NMEA Protocol Description

RT-500-M

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Note

The manufacturer reserves the right to make modifications of the here described product at any time and without previous information.

1 Change Log

Revision	Date	Changes
1.00	04.11.2021	First official release
1.01	17.05.2022	Examples for LISTSCANEX Control Sentence, SARSCANFR Control Sentence, MONSCANFR Control Sentence corrected

Content

2 General

2.1 Modes

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

- **External Heading/Compass Input:**

  Used for true/magnetic bearing indication and the compass rose display (see chapter: Input Sentences, page 11).

- **External GPS:**
  Used to get position and UTC time.

- **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 RHOTHETA DF Output Sentences).

- **Request Sentences:**

  With the request sentences it is possible to get (read) any information directly from the DF (see chapter Request Sentences, page 26).

- **Control Mode for Remote Operation:**
  With special NMEA input sentences all functions of the DF, like changing frequency etc., can be controlled remotely (see chapter: Control Sentences for Remote-Command Operation, page 62).

2.2 Data Format

The RT-500-M 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

The baud rate of DF is selectable in the DCU under "Setup/Interface/NMEA DF Remote/Baudrate".

We recommend using 4800 or 38400 to be compatible with NMEA 0183 or NMEA 0183 HS.

Further it is possible to use the Ethernet port on the rear side of the device for NMEA communication. This can be configured under "Setup/Interface/LAN Configuration" menu of the device.

2.3 Interface Connection

There are 3 possible interface connections:

- RS232 Level (standard computer levels)

- RS422 Level (standard NMEA)

- Ethernet

For more information refer to the user manual of the device.

2.4 Timing

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

3 Input Sentences

3.1 Heading/Compass Sentences

These approved NMEA 0183 sentences are used to convey the DF the actual heading from an external compass, gyro or GPS. The external heading can be used as magnetic or true heading reference.

To use one of these sentences for heading/compass input, you have to select the corresponding header under "Setup/Interface/NMEA Compass/NMEA Header". 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/magnetic bearing) is used.

For more detailed structure of approved sentences please refer to the original NMEA 0183 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).

3.1.1   HEHDT / HCHDT / xxHDT - True Heading Source: Compass or Gyro

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

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

Checksum

Heading, degrees
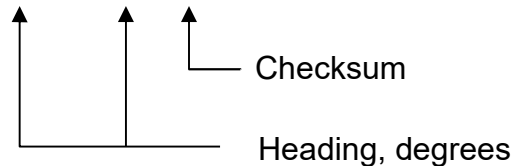
3.1.1.1 Example of a –HDT Sentence

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

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

3.1.2   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>
```

Checksum

Magnetic variation, degrees, E/W

Magnetic deviation, degrees, E/W

Magnetic sensor heading, degrees
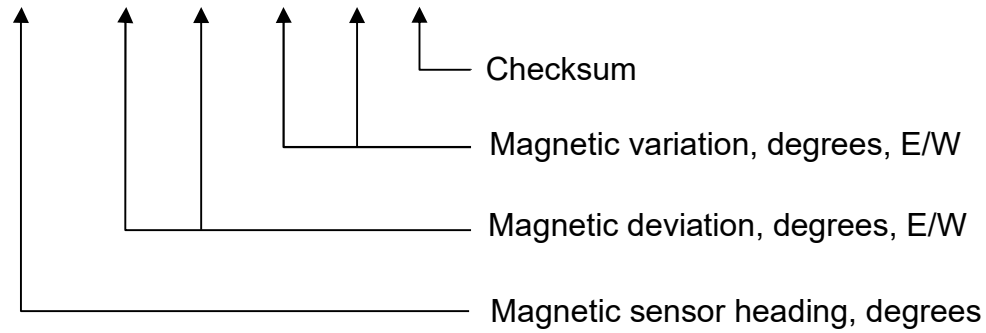
3.1.2.1 Example of a –HDG Sentence

```
$HCHDG,25.4,,,1.5,E*1E<CR><LF>
$HCHDG,107,4.0,W,1.2,E*4F<CR><LF>
```

3.2 GPS - Input Sentences

To provide the DF with GPS coordinates and UTC-Time, an external GPS device should be utilized.

3.3 --RMC - Recommended Minimum Navigation Information, Source: GPS

```
$--RMC,hhmmss.ss,A,llll.ll,a,yyyyy.yy,a,…,xxxxxx,x.x,a,a*hh<CR><LF>
```

Mode Indicator[2,3]

Magnetic variation, degrees E/W[1]

Date: ddmmyy

Longitude, E/W

Latitude, N/S

Status[3]: A = Data valid

V = Navigation receiver warning

UTC of position fix
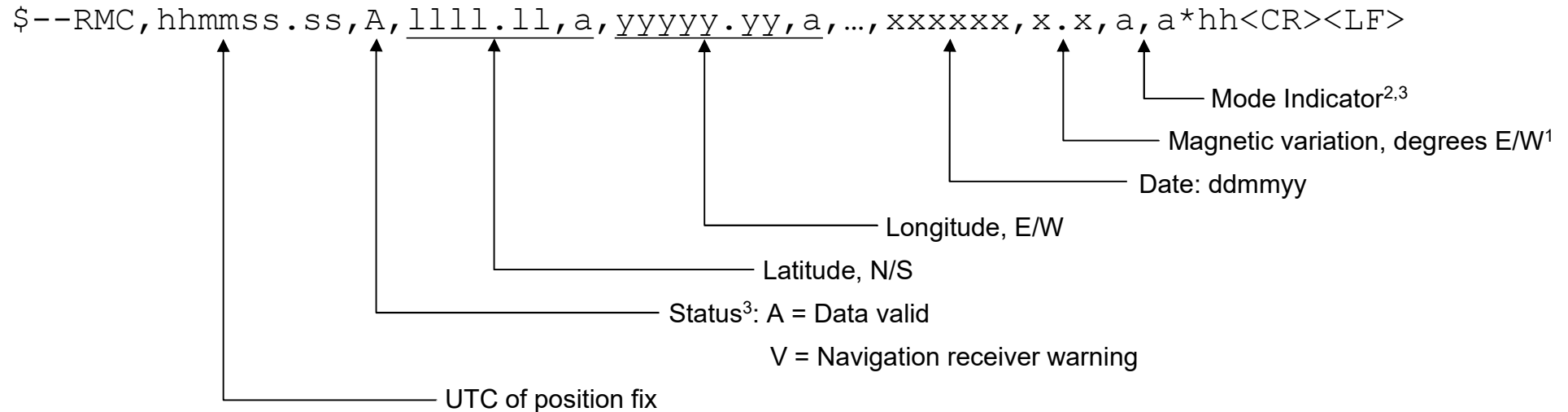
Notes:

1) Easterly variation (E) is subtracted from True course

Westerly variation (W) is added to True course

2) Positioning system Mode Indicator:

o A = Autonomous mode

o D = Differential mode

o E = Estimated (dead reckoning) mode

o M = Manual input mode

- o   S = Simulator mode

- o   N = Data not valid

3) The positioning system "Mode Indicator" field supplements the positioning system "Status" field.

The "Status" field shall be set to V = invalid for all values of "Mode Indicator", except for A = Autonomous and D = Differential. The positioning system "Mode Indicator" and "Status" fields shall not be NULL fields.

UTC, Date, Latitude, Longitude and Magnetic variation are only processed, if Status is set to "A" (data valid).

3.3.1   Example of an --RMC sentence

`$GPRMC,040302.663,A,3939.7,N,10506.6,W,0.27,358.86,200804,,*1A<CR><LF>`

3.3.2   --GGA - Global Position Fix Data, Source: GPS

`$--GGA,hhmmss.ss,llll.ll,a,yyyyy.yy,a,x...............*hh<CR><LF>`

GPS Quality Indicator[1]

Longitude, E/W

Latitude, N/S

UTC of position
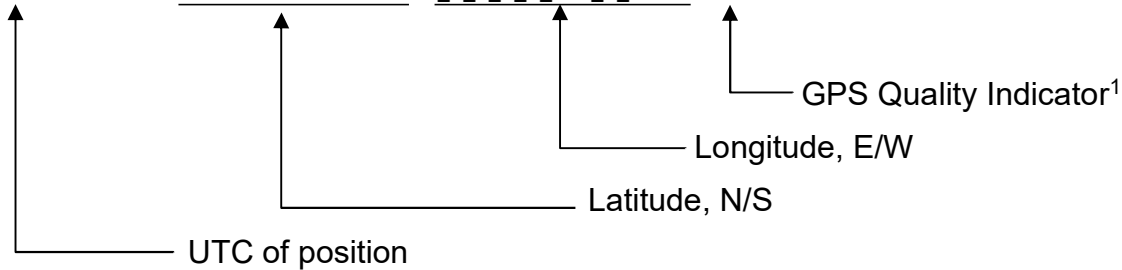
Note:

1) GPS Quality Indicator:

- o   0 = Fix not available or invalid

- o   1 = GPS SPS Mode, fix valid

- o   2 = Differential GPS, SPS Mode, fix valid

- o   3 = GPS PPS Mode, fix valid

- o   4 = Real Time Kinematic. System used in RTK mode with fixed integers

- o 5 = Float RTK. Satellite system used in RTK mode, floating integers

- o 6 = Estimated (dead reckoning) Mode

- o 7 = Manual Input Mode

- o 8 = Simulator Mode

The GPS Quality Indicator field shall not be a NULL field.
UTC, Latitude and Longitude are only processed, if GPS Quality Indicator is not set to "0" (fix not available or invalid).

3.3.2.1 Example of a –GGA Sentence

GPGGA,123519.23,4807.038,N,01131.000,E,1,08,0.9,545.4,M,46.9,M,,*47<CR><LF>

3.3.3 --DTM - Datum Reference Data, Source: GPS

$--DTM,ccc,…,ccc*hh<CR><LF>

Reference datum code: WGS84 = W84
WGS72 = W72
SGS85 = S85
PE90 = P90

Local datum code[1]: WGS84 = W84
WGS72 = W72
SGS85 = S85
PE90 = P90
User defined = 999
IHO datum code
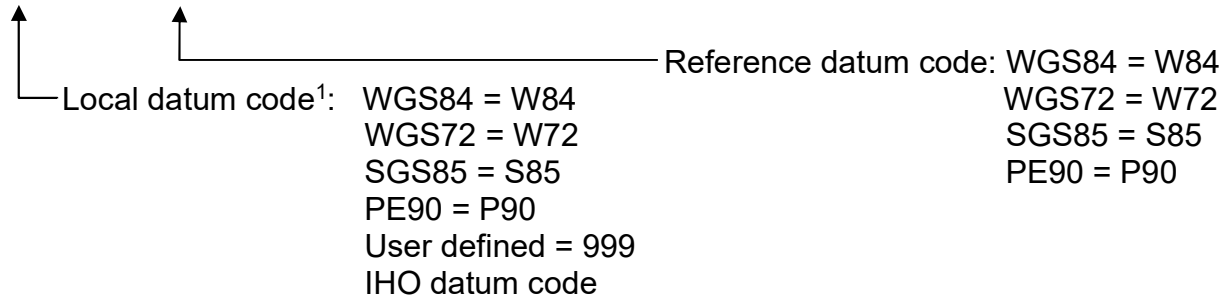
1) Three characters alpha code for local datum.

Only the fields for local datum code and reference datum code are used, all other fields are ignored! Both fields have to contain "W84", else a warning message will be generated!

3.3.3.1 Example of a –DTM Sentence

$GPDTM,W84,,0.000000,N,0.000000,E,0.0,W84*6F<CR><LF>

4 RHOTHETA DF Output Sentences

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.
This time period of the continuous data output is set to 250 ms by default, but can be changed over a special configuration file in the range from 250 ms to 2 sec.

4.1 Standard DF Output Sentence DFSTD

The data out is handled by proprietary NMEA 0183 sentences.

Remark: NULL field in the sentence body means, there is no value available.

The data sentence body consists always of the following elements:

$P => Proprietary sentence ID

Manufacturer's (RHOTHETA) sentence ID

(1) Device Address ID

Standard DF Output Sentence Indication

Data field(s) of Sentence Body

Checksum field

