

NMEA

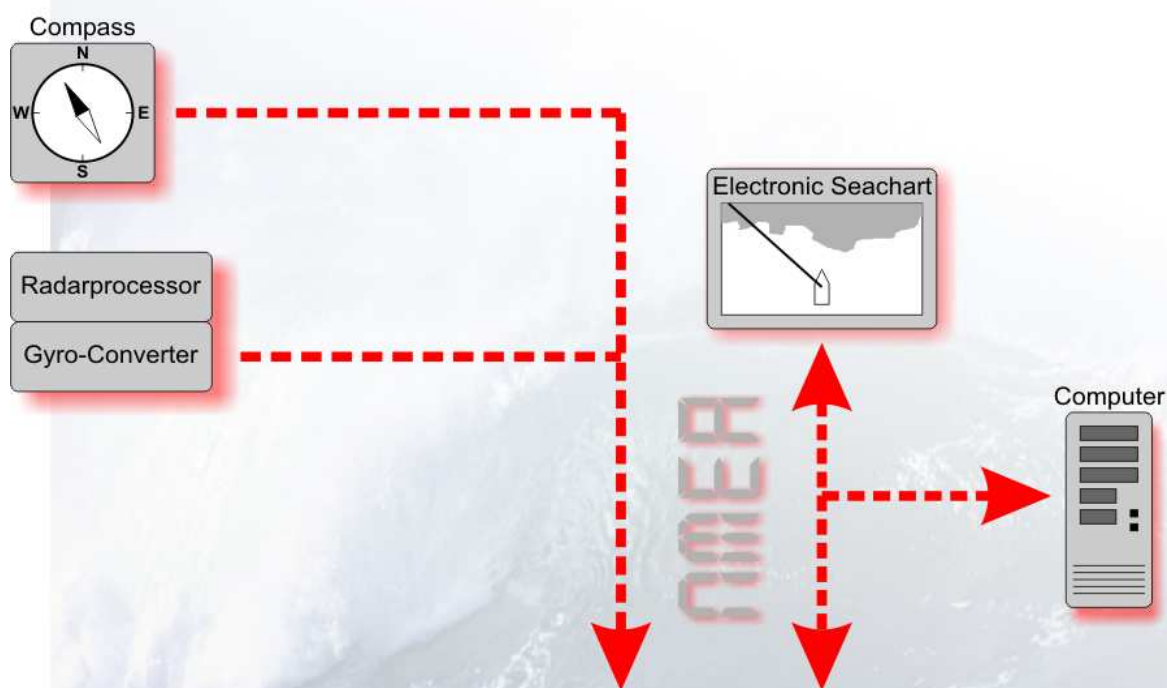
Protocol Documentation

for

RT-500-M (Marine)

4-Band Precision Direction Finder System Rhotheta

[Rev 1.12]



Edited by:

RHOTHETA Elektronik GmbH
Kemmelpark
Dr.-Ingeborg-Haeckel-Str. 2
82418 Murnau
Germany

Internet: <http://www.rhotheta.de>
eMail: email@rhotheta.de

Revision of DCU-Software: 1.80

*Copyright © by Rhotheta Elektronik GmbH
All rights reserved*

Note

The manufacturer reserves on making modifications at any time and without previous information of the here described product.

1 Change Log

Revision	Date	Changes
0.11	12.11.2008	Added SETSERIAL sentence
1.00	11.12.2008	First official release (Added several sentences; DFSTD updated)
1.01	18.12.2008	Modifications for Marine-Scan (DFSTD, MODE)
1.10	04.11.2009	Added several sentences (DFBRG, GEN, PART, REC, DCU, BAND, IVOLT, ITEMP, ISERVICE, BAUD, TALKMODE)
1.11	29.01.2010	Added sentence ALARMCFM; changed INFPART, ITEMP, IVOLT sentence
1.12	04.02.2010	Added Flag for AutoSquelch in DFSTD-sentence

Content

1	Change Log	3
2	General	6
2.1	Modes	6
2.2	Data Format	6
2.3	Interface Connection	7
2.4	Timing	7
3	Heading/Compass Input Sentences	8
3.1	HEHDT / HCHDT / xxHDT - True heading, source: Compass or Gyro	8
3.2	HEHDG / HCHDG / xxHDG - Heading, deviation and variation	8
4	Standard DF Output Sentence	9
5	Request Sentences	13
5.1	Data Request Sentences	13
5.1.1	DFSTD DF Standard Data Request	14
5.1.2	DFBRG Request for DFBRG Bearing Output (used by e.g. Taiyo...)	14
5.1.3	GEN General Info Request	15
5.1.4	PART Part Info Request	15
5.1.5	REC Receiver/AU Info Request	15
5.1.6	DCU Display Control Unit Info Request	16
5.1.7	BAND Receiver Band Info Request	16
5.1.8	VOL Volume Settings Request	16
5.1.9	IVOLT Internal Voltage Data Request	17
5.1.10	ITEMP Internal Temperature Data Request	17
5.1.11	ISERVICE Internal Service Data Request	17
5.1.12	CPSSDTA1 Cospas-Sarsat Data Request (Decoded Data)	18
5.1.13	CPSSDTA2 Cospas-Sarsat Data Request (Complete Hex-Message)	18
5.2	Data Out Sentences	19
5.2.1	DFSTD Standard DF Sentence	20
5.2.2	DFBRG DFBRG Bearing-Sentence (used by e.g. Taiyo....)	20
5.2.3	INFGEN General Info Sentence	21
5.2.4	INFPART Part Info Sentence	22
5.2.5	INFREC Receiver/AU Info Sentence	23
5.2.6	INFDCU DCU Info Sentence	24
5.2.7	INFBAND Band Info Sentence	25
5.2.8	VOL Volume Data Sentence	27
5.2.9	IVOLT Internal Voltages Data Sentence	28
5.2.10	ITEMP Internal Temperature Data Sentence	29
5.2.11	ISERVICE Internal Service Data Sentence	30
5.2.12	CPSSDTA1 Cospas-Sarsat-Data Sentence	31
5.2.13	CPSSDTA2 Cospas-Sarsat Data (Compl. HexMessage) Sentence	33
5.2.14	CMDOK Command OK	34
5.2.15	ERRCMD Command Unknown Error	34
5.2.16	ERRFIELD Field Unknown Error	34
5.2.17	ERRRANGE Field Value out of Range Rror	34
6	Control Sentences for Remote-Command Operation	35
6.1	FREQU Set Main Receiving Frequency	36
6.1.1	Receiving frequency:	36

6.1.2	Example A of a typical control sentence:.....	36
6.1.3	Example B of a typical control sentence:.....	36
6.2	SQU Set Squelch Threshold	37
6.2.1	Squelch threshold:	37
6.2.2	Example a typical control sentence:	37
6.3	MODE Set Special Operating Modes	38
6.3.1	Mode descriptor:	38
6.3.2	Condition:	38
6.3.3	Example of a typical control sentence:	38
6.4	VOL Set Volume	39
6.4.1	NF volume:.....	39
6.4.2	Reserved1:.....	39
6.4.3	Reserved2:.....	39
6.4.4	Example of a typical control sentence:	39
6.5	CPSSCFM Cospas-Sarsat Alarm Confirm	40
6.5.1	Example A of a typical control sentence:.....	40
6.6	ALARMCFM Alarm Confirm	41
6.6.1	Example A of a typical control sentence:.....	41
6.7	BAUD Set Serial Baud Rate	42
6.7.1	Baud rate number:	42
6.7.2	Example of a typical control sentence:	42
6.8	TALKMODE Set Serial Talking Mode.....	43
6.8.1	Sentence descriptor:	43
6.8.2	Talk time mode and intervall:	43
6.8.3	Example A of a typical control sentence:.....	43
6.8.4	Example B of a typical control sentence:.....	43
6.9	SETSERIAL Set Serial Number (ONLY FOR FACTORY USAGE)	44

2 General

2.1 Modes

The NMEA connectivity of the Direction Finder RT-500-M (DF) can be used for several functions:

- **External Heading/Compass Input**
is used for additional True/Mag. Bearing Indication and the Compass Card Display (see Chapter: Heading/Compass Input Sentences, Page 8)
- **Output of Standard DF Sentence**
if the DF works in Autotalk Mode (Default) one special NMEA Sentence with all relevant information of the Direction Finder is sent out cyclically with a fixed time period (see Chapter: Standard DF Output Sentence, Page 9)
- **Request Sentences**
with the Request Sentences it is possible to get (read) any information directly from the DF (see Chapter: Request Sentences, Page 13)
- **Control Mode for Remote Operation**
with special NMEA Input Sentences all Functions of the DF can be controlled remotely, like changing Frequency,... (see Chapter: Control Sentences for Remote-Command Operation, Page 35)

2.2 Data Format

This direction finder (DF) supports NMEA 0183 as communication method. The DF is compatible to NMEA 0183 Version 3.01 Standard (including galvanic isolation at the listener side).

