ACCU-GOLD

USER GUIDE

(FOR USE WITH ACCU-GOLD AND ACCU-GOLD+ DIGITIZERS)

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 (see page 22). You should save session files because they are most useful when reporting bugs. You must have a license/calibration file and is included with the shipment. Please contact Customer Support if you need one for your multi-sensor.

For more in-depth information or troubleshooting, contact Customer Support at (626) 357-7921 x 123 or email Cust_Sup@Radcal.com

Computer System Minimum Requirements

The specified performance requires a computer with the following minimum specifications:
Operating system:
- Windows XP (SP3 or greater)
- Windows Vista (32-bit)
- Windows Vista (64-bit)
- Windows 7 (32-bit)
- Windows 7 (64-bit)

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.

See Appendix A for software installation.

Getting Started

This section includes an overview of the Accu-Gold hardware and the main screen for the software. It also includes instructions for how to take a measurement so that you can begin using the Accu-Gold system.

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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 sensors(s).

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		
RGDM+MA	Rapid-Gold Digitizer Module w/mA		X	X		X
ADDM+	Accu-Dose Digitizer Module	X	X			

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

Sensors – see appendix B

Main Screen Overview
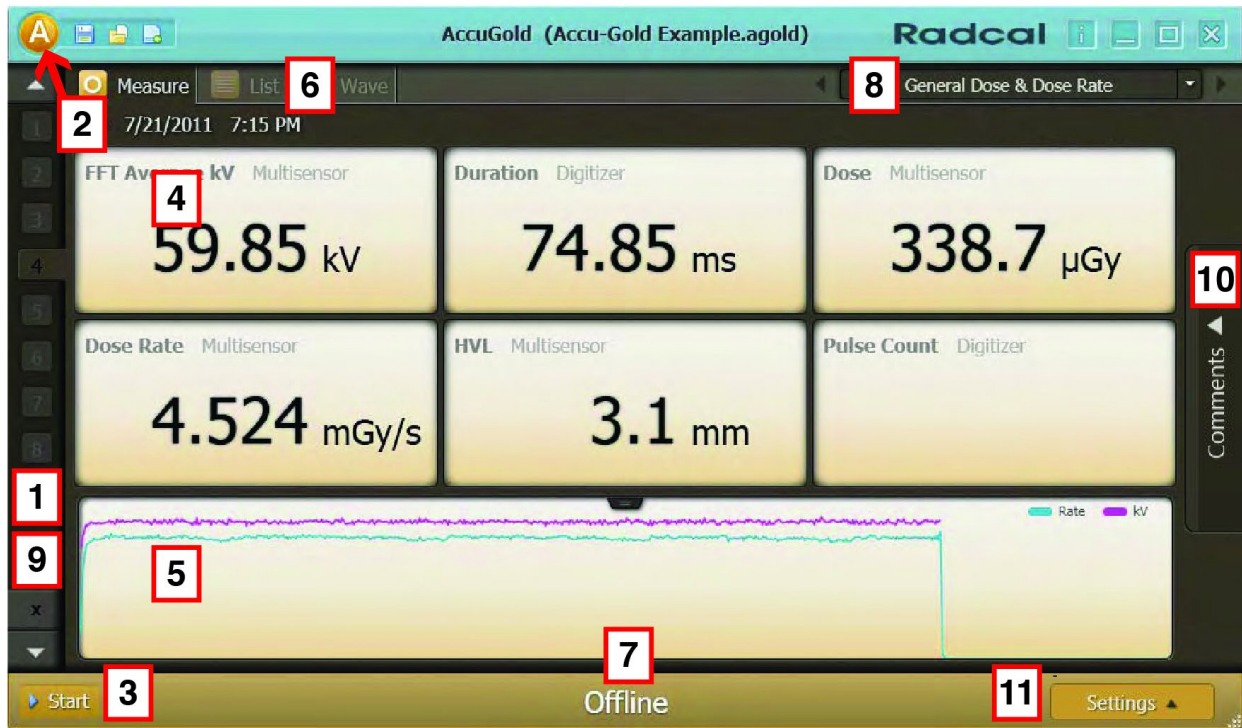
1 – Lists all readings/captures taken within the same session. You can scroll through each capture using the up and down arrows

2 – Allows you to access the [A]ctivities drop-down menu

3 – Click the **Start/Stop** button to begin or end a measurement series.

4 – Displays details of the information captured from the sensor (s) based upon the selected profile

5 – Displays a wave representation of the information captured

6 – Measure, List, and Wave tabs that allow you to view information in more detail

7 – Indicates if the system is ready to take a measurement. Other system status messages occur here depending on sensor and digitizer conditions.

8 – Drop-down menu with all available profiles. You can select different profiles to match your need.

9 – Delete measurement.

10- The Comments pane can be used to copy, cut and paste commands. 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 and users.

11   - Allows you to change settings. The available settings are:

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Trigger Source - The upper row of the selection area is populated by the sensors that are connected (MS, IC and/or DD). If multiple sensors are connected, the user can chose which sensor to use as a trigger. The above example features a Multi-sensor and Ion Chamber, with the Multi-sensor selected for triggering.

Trigger Level –

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[1]. If noise or false triggers prevent reliable ion chamber measurements and grounding the system has not improved the experience, connect the Multi-sensor and locate it somewhere in the radiation beam so that it can serve as a trigger source. The screen capture below shows such an example. The dark blue waveform is from a Radcal 10X6-6 ion chamber. The pulses are 25 ms wide from a Hologic Selenia Dimensions in tomosynthesis mode. The multi-sensor was not calibrated for this beam, but was used as a trigger source.

High – Select if Std causes false triggering.

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[1] 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).

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

IC Wave Mode – On – This function is only available once the system has been started and is ready to measure. IC gives 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) since it suppresses the noise. This of course makes the waveforms very distorted, but much lower IC dose and dose rates can be measured.

AGMS Pre Pulse Mode - 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. 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.

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Setting up the Hardware

To set up the Accu-Gold hardware

1. Connect the multi-sensor to the digitizer. Connect the USB cable to the digitizer and then the computer.

2. Position the sensor to make a measurement.
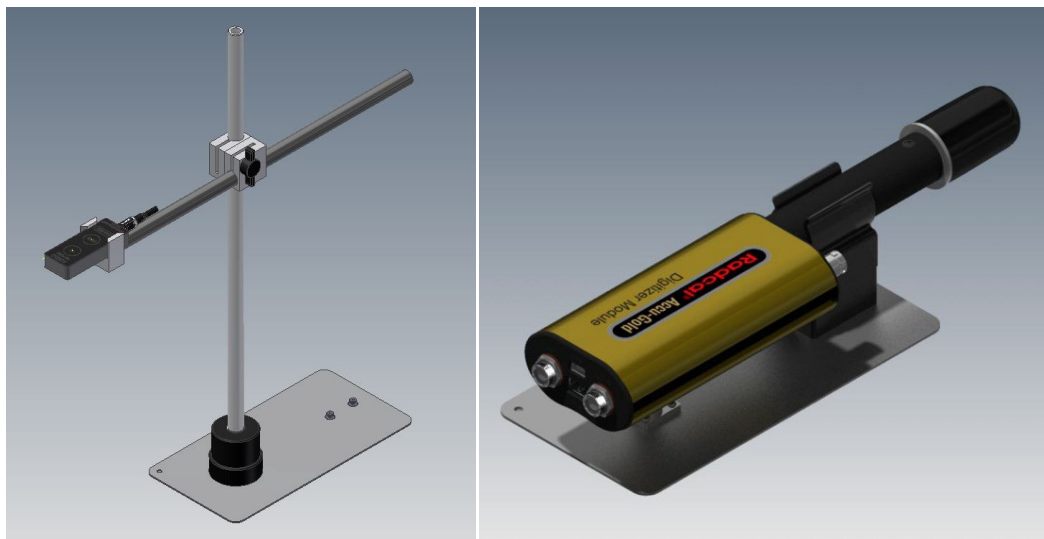
Note: Position the sensor before clicking the **Start/Stop** button; moving the sensor or cable after clicking the **Start/Stop** button may trigger a false measurement.

Taking a Measurement

Note: You can take a measurement in Measure, List, and Display modes.

To take a measurement:

1. Plug the sensor(s) into the Accu-Gold Digitizer Module.

2. Plug the Accu-Gold 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. The Accu-Gold screen appears and indicates that the sensor is offline.

5. To bring the sensor online and connect with the Accu-Gold software, click **Start**.

   Note: The **Comments** button along the right side of the screen is currently disabled. It will be enabled in a future release.
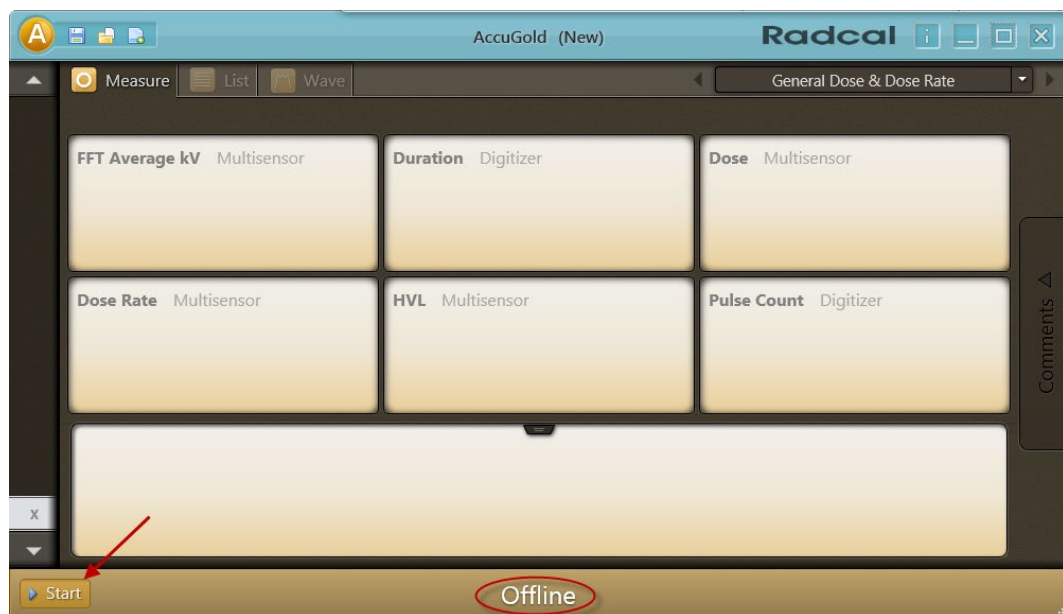
The software begins to connect to the digitizer, as indicated by the status at the bottom of the screen:

The software then begins to initialize the digitizer:

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6. 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 take a measurement.

    Note: All measurements are automatic (except for Free Trigger Level) until you press the **Stop** button.
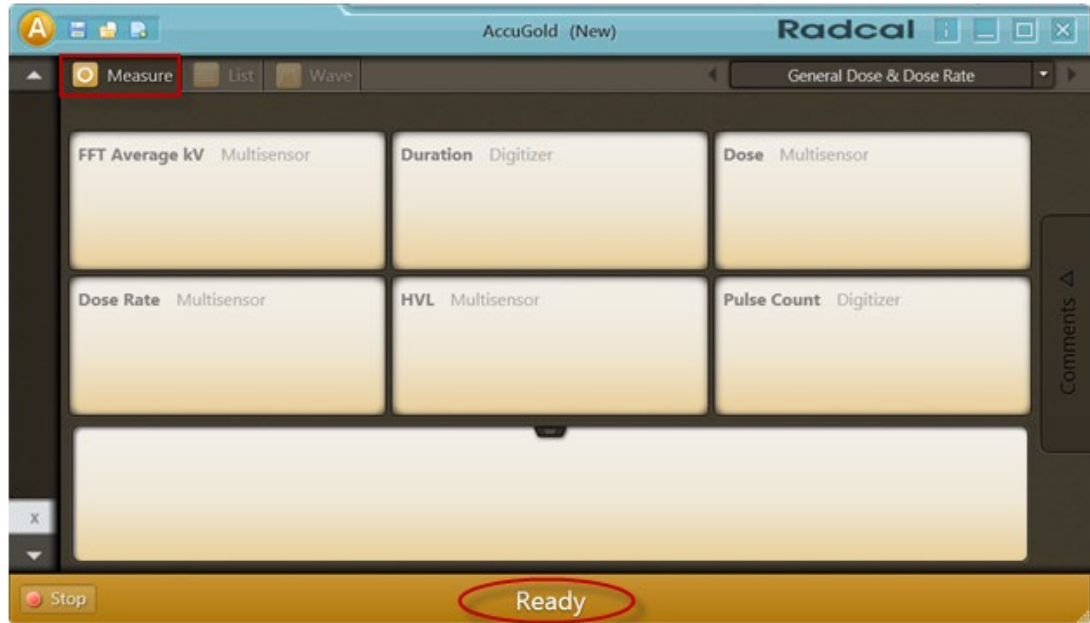
7. Activate the X-ray machine to capture the exposure data

