ACCU-GOLD T3

USER GUIDE

Radcal®

Simply Powerful

The Radcal Accu-Gold T3 is a state-of-the-art radiation quality control measurement system with software designed to provide accurate and reliable measurements for a wide range of applications. This instruction manual is designed to guide you through the features and functions of the software, so you can make the most of its capabilities.

With its advanced algorithms and sophisticated sensors, it is capable of making sophisticated measurements in real-time. With its user-friendly interface, Accu-Gold T3 is easy to use and understand, making it the perfect tool for anyone working with radiation.

The Radcal Accu-Gold T3 is the next generation x-ray measurement system that combines a portable standalone measurement system with software that has the ability to provide accurate and reliable dose measurements in real-time. This is achieved through the use of advanced algorithms and sophisticated sensors that are specifically designed to detect and measure radiation. The software also includes a range of customizable settings that allow users to tailor the measurement process to their specific needs.

At T3's core is the usage of profiles. Profiles are used to define the measurement process. They spell out trigger parameters, filtration requirements, the breakdown of the measurement (such as having a scout pulse) and the end of the pulse. Special calibrations are built into the profiles eliminating the need to install calibration files. Profiles allow you to specify different techniques for special measurements rather than relying on across-the-board catch-all techniques.

The T3 Pro with its Wi-Fi capability, adds to the ease of use of the AG3 software making it possible to have the T3 with it's sensors hooked up connected wirelessly 10 meters or more to the computer running AG3.

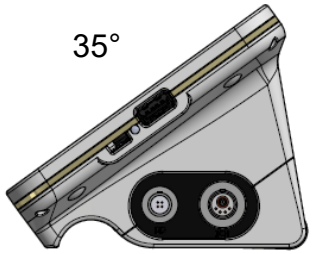
System overview

Accu-Gold T3 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.
The Accu-Gold T3 provides the ability to save all of your measurements. The Accu-Gold T3 system consists of a built-in digitizer module whose function is to transform the analog signals generated by a host of sensors into calibrated digital signals. The T3 is available in different models that are suited for specific applications, the differences being which sensors can be used.

System Configuration Options and Capabilities

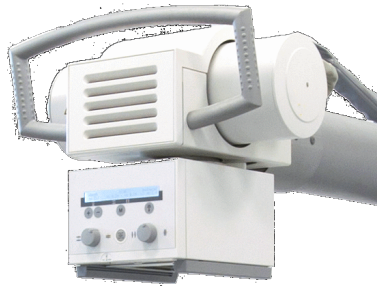
Model Number	Accu-Gold T3 AGT3-AG	Accu-Gold T3 Pro AGT3-P-AG	Rapid-Gold T3 AGT3-RG	Rapid-Gold T3 Pro AGT3-P-RG	Accu-Dose T3 AGT3-AD	Accu-Dose T3 Pro AGT3-P-AD
Standalone Operation	X	X	X	X	X	X
AG3 USB Connection		X		X		X
AG3 Wireless Connection		X		X		X
Sensor Options						
AGMS-D+ AGMS-M+ AGMS-DM+	X	X	X	X		
Ion Chambers	X	X			X	X
Dose Diode	X	X	X	X	X	X
mAs Sensor	X	X	X	X		
Light Sensor	X	X				

The T3 will auto-switch between two different viewing angles

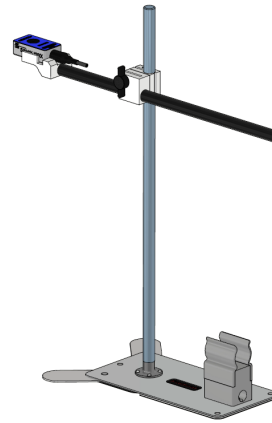


Caution: All connectors are push-pull – do not twist

Setting up the Hardware



1. Connect the sensor(s) to the T3.
2. Position the sensor to make a measurement.
Note: Position the sensor before starting the T3; moving the sensor or cable while it is measuring may trigger a false measurement.
3. Place the sensor in the path of the X-ray beam.
Note: Make sure the temperature of the ion chamber (if used) has stabilized* before making a measurement.
4. The unit will have Quick-Start on and will choose a profile automatically.
Turn on the T3. The unit will automatically go into measure mode.
5. The firmware begins to initialize the hardware as indicated by the status at the bottom of the screen. If an ion chamber is connected, the bias supply needs to start and stabilize.
6. As soon as the “READY” message is displayed at the bottom of the screen, you can make a measurement.
7. Activate the X-ray machine to capture the exposure data.
8. The T3 automatically saves and displays the data for the measurement when the exposure is complete.
9. At any time you can review outputs of the current measurement or previous measurements. Make additional exposures as necessary.
Note: All measurements are automatic (except for Manual Trigger Mode) until you press the **Pause** button.
10. If you need to reposition the sensor(s), click the **Pause** button to temporarily take the sensor offline and prevent any inadvertent null exposures from being added to your measurements.
11. Click the **Play** button when you are ready to make your next measurement.



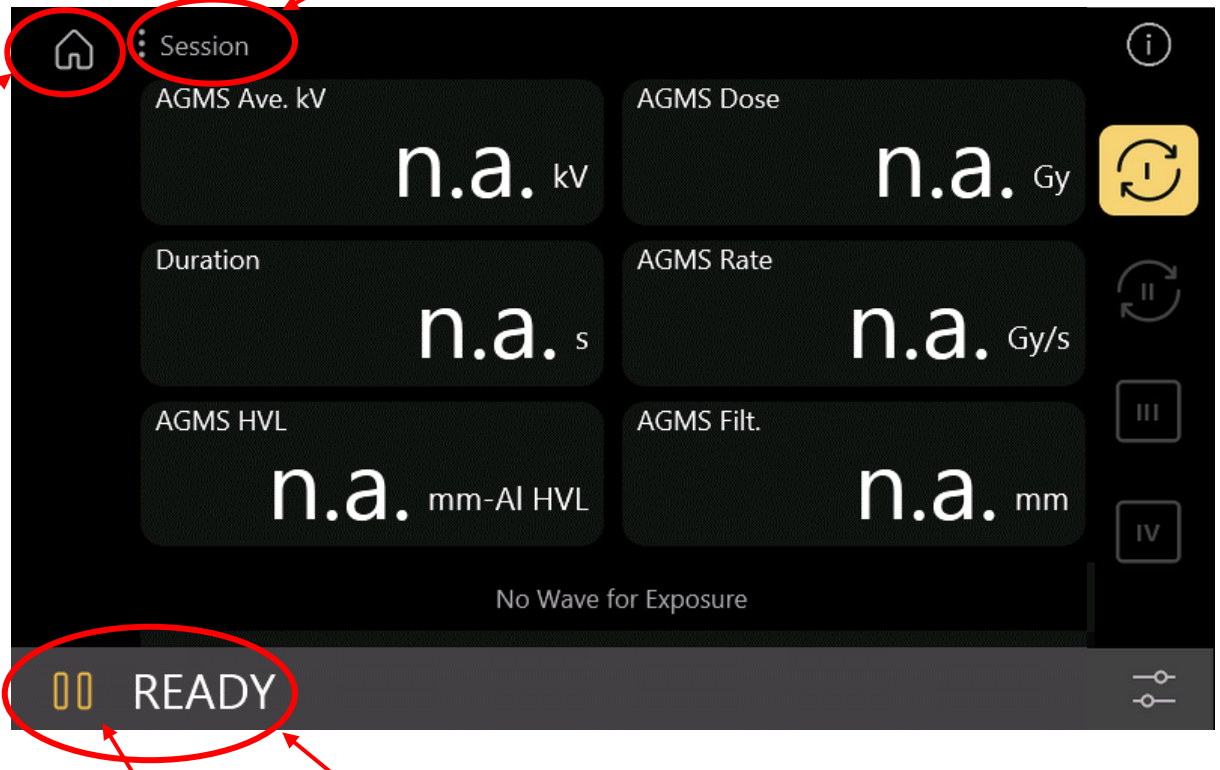
Measurements Using Solid State Mammographic Sensors
If using the multisensor for mammography, go to Manual Mode to choose the appropriate Anode-Filter (see Manual Mode). Radcal sensor calibrations assume that a 2.2 mm polycarbonate paddle, or the simulated paddle supplied with the multisensor (Model 8154), is placed on top of the sensor.

Making a Measurement with multiple sensors connected
The Accu-Gold T3 allows you to connect up to five sensors (depending on model – see System Configuration Options and Capabilities) simultaneously and collect data from all of the connected sensors.

*For changing environments, allow 10 minutes for every 10 C difference for the sensor/electronics to equilibrate.

Quick Start

Plug in your sensors, start the T3 - you are ready to make measurements …



Takes you to the Home screen

Play

Touch play when the sensors are in place.

Pause

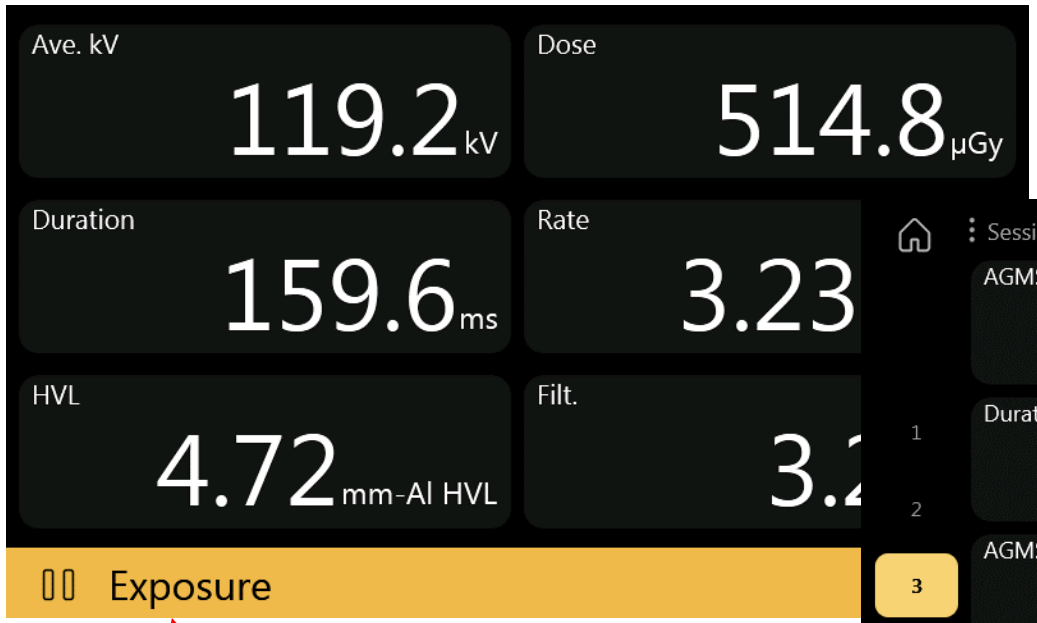
Touch pause before moving sensors or cables.

Indicates system is *Ready* to make a measurement.

