

APPLICATION NOTE

Measuring with Combo mode on a Hologic Selenia Dimensions using the Black Piranha and Ocean Quick Check software¹

This application note describes the ability to measure with the Black Piranha on a dual energy 3D Mammography system. Hereunde the use of Ocean Quick Check is described for measurements on the Hologic Selenia Dimensions.



¹ These instructions were made using version 2016.12.27.243 which can be found under the **About** selection under the **Help** menu. The version number refers to the (year) 2016.(month) 12.(day) 27.(build#)243 of the software release.

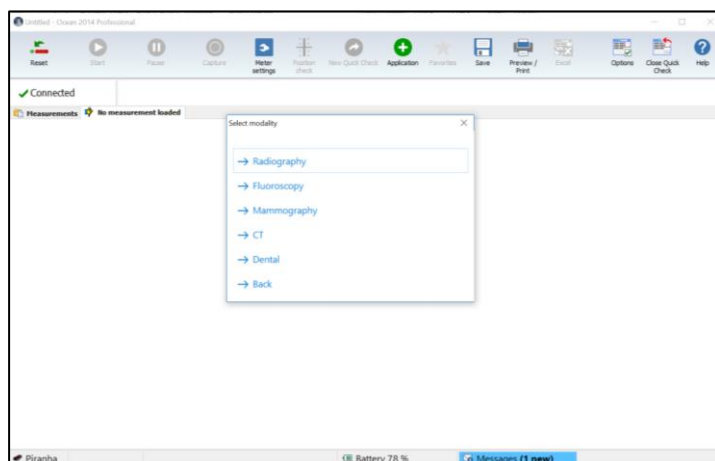
Introduction

The goal of measuring in Combo Mode is to obtain the sum of the 2 dose measurements measured from the tomo exposure using the W/0.7 mm Al beam quality and the stationary exposure W/50 μ m Rh beam quality which follows immediately after the tomo exposure. In order to measure this accurately with the BP (Black Piranha) you need to select the proper beam quality for each exposure and the QC software (Ocean Quick Check) has an application available with instruction to help you perform the measurement easily. This combo measurement can be obtained with the tomo sweep turned on or with it in a stationary mode. The dose measured from the tomo sweep may prove to be more accurate than using the sweep mode due to the angulation dependence of the detector but only by a small percentage. For questions on the angulation dependence of the BP detector please see the ***Piranha Reference Manual*** pages 23 and 24. The pertinent information from those pages has been added to the Appendix of this document for easy reference.

Measure

Turn on your BP and then start the Ocean software on your computer. This document assumes that you already know how to use the BP and the QC software and that your BP has already been connected to your PC either via Bluetooth or using a USB cable. It also assumes that you know how to position the BP in the mammo field which can be found in the ***Piranha Reference Manual*** page 53. The pertinent information from this page on how to properly position the BP in the mammo field has been added to the appendix of this document for easy reference.

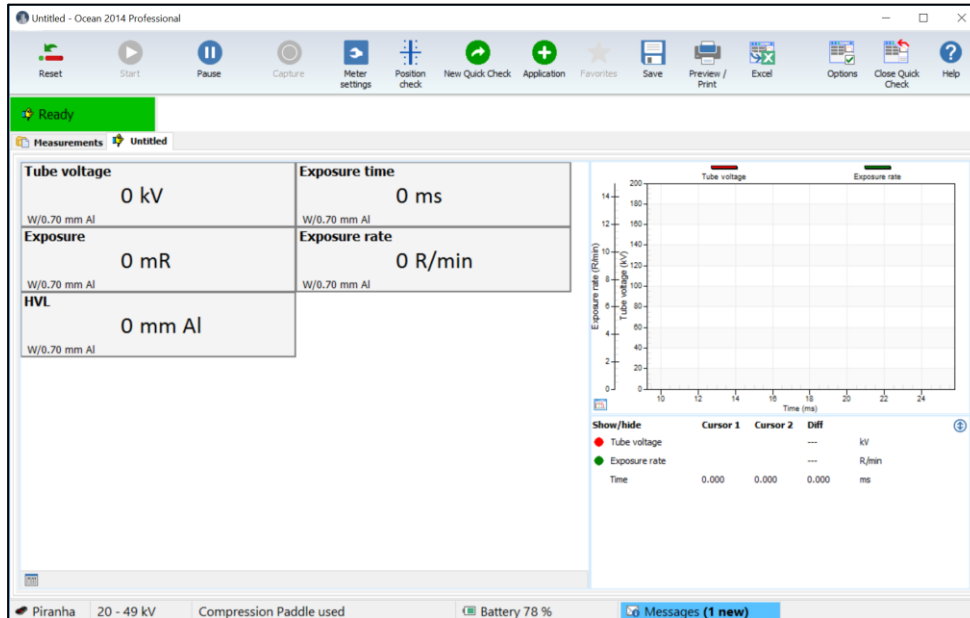
After starting the Ocean software QC should start and the ***Select Modality*** menu should be displayed as shown below. If QC starts with a different menu see page 37 of the ***Piranha & Quick Check Getting Started*** manual which covers the ***Preferred Modality*** menu. This has also been added to the Appendix of this document for easy reference.




