ACCU-GOLD2

USER GUIDE

For use with
all Accu-Gold digitizers and
Accu-Gold Touch Pro

Radcal®

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Introduction

Accu-Gold is the next generation X-ray measurement system at the heart of which is a compact multi-function digitizer module and powerful, intuitive software. Accu-Gold transforms your computer into a compact, cost effective, and multi-function X-ray analyzer and uses the latest technology in solid state sensors, gold standard ion chambers, mA, and light sensors.

Accu-Gold has features to increase your productivity such as: quick setup, ease of use, automatic settings and multiple-parameter data capture, unique remote operation, easy data analysis, and instant data recall. With an Auxiliary sensor input and customizable software, you have the capability to expand to meet future needs.

Please comment on this software and report any bugs that you may find. Accu-Gold software provides the ability to save all of your measurements as session files[1]. You should save session files because they are extremely valuable when solving application issues.[2]

Computer System Minimum Requirements

The specified performance requires a computer with the following minimum specifications:

Operating system:

- Windows 7
- Windows 8
- Windows 10

Processor: 800 MHz (Intel, AMD or VIA)

Screen Resolution of 1024 x 600

RAM: 150 MB free system memory to run application

Program storage: 10 MB for application and 50 MB for Framework.

Additional storage, greater than 50 MB, is recommended for storing measurement session files.

USB 2.0 Full-speed port for connection to the Accu-Gold Digitizer Module.

Excel 2007 or later is recommended for Excel data reports.

Getting Started

This section includes an overview of the Accu-Gold hardware and the main screen for the software[3]. It also includes instructions to quickly set up and begin making measurements.

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[1] see Saving a Session

[2] For more in-depth information or troubleshooting, contact Customer Support at (626) 357-7921 extension 123 or send an email to Cust_Sup@Radcal.com

[3] see Appendix A for software installation.

Hardware Overview

The Accu-Gold system consists of a digitizer module, sensor(s) and a display. The Accu-Gold digitizer is available in different models that are suited for specific applications, the differences being which sensors can be used. The Accu-Gold software is the same for all models but the measurement data that is available will depend on the model digitizer used and connected sensor(s).

Differences between the 'legacy' hardware and the 'plus' hardware

The original digitizers of the Accu-Gold system were the AGDM and the RGDM. The RGDM was available in several versions depending on the sensors they could be used with.

A desire for product enhancements brought us the Accu-Gold plus system. A new line of sensors were designed with a smaller footprint as well as a combination sensor that eliminates the need to carry multiple sensors – the DM+ sensor. While still being compatible with legacy hardware, the AGDM+ digitizers also provide improved performance for legacy sensors.[4]

Digitizers

Models*	Available sensor inputs:	Ion Chamber	Dose Diode	AGMS (Multisensors)	Aux (Light Sensor)	mA
AGDM+	Accu-Gold Digitizer Module	X	X	X	X	X
RGDM+	Rapid-Gold Digitizer Module		X	X		X
ADDM+	Accu-Dose Digitizer Module	X	X			

*The legacy digitizers are not compatible with the "+" series Multisensors.

[4] see Appendix E

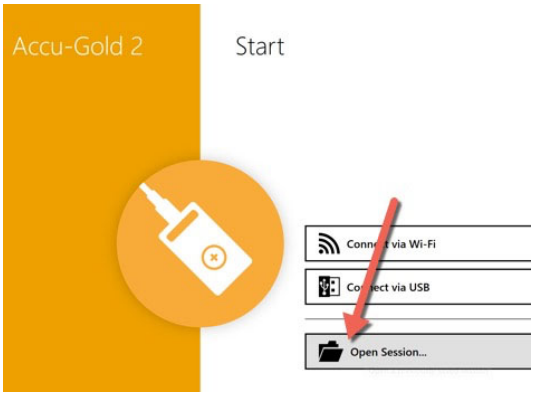
What is Accu-Gold2?

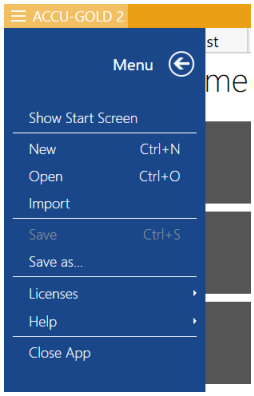
Radcal's Accu-Gold software has been redesigned from the ground up with a modernized user interface and under-the-hood capabilities that will ensure continuing compatibility with Microsoft products (e.g. Windows & Office) as well as expanded capabilities for the Accu-Gold family of measurement systems.

Important information regarding Accu-Gold2 (AG2) software:

1. Accu-Gold 2 is required to interface with the Accu-Gold Nugget Wi-Fi solution.
2. All existing Accu-Gold1 legacy capabilities are available in AG2. Some have been moved or may have different icons. Hover-helpers are provided to explain user interface selections.
3. AG2 session files have a new icon and file extension.

4. AG1 legacy session files can be opened and viewed with AG2. Use the Open Session option from the Start screen when launching AG2 or select "Open" from the Main Menu.

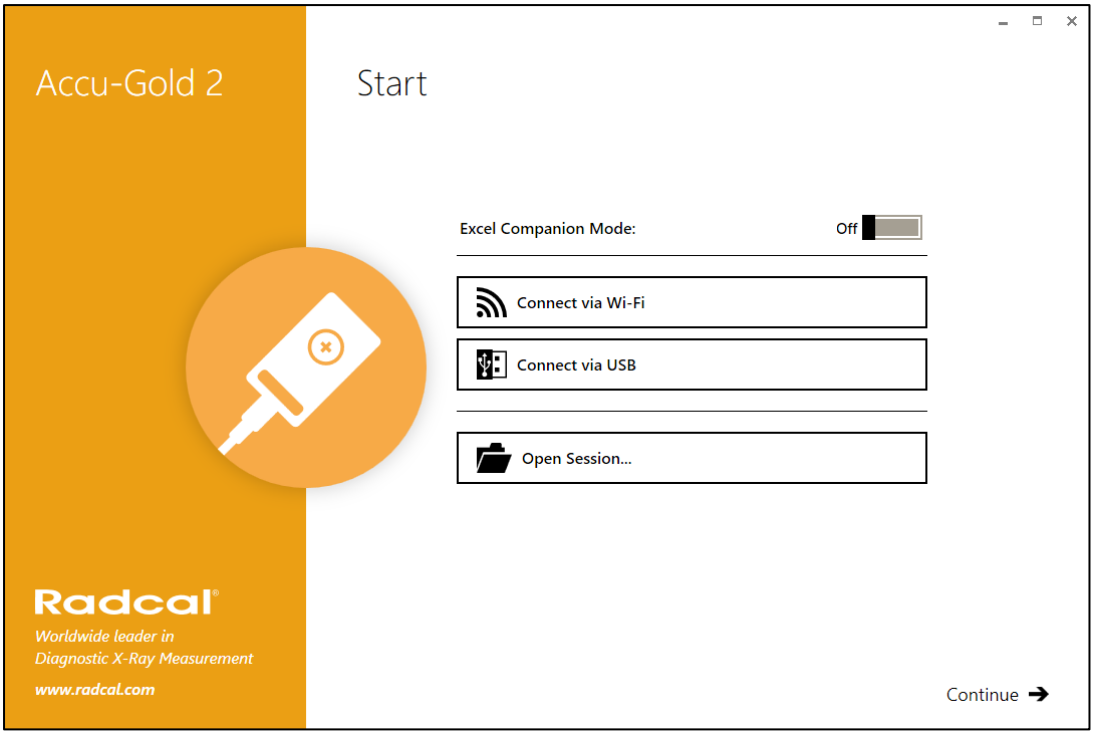




5. AG1 software will continue to be supported for bug fixes.

Starting Accu-Gold

When launched, the Accu-Gold2 brings up a screen that lets you choose the appropriate connection method to the Accu-Gold digitizer.

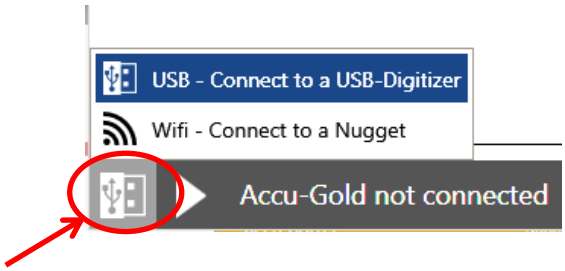


Connect via Wi-Fi – The Accu-Gold Nugget lets you connect to the digitizer wirelessly.

Connect via USB - When the USB cable is the connection method to the digitizer.

Open Session – Goes straight to the Open Session dialog without connecting to the digitizer

Continue – Bypasses the opening screen without connecting to the digitizer. The connection method can be chosen later by choosing the appropriate icon in the bottom left corner:



Clicking the icon will bring up options for connecting to the digitizer. Click on the USB or Wi-Fi icon as appropriate

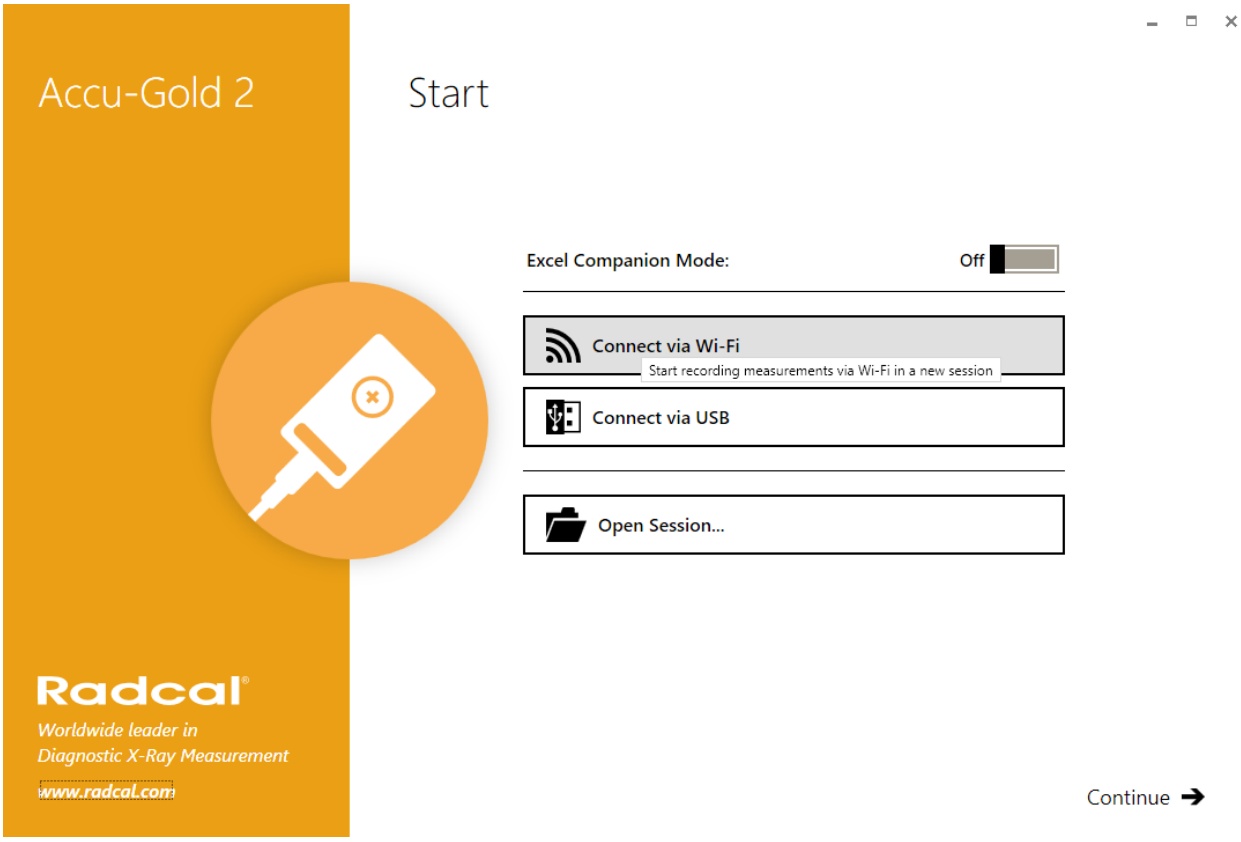
Starting Accu-Gold via Wi-Fi

For detail Nugget information, see Appendix C.

Snap the Nugget onto the digitizer module. Power on the Nugget and wait for the connection light to indicate being ready for connection (flashing green).

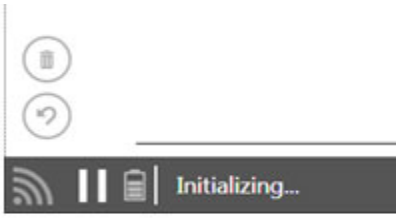
For the Accu-Gold Touch, start the Touch in WiFi mode and wait for the blue light to flash rapidly.

Start Accu-Gold2 and choose **Connect via Wi-Fi**:



The software will look for “Nugget…” (or “Touch”) on the wireless networks list, and establish a connection to it sending it the password it requires.

After a successful connection, you will see on the bottom:



The battery icon displays the charge level of the Nugget’s (or Touch’s) battery. It will initialize communication with the digitizer and power on the sensors. The measurement process is the same as using the USB cable directly. See Appendix C for the measurement feature comparison.

Note: some features are not available when using AG2 in WiFi mode.

Nomenclature (Accu-Gold or Accu-Gold+)

AGDM – Accu-Gold Digitizer Module

ADDM - Accu-Dose Digitizer Module

RGDM – Rapid-Gold Digitizer Module

AGMS – Accu-Gold Multi-sensor

ICH – Ion Chamber

DD - Dose Diode

AGLS – Accu-Gold Light Sensor

DAPCKP+ - DAP Check Plus

The AGDM+ digitizer is compatible with the AGMS sensors (models AGMS-D and AGMS-M) but the AGMS+ sensors (models AGMS-D+, AGMS-M+, and AGMS-DM+) are not compatible with the AGDM digitizers.

Accu-Gold Digitizers –

AGDM+: Solid State and Ion Chamber Sensors

ADDM+: Ion Chamber and Solid State Dose Sensors

RGDM+: Solid State Multisensors and Solid State Dose Sensors, mA/mAs Sensors

Accu-Gold Touch -

AGT-P-AG: Solid State and Ion Chamber Sensors

AGT-P-AD: ion chamber and Solid State Dose Sensors

AGT-P-RG: Solid State Multisensors and Solid State Dose Sensors, mA/mAs Sensors

Accessories –

Ion Chamber Dose Sensors

10X6-6: General Purpose

10X6-6M: Mammography

10X6-60: 'Service' and Image Intensifier

10X6-60DAP: DAP measurement of small beams

10X6-0.6: High Dose Rate

10X6-0.6CT: Modern Wide Beam Multi-Slice CT

10X6-3CT: Computed Tomography Dose Index (CTDI)

10X6-180: Leakage and Very Low Does Rates

10X6-1800: Radiation Protection

10X6-0.18: High Dose Rate

10X6-10: General Purpose

10X6-500: Leakage Measurement Chamber

mA, mAs Sensors

90M9-AG: Invasive mA / mAs

90M10-AG: Non-Invasive mA / mAs

Light Sensor

AGLS: Luminance / Illuminance

Solid State Dose Sensors

DDX6-WL: Diagnostic range (Low dose rates)

Solid State Multisensors

AGMS-DM+: Diagnostic and Mammographic range.

AGMS-D+: Diagnostic range

AGMS-M+: Mammographic range

AGMS-D: Diagnostic range

AGMS-M: Mammographic range

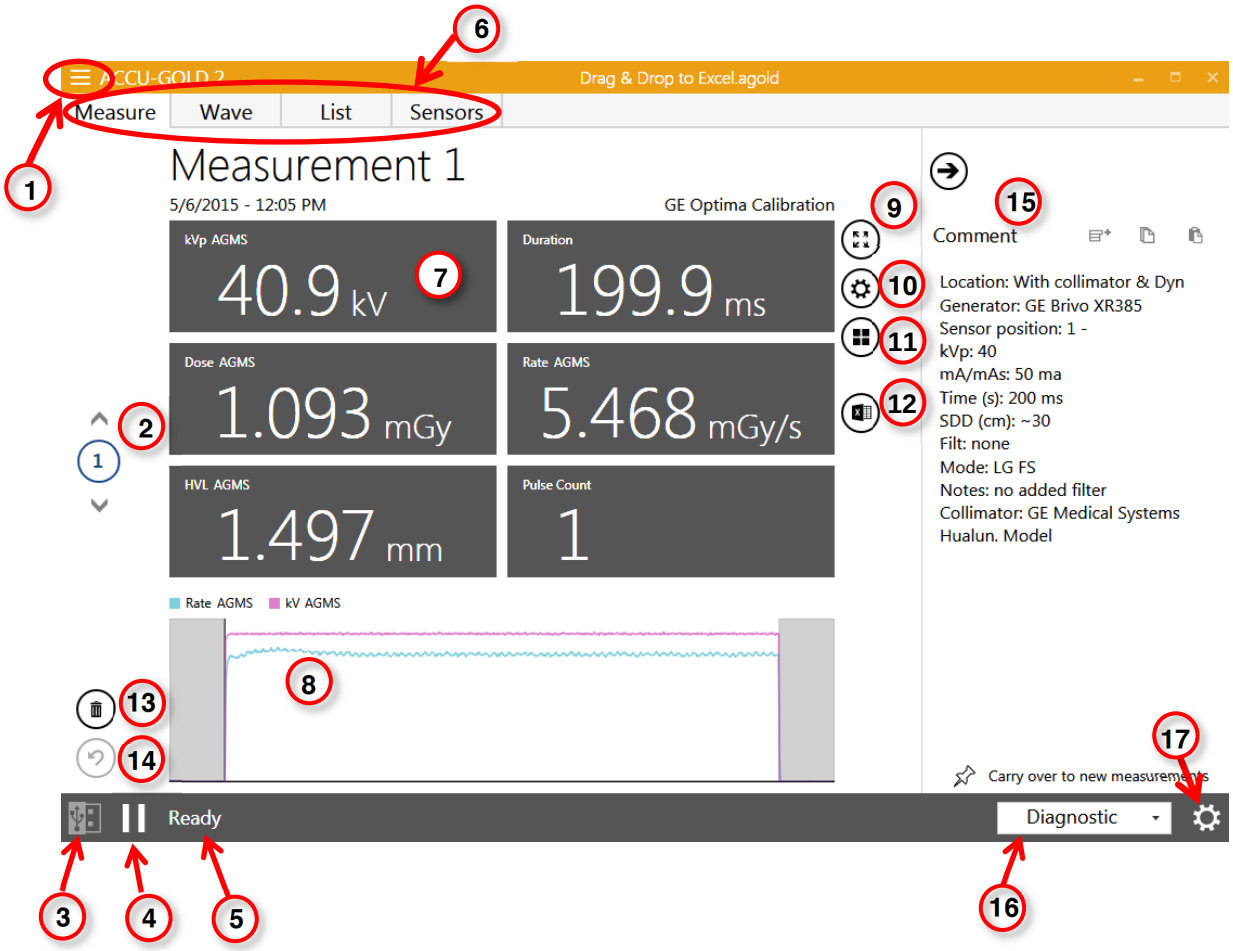
Chamber Adaptor /Extension Cable

DAPcheck Plus+ Sensor

WiFi Adapter

AGNugget: WiFi Adapter for the Accu-Gold Family of Digitizers

Main Screen Overview



1) Opens the Main Menu.
2) Lists all measurements made within the same session. You can scroll through each capture using the up and down arrows
3) Displays the connection method – USB or Wi-Fi
4) Click the **Connect** [▸] button to begin or the **Disconnect** [ıı] to halt a measurement series. Click the **Connect** [▸] button again, to continue.
5) Indicates if the system is ready to make a measurement. Other system status messages occur here depending on sensor and digitizer conditions.
6) Measure, Wave, List and Sensors tabs that allow you to view information in more detail
7) Displays details of the information captured from the sensor (s) based upon the selected profile
8) Displays a wave representation of the information captured
9) Matrix mode opens a separate window with just the measurements.
10) Opens the dose unit settings.
11) Opens the display profile settings to change the result matrix.
12) Export the current measurement to Excel.

13) Delete the active measurement.

14) Undo deleted measurement.

15) The Comments pane can be used to copy, cut and paste comments. Comments can be saved in the session along with any measurements and can optionally be carried over to the next measurement. The comments pane can be accessed from all views.

16) Displays the calibration modality. Diagnostic or mammographic with anode/filter type.

17) Allows you to change settings. The available settings are:

Note: Settings available will depend on the sensor attached and therefore will not show up until a sensor is attached and enabled by pressing **Connect**.

Device Settings Menu

The upper row of the Settings area is populated by the sensors that are connected (AGMS, DD and/or ICH). When multiple sensors are connected, the user can choose the trigger source.

Std - The default setting. Std" trigger sensitivity is recommended.

Low - Select if Std is not low enough. "Low" may allow smaller signals to be captured, but may also result in false triggers[5]. If noise or false triggers prevent reliable ion chamber measurements and grounding the

- [5] NOTE: Do not make sensitive measurements when the computer is hooked up to a charger unless the charger has a 3-wire AC cord (and the AC outlet is properly grounded). See AG-GND in appendix.

system has not improved the experience, connect a Multi-sensor or Dose Diode and locate it somewhere in the radiation beam so that it can serve as a trigger source.

High – Select if Std causes false triggering.

Note: If you have a strong, noise free signal, selecting **High** will minimize the time the system measures a background zero in between measurements allowing you to make continuous measurements rapidly. A new zero will be recalculated every 5 minutes.

Free - Disables the trigger. The Free mode provides a manual trigger with the Play/Pause button. A measurement will begin after you select **Free** and the sensor(s) are initialized. The measurement will continue until you select **Disconnect.** This can be useful to check for grounding issues since you can record and document the noise levels.

HINT: Use **Free** for very low dose rate measurements with the 180CC or 1800CC ion chambers.

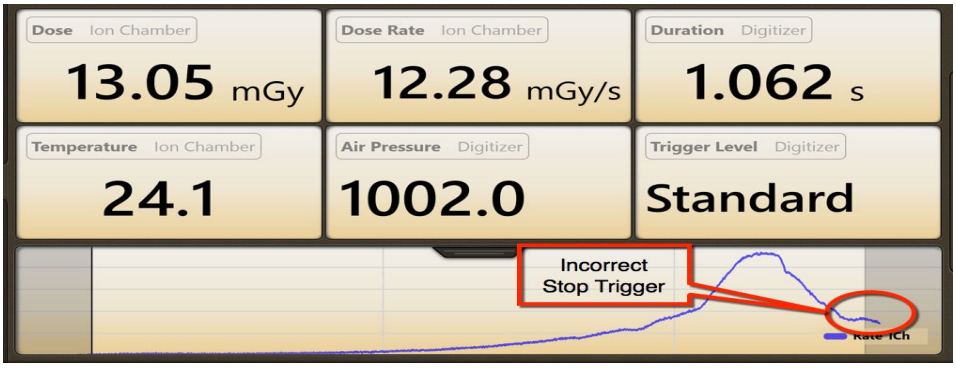
or in WiFi mode:

This function is only available when an ion chamber is connected and the system has been started and is ready to measure. Selecting IC ON will give a warning about grounding and provides frequency corrected IC waveforms. IC triggering with Wave mode set to Off will work with all settings (Low, Std & High) because it suppresses noise. This of course makes the waveforms very distorted, but much lower IC dose and dose rates can be measured.

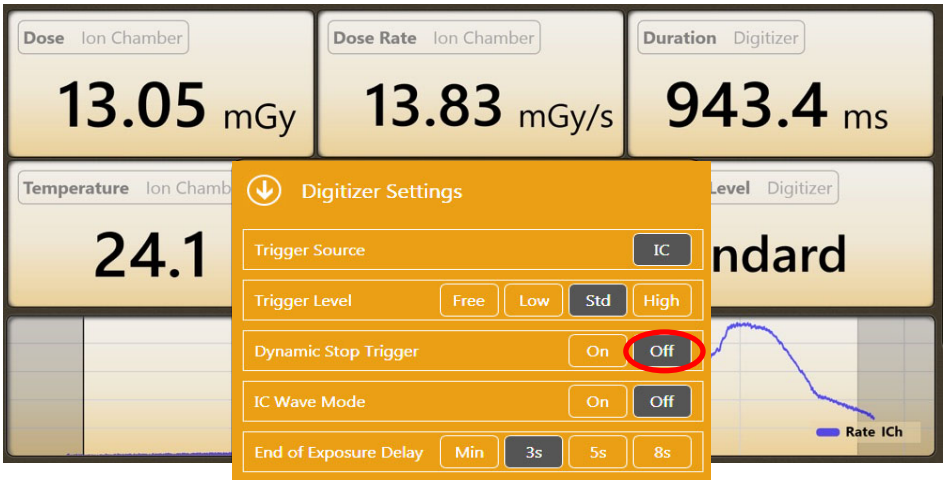
This setting becomes available when an Ion Chamber or a Dose Diode is connected and is the trigger source. There are occasions when using an IC or DD, that the automatic dynamic stop trigger ends an exposure inappropriately. This may happen with long slowly changing or undulating waveforms such as CT scans or fluoro exposures. One method to avoid this is to use a second sensor as a trigger (e.g. Dose Diode) or to use Free Run as a trigger. NOTE: The default value for Dynamic Stop trigger is On. Important: Only change the Dynamic Stop Trigger to Off if you experience a faulty ending triggers with ion chambers or dose diodes.

[6] Not available in WiFi mode

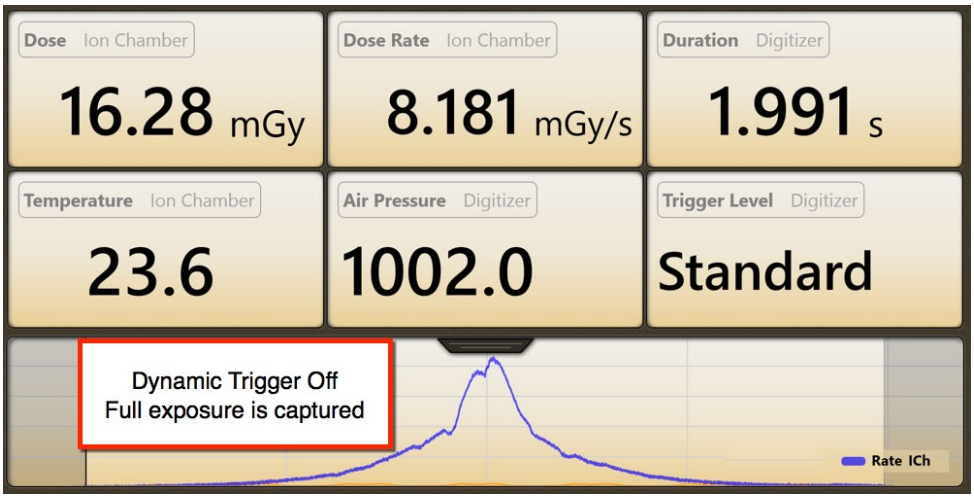
Ion Chamber Exposure with incorrect stop trigger:



Select Dynamic Stop Trigger **Off:**



New exposure with Dynamic stop trigger **Off:**



The “AGMS Pre-Pulse Mode” algorithm is designed to accommodate the initial pre-heat kV pulses commonly found with some dental generators such as the Gendex 770. Pre-Pulse ON should not be selected for other pulsed waveforms such as pulsed fluoroscopy or tomography.

Note: The dose remains integrated over the entire exposure regardless of the setting (On or Off), only the kV and time calculations are affected. Advice: The Accu-Gold default setting is AGMS Pre-Pulse Mode “Off”. If the correct number of pulses is not being reported, select “Settings” and then turn On “AGMS Pre Pulse Mode” and repeat the exposure.

The Accu-Gold Pre-Pulse algorithm automatically detects the correct trigger threshold and eliminates pre-heat pulse counting. The duration and pulse count are reported excluding the pre-pulse region. KVp is calculated over the last 60% of main exposure. Dose is calculated for the entire exposure, including the pre-pulse region.

Many modern x-ray generators now feature scout exposures which may introduce gaps of several seconds or more in the radiation output. The default end of exposure timing for Accu-Gold is 3 second for Diagnostic and Mammographic sensors. In some instances, this is not long enough and Accu-Gold may attempt to display the exposure results while the generator is finishing the exposure. If this situation is encountered, you may select an end of exposure delay of up to 8 seconds. ‘Min’ allows one to make successive measurements quickly. In between measurements, zeroing is skipped therefore use ‘Min’ with large signals only where zeroing in between measurements is not important – use with “High Threshold”.

