

PLB RT-B77 & DF RT-300

Trial with KNRM

Direction Finder System RHOTHETA: RT-300 & Personal Locator Beacon: RT-B77

6. November 2007

Trial-Area North of Schiermonnikoog

Version of report: [Rev 1.00]

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1 Introduction

1.1 Purpose & Background

The whole purpose of this trial was a practical system test of the new RHOTHETA PLB beacon RT-B77 and the direction finder RT-300. Under control of Mr. H.E. van der Molen (Technical Inspecteur KNRM) the trial was divided in three main-parts:

- Rendezvous with Coast Guard Helicopter on open sea for lifeboat visibility / recognizability tests (not part of this report)
- Range Test (Measurement of max. distance)
- Search Test (Simulation of MOB search under bad conditions)

Brief description of used equipment:

- Personal Locator Beacon: RT-B77 "HELB"
The RT-B77 "HELB" is currently the most advanced and most powerful personal locator beacon (PLB) available on the market for man overboard (MOB) emergencies. The RT-B77 is designed for automatic activation upon contact with water or inflation of the wearer's life jacket and can also be activated manually. Output Power 2W max. with Powermanagement.
This PLB also features a second frequency that can be used for testing or training purposes. Transmission of a dedicated ID and simple control of system and maintenance data by means of an IRDA interface are important benefits for operators of larger fleets. Autotest functions and status reports are announced by the system's speaker to guarantee high availability.
- Direction Finder: RT-300
Universal dual-band direction finder system for localization of marine band radio signals as well as emergency signals on the emergency frequency 121.500 MHz. SAR direction finder and navigation aid for commercial vessels.
- For recording all important data and reportgeneration there were used a Trial Test Sets (PDA based). This Hardware is connected via serial NMEA Bus directly to the direction finder system and logs all interesting data each 250ms. (Ship GPS position, Speed, Heading, Direction finder bearing, receiving signal level, ...)

2 General Informations about the trial

2.1 Date and Time

The trial took place at 6. November 2007, [07:59:07 ... 10:50:07 time UTC]

All timing data (LOG Files...) are referenced by UTC Time (= Local time – 1 h)

2.2 Location of the complete trial

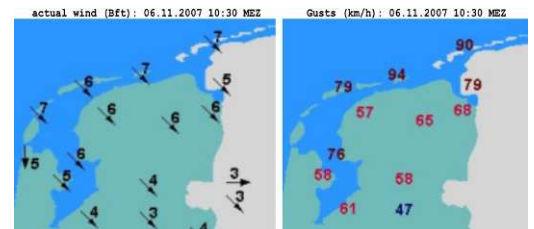
The trial took place in the North Sea / Netherlands / North of Schiermonnikoog.

Area: 53.52° North / 5.99° East ... 53.43° North / 6.61° East



2.3 Ambient Weather Conditions

Weather situation:	Stormy weather / no rain
Cloud-cover:	5/8 clouds
Temperature air:	9°C
Temperature water:	13°C
salt content water:	15 ... 25 per mill
Wave height:	1m (near bank) to 3..6m (surf/surge)



2.4 Participants

- H.E. van der Molen (Technical Inspecteur KNRM) / Organizer of the trial
- Jan Regeling (Nautical Inspecteur KNRM)
- Captain Peter Reymer (Nautical Inspecteur DGzRS)
- Dr. Thore Hagman, Klas Johansson, Fredrik Frsman (SSRS)
- Jugo Baya (Company Shiptron)
- Wimold Peters (Company PDEngineers)
- Ing. A.C.J. Ton Duivestein (Nederlands Loodswezen)
- Henk N.M. Scholten (Gaz de France)
- Skipper and crew of the KNRM Lifeboats: Koning Willem & Ameland
- Company RHOTHETA Elektronik GmbH:
Dipl.Ing. Oliver Lang-Deyhle, Dipl.Ing. Wolfgang Pichl, Dipl.Ing. Tony Baier

2.5 Installation and preparation of the Direction Finder System RT-300

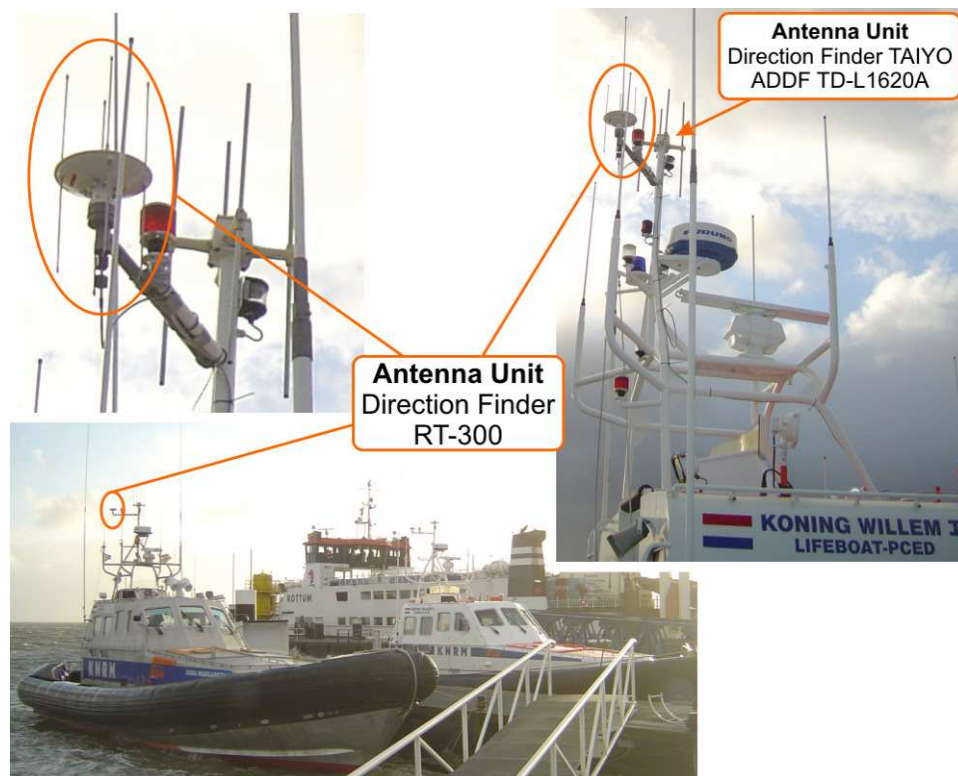
The used direction finder System RHOTHETA RT-300 (Serial No. 00038) was installed temporary shortly before the trial at the KNRM lifeboat "Koning Willem I".