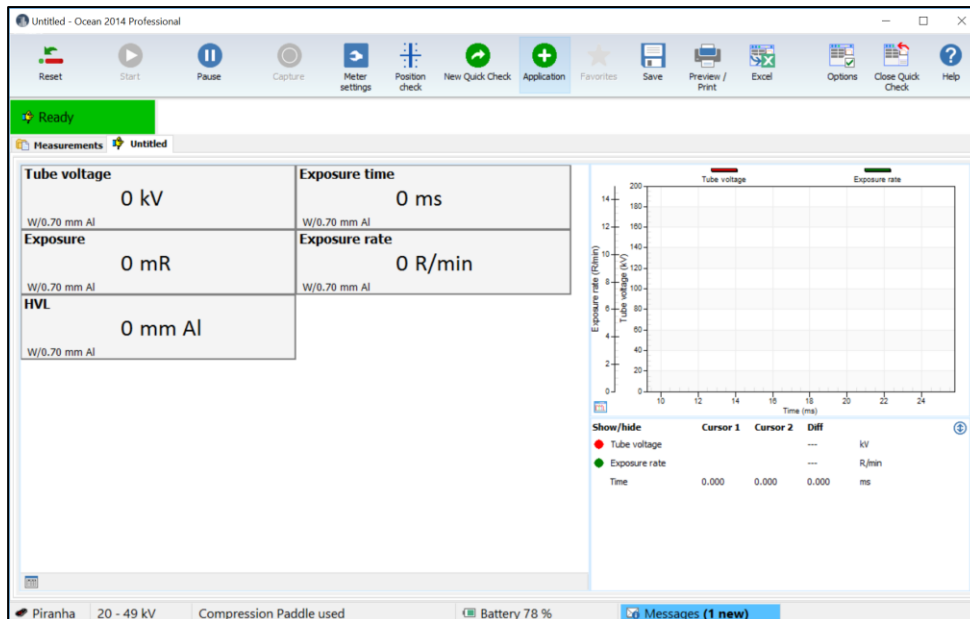
From the ***Select Modality*** menu and its submenus select Mammography, Hologic, Selenia Dimensions, W/0.70 mm Al, and whether you are using the compression paddle or not.



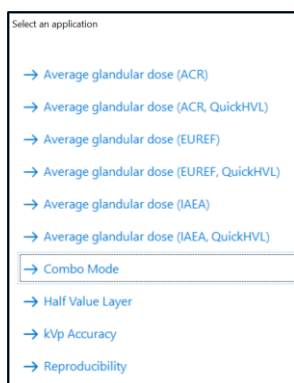
The QC measurement screen will appear next with all the parameters you can measure in that exposure showing the beam quality chosen in the bottom left corner of each of the different parameter display boxes.



