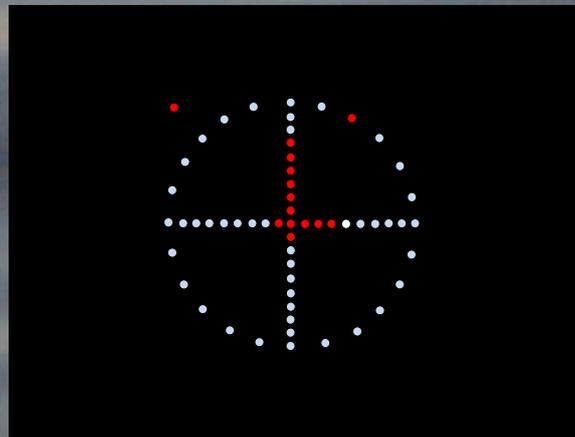


**Marine mammals**  
**Small scale behavior studies using tracking technologies**  
**The DDF unit – a new tracking tool**

**Manual for DDF Tracking Unit**

Update: February 2012



**Introduction**

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## Introduction

The digital radio direction finder DDF was originally projected by Norwegian Defence Research Establishment (FFI) and LKARTS-Norway FFI/Norway during the 3S-program (Cetaceans and naval sonar), mainly to solve the difficult tracking issues foreseen when studying minke whales. However, after full scale use of the DDF unit in a number of projects, the operational gain of the unit was so obvious, so it resulted in a commercialization of the unit in 2011. The production and trade of the DDF box is now through the companies ASJ Electronic Design and LKARTS-Norway, respectively.



*Figure 1. The DDF2011 including speaker and transport box.*

### **Physical description of the DDF unit**

The DDF unit has a front panel (fig.1) with LED lights in a circle with 24 red diodes (15 degrees between diodes), and a cross of 9 red diodes on each cardinal direction. Upon signal the diodes on the cross will hold the light during 30 seconds (optional), while the processed result indicating the direction to the tagged animal will light up one diode point on the circle and hold this until the next signal.

However, it is a relative direction and orientation and changes of the direction of the boat would be a basic value in the analyze during the tracking face.

At the back of the DDF unit there are 4 BNC antenna cable connectors and 1 BNC cable connector for the connection to the radio receiver. Furthermore, there are 1 audio out connector (3,5 mm jack plug), 1 PC connector, and 1 power (12V) connector. There is a setup to able power to a radio receiver (R-1000/12V). The speaker is operative through the DDF2011 unit.

## **Technical description of the DDF unit**

The DDF unit covers the frequency range from 140 to 220 Mhz, and at present the unit has been tested successfully with the radio receivers ATS 2000 and the R1000, and the specifications of the tags used during the tests are respectively 20ms pulse length, 20mW output and ppm240 pulse repletion rate.

The standard setup is to connect the DDF unit to 4 yagi antennas, a vhf radio receiver, and a speaker. Additional is an option to have the system linked to a PC with a GPS link, and by this be able to log the "pings" of the tagged animal along with the date, time and position of the tracking platform (best for larger vessels). This option is still under testing, and it would be valuable to have comments on the need of this option. This manual is not elaborating this option other than describing possible setup.

Most VHF tags have signal length longer than 20ms, and the DDF unit is therefore constructed to handle a spinning time of < 20ms for the 4 yagi antennas. To assure the quality of the incoming signal the centered LED will flash, indicating that you have had a good detection.

When mounting the DDF unit on a larger ship, the unit may be triggered by various signal noises at the antenna rig, however this is possible to tune by using the software and the setup via the PC connection (fig. 5). In this modus it is also possible to adjust the noise floor (fig. 5). However, we have never accoutered any need of adjustments of neither the antennas nor then noise floor when using smaller vessels or tag boats.

## **Tracking with the DDF unit**

During 2011 the DDF have been used in field projects involving the tracking of minke whales, pilot whales and humpback whales. Especially, in small scale behavior projects where the tracker boat will follow the tagged animal over a period of hours to days, the tracking is dependent of a device like the DDF.

