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**AQUA-METRE
D100-NG
Diver Topography Version

User's Manual**



*MiniPointer R300-NG with watertight Android tablet «AllTab 2.0»
(photo © Andromède Océanologie)*

Document History

Document reference	Document modifications
0133-800-001	Creation of the document
0133-800-002	Android application update version 1.2.0.0 : use of .map format maps with Mapforge.
0133-800-003	Android application update version 1.3.0.0 : new function of polygon measurements



MiniPointer R300-NG with the AllTab2.0 tablet on support

TABLE OF CONTENTS

1 System Overview	4
2 System Set-up	5
2.1 Installing the Application on the Android Tablet.....	5
2.2 Setting Up the Equipment	7
2.2.1 Assembling the Base Unit, Frame, and Mechanical Interface	7
3 Operating Instructions	11
3.1 Switching on the Base and MiniPointer.....	11
3.2 Base Unit Set-Up.....	12
3.3 Android Application User's Manual.....	13
3.3.1 “Settings” Menu.....	13
3.3.2 “BT-Link” Menu.....	15
3.3.3 “Sensor” Menu.....	16
3.3.4 “Georef” Menu.....	17
3.3.5 “Measures” Menu.....	18
3.3.6 “Map” Menu	20
3.4 System Limitations.....	24
3.4.1 Software limitations.....	24
3.4.2 Hardware limitations.....	24
4 Taking care of the Equipment	25
4.1 Fresh water rinsing.....	25
4.2 Charging the Base and MiniPointer batteries.....	25
4.3 Lubrication of connectors and bulkheads.....	26

1 System Overview

The AQUA-METRE D100-NG system replaces the discontinued D100 version and its diver-operated Pointer.

This is a local underwater positioning system, based on acoustical interferometry scheme particularly well suited to 3D accurate measurement within a radius of up to 250m. This equipment is completely waterproof and autonomous, and doesn't require the use of an underwater cable or connection to the surface. It can be operated from a pier or dock by a single diver (while respecting the security regulations for professional and recreational diving).

Dive set up, measurements and data retrieval are made through the tablet that is interfaced to the MiniPointer R300-NG using an underwater BlueTooth adapter. The underwater Android Tablet, watertight down to 100m, is produced by the VALTAMER Company (Finland, www.valtamer.com). PLSM does not directly supply this tablet (check dealers or direct sourcing from Valtamer).

The AQUA-METRE D100-NG is made from R300-NG Base and MiniPointer units that are well proven equipment. For over 10 years, these units have been used for a broad range of applications (ROV positioning), and have constantly been upgraded with new functions and improvements relating to range, autonomy, and ability to withstand sound noise. The D100-NG mode is mainly a specific embedded software mode that allows the diver to control the whole system from the MiniPointer through a simple graphical user interface (the tablet).

The AQUA-METRE D100-NG system is made up of :

- a R300-NG Base unit in D100-NG mode, with its interferometric frame,
- a R300-NG MiniPointer in D100-NG mode, attached to a mechanical stand for the tablet with the BlueTooth module,



R300-NG Base



The R300-NG MiniPointer and the waterproof tablet on the stand

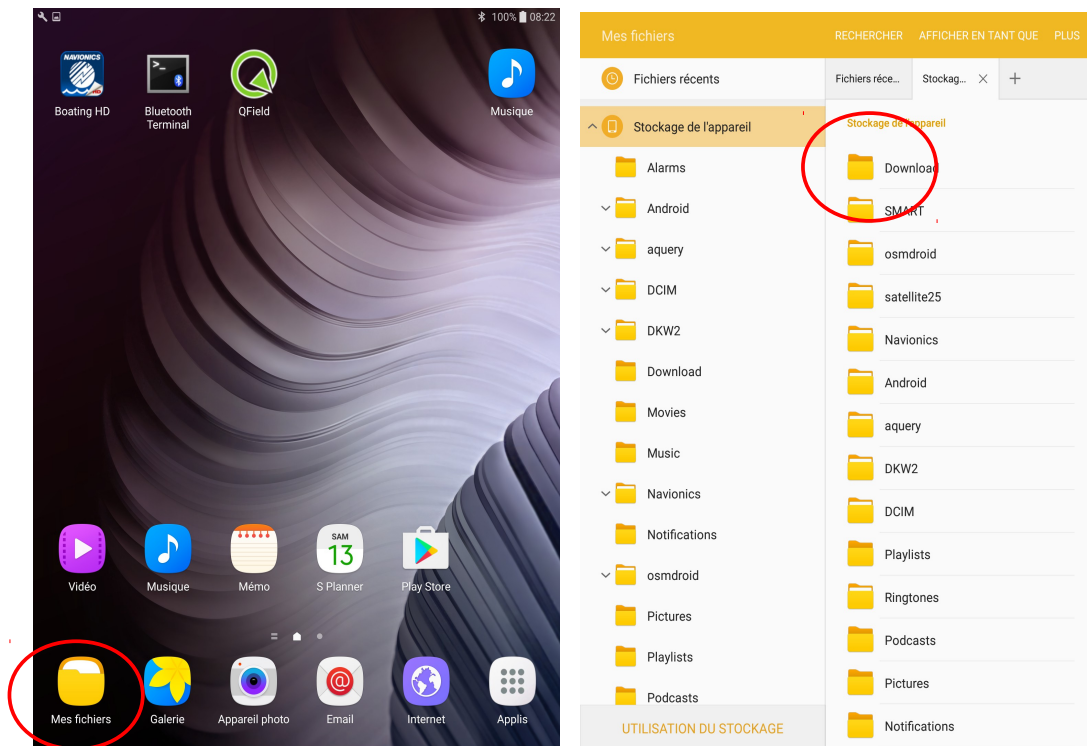
- And the Android Application developed by PLSM to manage the system and measurements from the tablet.

2 System Set-up

2.1 Installing the Application on the Android Tablet

The install package is not available on Google Play Store but delivered by PLSM with the equipment as an “.apk” install file: “AquaMetre_D100NG_V1_30.apk” for the 1.3.0.0 version, for instance.

To install it, the “.apk” file must first be transferred from the PC to the Tablet memory (in the download folder for instance) using a file transfer tool from PC to tablet with WIFI (if the AllTab 2.0 tablet doesn't allow access to a USB port). PLSM recommends using the “WIFI File Transfer” application which is easy to use.