    Accu-Gold automatically displays all data for the measurement when the exposure is complete:
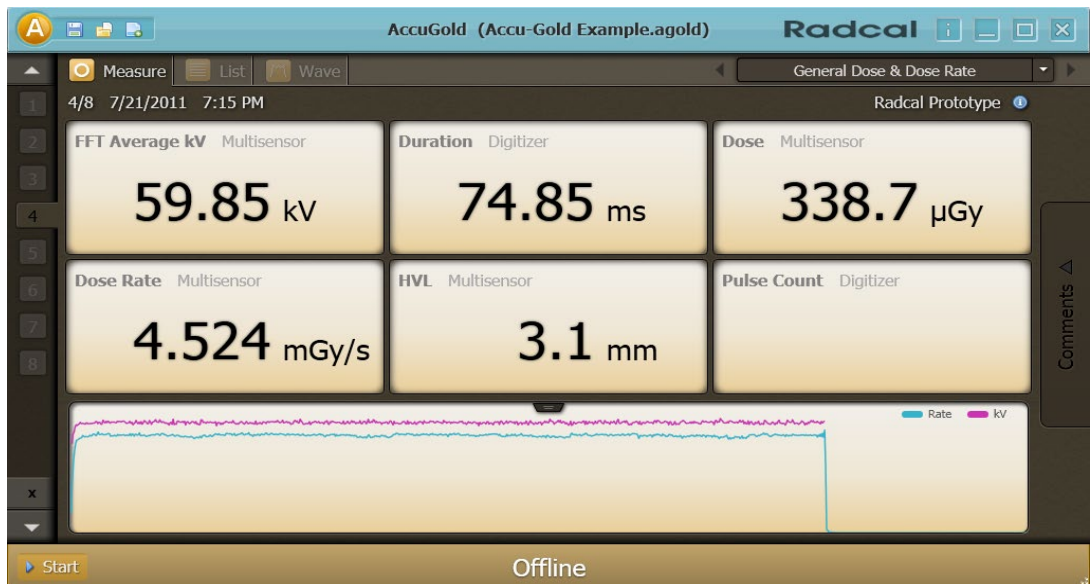
8. Make additional exposures as necessary. No data will be lost and you can review the previous measurements by clicking the **Up** and **Down** arrow buttons on the left side of the Measure screen.

9. Click the drop-down menu and choose **Save Session As** to save your new session. This will save all of the data, including full wave forms, for later review and editing.

New Session
Open Session...
Import Session ...

Save Session
Save Session As ...

Copy Wave to Clipboard
Export Session to Excel ...

Import Licenses ...
Show installed Licenses ...

Switch to Simple Mode
Switch to Expert Mode
Show Matrix Window

Dose Unit   ▸

About Accu-Gold ...

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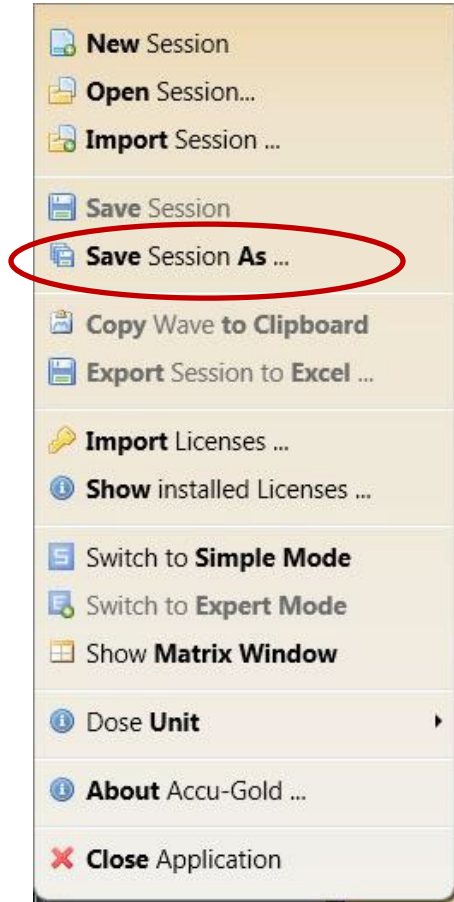
You can continue to review the data in List or Wave view by clicking on the **List** or **Wave** buttons in the title bar. You can also non-destructively switch from viewing measurements in Gy to R by clicking the drop-down menu and selecting **Dose Unit**. If additional changes are made, click the drop-down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

Note: If Accu-Gold is set to Simple Mode, you will not be able to see List and Wave view. To see List and Wave view, click the drop-down menu and select **Switch to Expert Mode** to turn List and Wave views back on.

10. If you need to reposition the sensor(s), click the **Stop** 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 List view and clicking the **Delete** button or by clicking the 'X' button in the Measure View.

11. Click **Start** when you are ready to take your next exposure.

Measurements

When taking measurements, you may need to adjust settings for mammographic sensors and/or multiple sensors, or you may need to change your display profile.

Using the AGMS-DM+ sensor

Once the sensor is connected, select the appropriate modality from the 'Select Calibration' drop down.

Taking a Measurement for Mammographic Sensors

Before making an exposure, choose the Anode/Filter combination that best represents the machine being measured from the pull-down located in the lower right corner. This pull-down menu appears when a mammographic sensor is connected.
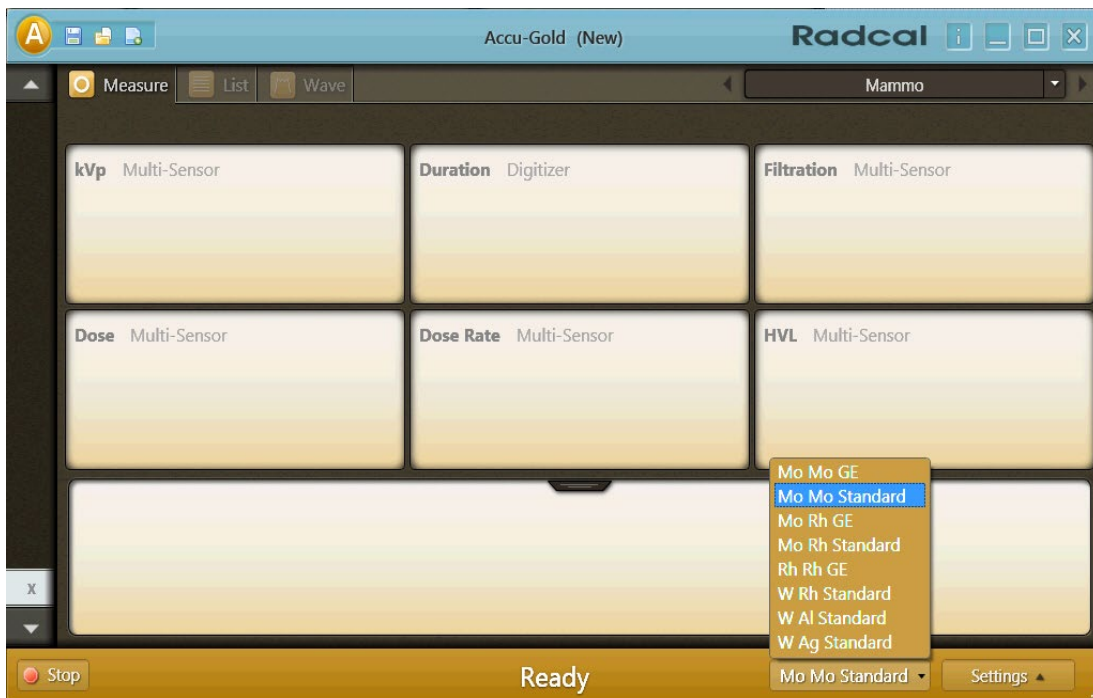
Taking a Measurement with Multiple Sensors Connected

Note: The only time you need to add a license file is when you are using a new multi-sensor and have not installed the license file. Sensor licenses apply only to diagnostic and/or mammo multi-sensors. The license files contain the calibration tables that match the sensor's serial number so that if you click **Start** and the AG software cannot locate a matching license file, it will provide a dialog box asking you to locate it.

The Accu-Gold Digitizer Module (AGDM) allows you to connect up to five sensors and take simultaneous measurements. The Rapid-Gold Digitizer Module (RGDM) has only the multi-sensor port. The five sensor ports are:

- **AGMS** – Accu-Gold multi-sensor (AGDM/RGDM)

- **ICH** – Ion Chamber (AGDM)

- **DD** – – Dose Diode (AGDM)

- **mAs** – I 90M9 and 90M10 mA/mAs sensors (AGDM)

- **AUX** – Auxiliary connector for the light sensor and future sensors (AGDM)

To take a measurement using more than one sensor:

1. Click **Stop** 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 **Start** to bring the sensor on line. Select a trigger source and expose to X-rays.

   In this example, an Ion chamber sensor is connected along with the multi-sensor and an mA meter. The top waveform represents the multi-sensor rate, the black one is the mA, then the multi-sensor kV and the bottom blue waveform represents the Ion chamber reading.
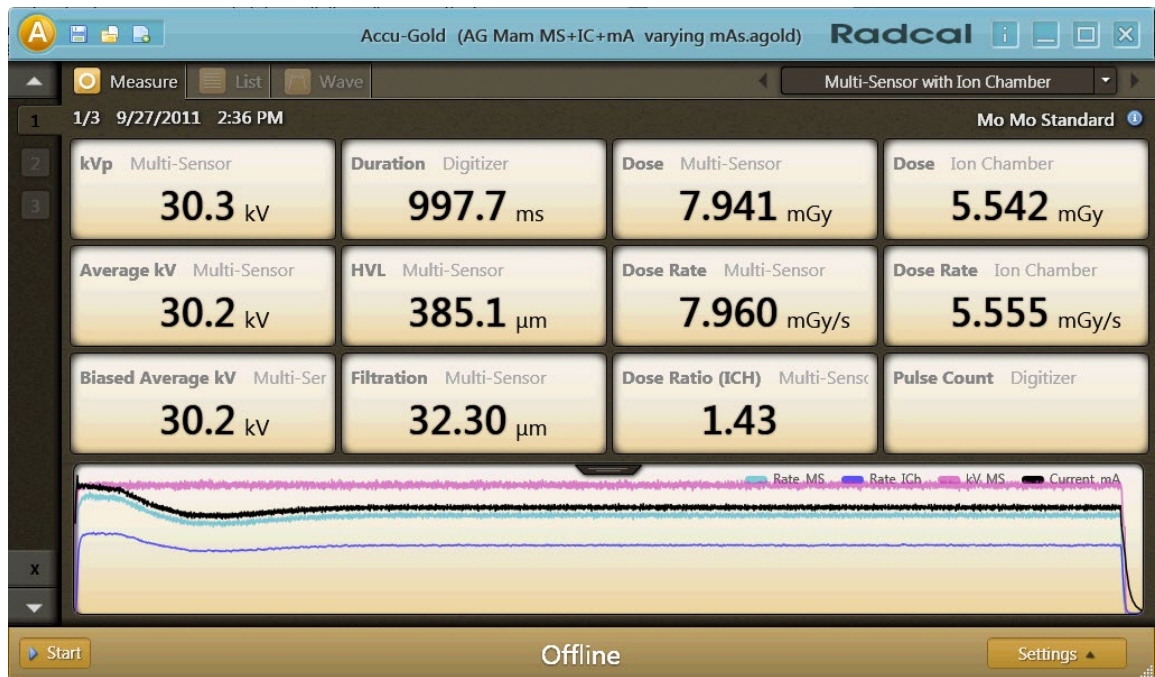
Selecting a Display Profile

In Accu-Gold, you can view measurement data using several different display profiles. The default profile is General Dose & Dose Rate. To change your display profile at any time from Measure, List, and Wave views, click the drop-down next to the current display profile and select a profile from the list that appears.

Note: See the *Profiles* section for a list of what information is measured in each profile.

- General Dose & Dose Rate

- General Fluoro

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- Mammo

- Multi-Sensor with mA

- Multi-Sensor with Ion Chamber

- Multi-Sensor with Dose Diode

- GE AMX

- Ion Chamber

- Ion Chamber with Dose Diode

- Dose Diode

Data in List View

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

- Switch between viewing all available measurement values and measurement values associated with your current display profile by clicking the **All** and **Profile** buttons. The green circle on the button indicates which view you are currently in.