```
$PRHO,xxx,DFSTD, . . . *hh<CR><LF>
```

```
x.x,x.x,C--C,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x
```

(2) Error

(3) Warning

(4) Modes

(5) Active RX-Frequency

(6) Squelch Threshold

(7) Signal Level

(8) Relative Bearing (averaged)

(9) True Bearing

(10) Magn. Bearing

(11) Live Min

(12) Live Max Relative Bearing

(1)	**Device Address ID:** [0...99] The device specific address of the DF (default = 0). This address can be adjusted in the DF Menu: Setup/Interface/NMEA DF Remote/Remote 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
	"P" Cospas-Sarsat-Scan-Mode is active
	"C" Cospas-Sarsat-Decoding-Mode is active
	"F" Fast Marine-Scan at Marine-Band is active
	"H" Fast Channel Scan is active (only possible, if AU-variant is [V] or option "Fast Channel Scan" is unlocked)
	"B" Fast Channel Scan with Beep Tone-Decoding is active (only AU [V] or option "Fast Channel Scan" is unlocked)
	"E" SAR Scan is active
	"G" Scan List is active
	
	"U" Alarm ELT (PLB)
	       (see 4.1.2 / Mode "U" with active status "Alarm ELT")
	"V" Alarm Cospas-Sarsat
	       (see 4.1.3 / Mode "V" with active status "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" is indicated, Monitoring with Cospas-Sarsat as main frequency was selected!

(5)	**Active RX-Frequency:** e.g. [118.000 ... 470.000], range depends on unlocked frequency options]
	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):** [NULL field, 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:** [NULL field, or 0…359]
	The true bearing field contains the bearing in degrees. "45" means an 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:** [NULL field, or 0…359]
	The Magnetic Bearing field contains the bearing in degrees. "62" means an absolute (reference is magnetic north) bearing of 62 degrees.
(11) (12)	**Relative Bearing Live Values:** [NULL fields, or 0…359]
	The relative live bearing field contains the Min / Max bearing in degrees without averaging. The relative live bearing reacts faster than the normal relative bearing, but it does not have the precision of the averaged bearing. The Min / Max bearing values are calculated within a time period of approx. 300 ms. 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.

4.1.1   Examples of DFSTD Sentences

`$PRHO,0,DFSTD,0,0,,121.500,32,28,,,,,*7A<CR><LF>`

0	> Device address is 0 (default)
No error, no warning	> Device is ok
Mode NULL field	> 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 121.500 MHz 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*78<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)
NULL field	
51,73	> Relative live max bearing values within the last 300 ms

This example shows a standard operation on 243.000 MHz 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.

4.1.2 Mode "U" with active status "Alarm ELT"

It is strictly recommended, to use the evaluation of this mode "U" character, when monitoring for active ELT/PLB signals.
The "U" character within the mode field is activated automatically whenever a typical ELT/PLB modulated signal is detected. These emergency signals (typically transmitted on 121.500 MHz / 243.000 MHz) are specified by a down/up-ward audio sweep tone. The audio decoding for ELT/PLB detection is always active in the background while receiving/bearing a signal.

There are a lot of unofficial voice communications also on 121.500 MHz. So only the evaluation of pure signal detection by the receiving level would result in a lot of false alarms.

The typical necessary ELT/PLB detection time is approx. 10 sec.

(See also example 7.1 / Monitoring for ELT signals on 121.500 MHz)

4.1.3 Mode "V" with active status "Alarm Cospas-Sarsat"

It is strictly recommended, to use the evaluation of this mode "V" character, when monitoring for active Cospas-Sarsat pulses.
The "V" character within the mode field is activated automatically whenever the direction finder Cospas-Sarsat Decoding mode is active and an accurate Cospas-Sarsat pulse is received at the adjusted main frequency.

(See also example 7.2 / Monitoring for Cospas-Sarsat pulses)

4.2 VTS DF Output Sentence DFVTS

Remark: NULL field in the sentence body means, there is no value available.
The data sentence body consists always of the following elements.

$P => Proprietary sentence ID

Manufacturer's (RHOTHETA) sentence ID

(1) Device Address ID

Indicates Standard DF Output Sentence

Data field(s) of Sentence body

Checksum field

```
$PRHO,xxx,DFVTS, . . . *hh<CR><LF>
```

```
x.x,x.x,c--c,x.x,x.x,x.x,x.x,hhmmss.sss
```

(2) Error

(3) Warning

(4) Modes

(5) Actice RX-Frequency

(6) Squelch Threshold

(7) Signal Level

(8) Bearing (averaged)

(9) UTC-Timestamp

(1)	**Device Address ID:** [0...99]
	The device specific address of the DF (default = 0). This address can be adjusted under Setup/Interface/NMEA DF Remote/Remote 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 "P" Cospas-Sarsat Scan Mode is active "C" Cospas-Sarsat Decoding Mode is active "F" Fast Marine Scan in the marine band is active "H" Fast Channel Scan is active (only possible, if AU-variant is [V] or option "Fast Channel Scan" is unlocked) "B" Fast Channel Scan with Beep Tone-Decoding is active (only AU [V] or option "Fast Channel Scan" is unlocked) "E" SAR Scan is active "G" Scan List is active "U" Alarm ELT (PLB) (see 4.1.2 / Mode "U" with active status "Alarm ELT") "V" Alarm Cospas-Sarsat (see 4.1.3 / Mode "V" with active status "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" is indicated, Monitoring with Cospas-Sarsat as main frequency was selected!

(5)	**Active RX-Frequency:** [118.000 ... 470.000] 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)	**Bearing (averaged):** [NULL field, or 0…359] Bearing field contains the actual bearing in degrees. "270" means a relative (reference is the antenna north marking) bearing of 270 degrees (= west, if antenna north marking is lined up with north).
(9)	**UTC-Timestamp:** [NULL field, or 000000.000…235959.999] The UTC-Timestamp is the UTC-Time at the moment of output of this NMEA-sentence. To get a valid UTC-Timestamp, NMEA-Sentence --RMC or --GGA must be provided at the NMEA-Input! Remark: This field only contains valid data if hardware option UTC timebase is installed!

4.2.1   Examples of DFVTS Sentences

```
$PRHO,0,DFVTS,0,0,,121.500,32,28,,043402.293*53<CR><LF>
```

0	> Device address is 0 (default)
No error, no warning	> Device is ok
Mode NULL field	> 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 field	> No bearing present
043402.293	> UTC is 04:34:02 and 293 Milliseconds

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

```
$PRHO,40,DFVTS,0,0,,243.000,25,86,32,125902.983*60<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	> averaged bearing is 32 degrees
125902.983	> UTC is 12:59:02 and 983 Milliseconds

This example shows a standard operation on 243.000 MHz where the signal is over the squelch threshold. A 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 some 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
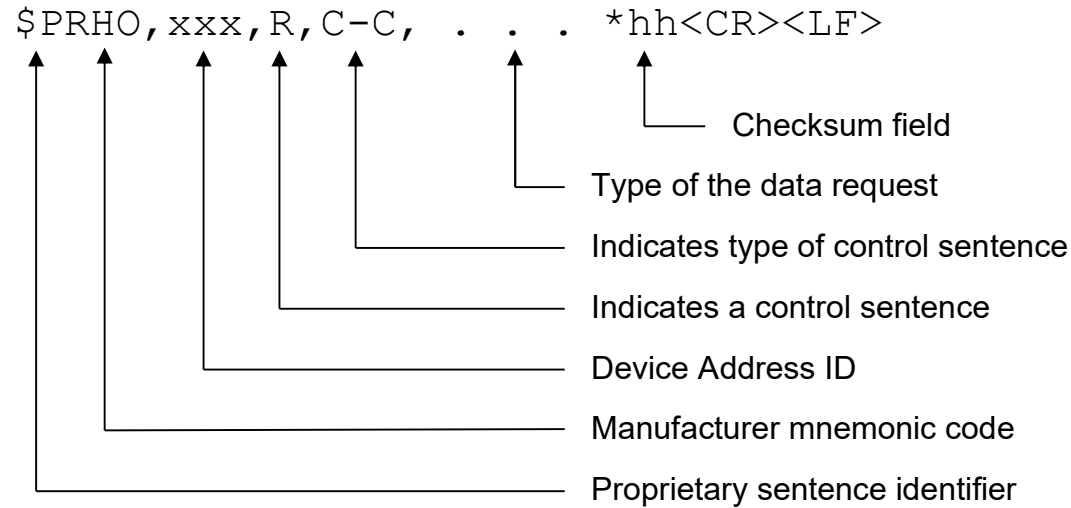
The DF only reacts to the request sentences if the Address ID in the sentence is 255 or is equal to the one set in the DF Setup/ Interface/NMEA DF Remote/Remote Address ID. The address allows to access different DFs that are connected to one TX.
C—C is a variable text field, which describes the type of data in this sentence.
When using address ID = 255 then all connected DF systems are addressed, independent of their internal IDs.

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 4.1.

5.1.2 DFVTS DF VTS Data Request

`$PRHO,xxx,R,DFVTS*hh<CR><LF>`

This sentence requests VTS DF data.
VTS DF data contains:
- Error code
- Warning code
- Mode of operation
- RX-frequency
- Squelch threshold
- Signal level
- Bearing

- UTC-Time

The answer to this request sentence is described in chapter 4.2.

5.1.3   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 used for example by Taiyo and other direction finders.
DFBRG data contains:
- RX-frequency
- Bearing value
- Indicator, if bearing value is absolute/relative
- Status of the bearing

The answer to this request sentence is described in chapter 5.2.3.

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

5.1.4   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 5.2.4.

5.1.5 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 5.2.5.

5.1.6 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 5.2.6.

5.1.7   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 5.2.7.

5.1.8   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 5.2.8.

5.1.9   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 5.2.9.

5.1.10   IVOLT Internal Voltage Data Request

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

This sentence requests the voltage data.
The answer to this request sentence is described in chapter 5.2.10.

5.1.11   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 5.2.11.

5.1.12   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 5.2.12.

5.1.13 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 MSSI
- Country-Code
- Frame-Identifier
- Protocol Identifier
- GPS-Position, if available

The answer to this request sentence is described in chapter 5.1.13.

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

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

This sentence requests the complete Cospas-Sarsat Hex Message, 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 5.2.14.

5.1.15 FSCANCHN Channel List for Fast Channel Scan

`$PRHO,xxx,R,FSCANCHN*hh<CR><LF>`

This sentence requests the Channel-List for the fast channel scan mode.
The answer to this request sentence is described in chapter 5.2.15.
To set a new channel list, please use FSCANCHN – Command! (see chapter 6.9)

5.1.16 FSCANSNR SNR List for Fast Channel Scan

`$PRHO,xxx,R,FSCANSNR*hh<CR><LF>`

This sentence requests the SNR-List for the fast channel scan mode.
The answer to this request sentence is described in chapter 5.2.16.
To set a new channel list, please use FSCANSNR – Command! (see chapter 6.10)

5.1.17 LISTSCANFR Start and Stop Frequencies for Scan List Mode

`$PRHO,xxx,R,LISTSCANFR*hh<CR><LF>`

This sentence requests the Start and Stop frequencies for the Scan List mode.
The answer to this request sentence is described in chapter 5.2.17.
To set new Start and Stop frequencies, please use LISTSCANFR – Command! (see chapter 6.11)

5.1.18 LISTSCANEX Exclude Frequencies for Scan List Mode

`$PRHO,xxx,R,LISTSCANEX*hh<CR><LF>`

This sentence requests the Exclude frequencies for the Scan List mode.
The answer to this request sentence is described in chapter 5.2.18.
To set new Exclude frequencies, please use LISTSCANEX – Command! (see chapter 6.12)

5.1.19 LISTSCANRES Result Frequencies for Scan List Mode

```
$PRHO,xxx,R,LISTSCANRES*hh<CR><LF>
```

This sentence requests the Result frequencies for the Scan List mode which have been found during the last scan.
The answer to this request sentence is described in chapter 5.2.19.