The DF system was equipped with the new Software (DCU & AU) [Rev 2.20] with improved bearing averaging. (PS-sumimator not cleared by short breaks as damped by waves or cyclic RF-transmissions breaks)

The Antenna height was aprox. 6m about sea-level. The focus of the trial was the range test (max. distance), so the bad location of the bearing antenna (concerning possible reflexions by the antennas around) was accepted.

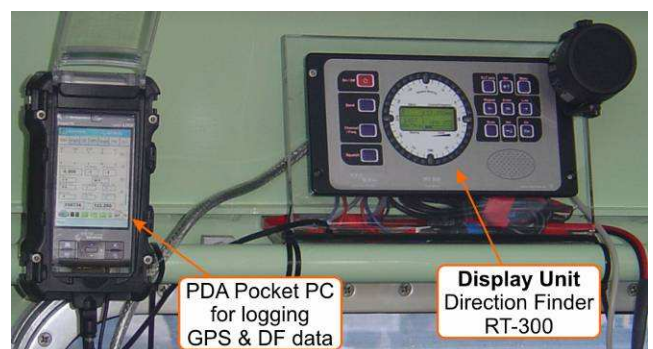
Very interesting are the good bearing results (about 360°) in spite of the bad bearing antenna position (between a lot of antennas and directly beside the other Doppler direction finder with 4 dipol beamers).

The reason for this is probably the good averaging algorithm and the always moving antenna within the incoming wave-field (boat was always in motion because of the rough sea)



The direction finder RT-300 Display (DCU) was also installed temporary. It was connected to the +24V DC Boat power (Casing isolated against boat hull).

For logging of all data a PDA with external GPS antenna and installed Trial Test Set Application Software was used.



On a precheck with frequency spectrum measurement there was detected a narrowband jamming signal on 121.650 MHz. (Noise accentuation of aprox 10%).

Remark: 121.500 MHz was Ok.

For the trial we used the Training-Frequency 122.250 MHz (Frequency for free balloons / Noise Check Ok)

2.6 Tayo Direction Finder

For comparison the already installed direction Finder from Tayo/Furuno Type: ADDF TD-L1620A was also in use while the trial.

The author of this report watched also this DF system during the trial, but there are actually no serious empiric data for direct comparison of the two DF's. available for me (separate from my subjective impressions).
Mr. H.E. van der Molen should have more informations and data for this.

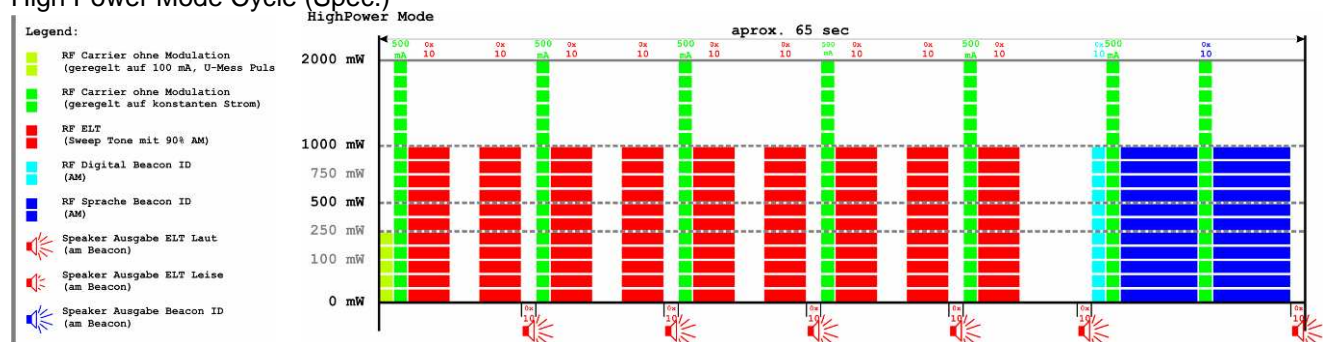


2.7 Used Transmitter Beacon PLB Type: RHOTHETA RT-B77

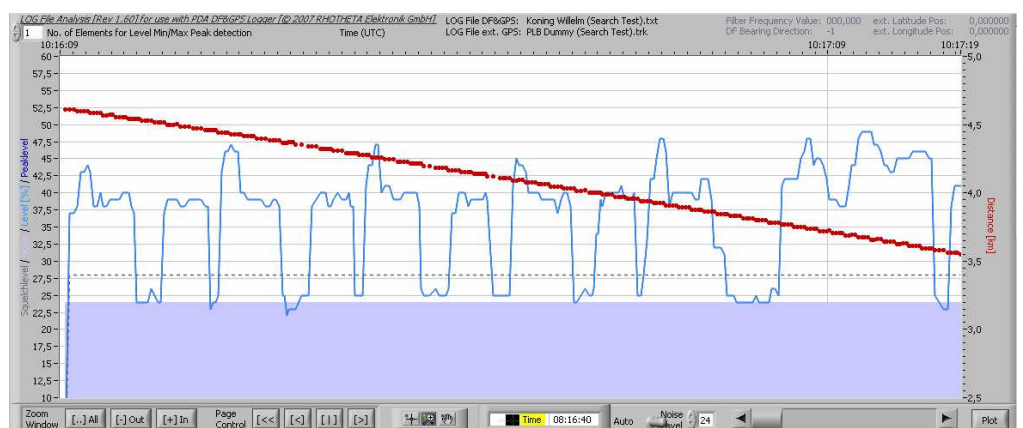
PLB's Serial No. 00200 & 00204 taken from the 1000 piece production October / 2007

Standard product: Hardware Rev. 2.00 / Software Rev 1.00.4 / Transmit cycle Rev. 1.61

High Power Mode Cycle (Spec.)