Data RX/TX parameters:

- Supported baud rates: 1200; 4800; 9600; 19200; 38400; 57600; 115200;
(4800 = NMEA 0183)
(38400 = NMEA High Speed Standard)
- Data bits: 8
- Parity: None
- Stop bits: 1

Baud rate of DF is selectable in Menu: Interface / NMEA Baudrate. We recommend to use 4800 or 38400 to be compatible with NMEA0183 or either NMEA0183HS.

2.3 Interface Connection

There are 2 possible Interface Connections:

- RS232 Level (standard Computer Levels)
- RS422 Level (standard NMEA)

(for more information see: [User Manual](#) Chapter ➔ Interfaces and Installation)

2.4 Timing

No special timing requirements are necessary. In normal operation Input and Output are independent from each other (asynchronous).

3 Heading/Compass Input Sentences

These approved NMEA0183 sentences are used to tell the DF the actual heading from an external compass, gyro or GPS. The external heading can be used as magnetically or true heading reference.

To use one of these sentences for heading/compass input, you have to select one item at the DF Setup Menu: Interface / Compass source. The heading input timeout is 2 sec, so within this timespan there has to be a minimum of one heading NMEA sentence available, otherwise a warning is displayed and the relative bearing (no more true/magn. bearing) is used.

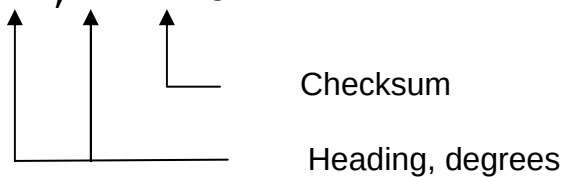
For more detailed structure of approved sentences please refer to the original NMEA0183 documentation. More NMEA heading sentences are available upon user request.

If xxHDT or xxHDG is selected in the DF menu, the first two characters of HDG/HDT sentence are ignored and the sentence is processed (except for HE or HC prefix).

3.1 HEHDT / HCHDT / xxHDT - True heading, source: Compass or Gyro

\$HEHDT, x.x, T*hh<CR><LF>

\$HCHDT, x.x, T*hh<CR><LF>



Example:

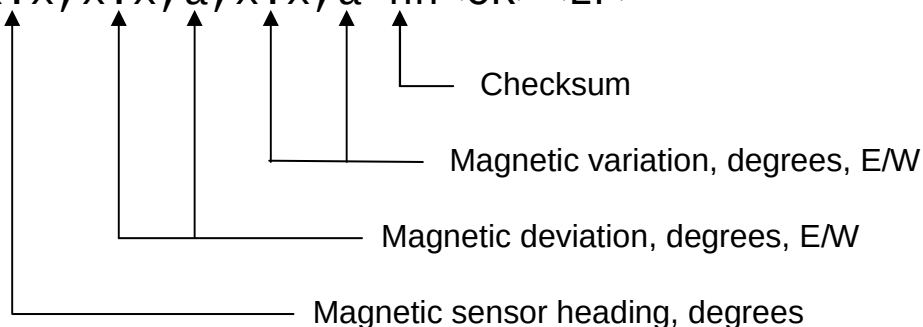
\$HEHDT, 316.4, T*2F<CR><LF>

\$ABHDT, 320.2, T*22<CR><LF>

3.2 HEHDG / HCHDG / xxHDG - Heading, deviation and variation

\$HEHDG, x.x, x.x, a, x.x, a*hh<CR><LF>

\$HCHDG, x.x, x.x, a, x.x, a*hh<CR><LF>



Example:

\$HCHDG, 25.4, , , 1.5, E*1E<CR><LF>

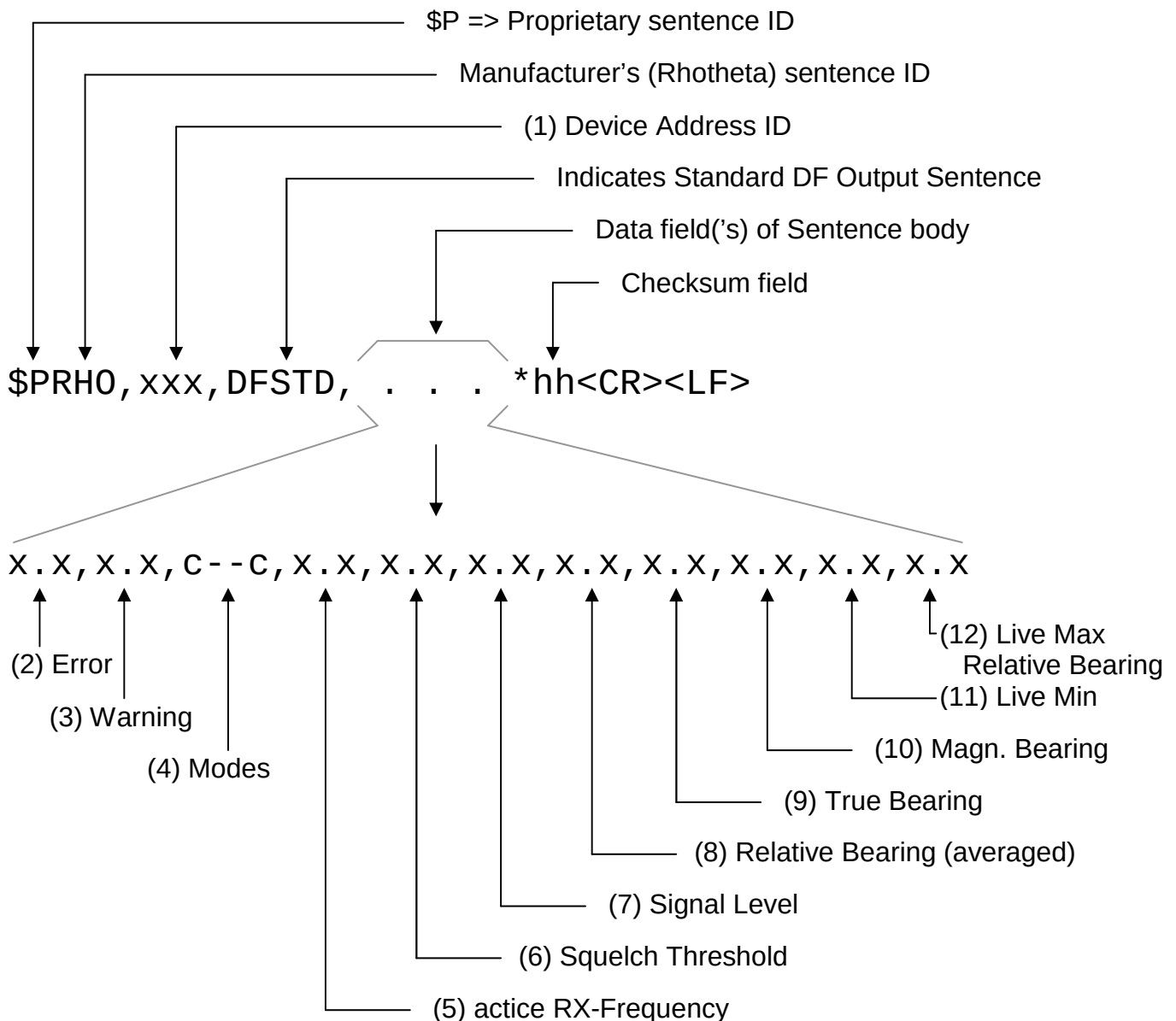
\$HCHDG, 107, 4.0, W, 1.2, E*4F<CR><LF>

4 Standard DF Output Sentence

If the DF works in Autotalk Mode (Default) one special NMEA Sentence with all relevant information of the direction finder is sent out cyclically with a fixed time period. The time period of this continuous data output can be selected in the DF Menu: Interface / NMEA Mode in the range from 250ms ... 2sec.

The data out is handled by a proprietary NMEA 0183 sentence. The data sentence body consists always of the following elements:

(a Nullfield in the sentence body means, there is no value available)



(1) **Device Address ID:** [0...99]

the device specific address of the DF (default = 0).

This address can be adjusted at the DF Menu: System / Address ID.

(2) **Error:** [0...99]

the error no. with the highest priority / 0 = No Error = Device Ok.

(see User Manual of RT-500-M: Appendix / Error messages)

(3) **Warning:** [0...99]

the warning no. with the highest priority / 0 = No Warning.