- Delete measurements by highlighting a row and clicking the **Delete** button. To save any changes to your session after you delete a measurement, click the **Save** icon.

- Export measurement data to your clipboard or to a CSV file by clicking the **Export** button. See *Exporting a Data Session to a New Excel File* for more information.

Exporting Data in List View

From List view, you can export measurement data by copying the data to the Windows clipboard and pasting it into an Excel file (recommended method) or saving the data to a CSV file:

Note: If you select **All** in the List view, all of the available data will be included in the exported file. To limit the data exported, select an appropriate profile.

1. Click **List** to display List view.

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2. Click **Export** to begin the process of exporting all measurements in your session. The Export dialog appears.

3. From this window you can perform one of the following actions:

   - Click **More Options** to display additional options for exporting your data and proceed to step 4.

   - Click **To Clipboard** to copy the data as it is displayed in the Accu-Gold List view and paste it into an Excel file.

   - Click **To CSV File** to save the data as it is displayed in the Accu-Gold List view in a .csv file on your PC.
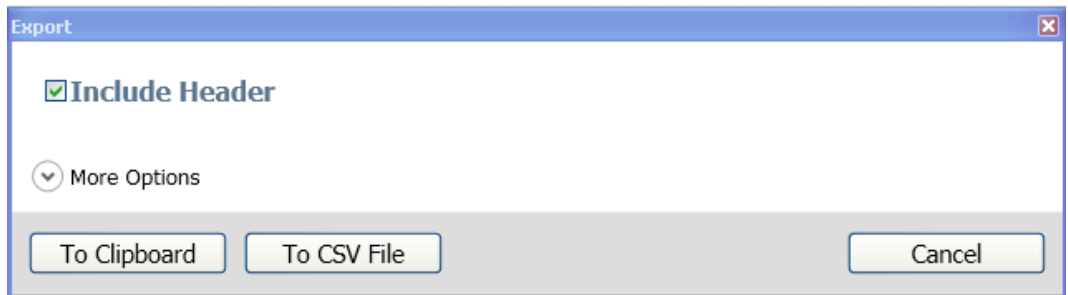
4. After you click **More Options**, the window expands to display additional export options. From this window, you can choose the following export options:

   - **Values in Viewing Profile** – Select to export the measurement values you currently see in List view (All or Profile view).
   - **All Results Values** – Select to export all measurement values.
   - **Standard Subset** – Select to only export the values associated with a spreadsheet template.
   - **Current System Format** – Select to export the data in the language format currently on your PC.
   - **International Format (English)** – Select to export the data in an International format. This format changes the decimal values to international comma values, but keeps the original language format.
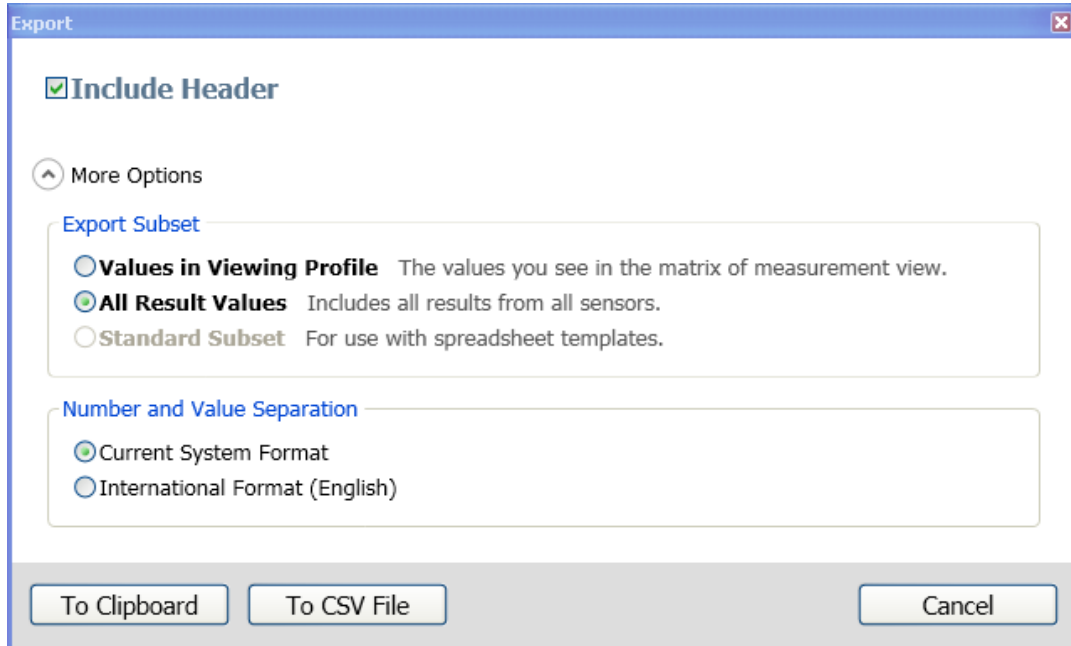
Deleting Data in List View

You can delete information for a measurement by performing the following actions:

1. Select the measurement you want to delete by clicking on it.

2. Click **Delete**. The information is deleted from the session.

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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.
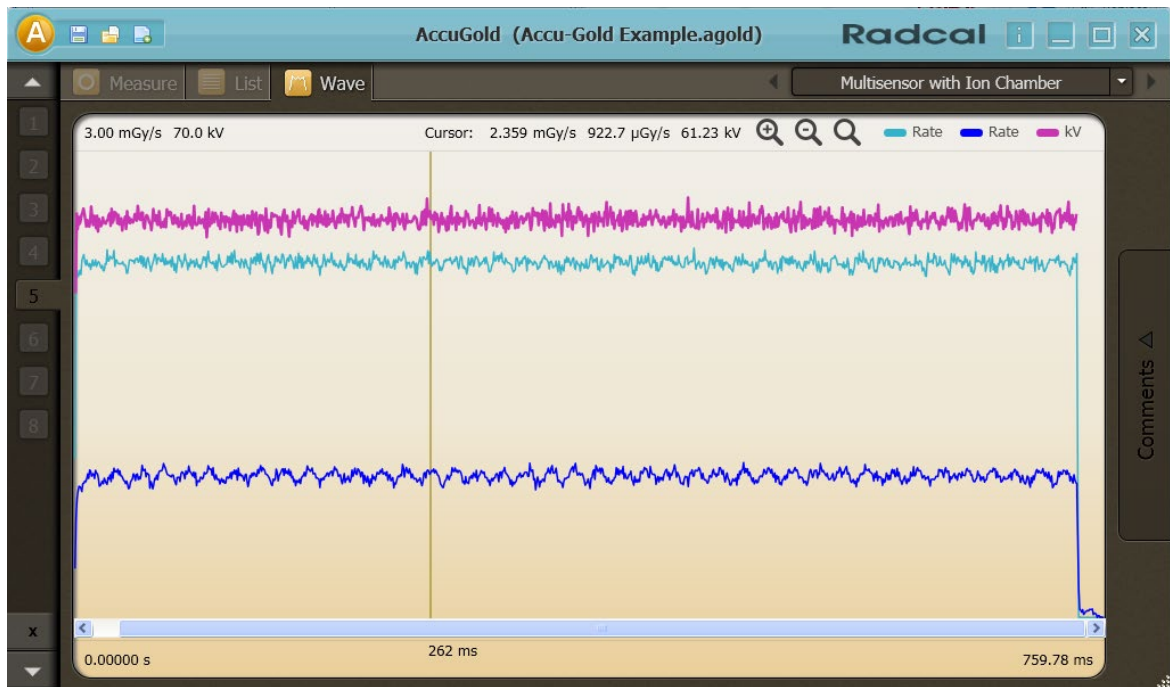
Viewing a Region of Interest

In Wave view, you can select a specific wave region to view that region in more detail:

1. On the Wave screen, click once to select a starting point for the region of interest.

2. Click again to select an ending point. A dialog appears with detailed information for the selected region of interest.

   Note: The region of interest may be adjusted by clicking and dragging the beginning and ending line.
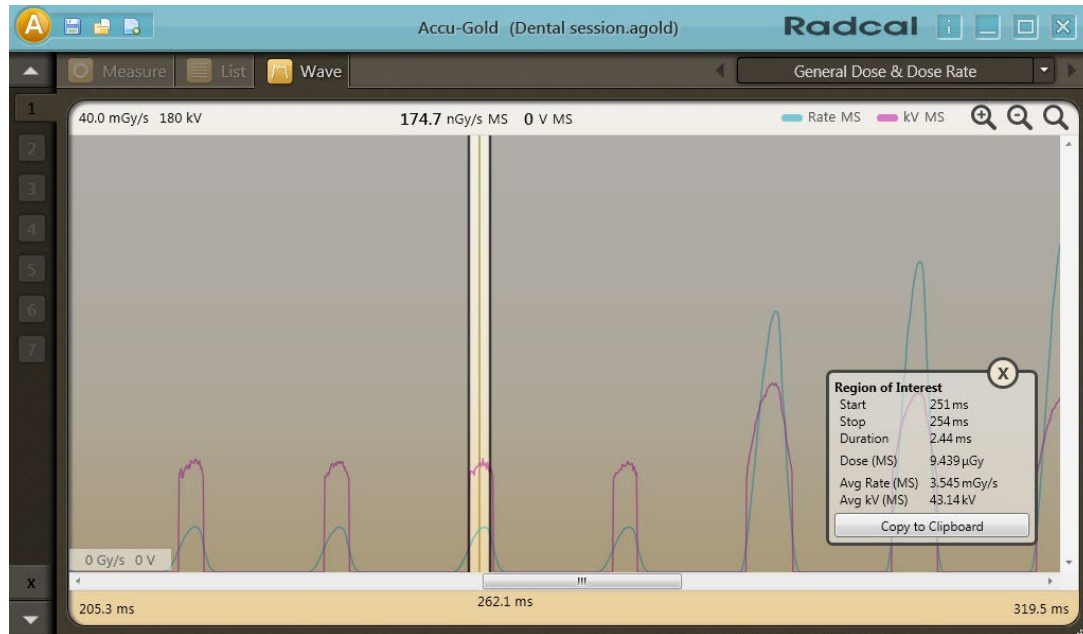
3. To export the wave to your Clipboard, click **Copy to Clipboard**.

4. Click **X** to remove the region of interest.

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Sessions

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

Note: All session data is stored in XML format and may be easily read with a standard text reader.

Starting a Session

To start a new session, perform the following actions:

1. On the Accu-Gold main screen, click **A** and select **New Session**. A new, blank session appears.

Click Start and you are now ready to take 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 **A** and select **Open Session**. The Open Accu-Gold Session dialog appears.
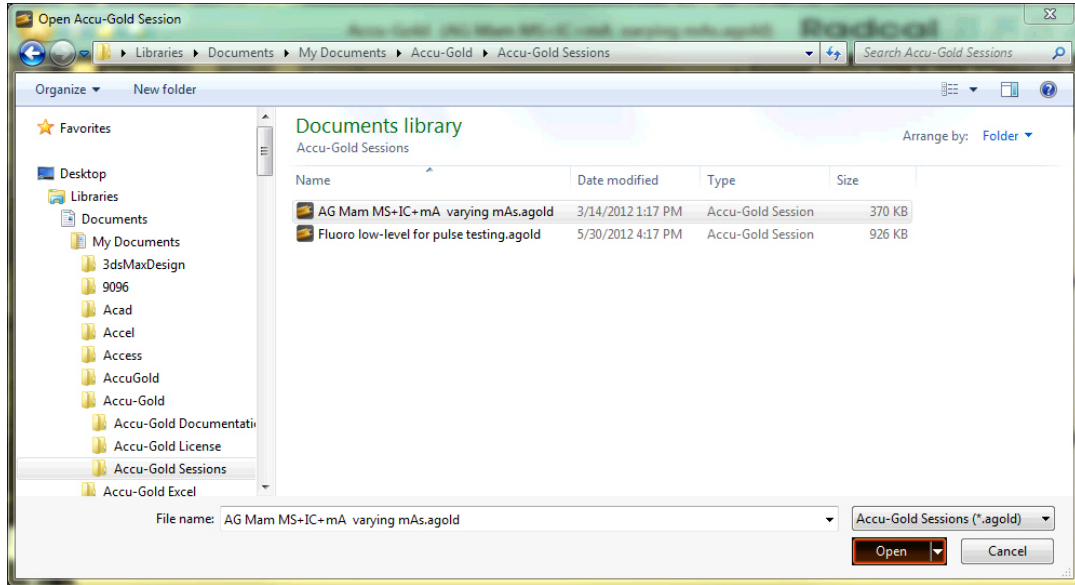
2. Navigate to a saved session and click **Open** to open the session.