During the tracking phase it is possible to adjust the distance to the tagged animal by combining the guidance from the DDF display with the visual observations. If the sensor package holds a GPS logger unit, and there is no need for the tracker team to record the track of the tagged animal, it is also possible to stay out of visual contact at distance and follow the tagged animal only by the indication from the DDF display. The DDF is also a useful tool to collect a released and floating tag. We preformed a pickup test starting out at 2nm where one person was operating the radio receiver and then communicating speed and direction to the

boat driver. None of them were looking for the tag before they decided to stop the boat. The exercise was performed 2 times and both times the tag was within 10-15m from the boat.

The audio aspect during tracking is vital when tracking difficult target species or in difficult weather conditions and a movable amplifier is added to the unit to be able to move the speaker according to staffing and tracker platform.

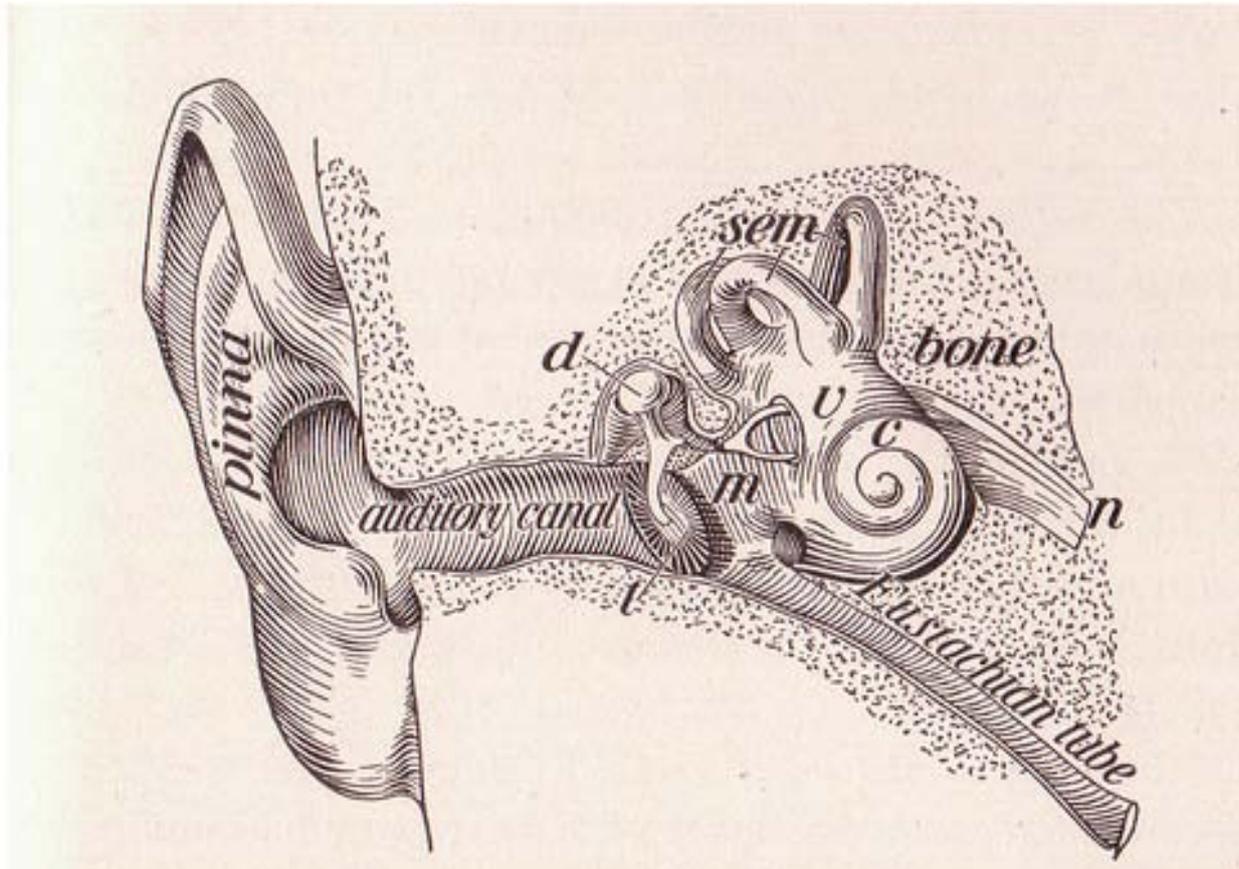


Figure 2. The importance of the audio for the operator of the DDF2011 unit.