(see User Manual of RT-500-M: Appendix / Warnings)

(4) **Modes:**

The modes field can contain a set of 0...5 characters, each indicating an operation-mode or status of the device:

"M" Monitoring-Mode is active
 "A" Standby-SAR-Mode is active
 "L" Standby-PLB-Mode is active
 "P" Cospas-Sarsat-Scan-Mode is active
 "C" Cospas-Sarsat-Decoding-Mode is active
 "F" Fast Marine-Scan at Marine-Band is active

"U" Alarm Elt (Plb)
 "V" Alarm Cospas-Sarsat
 "D" RT-BID available (future use)
 "I" Cospas-Sarsat data available
 "Q" AutoSquelch is active in the Main-Band

For example „MU“ means that *Monitoring* is active and *Alarm Elt/Plb* is active.

Remark: If "MP" or "AP" is indicated, Monitoring resp. StandbySAR with Cospas-Sarsat as main frequency was selected!

(5) **Active RX-Frequency:** [118.000 ... 409.975]

Current receiving frequency in MHz.

"121.500" means a current receiving frequency of 121.500 MHz

(6) **Squelch Threshold:** [0...60]

Receiver squelch threshold in %.

- signal level > squelch threshold → Receiving
- signal level < squelch threshold → No Receiving

(7) **Signal Level:** [0...100]

Receiver signal Level in %. "31" means a signal level of 31%

(8) **Relative Bearing (averaged):** [Nullfield, or 0...359]

Relative bearing field contains the actual bearing in degrees. "270" means a relative (reference is the ship bow) bearing of 270 degrees (= backboard)

(9) **True Bearing:** [Nullfield, or 0...359]

The true bearing field contains the bearing in degrees.

"45" means a absolute (reference is true north) bearing of 45 degrees (= NE).

This field is only available if the correct compass source is selected and a true Heading Compass/Gyro NMEA sentence is also detected.

(10) **Magn. Bearing:** [Nullfield, or 0...359]

The Magnetic Bearing field contains the bearing in degrees.

"62" means a absolute (reference is magnetic north) bearing of 62 degrees.

(11) **Relative Bearing Live Values:** [Nullfields, or 0...359]

(12) The relative live bearing field contains the max/min bearing in degrees without averaging. The relative live bearing reacts faster than the normal relative bearing, but it has not the precision of the averaged bearing.

The Min/Max Bearing Values are calculated within a time period of approx. 300ms. If they are very close together (for example "124" and "128" degrees), then the signal quality is quite good. A wide span of the min/max values (for example "97" and "162") shows very noisy, but nevertheless bearable signal quality.

Examples of DFSTD Sentences:

```
$PRHO,0,DFSTD,0,0,,121.500,32,28,,,,*hh<CR><LF>
```

0	> Device address is 0 (default)
No error, no warning	> Device is ok
Mode Nullfield	> No special mode is active
121.500	> receiving frequency is 121.500 MHz
32	> Squelch threshold is 32%
28	> Signal level is 28%
Empty bearing fields	> No bearing present

This example shows a standard operation on 121.500MHz where the signal is under the squelch threshold and therefore is no bearing present.

```
$PRHO,40,DFSTD,0,0,,243.000,25,86,32,135,,51,73*hh<CR><LF>
```

40	> Device Address is 40
No error, No warning	> Device is ok
Empty mode field	> No special mode is active
243.000	> receiving frequency is 243.000 MHz
25	> Squelch threshold is 25
86	> Signal level is 86% (very strong signal)

32	> Relative averaged bearing is 32 degrees
135	> Absolute true bearing is 135 degrees (= SE)
Nullfield	
51,73	> Relative live max bearing values within the last 300ms

This example shows a standard operation on 243.000MHz where the signal is over the squelch threshold. A relative and true bearing is present. The signal level is 86% and that is close to 100%, therefore the transmitter is not far away.

5 Request Sentences

5.1 Data Request Sentences

With special NMEA Input Sentences a couple information of the DF can be queried remotely. Requesting information remotely of the DF is handled by a set of proprietary NMEA 0183 sentences. The request - sentence body consists always of the following elements:

\$PRHO,xxx,R,C-C, . . . *hh<CR><LF>

- Checksum field
- Type of the data request
- Indicates type of control sentence
- Indicates a control sentence
- Device Address ID
- Manufacturer mnemonic code
- Proprietary sentence identifier

The DF only reacts to the request sentences if the Address ID in the sentence is 255 or is equal to the one selected in the DF setup Menu: System / Address ID. So the address allows to access different DF's connected to one TX. c—c is a variable text field, which describes the type of data in this sentence.

5.1.1 DFSTD DF Standard Data Request

\$PRHO, xxx, R, DFSTD*hh<CR><LF>

This sentence requests standard DF data.

Standard DF data contains:

- Error code
- Warning code
- Mode of operation
- RX-frequency
- Squelch threshold
- Signal level
- Relative bearing
- Absolute bearing true reference
- Absolute bearing magn reference
- Relative “live” bearing (without averaging)

The answer to this request sentence is described in chapter 4.

5.1.2 DFBRG Request for DFBRG Bearing Output (used by e.g. Taiyo...)

\$PRHO, xxx, R, DFBRG*hh<CR><LF>

This sentence requests standard DFBRG sentence, which is us for example by Taiyo and other direction finders.

DFBRG data contains:

- RX-frequency
- Bearing value
- Indicator, if bearing value is absolut/relative
- Status of the bearing

The answer to this request sentence is described in chapter 5.2.2.

NOTE: This sentence could be selected in the DF-Menu instead of DFSTD for standard bearing output!

5.1.3 GEN General Info Request

\$PRHO, xxx, R, GEN*hh<CR><LF>

This sentence requests a general info.

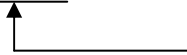
General Info contains:

- Type of Device
- Device Family
- Name of Device Parts

The answer to this request sentence is described in Chapter 5.2.3

5.1.4 PART Part Info Request

\$PRHO, xxx, R, PART, c - - c*hh<CR><LF>



This sentence requests a general part info.

Allowed part names are:

- AU (Antenna unit)
- DCU (Display control unit)

Device info contains:

- Variant
- Serial. no.
- System state
- Software revision

The answer to this request sentence is described in chapter 5.2.4

5.1.5 REC Receiver/AU Info Request

\$PRHO, xxx, R, REC*hh<CR><LF>

This sentence requests a general receiver info.

Receiver Info contains:

- Number of receiving bands included
- Possible demodulation types
- Receiver channel spacing
- Onboard compass available

The answer to this request sentence is described in chapter 5.2.5

5.1.6 DCU Display Control Unit Info Request

\$PRHO, xxx, R, DCU*hh<CR><LF>

This sentence requests a general receiver info.

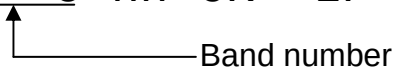
Receiver info contains:

- "Scan Mode" available
- "Only ELT" available
-

The answer to this request sentence is described in chapter 5.2.6

5.1.7 BAND Receiver Band Info Request

\$PRHO, xxx, R, BAND, c - - c*hh<CR><LF>

Band number

This sentence requests a general receiving band info.

For the standard RT-500-M following band numbers are available:

- 0
- 1
- 2
- 3

Band info contains:

- Default demodulation in this band
- Band start frequency
- Band stop frequency
- Band default frequency
- Flag: Band includes an emergency frequency
- Channel-spacing if the band

The answer to this request sentence is described in chapter 5.2.7

5.1.8 VOL Volume Settings Request

\$PRHO, xxx, R, VOL*hh<CR><LF>

This sentence requests volume settings.

Volume settings contain:

- NF volume (speaker volume)

The answer to this request sentence is described in chapter 5.2.8

5.1.9 IVOLT Internal Voltage Data Request

\$PRHO, xxx, R, IVOLT*hh<CR><LF>

This sentence requests the voltage data's.

The answer to this request sentence is described in chapter 5.2.9

5.1.10 ITEMP Internal Temperature Data Request

\$PRHO, xxx, R, ITEMP*hh<CR><LF>

This sentence requests the temperature data.

The answer to this request sentence is described in chapter 5.2.10

5.1.11 ISERVICE Internal Service Data Request

\$PRHO, xxx, R, ISERVICE*hh<CR><LF>

This sentence requests the internal service data.