Press *Pause* or *Play*

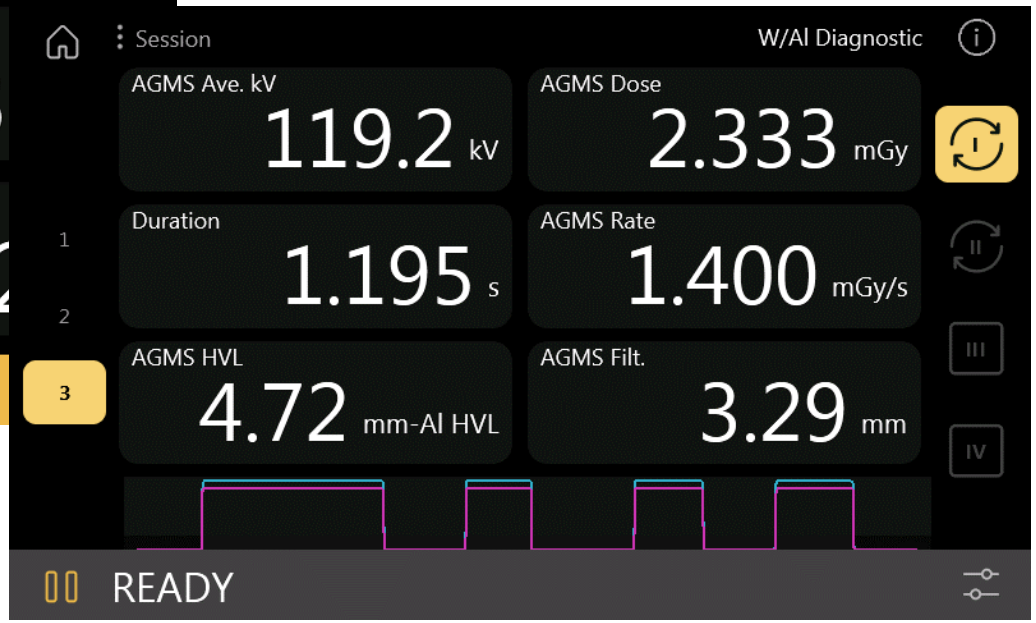
Make your first measurement…

Data shown is the real-time data as the exposure is happening

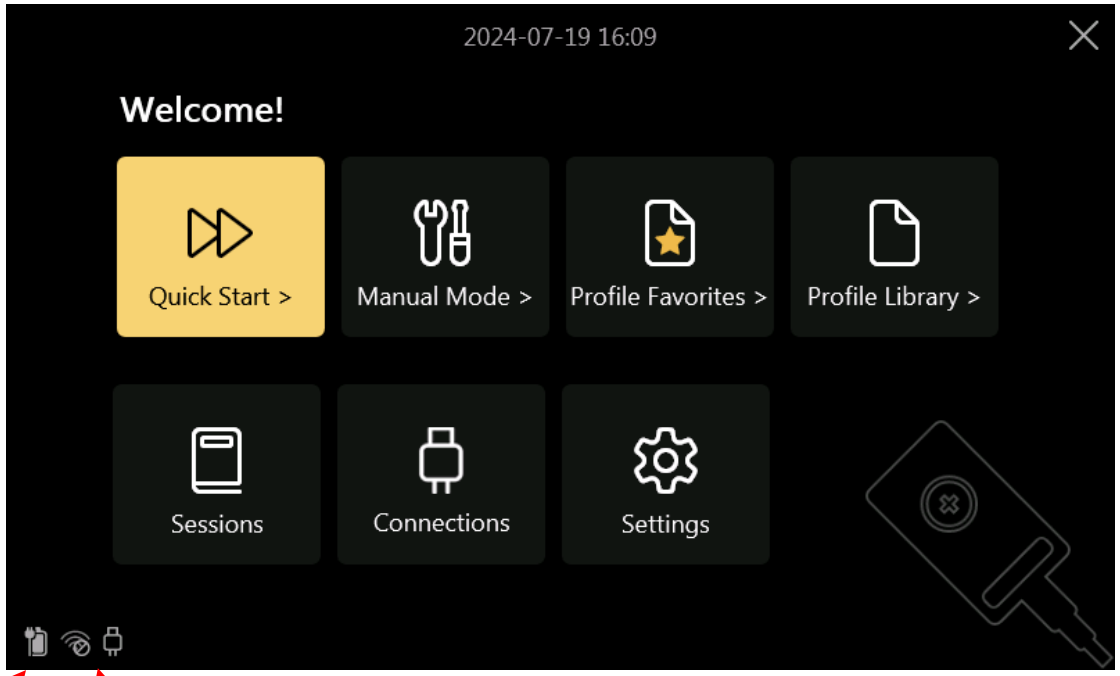


Measurement has been triggered

After the exposure the values are updated by the post-exposure results and the waveform is displayed.



The Main Menu



If you attach the sensor before you start, the software will go straight to measuring* (see previous page).
Otherwise, click on **Quick-Start** to start.

*This can be overridden in the Settings menu: "Auto-Start Measurement"

If the choices made by Quick-Start are not appropriate** for the measurements you are making, choose **Manual Mode** or select a profile from the Profile Library.

If you are continuing a previous session, choose **Sessions**.

Battery charge level

Connection method

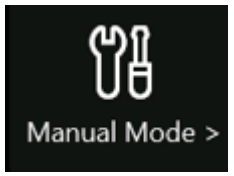

Level

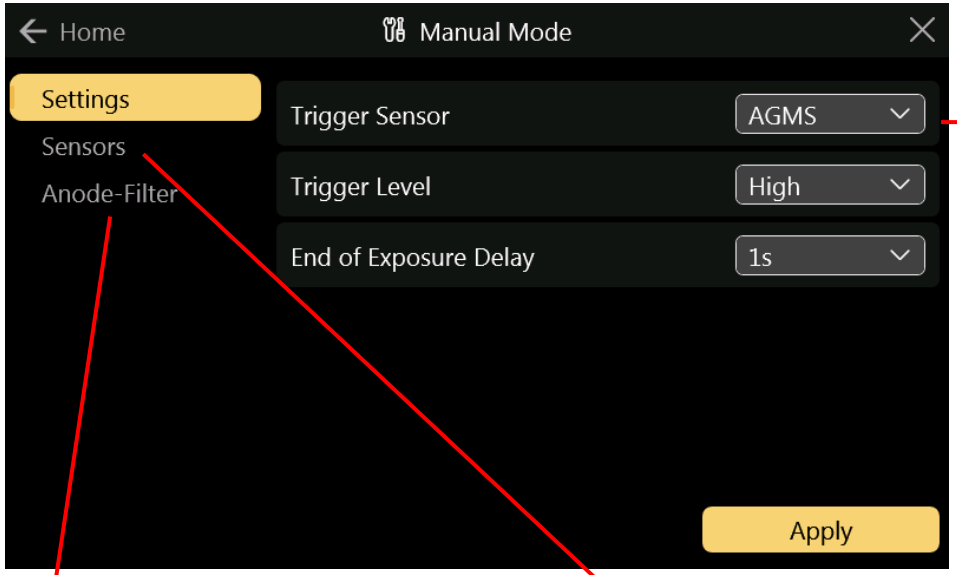

Charging

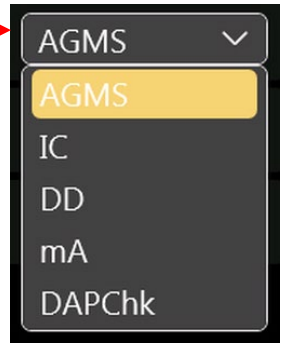

Error

**Quick-Start will look to see what sensors are attached and will automatically choose the appropriate profile. Note: when using the DM sensor, it will choose the W-Al diagnostic calibration as the default. If you are making Mammo measurements, you will have to choose the appropriate A-F manually.

The Manual Mode

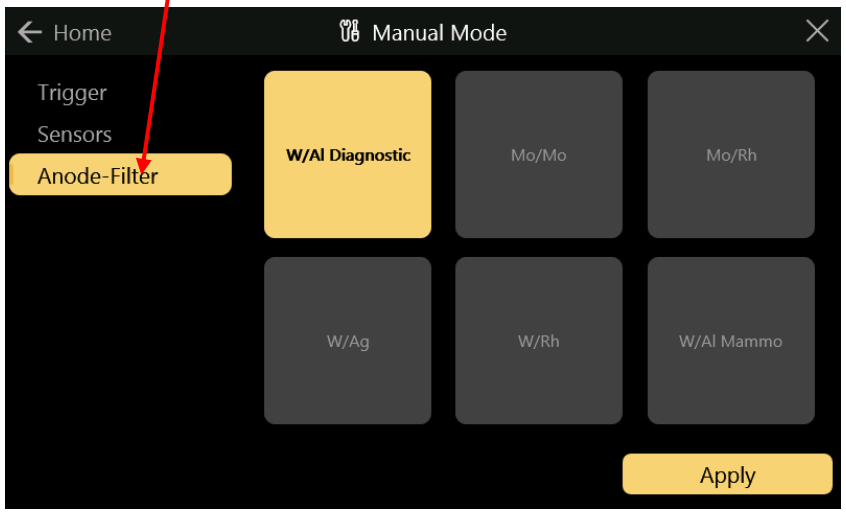


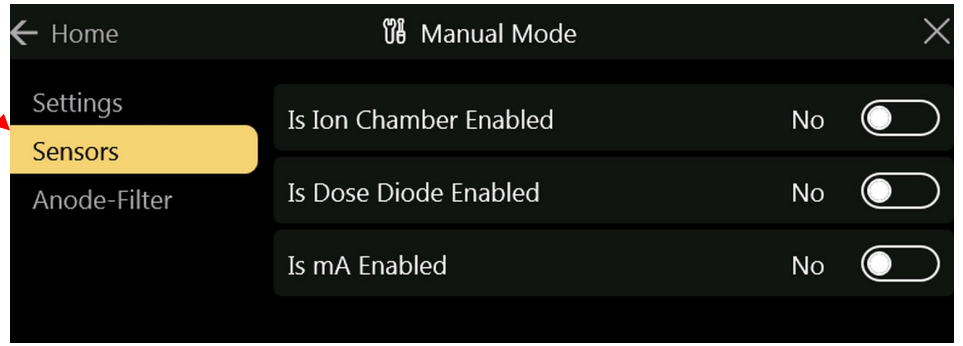




Choose the sensor to use for triggering the measurement

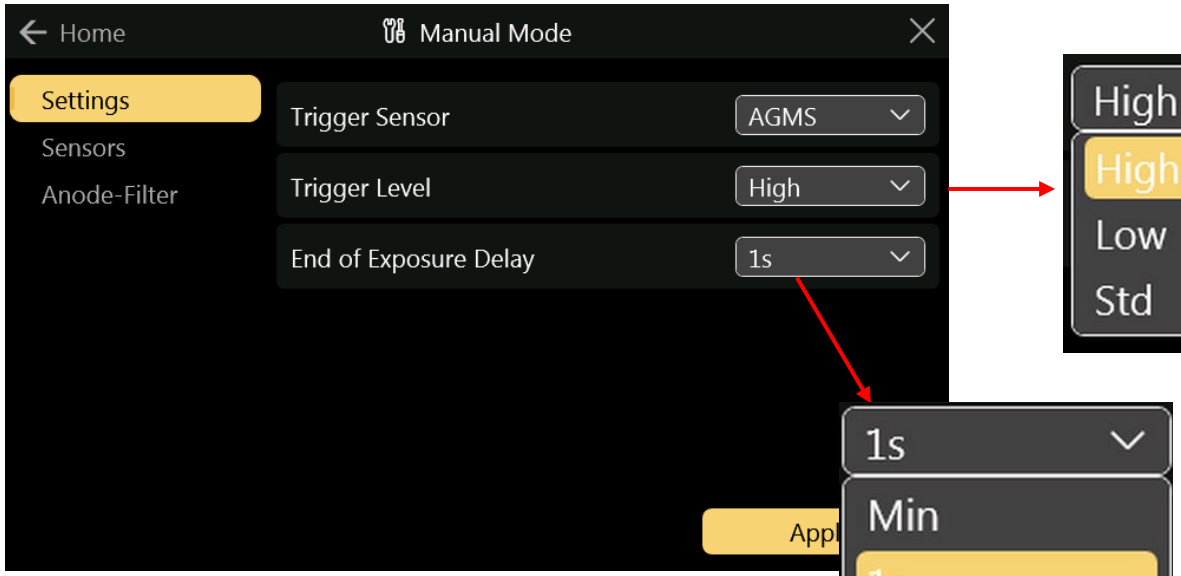
Before making an exposure, make sure to choose the Anode/Filter combination that matches the machine being measured.