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 **A** and select **Import Session**. The Open Accu-Gold Session dialog appears.
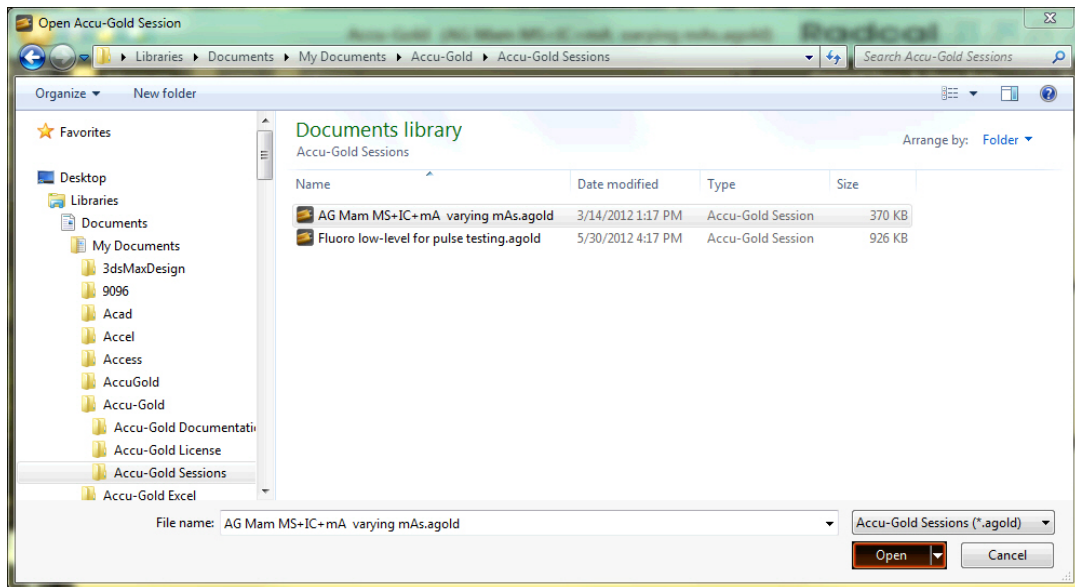
2. Navigate to a saved session and click **Open** to import the session.

Saving a Session

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

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1. On the Accu-Gold main screen, click **A** and select **Save Session**. The Save Accu-Gold Session dialog appears.
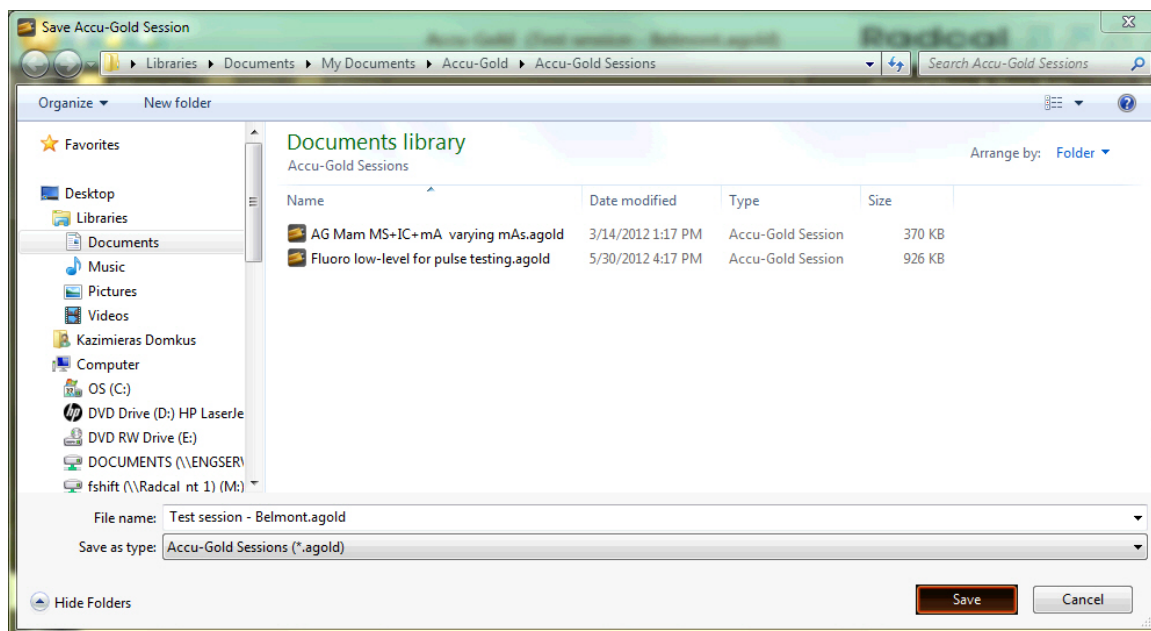
2. In **File name:** type a name for the session.

3. Navigate to the desired folder and click **Save** to save the session.

Exporting a Session

You can export or modify sessions in four ways:
*   Exporting a Session to a New Excel File
*   Exporting a Session to a Predefined Excel Template
*   Adding a Session to Open Excel Files
*   Adding a Measurement Session to Pre-exported Files

Note: Exporting session data to Excel does not export wave forms. To export wave forms, use Copy Wave to Clipboard.

Exporting a Session to a New Excel File

To export a measurement session to a new Excel file, perform the following actions:

1. Click **A**, and select **Export Session to Excel…**The Export Session to Excel dialog appears.
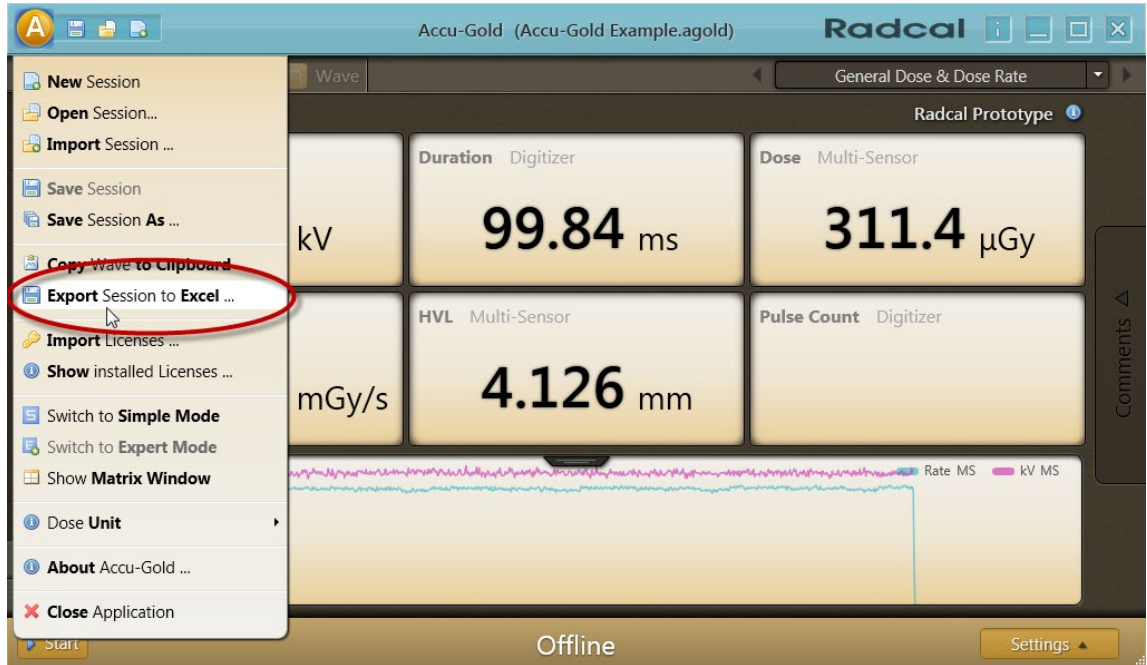
2.   Select **Export to new file…** and click **Ok**.
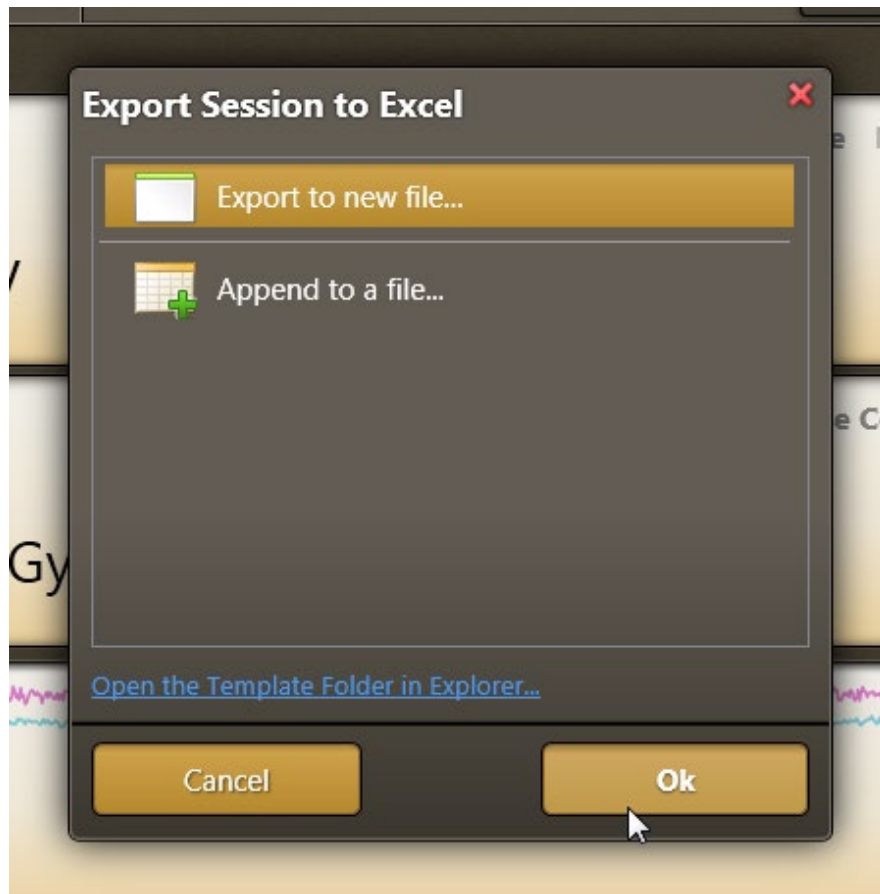
A new Excel file is generated and contains all fields set in the Accu-Gold profile.

	A	B	C	D	E	F	G	H	I	J	K
1	Start Time	kVp	Unit	Duration	Unit	Dose	Unit	Dose	Unit	Average k\	Unit	H
2		Multi-Sensor		Digitizer		Multi-Sensor		Ion Chamber		Multi-Sensor		N
3	5/30/2012 5:24:52 PM			0.00	s						
4	9/27/2011	30.30	kV	1.00	s	7.94	mGy	5.54	mGy	30.20	kV
5	9/27/2011	30.20	kV	0.50	s	3.96	mGy	2.76	mGy	30.20	kV
6	9/27/2011	30.20	kV	0.25	s	1.97	mGy	1.37	mGy	30.20	kV
7											
8											
9											
10											

Exporting a Session to a Predefined Excel Template

Radcal can ship Accu-Gold with predefined export templates. Users can add their own templates as well. Templates contain a definition of which values to export. They also may contain cell formatting and additional calculations to be applied to the data. Click **Open the Template Folder in Explorer…** to find the location of a directory. Any file in the directory will show up in the templates list and can be selected for data export. To export a session to a predefined Excel template, perform the following actions:

1. Click the drop-down menu and select **Export Session to Excel…**. The Export Session to Excel dialog appears. In this example, the Dose Min Max Report template appears.