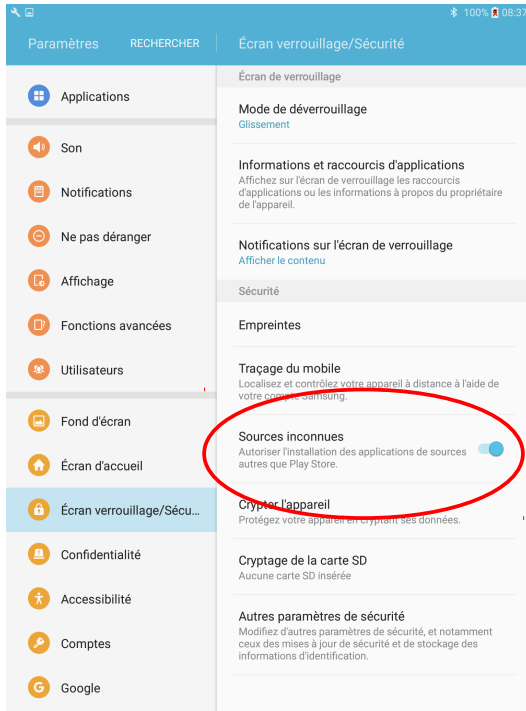


Application to browse through the tablet files

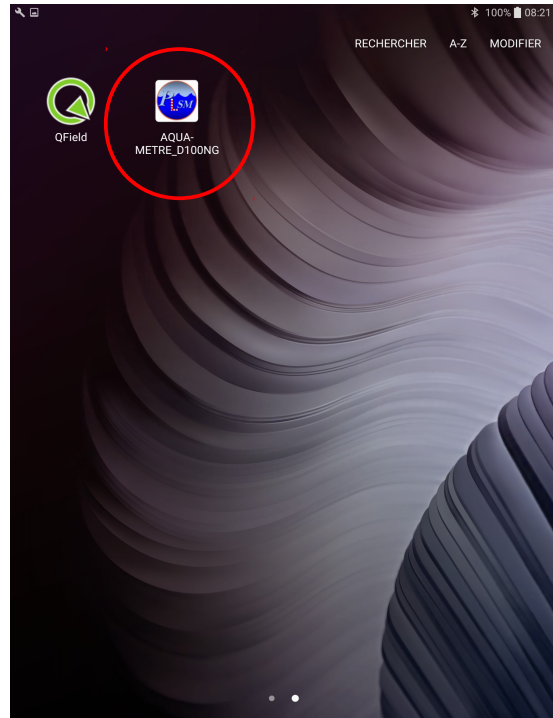
“Download” Folder

Before installing, the user has to go to the security settings and allow for application installations from unknown sources (mandatory when you want to install an application manually). During the installation, and depending on the Android version, the user also has to give authorization to access the Bluetooth, memory and location to the application.

PLSM guarantees its users that the application does not collect and transmit data to PLSM, the application works purely offline.

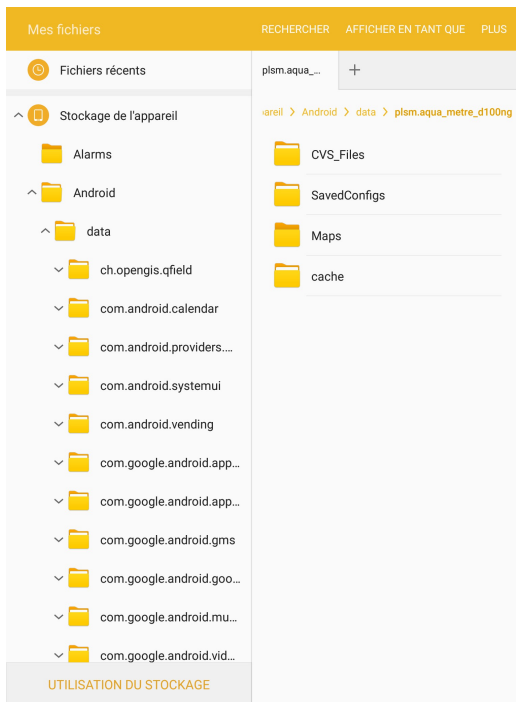


Authorization to install an application manually (without using Google Play Store)



AQUA-METER_D100NG application after installation

Once it's installed and running, the application creates four new folders in the tablet data storage in the location: **“Android/data/plsm.aqua_metre_d100ng”**



CVS_Files : folder in which the measurements are saved in .csvs format.

SavedConfigs : folder with saved configurations.

Maps : folder with maps in .map format (maps are used if the Base is georeferenced, this function is available since the 1.2.0.0 version))

cache : system folder used for display (do not modify)

2.2 Setting Up the Equipment

2.2.1 Assembling the Base Unit, Frame, and Mechanical Interface

Mounting the interferometric frame on top of the Base unit

The interferometric frame is simply screwed on top part of the Base unit, there is an alignment pin to fix the bottom of the frame in the right orientation (see photos). An M10 nylon screw with a prehensile knob is supplied by PLSM. Do not use a stainless steel screw, this would create corrosion issues (galvanic corrosion from the stainless steel – aluminum mix) and would not serve its function as a mechanical fuse in case there is too much stress on the frame.

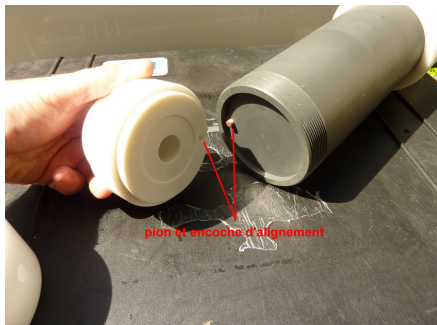


The interferometric frame connector must be plugged in the socket located on top of the Base unit, clearly indicated by a sticker with the logo (photo on the right). The second socket on the Base unit is identical to the first but receives the Start/Stop plug. If you plug the connector in the second socket, the equipment will not be damaged but the Base will not work properly.

Mounting the mechanical interface on the bottom of the Base unit

The mechanical interface to attach the Base to the pole is provided by PLSM according the customer requirements (external diameter of the pole). In any case, the mechanical interface comes with a machined support with a hole for the alignment pin and a DELRIN ring to screw to the bottom half of the frame.

Disassembling and reassembling can be done using only the ring. This means that the Base can be reassembled in the same position (within $<0.1^\circ$), and guarantees the coherence of measurements between different dives (as long as the support and underwater mast stay in the same place).



2.2.2. Mounting the MiniPointer and the tablet on the stand

Connecting the Hydrophone to the MiniPointer

Simply plug the hydrophone connector in the top socket (6 contacts connector) according the photos below. Then insert the mini-mast around the hydrophone and screw it to the MiniPointer. Do not over-tighten, this can be simply achieved by hand.



Mounting the MiniPointer onto the mechanical stand (varies depending on version)