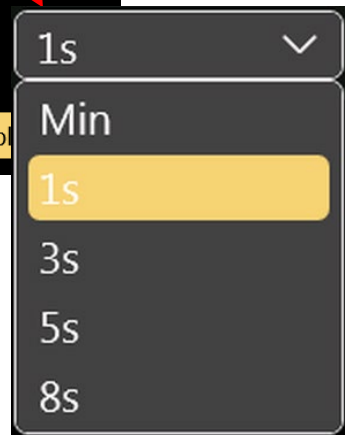




The Accu-Gold Digitizer Module (AGDM) allows you to simultaneously collect data from multiple sensors.

The Manual Mode (cont)





High – Select if ***Std*** causes false triggering.

Low - Select if Std is not low enough. ***Low*** may allow smaller signals to be captured, but may also result in false triggers.

Std - ***Std*** trigger sensitivity is recommended.

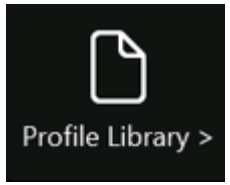
Many x-ray feature scout exposures may introduce gaps of several seconds or more in the radiation output. The default end of exposure timing in some instances will not be long enough and Accu-Gold may attempt to display the exposure results while the generator is still finishing the exposure. If this 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 and therefore use ***Min*** with large signals only where zeroing in between measurements is not important – use with "High Trigger Level".

Note: If noise or false triggers prevent reliable ion chamber measurements and grounding the 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. (refer to Application Note AN1007* for more information)

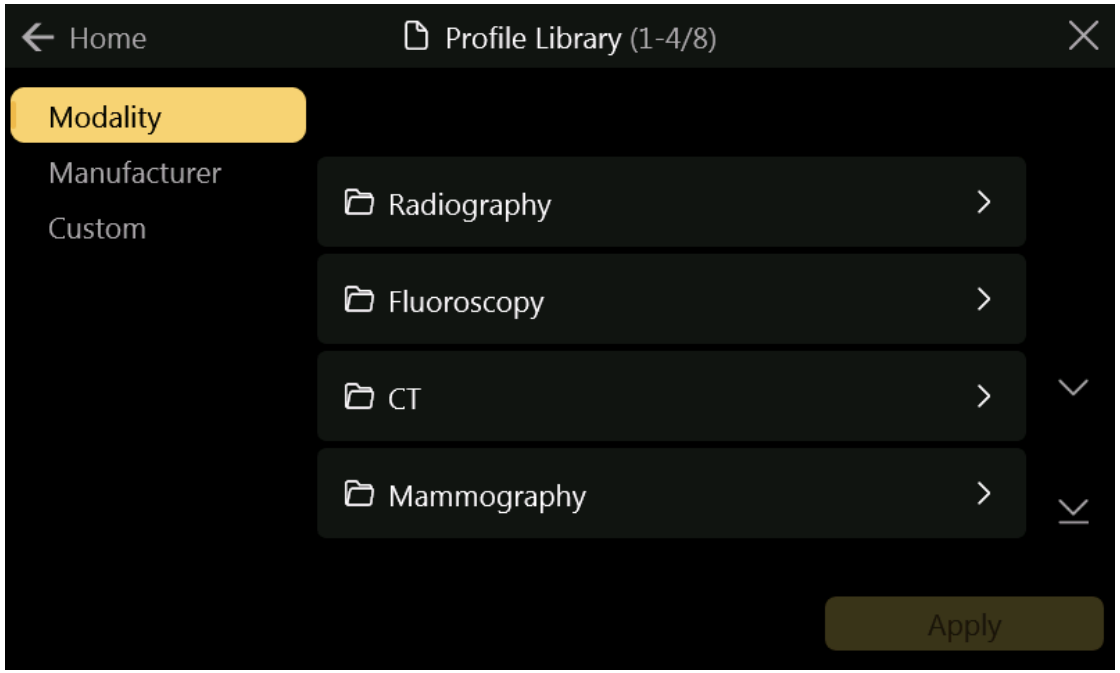
If you have a strong, noise free signal, selecting ***High*** will minimize the time the system measures a background zero in between measurements allowing you to make continuous measurements rapidly. A new zero will be recalculated every 5 minutes.

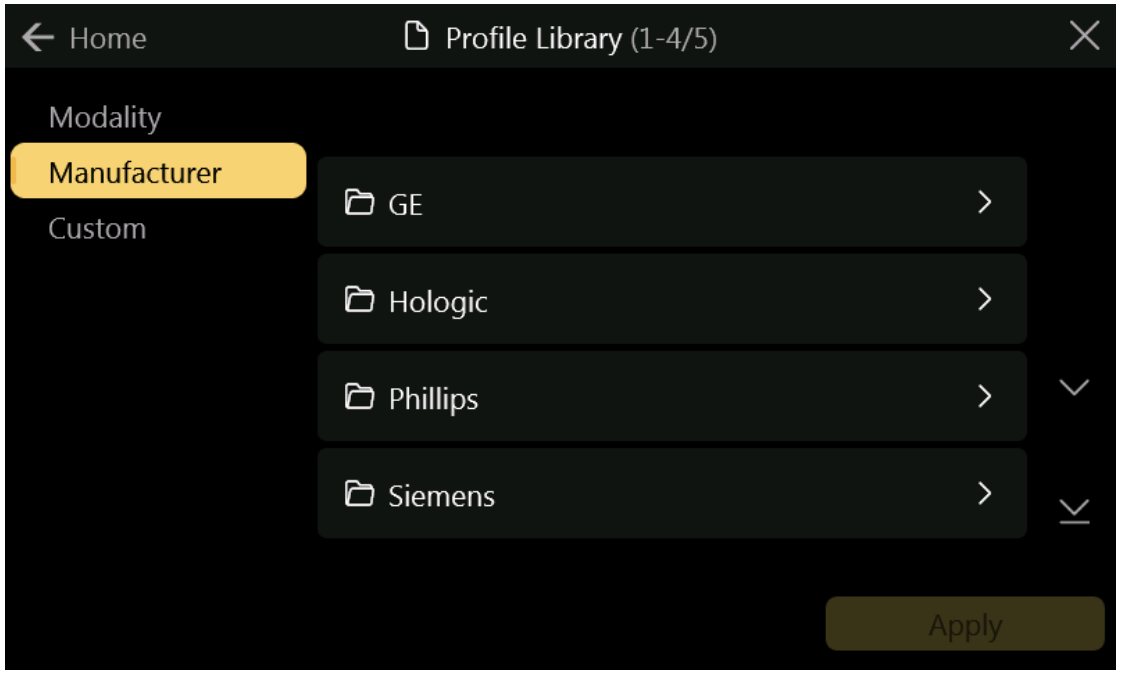
*https://radcal.com/download-application-notes/

The Profile Library

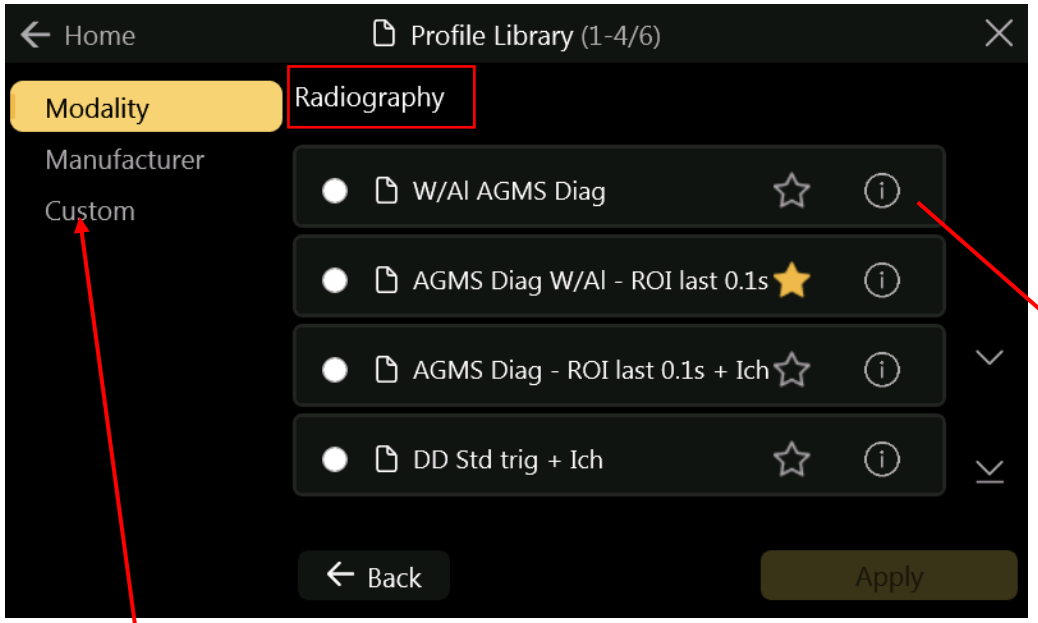


When you don’t get the desired result using Manual Mode, a suitable profile might be available based on Modality or Manufacturer.