The DDF operator is essential for a good tracking performance, so the experience of hearing and tuning the VHF receiver are vital points in the tracking domain. We advise that during the initial tracking period, personnel involved in tracking logistics are trained by an experienced “tracker”, and that tuning and training is continued until the system is well understood and the DDF operators are well familiar with the use of the tracking system.

Be prepared!! You will have good control of your tagged animal as long as you can detect directional signals from the tag. Status of range: this is dependent of the radio beacon and the position of the tag on the animal, and the height of the antennas, but generally we have good control of tagged animals at 3nm. For some test setups we heard tag at 6-7nm but then the gain was jamming the directionality. Please keep a field note on your DDF2011 settings and experiences during tracking. This will help you when you encounter difficult tracking conditions, like when the tag is low on the animal and/or during increasing bad weather conditions.

## Setup and modus of the DDF unit

(First install drivers (appendix) & software (USB pen) on you computer)

### Connecting the DDF unit

NB! The power supply is 12V

Follow the menu

1. Connect the DDF2011 unit with a PC, and power the DDF unit with 12V using the supplied cable (red as positive (+) & black as ground (-)). The fuse on the unit is 1A. *NB! The DDF2010 was supplied with brown positive (+) cable & blue cable as ground (-).*
2. Com setup: choose comport for the DDF unit and enter [115200, 8, 1, none, none], then enter connect, and this will display the Field Modus.
3. GPS setup: choose comport for GPS unit and enter [4800, 8, 1, none, none], then enter connect.
4. LabMode is a setup for more detailed parameters, only to be used by experienced operators.