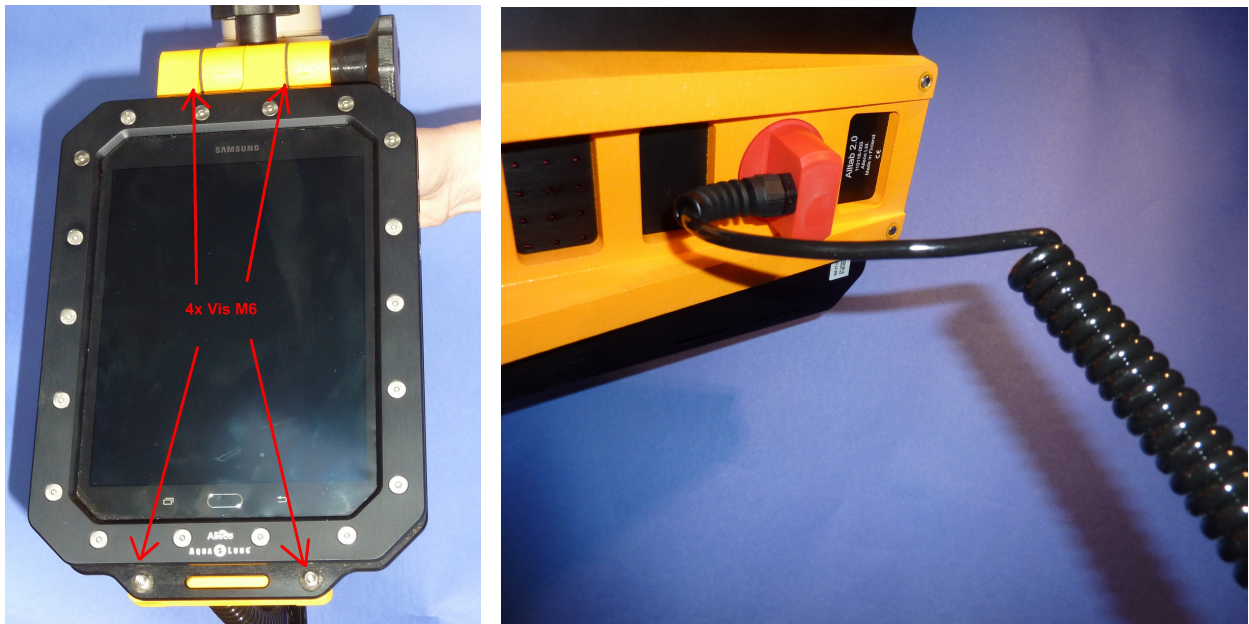
Simply insert the MiniPointer bottom in the cavity (see photo below) and secure it with the two M5 inox screws provided. Again, please tighten gently using a hex key to be gentle with the polymer housing.



Mounting the Tablet onto the mechanical stand

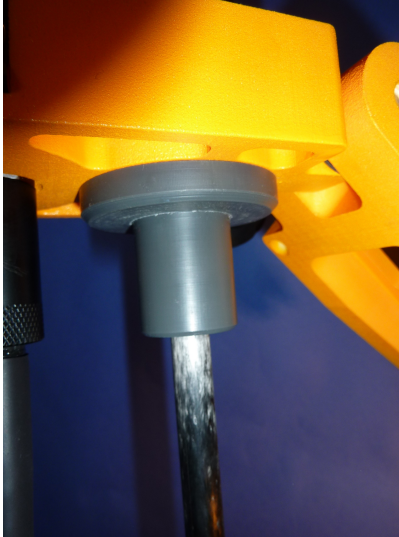
The Tablet is attached to the mechanical stand using four M6 inox screw (once again, do not over-tighten the screws).

Important: Before mounting the Tablet, do not forget to insert the waterproof Bluetooth module. This can be done by sliding the spiral cable in the module encasing on the stand. Do not plug the Bluetooth module connector yet (it would switch the MiniPointer on)



Fixing the measurement stick onto the mechanical stand

First screw the two parts of the mechanical stick together. Then insert the stick in the socket on the stand, locking it in place using an M10 screw.



3 Operating Instructions

3.1 Switching on the Base and MiniPointer

The Base and MiniPointer units must be switched on before diving following these steps:

Turning on the Base

Simply connect the On/Off plug into the Base socket (the second one, the first being used for the interferometric frame connector), the Base is then turned on using its internal batteries. After about 15 seconds, the Base will beep twice to indicate a successful initialization (not an error or alert signal). Then the Base unit will enter in sleeping mode, and activates every 20 seconds to see if the Pointer is present and active. Before diving, you can verify that the Base sends messages every 20 seconds when it's activated (you will hear a crackling sound on the top half of the hydrophone).



Turning on the MiniPointer:

To turn the MiniPointer on, simply connect the connector of the BlueTooth module provided by PLSM to the bottom bulkhead. After an initialization of about 15 seconds, the MiniPointer will beep 3 times to indicate a successful initialization in BlueTooth mode and then enter in sleeping mode.

In order to wake up the MiniPointer from sleeping mode, when it is configured in D100-NG mode, you need to use the Android application interface on the tablet.

Never dive with a Base Unit or MiniPointer Unit with an unplug interface connector, it would induce bulkhead contact pin corrosion.

Note: No need to switch on the tablet before turning the Base and MiniPointer on.

3.2 Base Unit Set-Up

The Base Unit must be set up on top of pole on the sea floor. There should be a distance of at least 2 meters between the sea floor and the interferometric frame.

The Base should be fixed as vertically as possible, not exceeding a range of 15 to 20°. In case of excessive inclination, greater than 45°, the warning message "Devers Base" will be send to the MiniPointer.

The pole should secure stability for the Base unit, with an oscillation movement no greater than 2 cm on top of the pole and a frequency lower or equal to 1 hertz. Small and slow frequency vibrations will be compensated by the internal inclinometer inside the Base in order to always output Z coordinates associated to the vertical axis.

Note: The geometry of the frame does not allow for measurements inferior to 2m from the Base.

When using this system, the user should have a direct line of vision, without obstacles, between the Base and the Pointer. Acoustic waves cannot pass through (or very badly) rocks, dunes, or other underwater obstacles.

Ambiant noise:

The AQUA-METRE R300-NG system uses high frequency acoustic waves (65 to 75 kHz) in order to measure distances and angles. Any other system that emits acoustic waves in the same frequency band may affect the accuracy of measurements and should be moved away from the AQUA-METRE during use. These systems include:

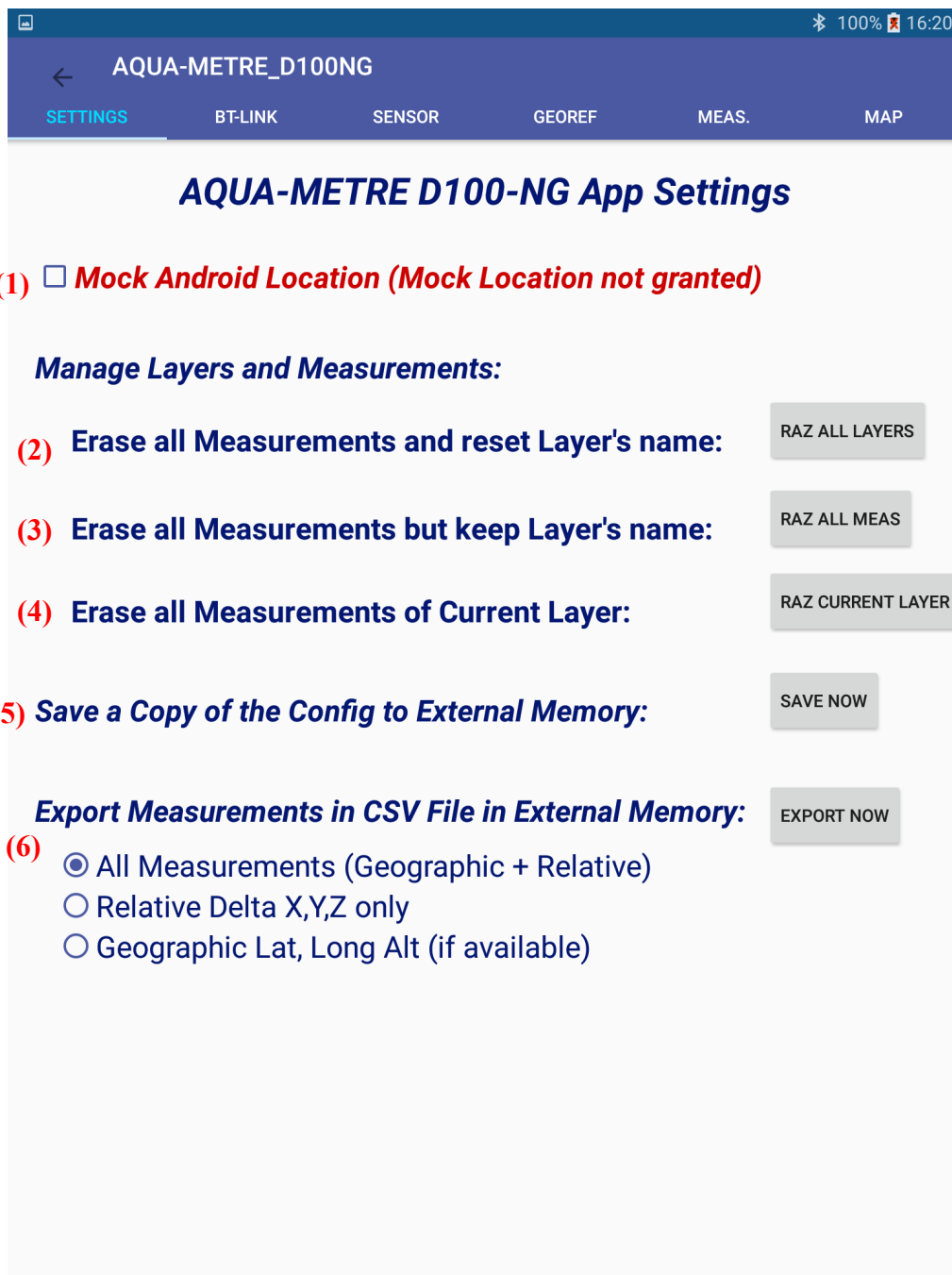
- Echo-sounders, especially if the boat is placed right above the working space,
- Underwater acoustic communication systems for divers (some of these are compatible with using the AQUA-METRE, contact PLSM for more detail),
- SONARS, if they emit the same frequency band (SONARS working with 200 kHz are generally compatible with the use of AQUA-METRE),
- Certain diving regulators (mainly during inhale) can disturb the Pointer. The Pointer can then lose some messages and the operation is slowed down, but the system at large remains operational.

3.3 Android Application User's Manual

The "AQUA-METRE D100-NG" android application offers a graphical user interface to the AQUA-METRE system, in order to control the whole system, collect measurements using a detailed map, and download measurements to another computer after the dive.

This application includes five sub-menus:

3.3.1 "Settings" Menu



On this menu, you can:

- (1) – Activate the «Mock Location» function that enables to emulate a GPS receiver from AQUA-METRE measurements (if you want to use another navigation or IGS application for instance).
- (2) – Delete all measurements and layer's name in the tablet memory
- (3) – Delete measurements only and keep the names of layers.
- (4) – Delete measurements of the active layer only.
- (5) – Save a copy of the configuration file (containing all application data including all the accumulated measurements) in external memory of the tablet (“external” in this case means accessible to the user and through USB). You can find this file in the application menu (in the “SavedConfig” folder).
- (6) – Export measurements in CSV text format with three different options: All measurements; Only relative measurements (relative to the Base frame); or Geographic measurements if available (if the Base frame has been georeferenced). The first line of the text file describes all saved parameter fields.

Names of exported .csv files:

Meas__ddmmyyyy_hhmmss (dd= day of the month, mm= month, yyyy= year and time: hh= hour, mm= minute and ss= seconds)

For example: Meas__15052017_085533.csv

CSV file content (since version 1.3) :

Content of each line exported in the .csv file

Export format « All Measurements » :

Layer, NumDive, TypeMeas, Xrel, Yrel, Zrel, Pressure, BaseMagHeading, BaseLatRef, BaseLongRef, BaseAltiRef, BaseThruNorth, Celerity, Date_Time

Export format « Relative Delta X,Y,Z only » :

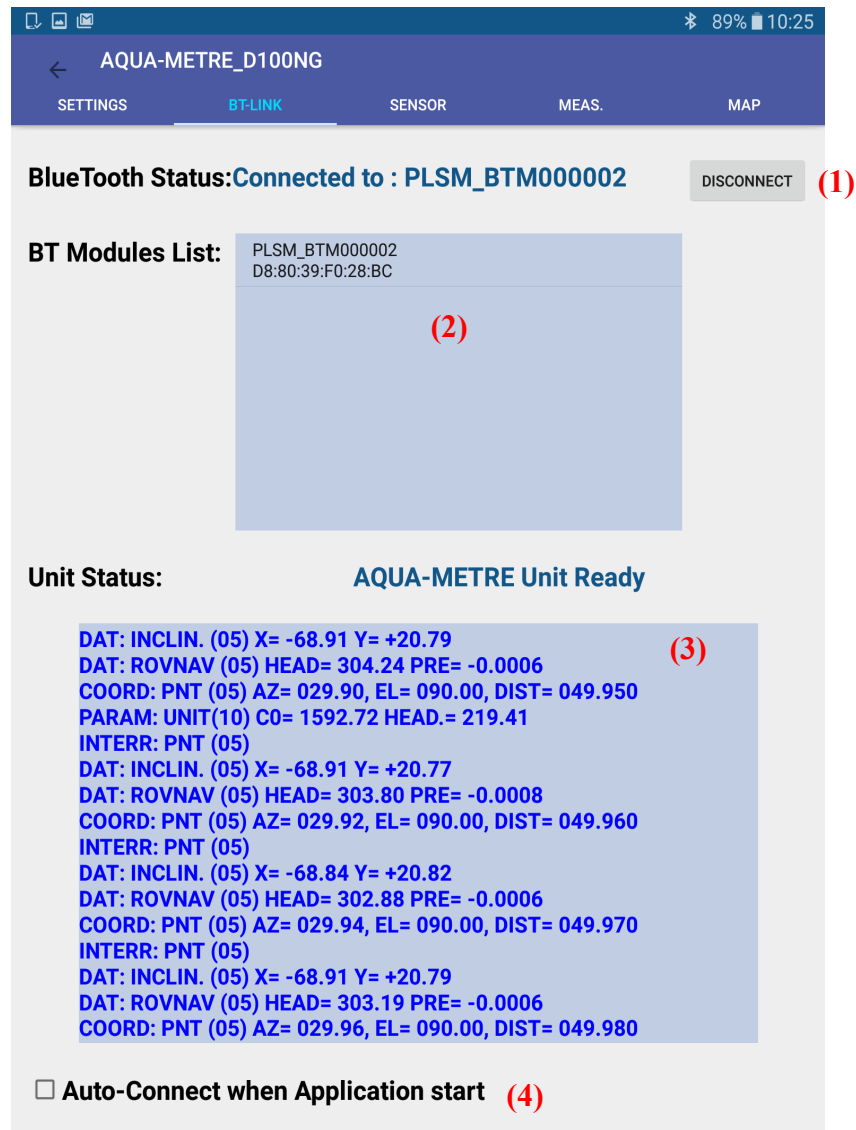
Layer, NumDive, TypeMeas, Xrel, Yrel, Zrel, Pressure, BaseMagHeading, Celerity, Date_Time

Export format «Geographic Lat,Long,Alt » :

Layer, NumDive, TypeMeas, LatMeas, LongMeas, AltiMeas, Pressure, Celerity, Date_Time

Note : TypeMeas is the kind of measurement : 0= isolated measurement, 1 = measurement that is part of a polygon, 2= measurement signifying the end of a polygon. This field was made available with version 3 of the application.