Measured while
Search Trial
[10:16:09 ... 10:17:19]



2.8 PLB Installation on Dummy with DGzRS Life Jacket

For a practical test the PLB was mounted on the KNRM Dummy with the new DGzRS standard Life-Jacket. PLB antenna position was in an optimal position. Straight position over sealevel (vertical polarisation).



2.9 Trial Test Set for data recording / logging

For data recording of all relevant data there was used the Trail Test Set from RHOTHETA. It connects the DF system via serial NMEA interface with a PDA (Pocket PC). All DF data (level, bearing averaged / not averaged; frequency; error message; ...) are logged 4 times each second. In addition the GPS data (position; elevation; ground speed; heading, ...) are recorded as well.

All data is stored in one log/source file (see printouts in the attachment)

2.10 Analysing software for creating of the report data / graphic

With the assistance of this software it is possible to generate all important LOG file graphics. The GPS dummy PLB position is synchronised with the DF GPS position (over UTC time) and so the true bearing value as reference is calculated at each time/position. Important, if the dummy is in practical use moved by the drift while the trial. The indicated distance at the LOG files is therefore the true distance.

(see also Appendix / LOG File description/legend)

3 Overview of complete recorded Boat & PLB Dummy Tracks

At this picture, the complete track of the Lifeboat Koning Willem is visible. Also the complete track of the GPS installed on the dummy (swimming in the water respectively carried by the second Ameland lifeboat).



3.1 Rendezvous with Coast Guard Helicopter

Aprox. 08:40 ... 09:15 UTC

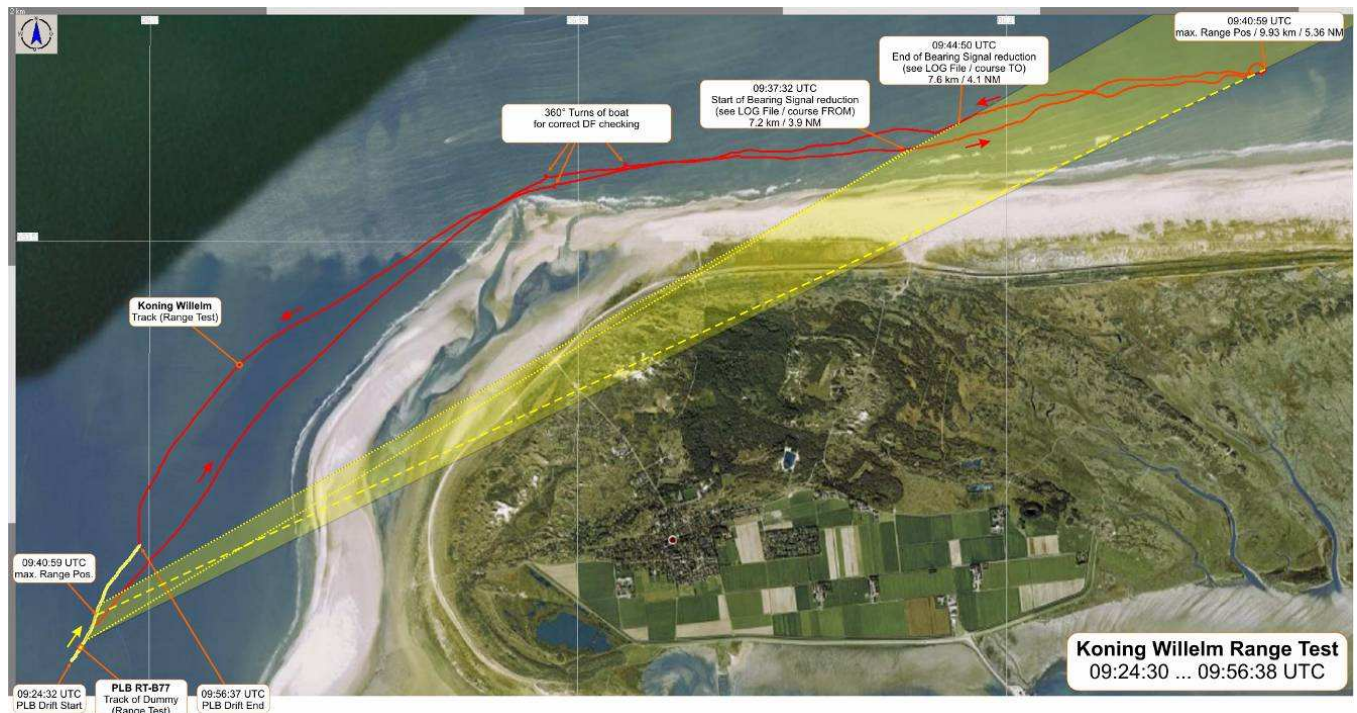
For KNRM internal lifeboat visibility / recognizability tests. Not part of this report and so no further comments.



4 Trial (1) Range Test with Results

Target of this trial was to test the max. possible range/distance PLB ⇔ Direction Finder.
The test was executed with the PLB RT-B77 Serial No. 00200.

Time of Test:	09:24:30 ... 09:56:38 UTC
Testfrequency:	122.250 MHz
Time On (active Trainingmode)	1 h : 39 min
Consumed RT-B77 Batterycapacity:	254,853 mAh
Averaged current consumption:	361,7 mA (while RF carrier pulse = approx. 2 Watt / 50 Ohm)