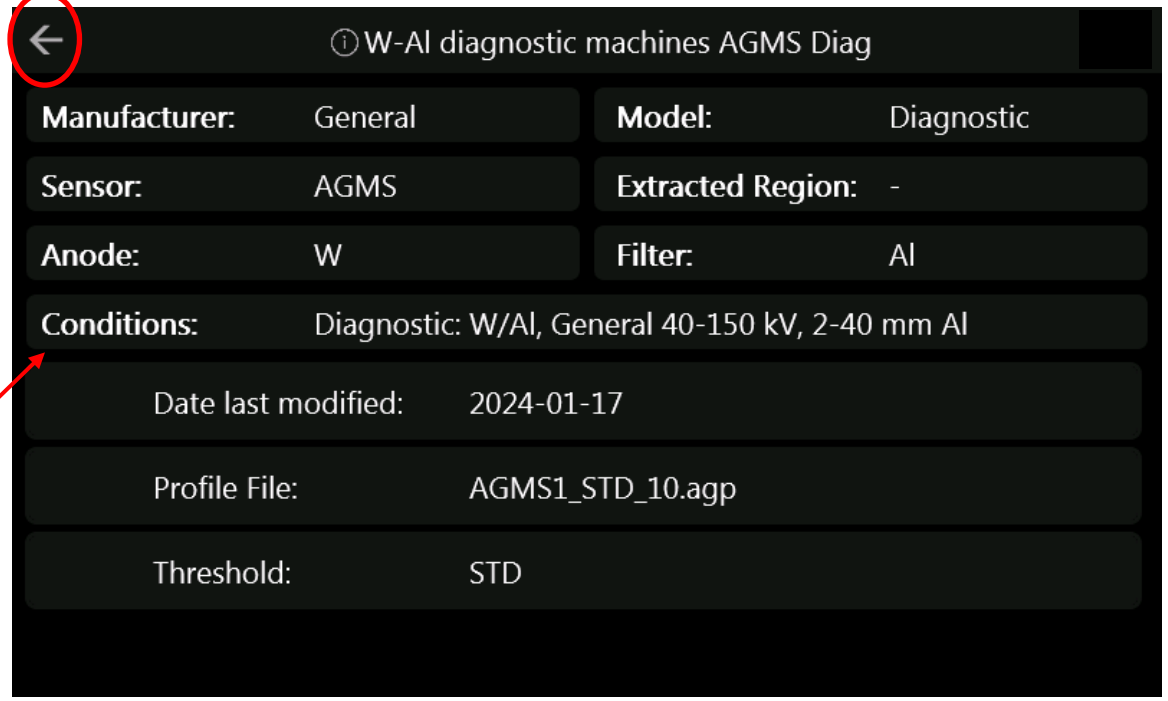
The Profile Library (cont)



Profile selection

Use this if a custom profile has been supplied to you.

Returns to previous screen



Profile information

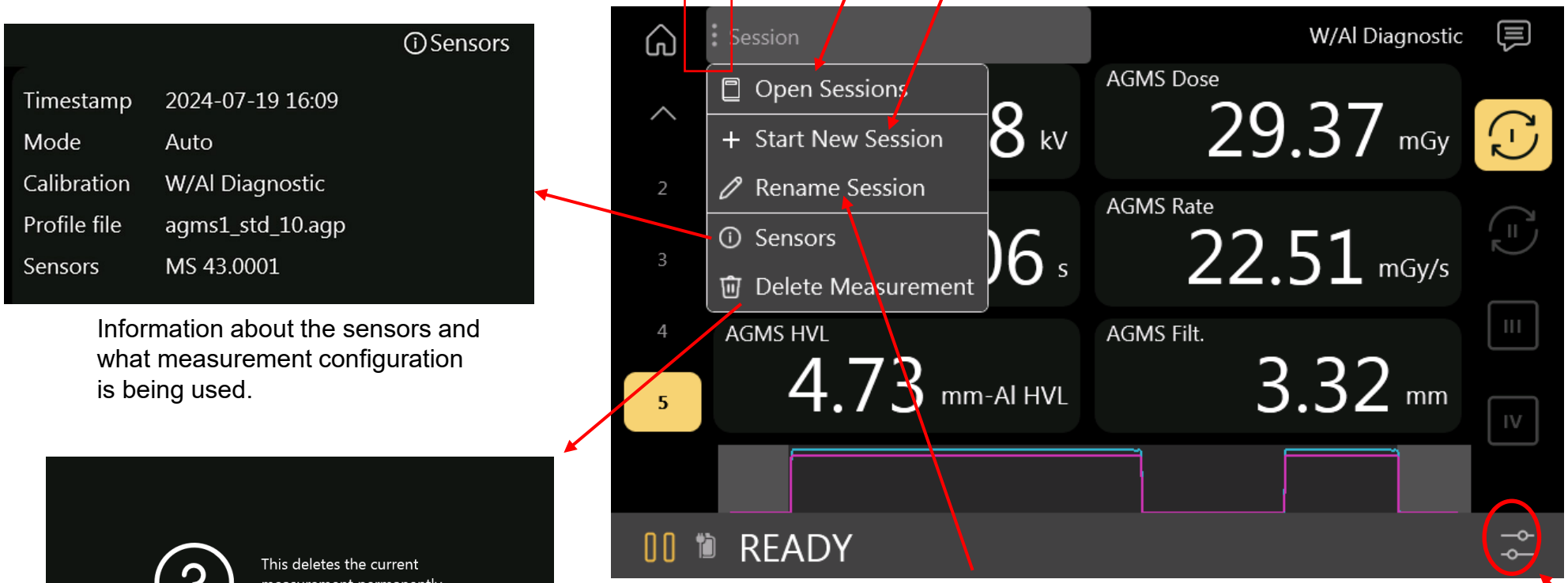
Describes the suggested usage conditions for the profile

The Measure Screen

Opens mini-menu

This will open the Sessions management screen.

A new session is started automatically. Use this if you want to start a new one.



Information about the sensors and what measurement configuration is being used.

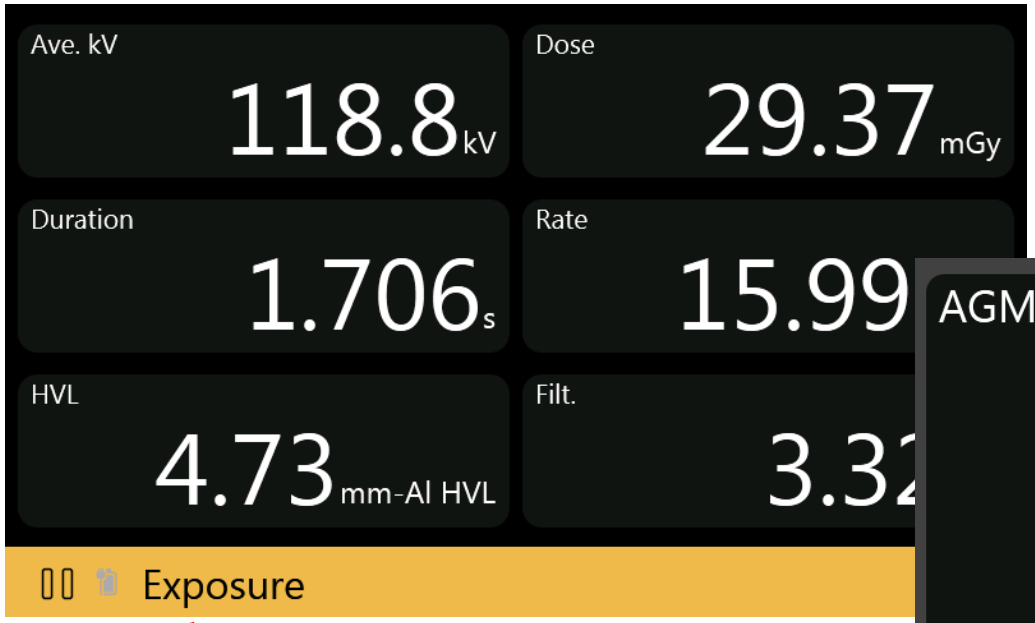
Deletes the current measurement only

Allows you to name the current session

Returns to Profile selection screen or where you were last

The Measure Screen

While making the measurement, the screen will expand* to make it easier to see the data from a distance. The screen will revert back to the original size after 5 seconds.

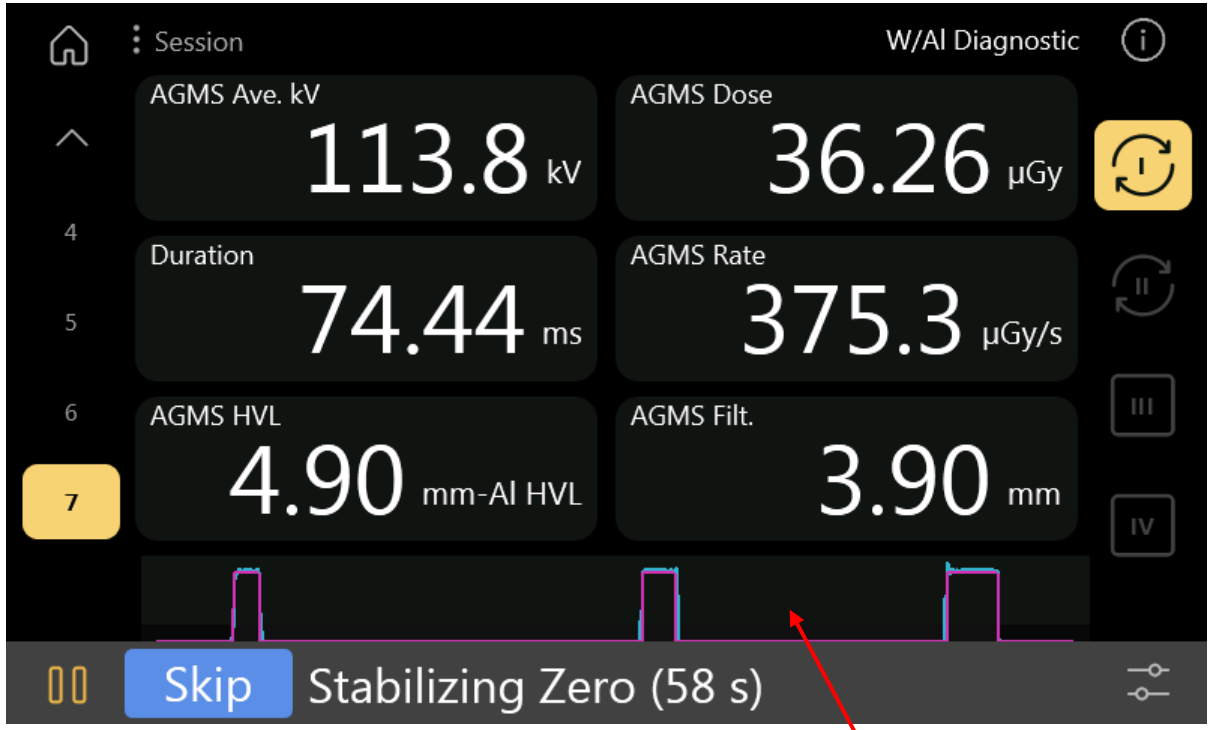


As the sensors react to an exposure, the screen expands and a wide yellow band indicator can be seen across the room.

Touching a cell will zoom that one cell out to the size of the screen in order to see the values even further across a room. Touch again to go back to regular size. Measurements can be made while the cell is expanded.