3.3.2 “BT-Link” Menu



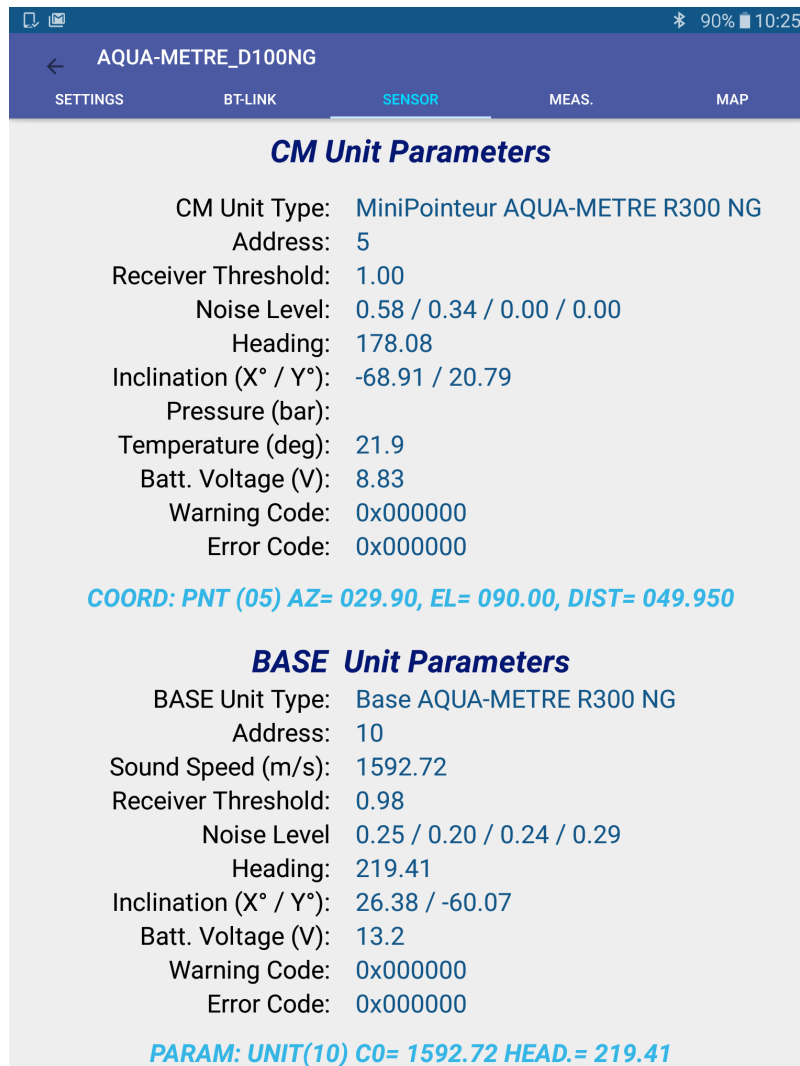
This menu manages the Bluetooth link between the Tablet and the MiniPointer.

Click on the “Connect” button; (1) The system will identify available modules, (2) to connect the first identified module that corresponds to an AQUA-METRE module (the one with the name “PLSM_BTMMxxxx”).

The activation of Bluetooth mode can last up to a minute. The activation and manipulation of the MiniPointer happens automatically, and the messages will appear in the window (3). The automatic connection option (4) is not yet activated, and the connection is made by the user.

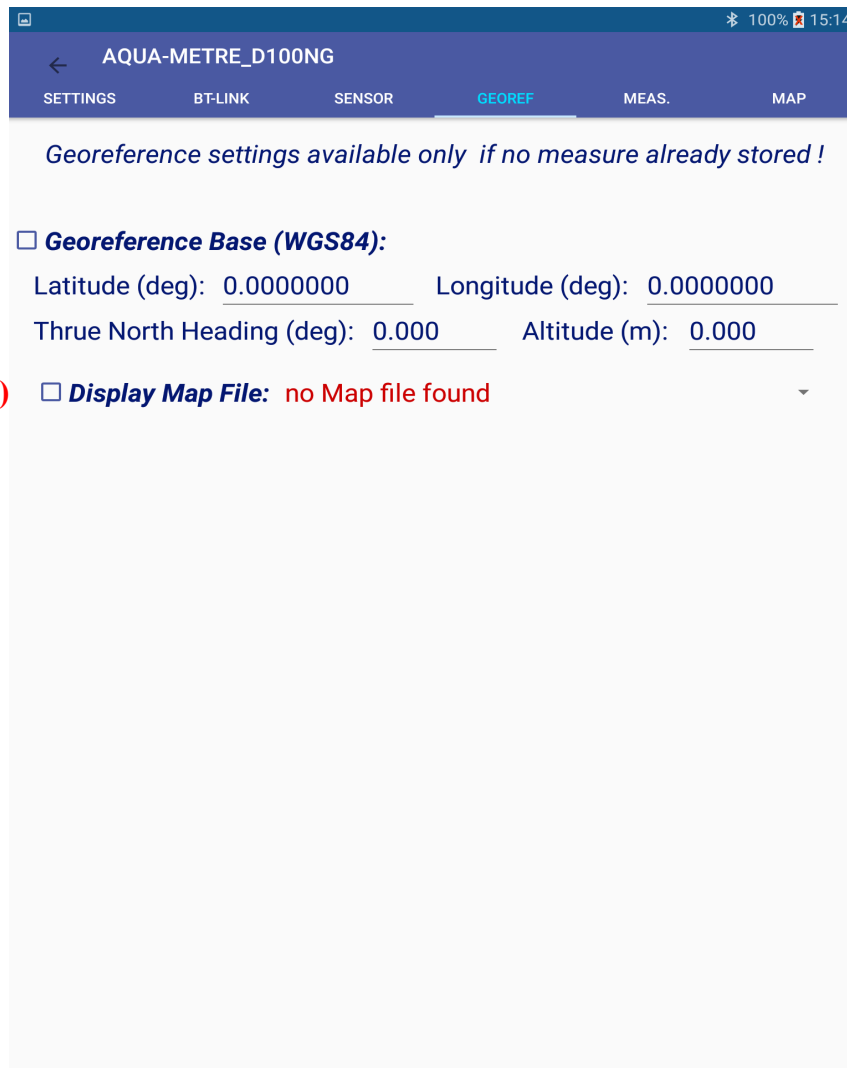
Once activated, the MiniPointer will respond to the Base interrogation, which will also leave the sleep mode. The interrogations and position measurements will then appear automatically (auto script from the Base in D100-NG mode).