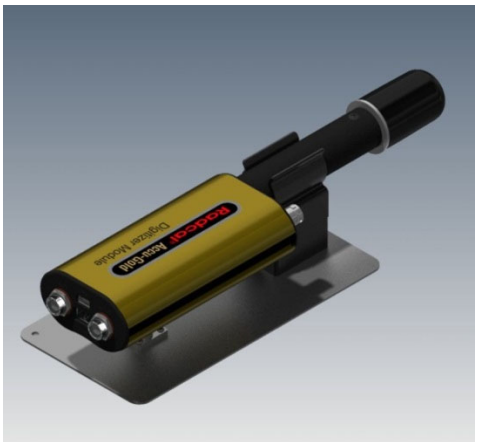
[7] Not available in WiFi mode

Setting up the Hardware

To set up the Accu-Gold hardware

1. Connect the sensor(s) to the digitizer. Connect the USB cable to the digitizer and then the computer.

2. Position the sensor to make a measurement.



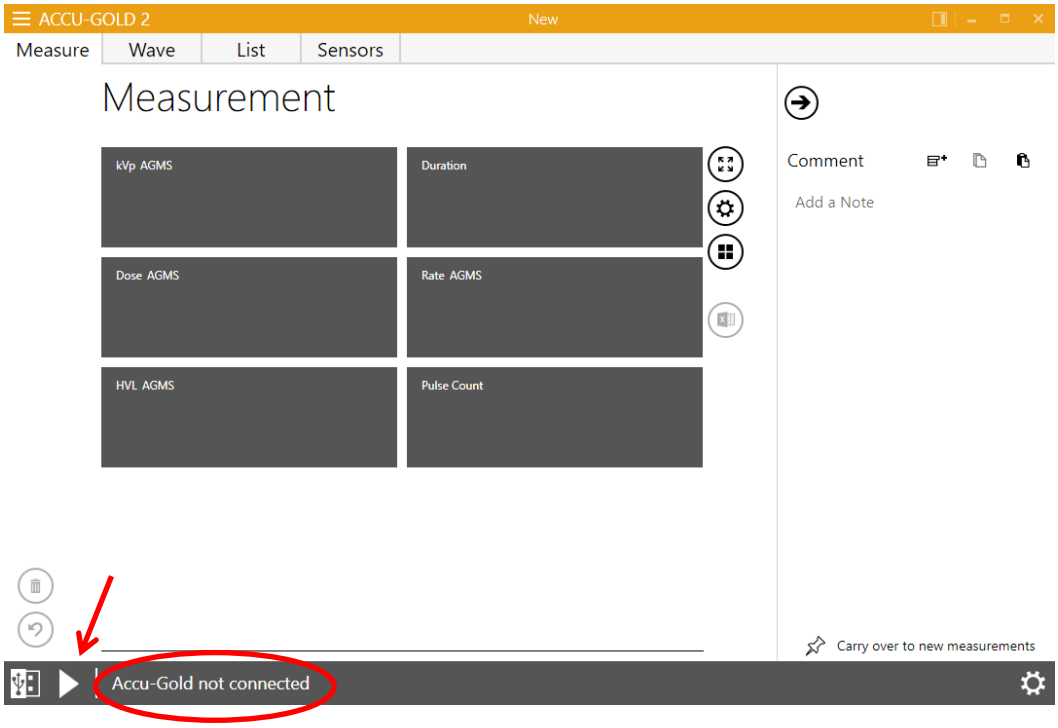
Note: Position the sensor before clicking the **Connect** button; moving the sensor or cable after clicking the **Connect** button may trigger a false measurement.

Making a Measurement

Note: You can make a measurement from any tab, Measure, Wave, List or Sensors.

To make a measurement:

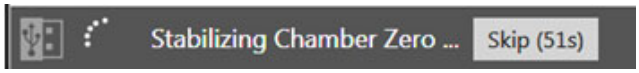
1. Plug the sensor(s) into the digitizer module.
2. Plug the digitizer module into the USB port of the computer where you installed the Accu-Gold software and device driver.
3. Place the sensor in the path of the X-ray beam.
4. Launch the Accu-Gold software. Select **Connect via USB** from the Start screen. Accu-Gold will automatically connect and initialize the sensors. If the software is already open, click on **Connect**. NOTE: Make sure the temperature of the ion chamber (if used) has stabilized before making a measurement.

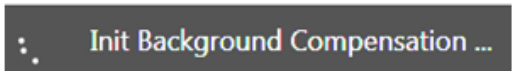


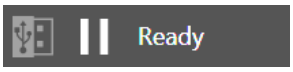
The software begins to connect to the digitizer, as indicated by the status at the bottom of the screen:

The software then begins to initialize the digitizer.

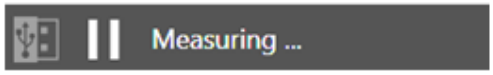
If an ion chamber is connected, the bias supply needs to start and stabilize.



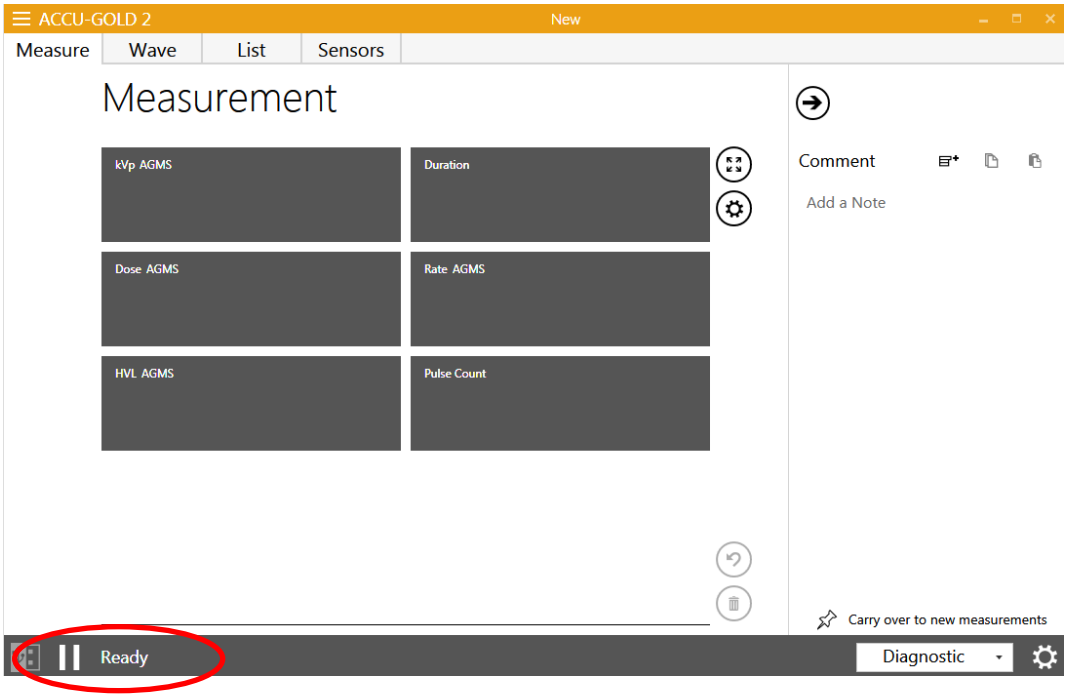




5. Check the detector status to make sure the detector is online. As soon as the “Ready” message is displayed at the bottom of the screen, you can make a measurement.

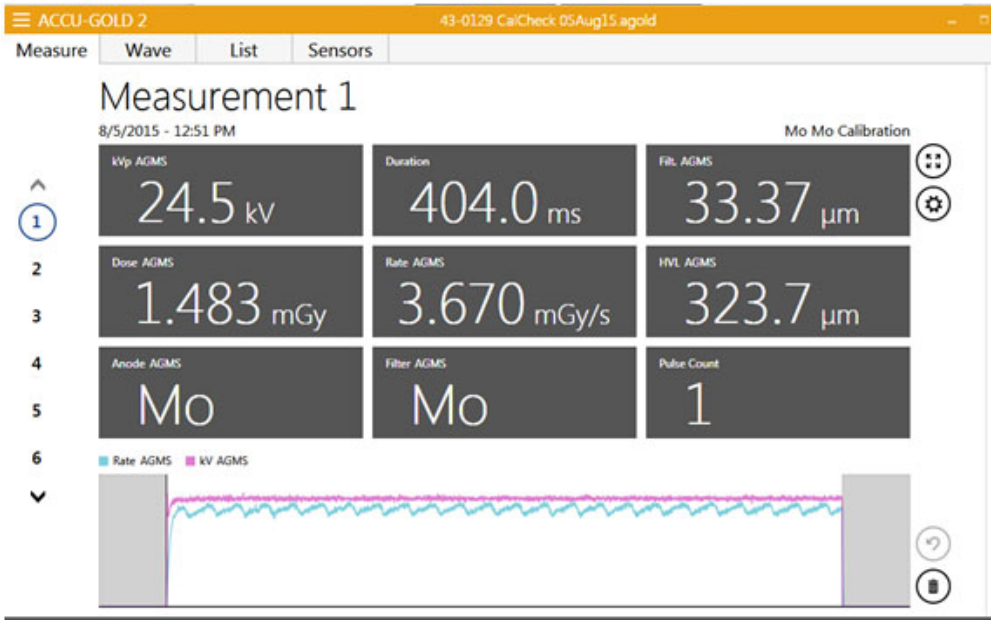


Note: All measurements are automatic (except for Free Trigger Level) until you press the **Disconnect** button.



6. Activate the X-ray machine to capture the exposure data.

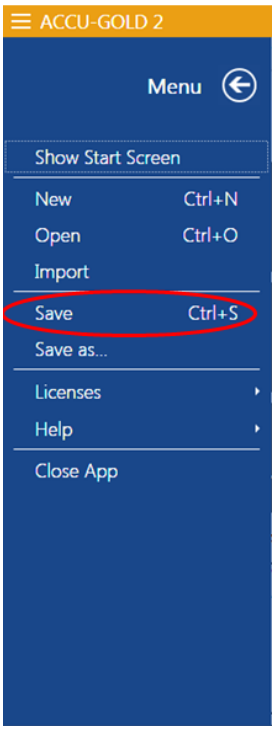
Accu-Gold automatically displays the data for the measurement when the exposure is complete:



7. Make additional exposures as necessary. No data will be lost and you can review the previous measurements by clicking the **Up** and **Down** arrow buttons on the left side of the Measure screen.

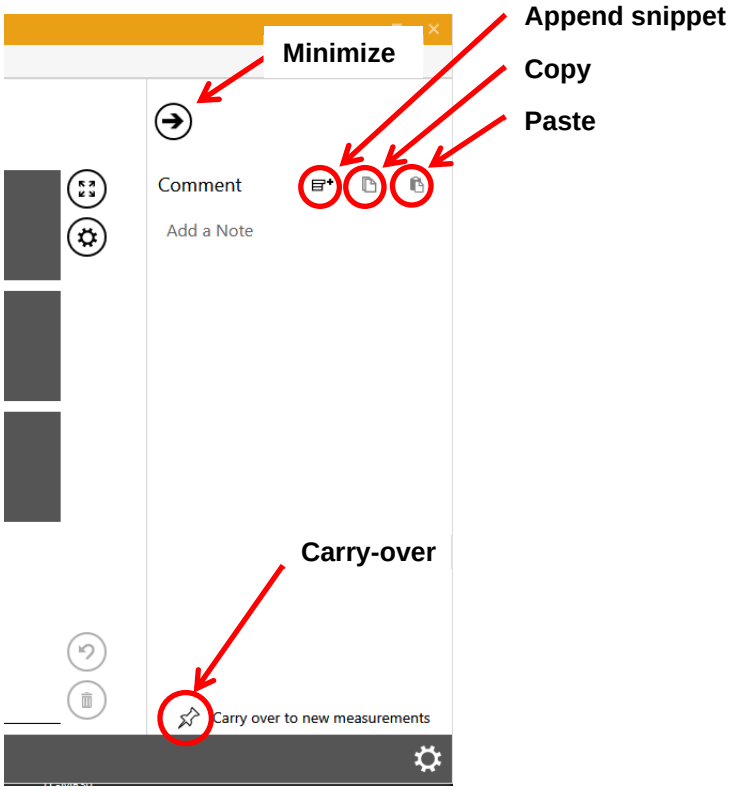
8. Click the Main Menu drop-down and choose **Save (Ctrl+S)** to save your new session. This will save all of the data, including full wave forms, for later review and editing. Note: If you attempt to quit Accu-Gold without saving or have made additional measurements since saving, Accu-Gold will prompt you with a “Save Session?” dialog box. Radcal strongly recommends that you always

save sessions. Session files can be sent to Radcal as email attachments for rapid responses to any questions or difficulties you may have.



You can continue to review the data in List or Wave view by clicking on the **List** or **Wave** buttons in the title bar. You can also non-destructively switch from viewing measurements in Gy to R by clicking Main Menu drop-down and selecting **Unit Settings**. If additional changes are made, click the drop-down menu and choose **Save (Ctrl-s).**

9. If you need to reposition the sensor(s), click the **Disconnect** button to temporarily take the sensor offline and prevent any inadvertent null exposures from being added to your measurement. You can delete unwanted measurements at a later time by highlighting the measurement in any tab and clicking the **Delete** button (trash can).
10. Click **Connect** when you are ready to make your next measurement.



The pane can be used to enter notes or copy and paste details regarding the measurement. Comments are saved in the session along with any measurements and can optionally be carried over to the next measurement. The pane can be accessed from all views. You can minimize the pane by clicking on the top arrow.

Append Snippet – The following can be pasted in the comments area to aid documenting measurements:

Location:
Generator:
Sensor position:
kVp:
mA/mAs:
Time (s):
SDD (cm):
Filt:
Mode:
Notes:

Copy – Highlight the text to be copied and click on the copy icon. This will copy the Comment text to the clipboard for use in other applications.

Paste – The contents of the clipboard will be pasted in the comments pane starting at the location of the cursor.

Carry-Over – When the push-pin is black, the comments pane information will be copied to the comments pane of the subsequent measurement. This can be very useful when conditions are not being changed between measurements.

Measurements

License Files

When the USB flash drive is used to install the software that was supplied with your system, any license file that is required will be automatically installed. For Legacy AGMS sensors, license files contain calibration tables that match the sensor's serial number. If you are using a Legacy multi-sensor (AGMS-D or AGMS-M) and have not installed the license file or if they have been recalibrated, you can use the Main Menu dropdown and select Licenses/Import license. If the AG software cannot locate a matching license file, it will provide a dialog box asking you to locate it. Plus sensors have the calibration files built into the sensors.

Custom calibrations, if not installed as part of software setup, would also be added this way.

NOTE: The **CPC date** (Calibration Parameters Change date) is saved with the sensor information for every measurement. When a sensor is sent in for annual calibration, the sensor's calibration is verified and the date is changed only if the calibration parameters need to be changed. If the sensor's parameters are within limits, the original CPC date is not changed, only the certification label is updated.

Using the AGMS-DM+ sensor

Once the sensor is connected, select the appropriate modality from the pop-up list in the bottom right corner. This pop-up menu appears when multi-sensor is connected. If it is a DM+ sensor, the default will be Diagnostic.

Taking a Measurement for Mammographic Sensors

Before making an exposure, make sure to choose the Anode/Filter combination that best represents the machine being measured.

Radcal sensor calibrations used the following mammographic tubes and assume a 2.2 mm polycarbonate paddle, or simulated paddle (Appendix H), are placed on top of the sensor:

Anode/Filter	X-Ray tube used
Mo-Mo	Lorad M2
Mo-Mo GE	GE DMR
Mo Rh	Lorad M2
Mo Rh GE	GE DMR
Rh Rh GE	GE DMR
Rh Cu	GE DMR
W Rh	Selenia
W Al	Selenia

W Ag	Selenia

Additional anode/filter combinations for specific machines are also included (see Appendix B)

Making a Measurement with multiple sensors connected

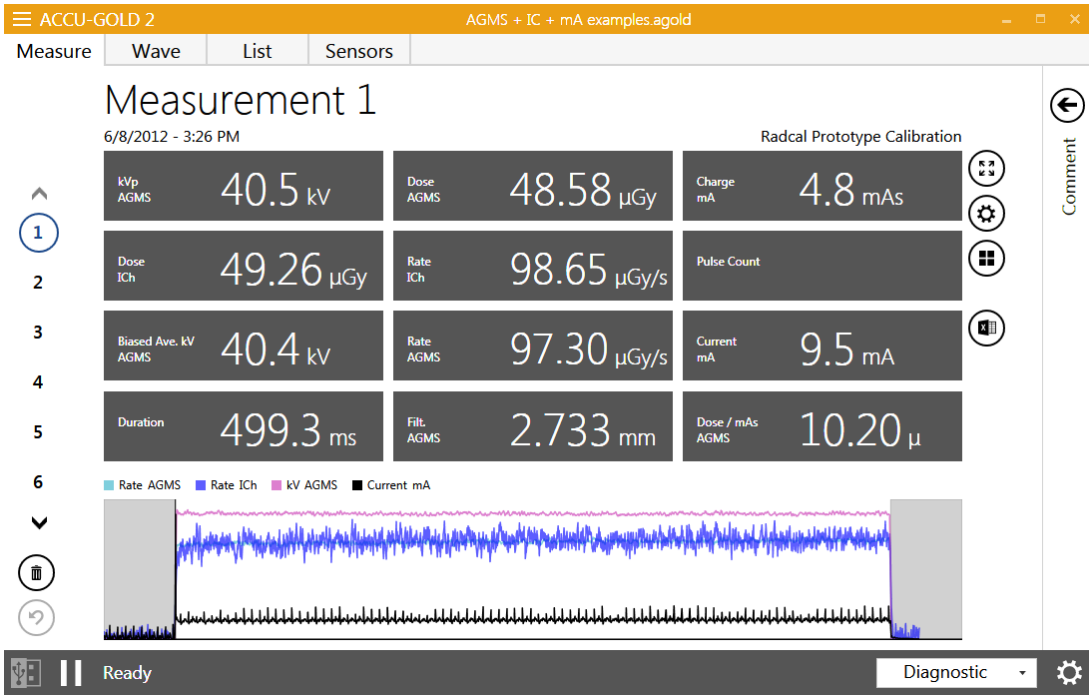
The Accu-Gold Digitizer Module (AGDM) allows you to connect up to five sensors and simultaneously collect data from all of the connected sensors. (The Rapid-Gold Digitizer Module (RGDM) and Accu-Dose Digitizer Module (ADDM) have a subset of these ports – see table on page 6.) The five sensor ports are:

- **AGMS** – Accu-Gold multi-sensor
- **ICH** – Ion Chamber
- **DD** – Dose Diode
- **mAs** – Invasive and non-invasive mA/mAs sensors
- **AUX** – Auxiliary connector for the light sensor, DAPCKP+ (uses Accu-Gold Excel software only), and future sensors (Aux sensors are not available for use with the Nugget)

To make a measurement using more than one sensor:

1. Click **Disconnect** in the Accu-Gold software Measurement view to stop the software from taking measurements.
2. Plug any additional sensors into the available ports.
3. Position the new sensors into the X-ray beam.
4. Press **Connect** to bring the sensor on line and stabilize. Select a trigger source and expose to X-rays.

In this example, an Ion chamber sensor is connected along with the multi-sensor and a mAs meter.



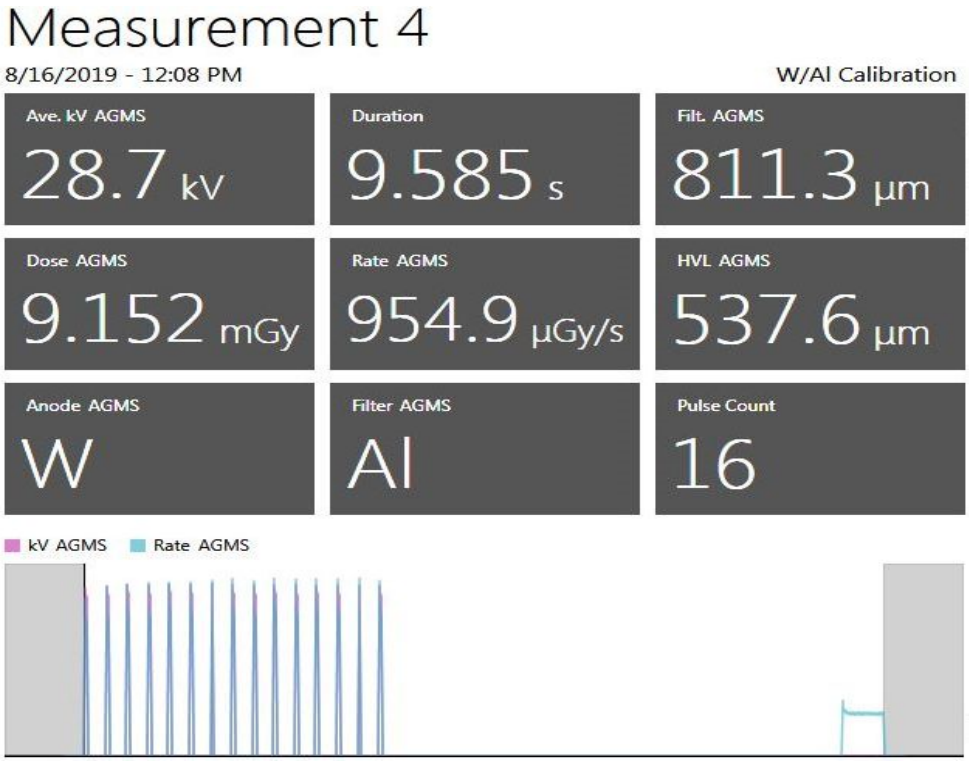
Long exposures

The maximum duration of any single exposure with waveform data is 300 seconds. The measurement will continue in “Extra Long Mode” after 300 seconds but no waveform data is available after stopping the measurement. The maximum duration in this mode is 2.45 days. Note that sessions containing many long exposures with waveform data may take significant time to save or load data. Modern computers with fast disc storage and processors will have better performance in this situation. Contact Sales for Radcal’s current tablet display options.

In , Nugget and Touch WiFi modes all the measurements will continue in “Extra Long Mode”. Nugget and WiFi measurements, however, limit waveform data to 40 seconds.

Pulsed-Fluoro Measurements

Calibration of pulsed-fluoroscopy machines is facilitated through use of the real-time display. When a fluoroscopy exposure is initiated, the dose rate will be measured and displayed in real-time *without the need to select a special mode*. The value of dose rate is updated at a rate of once per second making Accu-Gold an ideal instrument for tracking dose rate changes as fluoroscopy machine settings such as mA (current) are continuously adjusted. Previous Radcal products required selection of the pulse rate in advance in order to obtain accurate real-time measurements. This is no longer required as the Accu-Gold system automatically identifies individual pulses and pulse rate on the fly providing a stable accurate reading regardless of kV, pulse rate, and mA.



Combination Measurements

Mammography machines are increasingly supporting multi-mode or combination mode exposures in which multiple modalities such as 2D, Tomographic 3D, and High Contrast are incorporated in a single exposure (see above figure). Radcal’s Accu-Gold instruments support these modes in a number of ways.

Radcal's 10X6-6M ion chamber has excellent energy uniformity and provides accurate dose measurements for all mammography beam qualities. As a result, this sensor is an excellent solution for reliable dose measurement for combination modes.

Radcal's AGMS multi-sensors also support accurate dose measurements for a number of combination mode systems. In particular, the Hologic Dimensions systems are well characterized by the AGMS sensors. Simply select the W/Al anode filter combination for mammography and accurate total dose measurements are provided for the 2D+3D Tomographic combination mode.

For all combination mode measurements, ensure that the "End Delay" parameter is set to a sufficiently large value (8 sec recommended) so that the entire exposure is collected and the measurement doesn't stop after the first mode.

Measurement Limitations

The Radcal AGMS Series of Multi-Sensors are highly capable instruments that will generally provide a comprehensive set of measurements throughout a wide range of diagnostic x-ray applications. However, there are some conditions under which the sensor will provide a more restricted set of measurements. These conditions are described here:

In instances where filtration exceeds the operating range and/or kV is out of range, the spectral characteristics provide accurate measurements of Dose and Dose Rate only. Under these circumstances kV, HVL, and Filtration are not reported and the following warning is displayed:

Filtration for AGMS is out of range!
kV for AGMS is out of range!

The AGMS Multi-Sensor operates by measuring the x-ray intensity through several sensing elements equipped with increasing levels of internal filtration. As the dose decreases below certain levels that are anode/filter-specific measures of the spectral quantities (kV, HVL, and Filtration) cannot be made reliably. However, Dose and Dose Rate remain reliable and are reported along with the warning:

Low Dose Mode

Under certain circumstances such as very low kV, excess filtration, and/or large source to sensor distance there are insufficient x-rays for an accurate measurement or any of the beam properties. Under these circumstances, no values are reported and the following warning is displayed:

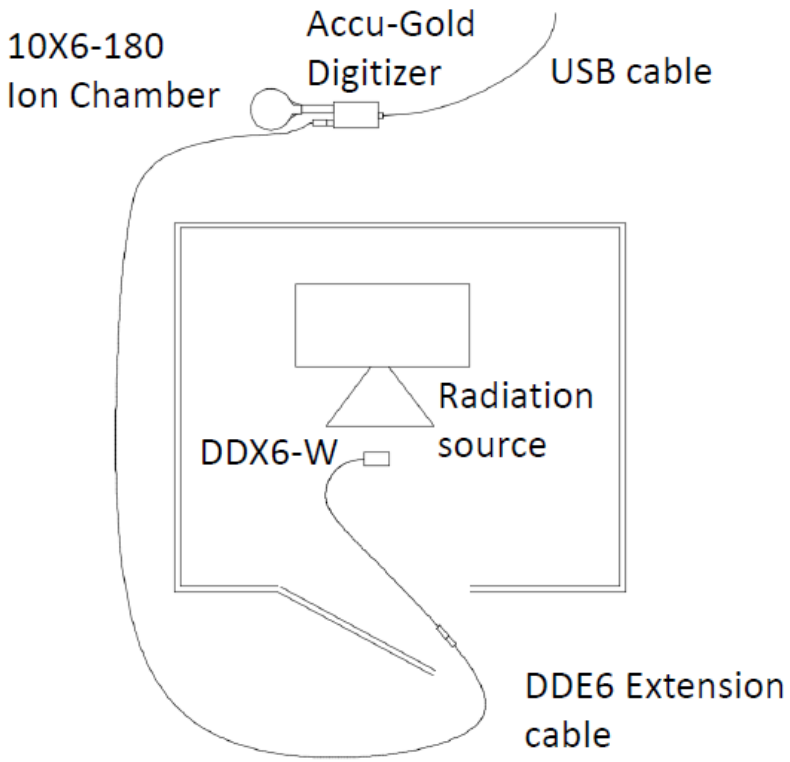
Insufficient Dose

Making Low Dose Measurements with Ion Chambers

When making low dose measurements using an ion chamber (in the range of 10 times the minimum rated range), it is important to eliminate all sources of noise including noise induced by changing temperatures of the surroundings and the electronics. Position the ion chamber. Set the threshold to low and wait 3 minutes. Do not touch the cable or digitizer. For changing environments, allow 10 minutes for every 10 C difference for the sensor/electronics to equilibrate. Grounding the system to eliminate interference may be warranted.

When making background or scatter measurements, the readings may be too low to trigger a measurement. In that case a second sensor placed in the beam can be used to trigger the measurement which will guarantee that the ion chamber's signal is captured during the triggering period of that sensor.

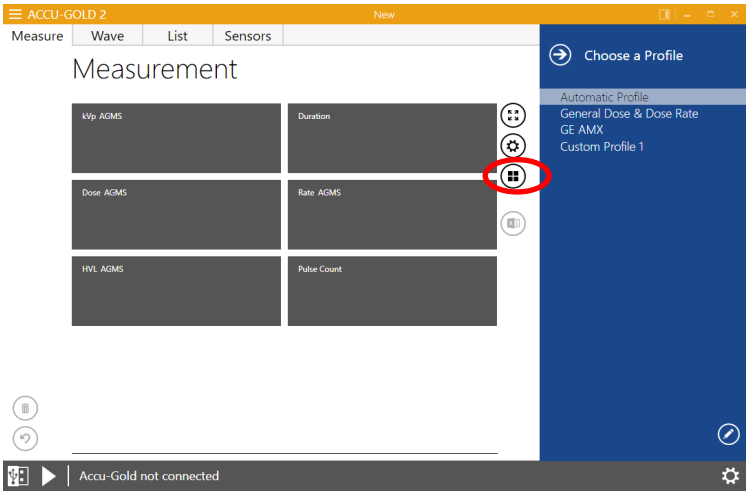
A 180cc, 500cc or 1800cc chamber may be used, depending on the radiation levels to be detected. (Note, build-up may be required for the 180cc or 500cc chamber for energies above 600 keV.) To minimize noise or pickup, connect the chamber directly to the digitizer and avoid using extension cables. Place the ion chamber/digitizer so it will not move by using a test stand or tripod. Position the trigger sensor, such as the DDX6-WL or even an AGMS sensor, in the beam and use an extension cable to connect it to the digitizer as shown. If necessary, the USB connection can be extended using active USB extensions or even USB-over-Ethernet. NOTE: To achieve the maximum sensitivity for the measuring sensor, the dose rate measured at the trigger sensor should not exceed 1% of its max dose rate (e.g. < 0.06 mGy/s for the DDX6-WL). To achieve the <1% max dose rate at the trigger sensor, it may be necessary to position it off axis from the radiation beam or add shielding to the trigger sensor.