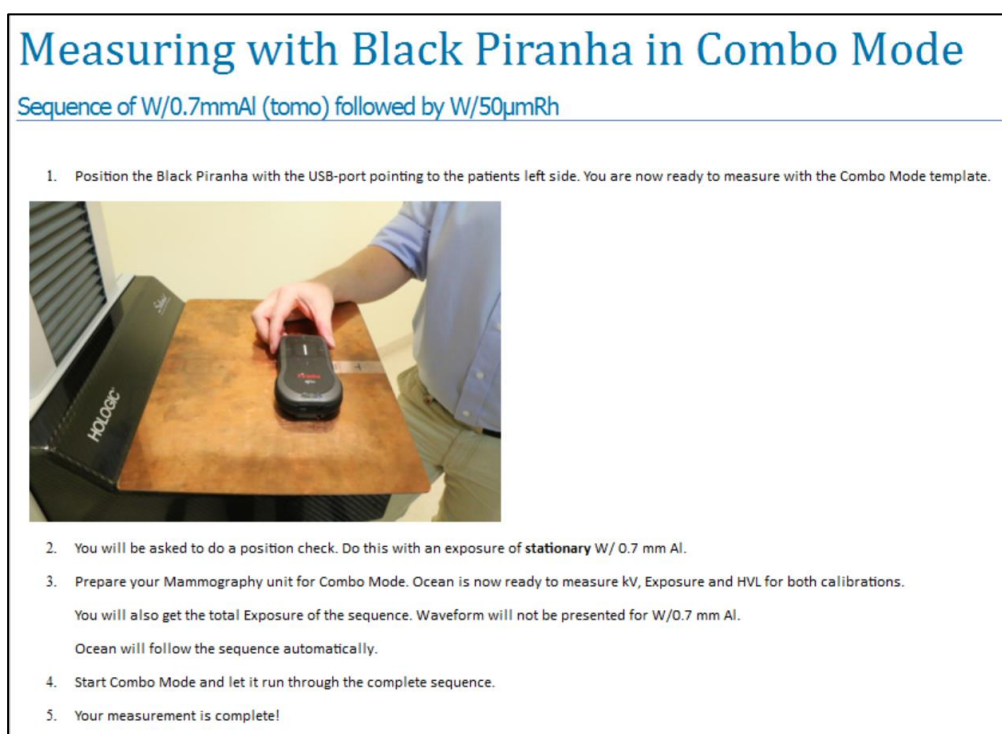
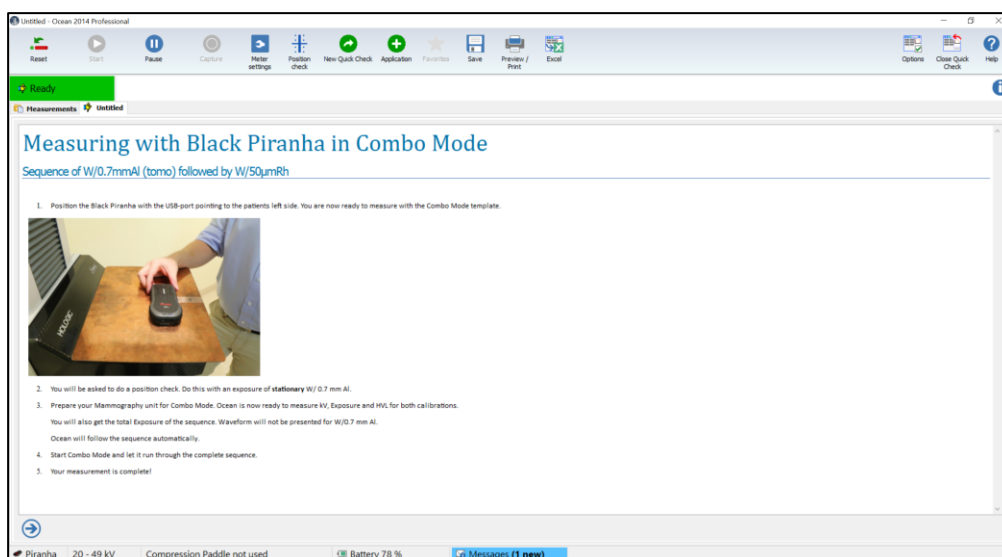
Select the *Application* icon  located on the ribbon bar as highlighted below.



Select the *Combo Mode* from the list.

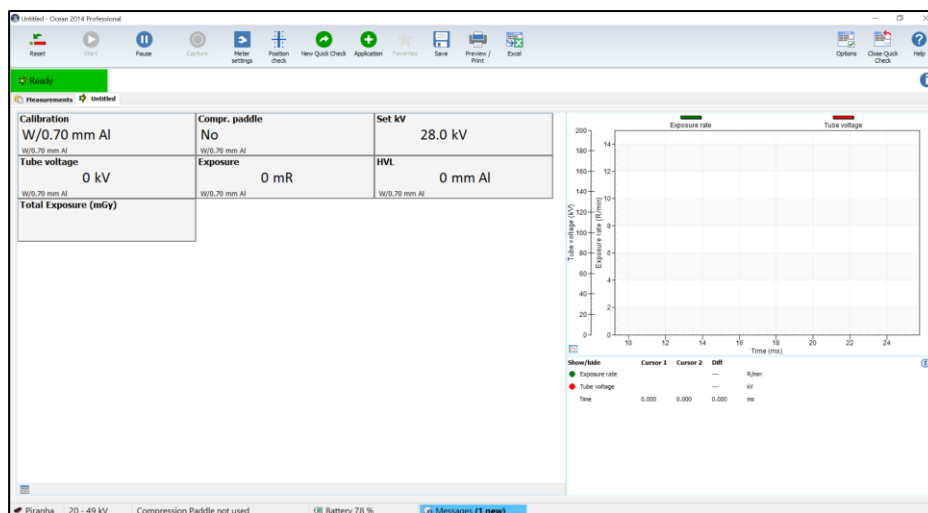


You will come to the following QC screen with a set of instructions.