2. Click **Dose Min Max Report**. A new file from the template and session data is created in Excel.

Adding a Measurement Session to Open Excel Files

When you open the Export Session to Excel dialog, Accu-Gold scans for opened excel workbooks that contain Accu-Gold-Export tokens. Open workbooks are listed in the Export Session to Excel dialog by workbook name. If there are no tokens, all of the data displayed in the List view will be exported.
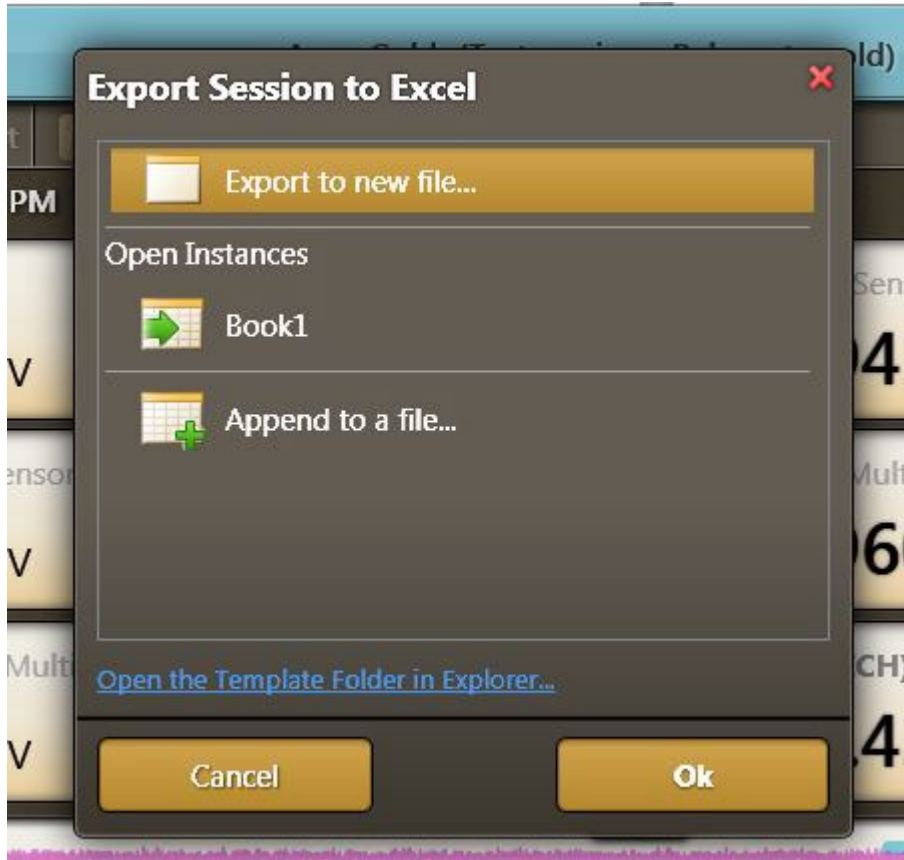
Adding a Measurement Session to Pre-exported Files

To add a new measurement session to exported measurement sessions in Excel, perform the following actions:

1. Click **A** and select **Export Session to Excel…** to open the Export Session to Excel dialog and click **Append to a file…**

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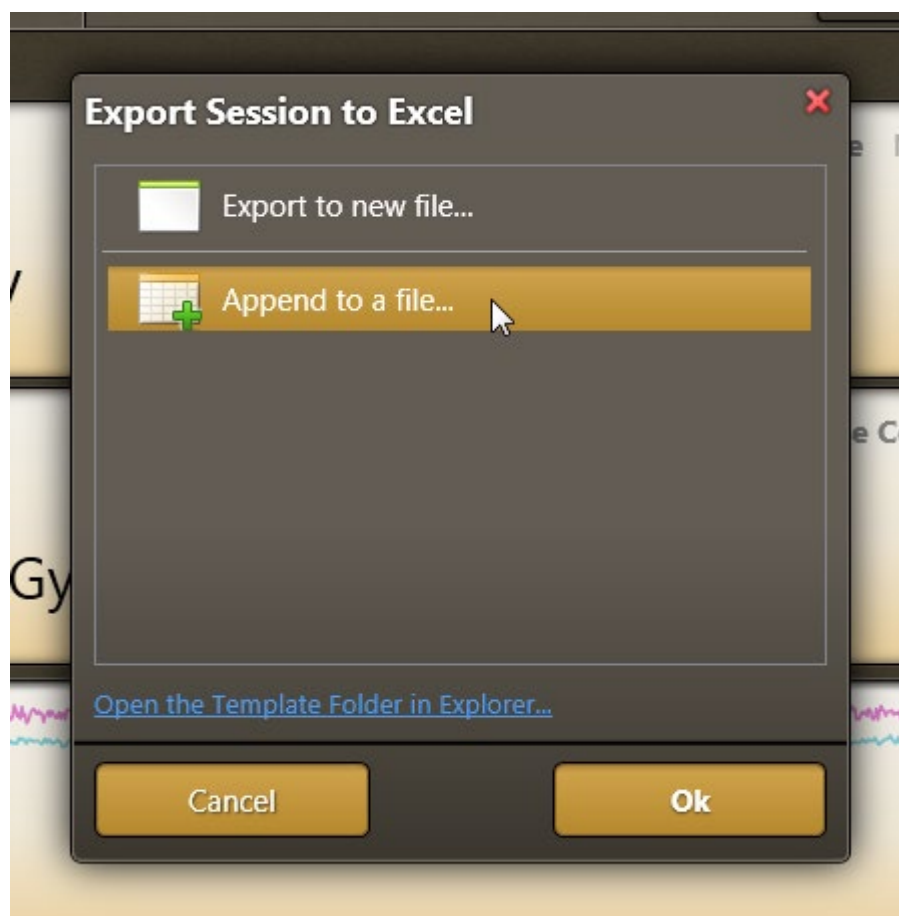
2. Click **Ok** to add the current measurement session's new data with the already exported measurement session in Excel.

Measurement Profiles

Each measurement profile features a specific corresponding token, refer to *List of Tokens* in Appendix B.

General Dose & Dose Rate

The General Dose & Dose Rate profile displays the following measurement data:

Description	Token
kVp (Multi-Sensor)	MultikVFftkVp
Duration (Digitizer)	DigitizerDuration
Dose (Multi-Sensor)	DigitizerPulseCount
Dose Rate (Multi-Sensor)	MultiDoseRate
HVL (Multi-Sensor)	MultiHVL
Pulse Count (Digitizer)	DigitizerPulseCount

General Fluoro

The General Fluoro profile displays the following measurement data:

Description	Token
kVp (Multi-Sensor)	MultikVFftkVp MultikVFftkVpUnitCol
Dose (Multi-Sensor)	MultiDoseRate MultiDoseRateUnitCol
Pulse Count (Digitizer)	DigitizerPulseCount
Dose / Pulse (Multi-Sensor)	MultiDosePerPulse
kV Pulse Repetition Frequency (Multi-Sensor)	MultikVFftPulseRepitionFrequency
Ave. Pulse Duration (Digitizer)	DigitizerPulseAverageDuration

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Mammo

The Mammo profile displays the following measurement data:

Description	Token
kVp (Multi-Sensor)	MultikVFftkVp MultikVFftkVpUnitCol
Duration (Digitizer)	DigitizerDuration DigitizerDurationUnitCol
Filtration (Multi-Sensor)	MultiFiltration MultiFiltrationUnitCol
Dose (Multi-Sensor)	MultiDose MultiDoseUnitCol
Dose Rate (Multi-Sensor)	MultiDoseRate MultiDoseRateUnitCol
HVL (Multi-Sensor)	MultiHVL MultiHVLUnitCol

Multi-Sensor with mA

The Multi-Sensor with mA profile displays the following measurement data:

Description	Token
kVp (Multi-Sensor)	MultikVFftkVp MultikVFftkVpUnitCol
Dose (Multi-Sensor)	MultiDose MultiDoseUnitCol
Charge (mA Sensor)	mACurrent mACurrentUnitCol
Biased Average kV (Multi-Sensor)	MultikVFftAveragekV MultikVFftAveragekVUnitCol
Dose Rate (Multi-Sensor)	MultiDoseRate MultiDoseRateUnitCol
Current (mA Sensor)	mACurrentRate mACurrentRateUnitCol
Duration (Digitizer)	DigitizerDuration DigitizerDurationUnitCol
Filtration (Multi-Sensor)	MultiFiltration MultiFiltrationUnitCol
Dose / mAs (Multi-Sensor)	MultiDosePermAs

Multi-Sensor with Ion Chamber

The Multi-Sensor with Ion Chamber profile displays the following measurement data:

Description	Token
kVp (Multi-Sensor)	MultikVFftkVp MultikVFftkVpUnitCol
Duration (Digitizer)	DigitizerDuration DigitizerDurationUnitCol
Dose (Multi-Sensor)	MultiDose MultiDoseUnitCol

Dose (Ion Chamber)	IonChamberDose IonChamberDoseUnitCol
Average kV (Multi-Sensor)	MultikVAverage MultikVAverageUnitCol
HVL (Multi-Sensor)	MultiHVL MultiHVLUnitCol
Dose Rate (Multi-Sensor)	MultiDoseRate MultiDoseRateUnitCol
Dose Rate (Ion Chamber)	IonChamberDoseRate IonChamberDoseRateUnitCol
Biased Average kV (Multi-Sensor)	MultikVFftAveragekV MultikVFftAveragekVUnitCol
Filtration (Multi-Sensor)	MultiFiltration MultiFiltrationUnitCol
Dose Ratio (ICH) (Multi-Sensor)	MultiDoseRatioIonChamberDose
Pulse Count (Digitizer)	DigitizerPulseCount

Multi-Sensor with Dose Diode

The Multi-Sensor with Dose Diode profile displays the following measurement data:

Description	Token
kVp (Multi-Sensor)	MultikVFftkVp MultikVFftkVpUnitCol
Duration (Digitizer)	DigitizerDuration DigitizerDurationUnitCol
Dose (Multi-Sensor)	MultiDose MultiDoseUnitCol
Dose (Dose Diode)	DoseDiodeDose DoseDiodeDoseUnitCol
Average kV (Multi-Sensor)	MultikVAverage MultikVAverageUnitCol
HVL (Multi-Sensor)	MultiHVL MultiHVLUnitCol
Dose Rate (Multi-Sensor)	MultiDoseRate MultiDoseRateUnitCol
Dose Rate (Dose Diode)	DoseDiodeDoseRate DoseDiodeDoseRateUnitCol
Biased Average kV (Multi-Sensor)	MultikVFftAveragekV MultikVFftAveragekVUnitCol
Filtration (Multi-Sensor)	MultiFiltration MultiFiltrationUnitCol
Dose Ratio (DD) (Multi-Sensor)	MultiDoseRatioDiodeDose
Pulse Count (Digitizer)	DigitizerPulseCount

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GE AMX

The GE AMX profile displays the following measurement data:

Description	Token
kVp (Multi-Sensor)	MultikVFftkVp MultikVFftkVpUnitCol
Duration (Digitizer)	DigitizerDuration DigitizerDurationUnitCol
Dose (Multi-Sensor)	MultiDose MultiDoseUnitCol
Dose (Dose Diode)	DoseDiodeDose DoseDiodeDoseUnitCol
PPV (Multi-Sensor)	MultikVPPV MultikVPPVUnitCol
HVL (Multi-Sensor)	MultiHVL MultiHVLUnitCol
Dose Rate (Multi-Sensor)	MultiDoseRate MultiDoseRateUnitCol
kV Peak Ripple Frequency (Multi-Sensor)	MultikVFftPeakRippleFrequency MultikVFftPeakRippleFrequencyUnitCol
kV Zero To Peak Ripple (Multi-Sensor)	MultikVFftZeroToPeakRipple MultikVFftZeroToPeakRippleUnitCol
Filtration (Multi-Sensor)	MultiFiltration MultiFiltrationUnitCol

Ion Chamber

The Ion Chamber profile displays the following measurement data:

Description	Token
Dose (Ion Chamber)	IonChamberDose IonChamberDoseUnitCol
Dose Rate (Ion Chamber)	IonChamberDoseRate IonChamberDoseRateUnitCol
Duration (Digitizer)	DigitizerDuration DigitizerDurationUnitCol
Temperature (Ion Chamber)	IonChamberTemperature
Air Pressure (Digitizer)	DigitizerAirPressure
Pulse Count (Digitizer)	DigitizerPulseCount

Ion Chamber with Dose Diode

The Ion Chamber with Dose Diode profile displays the following measurement data:

Description	Token
Dose (Ion Chamber)	IonChamberDose IonChamberDoseUnitCol
Dose (Dose Diode)	DoseDiodeDose DoseDiodeDoseUnitCol
Dose Rate (Ion Chamber)	IonChamberDoseRate IonChamberDoseRateUnitCol
Dose Rate (Dose Diode)	DoseDiodeDoseRate DoseDiodeDoseRateUnitCol
Duration (Digitizer)	DigitizerDuration DigitizerDurationUnitCol
Pulse Count (Digitizer)	DigitizerPulseCount
Dose Ratio (DD) (Ion Chamber)	IonChamberDoseRatioDiodeDose
Temperature (Ion Chamber)	IonChamberTemperature
Air Pressure (Digitizer)	DigitizerAirPressure
Trigger Level (Digitizer)	DigitizerTriggerLevel
Trigger Source (Digitizer)	DigitizerTriggerSource
Pulse Rate (Digitizer)	DigitizerPulseRate

Dose Diode

The Dose Diode profile displays the following measurement data:

Description	Token
Dose (Dose Diode)	DoseDiodeDose DoseDiodeDoseUnitCol
Duration (Digitizer)	DigitizerDuration DigitizerDurationUnitCol
Dose Rate (Dose Diode)	DoseDiodeDoseRate DoseDiodeDoseRateUnitCol
Trigger Level (Digitizer)	DigitizerTriggerLevel

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Templates

Templates are Excel workbooks with user-created formats that are located in a directory specific to Accu-Gold. Any file in the directory will show up in the templates list and can be selected for data export. Templates can be used over and over to gather data and reports. Radcal provides tokens that you can use that will export cells that match the tokens. If Accu-Gold does not find tokens, the data will be exported in the sequence matching that in the List view.