Selecting a Display Profile

In Accu-Gold, you can view measurement data using different display profiles. The default profile is which will show the appropriate measurement data for the recognized sensor(s). To change your display profile at any time, from the Measure views click the settings icon next to the measurement window and select a profile from the list that appears.

- Auto
- AGMS General
- AGMS GE AMX
- Custom Profiles



Automatic Profile

In Measurement view, profiles define which values are displayed in the matrix. You will rarely want to choose a different profile other than **Automatic Profile (Auto)**.

Automatic Profile looks at the sensors in a measurement and whether it is diagnostic, fluoro or mammo and adjusts the matrix dynamically. When a new measurement comes in from the digitizer, or when you navigate to another measurement within the session, **Automatic Profile** adjusts to this measurement. Accu-Gold always defaults to **Automatic Profile** when starting.

List view may contain measurements of various sensors and has to take multiple variations into account. List view uses its own profile for the values that are displayed. It aggregates all sensors present in the session and selects a profile that contains all of them. This is considered the 'Auto' profile. The profile choice of Measurement view does not influence List view or Wave view.

You can set the preferred kV result type for the auto profile in the measurement settings menu. Click on the settings button and choose between these types:

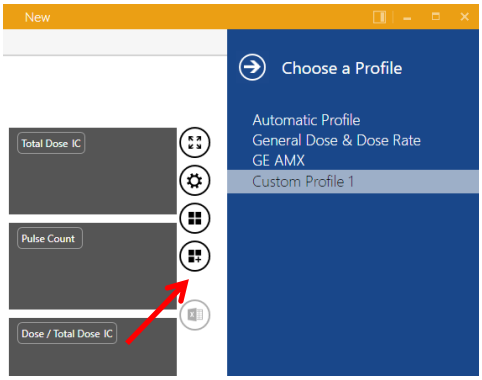
- Peak Average
- Average kV
- Practical Peak Voltage

For new installations, this value is set to .

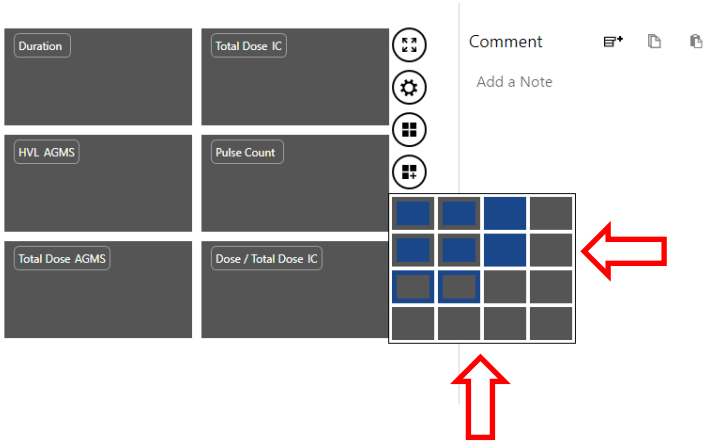
Custom Profile

Accu-Gold provides the user with the opportunity to create **custom profiles** that can be adjusted as needed. To customize the matrix setup, select Custom Profile from the profile list.

By switching to Custom Profile, the **matrix layout** icon appears to the right of the measurement matrix. Click the **matrix layout icon** to change the row and column count of the **Custom Profile**.

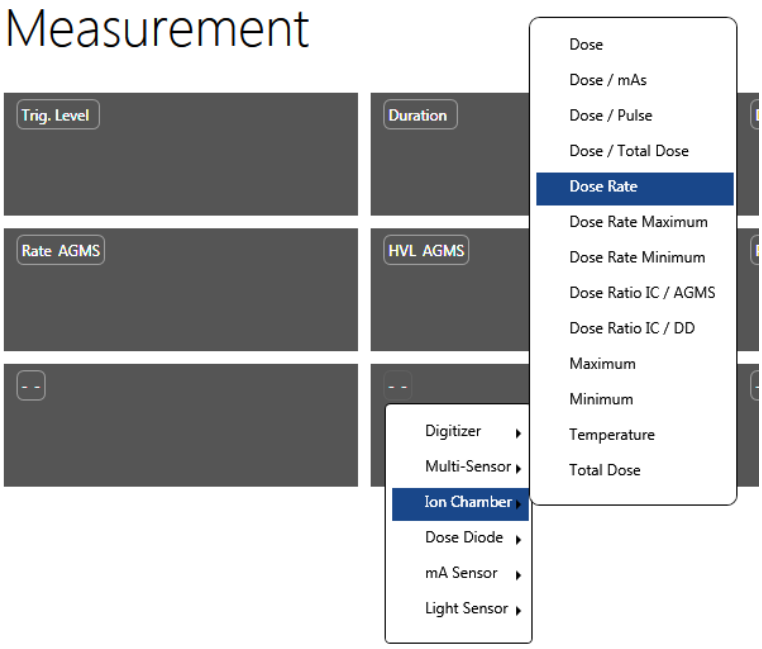


Use the table preview popup to select the desired matrix layout.

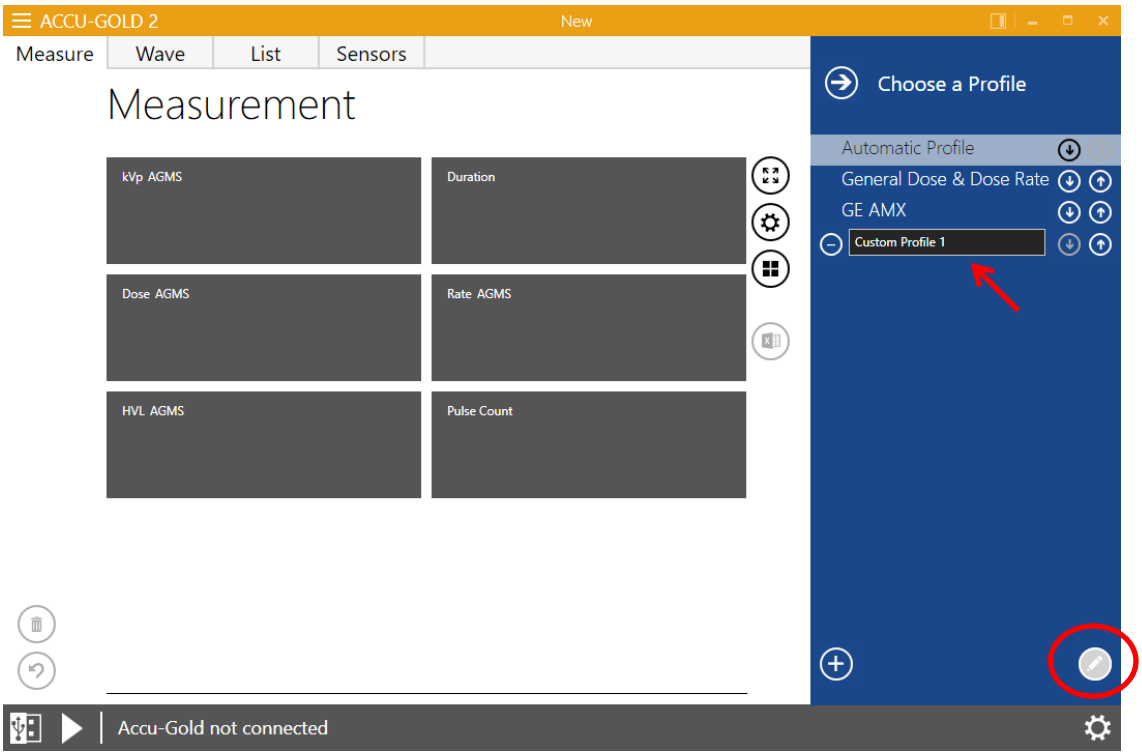


In the example above, the matrix changed from a 2x3 layout to a 3x3 layout. By changing to **Custom Profile**, the labels of the matrix fields become clickable. After clicking on the label, a drop-down menu appears for selecting a different result value. The **Custom Profile** is automatically saved when Accu-Gold software is closed.

Note: When a new instance of Accu-Gold is started and you select **Custom Profile**, the last custom profile setting is restored.

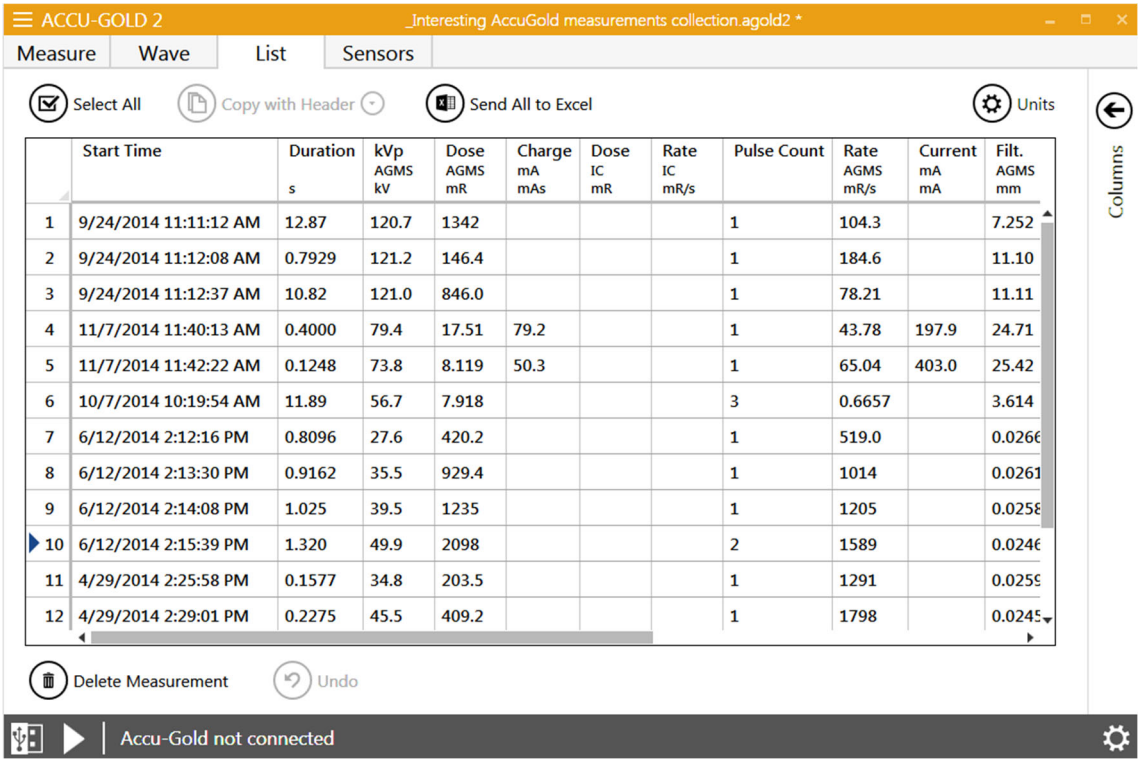


Each cell allows you to pick from the list of possible outputs from the digitizer and sensors. See Appendix E for a complete list.



To create multiple custom profiles, click on the pencil in the lower right corner. The 'Custom Profile' becomes changeable. Click on the 'plus' in the lower corner to add additional profiles. Click on the 'minus' next to the profile name to delete it. Click on the up/down arrows to rearrange the list.

Data in List View

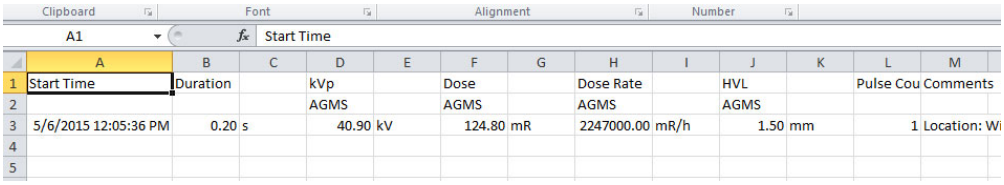


	Start Time	Duration s	kVp AGMS kV	Dose AGMS mR	Charge mA mAs	Dose IC mR	Rate IC mR/s	Pulse Count	Rate AGMS mR/s	Current mA mA	Filt. AGMS mm
1	9/24/2014 11:11:12 AM	12.87	120.7	1342				1	104.3		7.252
2	9/24/2014 11:12:08 AM	0.7929	121.2	146.4				1	184.6		11.10
3	9/24/2014 11:12:37 AM	10.82	121.0	846.0				1	78.21		11.11
4	11/7/2014 11:40:13 AM	0.4000	79.4	17.51	79.2			1	43.78	197.9	24.71
5	11/7/2014 11:42:22 AM	0.1248	73.8	8.119	50.3			1	65.04	403.0	25.42
6	10/7/2014 10:19:54 AM	11.89	56.7	7.918				3	0.6657		3.614
7	6/12/2014 2:12:16 PM	0.8096	27.6	420.2				1	519.0		0.0266
8	6/12/2014 2:13:30 PM	0.9162	35.5	929.4				1	1014		0.0261
9	6/12/2014 2:14:08 PM	1.025	39.5	1235				1	1205		0.0258
10	6/12/2014 2:15:39 PM	1.320	49.9	2098				2	1589		0.0246
11	4/29/2014 2:25:58 PM	0.1577	34.8	203.5				1	1291		0.0259
12	4/29/2014 2:29:01 PM	0.2275	45.5	409.2				1	1798		0.0245

List view lets you see the measurement data in a table format. From this screen, you can perform the following actions:

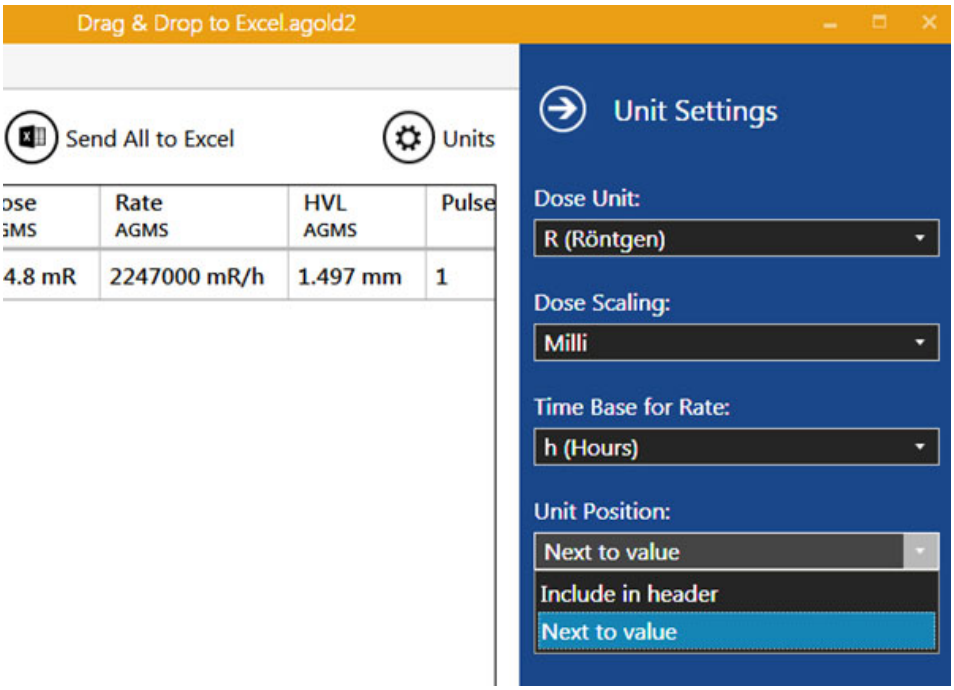
Exporting Data in List View

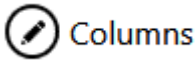
Send all to Excel – opens a new instance of Excel and exports all of the measurements in the format that had been selected.



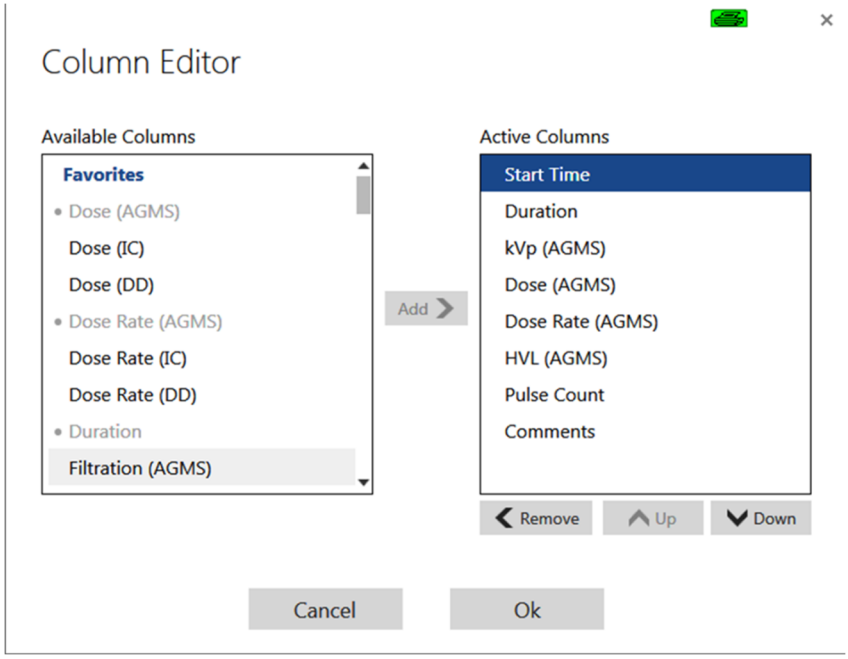
	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Start Time	Duration		kVp		Dose		Dose Rate		HVL		Pulse Cou	Comments
2				AGMS		AGMS		AGMS		AGMS			
3	5/6/2015 12:05:36 PM	0.20	s	40.90	kV	124.80	mR	2247000.00	mR/h	1.50	mm	1	Location: Wi
4													
5													

Units – can be changed before exporting to Excel.



Columns - Select the icon to expand 

the column chooser:

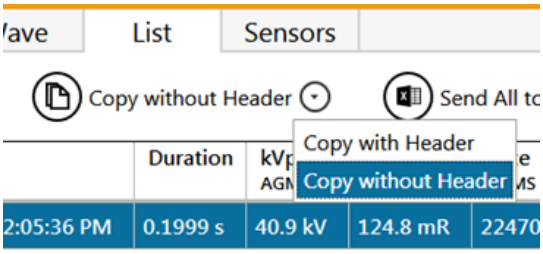


The columns included in the export and the order they are displayed can be selected. When exporting the data, the units will occupy a separate column. If the **Unit Position** is set to **Include in header**, the data will be exported using the same number of columns as displayed. This allows one to grab large groups of data and paste them into an Excel template (see Excel Companion Mode).

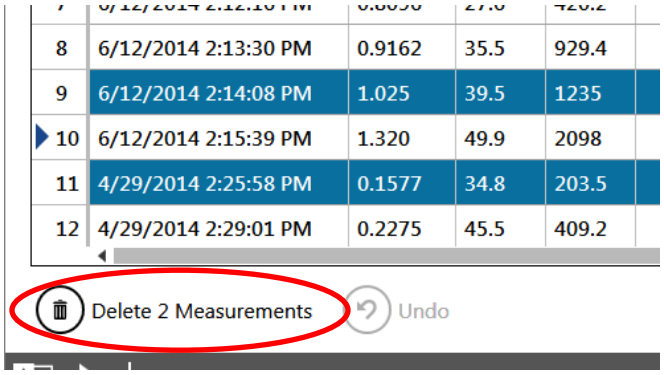
Copying Data in List View

Selected cells can by copied to the clipboard via the button **Copy** or the hotkey Ctrl+C or via the context menu of the selected range.

The header can be included or omitted by clicking on the arrow and selecting:



Deleting Data in List View



Individual measurements can be selected for deletion. After deleting, the measurements can be restored using **Undo.**

Data in Wave View

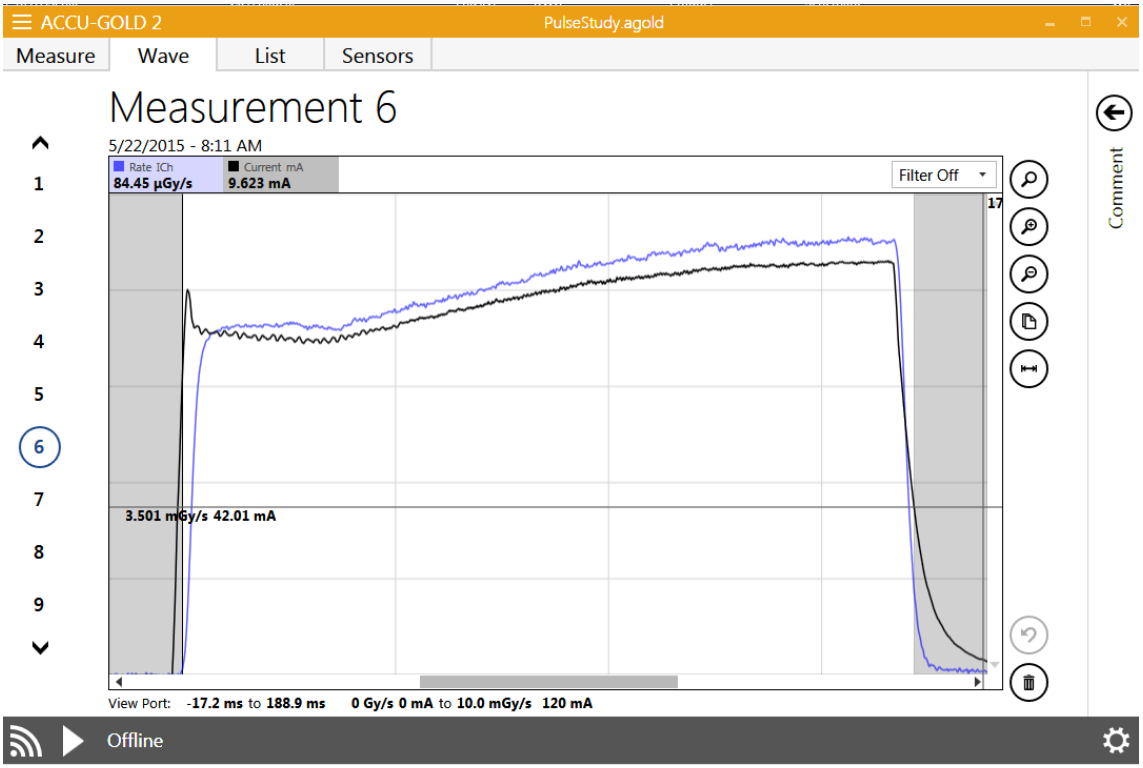
Wave view lets you see a representation of the measurement data as a waveform. From this screen you can perform the following:

Position your cursor on or use the mouse to scroll left to right on the Wave view to display details about that portion of the wave in the Cursor field at the top of the Wave view.

Click on the three **Magnification** buttons to zoom in, zoom out, and return to the default size of the wave.

Expand the wave view by clicking and dragging a box over the region to be expanded. To return to the normal view, click the open magnifier.

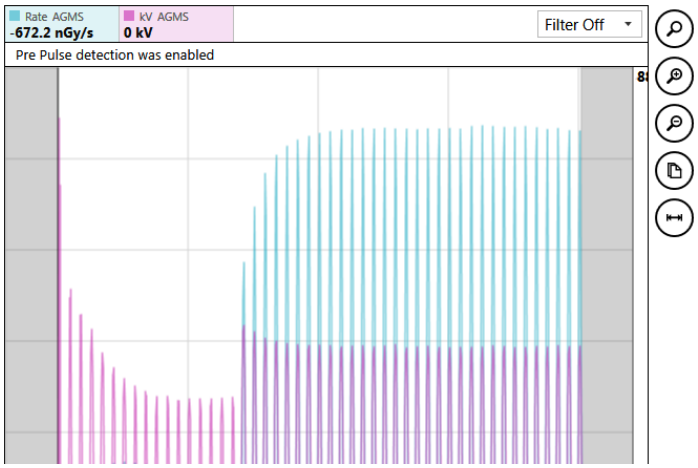
Analyze a region of interest.

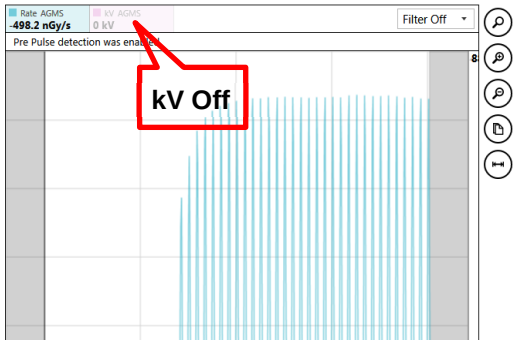

ACCU-GOLD 2
PulseStudy.agold
Measure
Wave
List
Sensors
Measurement 6
5/22/2015 - 8:11 AM
Rate ICh
84.45 µGy/s
Current mA
9.623 mA
Filter Off
3.501 mGy/s 42.01 mA
View Port: -17.2 ms to 188.9 ms 0 Gy/s 0 mA to 10.0 mGy/s 120 mA
Comment
Offline

Hide individual waveforms in Wave View

Occasionally one waveform may obscure detail in another waveform. You can now selectively hide any wave by clicking on the wave name (e.g. rate or kV) as listed at the top of the Wave graph. Clicking again will un-hide the wave.

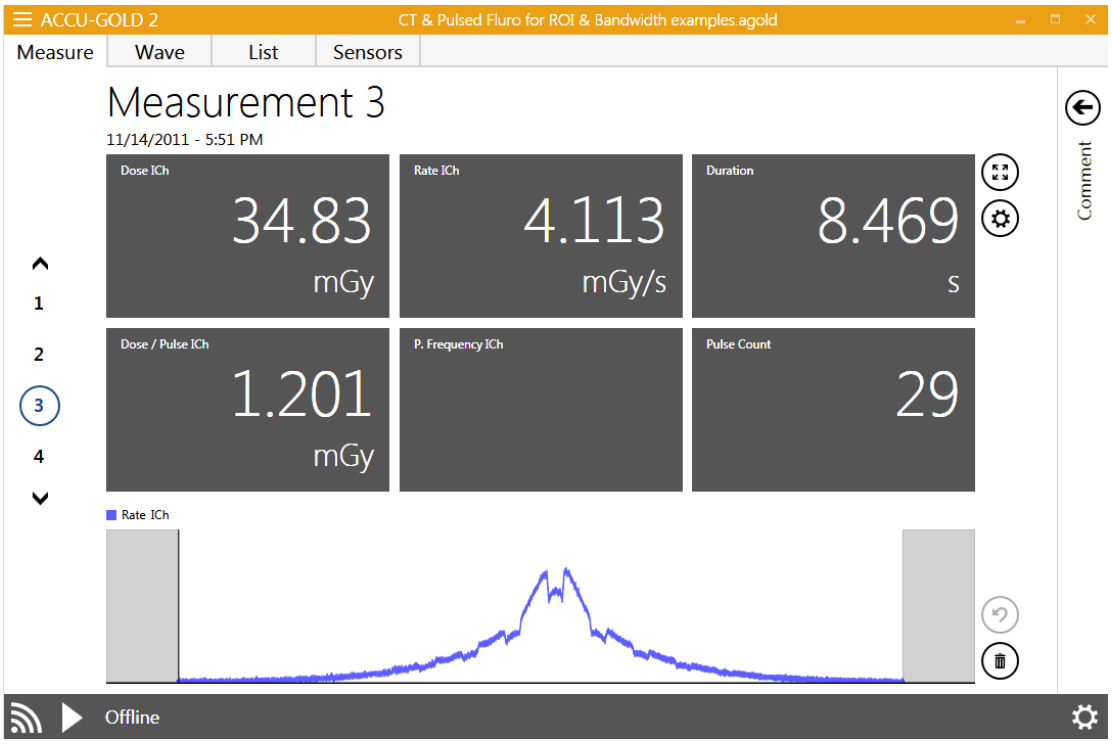
Wave view with difficult to see details



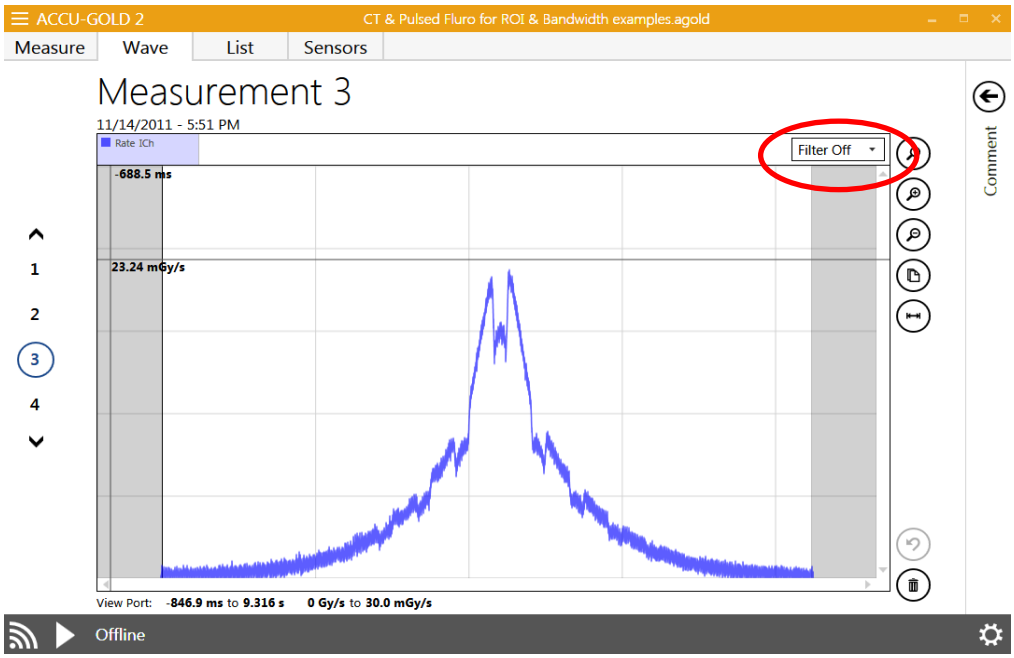


Waveform filters

Measurements made with low-level signals (e.g. low mA, fluoro, scatter & small ion chambers) may display noisy waveforms that obscure important details. Accu-Gold Wave View provides a dropdown selection to apply a “Low-pass Bandwidth Filter” to the waveform. The CT exposure you see below was made with a Radcal 0.15 cc thimble chamber placed in the central axial location of the Boone ICRU CT phantom. The scan started and ended with the beam beyond the end of the phantom.