3.3.3 “Sensor” Menu



This menu simply displays Base and MiniPointer parameters when they are transmitted to the tablet.

3.3.4 “Georef” Menu

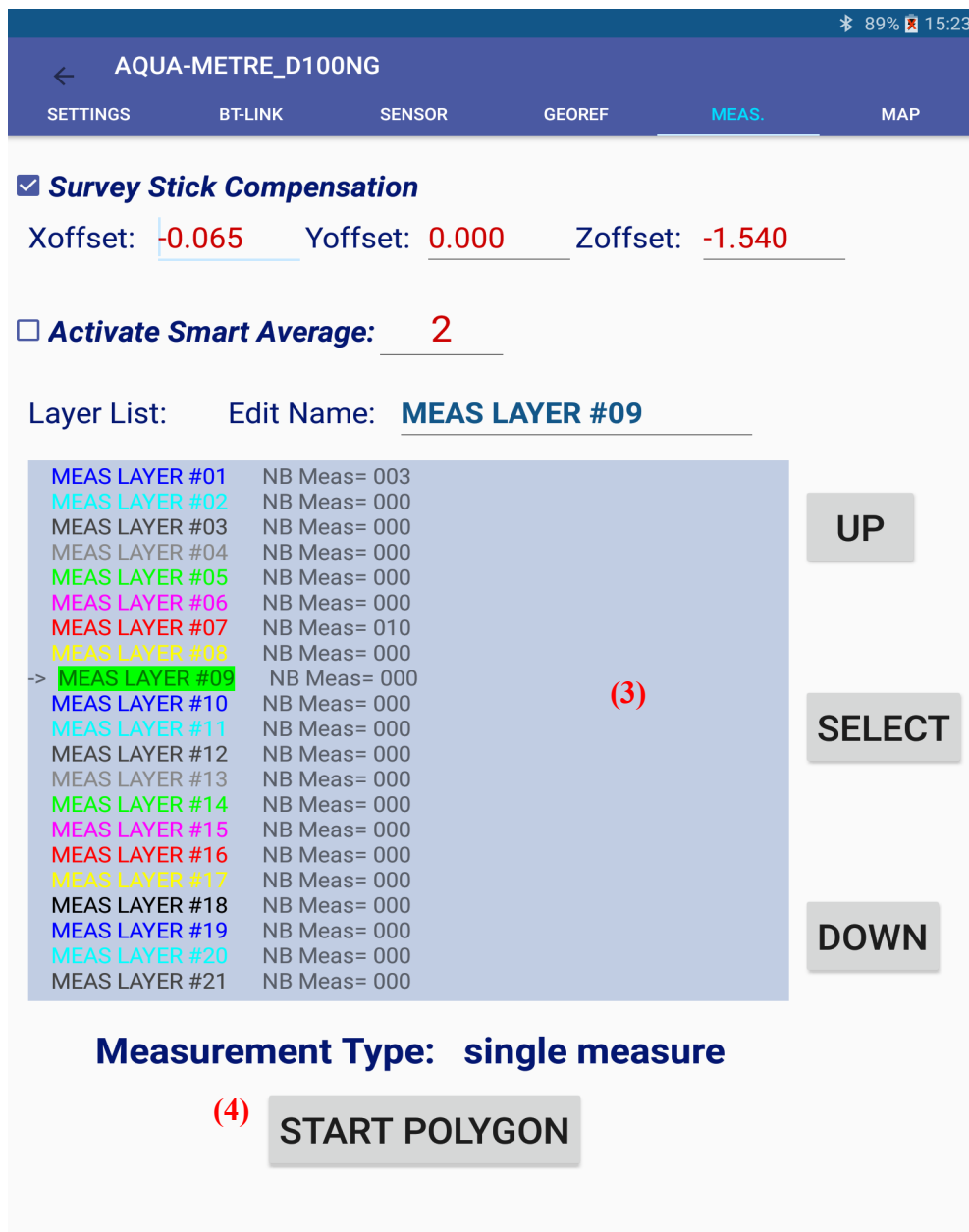


The “Georef” menu, available since the 1.2 version of the application, allows you to:

(1) – Define the geographical position of the Base in WGS84 format, as well as the true North heading to fix the orientation. If this georeferenced option is not checked in, measurements are taken relative to the interferometric frame.

(1) – Pick the background file of a map to display. This file is in .map file and needs to be compatible with MapForge (go to www.plsm.eu for links to servers with .map format files compatible with MapForge). The .map files should first be placed under location “\Android\data\plsm.aqua_metre_d100ng\Maps” and should include the geographical zone in which the user wishes to georeference the Base.

3.3.5 “Measures” Menu



The “Measures” menu enables you to:

(1) – Activate or deactivate the survey stick compensation while taking measurements. When activated, all measurements are translated from the MiniPointer hydrophone (the actual point of measure) down to the extremity of the survey stick. The survey stick tilt and orientation are compensated, but keep in mind that it is better to keep vertical in order to lower the survey stick compensation error. The shifts between the stick and the hydrophone

can be modified in case the stick is changed depending on what kind of measurements are taken. If you are using a standard survey stick, do not change these parameters.

(2) – Enable or disable the «smart average» function that filters measurements over N samples (N between 2 and 10 may be chosen by user), verifies their coherence and saves the geometrical average. This function also rejects erroneous measurements that may occur (in multi-path conditions, for instance).