The answer to this request sentence is described in chapter 5.2.11

5.1.12 CPSSDTA1 Cospas-Sarsat Data Request (Decoded Data)

\$PRHO, xxx, R, CPSSDTA1*hh<CR><LF>

This sentence requests the Cospas-Sarsat-Data, if a pulse was received and decoded successfully (indicated by "I" identifier in the mode field of DFSTD sentence)

Cospas-Sarsat-Data contains:

- Beacon-Identification 15hex or MSSl
- Country-Code
- Frame-Identifier
- Protocol Identifier
- GPS-Position, if available

The answer to this request sentence is described in chapter 5.2.9

5.1.13 CPSSDTA2 Cospas-Sarsat Data Request (Complete Hex-Message)

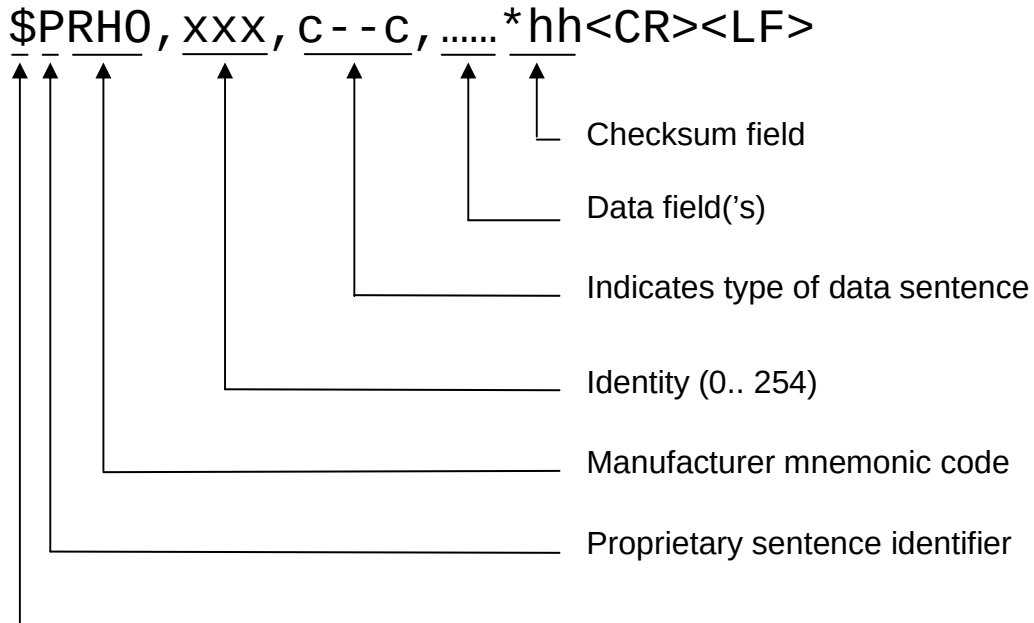
\$PRHO, xxx, R, CPSSDTA2*hh<CR><LF>

This sentence requests the complete Cospas-Sarsat HexMessage, if a pulse was received and decoded successfully (indicated by "I" identifier in the Mode-Field of DFSTD sentence)

The answer to this request sentence is described in chapter 5.2.13

5.2 Data Out Sentences

Data out of the DF is handled by a proprietary NMEA 0183 sentence. For most data a set of data-out sentences were created. Data-out sentences are sent out in reaction to data request sentences. The data out sentence body consists always of the following elements:



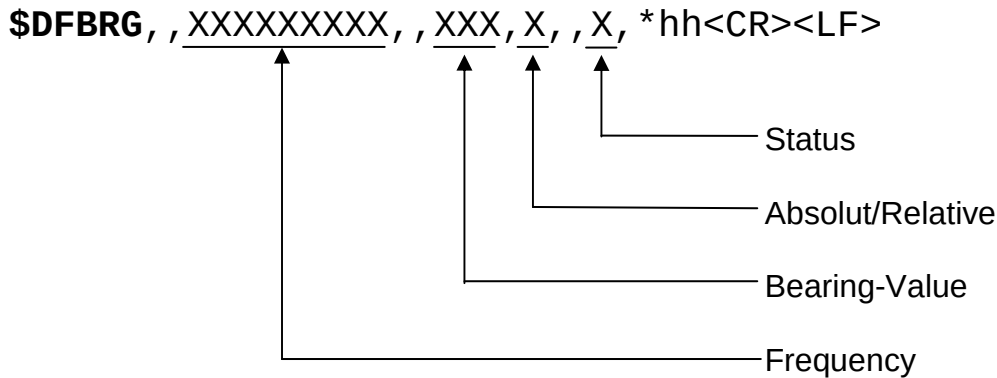
xxx is an identity field of numeric characters. The value is in the range of 0 to 254. The used format is without leading zeros. All data out from the DF is marked with the identity selected in setup. So the identity allows to separate data from different DF's connected to one RX.

c—c is a variable text field, which describes the type of data in this sentence.

5.2.1 DFSTD Standard DF Sentence

See page Chapter 4 on page 9!

5.2.2 DFBRG DFBRG Bearing-Sentence (used by e.g. Taiyo.....)



5.2.2.1 Frequency:

Receiving frequency in Hz

5.2.2.2 Bearing Value:

Current bearing value in degrees or empty field, if no signal is present.

5.2.2.3 Indicator for Absolut/Relativ-Bearing:

- 'A' bearing value is absolute (external Compass is connected).
- 'R' bearing value is relative (no external Compass connected or no compass signal is present)

5.2.2.4 Status:

- 'A' Bearing value is VALID.
- 'V' bearing value is INVALID

5.2.2.5 Example A of a DFBRG output:

\$DFBRG, , 121500000, , 145, R, , A*hh<CR><LF>

The bearing of 145° on the frequency 121.500MHz is relative and valid.

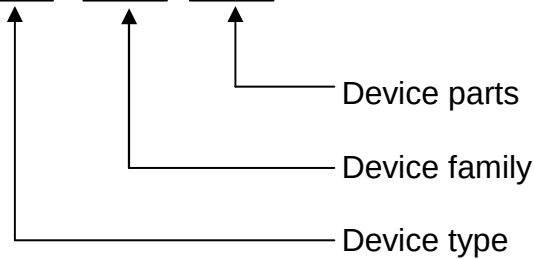
5.2.2.6 Example B of a DFBRG output:

\$DFBRG, , 121650000, , , A, , V*hh<CR><LF>

At the receiving Frequency 121.650 MHz no bearing signal is present (Bearing invalid). Data is received from external compass source.

5.2.3 INFGEN General Info Sentence

\$PRHO, xxx, INFGEN, c - - c, c - - c, c - - c*hh<CR><LF>



5.2.3.1 Device type:

For the RT-500-M the device Type is “DF” (for direction finder)

5.2.3.2 Device family:

The device family is “RT-500-M”

5.2.3.3 Device parts:

The different parts in the device are separated with a semicolon

For the default RT-500-M the output will be “DCU;AU”.

DCU = Display Control Unit

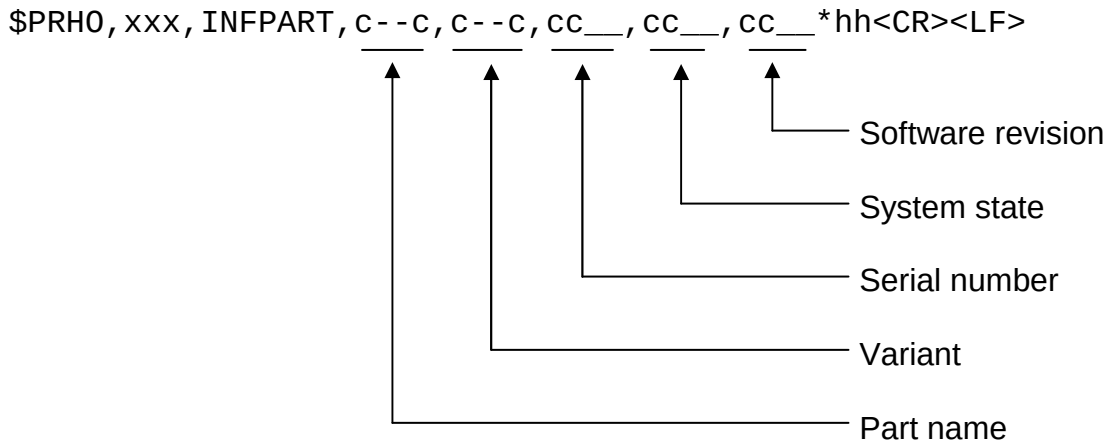
AU = Antenna Unit

5.2.3.4 Example A of a DF output:

\$PRHO, xxx, INFGEN, DF, RT-500-M, DCU;AU*hh<CR><LF>

It means that this device is a direction finder of the RT-500-M family, which consists of a display control unit and an antenna unit.