In the example below, the Lowpass Bandwidth Filter is OFF:



Turning the filter on to 60 Hz dramatically reduces the noise and enhances the detail. It is now clear, exactly when the beam intercepts the phantom. The periodic beam attenuation by the patient couch is now easily recognized.

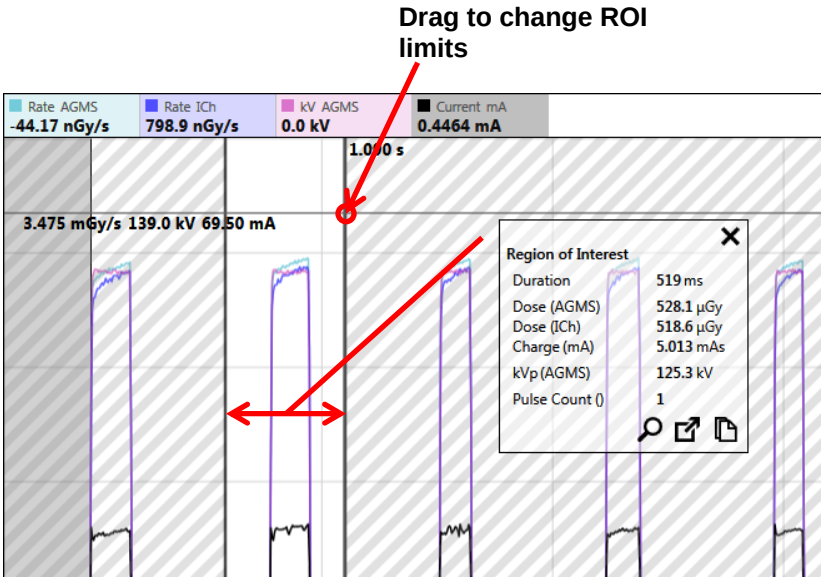
Note: For short exposures (<1 s), filters should be applied with care so as not to smooth important detail. Because the filter is non-destructive, different values may be easily tried. Application of a filter will not affect any of the measurement values (e.g. dose, kV, time). When a session is saved with filters applied, Accu-Gold will retain the filtered waveform selection when the file is re-opened. Since the filter is non-destructive, the filter may be changed to another value at any time. If a waveform is exported to Excel, and a filter has been applied, the filtered waveform is transferred and the number of data points in the waveform is reduced in proportion to the filter selected. This can be very useful to minimize the size of Excel files containing waveforms. In the case above, the original waveform was reduced from 254,214 data points to 4984.

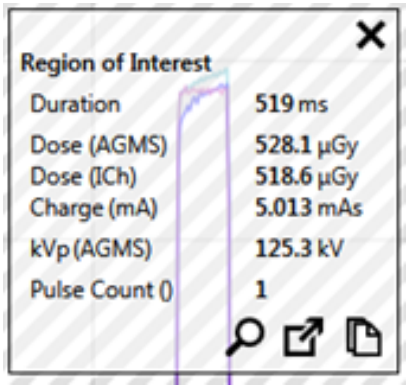
"Region of Interest" (ROI)

Waveform ROI selection is a 2-step process in Wave View.

- Move the cursor to the start of the ROI and click. A vertical line will appear.
- Move the cursor to the end of the target ROI and click. A second vertical line will appear that defines the ROI.

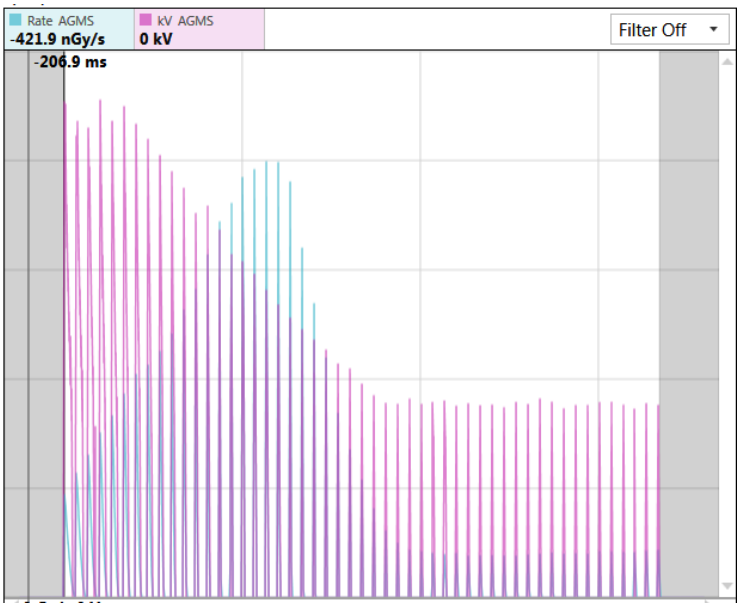
Note: You may re-position the ROI limits by clicking and dragging either limit line. Adjusting the limits will cause the ROI values to be immediately re-calculated. The ROI information window may be freely re-positioned by click and drag. To dismiss the ROI, click the "X" in the right-hand corner of the ROI information window.





- Clicking on the magnifying glass in the ROI window will automatically expand the ROI to fill the Wave screen.
- The copy results to clipboard and the Extract to new measurement from Region of Interest will be explained later in this document.

As another example, assessment of performance should probably occur near the end of the exposure after the mA has stabilized. Accu-Gold now has a simple selection tool to automatically perform this task.



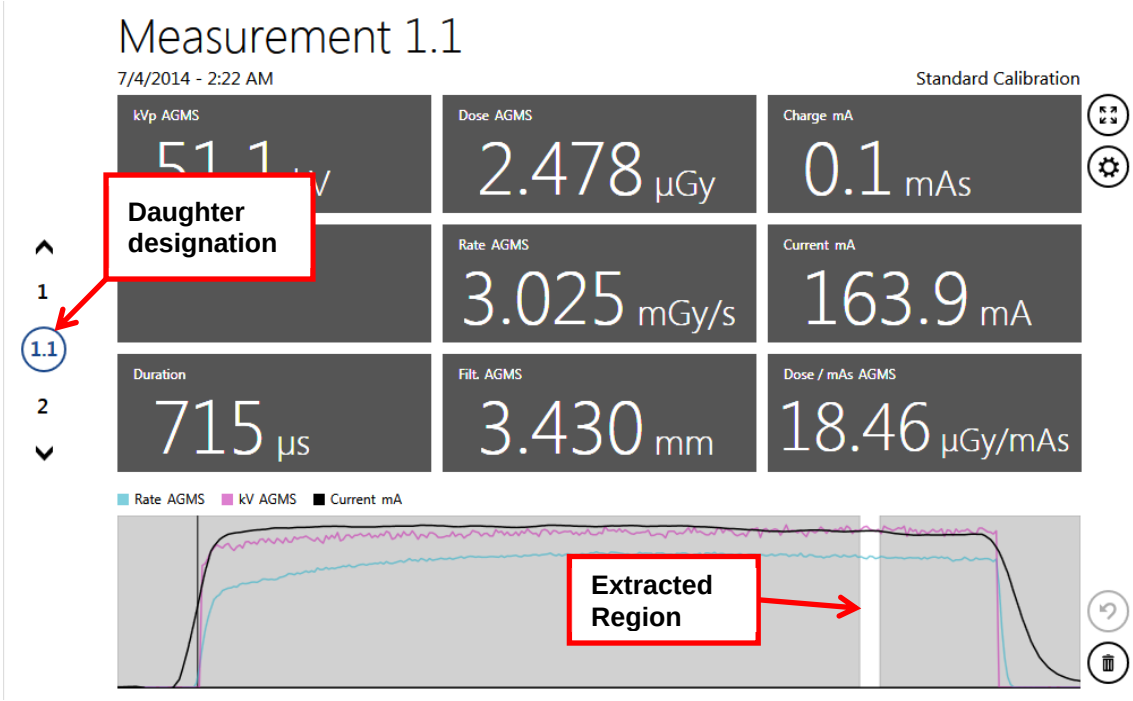
Clicking on the selection tool automatically selects the last 15% of an exposure. The last 5ms are excluded to eliminate any end of exposure artefacts.

If the data contained in the ROI window does not provide all of the details needed for evaluation, clicking on the icon in the ROI window will put all of the details on the clipboard. A simple "Paste" command (CTRL-V), will put the text data in Excel or a text document. For the Example above:

Time Begin	436	ms
Time End	508	ms
Time Duration	72	ms
Total P. Count	1	

		At Begin		At End		Integral		Average		Average Peak		Min		Max	
Dose Rate	Multi-Sensor	8.654	mGy/s	8.613	mGy/s	623.9	µGy			8.707	mGy/s	8.329	mGy/s	8.869	mGy/s
Dose Rate	Ion Chamber	8.501	mGy/s	8.529	mGy/s	617.2	µGy			8.585	mGy/s	8.431	mGy/s	8.658	mGy/s
kV	Multi-Sensor	30	kV	30.6	kV			30.3	kV	30.6	kV	29.2	kV	31.4	kV

When a region of interest has been selected, it is possible to non-destructively extract an ROI selection and preserve it as a daughter of the original parent. Once an ROI has been identified and selected, click on the icon. The screen will immediately change to the Measure view showing the extracted ROI as a daughter of the original measurement. Using the case above, the result is:


Measurement 1.1
7/4/2014 - 2:22 AM
Standard Calibration
kVp AGMS
Dose AGMS
2.478 µGy
Charge mA
0.1 mAs
Daughter designation
Rate AGMS
3.025 mGy/s
Current mA
163.9 mA
1
1.1
2
Duration
715 µs
Filt. AGMS
3.430 mm
Dose / mAs AGMS
18.46 µGy/mAs
Rate AGMS
kV AGMS
Current mA
Extracted Region

Extracted measurements have the same measurement index as the parent, but include a decimal value. Additional extractions of the same measurement will increment the decimal (1, 1.1, 1.2…etc.).

List View and export will also provide the results as a sequence.

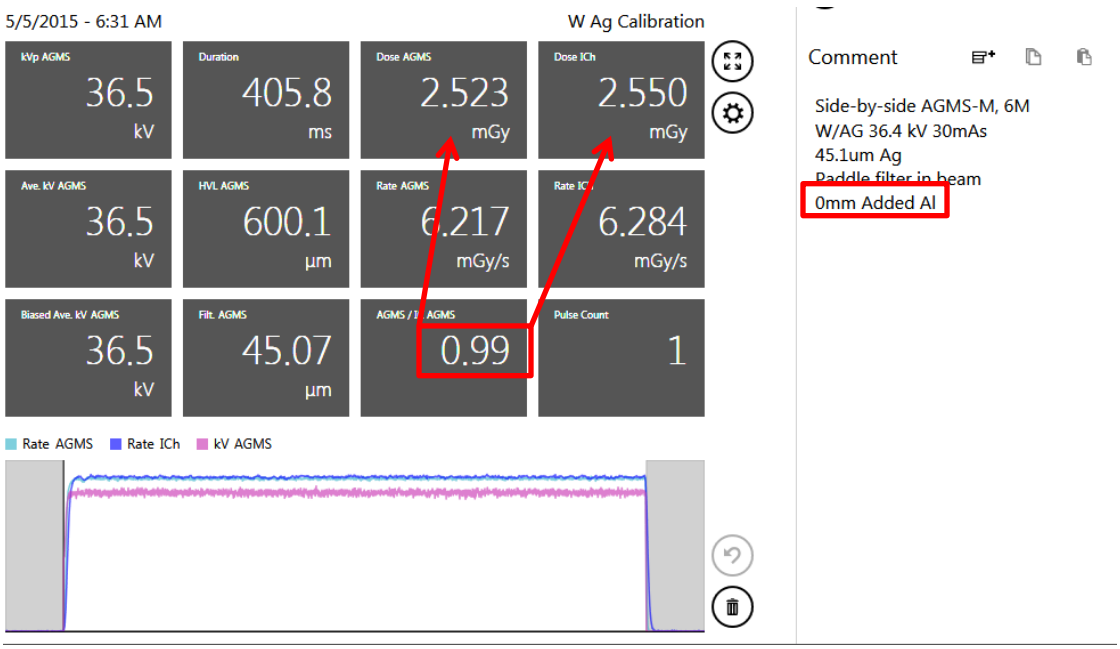
Index -	Start Time	kVp AGMS	Dose AGMS	Charge mA	Biased Ave. kV AGMS	Rate AGMS	Current mA	Duration	Filt. AGMS	Dose / mAs AGMS	Co
1	7/4/2014 2:22:58 AM	50.3 kV	83.88 µGy	4.8 mAs	49.5 kV	2.936 mGy/s	168.6 mA	28.57 ms	3.430 mm	17.41 µGy/mAs	
1.1	7/4/2014 2:22:58 AM	51.1 kV	2.478 µGy	0.1 mAs		3.025 mGy/s	163.9 mA	715 µs	3.430 mm	18.46 µGy/mAs	
2	7/4/2014 2:25:49 AM	50.6 kV	172.5 µGy	9.5 mAs	50.0 kV	2.910 mGy/s	160.1 mA	59.29 ms	3.367 mm	18.17 µGy/mAs	

Note: Waveforms are limited in length to 300 seconds (5 min) in USB mode, and 40 seconds when using WiFi mode. A measurement can continue past this but a waveform will not be available and the message “Extra Long Mode” will be displayed. Measurements lasting up to 2.45 days are possible.

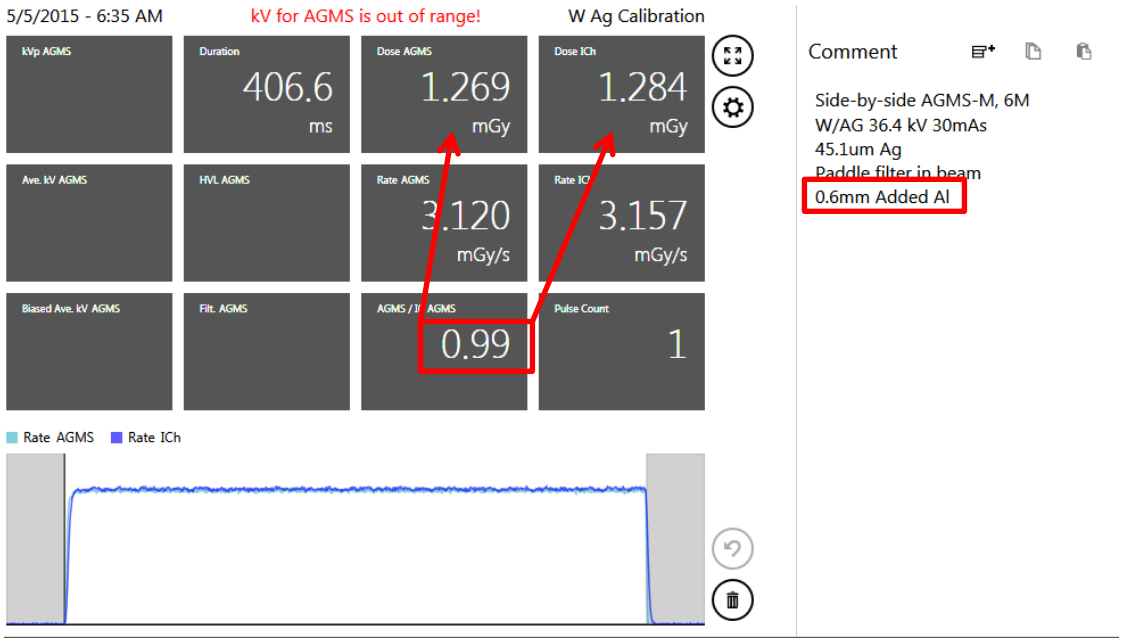
AGMS DM+, D+, M+ will display dose information when filter is out of range

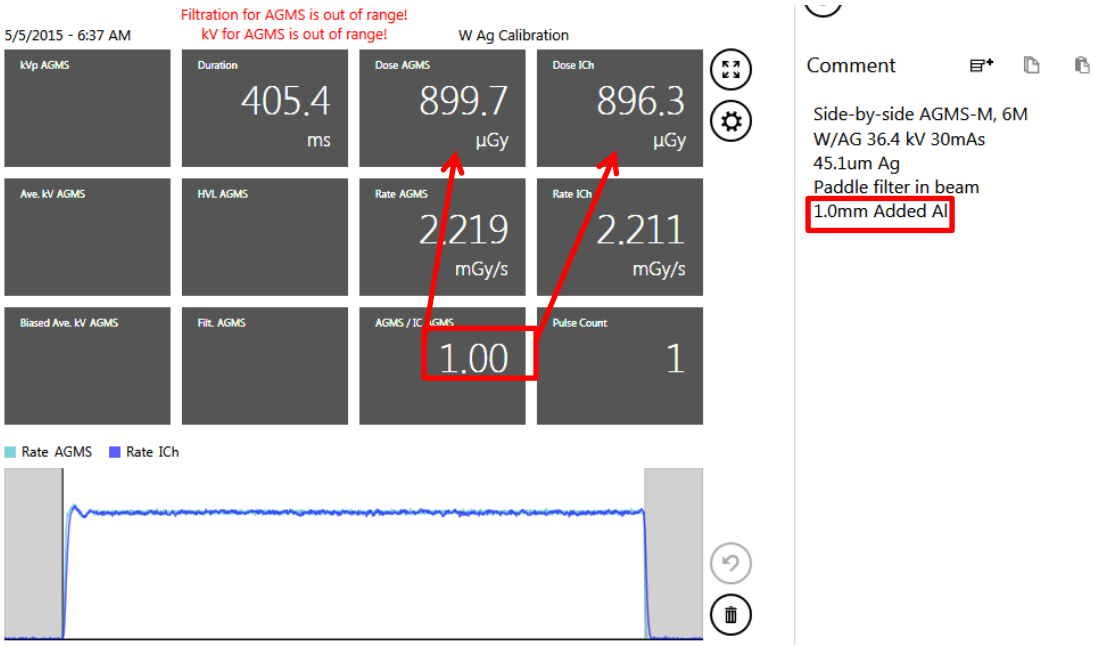
Previous versions of Accu-Gold did not display multi-sensor dose information when kV data could not be obtained when the reported filtration was out of range (e.g. >40 mm Al eq. for diagnostic x-ray). This information is now available for all Accu-Gold “Plus” multi-sensors. This capability is especially useful for copper filtered diagnostic beams (> 1mm Cu). For mammographic beams, aluminum filtration can now be added up to 1 mm without loss of dose accuracy (± 5%). Thus, manual hvl measurements can be performed with aluminum filters. Although dose will continue to be displayed with >1mm Al added filtration, the uncertainty may increase to >10% for filtrations exceeding 2mm Al. Note: there is no warning that the uncertainty has exceeded Radcal’s specification for dose once the 1 mm Al limit is reached.

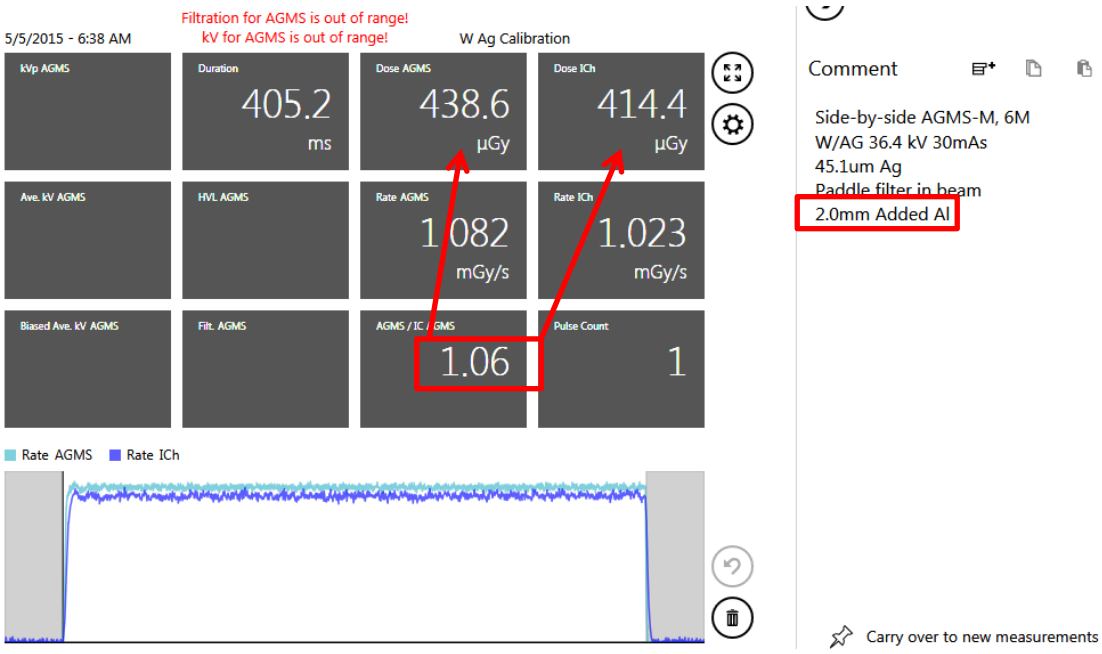
Examples with a W/Ag beam while adding aluminium. The ion chamber is a Radcal 6M:



Note: In the first exposure (above) Accu-Gold reported the hvl to be 600 um Al. In the exposure below, 600 um Al was added to the beam. The result was a reduction in dose of 0.50 mGy as reported by both the 6M ion chamber and the multi-sensor.





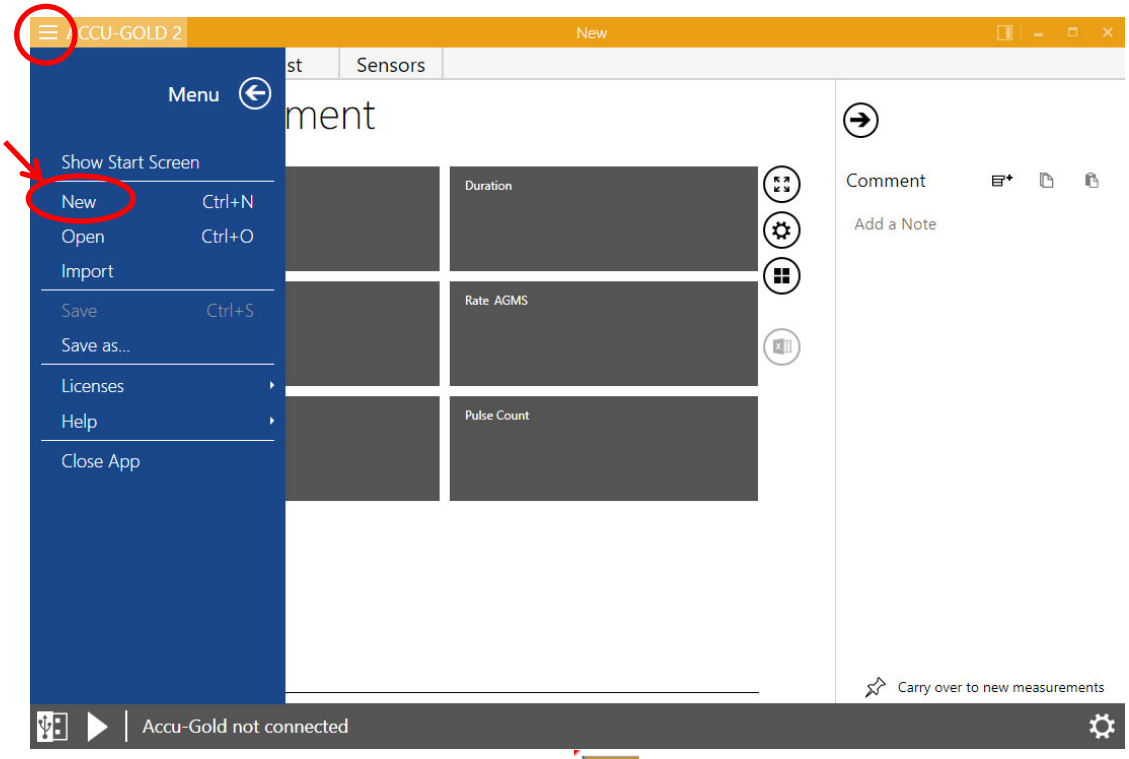

Filtration for AGMS is out of range!
kV for AGMS is out of range!
5/5/2015 - 6:38 AM
W Ag Calibration
kVp AGMS
Duration
405.2
ms
Dose AGMS
438.6
µGy
Dose ICh
414.4
µGy
Ave. kV AGMS
HVL AGMS
Rate AGMS
1.082
mGy/s
Rate ICh
1.023
mGy/s
Biased Ave. kV AGMS
Filt. AGMS
AGMS / IC / GMS
1.06
Pulse Count
1
Rate AGMS
Rate ICh
Comment
Side-by-side AGMS-M, 6M
W/AG 36.4 kV 30mAs
45.1um Ag
Paddle filter in beam
2.0mm Added Al
Carry over to new measurements

Sessions

Sessions allow you to perform multiple readings in one file. You can then review and save the information as necessary.

Starting a Session

To start a new session, perform the following actions:



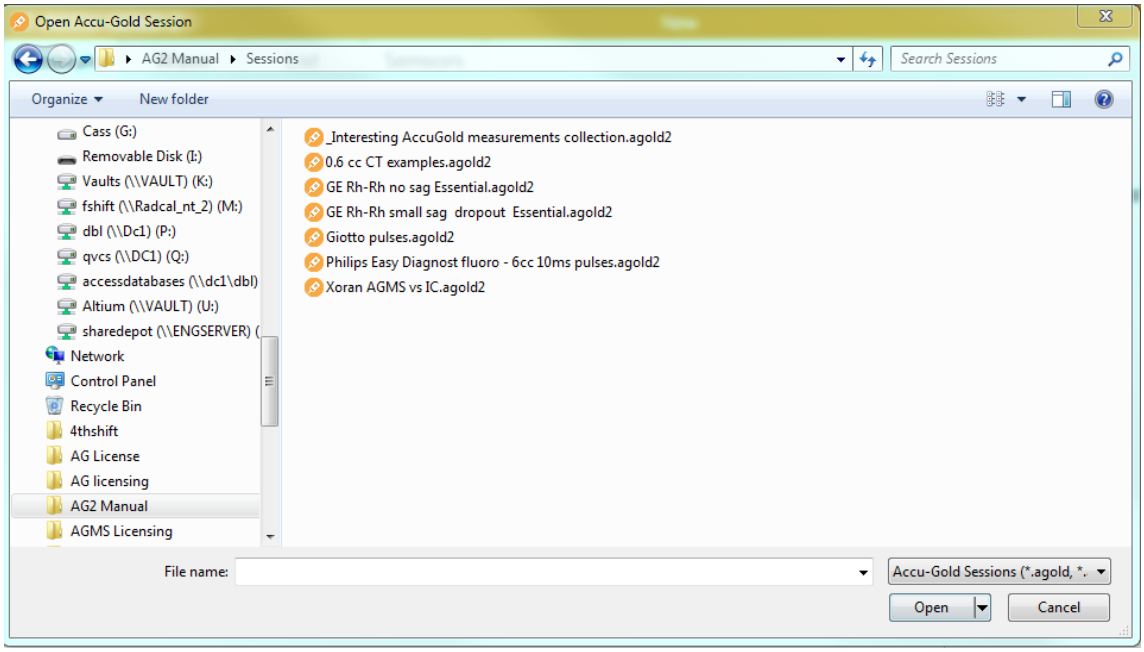
1. On the Accu-Gold main screen, click the icon in the upper left corner and select **New**.
2. A new, blank session appears.