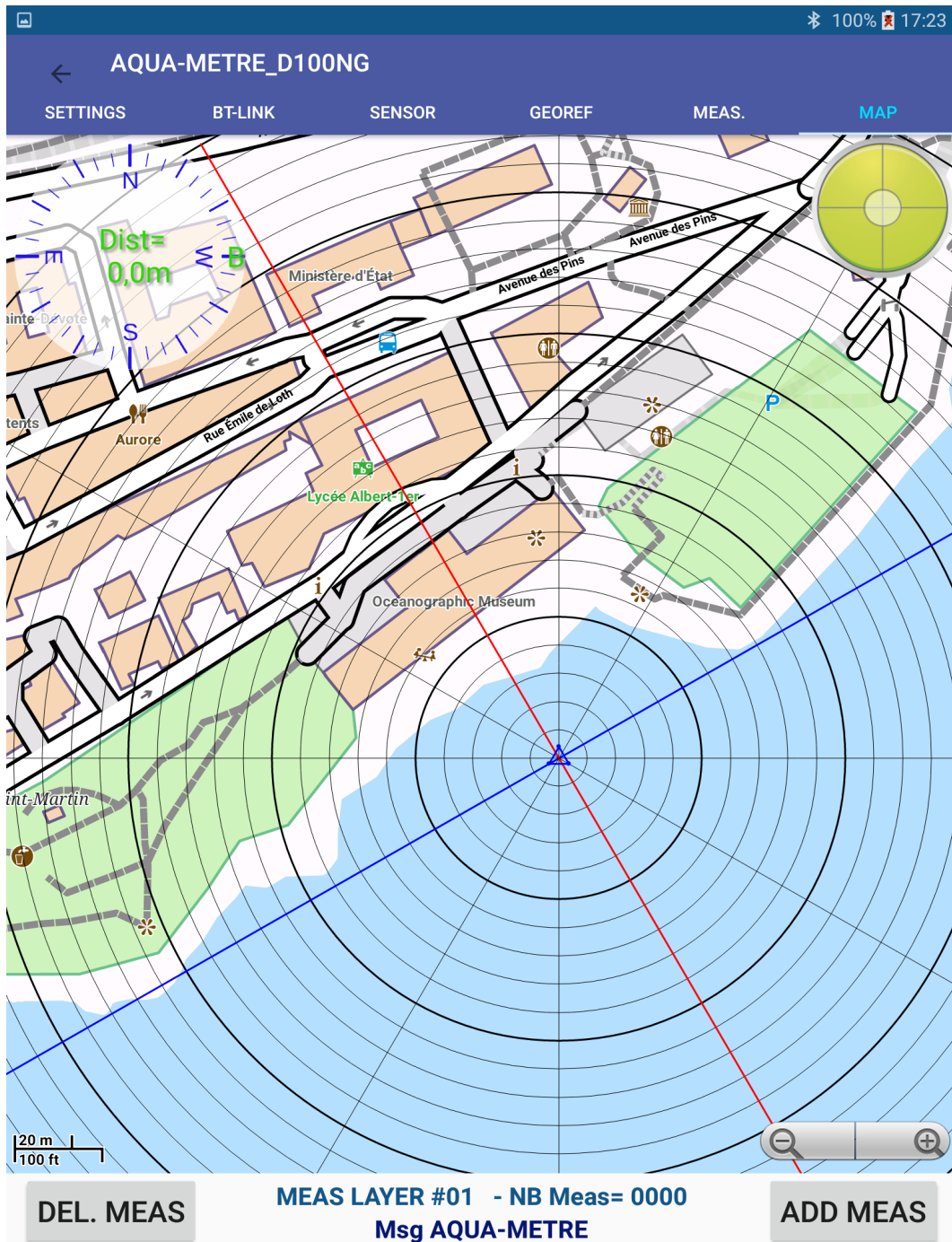
(3) – Manage the layer list measurements are collected. There are 50 available layers, and the user can change each layer's name according to their need. Thanks to this function, you can associate measurements to a specific zone or kind of object (for example, “Posidonia” for measurements relating to the size of a seaweed bed) and sort more easily when managing measurements. The “UP” and “DOWN” button allow you to point to a layer to modify its name in the “Edit Name” button. The “Select” button selects the appointed layer as active layer when collecting measurements.

(4) – (New with version 1.3) Activating Polygon Mode (to define the limits of a seaweed band for instance). Once activated, the next measurements are taken as if they belong to the same polygon. Once you activate the button, it displays “STOP POLYGON”, which allows you to stop the polygon. The last measurement that you took is then considered as the last point in the polygon. The kind of measured point (isolated point, point in a polygon, or the last point in a polygon) is part of a new field in the CSV files.

3.3.6 “Map” Menu

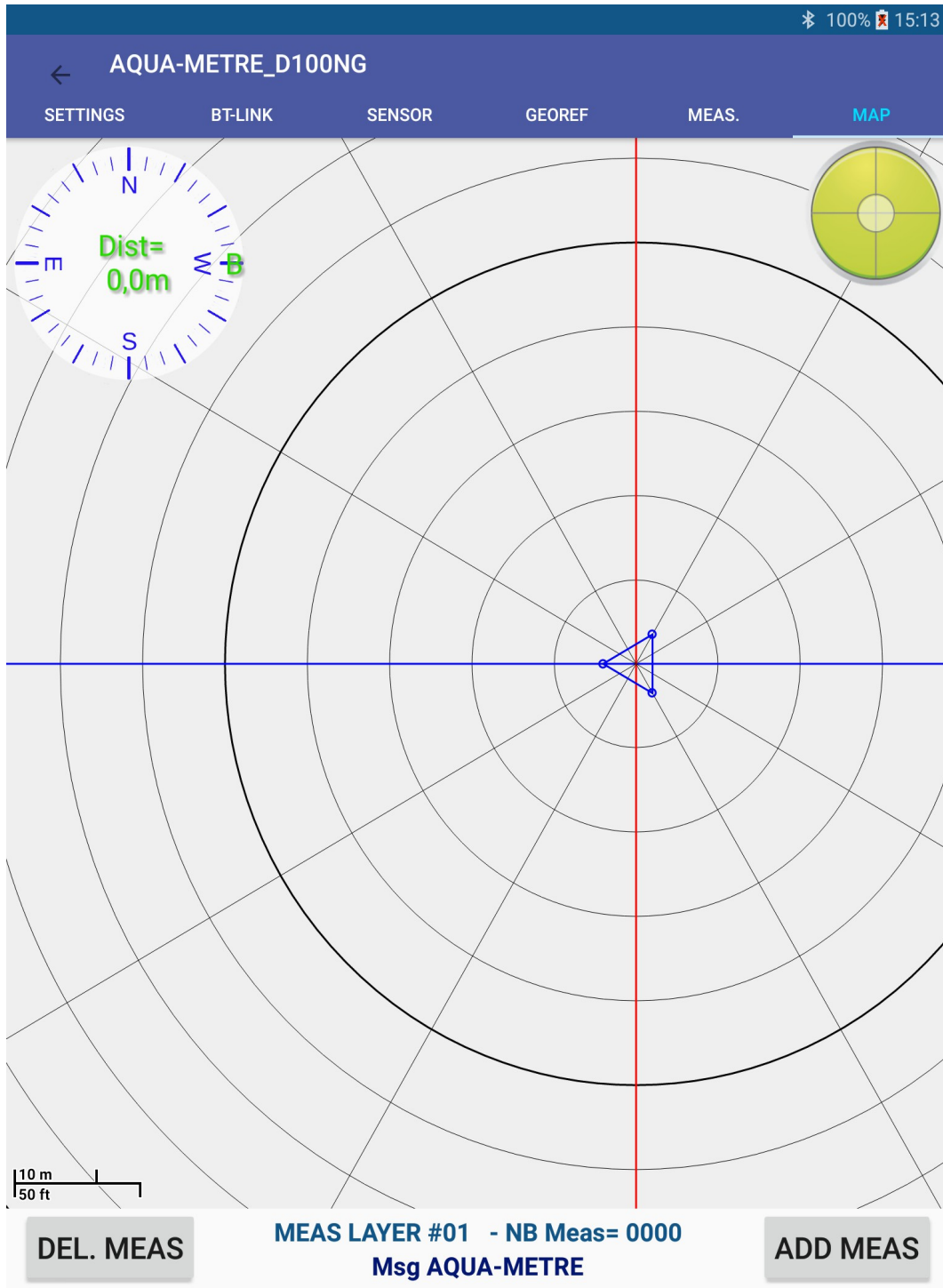
The “Map” menu displays the map in use according to two modes:

The geographic mode, if the Base is georeferenced and the map corresponding to the working area is selected (and previously uploaded to the map list):



Example of a map displayed for a dive beside the Monaco Oceanographic Museum (Base georeferenced to 43,730159° North and 7,425987° East, 60 ° true North heading)

The relative mode which displays the situation according to the Base (placed at point {0,0,0}):



Example of the Base in non-georeferenced mode (relative mode)

In both cases, the Base is situated in the center of concentric circles (one for every 10 meter). The blue X-axis corresponds to the X-axis of the frame and the same goes for the red Y-axis. Once the Pointer receives these coordinates, it then appears on the map and is

oriented in relation to the Base. The Pointer and the tablet are displayed as a circle and a rectangle respectively.