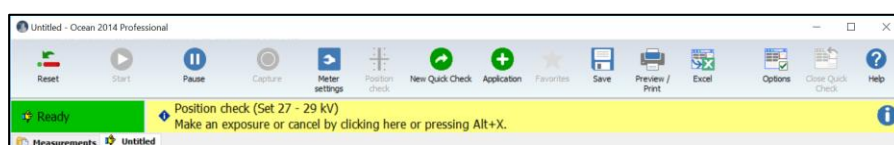
In order to close the instructions, select the blue arrow key at the bottom left hand corner of the instructions. The following QC screen will appear showing the different parameters which will be measured.



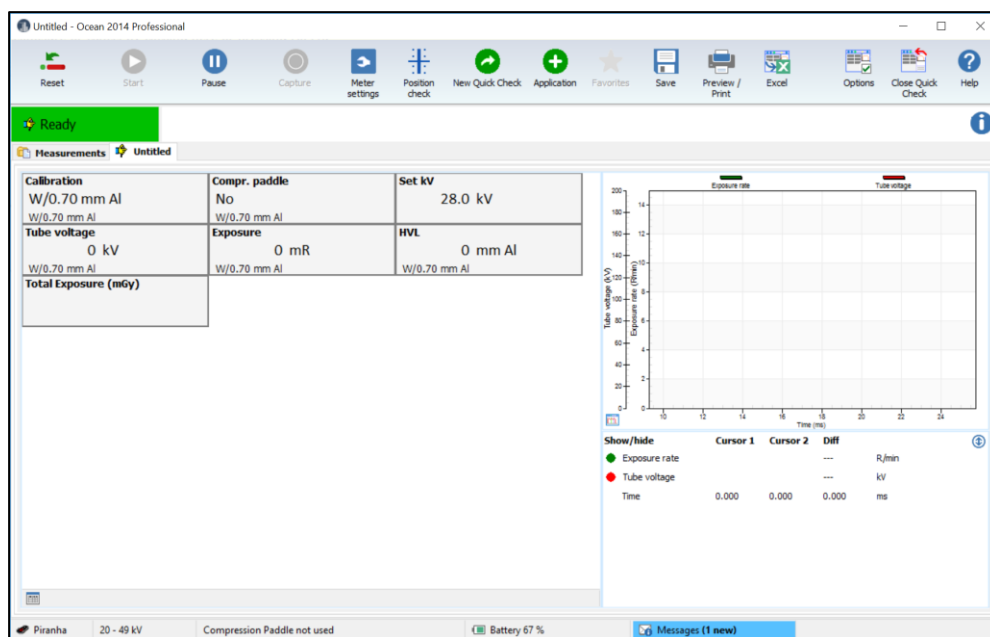
A **Position Check** in the W/0.7 mm Al beam quality should be performed before the Combo mode is run.



If the **Position Check** does not automatically open, select the **Position Check** icon located on the Ribbon Bar and the yellow highlight bar below the Ribbon Bar as shown below will appear. Follow the instruction and set the kV between 27 and 29 kV. In order to do this with the W/0.7 mm Al beam quality select a tomo exposure in a stationary mode. After that exposure is made a value will be displayed in the yellow highlighted area and if it is within the specification (between 0.95 and 1.05) it will disappear and you can then proceed with the Combo measurement. For questions on using **Position Check** in mammography see the **Piranha Reference** manual page 52 and **Measurement Principles** on page 46. These have been added to the appendix of this document for easy reference.

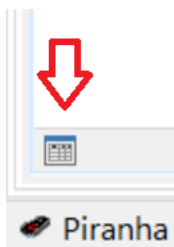


After the **Position Check** is completed the following measurement screen will appear again.