5.1.20 SARSCANFR Scan Frequencies for SAR Scan

```
$PRHO,xxx,R,SARSCANFR*hh<CR><LF>
```

This sentence requests the Scan frequencies for the SAR Scan.
The answer to this request sentence is described in chapter 5.2.20.
To set new Scan frequencies, please use SARSCANFR – Command! (see chapter 6.13)

5.1.21 MONSCANFR Scan Frequencies for Monitoring

```
$PRHO,xxx,R,MONSCANFR*hh<CR><LF>
```

This sentence requests the Scan frequencies for the Monitoring Scan.
The answer to this request sentence is described in chapter 5.2.21.
To set new Scan frequencies, please use MONSCANFR – Command! (see chapter 6.14)

5.1.22 TIME DCU System Time Request

```
$PRHO,xxx,R,TIME*hh<CR><LF>
```

This sentence requests DCU system time.
The answer to this request sentence is described in chapter 5.2.27.

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:

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

Checksum field

Data field(s)

Indicates type of data sentence

Identity (0 ... 254)

Manufacturer mnemonic code

Proprietary sentence identifier

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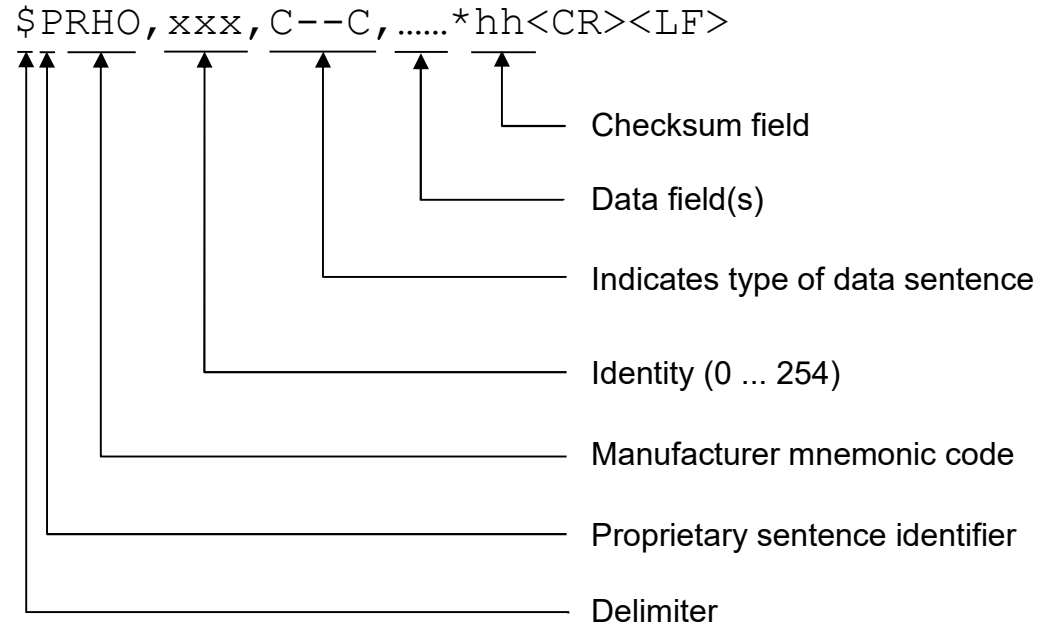
xxx is an identity field of numeric characters. The value is in the range of 0 to 254. The used format is without leading zeros. All data out from the DF is marked with the identity selected in setup. So the identity allows to separate data from different DF's connected to one RX.

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

5.2.1 DFSTD Standard DF Sentence

See chapter 4.1 on page 16!

5.2.2 DFVTS VTS DF Sentence

See chapter 4.2 on page 22!

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

```
$DFBRG,,XXXXXXXX,,XXX,X,,X,*hh<CR><LF>
```

- Status
- Absolut/Relative
- Bearing-Value
- Frequency
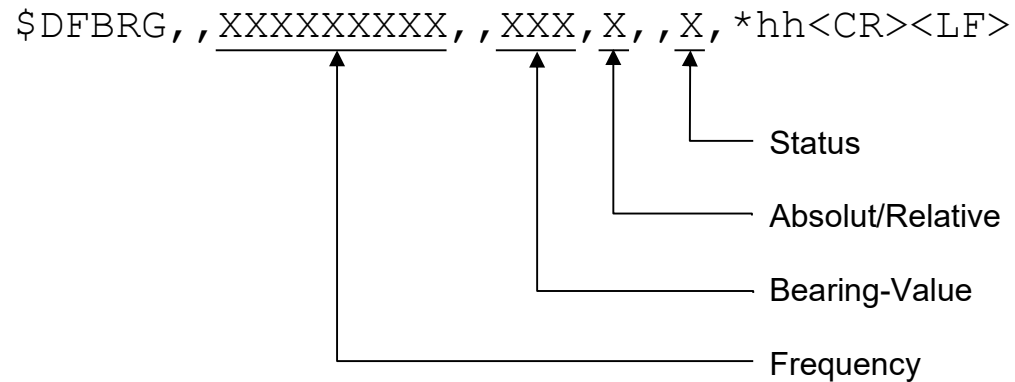
5.2.3.1 Frequency

Receiving frequency in Hz

5.2.3.2 Bearing Value

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

5.2.3.3 Indicator for Absolute/Relative-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)

5.2.3.4 Status

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

5.2.3.5 Example A of a DFBRG output

```
$DFBRG,,121500000,,145,R,,A*6D<CR><LF>
```

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

5.2.3.6 Example B of a DFBRG output

```
$DFBRG,,121650000,,,A,,V*5F<CR><LF>
```

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

5.2.4   INFGEN General Info Sentence

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

- Device parts
- Device family
- Device type
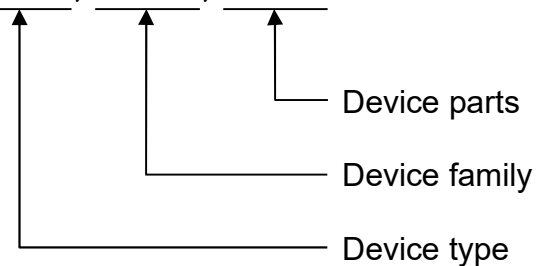
5.2.4.1 Device type
For the RT-500-M the device type is "DF" (direction finder).

5.2.4.2 Device family

The device family for RT-500-M is "RT-500-M".

5.2.4.3 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

5.2.4.4 Example A of a DF output

```
$PRHO,0,INFGEN,DF,RT-500-M,DCU;AU*15<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.

5.2.5   INFPART Part Info Sentence

```
$PRHO,xxx,INFPART,c--c,c--c,cc__,cc__,cc__*hh<CR><LF>
```

Software revision

System state

Serial number
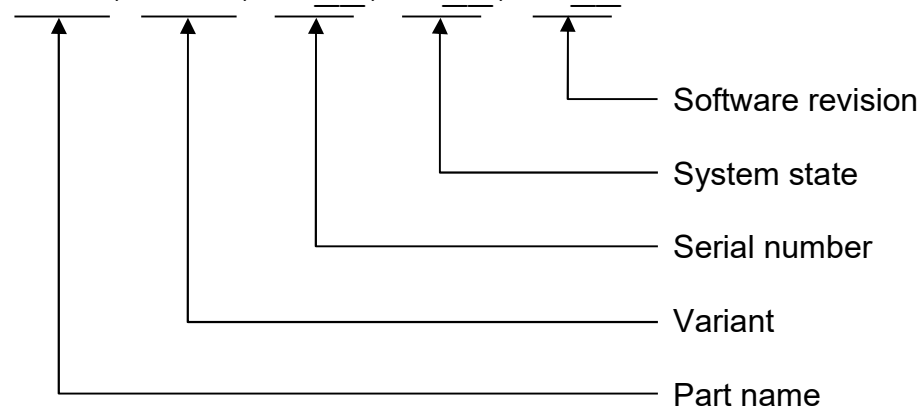
Variant

Part name

5.2.5.1 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').

5.2.5.2 Variant

For the DCU is up to now only the standard variant "A" defined.

The antenna unit is available in the following variants:
- "A"   Standard
- NULL field   Variant unknown

5.2.5.3 Serial number

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

5.2.5.4 System state

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

5.2.5.5 Software revision

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

5.2.5.6 Example A of a DF output

```
$PRHO,0,INFPART,DCU,A,03.2345,,02.11*5D<CR><LF>
```

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

5.2.5.7 Example B of a DF output

```
$PRHO,0,INFPART,AU,A,01.2345,,01.11*1A<CR><LF>
```

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

5.2.6   INFREC Receiver/AU Info Sentence

```
$PRHO,xxx,INFREC,x.x,c--c,x.x,cc__*hh<CR><LF>
```

- Compass available
- Channel spacing
- Demodulation types
- Number of receiving bands
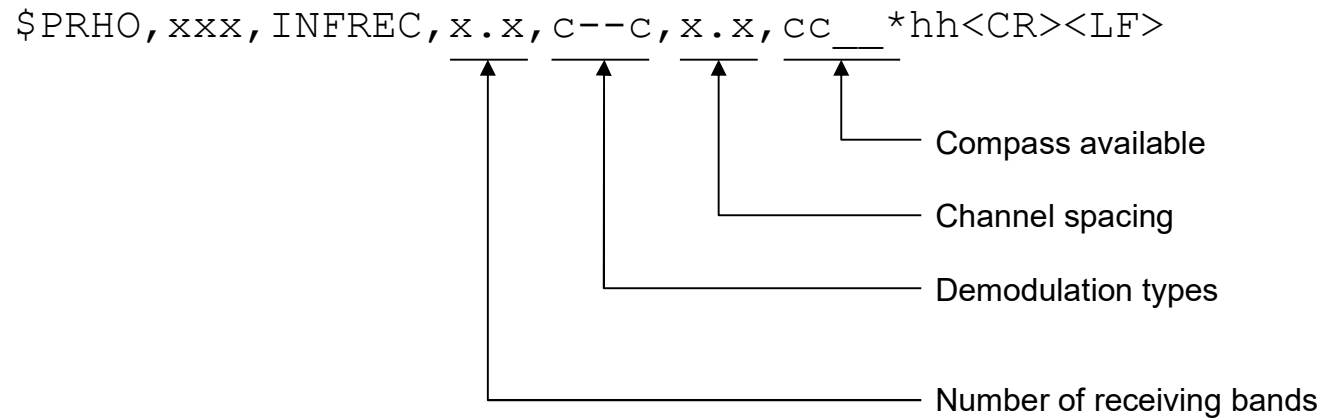
5.2.6.1 Number of receiving bands
For the standard RT-500-M the number of available receiving bands is "5".

5.2.6.2 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

5.2.6.3 Channel spacing
Empty field: this field is not used at RT-500-M -> See channel spacing field of INFBAND sentence (5.2.8)!

5.2.6.4 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.

5.2.6.5 Example of a DF output