5.2.4 INFPART Part Info Sentence



5.2.4.1 Part name:

For the standard RT-500-M the part name is either “DCU or AU” (For compatibility, ‘REC’ could also be used for ‘AU’)

5.2.4.2 Variant:

For the DCU is up to now only the standard variant “A” defined.
The antenna unit is up to now available in the following variants:

- “A” Standard

5.2.4.3 Serial number:

The serial number is a fixed field of 7 valid characters and looks normally “05.3234”.

5.2.4.4 System state:

Empty Field (not available at RT-500-M).

5.2.4.5 Software revision:

The software revision is a fixed field of 5 valid characters and looks normally “01.02”.

5.2.4.6 Example A of a DF output:

\$PRH0, xxx, INFPART, DCU, A, 03.2345, , 02.11<CR><LF>

It means the DCU part of the DF is a standard variant with serial: 03.2345 and software revision 02.11.

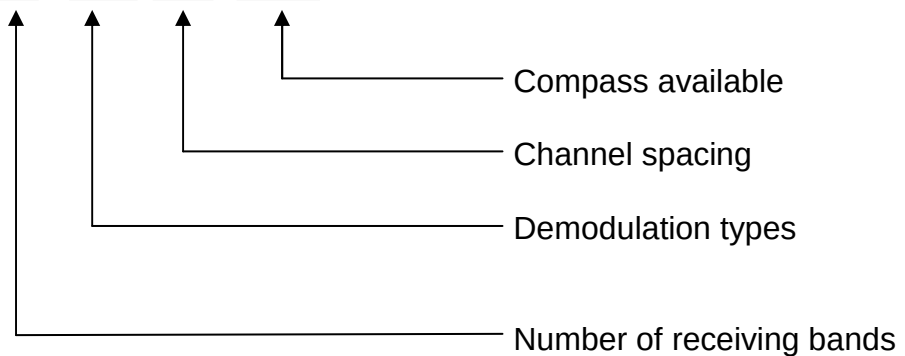
5.2.4.7 Example B of a DF output:

\$PRH0, xxx, INFPART, AU, A, 01.2345, , 01.11<CR><LF>

It means the AU part of the DF is a ‘A’ (Standard) variant with serial: 01.2345 and software revision 01.11.

5.2.5 INFREC Receiver/AU Info Sentence

\$PRHO,xxx,INFREC,x.x,c--c,x.x,cc_*hh<CR><LF>



5.2.5.1 Number of receiving bands:

For the standard RT-500-M the number of available receiving bands is “4”.

5.2.5.2 Demodulation types:

The possible demodulation types are separated with a semicolon.

Up to now the following demodulation types are defined:

- FM
- AM
- CW
- FSK
- ASK
- PM

The typical output for a receiver variant VS is “AM;FM”

5.2.5.3 Channel Spacing:

Empty field: this field is not used at RT-500-M -> See channel spacing field of INFBAND sentence!

5.2.5.4 Compass available:

If this field is empty, there is no compass installed. (Standard for RT-500-M)

If field contains “A” means, there is a compass installed.

5.2.5.5 Example of a DF output:

\$PRHO,xxx,INFREC,4,AM;FM,,*hh<CR><LF>

It means the receiver has 2 receiving bands. AM and FM demodulation is possible. No internal compass installed.

5.2.6 INFDCU DCU Info Sentence

\$PRHO, xxx, INFDCU, c - - c* hh<CR><LF>

↑
Available modes (features)

5.2.6.1 Special mode types (features):

The possible mode types are separated with a semicolon.

Up to now the following mode types are defined:

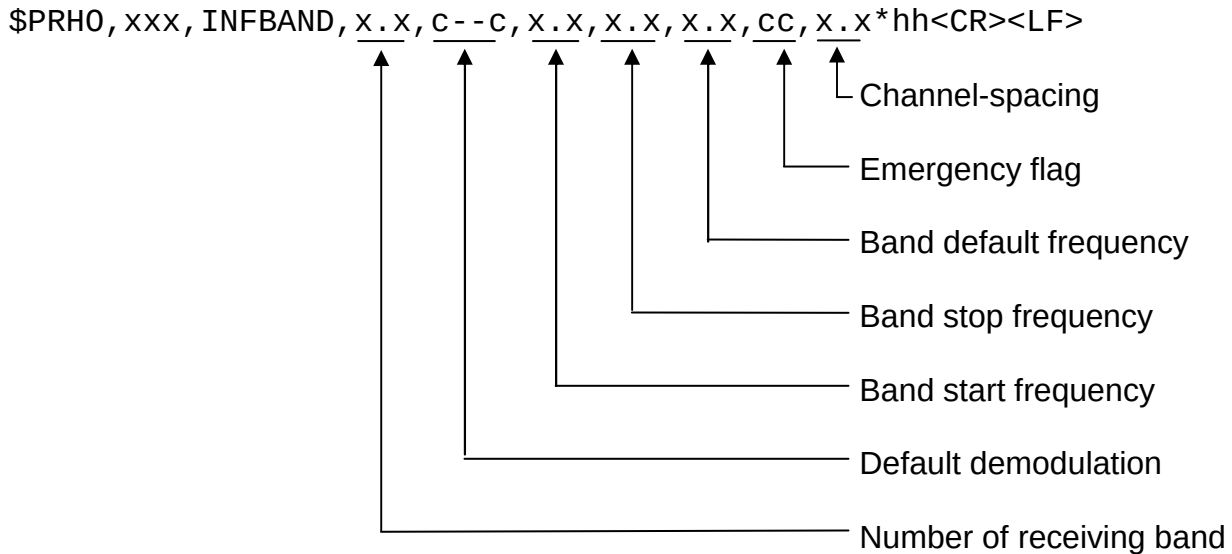
- "M" Monitoring mode
- "A" Standby SAR
- „L“ Standby PLB
- „P“ COSPAS/SARSAT Scan-Mode
- "C" COSPAS/SARSAT Decoding-Mode
- "D" Decoding of digital BeaconID-Data

5.2.6.2 Example A of a DF output:

\$PRHO, xxx, INFDCU, M; A; L; P; C<CR><LF>

It means the DCU has monitoring mode, standby-SAR-mode, standby-PLB-mode, COSPAS/SARSAT Scan- and Decoding mode.

5.2.7 INFBAND Band Info Sentence



5.2.7.1 Number of receiving band:

For the standard RT-500-M the possible numbers of the receiving bands are:

'0...3': Band 0 ... Band 3

5.2.7.2 Default demodulation:

The default demodulation type in this band.

Up to now the following demodulation types are defined (not implemented):

- FM
- AM
- CW
- FSK
- ASK

5.2.7.3 Band start frequency:

Start frequency of this band in MHz. (e.g. 118.000)

5.2.7.4 Band stop frequency:

Stop frequency of this band in MHz.

5.2.7.5 Band default frequency:

Default frequency of this band in MHz.

5.2.7.6 Emergency flag:

Empty field – This field is not used at RT-500-M

5.2.7.7 Channel Spacing:

The channel spacing if this band in kHz (e.g. '8.333' or '25')

5.2.7.8 Example A of a DF output:

```
$PRH0,xxx,INFBAND,0,AM,118.000,124.000,121.500,,8.333*hh<CR><LF>
```

The receiver band 0 uses AM demodulation. The band range is 118 MHz to 124 MHz and the default frequency 121.500 MHz. Channel spacing is 8.333 kHz.

5.2.7.9 Example B of a DF output:

```
$PRH0,xxx,INFBAND,1,FM,156.000,162.000,156.800,,5.000*hh<CR><LF>
```

The receiver 1 band uses FM demodulation. The band range is 156 MHz to 162 MHz and the default frequency 156.800 MHz. Channel spacing is 5 kHz.

5.2.8 VOL Volume Data Sentence

\$PRH0, xxx, VOL, xxx, xxx, xxx*hh<CR><LF>

Diagram illustrating the structure of the VOL sentence fields:

- NF volume**: Points to the first xxx field.
- reserved1**: Points to the second xxx field.
- reserved2**: Points to the third xxx field.

- 5.2.8.1 Volume:**
NF (speaker) volume in the range from 0% to 100%. (0% volume means that NF volume is muted!)
- 5.2.8.2 reserved1:**
Reserved for future use.
- 5.2.8.3 reserved2:**
Reserved for future use.

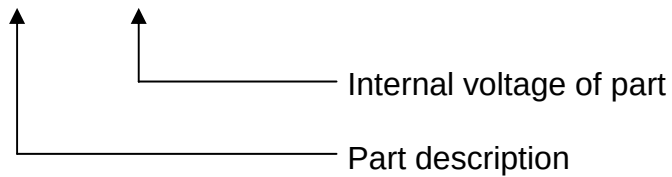
5.2.8.4 Example A of a DF output:

\$PRH0, xxx, VOL, 70, , *hh<CR><LF>

NF volume -> 70%

5.2.9 IVOLT Internal Voltages Data Sentence

\$PRHO, xxx, IVOLT, c - - c, x . x*hh<CR><LF>



Up to 8 parts are allowed in this sentence.