Click Play and you are now ready to make a new measurement in this session.

Opening a Session

To open an existing session, perform the following actions:

1. On the Accu-Gold main screen, click and select **Open**. The Open Accu-Gold Session dialog appears.



2. Navigate to a saved session and click **Open** to open the session.

Importing a Session

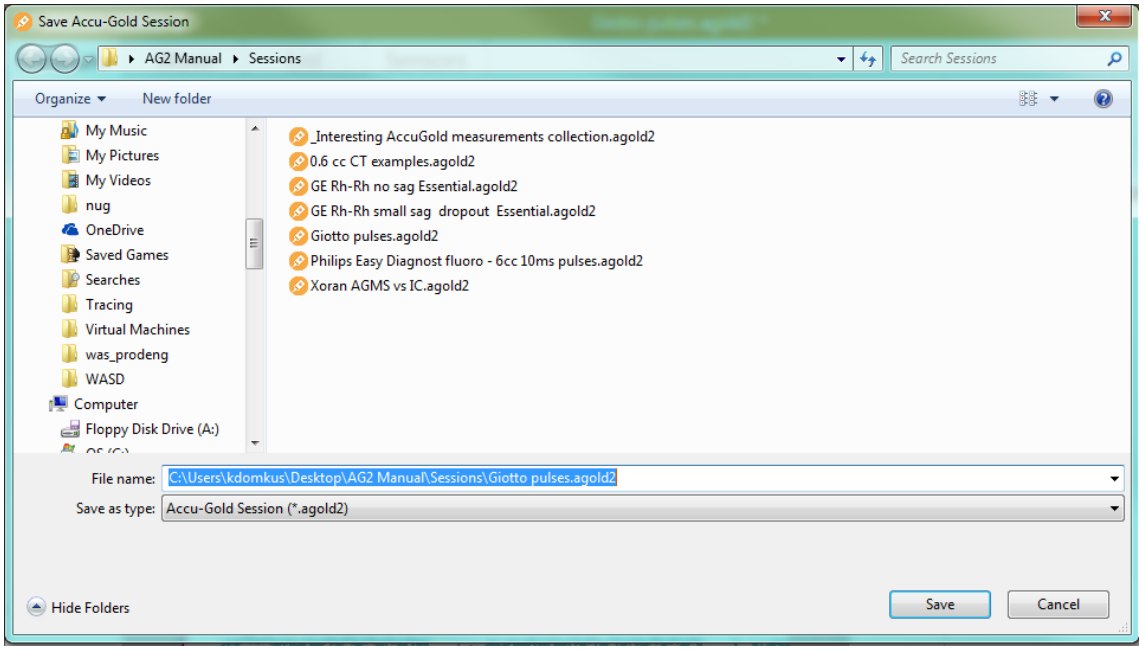
Importing a session provides an easy way to combine measurement sessions. To import a session, perform the following actions:

1. On the Accu-Gold main screen, click and select Import Session. The Open Accu-Gold Session dialog appears.
2. Navigate to a saved session and click Open to import the session. The session will be appended to the end of the current session.

Saving a Session

To save a session in progress, perform the following actions:

1. On the Accu-Gold main screen, click and select **Save** or **Save As..**. The Save Accu-Gold Session dialog appears.



2. In **File name:** type a name for the session.
3. Navigate to the desired folder and click **Save** to save the session.

Exporting a Session

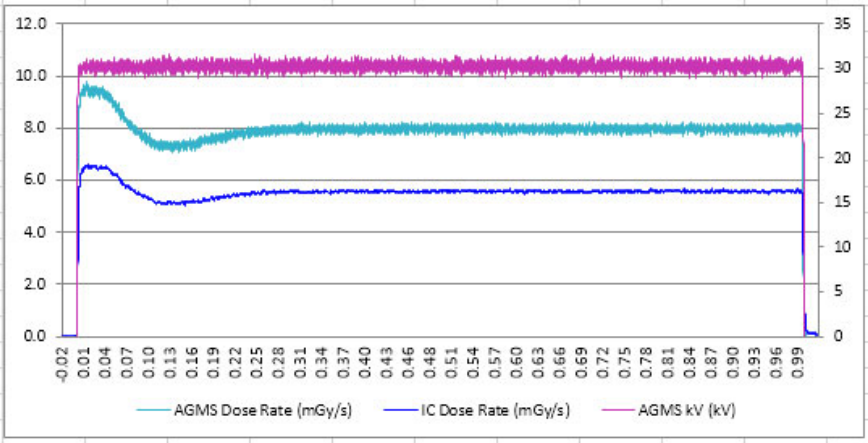
To export a measurement session to a new Excel file, use the List View (page 30).

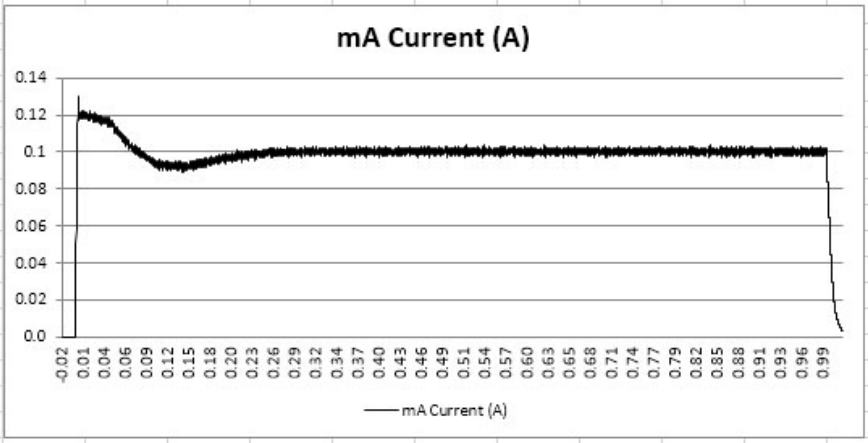
To export a single measurement to Excel, select the measurement and click the Excel export button in Measure View or Wave View.

A formatted report of the measurement is exported into a new Excel worksheet. It includes the wave chart and some key results of the measurement, as well as all available raw results on a second worksheet, including the wave results.

Measurement 1
9/27/2011 - 11:36 PM
Mo Mo Standard Calibration

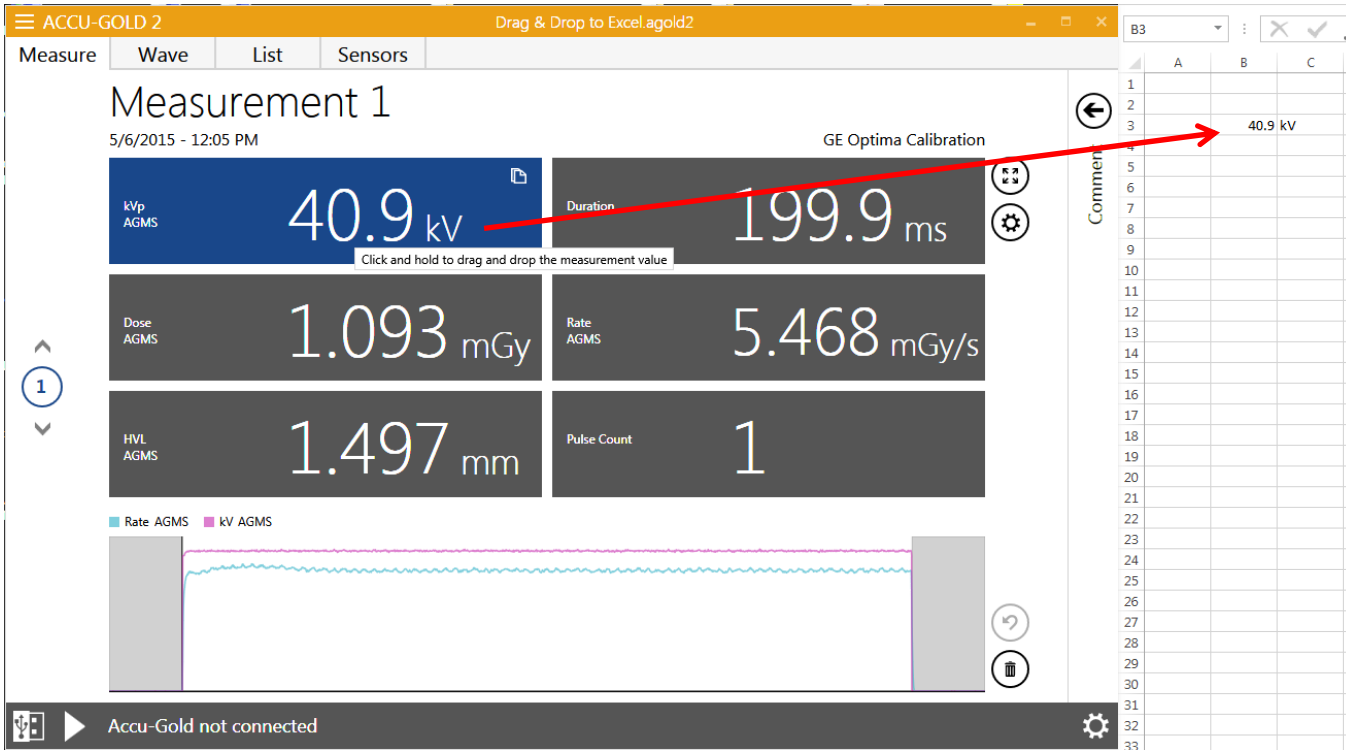
Sensor	Type	Value	Unit
	Duration	0.9977	s
	Pulse Count		
AGMS	Biased A	30.2	kV
	Dose	7.941	mGy
	Dose / m	7.9E-05	
	Dose Rat	7.96	mGy/s
	Filtratior	0.0323	mm
	kVp	30.3	kV
IC	Dose	5.542	mGy
	Dose Rat	5.555	mGy/s
mA	Charge	100.2	mAs
	Current	100.4	mA





Drag & Drop to Excel

In Measure view you may click on a data value and drag it directly to an open Excel sheet. You may also copy any individual Measure data item to the clipboard and then paste it in any open document.

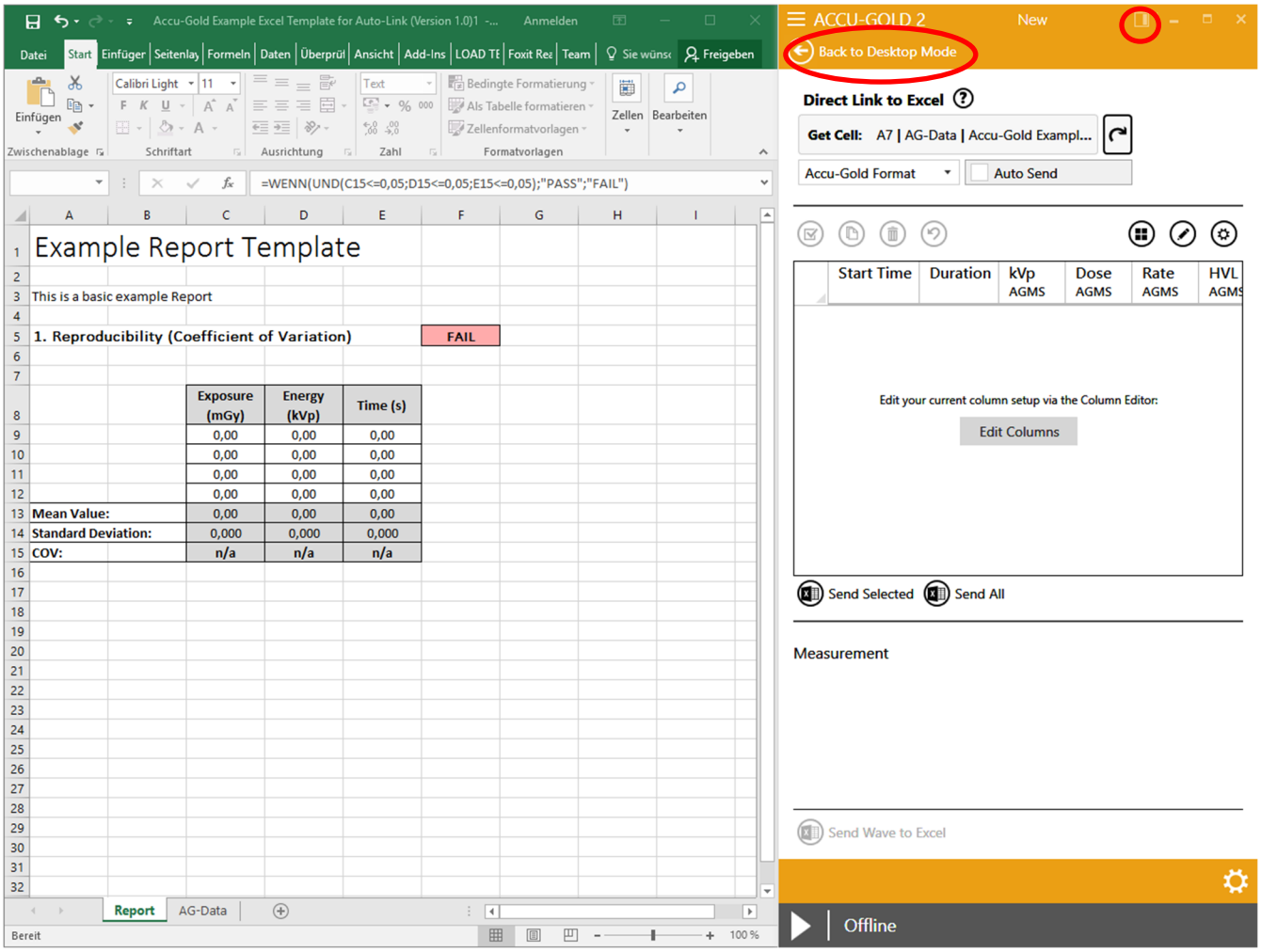


Excel Companion Mode

Excel Companion Mode helps you to keep Excel and Accu-Gold visible side by side. You can enter Excel Companion Mode from the Start Screen or from the Companion Mode icon in the title bar (near the minimize icon).

On entering companion mode, Accu-Gold switches to the side of the screen and opens an instance of Excel next to it. In Accu-Gold, you can see the list of measurements and a details area for the selected measurement. In the details area, you see the wave and measurement information. The device bar and the device settings menu are accessible, as well.

The preview wave area is only shown if the height of the screen is big enough to show several list items and the wave.



Excel Companion Mode Navigation

To leave Excel Companion Mode, press the button **“Back to Desktop Mode”** or the Companion Mode icon in the title bar.

Exporting to Excel in Companion Mode

Getting your measurement results into Excel worksheets can be accomplished in several ways:

- **Copy and Paste** is available for the current cell selection either via the “Copy”-Button or via the context menu(right-click) on the selected cells in Accu-Gold.
- **Drag and Drop**: The black border around the selected cells hints for drag and drop over to Excel. Simply press and hold the left mouse button on the black border (when the “hand” mouse icon is shown) and drag your selection over to the desired position in Excel. A preview in Excel is visible while dragging.

A single measurement with its wave can be exported to Excel by clicking the button **“Send Wave to Excel”.** This will add a formatted worksheet to your current workbook including the key results as well as the wave chart of the selected measurement. An additional worksheet is added with all available raw results for further analysis inside Excel.

By clicking on **“Get Cell”** the currently selected cell in Excel is linked to Accu-Gold. Previously made measurements can directly be send to Excel by clicking on **“Send Selected” or “Send All”.** The linked cell in Excel is automatically set to the next row.

You can switch the format of the exported data by selecting it from the drop-down box:

- **Accu-Gold Format:** The standard format with all necessary data produced by Accu-Gold. Radcal provides Excel templates for standard measurement tasks or sample templates that can be adjusted to your needs.
- **Nordic Format:** This is the same export format as used by another vendor. The dose values are taken from the currently connected sensor. If several sensors are connected this priority order is used: Ion Chamber, AGMS (Multisensor), Dose Diode.

When you select the **“Auto Send”** option every newly captured measurement is automatically send to Excel.

In many instances Accu-Gold will be able to auto configure the export settings by looking what you have already opened in Excel. When Companion Mode is entered and all open Excel worksheets are scanned. If a specific worksheet name (see table) is recognized, the link to Excel is automatically configured for the cell location and export format. By clicking on the rescan button (“Circular Arrow Icon”) this scanning can be repeated any time.

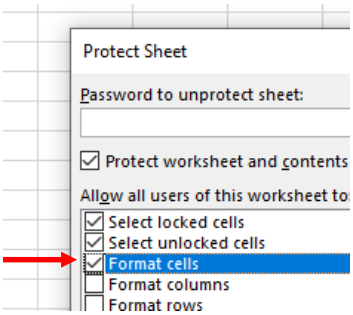
Worksheet Name	Selected Format
AG-Data	Accu-Gold Format
AG Data	Accu-Gold Format
Data	Nordic Format
XI-Data	Nordic Format

Recognized Worksheet names for Auto Link (case insensitive)

Note that the columns that are output are fixed and cannot be modified. This way all templates are guaranteed the same data layout. Using the Column editor only affects the list view display on the right of the screen. However, changing any of the unit settings will affect the output data. Be sure that the settings match what the template expects.

When creating a template in Excel, we suggest that the AG2 data be automatically put into a separate sheet (e.g. DATA) and other cells would refer to it from there (see Video Tutorial available on Radcal.com\Support).

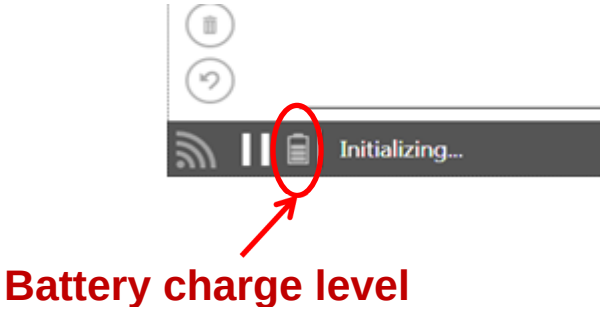
If the data is being captured amidst other data on the sheet and it is necessary to protect the sheet, check the box that allows formatting changes:



Nugget

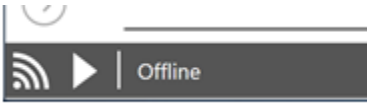
Using the Wi-Fi Nugget

Using the Wi-Fi adapter to connect to the digitizer is very similar with a few exceptions. Turn on the Nugget before launching the program. When you choose to “Connect via Wi-Fi”, the program will look for Nuggets on the network. The identification will be the Nugget’s serial number. It will automatically connect and will display the battery status of the Nugget. See Appendix C for greater detail.

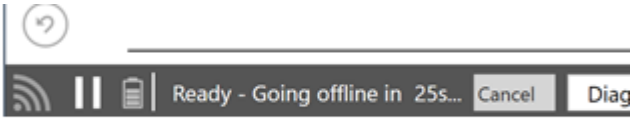


The program will sleep the Nugget as much as possible to extend battery life. When waking, it might take a few seconds to become active again.

If the Nugget/Touch WiFi is in “Offline” state, it will power off after approximately 12 minutes.

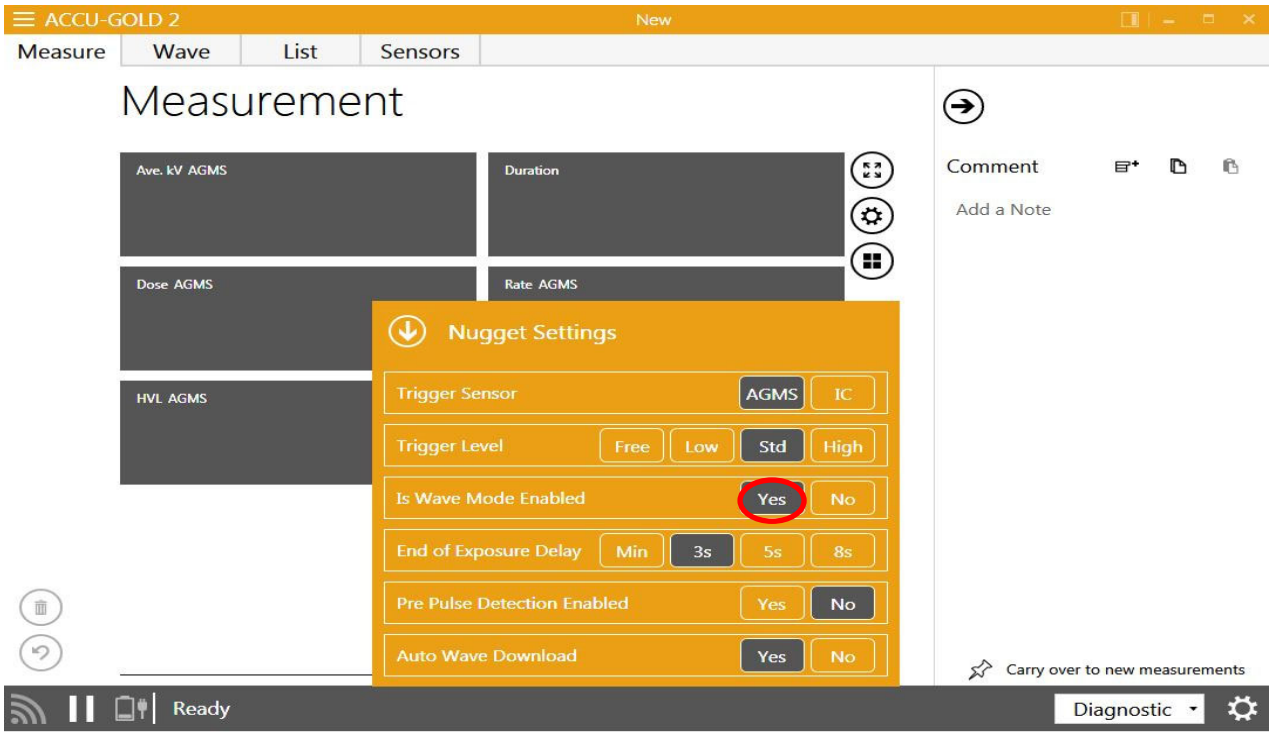


If the Nugget/Touch WiFi is in “Ready” state, it will go offline (disconnect the wireless connection) in about 3 minutes. It will give you a 30 second warning, however, so that you can stop it from disconnecting if desired. Click the Play button to reconnect.



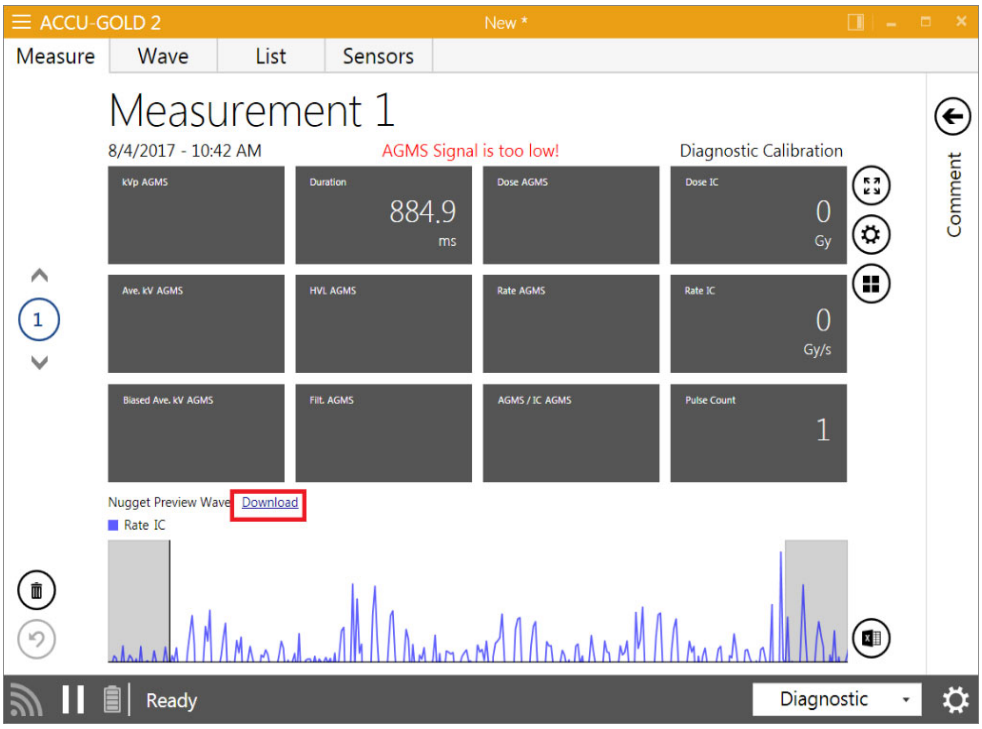
Nugget/Touch Waveform

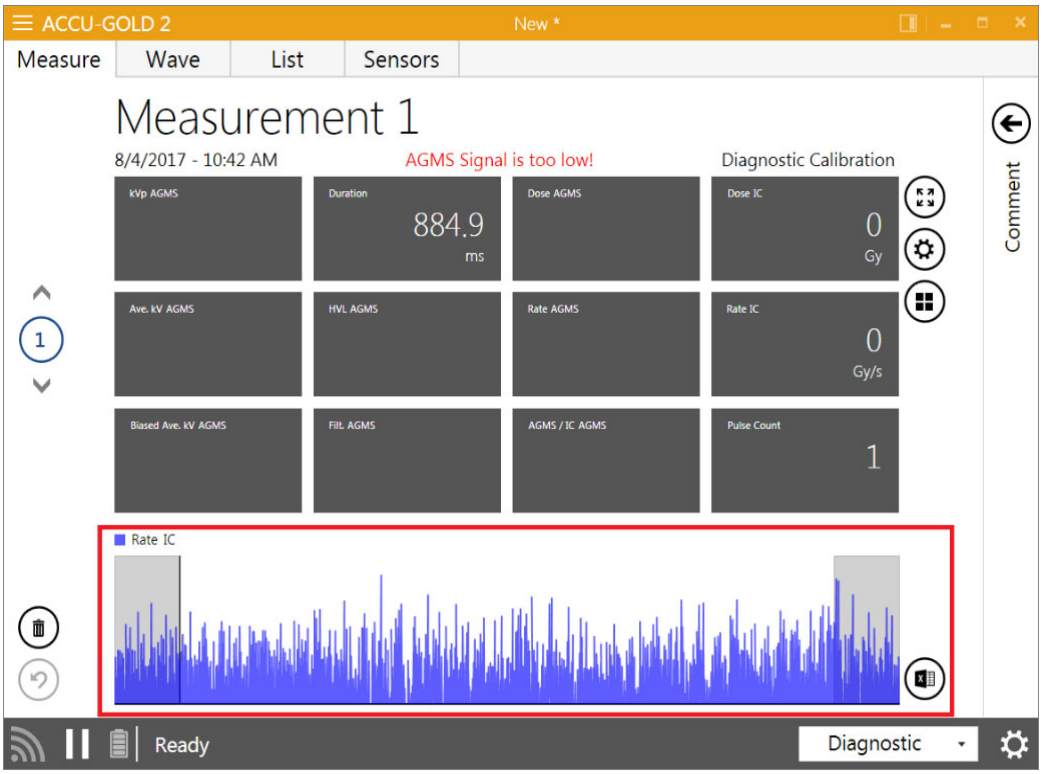
When the software is in the "Ready" state you can access the settings menu in the lower-right corner.



Select "Yes" for *Is Wave Mode Enabled*.

After recording a measurement, a preview of the waveform will be shown and will be automatically be downloaded unless you turn off the 'Auto Wave Download feature. If so, select 'Download' if required.





The full waveform is now available from the "Measure" and "Wave" view.

Waveforms can be accessed for each exposure (any order) while the nugget is powered on. Once the Nugget or Touch is turned off, the waveform data will no longer be accessible.

See additional discussion in Appendix C under Maximum Measurement Duration.

Appendix A

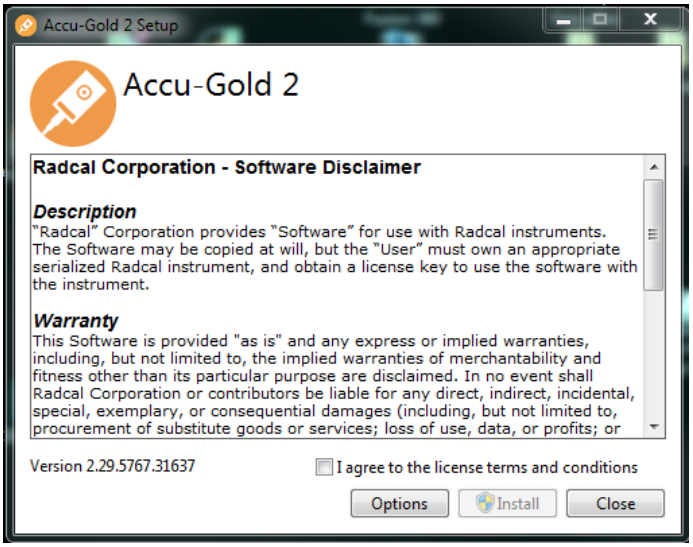
Installing Accu-Gold

Installation notes:

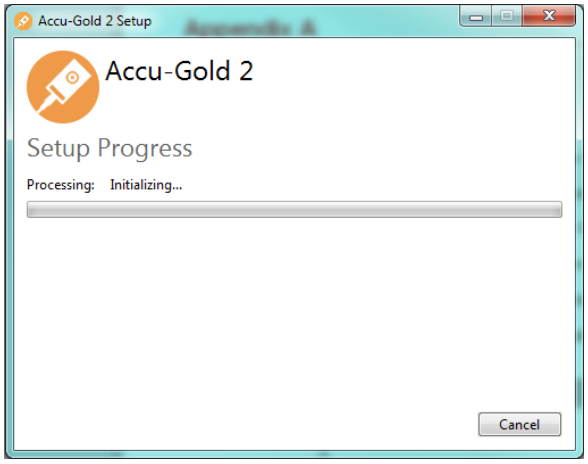
- Uninstalling old versions is not necessary.
- This manual is on the flash drive in the **Setup Content** folder and is also available for viewing by selecting ‘Help’ from the menu.
- Administrator privileges are required for installation.