```
$PRHO,0,INFREC,4,AM;FM,,*28<CR><LF>
```

It means the receiver has 4 receiving bands. AM and FM demodulation is possible. No internal compass installed.

5.2.7   INFDCU DCU Info Sentence

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

Available modes (features)
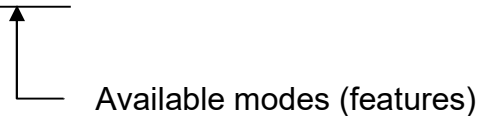
5.2.7.1 Special mode types (features)

The possible mode types are separated with a semicolon.

Up to now the following mode types are defined:
- "M"   Monitoring mode
- „P"   COSPAS-SARSAT Scan-Mode
- "C"   COSPAS-SARSAT Decoding-Mode
- "D"   Decoding of digital Beacon ID-Data
- "F"   Fast Scanning of lower Marine Band
- "H"   Fast Channel Scan Mode (only if option "Fast Channel Scan" is unlocked)
- "B"   Channel Scan Mode with Beep Tone Decoding (only if option "Fast Channel Scan" is unlocked)
- "E"   SAR Scan
- "G"   Scan List

5.2.7.2 Example A of a DF output:

`$PRHO,0,INFDCU,M;P;C;D;F;E;G*54<CR><LF>`

It means the DCU has monitoring mode, COSPAS-SARSAT Scan- and Decoding mode, Decoding of digital Beacon ID-Data, Fast Scanning of lower Marine Band, SAR Scan, Scan List.

5.2.8   INFBAND Band Info Sentence

`$PRHO,xxx,INFBAND,x.x,c--c,x.x,x.x,x.x,cc,x.x*hh<CR><LF>`

- Channel spacing
- Emergency flag
- Band default frequency
- Band stop frequency
- Band start frequency
- Default demodulation
- Number of receiving band
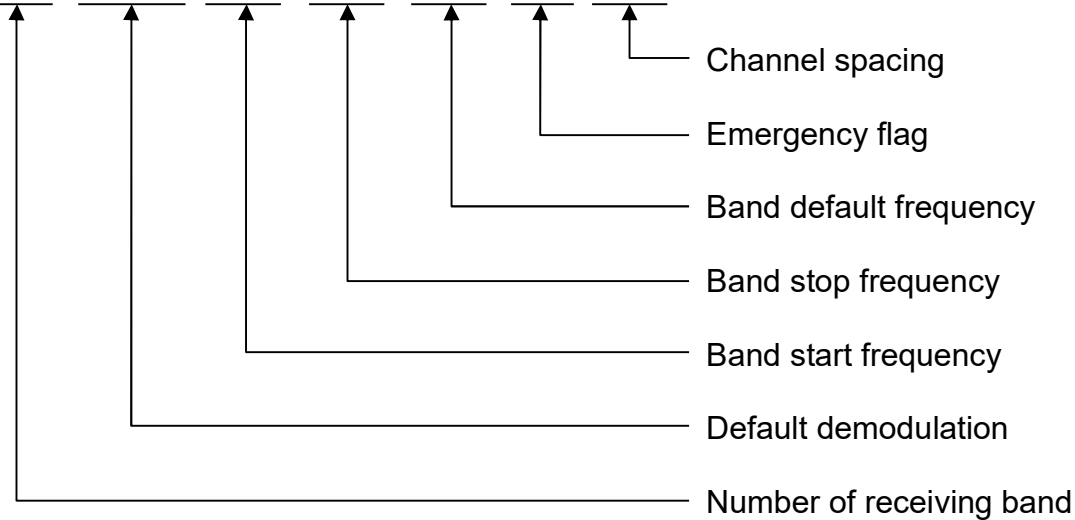
5.2.8.1 Number of receiving band
For the standard RT-500-M the possible numbers of the receiving bands are:
  '0…4':   Band 0 … Band 4

5.2.8.2 Default demodulation
The default demodulation type in this band.

Up to now the following demodulation types are defined:
- FM
- AM
- CW
- FSK
- ASK
- PM

5.2.8.3 Band start frequency

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

5.2.8.4 Band stop frequency

Stop frequency of this band in MHz.

5.2.8.5 Band default frequency

Default frequency of this band in MHz.

5.2.8.6 Emergency flag

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

5.2.8.7 Channel spacing

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

5.2.8.8 Example A of a DF output

```
$PRHO,0,INFBAND,0,AM,118.000,124.000,121.500,,8.333*6E<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.

5.2.8.9 Example B of a DF output

`$PRHO,0,INFBAND,1,FM,156.000,162.000,156.800,,5.000*63<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.

5.2.9 VOL Volume Data Sentence

`$PRHO,xxx,VOL,xxx,xxx,xxx*hh<CR><LF>`

reserved2

reserved1
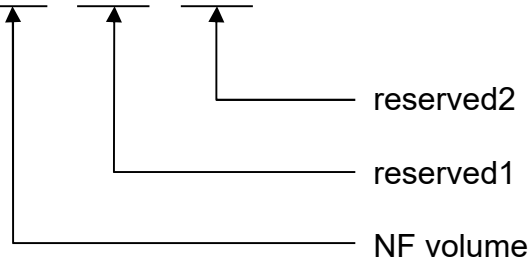
NF volume

5.2.9.1 NF volume
NF (speaker) volume in the range from 0% to 100% (0% volume means that NF volume is muted!).

5.2.9.2 reserved1
Reserved for future use.

5.2.9.3 reserved2
Reserved for future use.

5.2.9.4 Example A of a DF output

`$PRHO,0,VOL,70,,*4B<CR><LF>`
NF volume → 70%

5.2.10   IVOLT Internal Voltages Data Sentence

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

Internal voltage of part
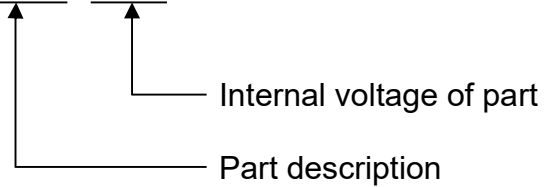
Part description

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 voltage of part

The internal voltage of the part in volt.
"14.8" means 14.8 Volt

5.2.10.3   Example A of a DF output

$PRHO,0,IVOLT,AU,12.8*7C<CR><LF>

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

5.2.11 ITEMP Internal Temperature Data Sentence

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

Internal temperature of part
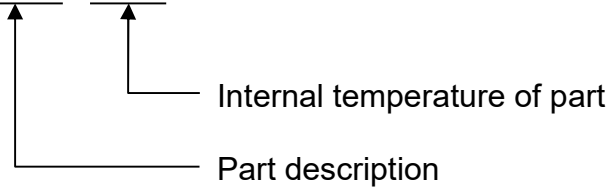
Part description

Up to 8 parts are allowed in this sentence.

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

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

5.2.11.3   Example A of a DF output

```
$PRHO,0,ITEMP,AU,25.3*7E<CR><LF>
```

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

5.2.12 ISERVICE Internal Service Data Sentence

```
$PRHO,xxx,ISERVICE,xx,xxx,xxx*hh<CR><LF>
```

PsRam Bearing value left

PsRam Bearing value right
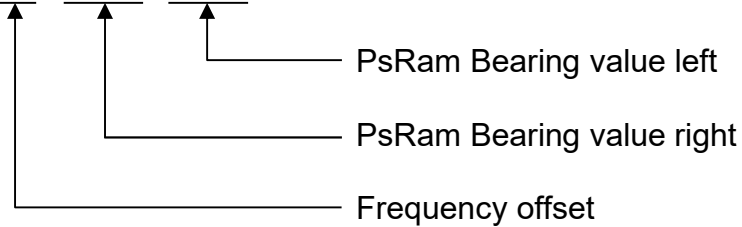
Frequency offset

5.2.12.1 Frequency offset

Frequency offset of received transmitter (service value for RHOTHETA internal use)
Valid Range: [-99…+99] (depends on AFC On/Off Mode)

5.2.12.2 PsRam bearing value right

Service value for RHOTHETA internal use
Valid Range: [0…179] (2° quant); [255] = invalid

5.2.12.3 PsRam bearing value left

Service value for RHOTHETA internal use
Valid Range: [0…179] (2° quant); [255] = invalid

5.2.12.4 Example A of a DF output

```
$PRHO,0,ISERVICE,-25,55,255*15<CR><LF>
```

5.2.13   CPSSDTA1 Cospas-Sarsat Data Sentence

```
$PRHO,xxx,CPSSDTA1,c-c,c,c,xxx,c-c,c,c-c,c*hh<CR><LF>
```

- Longitude East/West
- GPS-Pos. Longitude
- Latitude North/South
- GPS-Pos. Latitude
- Country-Code
- Protocol Identifier
- Frame Identifier
- BeaconID 15hex / MMSI
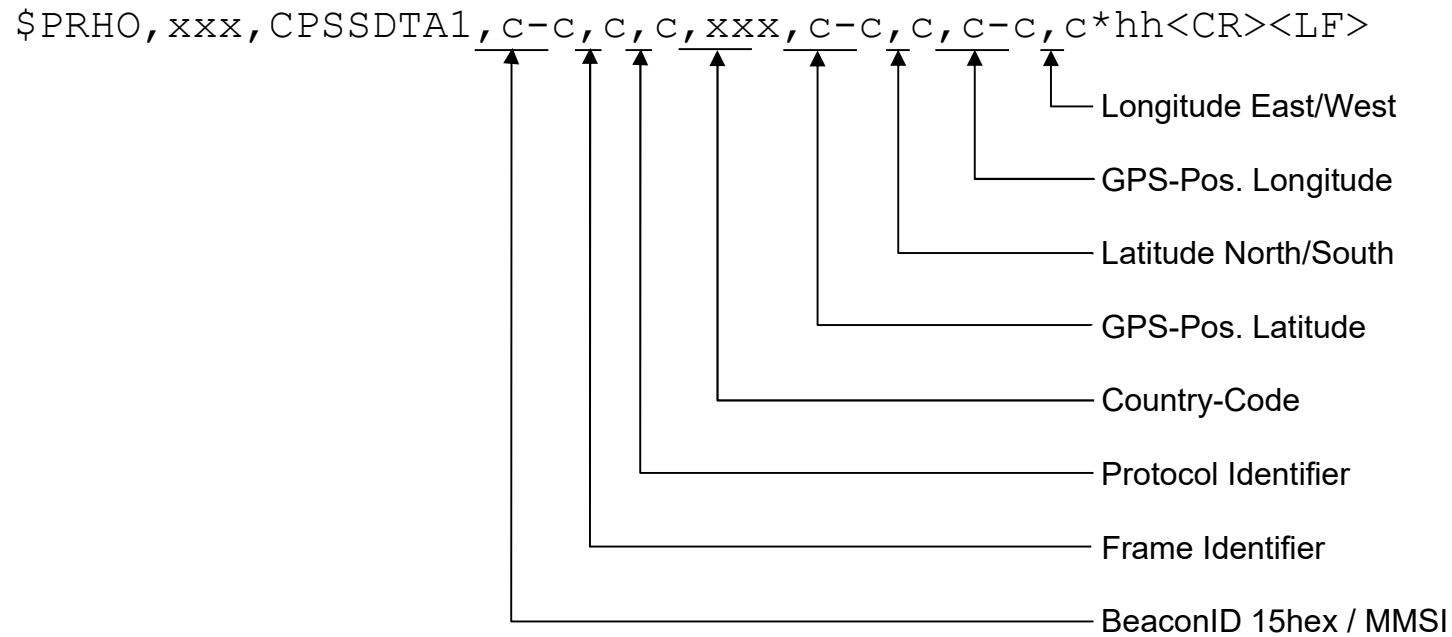
5.2.13.1   BeaconID 15hex / MMSI

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

5.2.13.2   Frame Identifier

"S":   Synchronisation Selftest
"O":   Synchronisation Normal OK
"Z":   Invalid data (or no data available)

5.2.13.3   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)

5.2.13.4   Country Code

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

5.2.13.5   GPS-Pos. Latitude

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

5.2.13.6   Latitude North/South

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

5.2.13.7   GPS-Pos. Longitude

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

5.2.13.8   Longitude East/West

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

5.2.13.9 Example A of a DF output

`$PRHO,0,CPSSDTA1,ADDF00625800AF7,O,U,366,4807.038,N,01131.000,E*68<CR><LF>`

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

5.2.13.10 Example B of a DF output

`$PRHO,0,CPSSDTA1,238456-5,O,N,358,,,,*45<CR><LF>`

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

5.2.14 CPSSDTA2 Cospas-Sarsat Data (Complete Hex Message) Sentence

`$PRHO,xxx,CPSSDTA2,`<u>`c-c`</u>`,*hh<CR><LF>`

Complete Hex Message
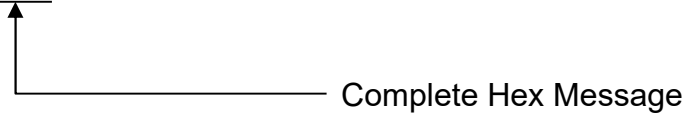
5.2.14.1 Complete Hex Message

Entire Beacon-Message, display in HEX-bytes.
If message is short-message, the hex bytes for the long message contain "--------"

5.2.14.2 Example of a DF output

`$PRHO,0,CPSSDTA2,56EF80312C0057B8CC3290--------*62<CR><LF>`

Complete Hex Message   56EF80312C0057B8CC3290 (short message)

5.2.15   FSCANCHN Fast Channel Scan Output Sentence

```
$PRHO,xxx,FSCANCHN,xxxxxx,....,xxxxxx*hh<CR><LF>
```

Frequency of Scanning-Channel 8

. . .

