see paragraph "Support of SBAS (Satellite Based Augmentation Systems)“.

See also: $PTYCSBAS

PTYCSERRD

$PTYCSERRD 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: ---

PTYCSERWR

$PTYCSERWR,<serial number> Sets serial number into the GPS receiver

Arguments:	Serial number	Acceptable are values within the decimal code 32 to 126

Description: Switches the serial number output sentences on, just once.

To activate the written serial number use: $PTYCSUPWR.

Attention: this possible only one time. Changing or deleting the serial number is NOT possible.

See also: ---

PTYCSUN

$PTYCSUN(,[1,0]) Controls the sunrise/sunset sentence

Arguments: 1 Sets the NMEA sentence ON.
0 Sets the NMEA sentence OFF.

Description: Controls NMEA sentence for sunrise/sunset around current location

Without the optional code the NMEA sentence is toggled (if it has been switched ON before it becomes switched OFF and vice versa).

If the optional code is 0, the NMEA sentence becomes switched OFF, no matter what it has been before.

If the optional code is 1, the NMEA sentence becomes switched ON, no matter what it has been before.

See also: ---

PTYCSUPWR

$PTYCSUPWR Save current configuration

Arguments: None

Description: This command saves the current configuration to non-volatile memory.

In order to store a configuration (e.g. NMEA sentences, baud rate) to non-volatile memory, this command needs to be issued. After doing this, the same configuration will be valid after reset.

For more details see paragraph ”Saving a Configuration“.

See also: ---

PTYCUTCP

$PTYCUTCP Activates raw UTC data output

Arguments: none

Description: Activates raw UTC data output. Response only once.

See also: ---

PTYCUTM

$PTYCUTM(,[1,0]) Controls the UTM sentence

Arguments:	1	Sets the NMEA sentence ON.
	0	Sets the NMEA sentence OFF.

Description: Controls NMEA sentence for UTM projection

Without the optional code the NMEA sentence is toggled (if it has been switched ON before it becomes switched OFF and vice versa).

If the optional code is 0, the NMEA sentence becomes switched OFF, no matter what it has been before.

If the optional code is 1, the NMEA sentence becomes switched ON, no matter what it has been before.

For more details see paragraph
" Universal Transverse Mercator Projection (UTM) "

See also: $PTYCDEF

PTYCVTG

$PTYCVTG(,[1,0]) Controls VTG sentence

Arguments:	1	Sets the NMEA sentence ON.
	0	Sets the NMEA sentence OFF.

Description: Controls NMEA sentence $GPVTG

Without the optional code the NMEA sentence is toggled (if it has been switched ON before it becomes switched OFF and vice versa).

If the optional code is 0, the NMEA sentence becomes switched OFF, no matter what it has been before.

If the optional code is 1, the NMEA sentence becomes switched ON, no matter what it has been before.

For more details about VTG sentence see paragraph

"VTG – Course Over Ground and Ground Speed".

See also: $PTYCDEF

PTYCXTD

$PTYCXTD,[<pos,pos>,0] Cross Track Distance calculation

Arguments:	pos,pos	Two waypoints, starts output.
	0	Stops output.

Description: Calculates and transmit the cross track distance between two waypoints.

See also: ---

PTYCZDA

$PTYCZDA(,[1,0]) Controls ZDA sentence

Arguments:	1	Sets the NMEA sentence ON.
	0	Sets the NMEA sentence OFF.

Description: Controls NMEA sentence $GPZDA

Without the optional code the NMEA sentence is toggled (if it has been switched ON before it becomes switched OFF and vice versa).

If the optional code is 0, the NMEA sentence becomes switched OFF, no matter what it has been before.

If the optional code is 1, the NMEA sentence becomes switched ON, no matter what it has been before.

For more details about ZDA sentence see paragraph

" ZDA – Time & Date".

See also: $PTYCDEF

This page was intentionally left blank.