To install the Accu-Gold software, perform the following actions:

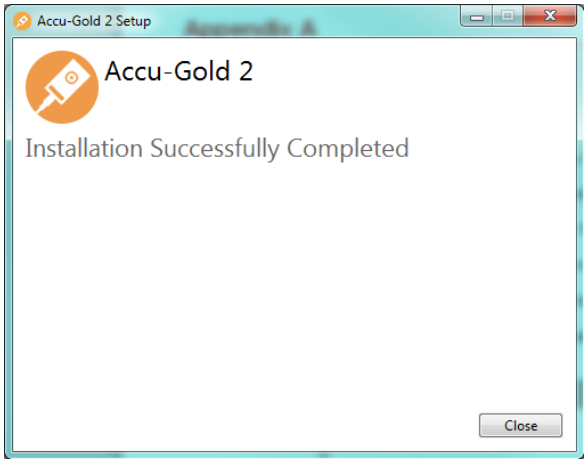
1. Insert the flash drive in the USB port on your computer.
2. Launch the file "Accu-Gold_setup.exe" located in the root of the flash drive.
3. The “setup.exe” file will launch an installation dialog. You must agree to the to continue. Click **Install**.



4. The dotNET Framework Client version 4.0 or greater is required and will be installed if it is not already installed on your computer. An internet connection is not required.



5. After the installation is complete, click **Close**.

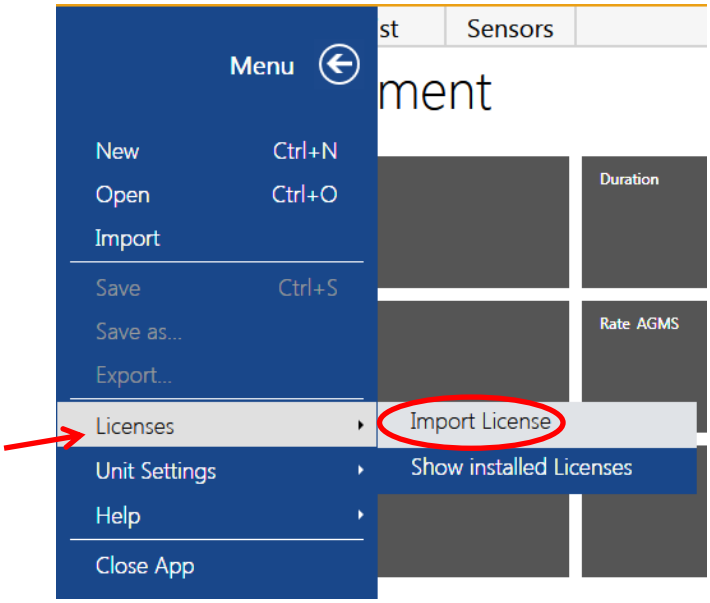


Installing the Calibration File

Calibration files for your multi-sensor will be imported during installation. If you receive a message that states that the calibration was not found, you can install the calibration manually. The legacy multi-sensor calibration data must be loaded from an external file and be reinstalled when it is recalibrated. You can find the license on the flash drive included with your sensor. For plus series sensors, the calibration is built into the sensor so calibration files are not required. However, a license files is required to access updates.

To install the license:

1. Launch the Accu-Gold software.
2. Click the icon and choose **Licenses,** then **Import License**.
3. Plug the flash drive (for legacy sensors, the flash drive attached to your sensor; for digitizer license, the flash drive for the software) into the computer.



4. In the Import window that appears, browse to the location of your flash drive and choose the file that contains the serial number of your sensor or digitizer.
5. For example, or, for the mammo, . If it is a general license:
6. Click **Open**. The file will load and a message will appear that says “License file was imported.”

Uninstalling Accu-Gold

To uninstall Radcal Accu-Gold, perform the following actions:

1. Navigate to **Add/Remove Programs** in the Control Panel and select **Accu-Gold 2**.
2. Click **Remove** and answer yes to the prompts. You may also run the setup program again to uninstall it.

Appendix B

Sensor specifications

The function of the digitizer is to transform the analog signals generated by a host of sensors into calibrated digital results. The Accu-Gold digitizer features multiple inputs for sensors.

SPECIFICATIONS / TECHNICAL DATA: All specifications subject to change.

TYPE		Anode / Filter	Tube	kV ±2% or ±0.7kV whichever is greater	Filt (um)	hvl (mm Al) ±5% or ±0.05 mm Al whichever is greater
Rad/Fluoro Dental /Mammo (AGMS-DM+) ***	Mammo (AGMS-M+) *	Mo/Mo	General	21-49	16-44	0.21-0.50
		Mo/Rh	General	21-49	6-42	0.18-0.56
		Mo/Mo	GE	22-48	16-44	0.24-0.51
		Mo/Rh	GE	22-48	6-42	0.20-0.56
		Rh/Rh	GE	25-48	12-80	0.27-0.78
		W/Ag	General	20-40	12-80	0.17-0.78
		W/Rh	General	20-40	12-78	0.17-0.69
		W/Al	General	20-50	300-3030	0.16-1.96
	Rad/Fluoro/Dental (AGMS-D+)	W/Al	General	40-160	2-24 mm	1.3-13.5**
				50-160	25-40 mm	
	Rad/Fluoro/Dental (AGMS-D+) and Mammo (AGMS-M+)	Dose†		Dose Rate / Pulse Rate†		Time
		40 nGy – >100 Gy, ±5% (4.5 µR – >11 kR, ±5%)		40 nGy/s – 200 mGy/s, ±5% 1 nGy/s with waveform analysis (0.27 mR/min – 1.4 kR/min, ±5%) 1 – 120 pulses/s Pulse Length: 1.0ms – 2.45 days		1 ms – 2.45 days ± 0.05% or 0.2 ms

* GE Healthcare Senographe Pristina Calibration is ±5%, Rh/Ag, Mo/Cu, Rh/Cu and IQST beam qua
** or ±0.2 mm Al whichever is greater
*** For AGMS-D+ and AGMS-DM+ Dose & Dose Rate measurements below 80 nGy, select model DDX6-WL Solid State Dose Sensor or model 10X6-60 ion chamber.
† Auto corrected to within ±2% for 1.5 mm to 40 mm Al total filtration.

Reference conditions	**Mammo:** 2.2 mm thick polycarbonate compression paddle in beam for all measurements (kVp, dose, hvl). Calibrated using large focal spot. **Rad/Fluoro/Dental:** 12° Tungsten anode.
Size	35.6 mm x 20.0 mm x 11.8 mm, 2 m cable
Reference point	Round marking 1 cm diameter midline – 3.2 mm from top surface.
Working temperature range	15°C - 35°C (Storage: 0°C / 32°F - 60°C / 140°F)
Humidity	< 80 % (without condensation)
Pressure	700 hPa – 1060 hPa

Notes:

The time range is different when using a Nugget (or Touch). See Feature Comparison, Appendix D.

Radcal mammographic sensor calibrations assume a 2.2 mm polycarbonate paddle, or simulated paddle (Appendix H), are placed on top of the sensor.

Custom anode/filter calibrations for **GE**

		Range of Applications			
Anode/Filter	Tube	kV	Filt (um)	hvl (mm Al)*	Paddle**
Mo/Al	GE DMR	22-49	1.0 mm	0.42-0.61	2.2 mm
Rh/Al	GE DMR	25-49	1.0 mm	0.42-0.61	2.2 mm
Mo/Mo	GE Pristina	22-32	16-44	0.24 -0.51	2.2 mm
Rh/Ag	GE Pristina	27-40	12-80	0.27 - 0.78	2.2 mm
Rh/Ag	IQST GE Pristina	34	-	-	No Paddle
Mo/Cu	GE Pristina	40-49	250	2.48-3.27	2.2 mm
Rh/Cu	GE Pristina	40-49	250	2.42-3.20	2.2 mm
Mo/Mo	GE Essential	22-48	16-44	0.24-0.51	2.2 mm
Mo/Rh	GE Essential	22-48	6-42	0.20-0.56	2.2 mm
Rh/Rh	GE Essential	25-48	12-80	0.27-0.78	2.2 mm
W/Al	GE Definium (diag)	Same as Diagnostic			No Paddle
W/Al	GE Optima (diag)	Same as Diagnostic			No Paddle

Custom anode/filter calibrations for **Philips**

		Range of Applications			
Anode/Filter	Tube	kV	Filt (um)	hvl (mm Al)*	Paddle**
W/Al	Philips Microdose	20-50	300-3030	0.16-1.96	No Paddle

Custom anode/filter calibrations for **Siemens**

		Range of Applications			
Anode/Filter	Tube	kV	Filt (mm)	hvl (mm Al)*	Paddle**
W/Al	Siemens Straton Tube CT with W filter	40-140	0-29	5-10	MDL8155 filter required
W/Ti	Mammomat Revelation	41-50	1.0	2.45-3.0	No Paddle

Custom anode/filter calibrations for **Hologic**

		Range of Applications			
Anode/Filter	Tube	kV	Filt (um)	hvl (mm Al)*	Paddle**
W/Cu	Hologic Dimensions	38-49	174-325	1.54-3.52	No Paddle

Custom anode/filter calibrations for **General CT**

		Range of Applications			
Anode/Filter	Tube	kV	Filt (mm)	hvl (mm Al)*	Paddle**
W/Al	CT	120-140	2-40	1.3-13.5	No Paddle

Conditions: Tube position 0 degrees
Bow-tie filter is OUT
Generator in service mode

Custom calibration for use with Radcal's Model 8463D **Pan-dental** positioner

		Range of Applications			
Anode/Filter	Tube	kV	Filt (mm)	hvl (mm Al)*	Paddle**
W/Al	Dental	60-100	1.5-4	1.3-5	No Paddle

Conditions: Use with positioner – see Appendix H

*Accuracy: same as above except hvl: ±5% or ±0.05 mm Al

** Reference Conditions: same as above except as noted.

10X6-6

For use with Accu-Gold, Accu-Pro, and Accu-Dose, the 10X6-6 is a general purpose in beam chamber with a well-documented wide dynamic range chamber with many dose and rate applications. It is also recommended for measuring exposure time in Auto Dose mode. The range of time (pulse width) extends from 10ms to 300s.

Chamber	10X6-6	
Min Rate	2 R/s	20 nGy/s
Max Rate	17 R/s	149 mGy/s
Min Dose	10 R	100 nGy
Max Dose	59 kR	516 Gy
Cine Specifications	0.1 R/f - >1 R/f	1 nGy/f - >10 mGy/f
Calibration Accuracy	±4% using X-rays @ 60kVp and 2.8 mm AL HVL	
Exposure Rate Dependence	±5%, 0.4 mR/s to 80 R/s, up to 500 R/s for 50 us pulses	
Energy Dependence	±5%, 30 keV to 1.33 MeV (with build-up material)	
Construction	Polycarbonate walls and electrode conductive graphite interior coating; 6 cm3 active volume; 0.05kg	

10X6-6M

For use with Accu-Gold, Accu-Pro, and Accu-Dose, the 10X6-6M is a dedicated mammography chamber. The chamber is a world standard for mammography, ready for any mammographic tube track-filter combination. Extraordinary flat energy response over 10 - 40 keV has been documented in technical papers and makes corrections unnecessary. It is also recommended for measuring exposure time in Auto Dose mode. The range of time (pulse width) extends from 10ms to 300s.

Chamber	10X6-6M	
Min Rate	2 R/s	20 nGy/s
Max Rate	10 R/s	88 mGy/s
Min Dose	10 R	100 nGy
Max Dose	59 kR	516 Gy
Cine Specifications	N/A	
Calibration Accuracy	±4% using X-rays @ 30kVp and 0.50 mm AL HVL	
Exposure Rate Dependence	±5%, 0.02 R/min to 600 R/min	
Energy Dependence	±5%, 10 keV to 40 keV	
Construction	0.7 mg/cm2 metalized polyester window; polyacetal exterior; 6cm3 active volume; 0.08kg	

10X6-60

For use with Accu-Gold, Accu-Pro, and Accu-Dose, the 10X6-60 is a service and image intensifier chamber. The dynamic range and thin profile is ideal for input dose at the image intensifier, high dose rates encountered in Fluoroscopy and Cine, spot film devices, and other special procedures.

Chamber	10X6-60	
Min Rate	200 R/s	2.0 nGy/s
Max Rate	2 R/s	19 mGy/s
Min Dose	1 R	10 nGy
Max Dose	5.9 kR	52 Gy
Cine Specifications	0.01 R/f ->100 mR/f	0.1 nGy/f ->1.0 mGy/f
Calibration Accuracy	±4% using X-rays @ 150kVp and 10.2 mm AL HVL	
Exposure Rate Dependence	±5%, 2 mR/min to 199 R/min	
Energy Dependence	±5% 20 keV to 1.33 MeV (with build-up material)	
Construction	Polycarbonate walls; conductive graphite exterior coating; 60 cm^3 active volume, 0.5 m low-noise triax cable; 0.13kg	

10X6-60DAP

For use with Accu-Gold the 10X6-60DAP is ideal for Dose Area Product (DAP) measurement of small beams such as Pan-Dental or CBCT-Dental.

Chamber	10X6-60DAP	
Rate Specifications	11 pGy-m^2/s	110 Gy-m^2/s
Exposure Specifications	56 pGy-m^2	290 mGy-m^2
Exposure Rate Dependance	<5% over rated rate specification	
Calibration Accuracy	±5% using X-rays @ IEC RQR-8 100 kV & 4.0 mm Al HVL	
Energy Dependence	±5%, RQR-3 to RQR-10 (50 kV-1.8 mm Al HVL to 150 kV-6.6 mm Al HVL)	
Chamber Beam Attenuation	6% ±2% over energy range RQR3 to RQR10	
Max beam size	80 mm dia or 56 mm square	
Construction:	Parallel plate. Polycarbonate wall. Conductive graphite exterior coating; 60 cm^3 active volume, 2 m low-noise triax cable; 0.13 kg	

10X6-3CT

For use with Accu-Gold, Accu-Pro, and Accu-Dose, the 10X6-3CT is a Computed Tomography Dose Index (CTDI) and DWP or DLP Chamber. Although designed specifically for CT X-ray beam measurements, either free-in-air or mounted in a head or body phantom, it can be used for DWP and DLP* applications such as Dental X-ray measurements because of the chamber's excellent energy and partial volume response as well as uniformity along its entire 10 cm active length.

Chamber	10X6-3CT	
Min Rate	2 R/s	20 nGy/s
Max Rate	40 R/s	350 mGy/s
Min Dose	20 R	200 nGy
Max Dose	118 kR	1 kGy
Cine Specifications	N/A	
Calibration Accuracy	±4% using X-rays @ 150kVp and 10.2 mm AL HVL	
Exposure Rate Dependence	±2%, 2mR/s to 40 R/s	
Energy Dependence	±5%, 3 to 20 mm AL HVL	
Construction	C552 air-equivalent walls and electrode: polyacetal exterior cap; 3 cm^3 active volume; 1.5-m low-noise triax cable; 0.11kg	

* The software produces a measurement in DLP units which is the product of the dose times the chamber length. This DLP unit should not be assumed to be a substitute for a full set of in-phantom measurements that are used to determine CTDIw or CTDIvol.

10X6-10

This 10cc multi-purpose ion chamber is suitable for measuring R&F as well fluoro. It's small size (5cm diameter x 1cm thick), excellent energy response and x-ray transparency makes it ideal for those difficult measurements where space is at a minimum.

Chamber	10X6-10	
Min Rate	2 R/s	20 nGy/s
Max Rate	17 R/s	149 mGy/s
Min Dose	10 R	100 nGy
Max Dose	59 kR	516 Gy
Cine Specifications	0.1 R/f ->1 R/f	1 nGy/f ->10 mGy/f
Calibration Accuracy	±5% using X-rays @ 150kVp and 10.2 mm AL HVL	
Exposure Rate Dependence	±5%, 0.4 mR/s to 80 R/s, up to 500 R/s for 50 us pulses	
Energy Dependence	±5%, 1.5 mm Al to 15 mm Al hvl	
Construction	Polycarbonate walls and electrode; conductive graphite exterior coating; 10.3 cm active volume; 1.5 m low noise triax cable; 0.05kg	

10X6-180

For use with Accu-Gold, Accu-Pro, and Accu-Dose, the 10X6-180 is a leakage and low level measurements chamber. The chamber is designed for leakage measurements with a cross-section of 100 cm (complies with CFR21) and volume of 180 cm . It is also used for very low dose to image receptors.

Chamber	10X6-180	
Min Rate	100 nR/s	1 nGy/s
Max Rate	0.6 R/s	4.9 mGy/s
Min Dose	200 nR	2 nGy
Max Dose	2.0 kR	17 Gy
Cine Specifications	N/A	
Calibration Accuracy	±4% using X-rays @ 150kVp and 10.2 mm AL HVL	
Exposure Rate Dependence	±5%, 20 mR/hr to 2000 R/hr	
Energy Dependence	±5%, 30 keV to 1.33 MeV (with buildup material)	
Construction	Polycarbonate walls and electrode; conductive graphite exterior coating; 180 cm active volume; 0.11kg	

10X6-1800

For use with Accu-Gold, Accu-Pro, and Accu-Dose, the 10X6-1800 is a radiation protection chamber used for low-level radiation measurements such as shielding leakage, irradiator, and environmental. Unlike typical survey meters, the 1800cm volume chamber offers improved accuracy over a wider dynamic range.

Chamber	10X6-1800	
Min Rate	5 nR/s	50 pGy/s
Max Rate	18 mR/s	200 Gy/s
Min Dose	20 nR	200 pGy
Max Dose	196 R	1.7 Gy
Cine Specifications	N/A	
Calibration Accuracy	±4% using X-rays @ 150kVp and 10.2 mm AL HVL	
Exposure Rate Dependence	+0%, -5%, 0.1 mR/hr to 20R/hr, -10% to 65 R/hr	
Energy Dependence	±5%, 33 keV to 1.33 MeV (with buildup material)	
Construction	Polycarbonate walls and electrode; conductive graphite exterior coating; 1800 cm active volume; 0.54 kg	

10X6-500 Leakage Measurement Chamber

A single sensor leakage measurement solution for very low-level radiation measurements such as shielding, leakage, irradiators and environmental that is part of the Accu-Gold family of systems. Equivalent to the Fluke® 96010A Ion Chamber used in the Fluke® Radiation Leakage Detection System, this chamber meets 21 CFR 1020.30(k) for leakage measurement requirements.

Chamber	10X6-500	
Min Rate	62 nR/s	0.6 nGy/s
Max Rate	130 mR/s	1.2 mGy/s
Min Dose	1 nR	0.01 nGy
Max Dose	45 R	0.4 Gy
Cine Specifications	N/A	
Calibration Accuracy	±4% using X-rays @ 100kVp and 3.96 mm AL HVL	
Exposure Rate Dependence	<5% up to 5 Gy/hr (570 R/hr)	
Energy Dependence	±5%, 40-150 kVp (RQR and RQA Beam Qualities)	
Construction	Truncated cylinder, polycarbonate walls and electrode; conductive graphite exterior coating; 522 cm^3 active volume; 0.54 kg.	

10X6-0.6

For use with Accu-Gold, Accu-Pro, and Accu-Dose, the 10X6-0.6 is a high dose rate chamber. This high dose rate chamber provides an excellent response at therapy and other high energy, high dose rate applications. The fully guarded chamber is mounted at the end of a 12-m low noise triax cable. It can be used with or without a build-up cap depending upon the application.

Chamber	10X6-0.6	
Min Rate	20 R/s	200 nGy/s
Max Rate	133 R/s	1.17 Gy/s
Min Dose	100 R	1 Gy
Max Dose	589 kR	5 kGy
Cine Specifications	N/A	
Calibration Accuracy	±4% using $_{60}$Co	
Exposure Rate Dependence	±2%, 10 mR/s to 100 R/s	
Energy Dependence	±5%, 40 keV to 1.33 MeV (with buildup cap)	
Active Length	19.7 mm ± 1 mm	
Construction	C552 air-equivalent material walls and electrode; polyacetal exterior cap, 0.6 cm^3 active volume 12-m triax cable (3 m version available)	

10X6-0.6CT

The 0.6cc thimble ionization chamber is ideal for dose measurements in modern wide beam multi-slice CT. It is calibrated using X-rays @ 150 kVp. Phantom adapter is included.

Chamber	10X6-0.6CT	
Min Rate	20 R/s	200 nGy/s
Max Rate	133 R/s	1.17 Gy/s
Min Dose	100 R	1 Gy
Max Dose	589 kR	5 kGy
Cine Specifications	N/A	
Calibration Accuracy	±4% using X-rays @ 150 kVp and 10.2mm Al HVL	
Exposure Rate Dependence	±2%, 10 mR/s to 100 R/s	
Energy Dependence	±5% 3 to 20mm Al HVL	
Active Length	19.7 mm ± 1 mm	
Construction	C552 air-equivalent material walls and electrode; polyacetal exterior cap, 0.6 cm active volume, 3-m triax cable	

10X6-0.18

For use with Accu-Gold, Accu-Pro, and Accu-Dose, the 10X6-0.18 is a high dose rate chamber used for in-beam measurements of high-intensity gamma radiation. The fully guarded chamber is mounted at the end of a 3-m low-noise triax cable.

Chamber	10X6-0.18	
Min Rate	50 R/s	500 nGy/s
Max Rate	720 R/s	6.31 Gy/s
Min Dose	200 R	2 Gy
Max Dose	2 MR	17 kGy
Cine Specifications	N/A	
Calibration Accuracy	±4% @ 60 Co	
Exposure Rate Dependence	±2%, 3 mR/s to 720 R/s	
Energy Dependence	±5%, 45 keV to 1.33 MeV	
Active Length	8.1 mm ± 1 mm	
Construction	C552 air-equivalent material walls and electrode; polyacetal exterior cap, 0.18 cm active volume, 3-m triax cable	

Calibrations at ^{60}Co and ^{137}Cs are available.

90M9-AG Invasive Sensor

The 90M9-AG is an invasive sensor. The mAs sensor connects to the 4-pin connector labeled mAs on the digitizer using a 4-m cable and to the X-ray generator with safety shrouded banana jacks. It is intended to be inserted in series with the X-ray generator return. The value of mAs is computed by summing mA values during the part of the kV waveform (requires kV sensor in beam) defined by the same thresholds that are applied to determine its width, generally 75% of kVp. Average mA is mAs divided by this width.

Key features:

- Automatic power control extends battery lifetime
- Automatic zero
- Measurement synchronized to kV waveform
- .001 to 9999 mAs and 10 uA to 2A dynamic range with no range switching
- Measures absolute value (no rectifier drop and optimum noise rejection)
- mA-waveform
- 2.33-kHz -3-dB bandwidth

Specification / Technical Data	
Full-scale	2000 mA or 9999 mA
mA accuracy	0.2% of reading at dc plus resolution of +/-0.015 mA or 3-4 digits
mAs accuracy	(1-s pulse): 5 As or 0.2% of reading; resolution of 0.001 mAs
Absolute value of bi-polar	720 Hz waveform accurate to 2.5%
Bandwidth	2.33 kHz, -3 dB
ON/OFF	controlled from 9096 or 4086 control unit (ON only when a kV function is active)
Batteries	1 x 9.0 V Alkaline

90M10-AG Non-Invasive Clamp-on Sensor

The 90M10-AG is a non-invasive clamp-on sensor that requires kV to be in beam. The mAs sensor connects to the 4-pin connector labeled mAs using a 4-m cable and couples to the X-ray generator by clamping to the X-ray anode HV cable (clamps up to 23 mm in diameter). The value of mAs is computed by summing mA values during the part of the kV waveform (requires kV sensor in beam) defined by the same thresholds that are applied to determine its width, generally 75% of kVp. To measure the anode current, clamp on the anode cable with the arrow on the clamp pointing towards the X-ray tube.

Key Features

- Automatic power control extends battery lifetime
- Automatic zero
- Measurement synchronized to kV waveform
- Maximum 9999 mAs and 0.7mA (RMS noise) to 2A dynamic range with no range switching
- Measures absolute value (no rectifier drop and optimum noise rejection)
- Measures absolute value of mA
- mA-waveform

Specification / Technical Data	
Range	1900 mA or 9999 mAs (2-2000 mA when used with 9095)
mA accuracy	±4% of reading (Limited by 0.7mA RMS noise below 18mA)
mAs accuracy	±4% of reading (Limited by 0.7mA RMS noise below 18mA)
Bandwidth	2.33 kHz, -3 dB
ON/OFF	ON/OFF controlled from Accu-Gold, Accu-Pro/Accu-kV (ON only when a kV function is active)
Batteries	2 x IEC-LR6 (1.5V AA Alkaline) Lifetime: Approximately 35 continuous operating hours

The sensor responds to the net current passing through the opening. This means that current flowing in the cable shield can add or subtract from the tube current. To a lesser extent, nearby electrical circuits can also affect the measurement, as can the motion of the cable within the clamp opening.

The instrument program compensates for the effect of these extraneous signals by continuously measuring the sensor output and computing a zero correction. When a measurement begins the most-recent zero measurement is stored and used to correct the reported value. This correction is limited to 50 mA; if the zero is larger than this value a measurement error occurs.

Extraneous signals are generally not a problem for tube currents above about 100mA.

For measurements where errors in the 5 mA range are significant, Radcal recommends the following:

1. Position the sensor on the anode cable so the cable doesn't move relative to the sensor.
2. Locate the sensor away from magnetic noise sources, particularly those that might change during the exposure because the zero correction is measured several seconds before the exposure. The tube rotor in particular could be a problem.

DDX6-W (DISCONTINUED)

The DDX6-W is a solid-state dose sensor for diagnostic range measurements. It is a small solid-state sensor for single exposures and fluoroscopy in the diagnostic range. It measures dose, dose-rate, and time and is passively corrected for beam quality. It may be used simultaneously with an AGMS-D multi-sensor in entrance / exit exposure measurements.

Sensor	DDX6-W	
Min Rate	2 R/s	20 nGy/s
Max Rate	23 R/s	205 mGy/s
Min Dose	10 R	100 nGy
Max Dose	64 kR	559 Gy
Accuracy	±5% using X-rays @ 80kVp with 2.5 mm Al total filtration (IEC 61267 RQR-6)	
Energy Dependence	+5% from 50 kVp to 120 kVp at 2.5 mm Al	
Filtration Dependence	+5% to -10% from 2.5 mm Al to 23 mm Al	

DDX6-WL

For use with Accu-Gold, Accu-Pro, and Accu-Dose, the DDX6-WL is a solid-state dose sensor for diagnostic range measurements. It is a small solid-state sensor for single exposures and fluoroscopy in the Diagnostic range. It measures dose, dose-rate, and time and is passively corrected for beam quality. It may be used simultaneously with an AGMS-D multi-sensor in entrance / exit exposure measurements. It is especially recommended for low dose-rate measurements, e.g. pediatric dose-rates.

Sensor	DDX6-WL	
Min Rate	50 nR/s	500 pGy/s
Max Rate	0.65 R/s	5.7 mGy/s
Min Dose	200 nR	2 nGy
Max Dose	1.8 kR	15 Gy
Accuracy	±5% using X-rays @ 80kVp with 2.5 mm Al total filtration (IEC 61267 RQR-6)	
Energy Dependence	+5% from 50 kVp to 120 kVp at 2.5 mm Al	
Filtration Dependence	+5% to -10% from 2.5 mm Al to 23 mm Al	

AGLS Light Sensor

The AGLS light sensor contains a silicone photo diode that can be exposed to ambient light through an optical filter, which very accurately simulates the spectral response of the human eye's photopic response, in order to measure illuminance in lux units. A luminance adapter can be screwed onto the base unit in front of the photo-diode for the measurement of luminance in cd/m2 units through an aperture with a 10-mm diameter. Accu-Gold automatically detects the presence or absence of the luminance adapter and automatically selects the appropriate units

Light Sensor	AGLS	Resolution
Luminance Range	0.05 to 50,000 cd/m^2	0.01 cd/m^2
Illuminance Range	0.05 to 50,000 lux	0.01 lux
Luminance Aperture	Ø10 mm measuring field. Contact measurement focusing lens 1:1.	
Calibration Uncertainty	<3% of value or 0.05, whichever is greater, relative to Illuminant A.	
Calibration Traceability	Traceable to NIST and international standards.	
Photopic Response	<4% (Deviation from 1931 CIE photopic curve standard)	
Cosine Response	<4% (CIE f2 test)	

Legacy Sensors

The Accu-Gold+ family of products offer a number of enhancements over the Accu-Gold products they replace. These include:

- Support for the AGDM+ multi-sensors providing simultaneous support for diagnostic and mammographic measurements.
- Improved sensitivity at lower dose rates consistent with the industry trend as imaging systems require less radiation to form excellent imagery.