5.2.9.1 Part description:

For the standard RT-500-M the only part name is "AU".

5.2.9.2 Internal voltage of part :

The internal voltage of the part in volt.

"14.8" means 14.8 Volt

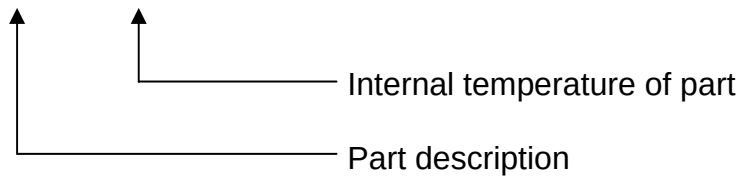
5.2.9.3 Example A of a DF output:

\$PRHO, xxx, IVOLT, AU, 12 . 8*hh<CR><LF>

It means that the AU has an input voltage of 12.8 Volt.

5.2.10 ITEMP Internal Temperature Data Sentence

\$PRHO, xxx, ITEMP, c - - c, x . x*hh<CR><LF>



Up to 8 parts are allowed in this sentence.

5.2.10.1 Part description:

For the standard RT-500-M the only part name is "AU".

5.2.10.2 Internal Temperature of part :

The internal Temperature of the part in degree Celsius (°C).
"30.5" means 30.5 °C.

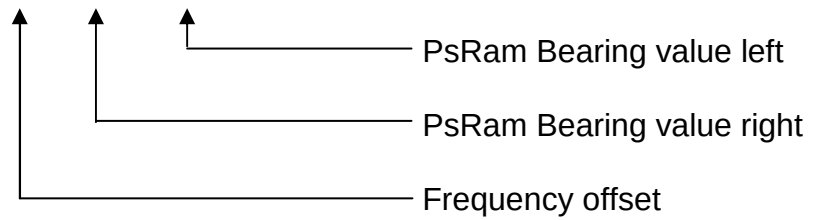
5.2.10.3 Example A of a DF output:

\$PRHO, xxx, ITEMP, AU, 25 . 3*hh<CR><LF>

It means that the AU has an internal Temperature of 25.3 °C.

5.2.11 ISERVICE Internal Service Data Sentence

\$PRH0, xxx, ISERVICE, xx, xxx, xxx*hh<CR><LF>



5.2.11.1 Frequency Offset:

Frequency offset of received Transmitter (service value for RHOTHETA internal use)

Valid Range: [-99...+99] (depends on AFC On/Off Mode)

5.2.11.2 PsRam Bearing value right:

(service value for RHOTHETA internal use)

Valid Range: [0...179] (2° quant); [255] = invalid

5.2.11.3 PsRam Bearing value left:

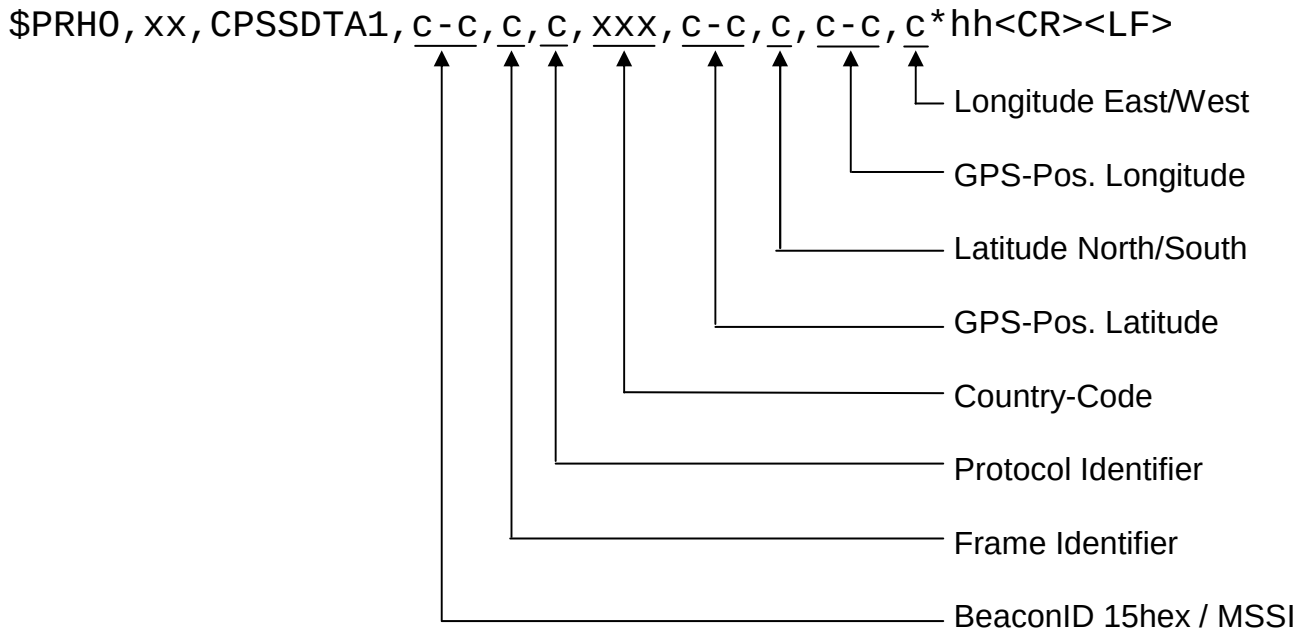
(service value for RHOTHETA internal use)

Valid Range: [0...179] (2° quant); [255] = invalid

5.2.11.4 Example A of a DF output:

\$PRH0, xxx, ISERVICE, -25, 55, 255*hh<CR><LF>

5.2.12 CPSSDTA1 Cospas-Sarsat-Data Sentence



5.2.12.1 BeaconID 15hex / MSSl:

The ID of the beacon displayed in HEX-bytes. If MSSl was decoded, the MSSl is displayed in clear text. (BeaconID15hex has always 15 hex-digits!) Nullfield, if no data available or checksum error.

5.2.12.2 Frame Identifier:

“S” : Synchronisation Selftest
 “O” : Synchronisation Normal OK

 “Z” Invalid data (or no data available)

5.2.12.3 Protocol Identifier:

“U” User protocol
 “S” Standard protocol
 “N” National protocol
 “T” User Test protocol
 “A” Standard Test protocol
 “O” National Test protocol

 “Z” Invalid data (or no data available)

5.2.12.4 Country Code:

Country code of the beacon (“0”, if no data available or checksum error!)

5.2.12.5 GPS-Pos. Latitude:

Latitude of the GPS-Position, if available (if not, nullfield).
Format-Example: "4807.038", means latitude 48°07.038'
"0131.983", means latitude 1°31.983'

5.2.12.6 Latitude North/South:

"N" North, "S" South (if GPS-Position not available, nullfield)

5.2.12.7 GPS-Pos. Longitude:

Latitude of the GPS-Position, if available (if not, nullfield).
Format-Example: "01131.000", means longitude 11° 31.000'
"00129.250", means longitude 1°29.250'

5.2.12.8 Longitude East/West:

"E" East, "W" West (if GPS-Position not available, nullfield)

5.2.12.9 Example A of a DF output:

```
$PRH0,xxx,CPSSDTA1,ADDF00625800AF7,0,U,366,4807.038,N,01131.000,E*hh<CR><LF>
```

BeaconID 15hex/MSSI	ADDF00625800AF7 (BeaconID 15hex)
Synchronisation	Normal OK
Protocol	User Protocol
Country Code	366 (United States)
GPS-Pos. Latitude	48°07.038' North
GPS-Pos. Longitude	11°31.000' East

5.2.12.10 Example B of a DF output:

```
$PRH0,xxx,CPSSDTA1,238456-5,0,N,366,,,,*hh<CR><LF>
```

BeaconID 15hex/MSSI	238456-5 (MSSI)
Synchronisation	Normal OK
Protocol	National Protocol
Country Code	358 (Puerto Rico)
GPS-Pos. Latitude	No GPS-Position
GPS-Pos. Longitude	No GPS-Position

5.2.13 CPSSDTA2 Cospas-Sarsat Data (Compl. HexMessage) Sentence

\$PRH0,xxx,CPSSDTA2,c-c,*hh<CR><LF>

↑
Complete Hex Message

5.2.13.1 Complete Hex Message:

Entire Beacon-Message, display in HEX-bytes.