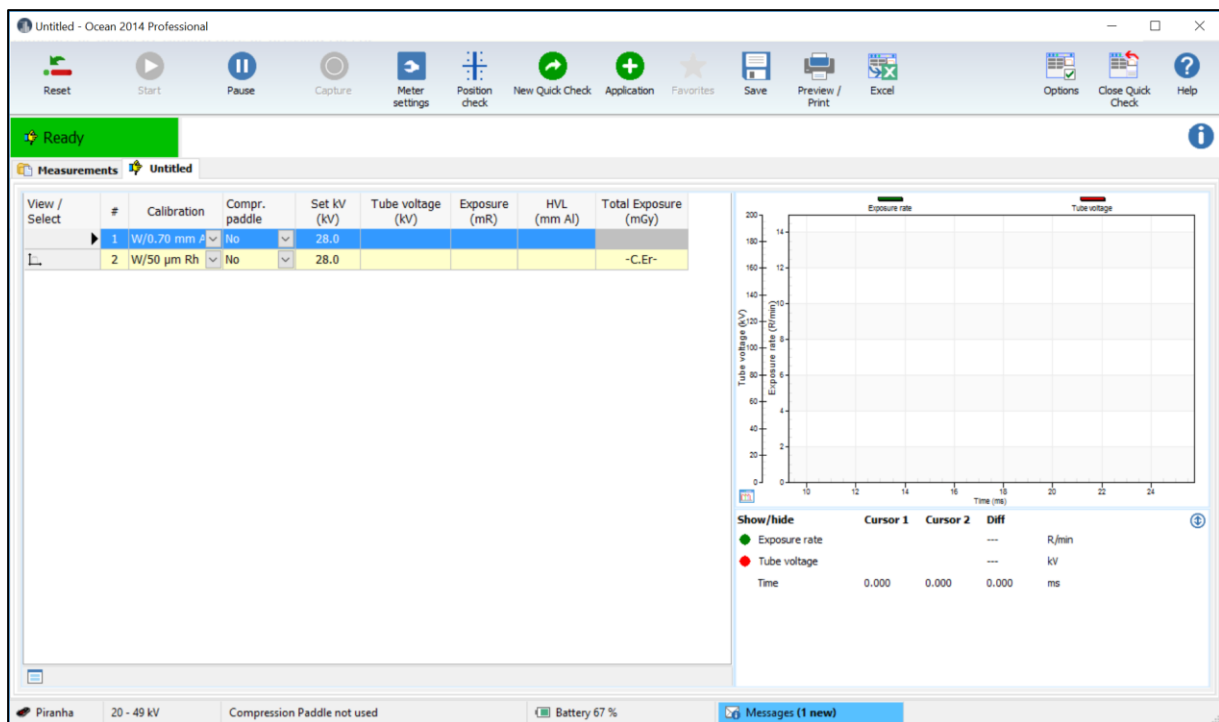


This display shows the settings display boxes as well as the measured values display boxes for the measurement. In the **Calibration** display box the **W/0.7 mm Al** beam quality is shown. Start the Combo mode sequence of exposures. Once the tomo sweep exposure is complete the values will be shown and then the beam quality in the **Calibration** display box as well as the bottom left of each of the parameter display boxes will change to **W/0.5 um Rh**. Once the second exposure has been made the values for that exposure will be displayed and in the display **Total Exposure (mGy)** will show the sum of both exposures.

To be able to change the settings for the different parameters as well as see all the exposure values in one display change to the **Grid** view. Select the **Show Grid** icon located at the bottom left of the screen.



The screen will change to the display below. In this view, it is possible to change the **set kV** value, the **Calibration** (beam quality) value and whether you are using the **Compression paddle** or not. There is really no need to change the **set kV** value or the **Calibration**. It could be beneficial to change whether the compression paddle is being used or not. In the second row and the last column titled **Total Exposure** the sum of the 2 dose values from the two exposures will be displayed. This information can be exported to Excel if that is desired. In order to export to Excel please see pages 31 – 34 of the **Piranha & Quick Check Getting Started** manual.



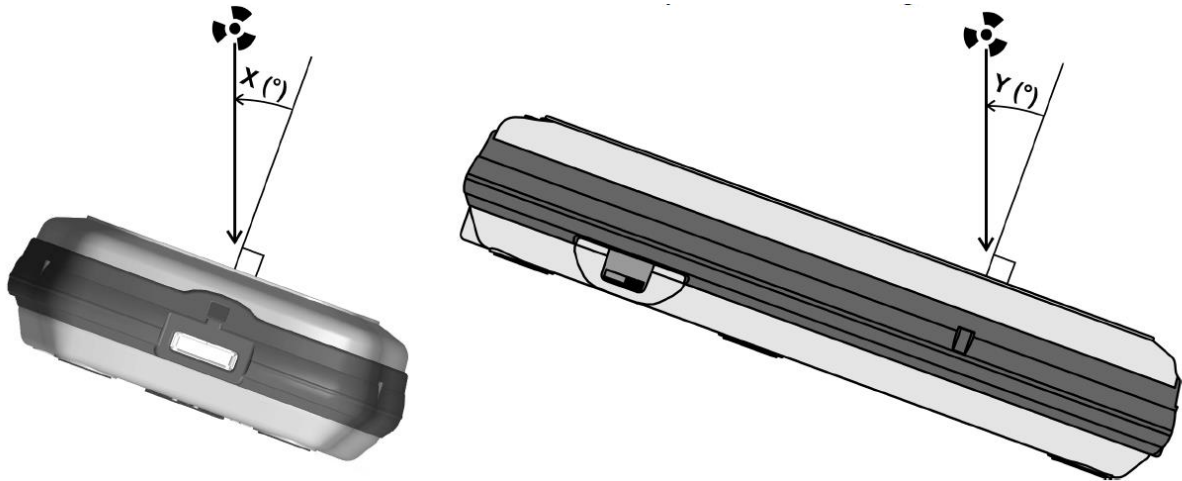
This concludes the instructions on how to use the **Combo Mode** application in the Ocean QC software using the BP. If you have any further questions, please contact your local RTI office for further help.