*This can be changed in the Settings menu: "Automatic Fullscreen on Trigger"

The Measure Screen (cont)

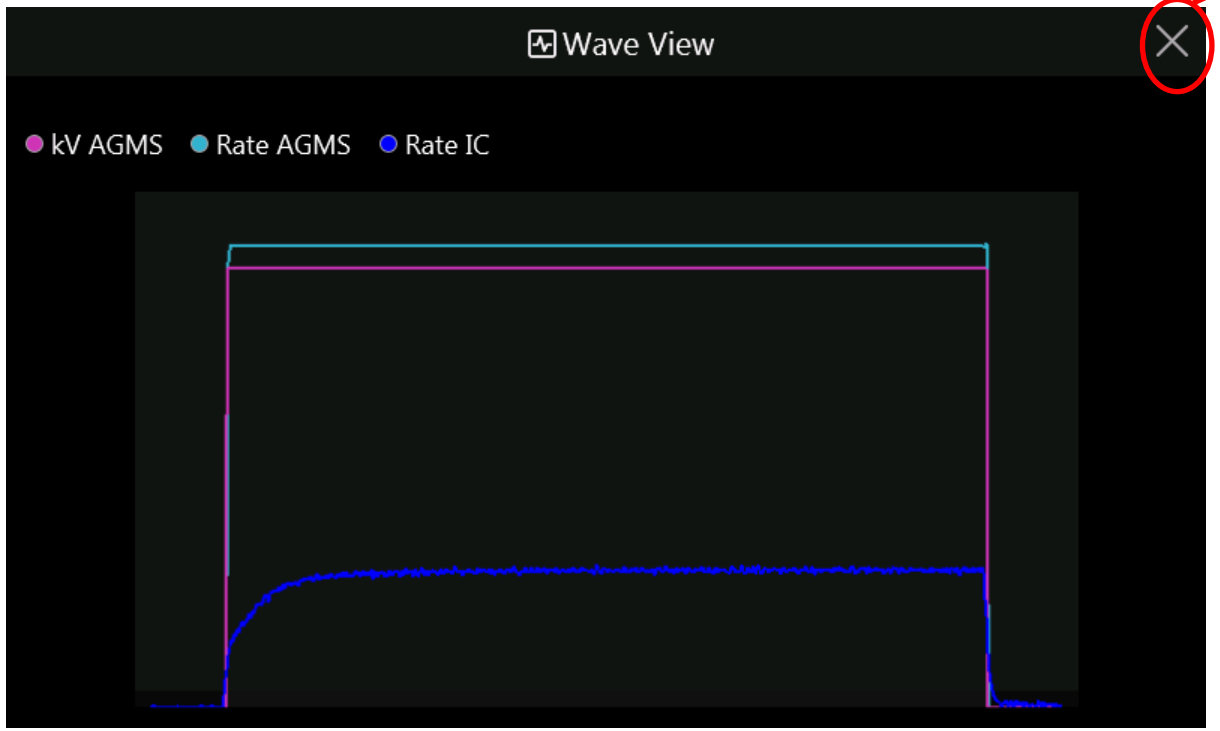


If an ion chamber is used, on the first measurement it will require that you wait 60 seconds while the bias supply stabilizes. Touching “Skip” terminates the recommended stabilizing time.

Touch the waveform anywhere to expand it (see next page)

The Measure Screen (cont)

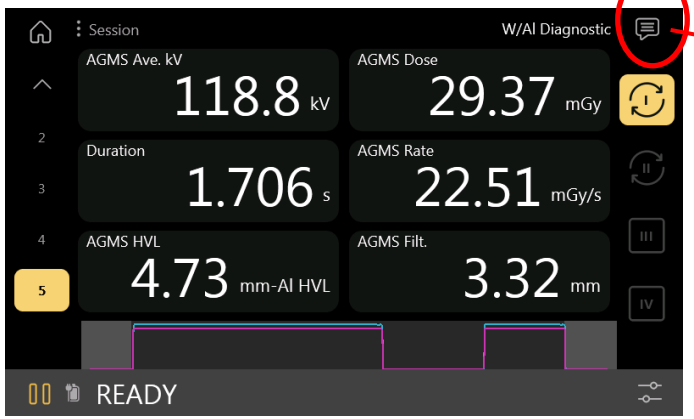
Touching the small waveform on the measurement screen will fill the screen with the waveform in order to see more detail. Touch the ‘X’ to return.

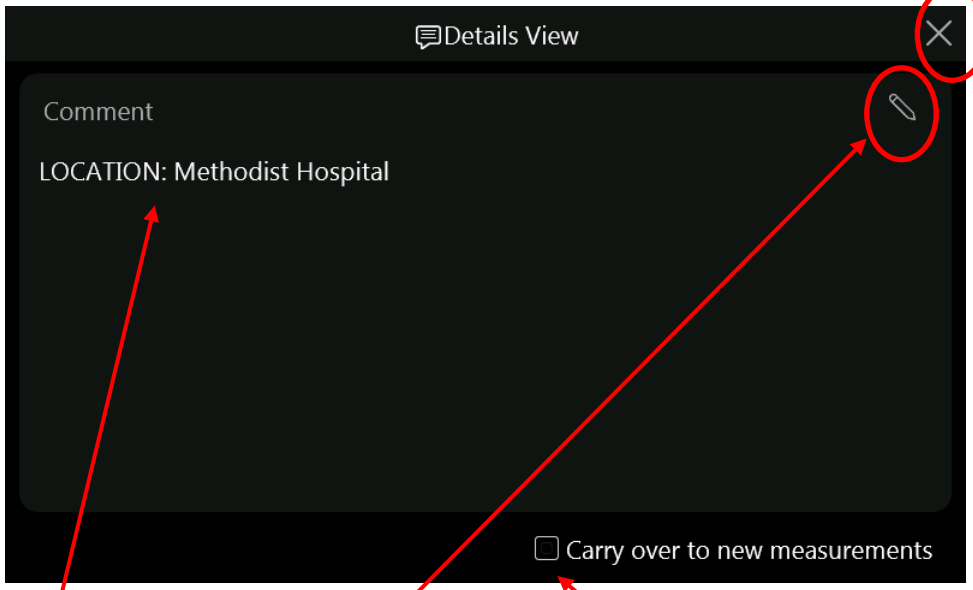


Returns to Measure screen

The Measure Screen (cont)

Touch the comment icon to open the Details View.



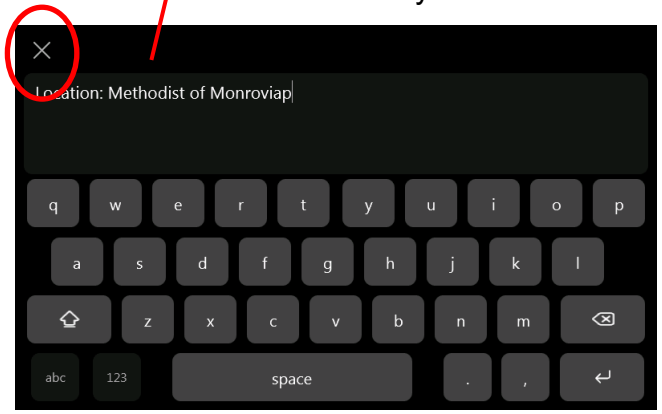


Returns to Measure screen

Touch the pencil and you can add comments to the measurement using the built-in keyboard.

Checking the box will copy the Comment to the next measurement.

Touch the 'X' to return.

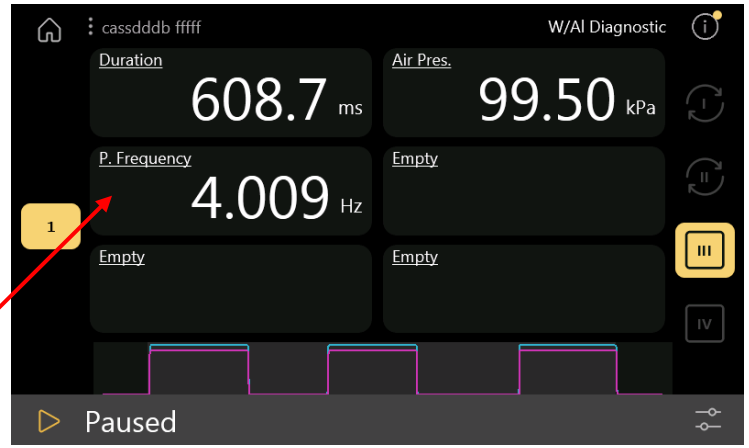


Customizing the Screen

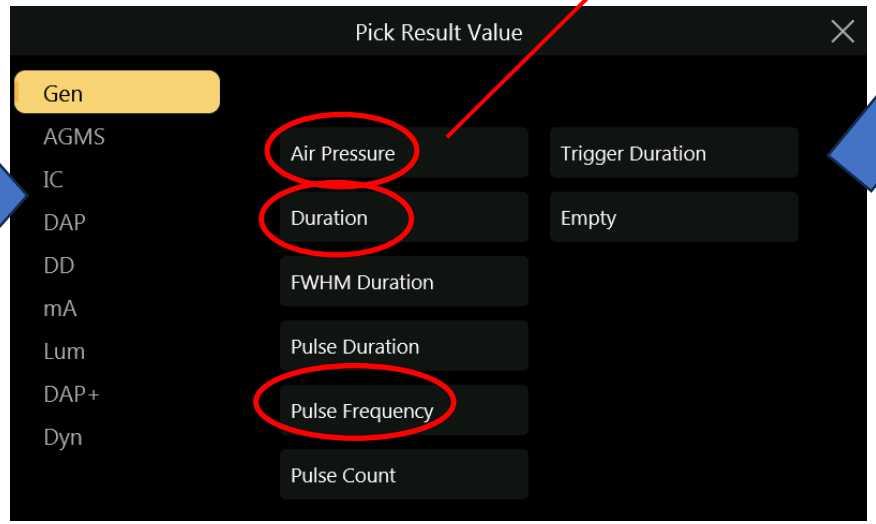
The screen can be customized to display different result values. There are two Standard display profile pages and two Custom pages that can be modified. The Standard pages will update based on the sensors being measured. The Custom pages will always show the values you have chosen.