The Accu-Gold+ digitizer is designed to be fully compatible with both the original family of Accu-Gold sensors (legacy) and the newer Accu-Gold+ sensors. As such it is a suitable replacement for the original Accu-Gold digitizer in the vast majority of applications.

Note: In order to obtain improved sensitivity at lower dose rates the ability to operate at rarely encountered very high dose rates (> 350mGy/s) was compromised.

For all other applications, the Accu-Gold+ family of digitizers (Accu-Gold+, Rapid-Gold+, and Accu-Dose+) are a direct replacement for the original Accu-Gold digitizers (Accu-Gold and Rapid-Gold) and operate within the appropriate specifications for those systems.

AGMS – M (DISCONTINUED)

For use with Accu-Gold, the AGMS-M is a Solid-State Dose multisensor for Mammographic Range Measurements. It measures dose, dose-rate, time, kVp with FFT analysis, Flash HVL, and beam filtration. It features Flash correction of dose for beam quality.

Type	Anode / Filter	Tube	kV ±2% or ±0.7kV whichever is greater	Filt (um)	hvl (mm Al) ±10% or ±0.05 mm Al whichever is greater
Mammo (AGMS-M)	Mo/Mo	General	21-49	16-44	0.21-0.50
	Mo/Rh	General	21-49	6-42	0.18-0.56
	Mo/Mo	GE	22-48	16-44	0.24-0.51
	Mo/Rh	GE	22-48	6-42	0.20-0.56
	Rh/Rh	GE	25-48	12-80	0.27-0.78
	W/Ag	General	20-38	12-80	0.17-0.78
	W/Rh	General	20-38	12-78	0.17-0.69
	W/Al	General	20-50	200-990	0.16-0.82

Mammo (AGMS-M)	Dose using AGDM	Dose Rate using AGDM	Dose using AGDM+	Dose Rate using AGDM+	Time
	150nGy–>100Gy,±5% (17 R–>11kR,±5%)	150nGy/s–350mGy/s,±5% (1.0mR/min–2.4kR/min,±5%)	80nGy->100Gy,±5% (9.1uR->11kR,±5%)	80nGy/s-150mGy/s,±5% (0.55mR/min-1.0kR/min,±5%)	1 ms – 300s ±0.1%+0.2 ms

Reference Conditions:

- 2.2 mm polycarbonate compression paddle in beam for all measurements (kVp, dose, hvl).
- Calibrated using large focal spot

For use with Accu-Gold, the AGMS-D is a Solid-State Dose multi-sensor for Diagnostic Range Measurements. It is used for single exposure and fluoroscopy. It measures dose, dose-rate, time, kVp with FFT analysis, Flash HVL, and beam filtration. It features Flash correction of dose for beam quality.

Type	Anode / Filter	Tube	kV	Filt (um)	hvl (mm Al) ±10% or ±0.2 mm Al whichever is greater
Rad/Fluoro/Dental (AGMS-D)	W/Al	General	40-160 ±2% (2-24 mm Al, 40-160 kV) ±2.5% (25-40 mm Al, 50-160 kV)	2-40 mm	1.3-13.5

Rad/Flouro/Dental (AGMS-D)	Dose using AGDM	Dose Rate using AGDM	Dose using AGDM+	Dose Rate using AGDM+	Time
	150 nGy – >100 Gy, ±5% (17 R – >11 kR, ±5%)	150 nGy/s – 350 mGy/s, ±5% (1.0 mR/min – 2.4 kR/min, ±5%)	80 nGy - >100 Gy, ±5% (9.1 uR - >11 kR, ±5%)	80 nGy/s - 150 mGy/s ±5% (0.55 mR/min - 1.0 kR/min, ±5%)	1 ms – 300 s ± 0.1% + 0.2 ms

Reference condition: 12 ° Tungsten anode

Appendix C

Nugget - Accu-Gold wireless adapter

The Accu-Gold Nugget provides a wireless connection between the Accu-Gold measurement system and the display device or computer. It contains a micro-computer that relays information via Wi-Fi to the desktop or tablet running the Accu-Gold software. It uses a built-in Lithium-ion polymer battery with battery management circuitry that maintains the life of the battery by carefully controlling the charging while monitoring its temperature and voltage.

	Radcal Part Number
Accu-Gold Nugget	MDL/AGNUGGET
Charger (5V, 2.0A)	PRS/PSA10F-050
AC power supply blades (US) or	(built in)
AC power supply blades (international kit)	PRS/PSA10F-Q(D)
Flash drive with the latest Accu-Gold software	MDL/AG2SW

Operating system - Windows 7, 8, 10 (Windows XP not supported)

Accu-Gold V2 or greater software required (Version 1 is not supported).

(Note: Accu-Gold Excel and Accu-Gold Excel Templates are not supported)

Power Switch Status	Meaning
Solid Green	Power On
Blinking Green	Low Battery (~25% remaining)
Blinking Yellow	Battery Charging
Solid Yellow	Battery Fully Charged
Long on-off pause (4 sec)	Battery Error

Wi-Fi Status	Meaning
Orange	Starting
Blinking Green	Wi-Fi Ready
Red	Error

Additional indications:

Fast blinking orange is used to indicate firmware update has been completed.

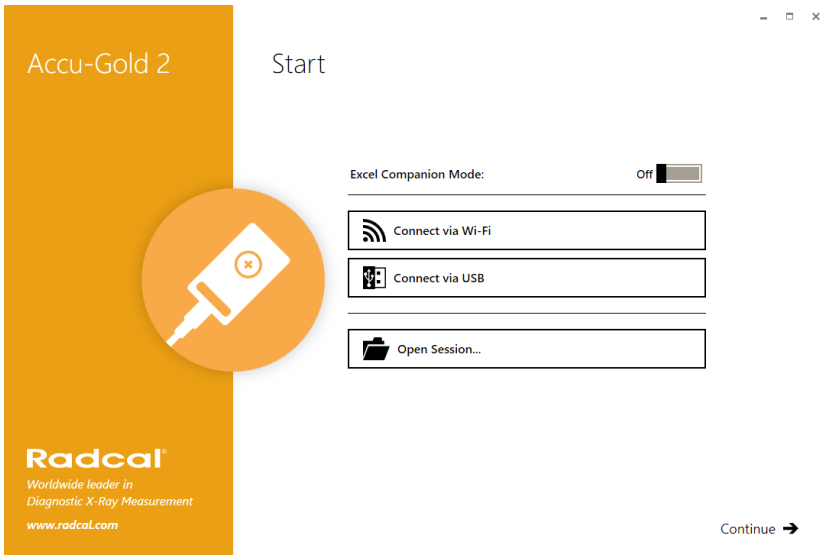
For information on installing the software, see Appendix A.

Snap the Nugget onto the digitizer module:

Align the USB connectors and slide the Nugget all the way in. (To remove it, pull out the connector first then unsnap it by tilting it upward or sliding it off the end of the digitizer.)

Plug in a multi-sensor, ion chamber or dose diode.

Press the power button on the Nugget. The power button will turn green. (If the charger is plugged in, it will blink yellow.) The Wi-Fi status light will turn on displaying green and then orange. When it blinks green, it is ready to connect.



Start the Accu-Gold 2 software.

Click on **Connect via Wi-Fi**. The software will detect the presence of the Nugget and connect to it automatically.

You are now ready to start.

Note that not all sensors, measurements and modes of the Accu-Gold software are available when using the Nugget. See Appendix C and *Nugget Measurement Feature Comparison* for a comparison list.

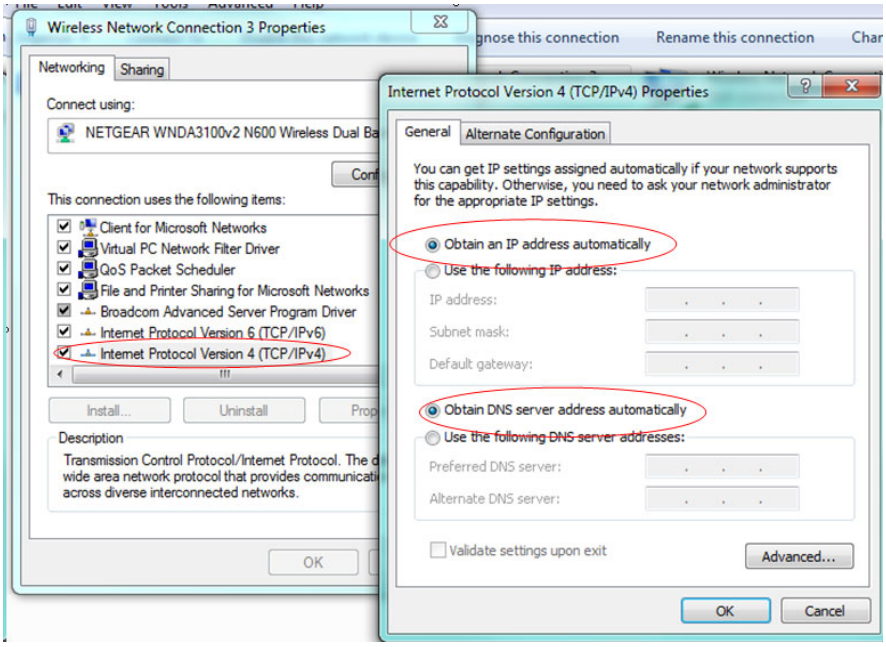
Connecting manually

If the Nugget is not able to connect automatically, you will need to connect manually. If there are multiple Nuggets that show up, you will also have to connect manually.

For Windows 10, if you get this dialog box, click on "Connect using a security key instead".

On the computer, check the Wireless Network Connection pane.

There, you will find "Nugget_51-xxxx" as one of the Wi-Fi devices (the ID number will be the Nugget_serial number). Click on the Nugget and when asked for the **password**, enter **12345678**.



NOTE: Internet Protocol Version 4 (IPv4) must <u>not</u> be set to a fixed IP address. IPv4 must be set to “Obtain an IP address automatically” and “Obtain DNS server address automatically. Contact us if any issues arise.

3.7 V Li-ion polymer 1150mAh single cell - not removable.

Battery life will depend on how it is being used. Turn off the unit when it is not being used to conserve battery life. Turning the unit back on will require the unit to re-establish the Wi-Fi connection which may take a minute or so at most.

The Nugget will go into sleep mode as much as possible. After a longer idle time, the Nugget will go into a lower power mode. After 12 minutes, if left unattended, the Nugget will power off.

The battery management circuitry prevents over-charging and over-usage. When the battery level drops to approximately 25%, the power LED will start to blink green. The battery icon on the AG2 software will indicate an approximate state of charge.

The charger that is supplied with the Nugget has been chosen to optimize the charging of the battery. The power-status light shows yellow when the charger is plugged in. Blinking yellow means that it is charging, solid yellow means that the charging is complete. The Nugget can be used while being charged and the charger may be left connected indefinitely. Typical charging time for a fully drained battery is approximately 3 hours.

If the battery has been exhausted, there will be a small delay while it charges up enough to operate.

The Nugget can be charged using other chargers or even using the USB port of a computer but the charging time may vary depending on the source and how it is recognized.

Note: firmware updates will be provided from time to time. In order to install an update, the charger and adapter supplied with the Nugget **WILL** be required.

The Nugget is capable of up to 40s of wave data for each exposure. For measurements that take up to 40s all measurement results are available - including the wave forms. For measurements that are longer than 40s, a subset of results is still available. Depending on the sensor setup, the result subset for measurement lengths beyond the wave recording capability includes dose, rate, time, average kV, filtration and HVL.

Full resolution wave data can take a lot of space. The space depends on the exposure length and the connected sensors. If you turn off automatic wave download, with every exposure, a low-resolution preview of the wave will be transmitted within Accu-Gold 2. The full resolution wave then may be transmitted on demand by the user in wave view of Accu Gold 2. The transmission can take a moment to complete.

The Nugget will keep the wave data of as many exposures as it has memory for. If that memory overflows, the oldest wave data will be discarded in order to make room for the most recent exposure wave data. Wave data is cached in the Nugget's RAM memory. When the Nugget is switched off or runs out of battery, the cached wave data is lost.

Measurements of more than 40s will not contain wave data. For such measurements, it is only numeric results that are available. The maximum duration for any measurement on the Nugget is 24 hours if on external power.

For Nugget firmware version older than version 1.4, the maximum measurement duration, with or without wave, is 20s.

Dimensions	135 mm x 62 mm x 33 mm (5.3" x 2.4" x 1.3")
Weight	0.12 kg (0.25 lbs)

Operating temperature:	15 °C to 35 °C
Pressure:	60 to105 kPa
Humidity:	Up to 80% RH or 20 g/m^3
Storage Temperature:	-20 °C to +60 °C

Network Standard Support: IEEE 802.11b/g/n

Frequency band: 2.400 - 2.472 Ghz, channels 1-11

Antenna power: <10 mW/MHz

Connectivity: Access Point mode

Wireless Security: WPA2

Networking protocol: TCP

NOTE:

This equipment shares a frequency band with a wide range of equipment: e.g. industrial, scientific, and medical equipment such as microwave ovens, premises radio stations (radio stations requiring licenses), and specified low-power radio stations (radio stations not requiring licenses), for RFID used for factory production lines as well as amateur radio stations (radio stations requiring licenses).

1. Before use, confirm that no premises radio stations and specified low-power radio stations for RFID or amateur radio stations operate in your vicinity.
2. In the event that this equipment causes harmful interference to any premises radio station for RFID, immediately halt radio wave emission and contact Customer Support for consultation on interference avoidance measures (e.g. partition installation).
3. Contact Customer Support if this equipment causes harmful interference to any specified low-power radio stations for RFID or amateur radio stations or if other problems arise.

Feature	Using Accu-Gold V2 software USB	Nugget
Support for AGDM	yes	yes
Support for AGDM+	yes	yes
10 kHz Signal Sampling	yes	yes
Support for AGMS-D Sensor	yes	yes
Support for AGMS-M Sensor	yes	yes
Support for AGMS-DM+ Sensor	yes	yes
Support for AGMS-D+ Sensor	yes	yes
Support for AGMS-M+ Sensor	yes	yes
Support for Ion Chambers	yes	yes
Support for Dose Diodes	yes	yes
Support for Light Sensor	yes	yes
Support for Current Clamp	yes	yes
Support for Current Sensor	yes	yes
Setting for End of Exposure Delay	yes	yes
Setting for Trigger Level	yes	yes
Setting for AGMS Calibration	yes	yes
Setting for IC Wave Mode	yes	yes
AGMS Corrections for Dose, HVL and kV	yes	yes
Ion Chamber Stabilization	yes	yes
Max Exposure Length (with waveform)	300 sec	40 sec[8]
Max Exposure Length (without waveform)	2.5 days	up to 2.5 hours[8]
PrePulse Detection Mode	yes	yes
FreeRun Mode	yes	yes[9]
TimeStamp for Measurement	yes	yes
Dose, Dose Rate, Time Results for AGMS, IC and DD	yes	yes
AGMS Ave kV, HVL, Filtration	yes	yes
Error Handling and Messages	yes	yes
Records all Sensor Serials	yes	yes
Support for Wave Bandwidth Filtering	yes	yes[10]
Support for Region of Interest	yes	yes[10]
Handling of legacy IC chambers	yes	yes
AGMS kVp Result	yes	yes
AGMS PPV Result	yes	yes
Max Sensor Rate Results	yes	yes
Min Sensor Rate Results	yes	not planned

[8] For Nugget firmware 1.0: Max exposure length is 20s – For version 1.4 up to 40s of exposure length with full wave data are supported. Exposure lengths of more than 40s are supported, but with a limited result set. 300 sec waveform date/ 2.5 day with out for units with 512 MB memory.

[9] Free run supported as of firmware version 1.4.

[10] Supported if full resolution wave has been downloaded.

Duty Cycle Results	yes	yes
Pulse Frequency	yes	yes
Ave Pulse Width Result	yes	yes
Max Pulse Width Result	yes	not planned
Min Pulse Width Result	yes	not planned
Dose / Pulse Result	yes	yes
Pulse Count	yes	yes
IC Temperature Result	yes	yes
IC Air Pressure Result	yes	yes
Reads temp and pressure on start	yes	yes
Updates calibrations, temp and pressure for each measurement	future	yes
Dose Ratios Results	yes	yes
Report dose without kV	yes	yes

Sensor availability comparison	**AG V2 with USB**	**AG V2 with Nugget**
AGMS multisensor	yes	yes
AGMS+ multisensor	yes	yes
Ion Chamber	yes	yes
Dose Diode	yes	yes
mAs sensor	yes	yes
Light Sensor	yes	yes

Turn off the Nugget.

NOTE: If the battery is exhausted, charge it for at least ten minutes before attempting a firmware update.

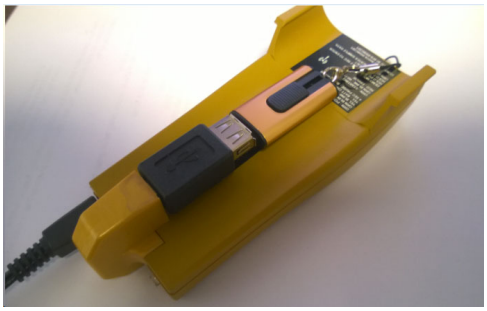
Required Equipment: **DO NOT SUBSTITUTE!**

PRS/PSA10F-050 CHARGER, 5VDC, 1.8A USB MICRO

CBL/USB-AF2MBF ADAPTER, USB A FEM TO MINI B FEM

Flash drive with new Nugget firmware

Assemble as shown:



Flip it over and observe the WiFi light.

Press the power-on button of the Nugget. The Wi-Fi light will come on GRN then ORN. When it starts blinking orange quickly, the update is complete. Unplug the flash drive, press the Nugget power button to turn it off and then back on again. It is now ready to use.

EU (ETSI):

This device is intended for home and office use in all EU countries (and other countries following the EU directive 1999/5/EC).

FCC:

Contains FCC ID: XF6-RSWC201

This device complies with the Part 15 of the FCC Rules.

(1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC RF Radiation Exposure Statement:

This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This device and its antenna must not be co-located or operating in conjunction with any other antenna or transmitter. To comply with FCC RF exposure compliance requirements, this grant is applicable to only Mobile Configurations. The antennas used for this transmitter must be

installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

Industry Canada Statement:

Contains: IC: 8407A-RSWC201

This device complies with RSS-210 of the Industry Canada Rules.

Japan (Telec)

Contains: Telec Construction Certification Number 001-A13582.

The Wi-Fi module used by the Nugget has been certified for use in Japan.

(1) “2.4”: Represents radio equipment using the 2.4 GHz band.

(2) “DS/OF”: Represents modulation system (refer to Section 2.4.1 for details[11]).

(3) “4”: Represents estimated interference-causing radius to premises radio stations for RFID (refer to Section 2.4.2 for details[1]).

(4) “▬ ▬ ▬”: Indicates that the equipment can use the entire band and is capable of avoiding the band used by RFID systems (refer to Section 2.4.3 for details[2]).

China PRC (CMIIT)

The equipment contains the RF modules of which Type Approval code is CMIIT ID: 2014DJ6439

[11]SECOND GENERATION LOW POWER DATA COMMUNICATION SYSTEM/WIRELESS LAN SYSTEM ARIB STD-T66

Appendix D

Accu-Gold Touch

The Accu-Gold Touch USB mode and WiFi mode mimic the computer connected digitizer and WiFi connected Nugget operation.

The regulatory specifications of the Nugget apply to the Touch.

Measurements exported from the Accu-Gold Touch can be read by Accu_Gold 2 Version 2.46 and on. All functions for displaying and manipulating measurement session data are available for the Touch measurement sessions. (Waveforms are not exported.)

The latest software is always available on the web at www.r_____.

Charger (5V, 2.0A)	PRS/PSA10F-050
AC power supply blades (US) or	(built in)
AC power supply blades (international kit)	PRS/PSA10F-Q(D)

Appendix E

Accu-Gold measurements and Feature comparison

The following are measurements that can be assigned to any cell when creating custom profiles. These are grouped by the measurement source. Note that not all measurements are available when using the Nugget or Touch WiFi mode.

	USB Cable/ AGT Pro	Nugget/ Touch WiFi	Definition
Digitizer			
Air Pressure	yes	yes	The atmospheric corrections compensate for the effects of variations in the current temperature (T in C) and pressure (P in kPa) on an unsealed ion chamber and uses the following equation: Displayed value = (101.3/P) * ((T + 273.15)/295.15) * Instrument value
Ave. Pulse Duration	yes	yes	Average duration of pulses.
Duration	yes	yes	Exposure duration from start to stop trigger. If pre-pulse detection was activated, duration is the duration of the main signal without pre-pulse.
Pre-Pulse Detected	yes	no	True if pre-pulse detection was active and pre-pulse signal was detected.
Pre-Pulse Duration	yes	no	Duration from detection of pre-pulse start to main signal start.
Pulse Count	yes	yes	Measurement pulse count.
Pulse Duty Cycle	yes	yes	Pulse duty cycle.
Pulse Frequency	yes	yes	Pulse frequency
Pulse Rep. Period	yes	no	Measurement pulse repetition period.
Total Duration	yes	no	Exposure duration from start to stop trigger, ignores pre-pulse detection.
Trigger Level	yes	yes	Trigger level used for this measurement.
Trigger Sensor	yes	yes	Sensor that was trigger.
Typical Pulse Count	yes	no	Measurement pulse count ignoring scout pulse.
Multi-Sensor			
Anode	yes	yes	Tube anode setting used for this measurement.
Average kV	yes	yes	Average kV is derived from the ratios of the outputs of diodes in the multi-sensor, where these averages use the entire region of interest.
Biased Average kV	yes	no	The average value of kV in the region of interest above an adaptive kV threshold.
Calibration Description	yes	yes	The name of the calibration and correction that was used for making the measurement. e.g. "Diagnostic", "Standard", "Mo Mo", "Mo Mo GE" etc.
Dose	yes	yes	Dose Integral
Dose / mAs	yes	no	Dose / mAs
Dose / Pulse	yes	yes	Dose / Pulse

Dose / Total Dose	yes	no	Ratio of the measurements of extracted dose to total dose.
Dose Rate	yes	yes	Dose Rate
Dose Ratio AGMS / DD	yes	yes	Multi-sensor dose divided by dose-diode dose.
Dose Ratio AGMS / IC	yes	yes	Multi-sensor dose divided by ion-chamber dose
End Average kV	Yes	Yes	END is useful for capturing the radiation values at the end of an exposure. For exposures longer than 100 ms, and less than 1 second, END captures the last 15% of the exposure. For exposures longer than 1 second, END captures the last 1 second. End ignores the he last 5 ms when calculating the values. END results are available for: AGMS (avg. kV, filtration, HVL, dose rate) IC (dose rate) DApCheck+ (dose rate)
End Dose Rate	Yes	Yes	
End Filtration	Yes	Yes	
End HVL	Yes	Yes	
Filter	yes	yes	Tube filter setting used for this measurement.
Filtration	yes	yes	Measured beam-filtration thickness.
HVL	yes	yes	Half value layer result.
kV Duration	yes	no	Width of the kV signal
kV Peak Ripple Frequency	yes	no	The frequency of the largest ripple component in the spectrum from the Fourier Transform.
kV Pulse Repetition Frequency	yes	no	Pulse-repetition frequency as calculated from the kV wave in the region of interest with synchronization to pulse edges when possible.
kV RMS Noise	yes	no	Root-mean-square of the noise and ripple in the kV values above the adaptive threshold used in the calculation of kVp.
kV Zero to Peak Ripple	yes	no	Zero-to-peak amplitude of the largest ripple component in the spectrum from the Fourier Transform.
kVp	yes	yes	Average peak voltage
PPV	yes	no	The Practical (PPV) mode computes a weighted average of the kV waveform in the region of interest, with weighting toward higher-kV values, employing the algorithm of Kramer, Selbach and Iles.
Total Dose	yes	yes	Total dose of source measurement.
Ion Chamber			
Dose	yes	yes	Dose Integral
Dose / mAs	yes	no	Dose / mAs
Dose / Pulse	yes	yes	Dose / Pulse
Dose / Total Dose	yes	yes	Ratio of the measurements of extracted dose to total dose.
Dose Rate	yes	yes	Dose Rate
Dose Ratio IC / AGMS	yes	yes	Dose Ratio IC / AGMS
Dose Ratio IC / DD	yes	yes	Dose Ratio IC / DD
End Dose Rate	Yes	Yes	(see END for AGMS)
Temperature	yes	yes	Temperature measured by ion chamber.
Total Dose	yes	yes	Total dose of source measurement.
Dose Diode			
Dose	yes	yes	Dose Integral
Dose / mAs	yes	no	Dose / mAs
Dose / Pulse	yes	yes	Dose / Pulse

Dose / Total Dose	yes	yes	Ratio of the measurements of extracted dose to total dose.
Dose Rate	yes	yes	Dose Rate
Dose Ratio DD / AGMS	yes	yes	Dose Ratio DD / AGMS
Dose Ratio DD / IC	yes	yes	Dose Ratio DD / IC
Total Dose	yes	yes	Total dose of source measurement.
DAP Chamber			
DAP	yes	yes	Dose Are Product
DAP Rate	yes	yes	DAP Rate
DAP/Pulse	yes	yes	DAP per pulse
DAP Temperature	yes	yes	Temperature of the DAP sensor
DAPChkp+			
DAP	yes	yes	Dose area product
DAP Rate	yes	yes	DAP rate
Temperature	yes	yes	Temperature of the DAP sensor
DAP End Rate	yes	yes	(see END for AGMS)
mA Sensor			
Charge	yes	yes	The sum of mA values during the region of interest is the value of mAs.
Current	yes	yes	Average mA is mAs divided by the width of the region of interest.
Light Sensor			
Illuminance	yes	yes	Measured illuminance
Luminance	yes	yes	Measured luminance with luminance adapter

Appendix F

Quiet-Bias Technology

The ion chamber brings reliability and versatility to the radiation protection industry and has been the gold standard for decades. Originally, Radcal developed a unique filter making ion chambers that were robust to electromagnetic interference.

Through a second major innovation, Radcal was able to provide high fidelity waveforms (time-dependent representations of the dose rate signal) as measured by the ion chamber. Visualization of the waveform provides unparalleled quality assurance and failure mode identification for today's x-ray imaging systems.

Unfortunately, achieving the rapid time response necessary to produce useful waveforms compromised some of the electromagnetic interference robustness of prior instruments. In particular, triggering for very low dose rate measurements became challenging in the presence of high levels of electromagnetic noise. Special grounding accessories partially mitigated this effect, but were often inconvenient.

Radcal is excited to announce that research and development efforts have yielded a new ion chamber technology, the "Quiet Bias". A specially designed electronic circuit filters the bias voltage supply eliminating noise that would have appeared in the output signal.

Quiet-Bias technology is now incorporated into the current generation of Accu-Gold+ Digitizers and Accu-Gold+ Touch systems. Additionally, it can be provided as a retrofit to any Accu-Gold+ instrument at no cost during regular service and calibration. Note: Quiet Bias is only compatible with the Accu-Gold+ family systems.

Quiet-Bias Technology eliminates the need to use grounding accessories and for this reason Radcal will discontinue the practice of sending grounding kits with each unit unless specifically requested.