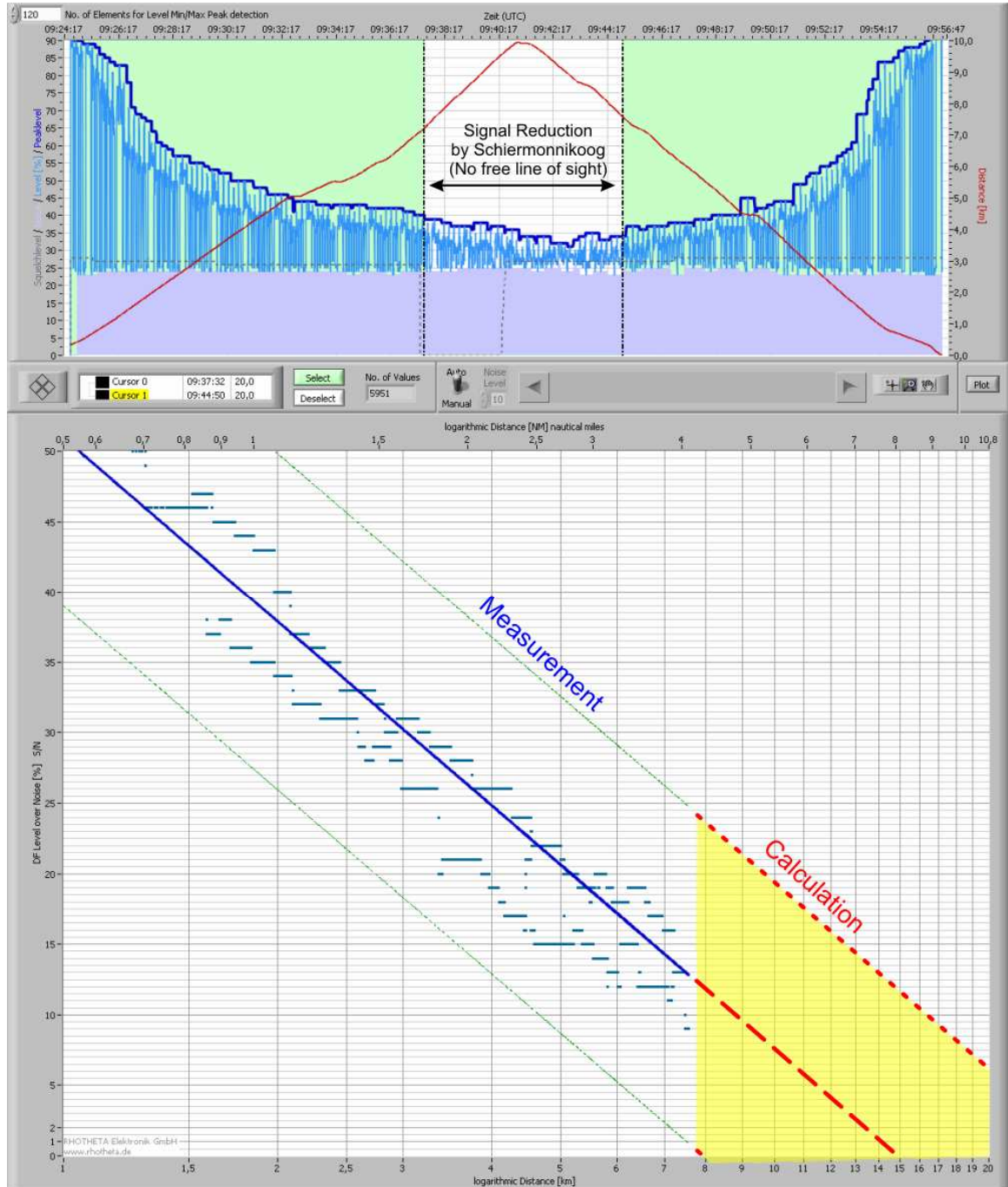
Trackpicture with shadowed range-area (yellow area = no free line of sight / strongly damped signal)

The position of the PLB installed on the dummy was correct.
(nearly vertical polarisation of Monopole antenna)



4.1 Results

See also detailed LOG Files (Chapter 6.2)



Unfortunately the max. Range could not be measured, because after a distance of 7.2 km the island Schiermonnikoog was between PLB and DF (no more free line of sight / see Track-Picture). Also in the "shadow" of the island there was a level of the PLB received, but probably the direct (strongly damped) wavefield was heterodyned from reflected signals by a lot of VHF/marineband frequency antennas & buildings etc. on Schiermonnikoog. At a distance of aprox. 7.5 km the bearing signal quality was still very good (see protocol at appendix). The max. expected range is calculated of about 15..20 km.

5 Trial (2) Search Test with Results

Target of this test was a practical MOB search procedure. The second Ameland Lifeboat placed the Dummy with PLB aprox. 4.6 km away inside an area with high waves (2..6 m). The Koning Willem Lifeboat equipped with the RT-300 DF should find and rescue the dummy quickest possible.

The test was executed with the PLB RT-B77 Serial No. 00204.

Time to run out the Dummy:	aprox. 10:12 UTC ... 10:16:10 UTC
Time of Test (Search procedure):	10:16:10 ... 10:23:06 UTC
Testfrequency:	122.250 MHz

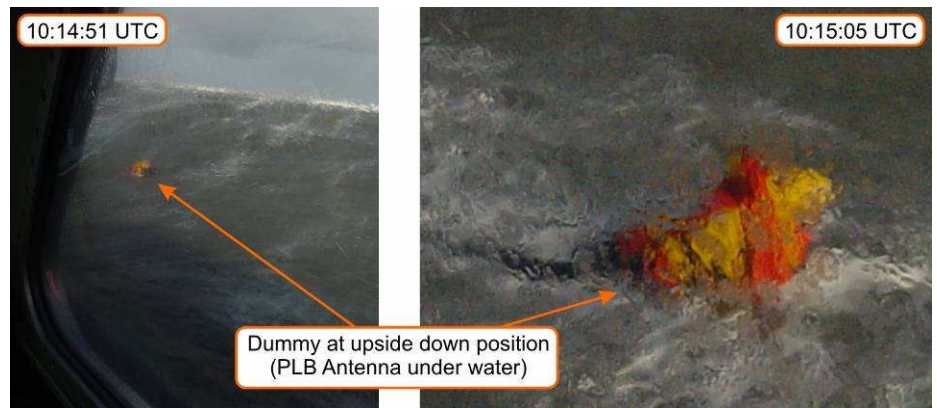
While dragging the dummy out of the water (after the trial) the PLB was unfortunately demolished from the life jacket (because of the rough sea) and so plunged in the sea.