If message is short-message, the hex bytes for the long message contain "-----"

5.2.13.2 Example of a DF output:

\$PRH0,xxx,CPSSDTA2,56EF80312C0057B8CC3290-----
*hh<CR><LF>

Complete Hex Message 56EF80312C0057B8CC3290 (short message)

5.2.14 CMDOK Command OK

\$PRH0, xxx, CMDOK*hh<CR><LF>

The requested operation finished successfully.

5.2.15 ERRCMD Command Unknown Error

\$PRH0, xxx, ERRCMD*hh<CR><LF>

This sentence is the answer to an unknown request or control sentence.

5.2.16 ERRFIELD Field Unknown Error

\$PRH0, xxx, ERRFIELD*hh<CR><LF>

This sentence is the answer to an unknown field descriptor in a known sentence.

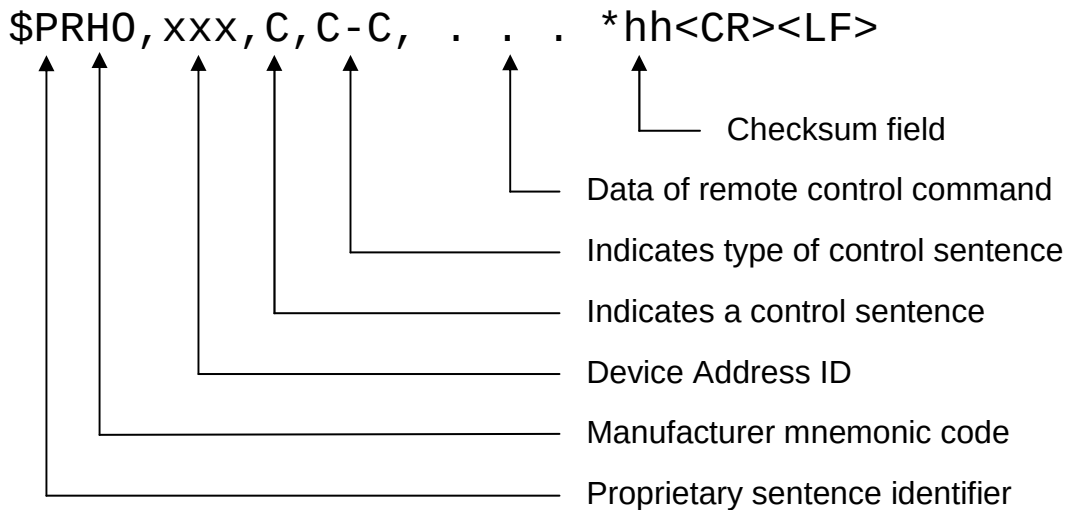
5.2.17 ERRRANGE Field Value out of Range Error

\$PRH0, xxx, ERRRANGE*hh<CR><LF>

This sentence is the answer to a value field, which is out of range or not in the right spacing.

6 Control Sentences for Remote-Command Operation

With special NMEA Input Sentences all functions of the DF can be controlled remotely. Remote control of the DF is handled by a set of proprietary NMEA 0183 sentences. The control sentence body consists always of the following elements:



The DF only reacts to the control sentences if the address ID in the sentence is 255 or is equal to the one selected in the DF setup Menu: System / Address ID. So the address allows to access different DF's connected to one TX. c—c is a variable text field, which describes the type of data in this sentence.

6.1 FREQU Set Main Receiving Frequency

This sentence sets the current main receiving frequency.

`$PRHO, xxx, C, FREQU, x.x*hh<CR><LF>`

Diagram illustrating the structure of the \$PRHO sentence:

- `xxx`: Device Address ID (see Page 12)
- `x.x*hh`: Main Receiving Frequency

The answer to a successful FREQU command will be the DFSTD sentence, which is described in chapter 4.

If the operation was not successful, the answer is one of the three error sentences ERRCMD(5.2.15), ERRFIELD(5.2.16) or ERRRANGE (5.2.17) .

CAUTION:

- DFSTD-Sentence contains the *old* frequency for approx. 600ms due to frequency change -> New Frequency can be checked by DFSTD-Request after 600ms!
- FREQU – Command activates Autosquelch, if new frequency is in VHF-Marineband or Cospas-Sarsat-Band

6.1.1 Receiving frequency:

This field contains the receiving frequency in MHz. “121.500” means a frequency of 121.500MHz. If the frequency is not a multiple of the receiver channel spacing, the nearest receiving frequency will be set as new receiving frequency.

6.1.2 Example A of a typical control sentence:

`$PRHO, xxx, C, FREQU, 121.650*hh<CR><LF>`

The new receiving frequency will be 121.650MHz

6.1.3 Example B of a typical control sentence:

`$PRHO, xxx, C, FREQU, 121.510*hh<CR><LF>`

The new frequency is not available, cause the receiver channel spacing is 25kHz. Therefore the new receiving frequency is 121.500MHz.

Band	Frequency Range in MHz		
VHF Civil Airband:	118.000	...	123.975
VHF Marineband:	156.000	...	162.025
UHF Military Airband:	240.000	...	245.975
Cospas/Sarsat:	400.000	...	409.975

6.2 SQU Set Squelch Threshold

This sentence sets the squelch threshold in the current main receiving band.

\$PRHO, xxx, C, SQU, xx*hh<CR><LF>

↑
_____ squelch threshold

The answer to a successful SQU command will be the DFSTD sentence, which is described in chapter 4.

If the operation was not successful, the answer is one of the three error sentences ERRCMD(5.2.15), ERRFIELD(5.2.16) or ERRRANGE (5.2.17) .

6.2.1 Squelch threshold:

This field contains the squelch threshold in %. "32" means a squelch threshold of 32%. If the field value is not in the range from 0 to 60%, the ERRRANGE (5.2.17) sentence will be the answer instead of the DFSTD sentence.

To activate the Auto-Squelch, set the Squelch threshold to "255"!

CAUTION:

- DFSTD-Sentence contains the *old* squelch value for approx. 600ms due to frequency change -> New squelch level can be checked by DFSTD-Request after 600ms!
- If Cospas-Sarsat-Scanning is active, squelch can not be changed (Autosquelch remains activated)!
- If Autosquelch is activated, the current squelch level (controlled by DCU) is written in the DFSTD sentence as squelch level (not 255)!

6.2.2 Example a typical control sentence:

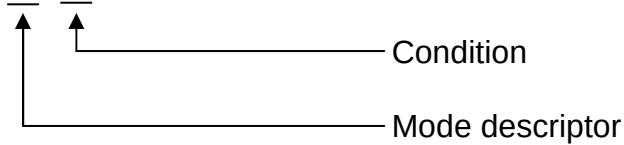
\$PRHO, xxx, C, SQU, 35*hh<CR><LF>

The new squelch threshold will be 35 %

6.3 MODE Set Special Operating Modes

This sentence sets the special operating modes.

\$PRHO, xxx, C, MODE, c, c*hh<CR><LF>



The answer to a successful MODE command will be the DFSTD sentence, which is described in chapter 4.

If the operation was not successful, the answer is one of the three error sentences ERRCMD (5.2.15), ERRFIELD(5.2.16) or ERRRANGE (5.2.17) .

6.3.1 Mode descriptor:

Following modes are defined:

- “M” Monitoring Mode
- “A” Standby-SAR Mode
- “L” Standby-PLB
- “P” Cospas-Sarsat Scan Mode (Main-Frequency is set to 406.000, squelch-level to “Auto-Squelch” and Scan Mode starts)
- “C” Cospas-Sarsat Decoding Mode (if current frequency is not in Cospas-Sarsat band then the frequency found by last Cospas-Sarsat-Scan is set)
- “F” Fast-Scanning of Marine-Band

REMARK:

- If an Error- or Alarm-Flag is set (see description of mode field of DFSTD sentence in chapter 4) Standby-SAR and – PLB – Modes can not be set. (The result is an ERRRANGE sentence)
- If the DF doesn't support the required special mode, the answer will be the ERRFIELD sentence (Chapter: 5.2.16)
- Monitoring can be switched off remotely in spite of having set “Monitoring/Off blocked” in the system menu!

6.3.2 Condition:

- “A” Activation
- “C” Deactivation (cancelling)

For activation of a special mode, this field must contain an “A”, and for deactivation a “C”.

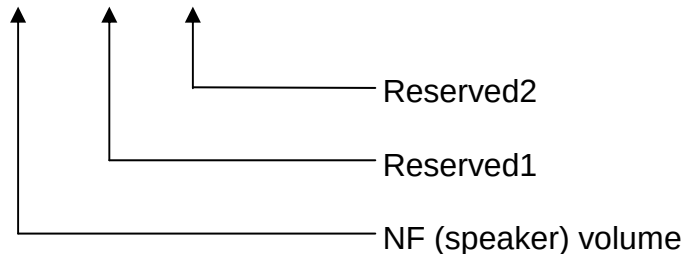
6.3.3 Example of a typical control sentence:

\$PRHO, xxx, C, MODE, M, A*hh<CR><LF>

This sentence will activate the Monitoring-Mode.