Frequency of Scanning-Channel 1
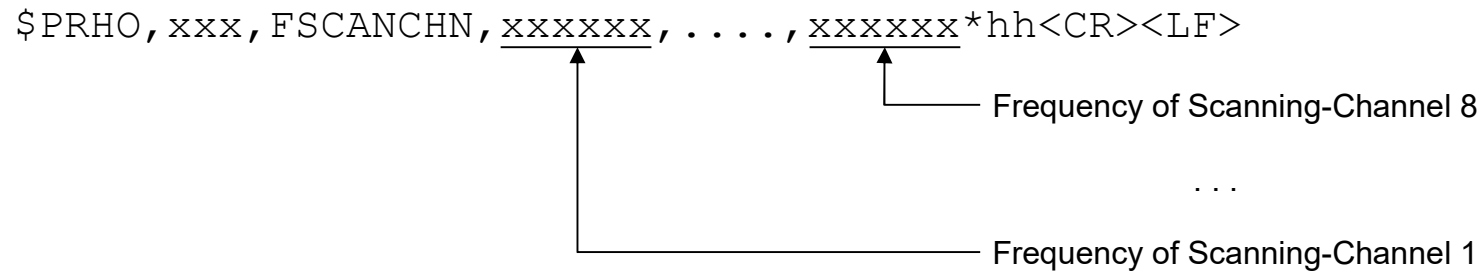
5.2.15.1   Frequencies of Scanning-Channels

Each frequency field contains the frequency of the corresponding channel of the Fast-Channel-Scan-Mode. The maximum count of channel-frequencies is 8! If there are only 5 frequencies set, 3 NULL fields are at the end of the sentence.

The format of the frequency is in [kHz] e.g., 121500 means 121500 kHz = 121.500 MHz!

Attention: This format differs from the frequency-format in the DFSTD, DFVTS and FREQU sentences!

Attention: This sentence only makes sense if option "Fast Channel Scan" is unlocked!

5.2.15.2   Example of a DF output

```
$PRHO,0,FSCANCHN,121500,121650,156800,156000,,,,*27<CR><LF>
```

Frequency of scanning channel 1:	121.500 MHz
Frequency of scanning channel 2:	121.650 MHz
Frequency of scanning channel 3:	156.800 MHz
Frequency of scanning channel 4:	156.000 MHz
Frequency of scanning channel 5:	not used
Frequency of scanning channel 6:	not used
Frequency of scanning channel 7:	not used
Frequency of scanning channel 8:	not used

5.2.16 FSCANSNR Fast Channel Scan SNR Output Sentence

```
$PRHO,xxx,FSCANSNR,xx,....,xx*hh<CR><LF>
```

SNR-Value of Scanning-Channel 8

. . .

SNR-Value of Scanning-Channel 1
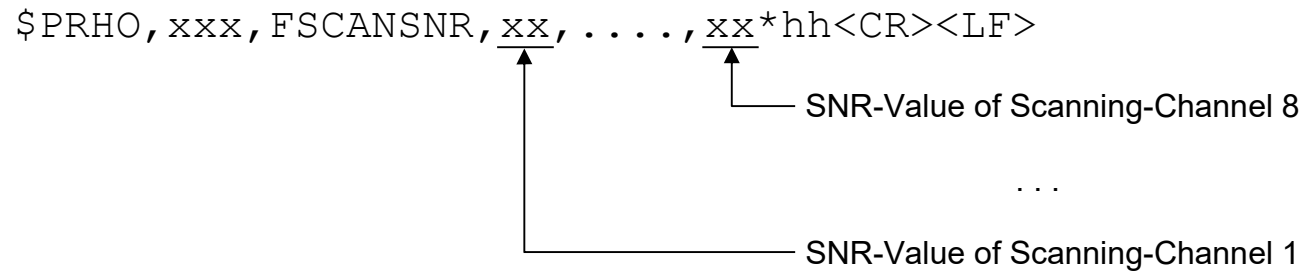
5.2.16.1   SNR-Values of Scanning-Channels

Each SNR-Value-Field contains the SNR-Value for the corresponding Channel. SNR means the amount of level-points where the autosquelch is placed above the noise level. E.g., if noise level is 35% and SNR of 6 is set, then the autosquelch-level is set to 41! Range: 1…..15, 0 or NULL field means "Auto".

Attention: This sentence only makes sense if option "Fast Channel Scan" is unlocked!

5.2.16.2   Example of a DF output

```
$PRHO,0,FSCANCHN,10,5,6,1,,,,*30<CR><LF>
```

SNR of scanning channel 1:   10
SNR of scanning channel 2:   5
SNR of scanning channel 3:   6
SNR of scanning channel 4:   1
SNR of scanning channel 5:   Auto SNR
SNR of scanning channel 6:   Auto SNR
SNR of scanning channel 7:   Auto SNR
SNR of scanning channel 8:   Auto SNR

5.2.17 LISTSCANFR Start and Stop Frequencies for Scan List Mode Output Sentence

```
$PRHO,xxx,LISTSCANFR,xxxxxx,xxxxxx,....,xxxxxx,xxxxxx*hh<CR><LF>
```

Stop of Freq. Range n (max. 10)
Start of Freq. Range n (max. 10)
. . .
Stop of Freq. Range 1
Start of Freq. Range 1
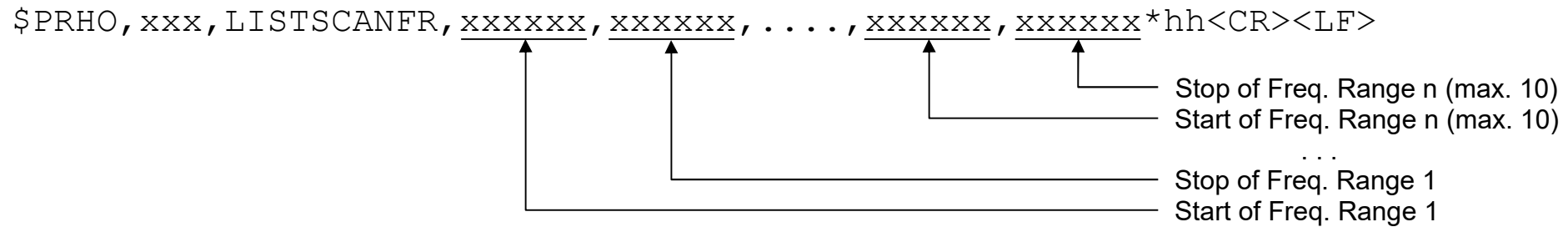
5.2.17.1 Start Frequencies of Frequency Ranges

Each frequency field contains the start frequency of the corresponding frequency range of the Scan List Mode.
The format of the frequency is the same as in FSCANCHN Fast Channel Scan Output Sentence.

5.2.17.2 Stop Frequencies of Frequency Ranges

Each frequency field contains the stop frequency of the corresponding frequency range of the Scan List Mode.
The format of the frequency is the same as in FSCANCHN Fast Channel Scan Output Sentence.

5.2.17.3 Example of a DF output

```
$PRHO,0,LISTSCANFR,118000,125000,156050,157400*32<CR><LF>
```

Start Frequency of Frequency Range 1: 118.000 MHz
Stop Frequency of Frequency Range 1: 125.000 MHz
Start Frequency of Frequency Range 2: 156.050 MHz
Stop Frequency of Frequency Range 2: 157.400 MHz

5.2.18 LISTSCANEX Exclude Frequencies for Scan List Mode Output Sentence

```
$PRHO,xxx,LISTSCANEX,xxxxxx,xxxxxx,....,xxxxxx,xxxxxx*hh<CR><LF>
```

Stop of E. Freq. Range n (max. 20)
Start of E. Freq. Range n (max. 20)
. . .
Stop of Exclude Freq. Range 1
Start of Exclude Freq. Range 1
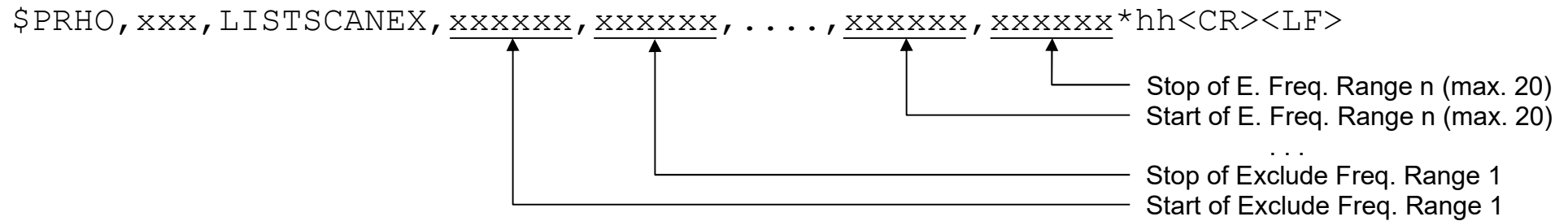
5.2.18.1 Start Frequencies of Exclude Frequency Ranges

Each frequency field contains the start frequency of the corresponding Exclude frequency range of the Scan List Mode.
The format of the frequency is the same as in FSCANCHN Fast Channel Scan Output Sentence.

5.2.18.2 Stop Frequencies of Exclude Frequency Ranges

Each frequency field contains the stop frequency of the corresponding Exclude frequency range of the Scan List Mode.
The format of the frequency is the same as in FSCANCHN Fast Channel Scan Output Sentence.

5.2.18.3 Example of a DF output

```
$PRHO,0,LISTSCANEX,,156400,156850*10<CR><LF>
```

Exclude Frequencies of Frequency Range 1: -
Exclude Frequencies of Frequency Range 2: 156.400 MHz … 156.800 MHz

5.2.19 LISTSCANRES Result Frequencies for Scan List Mode Output Sentence

```
$PRHO,xxx,LISTSCANRES,xxxxxx,....,xxxxxx*hh<CR><LF>
```

Result Frequency n

...

Result Frequency 1

5.2.19.1   Result Frequencies

Each frequency field contains a result of the last Scan List run.
The format of the frequency is the same as in FSCANCHN Fast Channel Scan Output Sentence.

5.2.19.2   Example of a DF output

```
$PRHO,0,LISTSCANRES,121500,156300,156175,156325*6D<CR><LF>
```

Result Frequency 1: 121.500 MHz
Result Frequency 2: 156.300 MHz
Result Frequency 3: 156.175 MHz
Result Frequency 4: 156.325 MHz

5.2.20 SARSCANFR Scan Frequencies for SAR Scan Output Sentence

```
$PRHO,xxx,SARSCANFR,xxxxxx,xxxxxx,xxxxxx,xxxxxx,xxxxxx*hh<CR><LF>
```

- Scan Frequency 4
- Scan Frequency 3
- Scan Frequency 2 = 243000
- Scan Frequency 1 = 121500
- CP-SS Frequency

5.2.20.1 CP-SS Frequency

This field can contain:
- A Cospas-Sarsat frequency (with the same format as in FSCANCHN Fast Channel Scan Output Sentence)
- ",,": This means, there is no defined Cospas-Sarsat frequency set, but there should run a Cospas-Sarsat Scan.

5.2.20.2 Scan Frequencies

Each frequency field contains a frequency for the SAR Scan.
The format of the frequency is the same as in FSCANCHN Fast Channel Scan Output Sentence.
Scan Frequencies 1 and 2 are always set to "121500" and "243000".