(⚓ 10:28:00 UTC; Position N 53,51243°/ E 6,18644°)

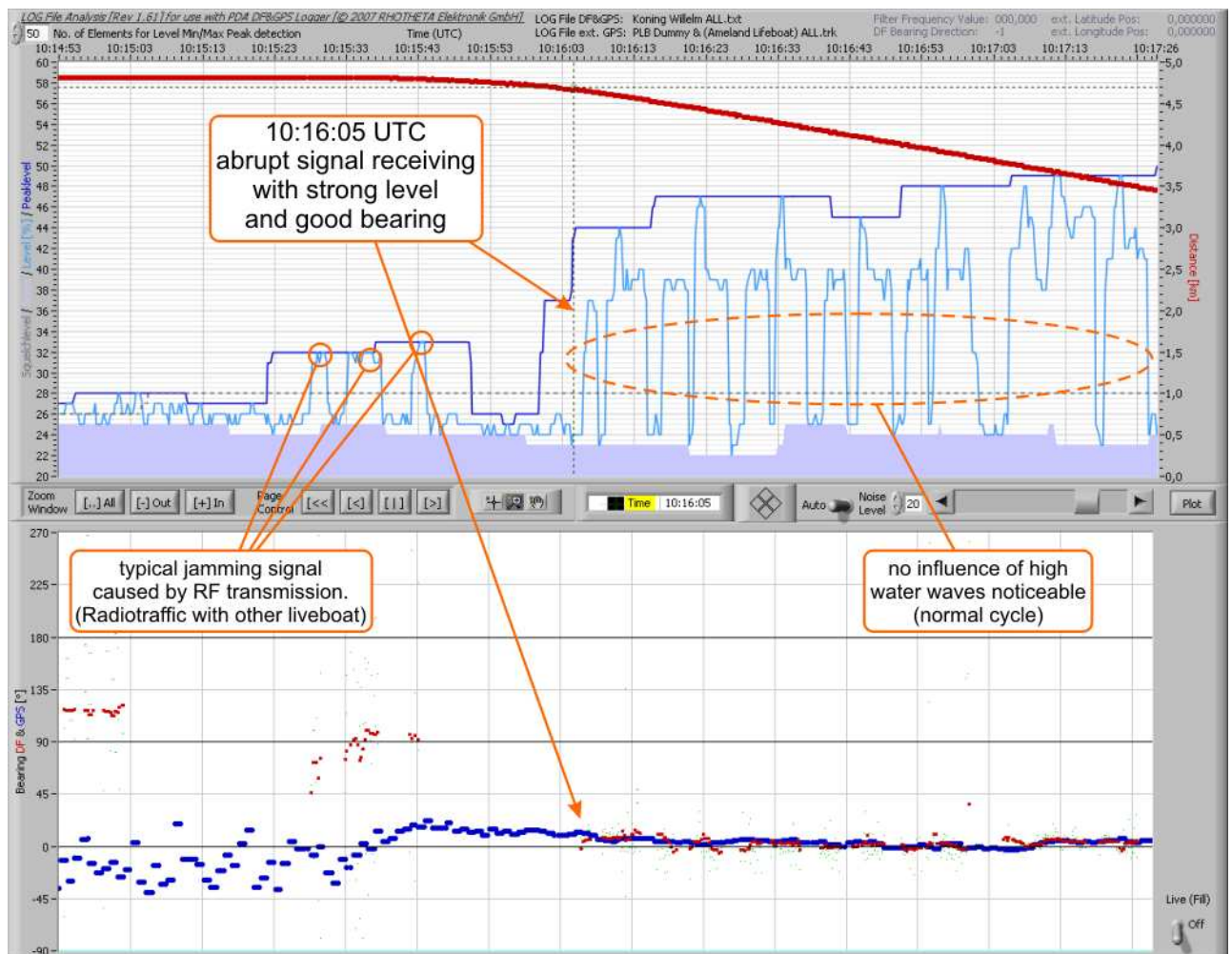
Remark: Maybe we can dive at this position in 5 years and check, if the beacon is still correct waterproved !?



At first the dummy was placed upside down in the water. The PLB antenna was in/under water. At this time there was very low signal receiving.



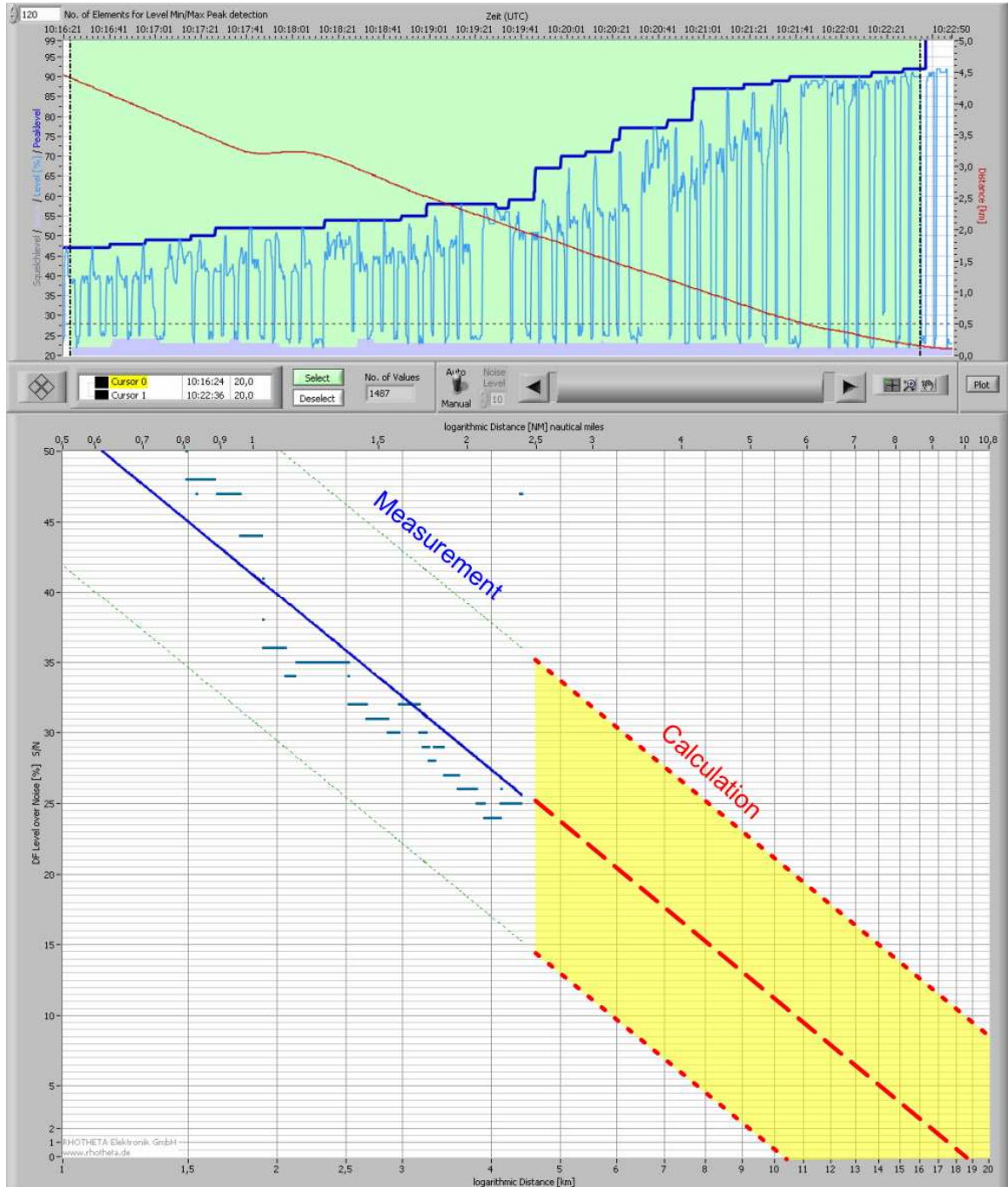
At 10:16:05 UTC a abrupt signal receiving was logged. We expect, that at this time the dummy was turned over to its right normal position (by crew of lifeboat ameland or wave). After this, the signal was at a distance of 4.6 km very good and the approach of the search procedure could start.