Standard display profiles

Custom display profiles

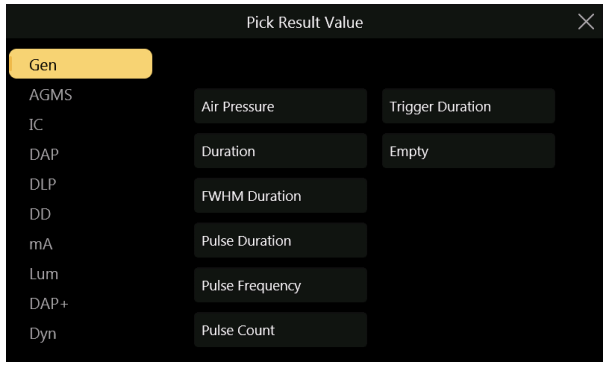


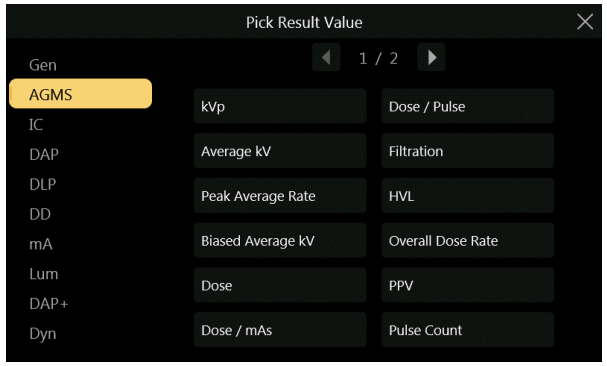
Select the underlined title to change to display a different measurement result value:

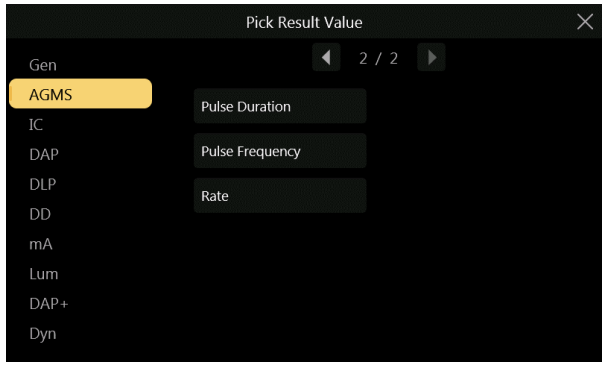


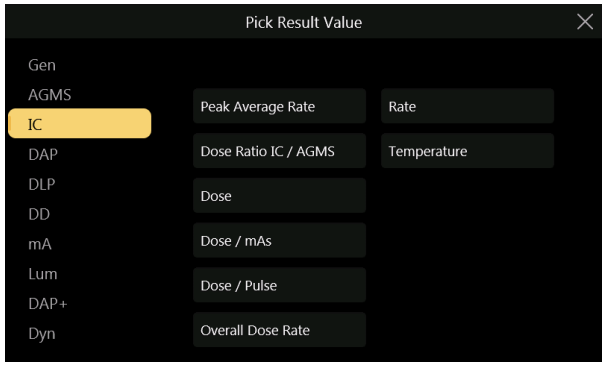
Gen results are measured by sensors in the digitizer itself.

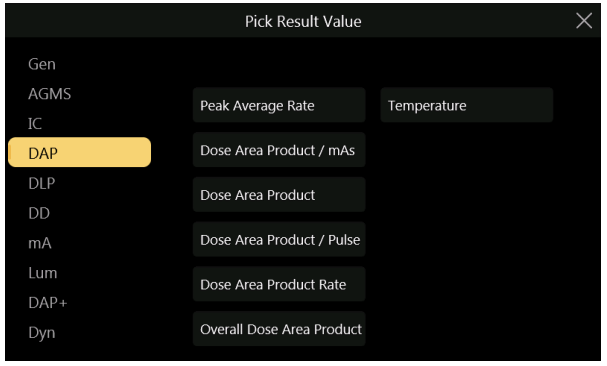
Customizing the Screen (cont)

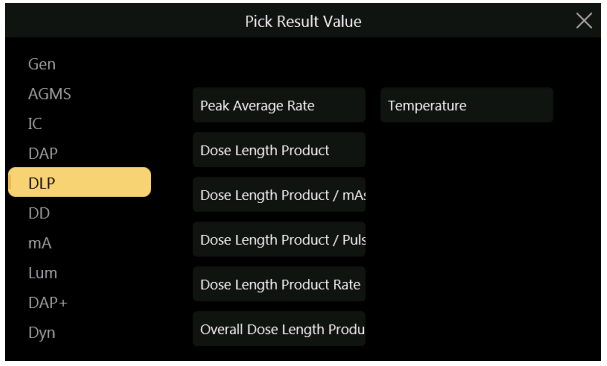


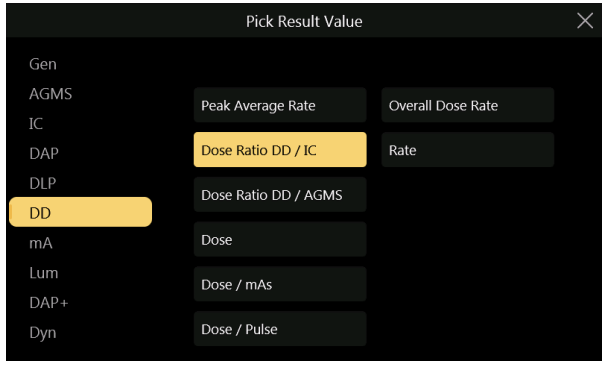


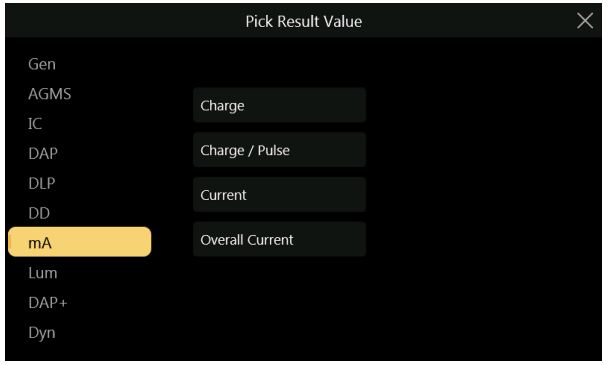


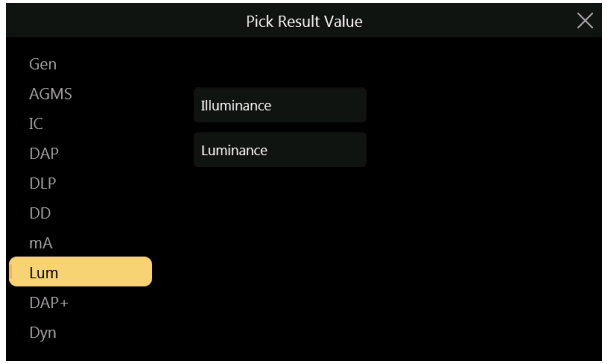


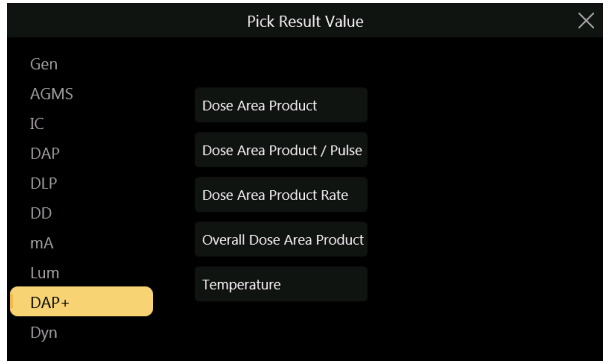


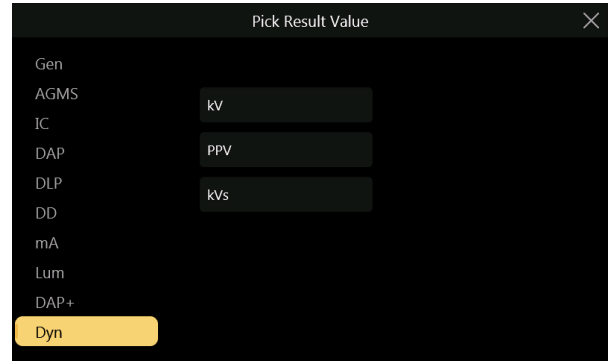






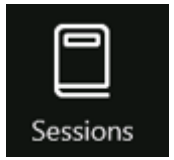






The default kV measurement is Average kV. See AN1016 for more information on the different types.

Sessions



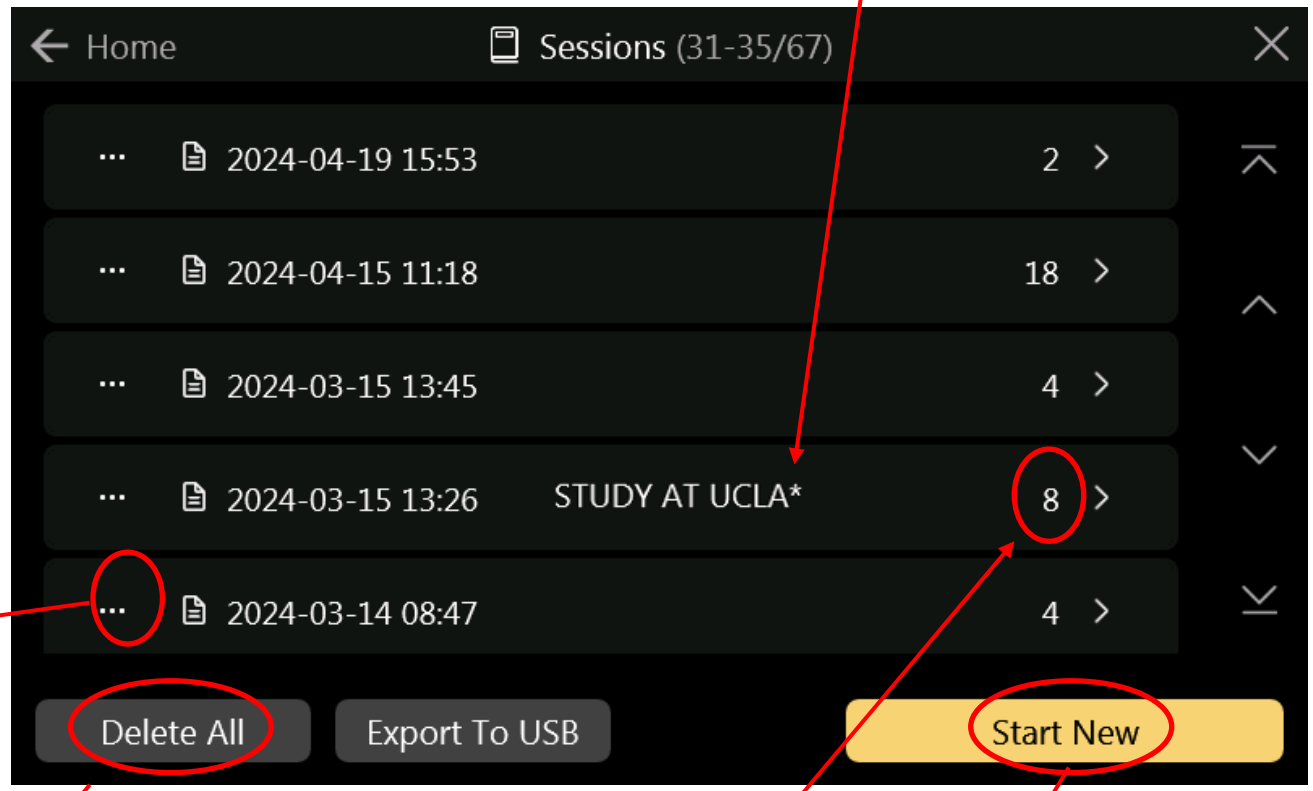
Data on the T3 is segregated into sessions. Every time the T3 is turned on, a new session is automatically created and automatically saved when turned off. Use “Start New” to create additional session groups without turning off the unit.

Adding data to a previous session is possible by touching the ‘>’ symbol.