5.2.20.3 Example of a DF output

```
$PRHO,0,SARSCANFR,406033,121500,243000,121650,,*7F<CR><LF>
```

CP-SS Frequency: 406.033 MHz
Scan Frequency 1: 121.500 MHz
Scan Frequency 2: 243.000 MHz
Scan Frequency 3: 121.650 MHz
Scan Frequency 4: Not used

5.2.21 MONSCANFR Scan Frequencies for Monitoring Output Sentence

```
$PRHO,xxx,MONSCANFR,xxxxxx,xxxxxx,xxxxxx,xxxxxx*hh<CR><LF>
```

Monitoring Scan Frequency 4
Monitoring Scan Frequency 3
Monitoring Scan Frequency 2
Monitoring Scan Frequency 1 = 121500

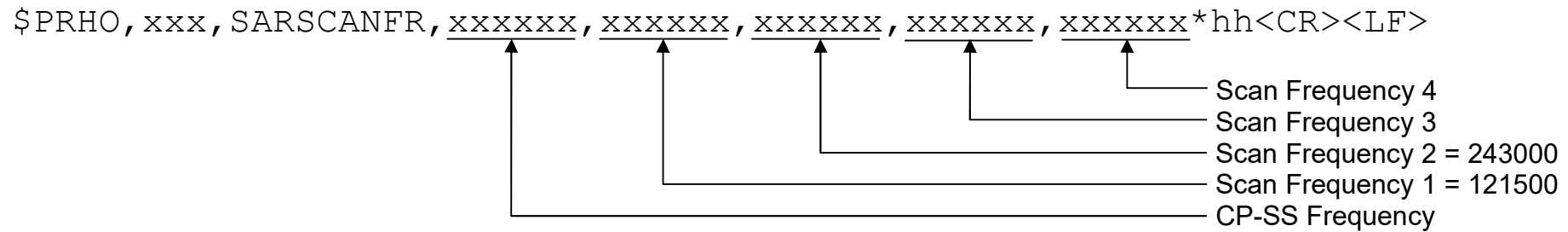#### 5.2.21.1 Monitoring Scan Frequencies

Each frequency field contains a frequency for the Monitoring Scan.
The format of the frequency is the same as in FSCANCHN Fast Channel Scan Output Sentence.
Monitoring Scan Frequencies 1 is always set to "121500".

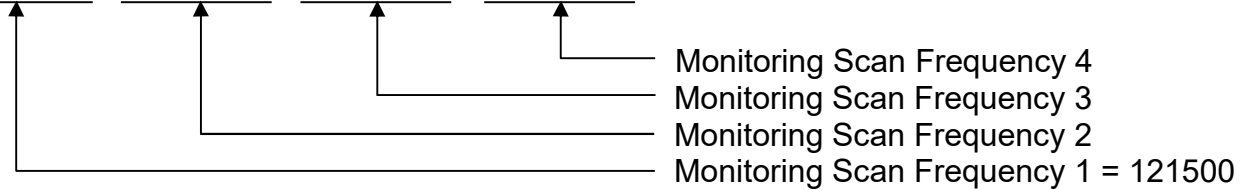#### 5.2.21.2 Example of a DF output

```
$PRHO,0,MONSCANFR,121500,243000,121650,,*5D<CR><LF>
```

Monitoring Scan Frequency 1: 121.500 MHz
Monitoring Scan Frequency 2: 243.000 MHz
Monitoring Scan Frequency 3: 121.650 MHz
Monitoring Scan Frequency 4: Not used

5.2.22 LISTSCANEX Exclude List frequencies for Marine Scan and Scan List mode

```
$PRHO,xxx,LISTSCANEX,xxxxxx,xxxxxx,...,xxxxxx,xxxxxx*hh<CR><LF>
```

— Exclude List Stop Frequency x
— Exclude List Start Frequency x
— Exclude List Stop Frequency 1
— Exclude List Start Frequency 1
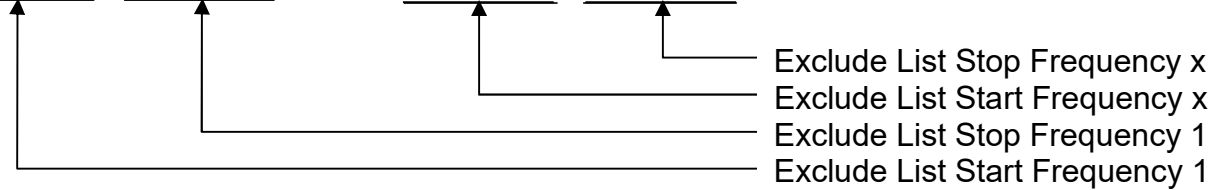
5.2.22.1   Exclude List Start and Stop Frequency

This fields contain Start and Stop frequencies of the frequency ranges in the Exclude List.
If only one Exclude frequency is defined, Start and Stop frequencies contain the same value.
To set new Exclude frequencies, please use LISTSCANEX – Command! (see chapter 6.12).

5.2.22.2   Example of a DF output

```
$PRHO,0,LISTSCANEX,119225,123000,155800,155800*39<CR><LF>
```

Exclude List Start Frequency 1: 119.225 MHz
Exclude List Stop Frequency 1: 123.000 MHz
Exclude List Start Frequency 2: 155.800 MHz
Exclude List Stop Frequency 2: 155.800 MHz

5.2.23 CMDOK Command OK

```
$PRHO,xxx,CMDOK*hh<CR><LF>
```

The requested operation finished successfully.

5.2.24 ERRCMD Command Unknown Error

`$PRHO,xxx,ERRCMD*hh<CR><LF>`

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

5.2.25 ERRFIELD Field Unknown Error

`$PRHO,xxx,ERRFIELD*hh<CR><LF>`

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

5.2.26 ERRRANGE Field Value out of Range Error

`$PRHO,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.

5.2.27 TIME DCU System Time Sentence

```
$PRHO,xxx,TIME,c-c,c-c,c-c*hh<CR><LF>
```

Summer time

Time zone offset
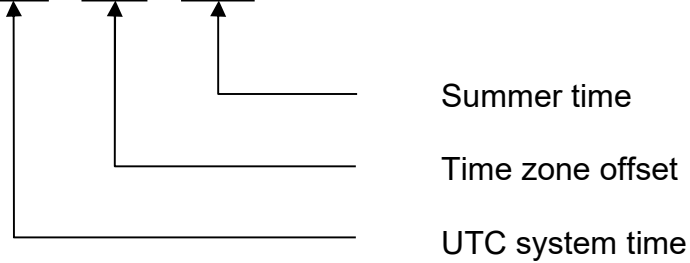
UTC system time

5.2.27.1 UTC system time
Time in format: HH:MM:SS

5.2.27.2 Time zone offset
Time in format: +HH:MM
Standard time zones: +00:00; +01:00; +02:00; +03:00; +03:30; +04:00; +04:30; +05:00; +05:30; +05:45; +06:00; +06:30; +07:00; +08:00; +08:30; +08:45; +09:00; +09:30; +10:00; +11:00; +12:00; +12:45; +13:00; +14:00; -01:00; -02:00; -03:00; -03:30; -04:00; -04:30; -05:00; -06:00; -07:00; -08:00; -09:00; -09:30; -10:00; -11:00; -12:00; -13:00; -14:00

5.2.27.3 Summer time
Summer time in format: ON/OFF

5.2.27.4 Example of a DF output

```
$PRHO,xxx,TIME,15:06:21,+00:00,OFF*hh<CR><LF>
```

UTC system time → 15:06:21
Time zone offset → +00:00
Summer time → OFF

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:

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

Checksum field

Data of remote control command

Indicates type of control sentence

Indicates a control sentence

Device Address ID

Manufacturer mnemonic code

Proprietary sentence identifier
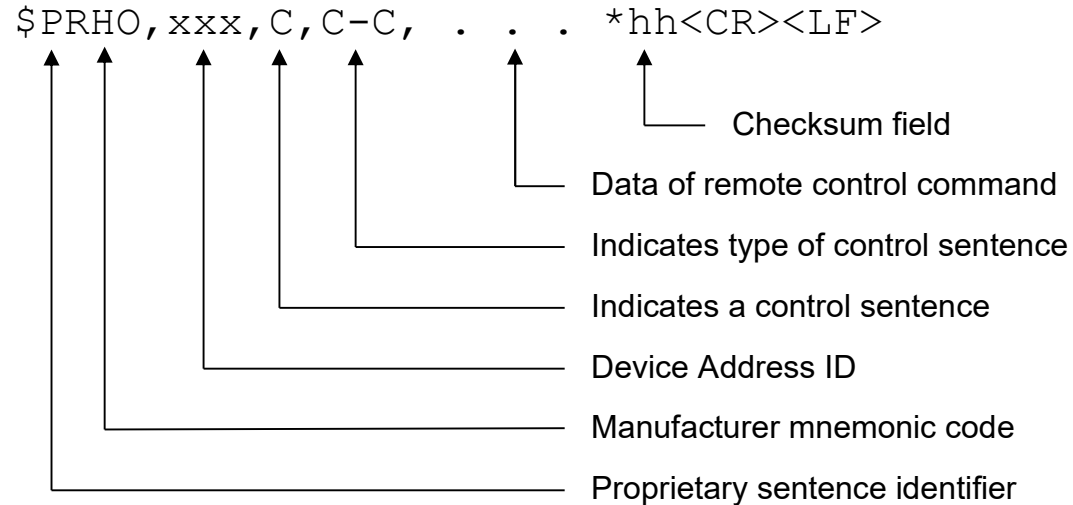
The DF only reacts to the control sentences if the address ID in the sentence is 255 or is equal to the one selected in the Setup/Interface/NMEA DF Remote/Remote Address ID. The address allows to access different DFs that are connected to one TX.
c—c is a variable text field, which describes the type of data in this sentence.

Remark:
The values set by NMEA commands will not be stored in the DF internal flash memory, so these values are only valid as long the DF has power. After the reset of the DCU, all those values have to be set again.

6.1 FREQU Set Main Receiving Frequency

This sentence sets the current main receiving frequency.

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

Main Receiving Frequency

Device Address ID (see Page 26)

The answer to a successful FREQU command will be the DFSTD sentence, which is described in chapter 4.1.
If the operation was not successful, the answer is one of the three error sentences ERRCMD (5.2.24), ERRFIELD (5.2.25) or ERRRANGE (5.2.26) .

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

6.1.1   Main Receiving Frequency

This field contains the receiving frequency in MHz. "121.500" means a frequency of 121.500 MHz. If the frequency is not a multiple of the receiver channel spacing, the nearest receiving frequency will be set as new receiving frequency.
The frequency ranges for each band depend on the connected AU and can be obtained with the "BAND" request!

6.1.2   Example A of a typical control sentence

```
$PRHO,0,C,FREQU,121.650*0C<CR><LF>
```

The new receiving frequency will be 121.650 MHz

6.1.3   Example B of a typical control sentence

`$PRHO,0,C,FREQU,121.510*0B<CR><LF>`

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

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 4.1.
If the operation was not successful, the answer is one of the three error sentences ERRCMD (5.2.24), ERRFIELD (5.2.25) or ERRRANGE (5.2.26) .

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 (5.2.26) sentence will be the answer instead of the DFSTD sentence.

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

Attention:
- DFSTD-Sentence contains the *old* squelch value for approx. 600 ms due to frequency change -> new squelch level can be checked by DFSTD-Request after 600 ms!
- If Cospas-Sarsat scanning is active, squelch cannot 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 of a typical control sentence

`$PRHO,0,C,SQU,35*27<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>`

Condition
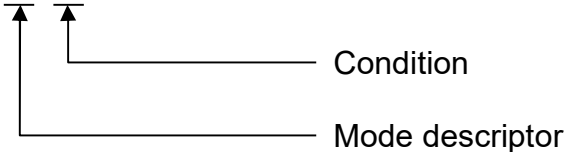
Mode descriptor

The answer to a successful MODE command will be the DFSTD sentence, which is described in chapter 4.1.
If the operation was not successful, the answer is one of the three error sentences ERRCMD (5.2.24), ERRFIELD (5.2.25) or ERRRANGE (5.2.26) .