Appendix

Angular Dependence of the BP:

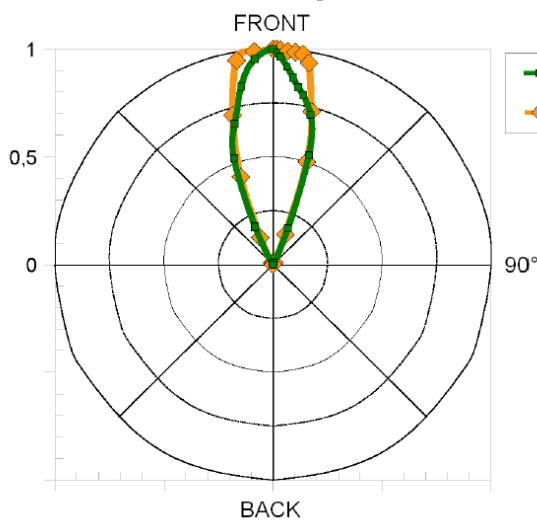
2.4.1.5 Angular Sensitivity, Piranha

In this section, you can see graphs of the typical angular sensitivity for dose measured with the Piranha at 28 and 70 kV. The setup is shown in figures below.

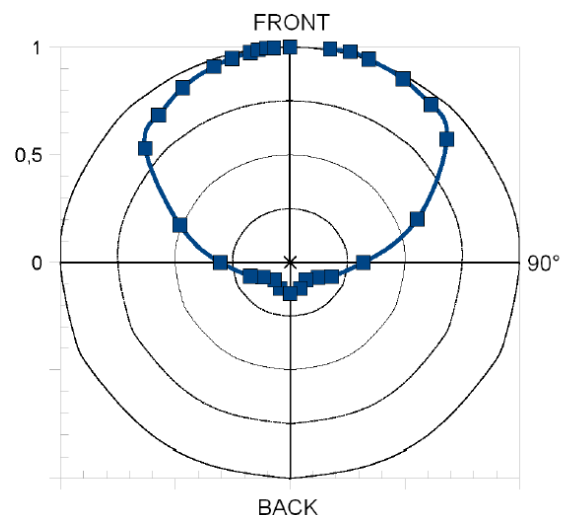


This "directional" behavior makes it excellent for reproducible measurements, with less influence by nearby spreading matter. This makes it possible to make accurate HVL measurements even when measuring with "bad geometry", which is especially interesting for mammography. To understand, please see the polar plot shown below. The Piranha is shown to the left, and a typical mammographic ion chamber to the right.

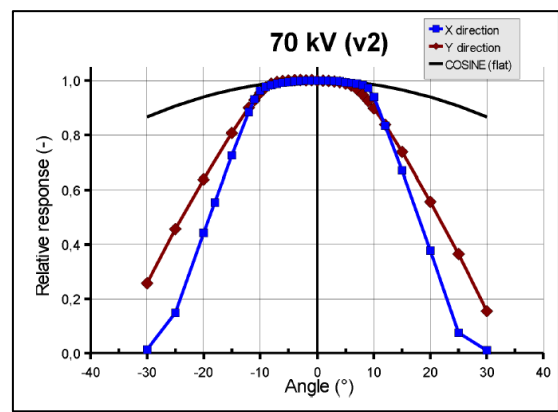
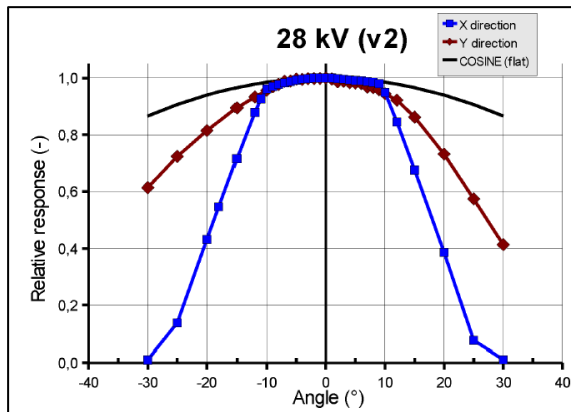
Polar Sensitivity - 28 kV



Polar Sensitivity - 28 kV Chamber



The angular sensitivity graphs for the BP in mammographic and radiographic energies are shown below. The Y direction shows how it will respond with the mammo sweep of the Selenia Dimensions with a 15 degree sweep.