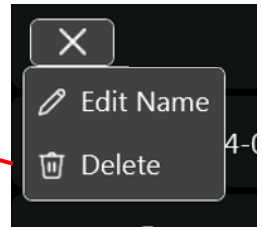
Sessions can be titled to identify the locale where the data were taken.

The data can be exported to a flash drive to share the data or create additional reports.

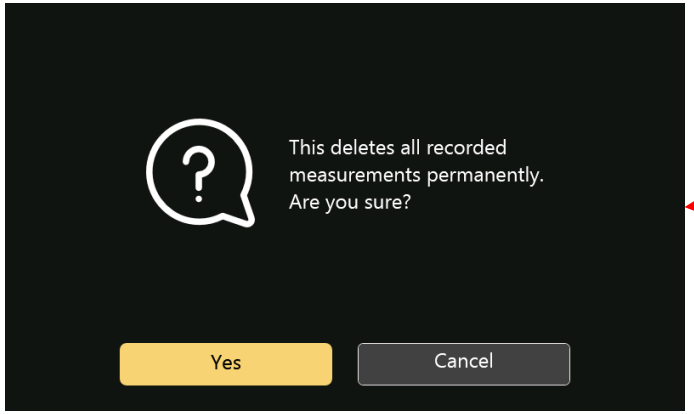
* = Current session



Touch the three dots to bring up this menu:



This will delete only the one session.



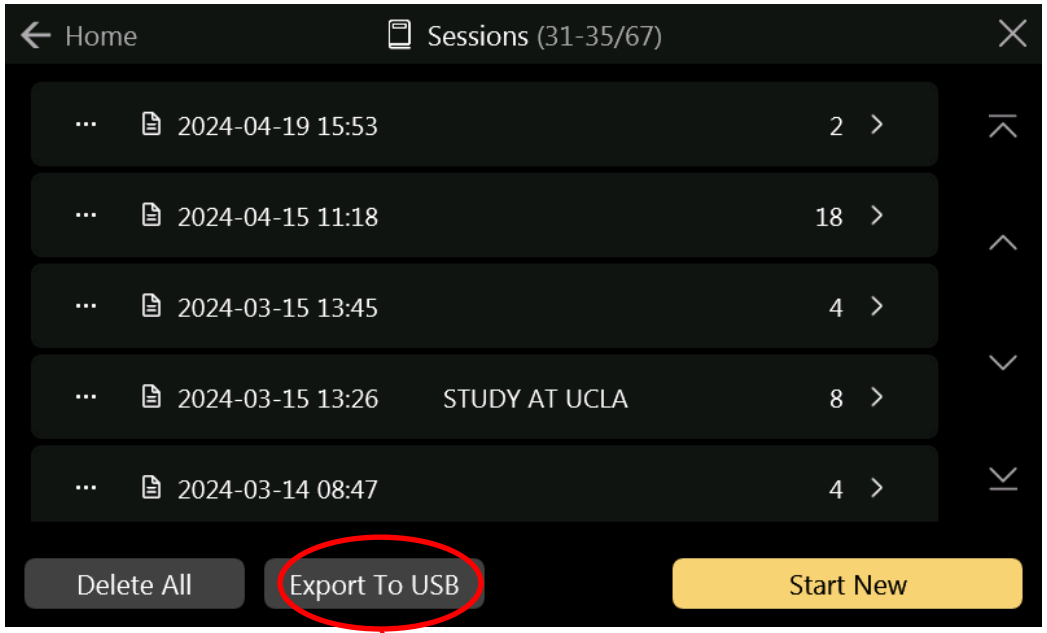
This will delete all data on the T3.

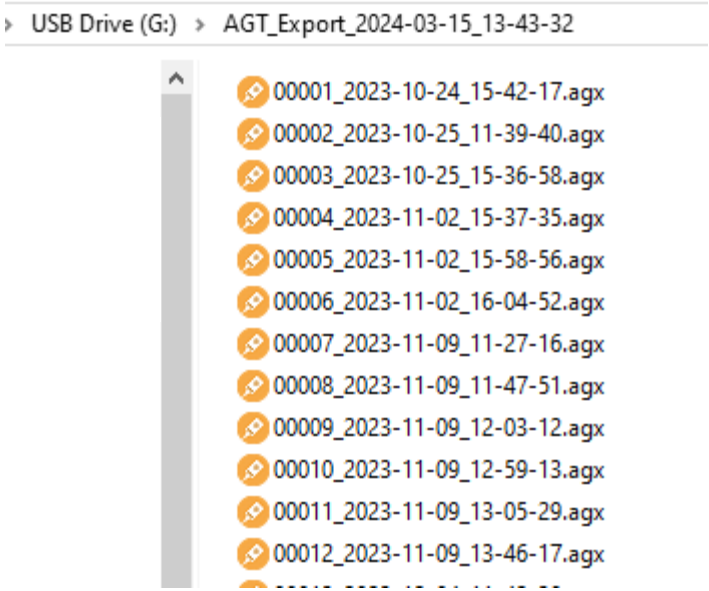
Note: only values will be exported, wave data will not.

Number of measurements in the session

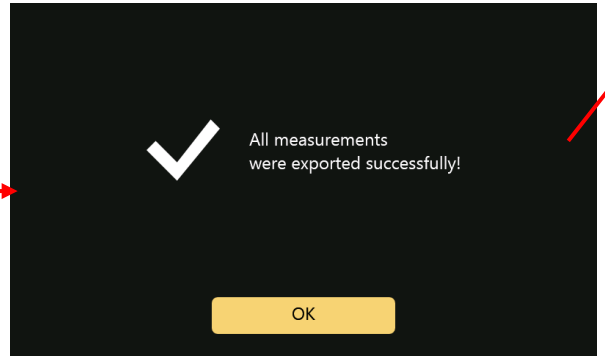
This will start a new session without turning off the unit.

The Sessions screen (cont)



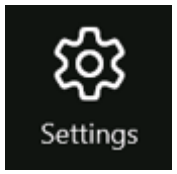


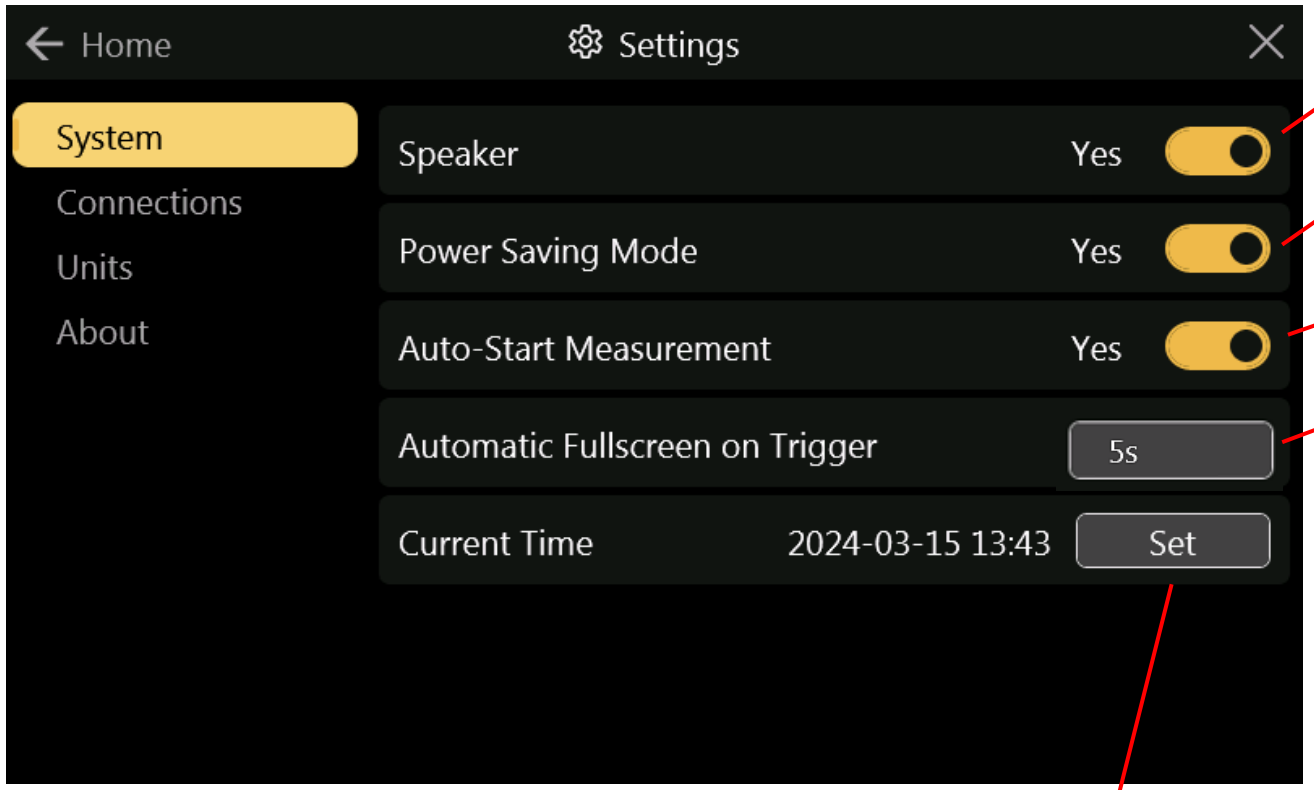
Insert a USB flash drive into the unit first. All of the T3 data will be exported. The exported sessions are compatible with AG3 (install AG3 first). Note: do not use a USB flash drive that was used for a firmware upgrade.



The flash drive will contain .agx files that correspond to the session files from the T3. Measurement data can be viewed using AG3 and then exported to Excel if desired. (Note: Wave data will not be available)

The Settings Menu - System



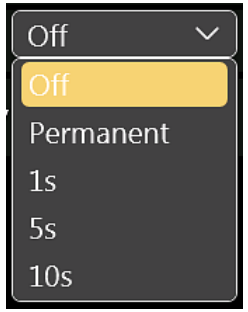


Turns on/off the sounds generated during measurements

The unit will dim the display after 30 seconds and power off after 30 minutes of no activity unless turned off here.

The unit will go into Quick-Start when turned on unless turned off here.

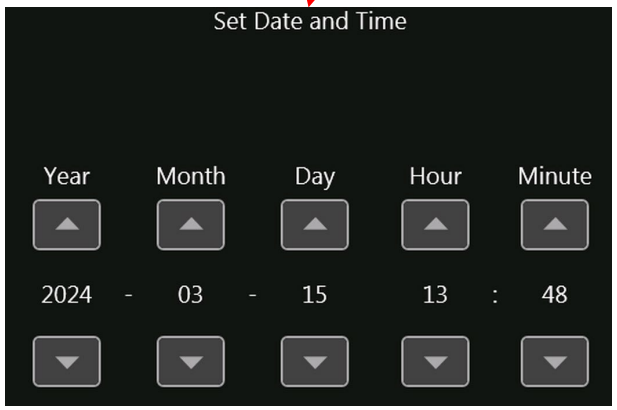
When making a measurement, the measure screen will automatically expand to full screen making the measurement values bigger. After approximately 5 seconds, it will go back to normal size. You can also choose the length of time it waits or turn off this feature:



Permanent will leave it expanded until you manually restore it by tapping the screen.