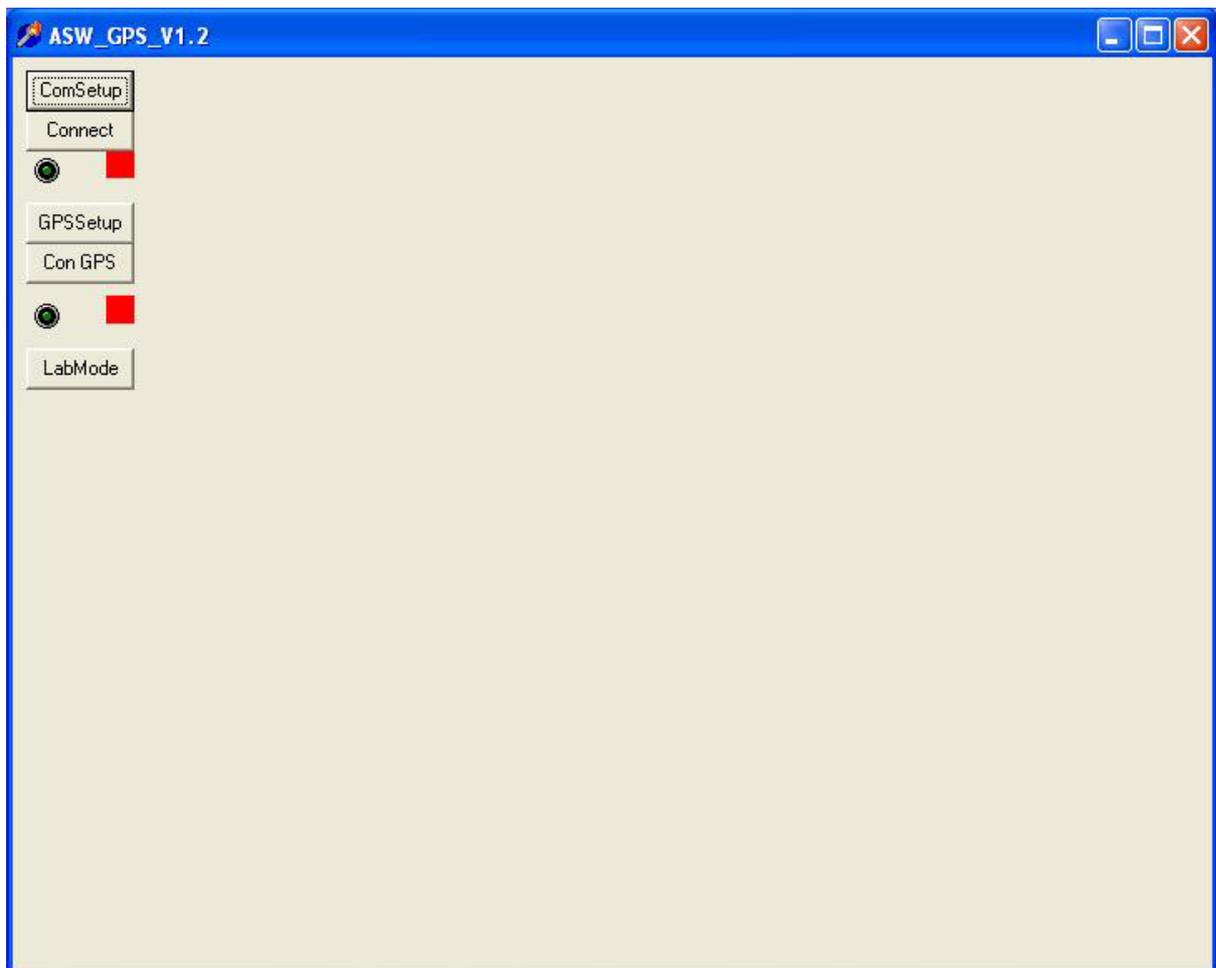


Figure 3. Field modus before the DDF2011 is connected.

## DDF field modus

The window screen option for the DDF unit in field modus will only open changes of field related parameters, like the tuning of the antennas (ANT MULT (HEX Val), read the power on the unit and the software version number. In this modus it is possible to adjust the intensity of the LED light and at the bottom it is an option to send GPS data (time and pos) to a file along with the signal strength on the antennas. Additionally it is here also possible to add comments to this file. The last parameter is the noise floor.

For the vital parameters like **the adjustment of the antennas** and **the noise floor**, different values maybe appropriate for different tracker platforms. "Read Antenna Data" (reads the multiplication values of the antennas of the DDF unit). If any of the antennas require tuning due to a noise factor, set the multiplication factor and then "WRITE MULT to ASW". There are 4 numbers where 1000HEX = x1. To make this a default setup in the DDF unit, write "Store EEPROM". Normalized antennas expose the online values on each antenna. During our tests and during full scale use we have set the ANT 1-4 at 1800, and the noise floor to 0010. We recommend that these values are used initially, and that each tracker group need to find out their optimal adjustments.