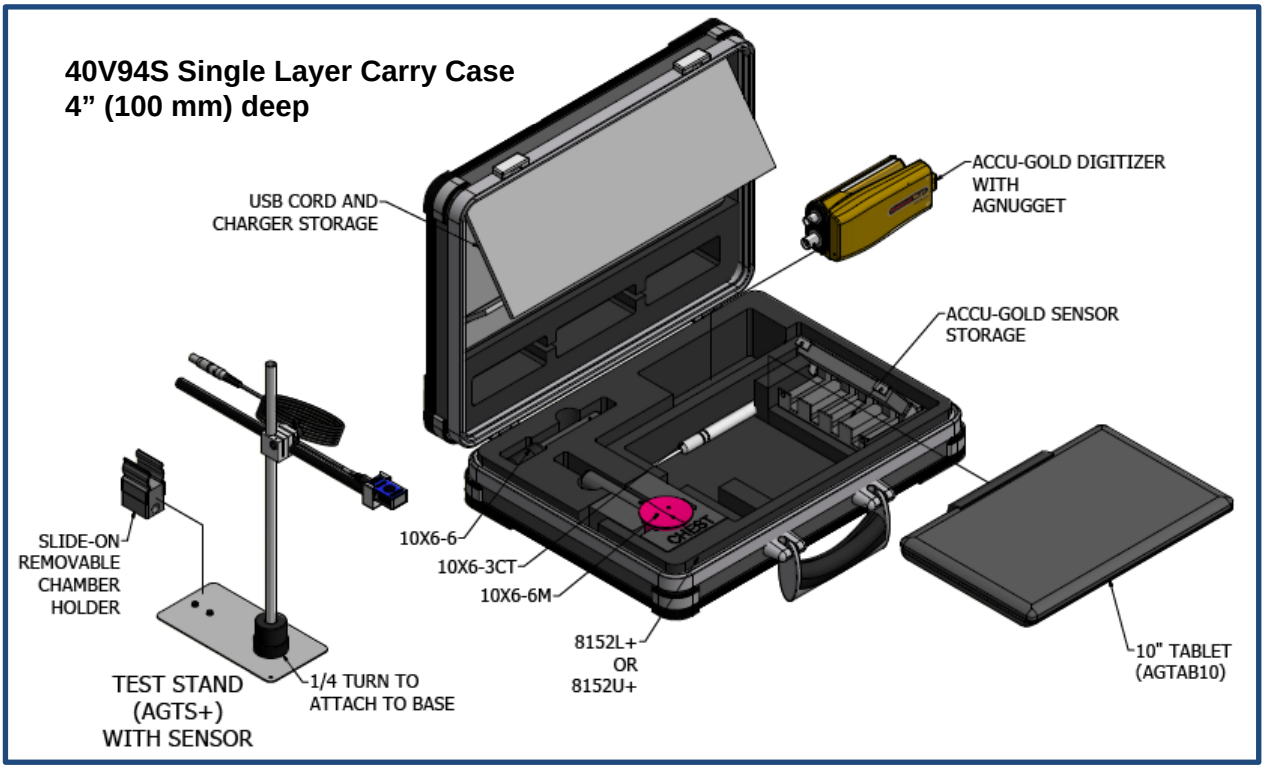
Appendix G

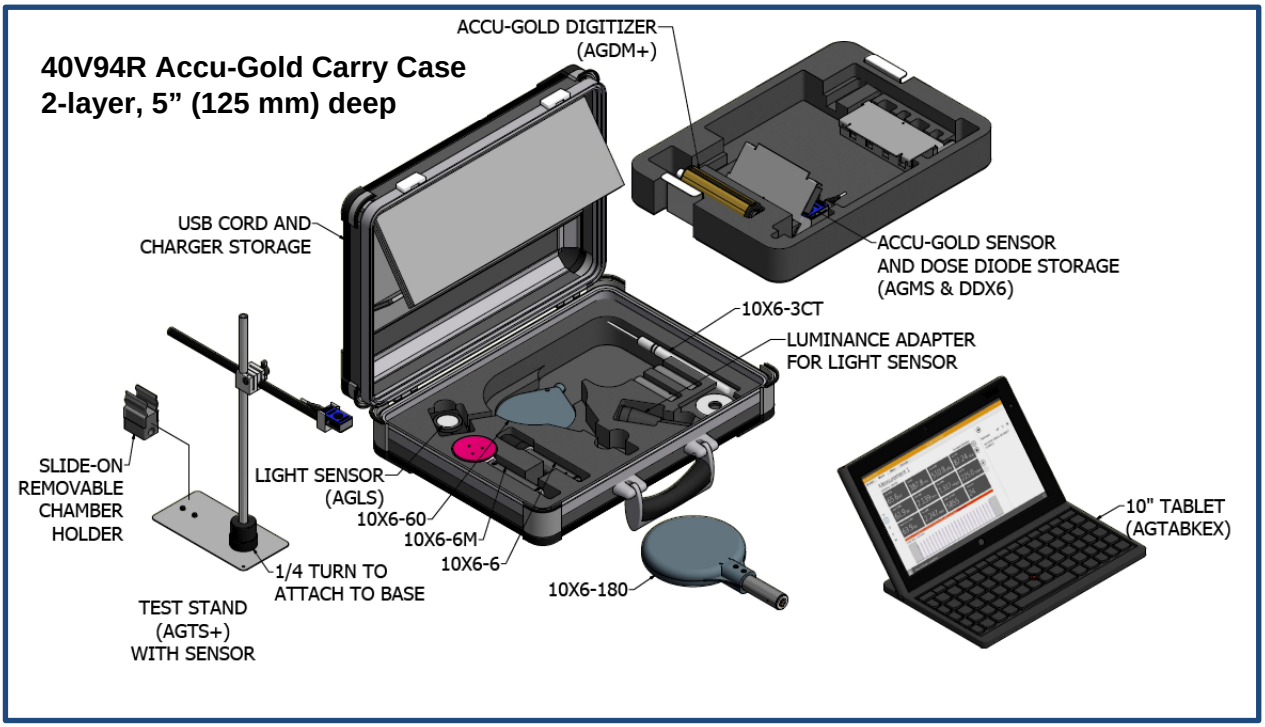
Carrying cases – Accu-Gold

Soft Cases –

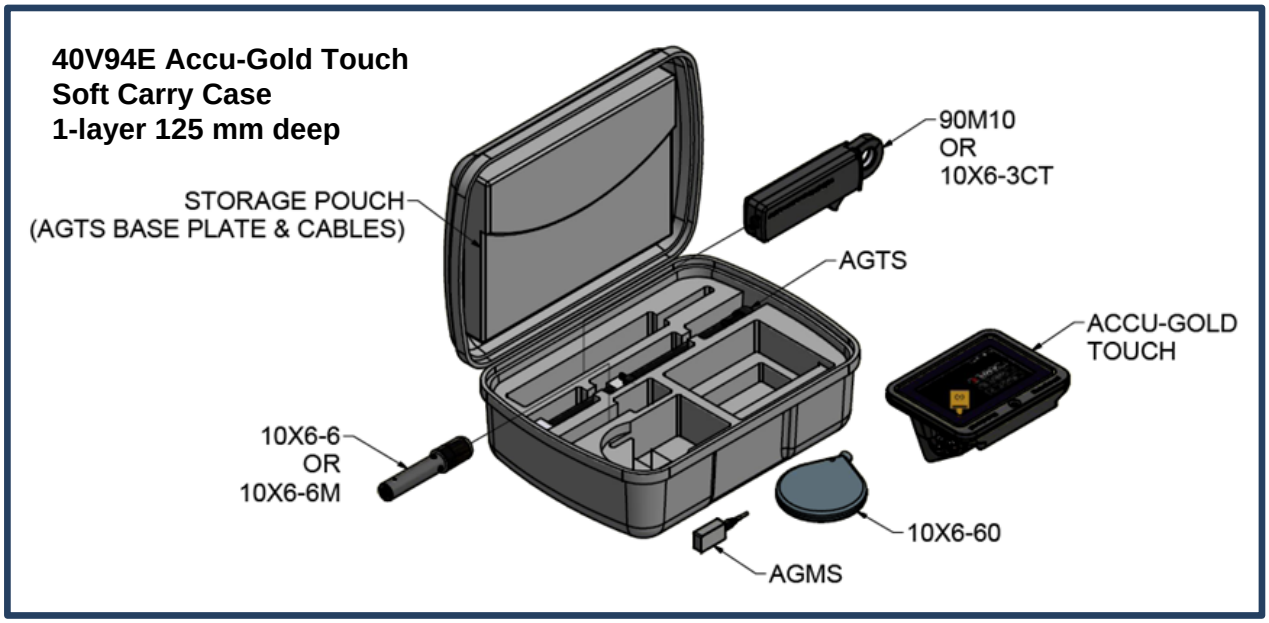
Model AGSC

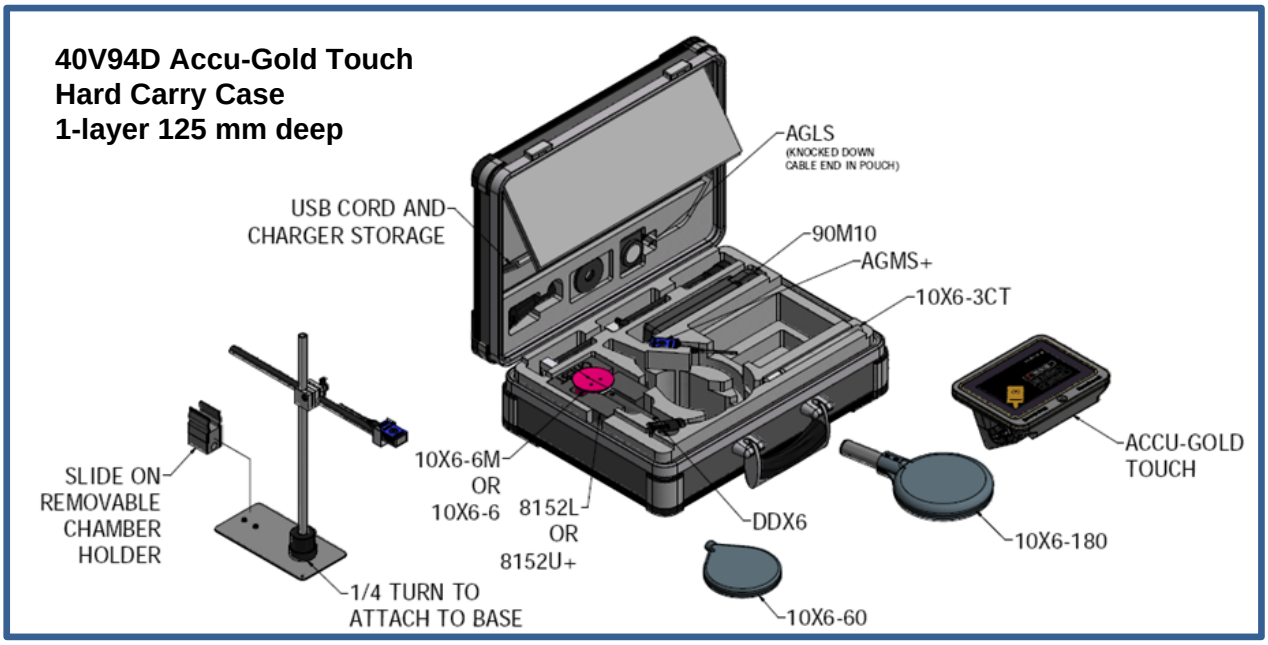
Hard Cases:

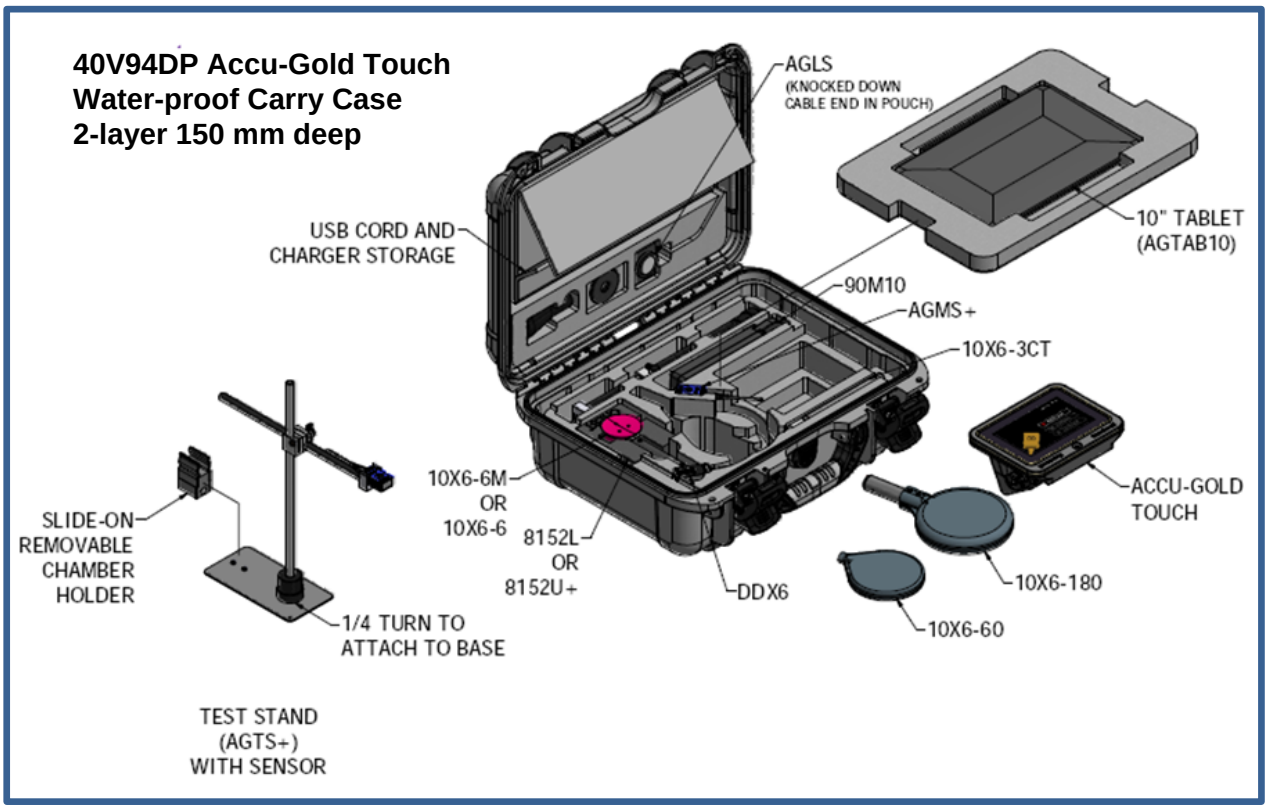

40V94S Single Layer Carry Case
4” (100 mm) deep
USB CORD AND
CHARGER STORAGE
ACCU-GOLD DIGITIZER
WITH
AGNUGGET
ACCU-GOLD SENSOR
STORAGE
SLIDE-ON
REMOVABLE
CHAMBER
HOLDER
10X6-6
10X6-3CT
10X6-6M
8152L+
OR
8152U+
10" TABLET
(AGTAB10)
TEST STAND
(AGTS+)
WITH SENSOR
1/4 TURN TO
ATTACH TO BASE


40V94R Accu-Gold Carry Case
2-layer, 5” (125 mm) deep
ACCU-GOLD DIGITIZER
(AGDM+)
USB CORD AND
CHARGER STORAGE
ACCU-GOLD SENSOR
AND DOSE DIODE STORAGE
(AGMS & DDX6)
10X6-3CT
LUMINANCE ADAPTER
FOR LIGHT SENSOR
SLIDE-ON
REMOVABLE
CHAMBER
HOLDER
LIGHT SENSOR
(AGLS)
10X6-60
10X6-6M
10X6-6
10X6-180
10" TABLET
(AGTABKEX)
1/4 TURN TO
ATTACH TO BASE
TEST STAND
(AGTS+)
WITH SENSOR

Carrying cases – Accu-Gold Touch




40V94D Accu-Gold Touch
Hard Carry Case
1-layer 125 mm deep
AGLS
(KNOCKED DOWN
CABLE END IN POUCH)
USB CORD AND
CHARGER STORAGE
90M10
AGMS+
10X6-3CT
ACCU-GOLD
TOUCH
SLIDE ON
REMOVABLE
CHAMBER
HOLDER
10X6-6M
OR
10X6-6
8152L
OR
8152U+
DDX6
10X6-180
1/4 TURN TO
ATTACH TO BASE
10X6-60

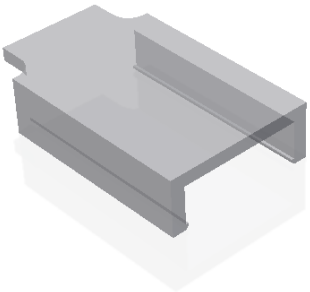

40V94DP Accu-Gold Touch
Water-proof Carry Case
2-layer 150 mm deep
AGLS
(KNOCKED DOWN
CABLE END IN POUCH)
10" TABLET
(AGTAB10)
USB CORD AND
CHARGER STORAGE
90M10
AGMS+
10X6-3CT
ACCU-GOLD
TOUCH
SLIDE-ON
REMOVABLE
CHAMBER
HOLDER
10X6-6M
OR
10X6-6
8152L
OR
8152U+
DDX6
10X6-180
10X6-60
1/4 TURN TO
ATTACH TO BASE
TEST STAND
(AGTS+)
WITH SENSOR

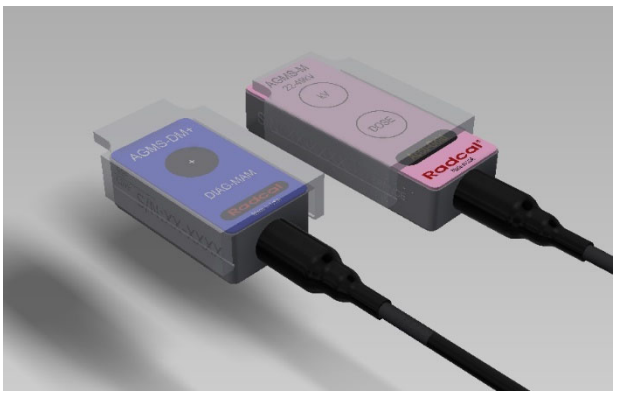
Appendix H

Accessories ----

Note for Mammography Sensor users.

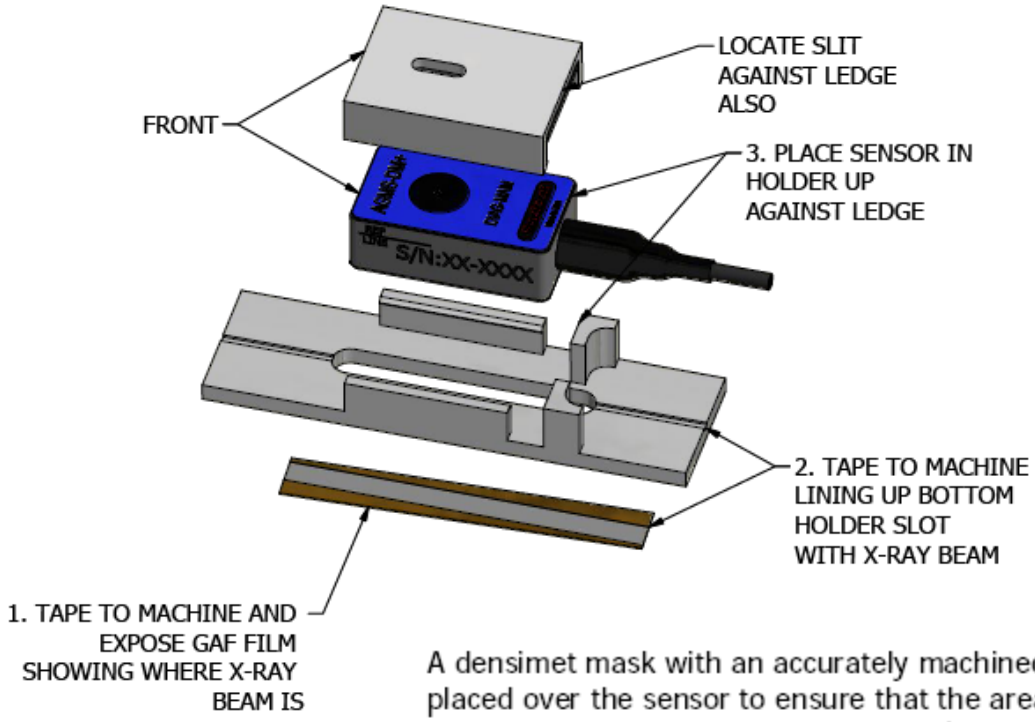
The Mammographic Sensors, models RAPD-M, AGMS-M, AGMS-DM+ and AGMS-M+ are calibrated using a 2.2 mm thick polycarbonate compression paddle placed in beam for all measurements (kVp, dose, hvl). If you are making measurements where it is not practical to use the machine's paddle in beam, use this 2.2 mm polycarbonate plate (Model 8154 - Simulated Paddle) on top of the sensor during your measurements.





The Model 8463D Pan-Dental Positioner has been designed to facilitate attaching and reliably positioning an AGMS-D+ or –DM+ multisensor on many types of panoramic dental systems.

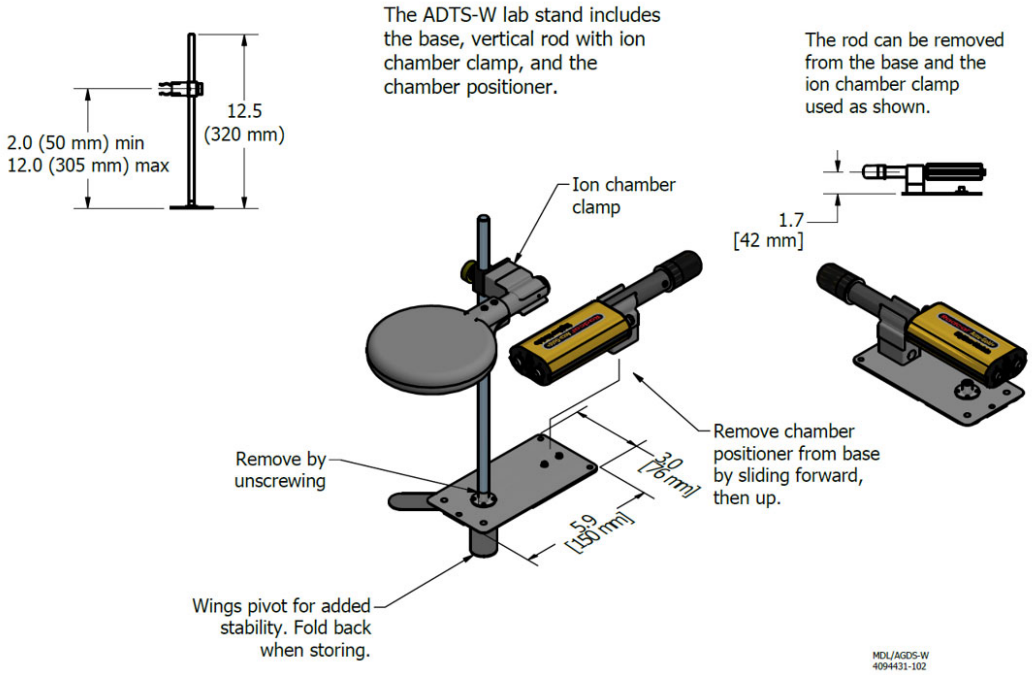
Using the Accu-Gold 2 software, a correct dose measurement can be obtained.



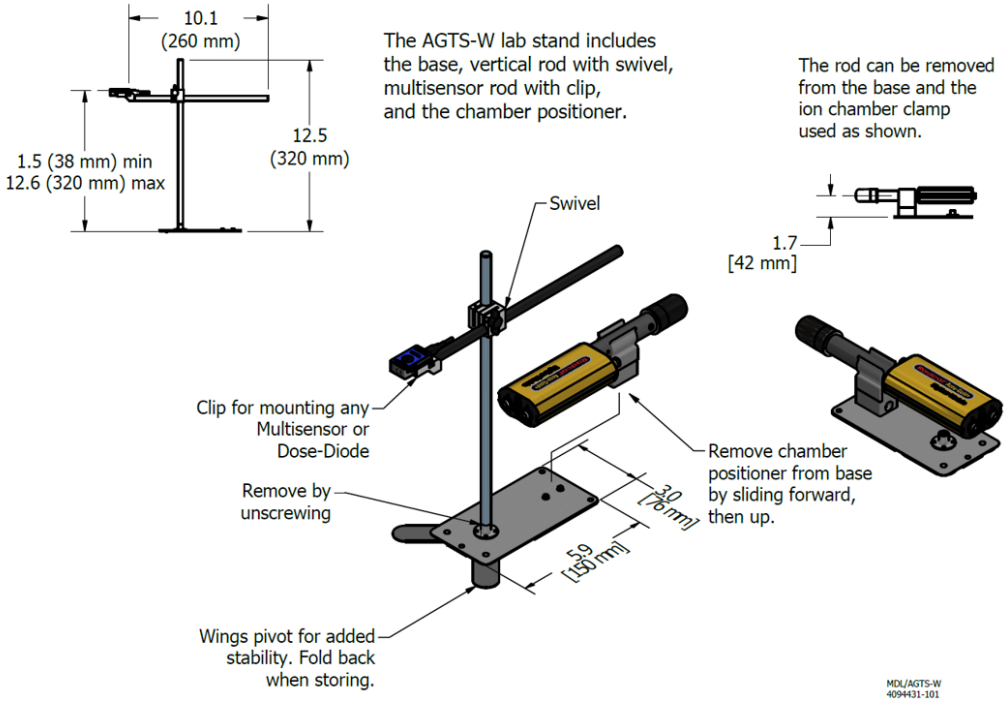
A densimet mask with an accurately machined slit is placed over the sensor to ensure that the area exposed is known. Lining up the slot of the base with the location of the beam as determined by the Gafchromic film, ensures that the slit for the sensor is within the beam. Angular alignment is easy since the exposed area defined by the slot is short which allows for larger angular misalignment. A correction based on the known area of the slit versus an entirely exposed detector, is then applied to the reading. Measurement accuracy is ±5%.

Test Stands and Positioners –

ADTS-W – Accu-Dose Test Stand



AGTS-W – Accu-Gold Test Stand



Appendix I - Warranties and Disclosures

Warranty for the Accu-Gold Measurement System

Radcal Corporation warrants that, in the event that any defects in material or workmanship should develop within one year of the date of shipment, the company assumes full responsibility for servicing equipment of its manufacture without charge upon return of the equipment to Radcal, with shipping costs prepaid by the customer. Costs to return-ship to customer by ground transportation will be paid by Radcal if the repairs are warranty-applicable. This warranty excludes batteries.

Radcal shall not be held liable for damages or delays caused by defects beyond making repairs or furnishing replacement parts, nor shall Radcal be liable for any defective material replaced without Radcal's consent during the period of this warranty. Radcal reserves the right to perform warranty services at its own factory.

Non-Warranty Repairs

The calibration of this instrument was correct within specified limits when the instrument left our factory. Radcal cannot be responsible for injury or damage resulting from improper use or calibration errors which develop subsequent to our shipment of the instrument.

If Radcal determines that a fault has been caused by misuse, abnormal operating conditions, or repairs by unauthorized personnel during the warranty period, repairs and shipping costs will be billed at normal rates.

If the equipment is found to be in proper working condition, Radcal will return-ship the equipment at customer expense.

Data Loss

Although we take great effort to save your data, the customer is responsible for backing up any and all data that is stored on their computers prior to being serviced.

WEEE and RoHS

Accu-Gold meets the requirements of the . Radcal has implemented full compliance. Recycling manuals are available on request.

Accu-Gold/Rapid-Gold/Accu-Dose+ meets the requirements of the EU-RoHS directive for RoHS 3, *The Restriction of the Use of Certain Hazardous Substances (RoHS) in Electrical and Electronic Equipment Directive* (EU Directive 2015/863) *.*

The Accu-Gold/Rapid-Gold/Accu-Dose+ comply with China's requirements for RoHS Marking and EFUP pursuant to 6.2 of .

The Accu-Gold/Rapid-Gold/Accu-Dose+ comply with the requirements of the . The aforementioned Radcal products do not contain added substances above 0.1% weight of Substance of Very High Concern (SVHC) listed in the Annex XVII as of June 27th, 2018.

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EU Declaration of Conformity

Manufacturer's Name: Radcal Corporation
Manufacturer's Address: 426 West Duarte Road
Monrovia, CA 91016
U.S.A.

Product Name: Accu-Gold, Rapid-Gold, Accu-Dyn
Model Number(s): AGDM+, RGDM+MA, ADDM+, AGDN+
Product Accessories: All

Is in conformity with the provisions of the following CE directives:

- 2014/30/EU Electromagnetic Compatibility (EMC) Directive
- 2014/35/EU Low Voltage Directive (LVD)
- 2011/65/EU The Restriction of the Use of Certain Hazardous Substances (RoHS) in Electrical and Electronic Equipment Directive

Conforms to the following Product Specification:
EMC:
EN 61326-1 (2013) Group 1 Class B

PERFORMANCE:
IEC 61674
IEC 61676

E. MacIntosh
Technical Manager
28 Oct 2020

UK Declaration of Conformity

Manufacturer's Name: Radcal Corporation
Manufacturer's Address: 426 West Duarte Road
Monrovia, CA 91016
U.S.A.

Product Name: Accu-Gold, Rapid-Gold, Accu-Dyn
Model Number(s): AGDM+, RGDM+MA, ADDM+, AGDN+
Product Accessories: AGMS-x, 10X6-x, 90Mx, DDX6-WL

Is in conformity with the provisions of the following UK directives:

- Electromagnetic Compatibility Regulations 2016
- Electrical Equipment (Safety) Regulations 2016
- The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

Conforms to the following Product Specification:
EMC:
S.I. 2016 No. 1091 Group 1 Class B

PERFORMANCE:
IEC 61674
IEC 61676

E. MacIntosh
Technical Manager
23 Apr 2021