(cutout of LOG file 10:14:53 ... 10:17:26 UTC)

5.1 Results

See also detailed LOG Files (Chapter 6.3)



At start of the search procedure (10:16:10 UTC) there was a very good and steady bearing signal available (distance only 4.6 km). The direct target approach was executed directly to the MOB (dummy with PLB RT-B77) without any problems. Also a 360° turn of the search liveboat showed always a correct and steady bearing signal.

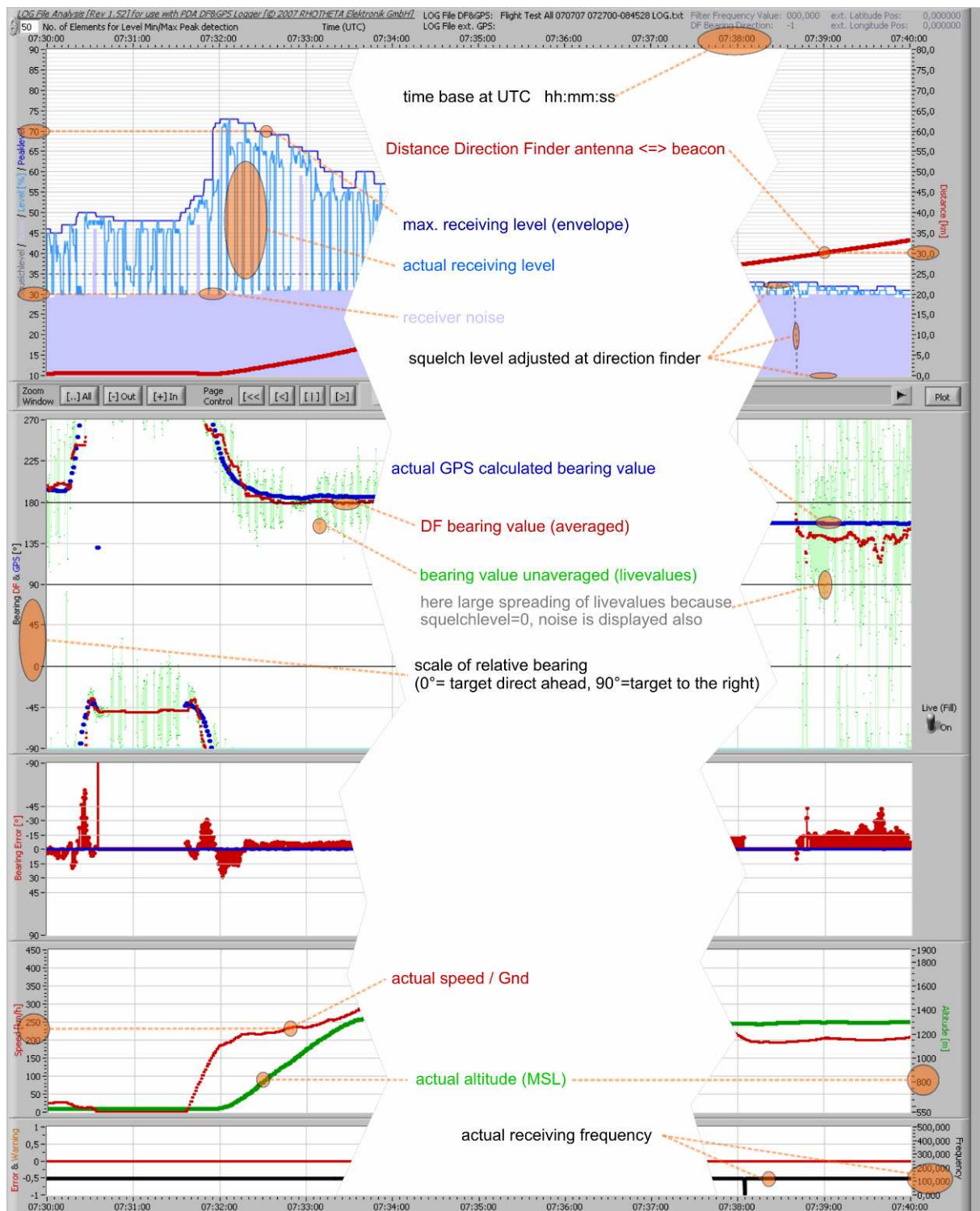
The calculated max. distance with the source data of this trial shows a value of approx. 15...20 km. (Normal)

There was also no influence caused by the high water waves visible (no RF damping by trough of the sea).