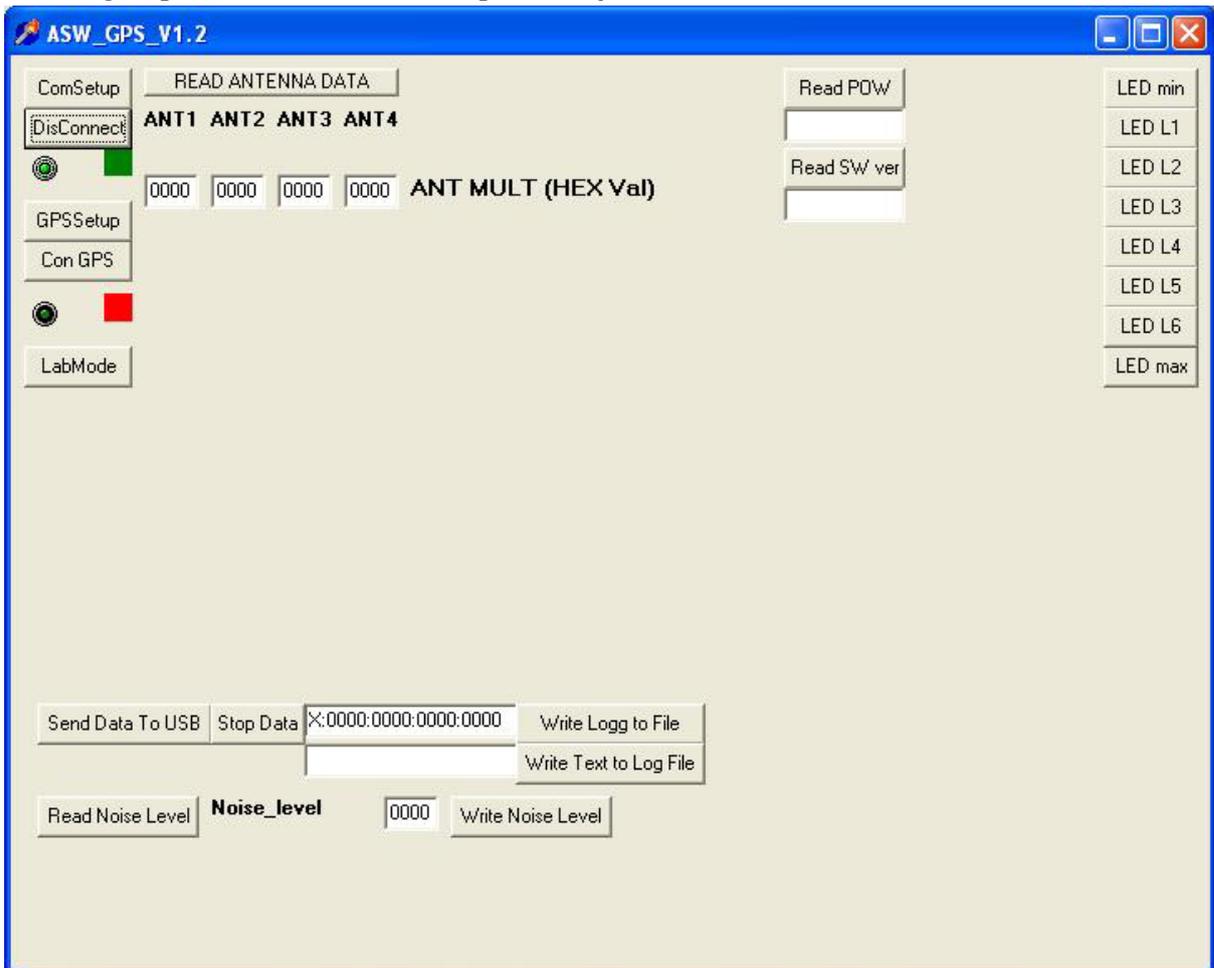


Figure 4. In Field modus when the DDF2011 is connected.