6.4 VOL Set Volume

\$PRH0, xxx, C, VOL, x.x, x.x, x.x*hh<CR><LF>



The answer to a successful VOL command will be the VOL sentence, which is described in chapter 5.2.8.

If the operation was not successful, the answer is one of the three error sentences ERRCMD(5.2.15), ERRFIELD(5.2.16) or ERRRANGE (5.2.17) .

6.4.1 NF volume:

NF volume in the range from 10% to 100%. If the value is not in the right spacing, the nearest possible value will be set as new value. If the field value is not in the range from 10 to 100%, the ERRRANGE (chapter: 5.2.17) sentence will be the answer instead of the VOL sentence.

To activate NF-muting, set the volume value to "0"!

6.4.2 Reserved1:

Reserved for future use.

6.4.3 Reserved2:

Reserved for future use.

6.4.4 Example of a typical control sentence:

\$PRH0, xxx, C, VOL, 80, , *hh<CR><LF>

NF (speaker) volume -> 80%

6.5 CPSSCFM Cospas-Sarsat Alarm Confirm

\$PRH0,xxx,C,CPSSCFM*hh<CR><LF>

The answer to a successful CPSSCFM command will be the CMDOK sentence (see chapter 5.2.14).

If the operation was not successful, the answer is one error sentences ERRCMD(5.2.15), ERRFIELD(5.2.16).

If a Cospas-Sarsat pulse was successfully decoded an acoustic alarm is activated at the DCU. Normally the alarm has to be confirmed at the DCU. This sentence allows the remote confirmation of the alarm.

A Cospas-Sarsat-Alarm is remotely indicated by the “V” – character in the mode-field of DFSTD output sentence!

6.5.1 Example A of a typical control sentence:

\$PRH0,xxx,C,CPSSCFM*hh<CR><LF>

The Cospas-Sarsat alarm is confirmed!

6.6 ALARMCFM Alarm Confirm

\$PRHO,xxx,C,ALARMCFM*hh<CR><LF>

The answer to a successful ALARMCFM command will be the CMDOK sentence (see chapter 5.2.14).

If the operation was not successful, the answer is one error sentences ERRCMD(5.2.15), ERRFIELD(5.2.16).

If a Cospas-Sarsat pulse was successfully decoded or ELT/PLB-Modulation was recognized an acoustic alarm is activated at the DCU. Normally the alarm has to be confirmed at the DCU. This sentence allows the remote confirmation of the alarm.

A Cospas-Sarsat-Alarm is remotely indicated by the “V” – character (resp. “U”-character for ELT-Alarm) in the mode-field of DFSTD output sentence!

6.6.1 Example A of a typical control sentence:

\$PRHO,xxx,C,ALARMCFM*hh<CR><LF>

The alarm is confirmed!

6.7 BAUD Set Serial Baud Rate

For the DF a baud rate change via a serial command is possible. Pay attention, because the baud rate of the communication partner has to be changed too!

\$PRHO, xxx, C, BAUD, x.x*hh<CR><LF>

↑
Baud rate number

The answer to a successful baud rate setting will be the CMDOK sentence at the new baud rate, which is described in chapter 5.2.14.

6.7.1 Baud rate number:

The following baud rate numbers are defined:

- "1" 1200Baud
- "2" not valid
- "3" 4800Baud
- "4" 9600Baud
- "5" not valid
- "6" 19.2kBaud
- "7" not valid
- "8" 38.4kBaud
- "9" 57.6kBaud
- "10" not valid
- "11" 115.2kBaud

If this field contains a non-recognised character or number, the ERRFIELD(5.2.16) or ERRRANGE (5.2.17) sentence will be the answer instead of the CMDOK sentence (chapter:5.2.14).

6.7.2 Example of a typical control sentence:

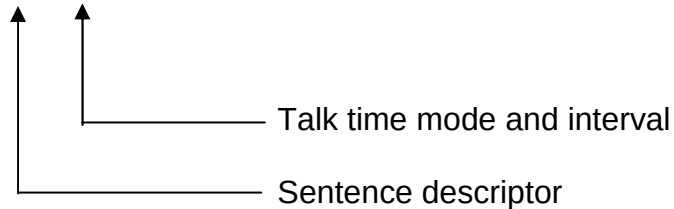
\$PRHO, xxx, C, BAUD, 4*hh<CR><LF>

9600 Baud will be the new serial communication speed.

6.8 TALKMODE Set Serial Talking Mode

This sentence set the serial talking mode.

\$PRH0, xxx, C, TALKMODE, c-c, x*hh<CR><LF>



The answer to a successful TALKMODE command will be the CMDOK sentence, which is described in chapter 5.2.14.

If the operation was not successful, the answer is one of the two error sentences ERRCMD(5.2.15), ERRFIELD(5.2.16) .

6.8.1 Sentence descriptor:

Up to now, the following types are defined:

- “DFSTD” RHOTHETA standard bearing sentence is sent.
- “DFBRG” DFBRG sentence is sent.

Note: Sentence descriptor MUST NOT be empty because this setting is stored in the Setup menu!

6.8.2 Talk time mode and intervall:

- “0” Talk mode ONLY ON REQUEST
- “1” Talk mode AUTO, Talk time 2 seconds
- “2” Talk mode AUTO, Talk time 1 second
- “3” Talk mode AUTO, Talk time 500 milliseconds
- “4” Talk mode AUTO, Talk time 250 milliseconds

6.8.3 Example A of a typical control sentence:

\$PRH0, xxx, C, TALKMODE, DFBRG, 4*hh<CR><LF>

The device will now auto talk sending the \$DFBRG sentence every 250ms.

6.8.4 Example B of a typical control sentence:

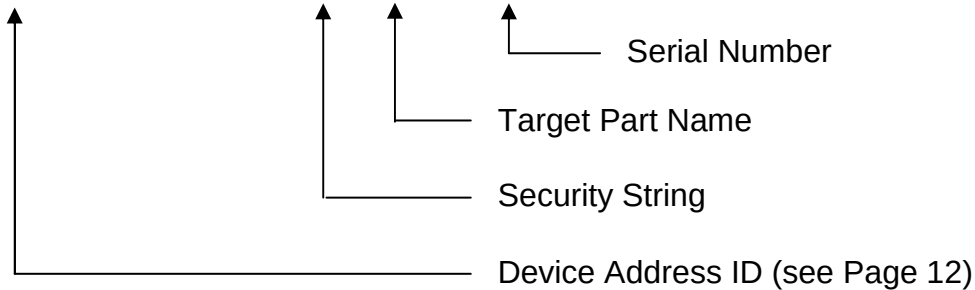
\$PRH0, xxx, C, TALKMODE, DFSTD, 0*hh<CR><LF>

The device will now talk only at a request. (RT-500-M Menu settings are set to DFSTD-sentence)

6.9 SETSERIAL Set Serial Number (ONLY FOR FACTORY USAGE)

This sentence sets the serial number of DF-Components.

\$PRH0,xxx,C,SETSERIAL,c-c,c-c,c---c*hh<CR><LF>



The answer to a successful SETSERIAL command will be the CMDOK sentence (see chapter 5.2.14).

WARNING: If a SETSERIAL,AU sentence is sent to an AU which does not support the SETSERIAL-sentence, CMDOK is returned as well! Using the PART-sentence to check if the serial number was set correctly is mandatory!!

If the operation was not successful, the answer is one of the three error sentences ERRCMD(5.2.15), ERRFIELD(5.2.16) or ERRRANGE (5.2.17) .

6.9.1.1 Security String:

This field contains the security string for setting the serial number.

6.9.1.2 Target Part Name:

This field contains the name of the DF-part which serial number should be set.

DCU	The serial number of the DCU is set.
REC	The serial number of the AU is set (for compatibility with RT-300).
AU	The serial number of the AU is set.

6.9.1.3 Serial Number:

This field contains the new serial number of the DF-device. The field-length is valid from 2 to 10.

6.9.1.4 Example A of a typical control sentence:

\$PRH0,xxx,C,SETSERIAL,???,DCU,00815*hh<CR><LF>

The serial number of the DCU is set to "00815"

6.9.1.5 Example B of a typical control sentence:

\$PRH0,xxx,C,SETSERIAL,???,AU,00816*hh<CR><LF>

The serial number of the AU is set to "00816"