6.3.1 Mode descriptor

Following modes are defined:
- "M"   Monitoring Mode
- "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
- "H"   Fast Channel Scan Mode (only for AU-variant [V] or option "Fast Channel Scan" is unlocked)
- "B"   Fast Channel Scan Mode with BeepTone-Decoding (only for AU-variant [V] or option "Fast Channel Scan" is unlocked)
- "E"   SAR Scan
- "G"   Scan List

Attention:
- If the DF (especially the AU) doesn't support the required special mode, the answer will be the ERRRANGE sentence (Chapter: 5.2.26)
- Monitoring can be switched off remotely in spite of having set "Monitoring/Off blocked" in the system menu!
- If Fast Channel Scan is activated and no valid channels are set before using the "FSCANCHN" sentence, scanning is not started and ERRRANGE sentence is replied!

6.3.2   Condition

- "A"   Activation
- "X"   Activation with usage of Exclude List. Only available for:
    - "F"   Fast-Scanning of Marine-Band
    - "G"   Scan List
- "E"   Activation with ELT/PLB only filtering for the corresponding frequencies. Only available for:
    - "M"   Monitoring Mode
    - "E"   SAR Scan
- "R"   Going to the result of the last scan. The effect depends on the mode:
    - Modes "M", "P", "F", "H", "B", "E": Bearing on the last detected frequency.
    - Mode "G": Activation of the Scan List (only the results of the last run are scanned).
- "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,0,C,MODE,M,A*55<CR><LF>
```

This sentence will activate the Monitoring-Mode.

6.4 VOL Set Volume

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

Reserved2

Reserved1

NF (speaker) volume
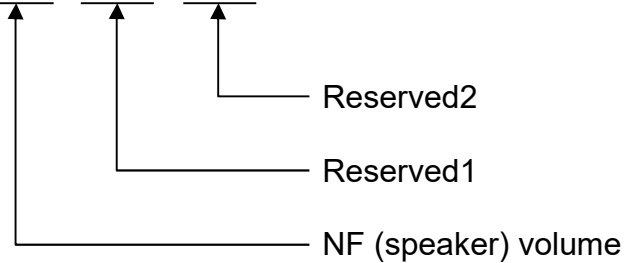
The answer to a successful VOL command will be the VOL sentence, which is described in chapter 5.2.9.

If the operation was not successful, the answer is one of the three error sentences ERRCMD (5.2.24), ERRFIELD (5.2.25) or ERRRANGE (5.2.26) .

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 (5.2.26) 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

`$PRHO,0,C,VOL,80,,*2B<CR><LF>`

NF (speaker) volume → 80%

6.5 CPSSCFM Cospas-Sarsat Alarm Confirm

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

The answer to a successful CPSSCFM command will be the CMDOK sentence (see chapter 5.2.23).
If the operation was not successful, the answer is one of the error sentences ERRCMD (5.2.24), ERRFIELD (5.2.25).

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

`$PRHO,0,C,CPSSCFM*01<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 5.2.23).
If the operation was not successful, the answer is one of the error sentences ERRCMD (5.2.24), ERRFIELD (5.2.25).

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, "B"-character for BeepTone-Alarm) in the mode-field of DFSTD output sentence!

6.6.1 Example A of a typical control sentence

`$PRHO,0,C,ALARMCFM*41<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.
Attention: 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 5.2.23.

6.7.1   Baud rate number

The following baud rate numbers are defined:
- "1"   1200 Baud
- "2"   not valid
- "3"   4800 Baud
- "4"   9600 Baud
- "5"   not valid
- "6"   19.2 kBaud
- "7"   not valid
- "8"   38.4 kBaud
- "9"   57.6 kBaud
- "10"   not valid
- "11"   115.2 kBaud

If this field contains a non-recognised character or number, the ERRFIELD (5.2.25) or ERRRANGE (5.2.26) sentence will be the answer instead of the CMDOK sentence (chapter 5.2.23).

6.7.2   Example of a typical control sentence

```
$PRHO,0,C,BAUD,4*50<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.

$PRHO,xxx,C,TALKMODE,<u>c—c</u>,<u>x</u>*hh<CR><LF>

Talk time mode and interval

Sentence descriptor

The answer to a successful TALKMODE command will be the CMDOK sentence, which is described in chapter 5.2.23.
If the operation was not successful, the answer is one of the two error sentences ERRCMD (5.2.24), ERRFIELD (5.2.25) .

6.8.1 Sentence descriptor

Up to now, the following types are defined:
- "DFSTD"   RHOTHETA standard bearing sentence is sent.
- "DFVTS"   RHOTHETA standard VTS sentence is sent.
- "DFBRG"   DFBRG sentence is sent.

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

6.8.2 Talk time mode and interval

- "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

`$PRHO,0,C,TALKMODE,DFBRG,4*2A<CR><LF>`

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

6.8.4   Example B of a typical control sentence

`$PRHO,0,C,TALKMODE,DFSTD,0*3A<CR><LF>`

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

6.9 FSCANCHN Fast Channel Scan Control Sentence

This sentence sets the frequencies of the fast channel scan mode.

`$PRHO,xxx,C,FSCANCHN,`<u>`xxxxxx`</u>`,....,`<u>`xxxxxx`</u>`*hh<CR><LF>`

                                        — Frequency of Scanning-Channel 8

. . .

Frequency of Scanning-Channel 1

The answer to a successful FSCANCHN command will be the FSCANCHN data out sentence, which is described in chapter 5.2.15.
If the operation was not successful, the answer is one of the three error sentences ERRCMD (5.2.24), ERRFIELD (5.2.25) or ERRRANGE (5.2.26) .

Attention: This sentence only makes sense if option "Fast Channel Scan" is unlocked!

6.9.1 Frequencies of Scanning-Channels

Each frequency field contains the frequency of the corresponding channel of the Fast-Channel-Scan-Mode. The maximum count of channel-frequencies is 8! If there are only 5 frequencies to set (scan), 3 NULL fields must be inserted at the end of the sentence.

The format of the frequency is in [kHz] e.g., 121500 means 121500 kHz = 121.500 MHz!

Attention: This format differs from the frequency-format in the DFSTD, DFVTS and FREQU sentences!

6.9.2 Example of a typical FSCANCHN control sentence

`$PRHO,0,C,FSCANCHN,121500,121650,156800,156000,,,,*48<CR><LF>`

Frequency of scanning channel 1:   121.500 MHz
Frequency of scanning channel 2:   121.650 MHz

Frequency of scanning channel 3:	156.800 MHz
Frequency of scanning channel 4:	156.000 MHz
Frequency of scanning channel 5:	Set to empty!
Frequency of scanning channel 6:	Set to empty!
Frequency of scanning channel 7:	Set to empty!
Frequency of scanning channel 8:	Set to empty!

6.10 FSCANSNR Fast Channel Scan SNR Control Sentence

```
$PRHO,xxx,C,FSCANSNR,xx,....,xx*hh<CR><LF>
```

SNR-Value of Scanning-Channel 8

. . .

SNR-Value of Scanning-Channel 1
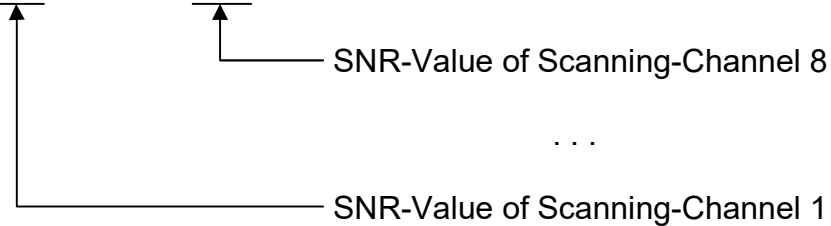
6.10.1 SNR-Values of Scanning-Channels

Each SNR-Value field contains the SNR-Value for the corresponding channel. SNR means the amount of level-points where the autosquelch is placed above the noise level. E.g., if noise level is 35% and SNR of 6 is set, then the autosquelch-level is set to 41! Range: 1…..15, 0 or NULL field means "Auto".

Remark: This sentence only makes sense, if option "Fast Channel Scan" is unlocked!

6.10.2 Example of a typical control sentence

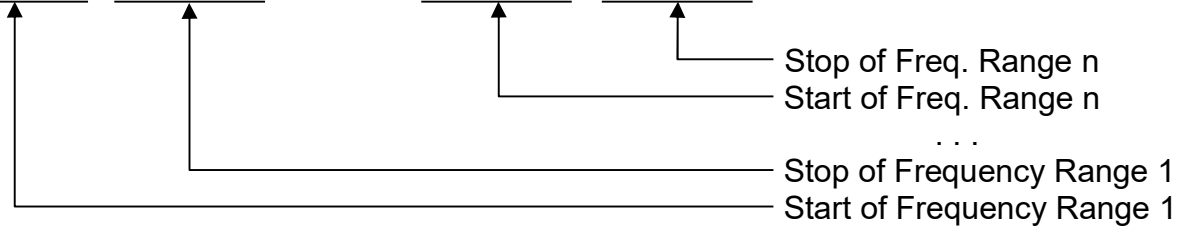```
$PRHO,0,C,FSCANSNR,10,5,6,1,,,,*7F<CR><LF>
```

| SNR of scanning channel 1: | 10 |
| SNR of scanning channel 2: | 5 |
| SNR of scanning channel 3: | 6 |

SNR of scanning channel 4:        1
SNR of scanning channel 5:        Auto SNR
SNR of scanning channel 6:        Auto SNR
SNR of scanning channel 7:        Auto SNR
SNR of scanning channel 8:        Auto SNR

## 6.11  LISTSCANFR Scan List Frequencies Control Sentence

This sentence sets the frequencies of the Scan List Mode.

```
$PRHO,xxx,C,LISTSCANFR,xxxxxx,xxxxxx,....,xxxxxx,xxxxxx*hh<CR><LF>
```

- Stop of Freq. Range n
- Start of Freq. Range n
  . . .
- Stop of Frequency Range 1
- Start of Frequency Range 1

The answer to a successful LISTSCANFR command will be the LISTSCANFR data out sentence, which is described in chapter 5.2.17. If the operation was not successful, the answer is one of the three error sentences ERRCMD (5.2.24), ERRFIELD (5.2.25) or ERRRANGE (5.2.26).

6.11.1 Start Frequencies of Frequency Ranges

Each frequency field contains the start frequency of the corresponding frequency range of the Scan List Mode.
The format of the frequency is the same as in FSCANCHN Fast Channel Scan Output Sentence.

6.11.2 Stop Frequencies of Frequency Ranges

Each frequency field contains the stop frequency of the corresponding frequency range of the Scan List Mode.
The format of the frequency is the same as in FSCANCHN Fast Channel Scan Output Sentence.
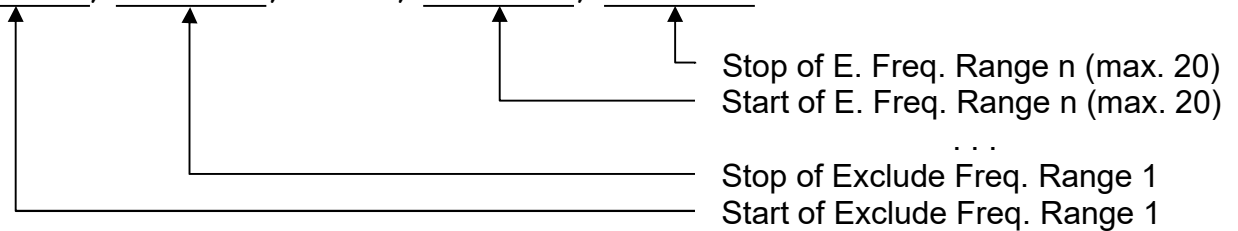
6.11.3 Example of a typical LISTSCANFR Control Sentence

`$PRHO,0,C,LISTSCANFR,118000,125000,156050,157400*5D<CR><LF>`

Start Frequency of Frequency Range 1: 118.000 MHz
Stop Frequency of Frequency Range 1: 125.000 MHz
Start Frequency of Frequency Range 2: 156.050 MHz
Stop Frequency of Frequency Range 2: 157.400 MHz

6.12 LISTSCANEX Scan List Exclude Frequencies Control Sentence

`$PRHO,xxx,C,LISTSCANEX,xxxxxx,xxxxxx,....,xxxxxx,xxxxxx*hh<CR><LF>`

Stop of E. Freq. Range n (max. 20)
Start of E. Freq. Range n (max. 20)
. . .
Stop of Exclude Freq. Range 1
Start of Exclude Freq. Range 1

6.12.1 Start Frequencies of Exclude Frequency Ranges

Each frequency field contains the start frequency of the corresponding Exclude frequency range of the Scan List Mode.
The format of the frequency is the same as in FSCANCHN Fast Channel Scan Output Sentence.

6.12.2 Stop Frequencies of Exclude Frequency Ranges

Each frequency field contains the stop frequency of the corresponding Exclude frequency range of the Scan List Mode.
The format of the frequency is the same as in FSCANCHN Fast Channel Scan Output Sentence.

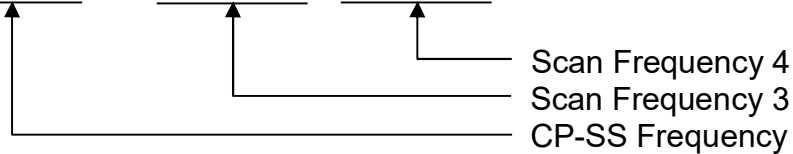### 6.12.3 Example of a typical LISTSCANEX Control Sentence

`$PRHO,0,C,LISTSCANEX,156400,156850*53<CR><LF>`

Exclude Frequencies of Frequency Range 1: -
Exclude Frequencies of Frequency Range 2: 156.400 MHz … 156.800 MHz

6.13 SARSCANFR Scan Frequencies for SAR Scan Control Sentence

`$PRHO,xxx,C,SARSCANFR,xxxxxx,,,xxxxxx,xxxxxx*hh<CR><LF>`