Managing Templates

Accu-Gold lists all Excel template files at this folder location:
C:\Users\<*USERNAME*>\AppData\Roaming\Microsoft\Windows\Templates\Accu-Gold
To manage templates in Accu-Gold, perform the following actions:

1. Click the drop-down menu and select **Export Session to Excel…**The Export Session to Excel dialog appears.
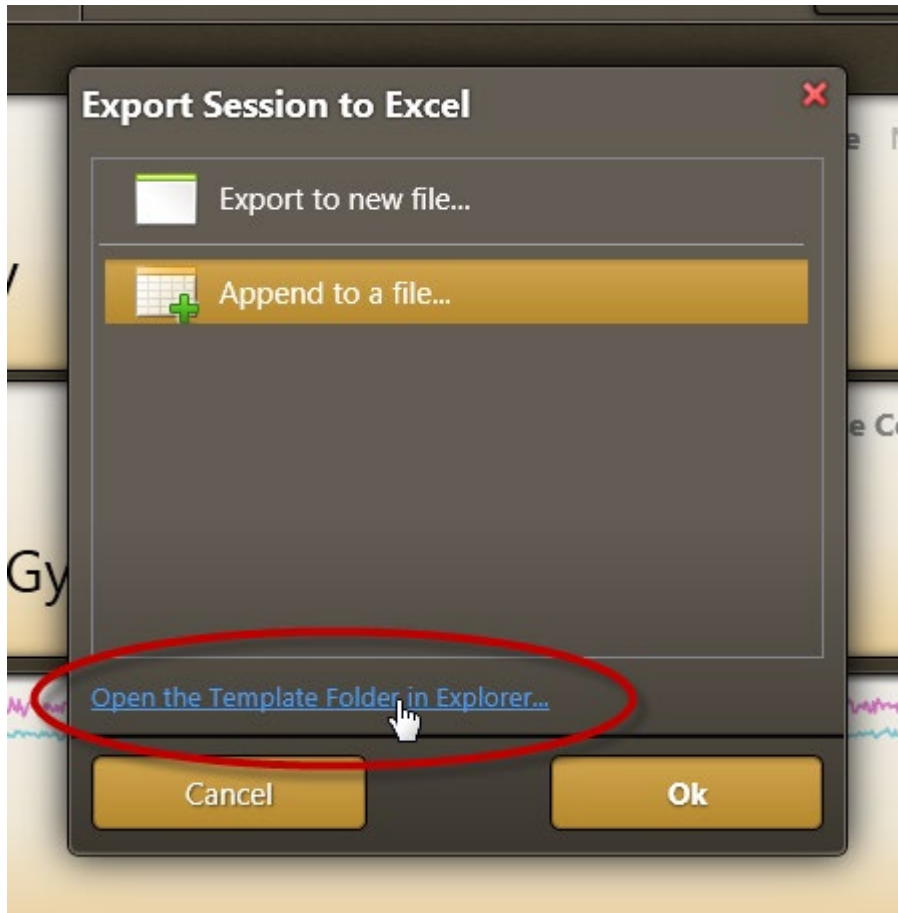
2. Click **Open the Template Folder in Explorer…**to open the template directory in Windows Explorer where you can view and manage templates as necessary.

Creating Templates

Accu-Gold knows where to export data by naming header cells in a special way; the cell names become tokens that Accu-Gold looks for to map values to columns. The tokens consist of the sensor identifier and value-type identifiers (see *List of Tokens* – Appendix B).

This list provides some examples for cell name tokens:
- DigitizerDuration   Exposure duration
- MultiDose   Multi-Sensor Dose
- MultiDoseRateUnit   Multi-Sensor Dose Unit

After defining the needed columns and formatting the template, click **Save as…**in Excel and save your template as a template with the extension ".xltx" in the Accu-Gold-Template folder "C:\Users*USERNAME*\AppData\Roaming\Microsoft\Windows\Templates\Accu-Gold" (see *List of Tokens* – Appendix B).

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Appendix A

Installing Accu-Gold

Installation notes:
- Uninstalling old versions is not necessary.
- Manuals (in Adobe PDF format) are on the flash drive and will be copied to "MyDocuments" on your computer in an Accu-Gold folder.
- 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 "setup.exe" located in the root of the flash drive.

3. The "setup.exe" file will launch an installation dialog. On the Welcome to the Accu-Gold Setup Wizard screen, click **Next**.
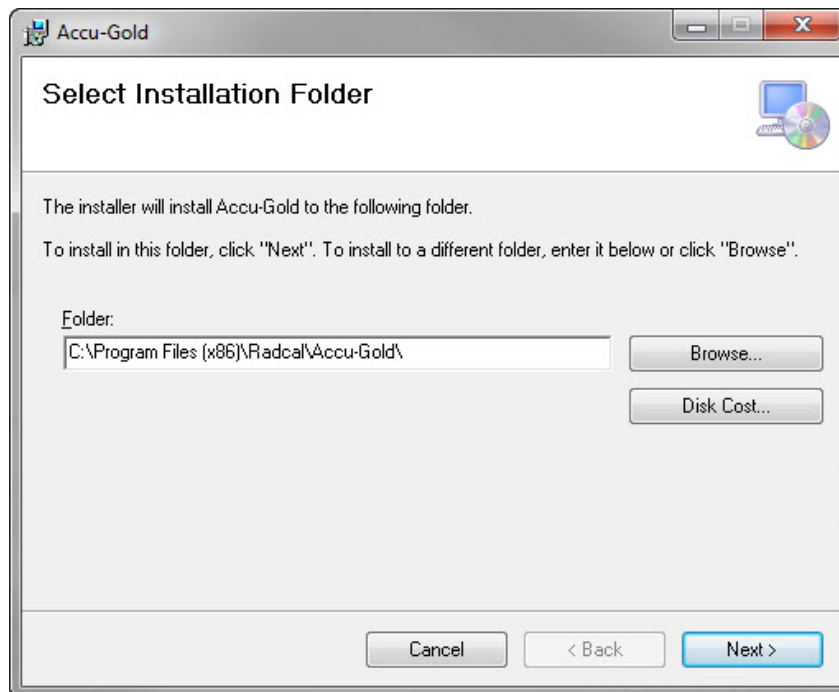
The dotNET Framework Client version 4.0 or greater is required and will be installed if it is not already installed on your computer. An internet connection is not required.

4. Choose the installation directory for the software. The default is Program Files\Radcal\Accu-Gold.

5. Click **Next** to continue.

6. If you choose to include additional content, installation manuals and sample files will be installed in the MyDocuments\Accu-Gold folder.
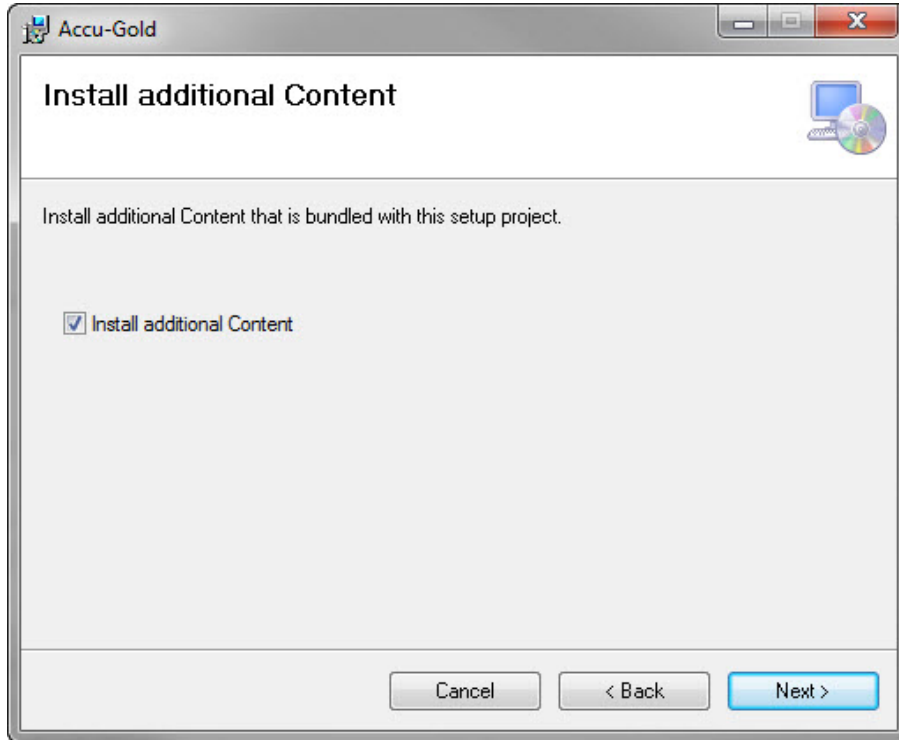
7. Click **Next** to begin installation. USB drivers, which allow Microsoft Windows to recognize the Accu-Gold digitizer, will also be installed when the Accu-Gold digitizer is first plugged into a USB port.
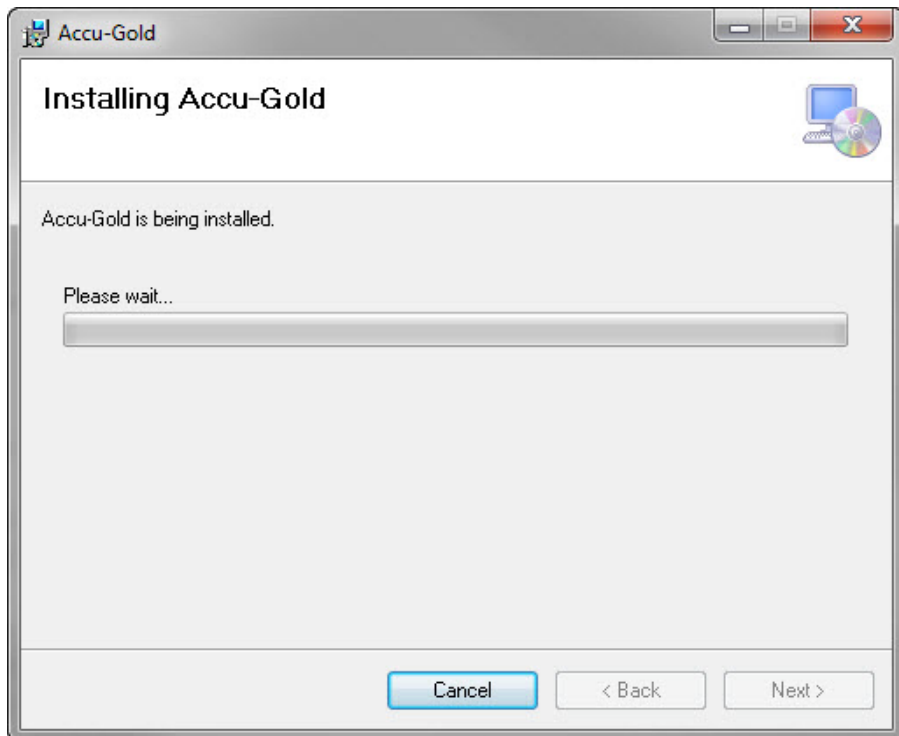
8. After the installation is complete, click **Close**.
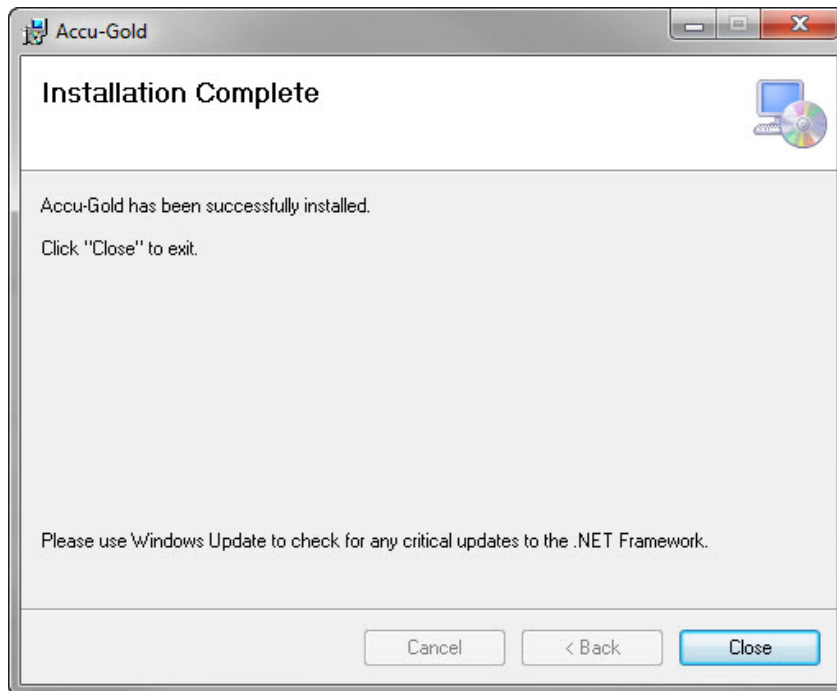
Installing the Calibration File

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 multi-sensor must be calibrated from an external file or reinstalled if it is recalibrated. You can find the license in the flash drive included with your sensor.