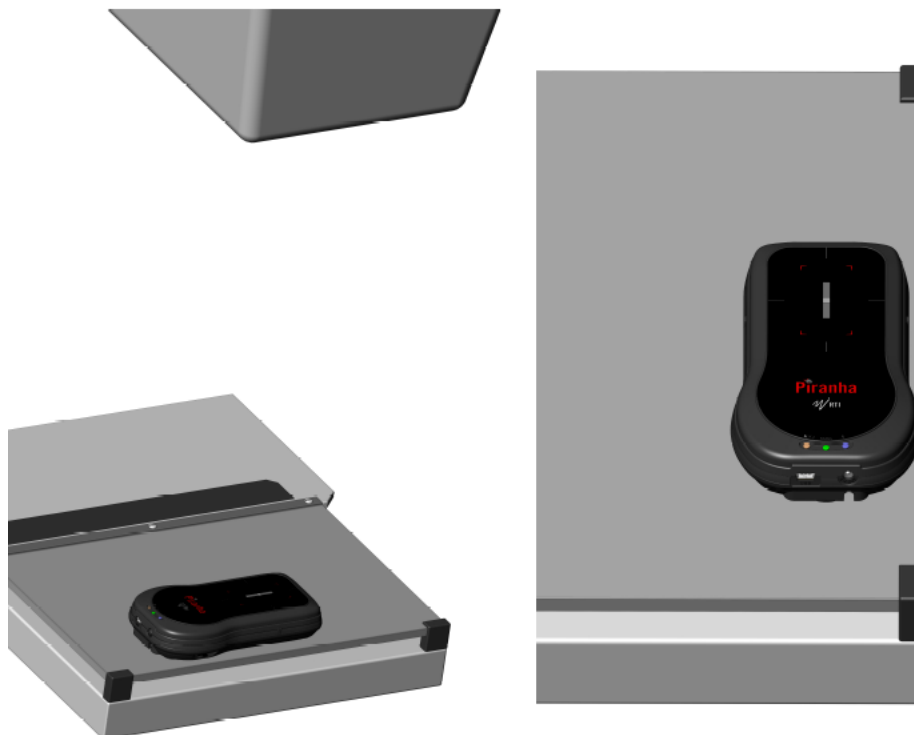
How to properly position the BP in the mammo field:

Make sure that the image receptor is positioned at a clinically relevant distance.

Place the Piranha flat on the image receptor with its long axis parallel to the chest wall making sure the center of the detector surface is placed in the center of the light field, as shown in the pictures below (40 mm distance shown).

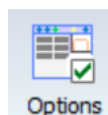
This placement of the Piranha makes the detector surface perpendicular to the cathode/anode axis, to avoid influence from the heel effect.

For general mammography, it is important that the USB port is to the patients left, as shown in the pictures below.

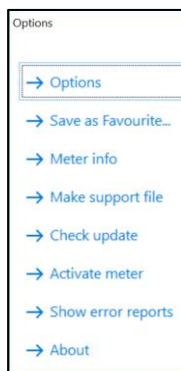


Preferred Modality Menu:

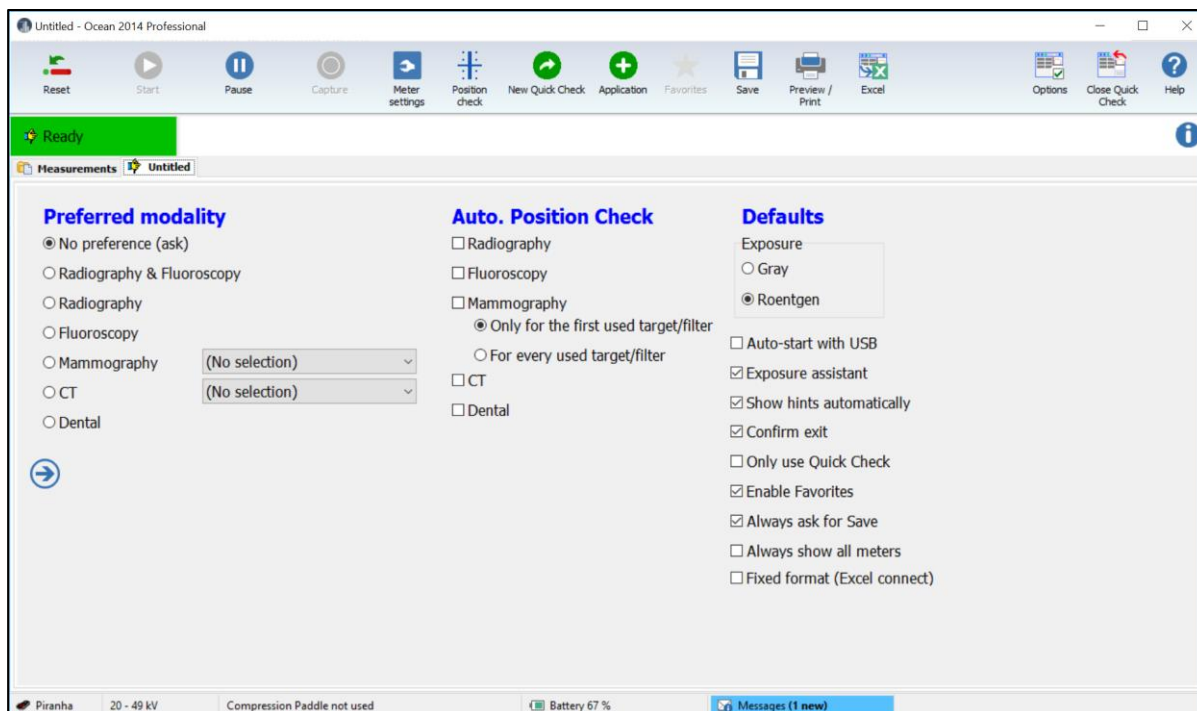
As a standard, the default start up for the **Preferred Modality** menu lists all of the modality's which a user could choose to select in order to do the measurements. There is a setting in the **Options** menu which



you can open by selecting the **Options** icon found on the Ribbon Bar. The **Options** menu will be displayed.



Choose **Options** which will open the following display below. Under the **Preferred Modality** the preference of what modality the first menu shows can be chosen by selecting the radio button next to it. The **No preference (ask)** is the default to show all modalities for the user to select from. If the user only performs measurements on Mammography they could select the **Mammography** radio button selection and the first menu shown would be to select name of the mammography unit manufacturer.



Position Check:

To measure kVp on a mammography unit is straightforward. This is true since the Piranha automatically can detect whether the detector area is not fully uniformly irradiated, by means of the Position Check. The mammography kV calibrations available for the Piranha is ranging from 18 to 49 kV.

To be able to trust the kVp reading it is always very important to make the Position Check to verify that the whole detector area is uniformly irradiated. The Position Check is normally started automatically every time you change Radiation Quality, but please make sure to do a Position Check every time the Piranha is repositioned.

Measurement Theory of the detector explaining how the Position Check works using the Check Filter:

The design of the detector package is very important to be able to measure kV and dose correctly in the whole range of 20 to 155 kV.

The Piranha design makes it possible to measure small field sizes, less than 3 mm width, and low output levels down to approximately 1 $\mu\text{Gy/s}$. Basically the detector packages consist of four separate electrometer channels connected to detectors D1, D2, D3, and D4 and a moveable filter package that can change to one of six positions, each a combination of different filters for the detectors. *One of these positions is used as a "check-filter". It has the same filter thicknesses for both D1 and D2. When the detector is perfectly positioned and both detectors have the same radiation the ratio between the two signals should thus be exactly "1.000". This is very useful information, and testing this makes sure that your measurement geometry is fine, giving reproducible readings.* The other 5 filter pairs have different thicknesses all optimized for different ranges of the tube voltage; two (1 and 2) are used for the low mammography energy range 20 to 45 kV, and three filters (3 - 5) are used for the radiography range 35 to 155 kV (35 - 75, 55 - 105, and 80 - 155 kV).

Using these four signals S1-S4 (from detectors D1 to D4) the Piranha can accurately calculate the corresponding tube voltage. The signal S3 is not affected by the moveable filters and is designed to measure the dose. This detector is marked by a square inside the rectangular detector area on the top panel. The reference depth for the sensitive area of the dose detector is 10 mm under the Piranha top panel surface.

The detector D4 is placed directly under D3 with additional filter in between. The ratio between S3 and S4 is used to estimate the total filtration for the radiography range. Using these signals together more accurate dose and tube voltage readings can be obtained.

Since all signals is measured simultaneously and with a relative high speed, the Piranha can thus automatically compensate the kV and dose for the dependence of the waveform and inherent/added tube filtration.

*** END ***