## DDF Lab modus (To be used by experienced operators)

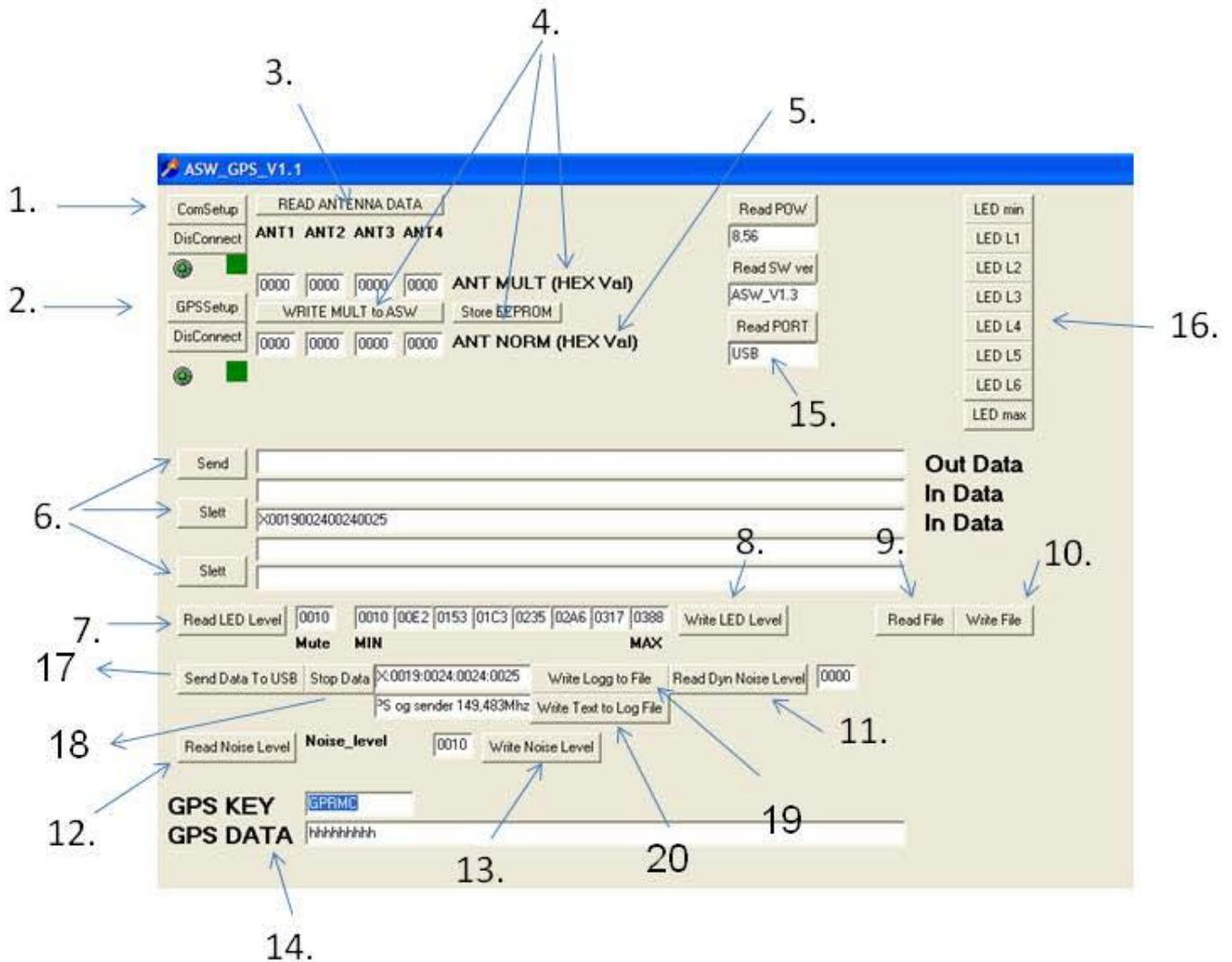


Figure 5. In Lab Modus showing different DDF2011 options

1. Com setup: choose comport for the DDF unit and enter [115200, 8, 1, none, none], then enter connect.
2. GPS setup: choose comport for GPS unit and enter [4800, 8, 1, none, none], then enter connect.
3. "Read Antenna Data" (reads the multiplication values of the antennas of the DDF unit).
4. If any of the antennas require tuning due to a noise factor, set the multiplication factor and then "WRITE MULT to ASW". There are 4 numbers where 1000HEX = x1. To make this a default setup in the DDF unit, write "Store EEPROM".
5. Normalized antennas expose the online values on each antenna.
6. Advanced use for debug and setup purposes should only be used in cooperation with producer.
7. "Read LED Level"& "Mute": Mute is an optional noise level variable. It can be tuned with experience of the system. All incoming signals under this threshold will not be displayed. The read LED Level reads back the "turn on level" for each LED. These are Hex values!!! The default values are at present according to our test protocol. This may change in the future to improve the performance of the DDF unit under difficult tracking conditions.
8. To make your LED level changes as default setup "Write LED Level" and then "Store EEPROM"

9. If you want to load a saved setup apply "Read File". If you like to change this to a default setup apply "WRITE MULT to ASW" and "Write LED Level", and then apply "Store EEPROM".
10. If you want to store the setup to file "Write File" and follow the instructions.
11. "Read Dynamic Noise Level": read only
12. In "Read Noise Level", the minimum signal level needed to activate the DDF is read. When the Dynamic Noise Level is higher than the Noise Level, the Dynamic Level is used.
13. Check of the active signal level (minimum) of the DDF unit by applying "Write Noise Level".
14. Here the GPS streamer is displayed. The "GPS KEY" = GPRMC is used to catch the correct data from the GPS.
15. "Read Port": Status information.
16. It is possible to adjust the intensity of the LED display depending on the light conditions.
17. "Send Data to USB" will send the measured antenna values to the PC.
18. "Stop Data" will turn off the data stream to the PC.
19. To record a log, apply "Write Log to File". Remember to turn on the data stream.
20. It is possible to add text to the Log file by writing in the text box and then apply "Write Text to Log File".