The «ADD MEAS» will take the next incoming coordinate as a new measurement.

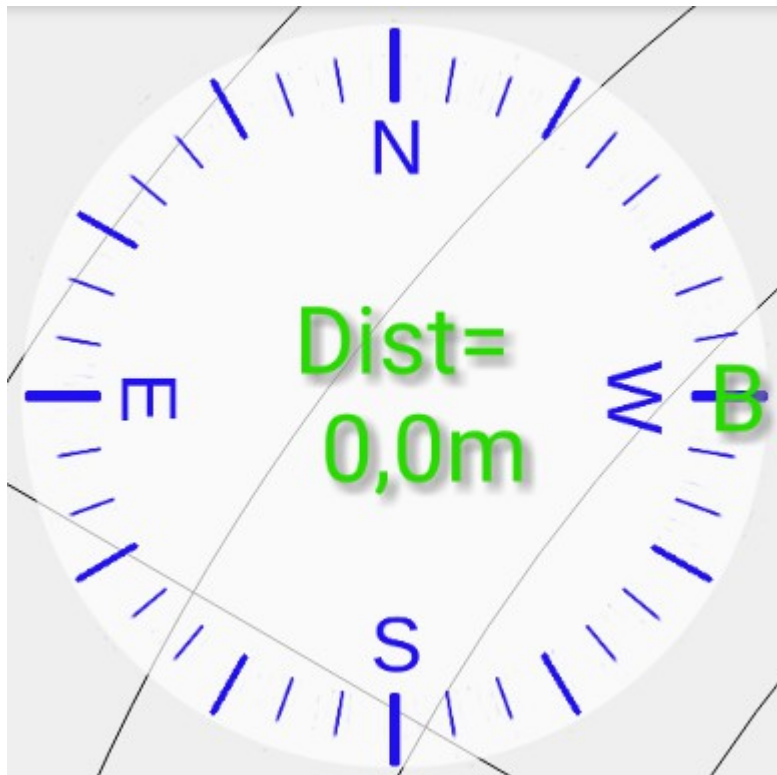
The «DEL MEAS» will delete the measurement in progress if it's activated or delete the last measurement taken,

Two lines are displayed between the two buttons;

- the first line displays the active layer name for saving measurements and the number of measurements stored in it,
- the second line displays information related to the incoming messages from the MiniPointer like “Pointer Interrogation”, “new coordinate”, “measurement progress”,etc. It is useful to check that the Base and MiniPointer are still active!

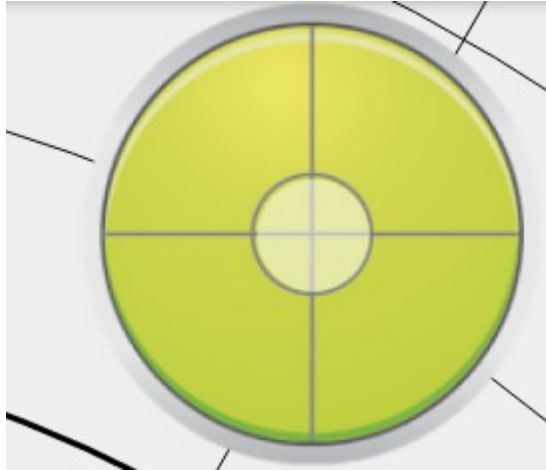
Compass and looking for the Base :

Since the 1.2 version of the application, a compass is displayed on the top left of the map to show the orientation of the tablet. The distance to reach the Base is also shown in the center, along with a “B” sign to find the direction of the Base.



Bubble level :

Since the 1.2 version of the application, a bubble level is displayed on the top right of the screen to indicate the inclination of the MiniPointer. This ensures the user can keep the MiniPointer in a vertical position in order to minimize survey stick compensation errors.



3.4 System Limitations

3.4.1 Software limitations

The 1.3.0.0 version presents the following known limitations:

- Once the Bluetooth link has been made, the user should not exit the application to launch another application. This can lead to a rupture in the Bluetooth link and the activation of sleep mode for the Pointer from the Base. The MiniPointer activates sleep mode whenever it detects a deactivation of the Bluetooth link. The Base goes in sleep mode after one minute if the MiniPointer doesn't respond to acoustic interrogation.

3.4.2 Hardware limitations

- The Base in D100-NG mode, with the V0516 internal software, can work coupled with only one Pointer at the 05 address (the multi-pointer mode will be added at a later stage).

4 Taking care of the Equipment

4.1 Fresh water rinsing

After use in sea or polluted water, the system must be rinsed before drying. If it is not rinsed, a salt deposit will form on the equipment. If this happens, submerge the system in fresh water for at least an hour, changing the water if necessary, in order to dissolve the salt deposit. Make sure to connect all the connectors to the bulkhead before this operation!






4.2 Charging the Base and MiniPointer batteries

Plug the charger on the Base or MiniPointer interface/charge connector (where the on/off button goes), or at the inferior bulkhead of the Pointer (where the Bluetooth interface goes). Then plug the charger into a wall AC supply (90 to 265VAC). A green light will turn on to indicate that the equipment is charging properly.



Note: PLSM can equip the charger with different kinds of connectors in order to be used in different countries. EU, US, and UK power cords can be supplied with the system. Contact PLSM in case you do not have the right adapter.

While charging, the orange indicator will blink every 15 seconds to show charging progress:

	1x blink:	Charged 15 %
	2x blink:	Charged 30 %
	3x blink:	Charged 50 %
	4x blink:	Charged 65 %
	5x blink:	Charged 80 %



6x blink: Fully charged.

Once it is done charging, the system will automatically reduce the current to a steady charge. It is then recommended to unplug the battery charger. The Base and/or MiniPointer will then automatically switch off.

Charging is not possible if the battery temperature is lower than 5°C or greater than 40°C.

4.3 Lubrication of connectors and bulkheads

Before plugging any connectors in bulkheads, make sure that they are free of sand or other fine particles. If that is the case, remove the particles using a brush (non-metal), or preferably with an air pressure duster.

Before any mission or at least after every five uses, oil the connectors and bulkheads with a silicone oil (do not use silicon grease):

**Brand: ELECTROLUBE,
reference: OSL (aerosol)
Available at Farnell or RS**