To install the license:

1. Plug the flash drive into your PC.

2. Launch the Accu-Gold software.

3. Click the **A** button and choose **Import Licenses**.
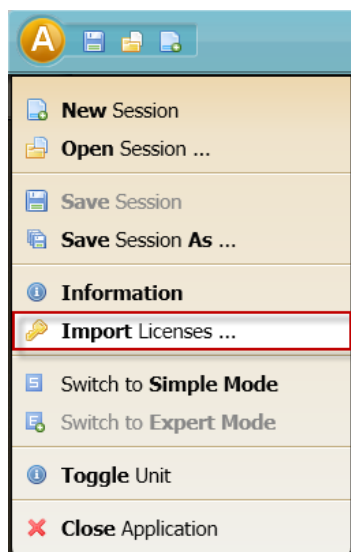
4. In the Import window that appears, browse to the location of your flash drive and choose the file that contains the serial number of your sensor.

    For example, MS Calibration 41-001.aglicenses or, for the mammo, MS Calibration 42-0017 Mo-Mo.aglicenses.

    Note: If the license/calibration file has not been installed, the program will say that there is no calibration for the sensor, and it will put up a dialog. You must locate the file, which will be on the flash drive, or in My Documents\Accu-Gold\Accu-Gold License\. The file name is: MS Calibration 41-0011.aglicense, where 41-0011 is the serial number

5. 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 **Radcal Accu-Gold**.

2. Click **Remove** and answer yes to the prompts. You may also run the setup program again to uninstall it.

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Appendix B

Sensors

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) ±10% 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	20-38	12-80	0.17-0.78
		W/Rh	General	20-38	12-78	0.17-0.69
		W/Al*	General	20-50	200-990	0.16-1.00
	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
	80 nGy – >100 Gy, ±5% (9.1 µR – >11 kR, ±5%)	80 nGy/s – 200 mGy/s, ±5% (0.55 mR/min – 1.4 kR/min, ±5%) 1 - 120 pulses/s Pulse Length: 1.0ms-300s	1 ms – 300 s ± 0.1% or 0.2 ms

* Optional calibration order separately
** 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.

(AGMS-DM+)   (AGMS-D+)   (AGMS-M+)

Size	35.6 mm x 20.0 mm x 11.8 mm
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

AGMS – Solid State Multi Sensors

AGMS – M

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	Dose Rate	Time
	150 nGy – >100 Gy, ±5% (17 μR – >11 kR, ±5%)	150 nGy/s – 350 mGy/s, ±5% (1.0 mR/min – 2.4 kR/min, ±5%)	1 ms – 300 s ± 0.1% +0.2 ms

* Ordered separately

Reference Conditions:

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

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AGMS – D

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	Dose Rate	Time		
	150 nGy – >100 Gy, ±5% (17 µR – >11 kR, ±5%)	150 nGy/s – 350 mGy/s, ±5% (1.0 mR/min – 2.4 kR/min, ±5%)	1 ms – 300 s ± 0.1% + 0.2 ms		

Reference Condition:

    12° Tungsten anode

ICH – Ion Chambers

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 9999s.

Chamber	10X6-6	
Min Rate	2 µR/s	20 nGy/s
Max Rate	17 R/s	149 mGy/s
Min Dose	10 µR	100 nGy
Max Dose	59 kR	516 Gy
Cine Specifications	0.1 µR/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	

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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 9999s.

Chamber	10X6-6M	
Min Rate	2 µR/s	20 nGy/s
Max Rate	10 R/s	88 mGy/s
Min Dose	10 µR	100 nGy
Max Dose	59 kR	516 Gy
Cine Specifications	N/A	
Calibration Accuracy	±4% using X-rays @ 20kVp and 0.26 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	

10X6-60/10X6-60E

For use with Accu-Gold, Accu-Pro, and Accu-Dose, the 10X6-60/60E 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. Additionally, the -60E (extended) chamber's increased sensitivity at lower energies turns the chamber into a "Universal" detector, covering mammography through R&F and beyond.

Chamber	10X6-60/60E	
Min Rate	200 µR/s	2.0 nGy/s
Max Rate	2 R/s	19 mGy/s
Min Dose	1 µR	10 nGy
Max Dose	5.9 kR	52 Gy
Cine Specifications	0.01 µR/f ->100 mR/f 0.1 nGy/f ->1.0 mGy/	
Calibration Accuracy	**-60** ±4% using X-rays @ 150kVp and 10.2 mm AL HVL **-60E** ±4% using X-rays @ 50kVp and 0.88 mm AL HVL	
Exposure Rate Dependence	±5%, 2 mR/min to 199 R/min	
Energy Dependence	**-60** ±5% 20 keV to 1.33 MeV (with build-up material) **-60E** ±5% 0.2 mm Al HVL to 1.33 MeV (with build-up material)	
Construction	Polycarbonate walls; conductive graphite exterior coating; 60 cm3 active volume, 0.5 m low-noise triax cable; 0.13kg	

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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 µR/s	20 nGy/s
Max Rate	40 R/s	350 mGy/s
Min Dose	20 µR	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	

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 cm² and volume of 180 cm³. 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 cm³ active volume; 0.11kg	

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10X6-1800

For use with Accu-Gold, Accu-Pro, and Accu-Dose, the 10X6-6M is a radiation protection chamber used for low-level radiation measurements such as shielding leakage, irradiator, and environmental. Unlike typical survey meters, the 1800cm³ volume chamber offers improved accuracy over a wider dynamic range.

Chamber	10X6-1800	
Min Rate	5 nR/s	50 pGy/
Max Rate	18 mR/s	0.2 mGy/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 cm³ 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 µR/s	200 nGy/s
Max Rate	133 R/s	1.17 Gy/s
Min Dose	100 µR	1 µGy
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	**0.6**±5%, 40 keV to 1.33 MeV(with buildup cap) **0.6CT**±5% 3 to 20mm Al HVL	
Construction	C552 air-equivalent material &mbps; electrode; polyacetal exterior cap, 0.6 cm^3 active volume 12-m triax cable (3 m version available)	

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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 adapters are included.

Chamber	10X6-0.6CT	
Min Rate	20 µR/s	200 nGy/s
Max Rate	133 R/s	1.17 Gy/s
Min Dose	100 µR	1 µGy
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	**0.6**±5%, 40 keV to 1.33 MeV(with buildup cap) **0.6CT**±5% 3 to 20mm Al HVL	
Construction	C552 air-equivalent material &mbps; electrode; polyacetal exterior cap, 0.6 cm³ 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 µR/s	500 nGy/s
Max Rate	720 R/s	6.31 Gy/s
Min Dose	200 µR	2 µGy
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	
Construction	C552 air-equivalent material &mbps; electrode; polyacetal exterior cap, 0.18 cm³ active volume, 3-m triax cable	

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mA/mAs

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 available to an external PC using a spreadsheet
- 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 uAs 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 available to an external PC using optional XLPRO software

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 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 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.

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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.

DD - Solid State Dose Sensors

DDX6-W

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 µR/s	20 nGy/s
Max Rate	23 R/s	205 mGy/s
Min Dose	10 µR	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	

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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	

DDX6-M

For use with Accu-Gold, Accu-Pro, and Accu-Dose, the DDX6-M is a small solid state dose sensor for mammographic range measurements in the energy range of 22-49 kV. It simultaneously measures dose, dose-rate, time and more. It is passively corrected for Mo/Mo beam quality. Connect it to an AGMS-M multi-sensor for entrance/exit dose measurements.

Sensor	DDX6-M	
Min Rate	2 µR/s	20 nGy/s
Max Rate	23 R/s	203 mGy/s
Min Dose	10 µR	100 nGy
Max Dose	63 kR	552 Gy
Accuracy	±5% using Mo Anode X-rays @ 30kVp with 30u Mo filtration (IEC 61267 RQR-M-3)	
Energy Dependence	+5% from 25 kVp to 30 kVp at 30 um Mo	
Filtration Dependence	5% from 25 kVp to 30 kVp at 30 um Mo + 2 mm Al	

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AUX sensors -

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 Aperature	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)	

Appendix C

List of Tokens

If a token from this list is used as a cell name in Excel then Accu-Gold will write corresponding measurement data into the column below the marked cell.

Token	Sensor	Type
StartTime	Digitizer	Start Time
DigitizerDuration	Digitizer	Duration
DigitizerDriverVersion	Digitizer	Driver Version
DigitizerEngineVersion	Digitizer	agHost DLL
DigitizerPulseCount	Digitizer	Pulse Count
DigitizerPulseRate	Digitizer	Pulse Rate
DigitizerPulseList	Digitizer	PulseList
DigitizerPulseAverageDuration	Digitizer	Ave. Pulse Duration
DigitizerAirPressure	Digitizer	Air Pressure
DigitizerAirPressureIsFromDigitizer	Digitizer	Air Pressure Is From Digitizer
DigitizerAirPressureIsOutOfRange	Digitizer	Air Pressure Is Out Of Range
DigitizerMeasurementTooShort	Digitizer	Measurement is too short
DigitizerErrorMessage	Digitizer	Measurement error message
DigitizerFirmwareVersion	Digitizer	Firmware Version
DigitizerTriggerLevel	Digitizer	Trigger Level
DigitizerTriggerSource	Digitizer	Trigger Source
DigitizerSerial	Digitizer	Serial
DigitizerCalibrationDate	Digitizer	Calibration Date
DigitizerType	Digitizer	Type
DigitizerCalibrationLab	Digitizer	Calibration Lab
DigitizerCalibrationReport	Digitizer	Calibration Report
DigitizerSensorID	Digitizer	Sensor ID
DigitizerDescription	Digitizer	Description
DigitizerDeltaSigmaSignalBad	Digitizer	Delta Sigma Signal is bad
DigitizerDeltaSigmaSignalWorse	Digitizer	Delta Sigma Signal is out of Range
MultiDose	Multi	Dose
MultiDoseRate	Multi	Dose Rate
MultiDosePerPulse	Multi	Dose / Pulse
MultiDosePermAs	Multi	Dose / mAs
MultiDoseRatio	Multi	Dose Ratio
MultiDoseRatioIonChamerDose	Multi	Dose Ratio (ICH)
MultiDoseRatioDiodeDose	Multi	Dose Ratio (DD)
MultikVAverage	Multi	Average kV