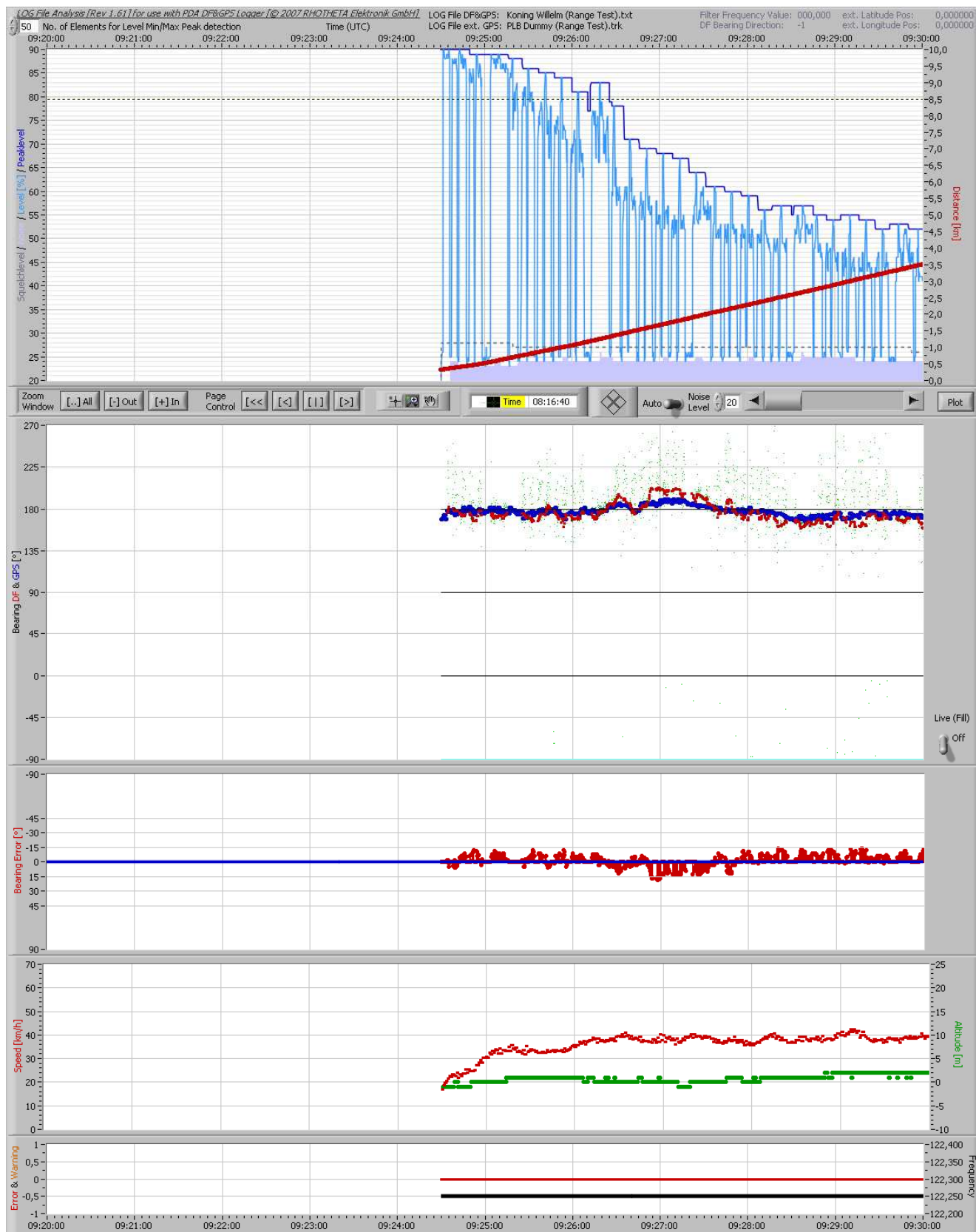
6 Appendix

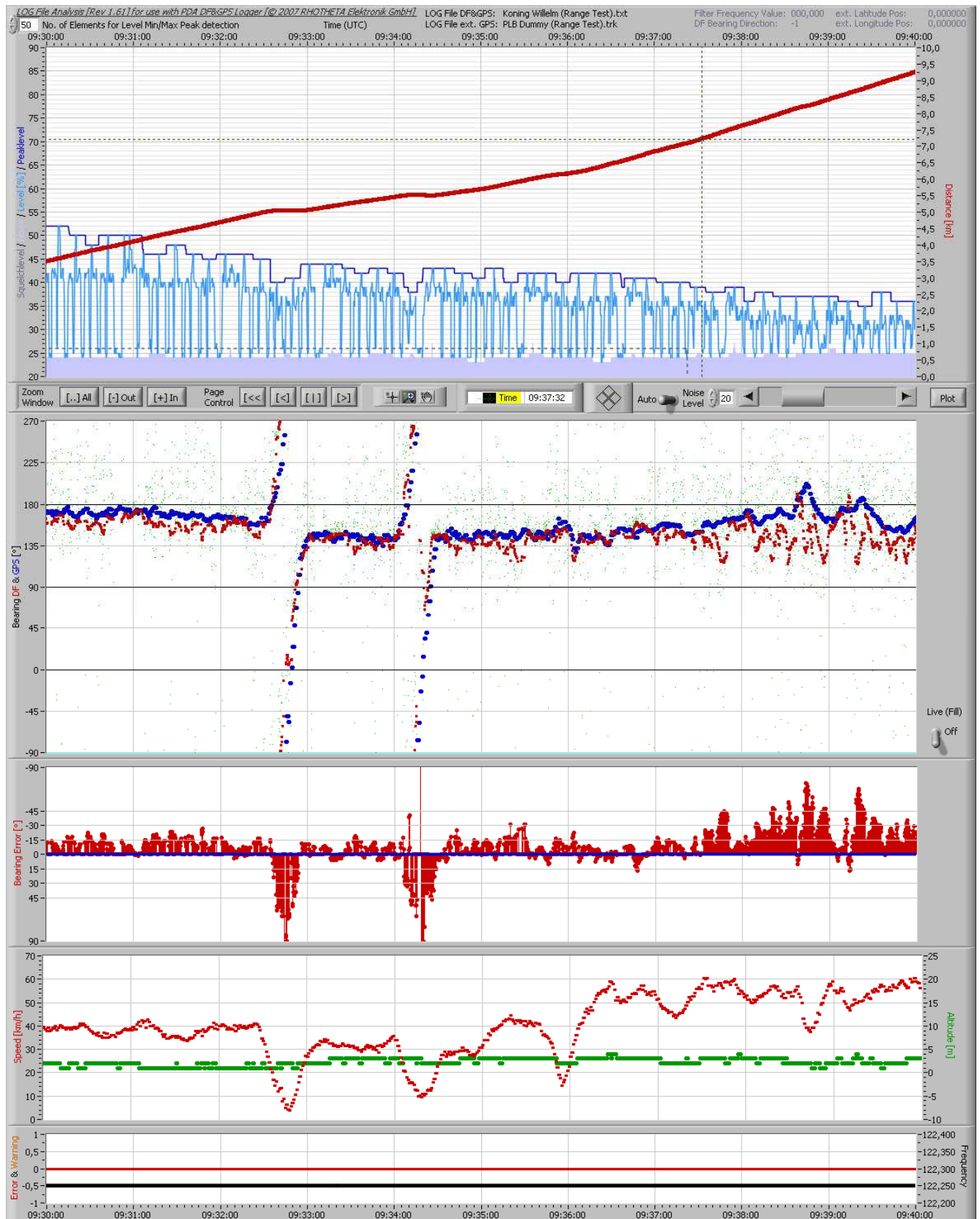
6.1 LOG File Description / Legend

Example of LOG File (timespan 10 min) (Only as example; source data