## Classical radio tracking at sea

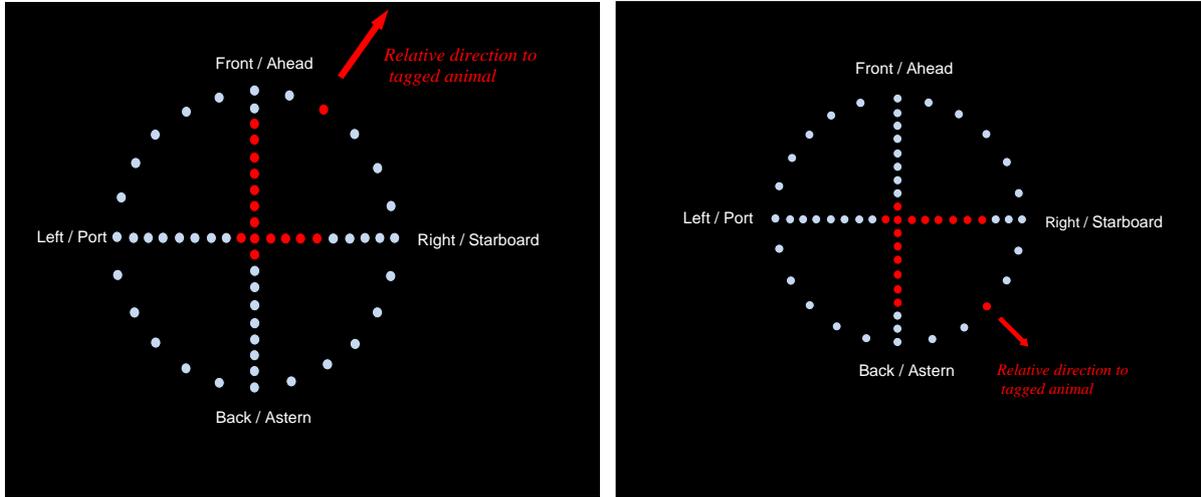
Using the DDF tracking unit without recording

The tracking team will often comprise of marine mammal observers, a data recorder and a driver. The field logistics would normally be a radio receiver connected to a direction finder and a 4 Yagi antenna setup, along with a ruggedized PC with a GPS link. Observed data like angle, distance and aspect to the tagged animal would be communicated to the data recorder and recorded on software like "Logger". The data logger and/or the driver would have the visual contact with the DDF unit, and communicate the heading to the tagged animal to the MMOs whenever needed.

However, if possible the DDF unit should be placed in a position where all team members can see the active signals. The new LEDs in the DDF unit are wide angled and facilitate this basic setup. All team members should also be able to hear the incoming signals if possible. The data recorder would usually also be handling the radio receiver during the tracking phase, and fine tuning the gain, volume and dial settings of the VHF receiver. Scaling and tuning the gain and the volume of the incoming signals, is a vital operation to optimize the functionality of the DDF unit. The scaling is dependent of the distance to the tagged animal, and during a tracking period the DDF operator sometimes needs to continuously adjust both the gain and volume. Initially, the DDF operator should try out and test different gain and volume settings, and get experience of the variations on the LED display on the DDF unit. Whenever, the situation is critical, and there is possibility of losing contact with the tagged animal, the fine tuning of the radio receiver is critical.

The images below show how to interpret the information given by the DDF tracker unit. The four cardinal directions all have a set of 8 LEDs (circles), while the outer circle has 24 LEDs. Whenever the tagged animal is within the range of the radio receiver, the relative number of activated LEDs (red circles) on the cardinal directions indicates the direction of the signals from the tag. To illustrate this in the figure it is indicated by a red arrow. The LED display on the cardinal directions will be on for 30 seconds after the last signal, that is if the target

species is a diving animal. The LED on the outer circle will always be on and updated. Out on a boat it is important to note that the displayed result is always relative to the heading of the boat at the time of the signal.



## Using the DDF tracking unit with recording

The DDF tracker unit can be linked to a PC with a GPS connection, to enable a recording of the track log of the platform and the performance of the Yagi antennas. Today the tracker operator can add text to the log file during the tracking period, however, we await feedback from DDF users to analyze the need for further logging data research. We envisage futuristic options like logging and tracking satellite tags (a modified DDF unit), and the logging of dive data etc...