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MultiHVL	Multi	HVL
MultiFiltration	Multi	Filtration
MultikVPPV	Multi	PPV
MultikVFftPeakRippleFrequency	Multi	kV FFT Peak Ripple Frequency
MultikVFftkVp	Multi	FFT kVp
MultikVFftZeroToPeakRipple	Multi	kV FFT Zero To Peak Ripple
MultikVFftAveragekV	Multi	FFT Average kV
MultikVFftTimeCompressionFactor	Multi	FFT kV Time Compression Factor
MultikVFftPulseRepitionFrequency	Multi	FFT kV Pulse Repition Frequency
MultikVFftRMSkVNoise	Multi	FFT kV RMS Noise
MultikVSpectrum	Multi	kV Spectrum
MultiCalibrationTitle	Multi	Calibration
MultiCalibrationName	Multi	Base Calibration
MultiCalibrationGuid	Multi	Base Calibration ID
MultiCorrectionName	Multi	Correction
MultiCorrectionGuid	Multi	Correction ID
MultiTubeAnode	Multi	Anode
MultiTubeFilter	Multi	Filter
MultiHideCalibrationTitle	Multi	Standard Calibration
MultikVFftTooManyDropOuts	Multi	FFT too many drop outs
MultikVFftInsufficientPoints	Multi	FFT insufficient samples
MultikVIterationsReachedMaxLimit	Multi	kV calculation failed
MultiSerial	Multi	Serial
MultiCalibrationDate	Multi	Calibration Date
MultiType	Multi	Type
MultiCalibrationLab	Multi	Calibration Lab
MultiCalibrationReport	Multi	Calibration Report
MultiSensorID	Multi	Sensor ID
MultiDescription	Multi	Description
MultiDeltaSigmaSignalBad	Multi	Delta Sigma Signal is bad
MultiDeltaSigmaSignalWorse	Multi	Delta Sigma Signal is out of Range
IonChamberDose	Ion Chamber	Dose
IonChamberDoseRate	Ion Chamber	Dose Rate
IonChamberDosePerPulse	Ion Chamber	Dose / Pulse
IonChamberDosePermAs	Ion Chamber	Dose / mAs
IonChamberDoseRatio	Ion Chamber	Dose Ratio
IonChamberDoseRatioKvDose	Ion Chamber	Dose Ratio (kV)
IonChamberDoseRatioDiodeDose	Ion Chamber	Dose Ratio (DD)
IonChamberTemperature	Ion Chamber	Temperature
IonChamberTemperatureIsFromDigitizer	Ion Chamber	Temperature Is From Digitizer
IonChamberTemperatureIsOutOfRange	Ion Chamber	Temperature Is Out Of Range
IonChamberSerial	Ion Chamber	Serial

IonChamberCalibrationDate	Ion Chamber	Calibration Date
IonChamberType	Ion Chamber	Type
IonChamberCalibrationLab	Ion Chamber	Calibration Lab
IonChamberCalibrationReport	Ion Chamber	Calibration Report
IonChamberSensorID	Ion Chamber	Sensor ID
IonChamberDescription	Ion Chamber	Description
IonChamberDeltaSigmaSignalBad	Ion Chamber	Delta Sigma Signal is bad
IonChamberDeltaSigmaSignalWorse	Ion Chamber	Delta Sigma Signal is out of Range
DoseDiodeDose	Dose Diode	Dose
DoseDiodeDoseRate	Dose Diode	Dose Rate
DoseDiodeDosePerPulse	Dose Diode	Dose / Pulse
DoseDiodeDosePermAs	Dose Diode	Dose / mAs
DoseDiodeDoseRatio	Dose Diode	Dose Ratio
DoseDiodeDoseRatioKvDose	Dose Diode	Dose Ratio (kV)
DoseDiodeDoseRatioIonChamberDose	Dose Diode	Dose Ratio (ICH)
DoseDiodeSerial	Dose Diode	Serial
DoseDiodeCalibrationDate	Dose Diode	Calibration Date
DoseDiodeType	Dose Diode	Type
DoseDiodeCalibrationLab	Dose Diode	Calibration Lab
DoseDiodeCalibrationReport	Dose Diode	Calibration Report
DoseDiodeSensorID	Dose Diode	Sensor ID
DoseDiodeDescription	Dose Diode	Description
DoseDiodeDeltaSigmaSignalBad	Dose Diode	Delta Sigma Signal is bad
DoseDiodeDeltaSigmaSignalWorse	Dose Diode	Delta Sigma Signal is out of Range
LuminanceLuminanceIntegral	Luminance	Luminance Integral
LuminanceLuminanceRate	Luminance	Luminance
LuminanceSerial	Luminance	Serial
LuminanceCalibrationDate	Luminance	Calibration Date
LuminanceType	Luminance	Type
LuminanceCalibrationLab	Luminance	Calibration Lab
LuminanceCalibrationReport	Luminance	Calibration Report
LuminanceSensorID	Luminance	Sensor ID
LuminanceDescription	Luminance	Description
LuminanceDeltaSigmaSignalBad	Luminance	Delta Sigma Signal is bad
LuminanceDeltaSigmaSignalWorse	Luminance	Delta Sigma Signal is out of Range
IlluminanceIlluminanceIntegral	Illuminance	Illuminance Integral
IlluminanceIlluminanceRate	Illuminance	Illuminance
IlluminanceSerial	Illuminance	Serial
IlluminanceCalibrationDate	Illuminance	Calibration Date
IlluminanceType	Illuminance	Type
IlluminanceCalibrationLab	Illuminance	Calibration Lab
IlluminanceCalibrationReport	Illuminance	Calibration Report

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IlluminanceSensorID	Illuminance	Sensor ID
IlluminanceDescription	Illuminance	Description
IlluminanceDeltaSigmaSignalBad	Illuminance	Delta Sigma Signal is bad
IlluminanceDeltaSigmaSignalWorse	Illuminance	Delta Sigma Signal is out of Range
NullModality		Modality
NullUserkV		Set kV
NullUsermA		Set mA
NullUserDuration		Set Duration
NullUsermAs		Set mAs
NullUserSDD		Set SDD
NullUserLocation		Location
NullUserComments		Comments
NullSerial		Serial
NullCalibrationDate		Calibration Date
NullType		Type
NullCalibrationLab		Calibration Lab
NullCalibrationReport		Calibration Report
NullSensorID		Sensor ID
NullDescription		Description
NullDeltaSigmaSignalBad		Delta Sigma Signal is bad
NullDeltaSigmaSignalWorse		Delta Sigma Signal is out of Range
mACurrent	mA Sensor	Current (mA)
mACurrentRate	mA Sensor	Charge (mAs)
mASerial	mA Sensor	Serial
mACalibrationDate	mA Sensor	Calibration Date
mAType	mA Sensor	Type
mACalibrationLab	mA Sensor	Calibration Lab
mACalibrationReport	mA Sensor	Calibration Report
mASensorID	mA Sensor	Sensor ID
mADescription	mA Sensor	Description
mADeltaSigmaSignalBad	mA Sensor	Delta Sigma Signal is bad
mADeltaSigmaSignalWorse	mA Sensor	Delta Sigma Signal is out of Range
AuxSerial	Aux	Serial
AuxCalibrationDate	Aux	Calibration Date
AuxType	Aux	Type
AuxCalibrationLab	Aux	Calibration Lab
AuxCalibrationReport	Aux	Calibration Report
AuxSensorID	Aux	Sensor ID
AuxDescription	Aux	Description
AuxDeltaSigmaSignalBad	Aux	Delta Sigma Signal is bad
AuxDeltaSigmaSignalWorse	Aux	Delta Sigma Signal is out of Range

Appendix D

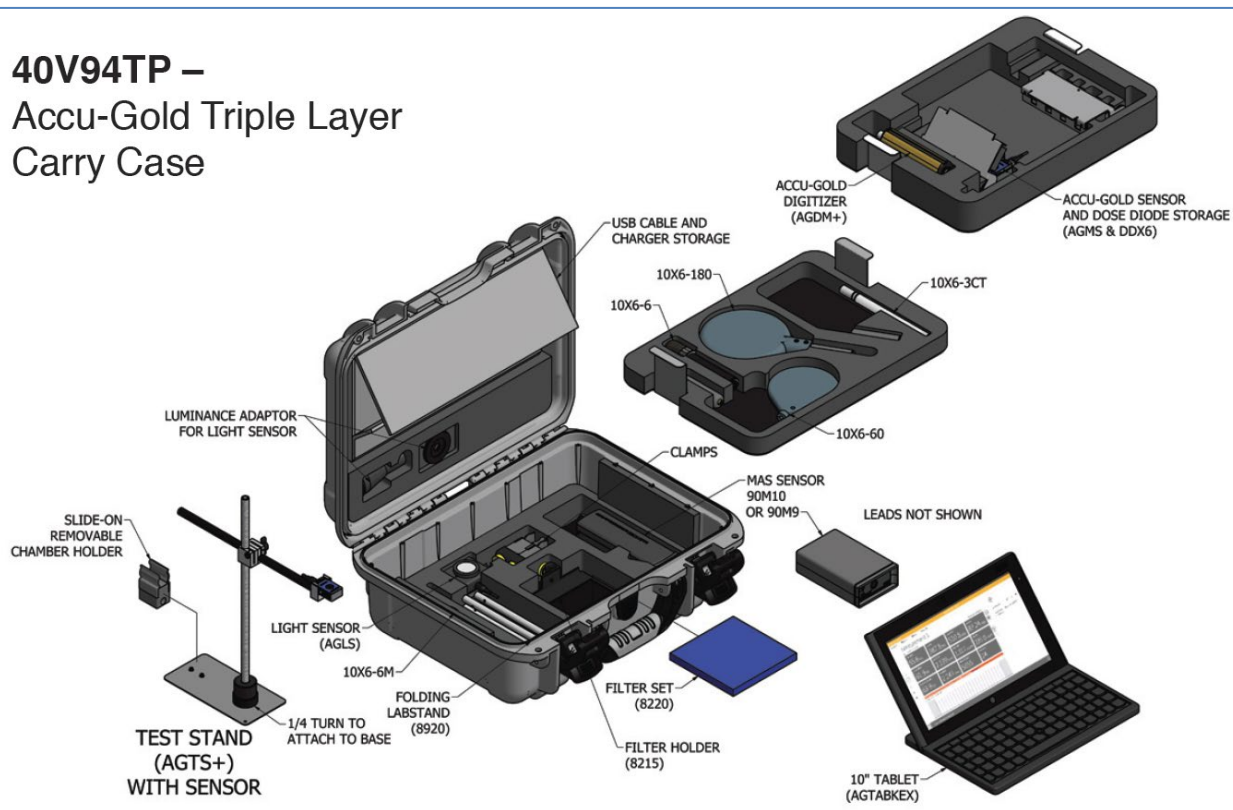## Carrying cases

Soft Cases –

Model AGSC

Hard Cases

40V94R (AGTAB10) /
40V94R7 (AGTAB7) –
Accu-Gold Double Layer
Carry Case

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40V94TP –
Accu-Gold Triple Layer
Carry Case

ACCU-GOLD
DIGITIZER
(AGDM+)

ACCU-GOLD SENSOR
AND DOSE DIODE STORAGE
(AGMS & DDX6)

USB CABLE AND
CHARGER STORAGE

10X6-180

10X6-3CT

10X6-6

LUMINANCE ADAPTOR
FOR LIGHT SENSOR

10X6-60

CLAMPS

MAS SENSOR
90M10
OR 90M9

LEADS NOT SHOWN

SLIDE-ON
REMOVABLE
CHAMBER HOLDER

LIGHT SENSOR
(AGLS)

10X6-6M

FILTER SET
(8220)

1/4 TURN TO
ATTACH TO BASE

FOLDING
LABSTAND
(8920)

FILTER HOLDER
(8215)

TEST STAND
(AGTS+)
WITH SENSOR

10" TABLET
(AGTABKEX)

Appendix E

Making low-level measurements

The Model AG-GND Grounding Cord is to be used when the measuring system lacks an earth ground and low-level signals are to be measured. Laptop computers normally are isolated from earth ground even when the charger is plugged in as a result of transformer isolation. When making low-level measurements, it is necessary to remove all sources of electrical interference by grounding the system. In order to add the missing ground, Radcal offers the AG-GND grounding cord that allows one to conveniently earth-ground the computer by plugging one end into the ground pin of a standard 3-pin AC socket and the other end into an available USB port. Only the shell of the USB port is connected.

Note that this plug is intended for use with standard 3-pin North American sockets only. For other plug-socket arrangements (or if used with an extension cord) it must be used with an appropriate adapter that properly grounds the center pin of the plug.

A grounding wire with alligator clips is also provided that can be used when an AC receptacle is not accessible. The alligator clip can be attached to a grounded cabinet or conduit and the other end attached to one of the unused connector's shell.

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Appendix E Warranties and Disclosures

Warranty for the Accu-Gold Measurement System

Radcal 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

Radcal understands that the Accu-Gold must meet the requirements of the 2002/06/EC (WEEE) Directive, and have implemented full compliance. Recycling manuals are available on request.
The Accu-Gold is considered Test & Monitoring Equipment under Category 9 of the 2002/96/EC (WEEE) Directive, and therefore does not fall under the 2002/95/EC (RoHS) Directive. According to Article 2 of the RoHS Directive, all categories except 8 and 9 must comply.

Declaration of Conformity

According to Test Report No. EM-1150122

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

Declares that the Product

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

Conforms to the following Product Specification:

EMC:	EN61326-1 (2006) Group 1 Class A
	EN 61000-4-2 (1995) +A1 +A2
	EN 61000-4-3 (2002)
	EN 61000-4-4 (2004)
	EN 61000-4-6 (2009)

The product herewith complies with the RFI-emissions requirements and immunity requirements and carries the CE marking accordingly.

Ivan Chanca
QA Manager
14 March 2014

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