of this picture not of this trial)

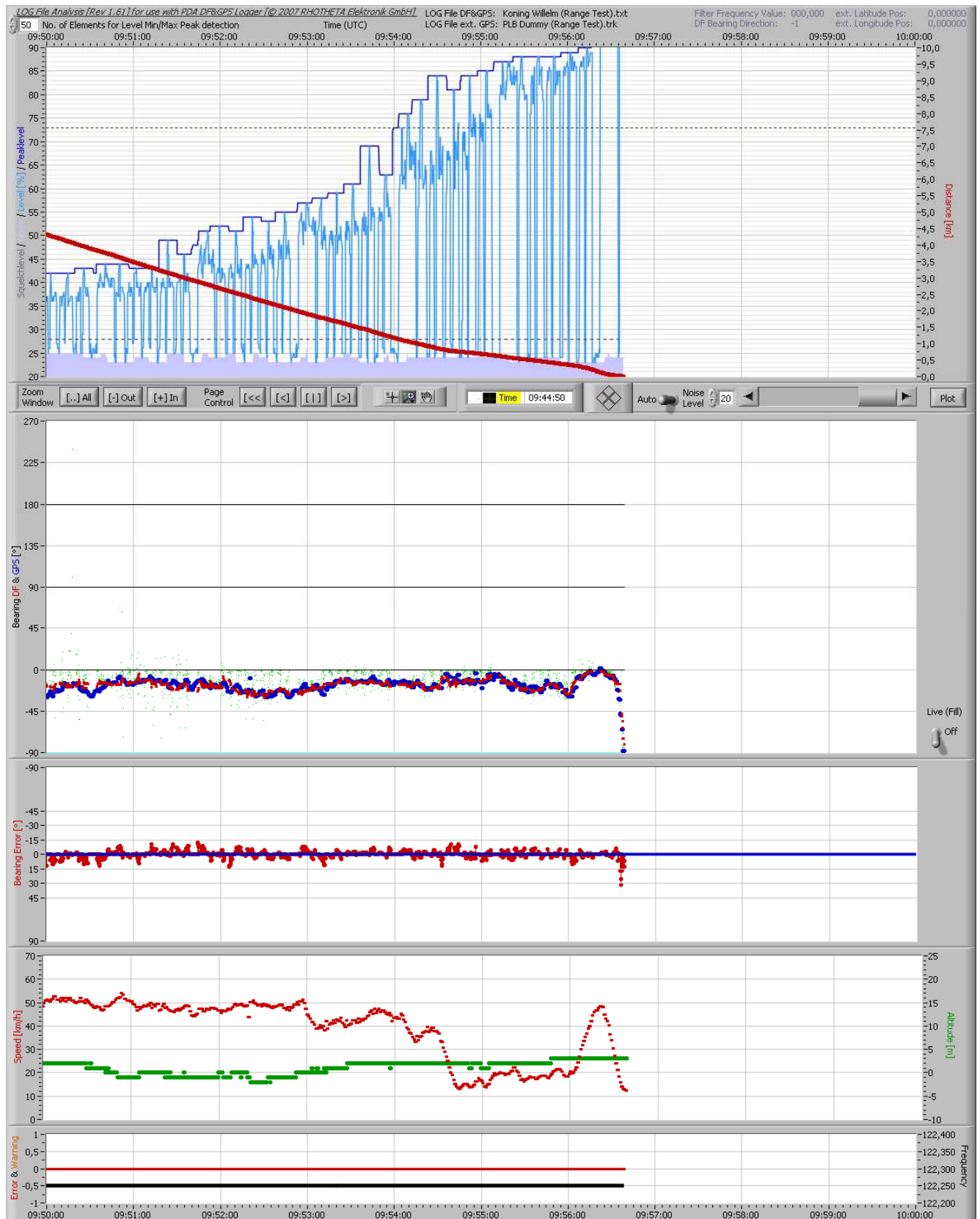


6.2 LOG Files Range Test (09:24:30 ... 09:56:38 UTC)









6.3 LOG Files Search Test (10:16:10 ... 10:23:06 UTC)