At the moment this option of logging is still under research.



Figure 6. The tag & tracker boat docking at landbase during fieldwork in Lofoten, Norway, 2010

## Installation of drivers to the DDF unit

### Online driver installation:

Connect the DDF2011 unit to a 12V DC power and to the PC.  
The computer needs to be connected to the internet to find the driver.

Just select “I want to search for MS Update for a driver”.



Select “do it automatically”



The next page should be that the “USB Serial Converter” driver is installed.



The computer will ask you to select a driver again.



Do it the same way. Load the driver from MS Update, automatically.



The computer will tell you that the "USB Serial Port" driver is OK.



And the computer should be ready.



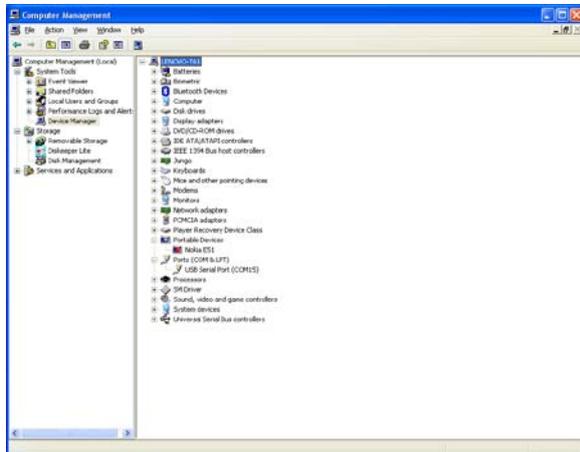
When you want to run the software for the DDF tracker unit, you should check for the port number of the unit under System, Hardware, Device Manager and Ports (COM & LPT). Select the appropriate Comport from the list.

### Off line driver installation:

You can install the drivers from the USB pen. There are two options. One is to load the drivers from the USB pen, when the DDF is connected the first time. Otherwise you can run the .exe file from FTDI, and the drivers will also be installed.

If you have problems installing the drivers, the drivers can be found at <http://www.ftdichip.com/Drivers/VCP.htm>

A VCP driver must be downloaded!! The USB interface used is a FT232B.



### Recommended tracking equipment

1. Cables; doubled shield RG 214 cables
2. Antennas can be bought at: <http://www.atstrack.com/Antenna.aspx>  
the array are 4 element folding yagi. The frequency is VHF beacon dependent, however the freqs are 148MHz-152MHz for dtag2 and 216MHz-220MHz for dtag3
3. Radio receiver; ATS R2000 (2100) or R1000

### Track-Tag option from the 2012 season

For tagging issues, especially related to tracking studies and the use of the DDF unit, technical matters or orders can be addressed to LKARTS-Norway at: [lk1@ffi.no](mailto:lk1@ffi.no).

LKARTS-Norway also promote the whale tag launcher ARTS, and offers ARTSCarrier for different instruments (satellite tags and vhf tags) and sensor packages (logger units), along with the biopsy system LK Dart enabling full core biopsy profiles.

**ASJ Electronic Design**

arne@asj.no

**LKARTS-Norway**

lk11@lkarts.no

## **Pricing and delivery**

Unit price of DDF2011: 25.000 NOK + shipping

Prices are given ExW Horten, Norway (Incoterms 2000) and Ex VAT.

The DDF2011 unit will include the standard unit and software for the setup with the PC-GPS, a speaker with 2m cable and 3,5 jack connector, audio splitter (3,5mm), 2m doubled shielded coax cable with BNC connectors (male), a transport box, USB pen with software and manual.

Shipment 6-8 weeks after the date of confirmed order.

***NB! The DDF unit power supply is 12V. It is important that the DDF2011 operator turns off the serial ports for the DDF unit before turning off the power supply.***

***Support contact: Arne Skauge Johannessen***

*arne@asj.no*

***Field logistics: Lars Kleivane***

*lkl@ffi.no*



**NB!**

- 1. This product has 6 month guarantee on production and components.**
- 2. The DDF2011 is not water proof and must be protected against mud, water and sea water. The guarantee is not covering misuse in handling the unit. This also includes wrong powering, over voltage on any input, or if the unit has been opened.**

**--- end**