```
                                                        Scan Frequency 4
                                                        Scan Frequency 3
                                                        CP-SS Frequency
```

6.13.1 CP-SS Frequency
This field can contain:
-   A Cospas-Sarsat frequency (with the same format as in FSCANCHN Fast Channel Scan Output Sentence)
-   ",,": This means, there is no defined Cospas-Sarsat frequency set, but there should run a Cospas-Sarsat scan.

6.13.2 Scan Frequencies
Each frequency field contains a frequency for the SAR Scan.
The format of the frequency is the same as in FSCANCHN Fast Channel Scan Output Sentence.
Scan Frequencies 1 and 2 are always set to "121500" and "243000".
The frequency "121500" cannot be modified. The frequency "243000" can be removed from the list if desired.

6.13.3 Example of a typical SARSCANFR Control Sentence

`$PRHO,0,C,SARSCANFR,406033,,,121650,*3E<CR><LF>`

CP-SS Frequency: 406.033 MHz
Scan Frequency 1: 121.500 MHz
Scan Frequency 2: 243.000 MHz
Scan Frequency 3: 121.650 MHz
Scan Frequency 4: Not used

6.14 MONSCANFR Scan Frequencies for Monitoring Control Sentence

`$PRHO,xxx,C,MONSCANFR,,xxxxxx,xxxxxx,xxxxxx*hh<CR><LF>`

Monitoring Scan Frequency 4
Monitoring Scan Frequency 3
Monitoring Scan Frequency 2
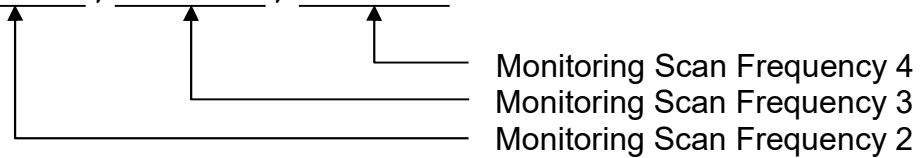
6.14.1.1 Monitoring Scan Frequencies

Each frequency field contains a frequency for the Monitoring Scan.
The format of the frequency is the same as in FSCANCHN Fast Channel Scan Output Sentence.
Monitoring Scan Frequencies 1 is always set to "121500" and cannot be modified.

6.14.1.2 Example of a typical MONSCANFR Control Sentence

`$PRHO,0,C,MONSCANFR,,243000,121650,*19<CR><LF>`

Monitoring Scan Frequency 1: 121.500 MHz
Monitoring Scan Frequency 2: 243.000 MHz
Monitoring Scan Frequency 3: 121.650 MHz
Monitoring Scan Frequency 4: Not used

6.15 REBOOT Reset of the DCU

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

The answer to a successful REBOOT command will be the CMDOK sentence (see chapter 5.2.23).
The DCU is rebooted afterward.
If the operation was not successful, the answer is one error sentences ERRCMD (5.2.24), ERRFIELD (5.2.25).

6.15.1 Example A of a typical control sentence

```
$PRHO,0,C,REBOOT*5B<CR><LF>
```

The DCU is rebooted!

6.16 KEYLOCK Remote Locking of Keyboard

This sentence locks the keyboard from remote.

```
$PRHO,xxx,C,KEYLOCK,c*hh<CR><LF>
```
                            └─────────── Condition

The answer to a successful KEYLOCK command will be the CMDOK sentence (see chapter 5.2.23).
If the operation was not successful, the answer is one of the three error sentences ERRCMD (5.2.24), ERRFIELD (5.2.25) or ERRRANGE (5.2.26) .

6.16.1 Condition

- "A"   Activation of keyboard lock
- "C"   Deactivation (cancelling) of keyboard lock

6.16.2 Example of a typical control sentence

`$PRHO,0,C,KEYLOCK,A*6B<CR><LF>`

This sentence will activate the keyboard locking.

6.17 SCANOPT Set Scanning Options

This sentence sets scanning options.

`$PRHO,xxx,C,SCANOPT,c*hh<CR><LF>`

Option

The answer to a successful SCANOPT command will be the CMDOK sentence (see chapter 5.2.23).
If the operation was not successful, the answer is one of the three error sentences ERRCMD (5.2.24), ERRFIELD (5.2.25) or ERRRANGE (5.2.26) .

6.17.1 Option

"P"   Proceed scanning with the next channel/frequency immediately

6.17.2 Example of a typical control sentence

`$PRHO,0,C,SCANOPT,P*72<CR><LF>`

This sentence will continue scanning.

6.18 SETTIME SET DCU System Time

```
$PRHO,xxx,C,SETTIME,c—c,c—c,c—c*hh<CR><LF>
```

                                    └──────── Summer time
                          └────────────────── Time zone offset
                └──────────────────────────── UTC system time

The answer to a successful SETTIME command will be CMDOK sentence (see chapter 5.2.23).
If the operation was not successful, the answer is an error sentence ERRCMD (s. 5.2.24)

6.18.1 UTC system time
Time in format: HH:MM:SS

6.18.2 Time zone offset
Time in format: +HH:MM
Standard Time zones: +00:00; +01:00; +02:00; +03:00; +03:30; +04:00; +04:30; +05:00; +05:30; +05:45; +06:00; +06:30; +07:00; +08:00; +08:30; +08:45; +09:00; +09:30; +10:00; +11:00; +12:00; +12:45; +13:00; +14:00; -01:00; -02:00; -03:00; -03:30; -04:00; -04:30; -05:00; -06:00; -07:00; -08:00; -09:00; -09:30; -10:00; -11:00; -12:00; -13:00; -14:00

6.18.3 Summer time
Summer time in format: ON/OFF

6.18.4 Example of a DF output

```
$PRHO,xxx,C,SETTIME,11:08:00,+01:00,OFF*hh<CR><LF>
```

UTC system time   → 11:08:00
Time zone offset   → +01:00
Summer time   → OFF

7 Examples for NMEA Applications

7.1 Monitoring for ELT signals on 121.500 MHz

See also 4.1.2 / Mode "U" with active status "Alarm ELT".

Command sentences:

Set main frequency to 121.500 MHz
`$PRHO,255,C,FREQU,121.500*08<CR><LF>`
Set Squelch Level to 0% (= max. sensitivity)
`$PRHO,255,C,SQU,0*13<CR><LF>`

Wait for min. 10 sec.
The necessary audio decoding time span depends strictly on the signal quality. Even if the RF ELT signal is very weak and maybe also sometimes interrupted (as example by waves) a wait time of [15 … 20] sec is recommended.

Evaluate standard DF Output Sentence DFSTD:

Example (1) DFSTD sentence with **NO ELT** detection:
DF: `$PRHO,0,DFSTD,0,0,,121.500,0,30,288,,,190,32*49<CR><LF>`

Example (2) DFSTD sentence with **active ELT** detection (Mode character "U" set)
DF: `$PRHO,0,DFSTD,0,0,U,121.500,0,59,290,,,243,30*15<CR><LF>`
If a mode character "U" is set once, it is hold also if no more ELT signal is active and can only be deleted/confirmed with the ALARMCFM (Alarm Confirm) NMEA command sentence …
`$PRHO,255,C,ALARMCFM*43<CR><LF>`

7.2 Monitoring for Cospas-Sarsat pulses

See also 4.1.3 / Mode "V" with active status "Alarm Cospas-Sarsat"

Preliminary note:

Practical monitoring of active Cospas-Sarsat signals is complicated by a few reasons. The signal is specified approx. as a short pulse of 500 ms with a repetition rate of 50 sec. Furthermore, the exact transmitting channel is unknown and can be different for each transmitter within the frequency spectrum in the band 406.000 … 406.100 MHz.

The example below is a help for implementation of a complete Cospas-Sarsat monitoring process, controlled by a custom specific remote control application. This process is containing two steps and for each step the receiving of one Cospas-Sarsat pulse is necessary. Two transmitted pulses are meaning a necessary time span of approx. 2 minutes (min. 2 x 50 sec).
The first pulse is needed to detect the actually frequency by scanning the whole band, and the second step is mandatory to verify the signal by decoding the binary message. The decoding and verifying is important, because also RF jamming could stop the scanning and could result in a false alarm.

1. Step / Scan frequency

Command sentence:

Activate Direction Finder Cospas-Sarsat Scan Mode
$PRHO,255,C,MODE,P,A*4A<CR><LF>

Evaluate standard DF Output Sentence DFSTD for 60 sec

Example (1) DFSTD sentence with **no frequency detection** (scanning is in process):
DF: $PRHO,0,DFSTD,0,0,PQ,406.000,16,11,,,,,<CR><LF>
Mode "P" = Cospas-Sarsat Scan Mode is still active

Example (2) DFSTD sentence with scan finished and **active frequency detection**
DF: $PRHO,0,DFSTD,0,0,Q,406.058,14,12,,,,,<CR><LF>

NO mode "P" indicates Scan mode finished
       "406.058" shows exact detected Cospas-Sarsat puls frequency
       (this frequency is automatically set as main frequency when the scan stops)

Only if the scan is finished (and the frequency of the last Cospas-Sarsat pulse is detected) the second step is executed for verifying. The direction finder has to be switched to decode mode and the next received pulse is checked for accurate decoded binary data message.

2. Step / Verify by decoding (the next pulse)

Command sentence:

Activate Direction Finder Cospas-Sarsat Decode Mode
`$PRHO,255,C,MODE,C,A*59<CR><LF>`

Evaluate standard DF Output Sentence DFSTD for 60 sec

Example (1) DFSTD sentence with **NO accurate puls**

DF: `$PRHO,0,DFSTD,0,0,CQ,406.058,16,20,,,,,<CR><LF>`

Mode "C" = Cospas-Sarsat Decode mode is still active

If after 60 sec no accurate pulse was detected, then the decoding has to be stopped and step (1) or any other custom specific process has to be continued.

Command to finish the Decode Mode
`$PRHO,255,C,MODE,,C*18<CR><LF>`

Example (2) DFSTD sentence with **detection** and verification of **active Cospas-Sarsat** signal
`$PRHO,0,DFSTD,0,0,CVQI,406.058,14,21,,,,,<CR><LF>`

Mode "V" = Alarm Cospas-Sarsat (decoding of Cospas-Sarsat pulse was successful)

Also here the command to finish the Decode Mode is necessary
`$PRHO,255,C,MODE,,C*18<CR><LF>`