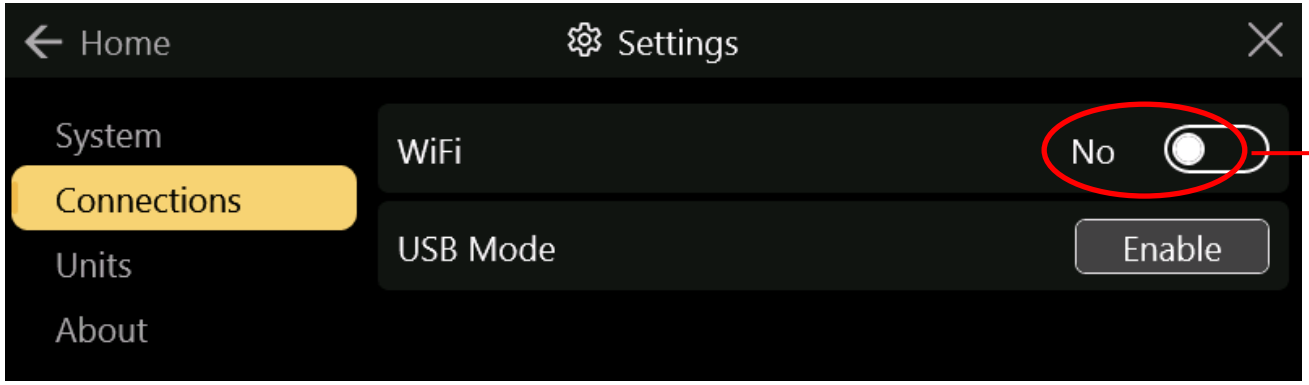
Measurements and sessions include time information. If the time needs to be set, touch *Set*

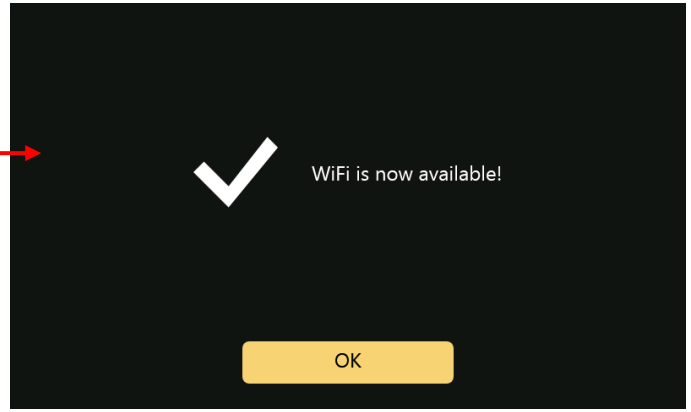
Touch up or down arrows to set the time. When done, select the *Back* arrow to continue.



The Settings Menu – Wi-Fi mode

The T3 Pro can work in sync with AG3 wirelessly using a Wi-Fi connection as an access point.

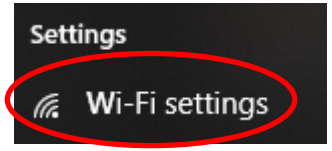




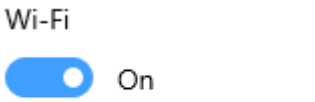
You will need to tell your PC how to connect to the T3:

Press the Windows key and start to type ‘WiFi settings’.

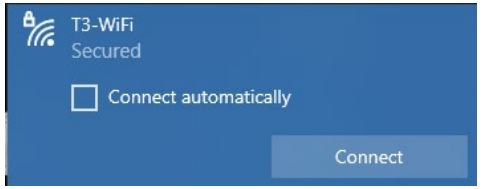
Then select ‘WiFi settings’.



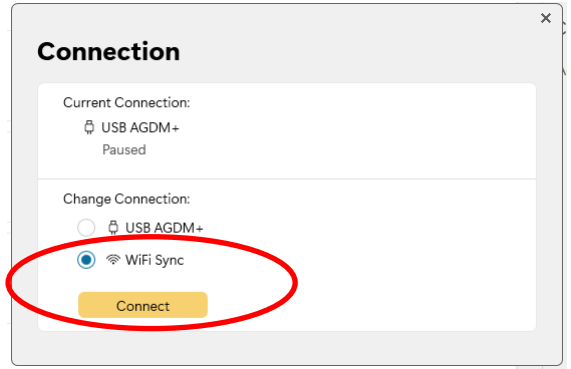
Make sure Wi-Fi is ‘On’ on your computer then select ‘Show available networks’



You will see ‘T3_56-xxxx’ with the serial number of your unit in the list. Click ‘Connect’ and enter 12345678 as the password.



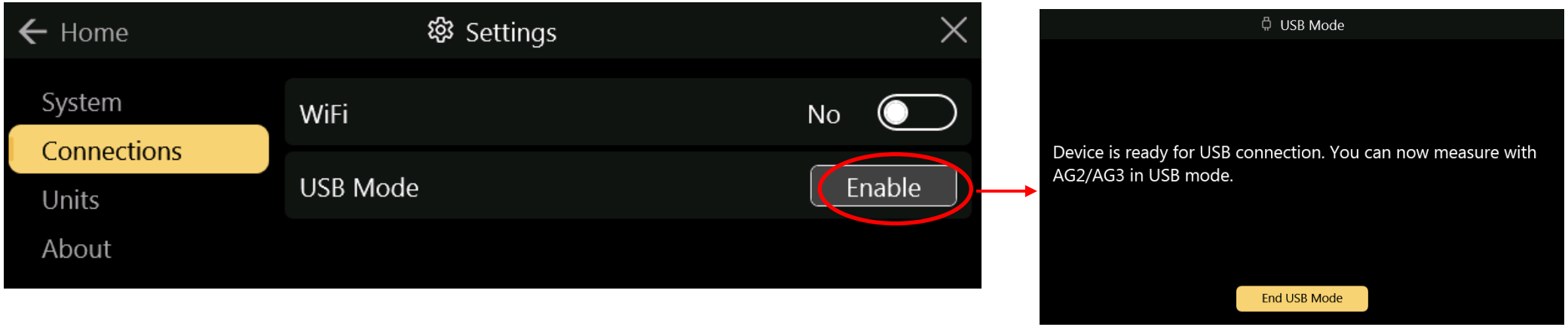
In AG3, at the *Main* menu, choose *Connection* then “WiFi Sync



See AG3 manual for more information

The Settings Menu – USB mode

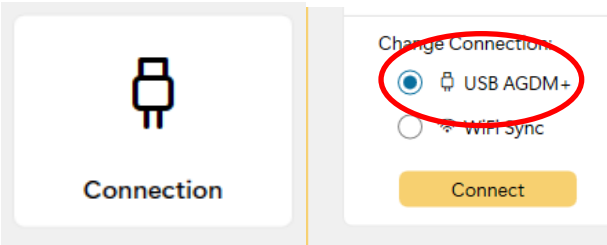
The T3 Pro version can work in sync with AG3 also by using a USB cable, thru a USB connection.



Connect your computer USB connection to the T3 USB using a USB cable with a 'micro-USB' connector.

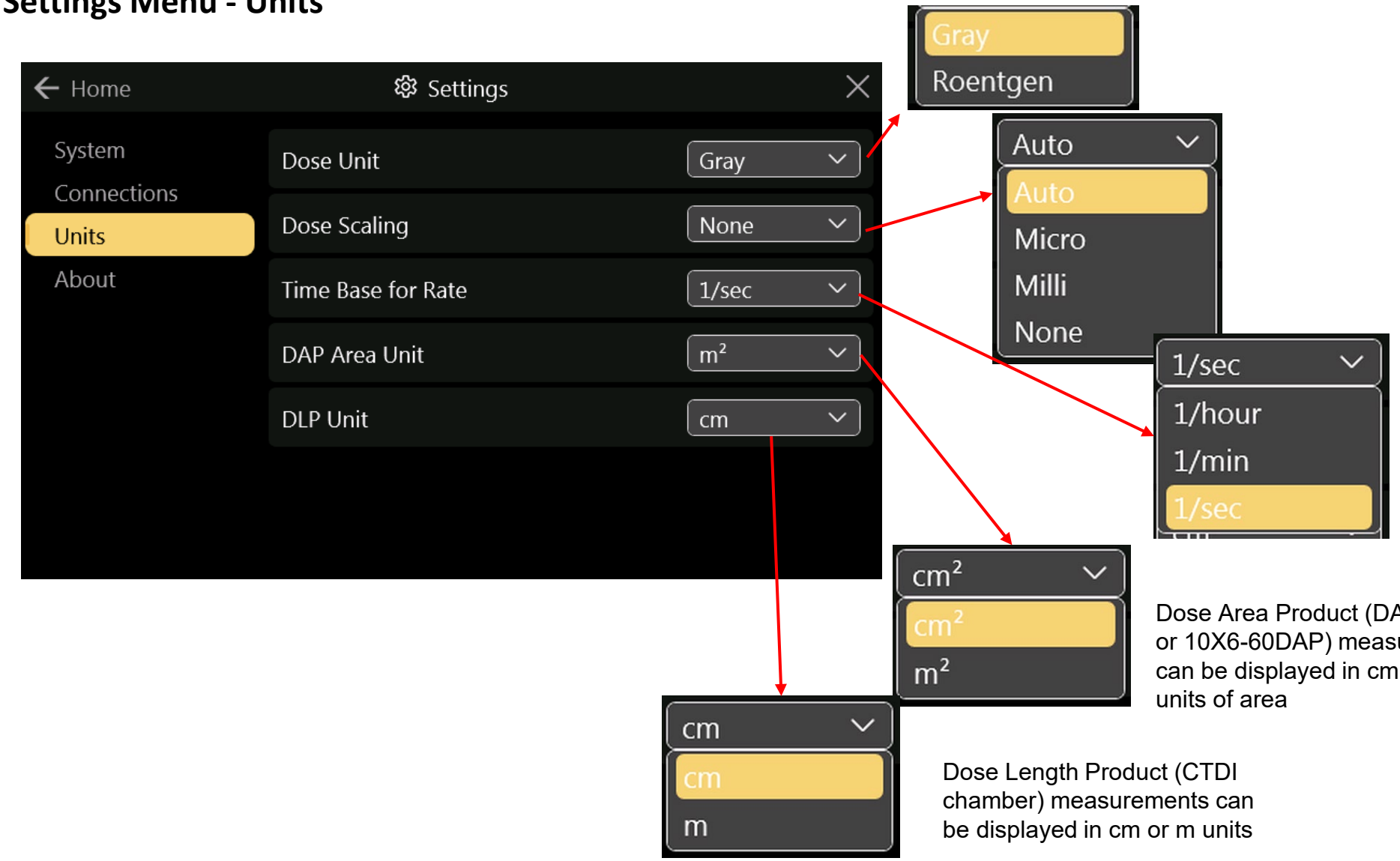
A Male to Micro B Male shielded with ferrites.

In AG3, choose *Connection* then "USB AGDM+"



See AG3 manual for more information

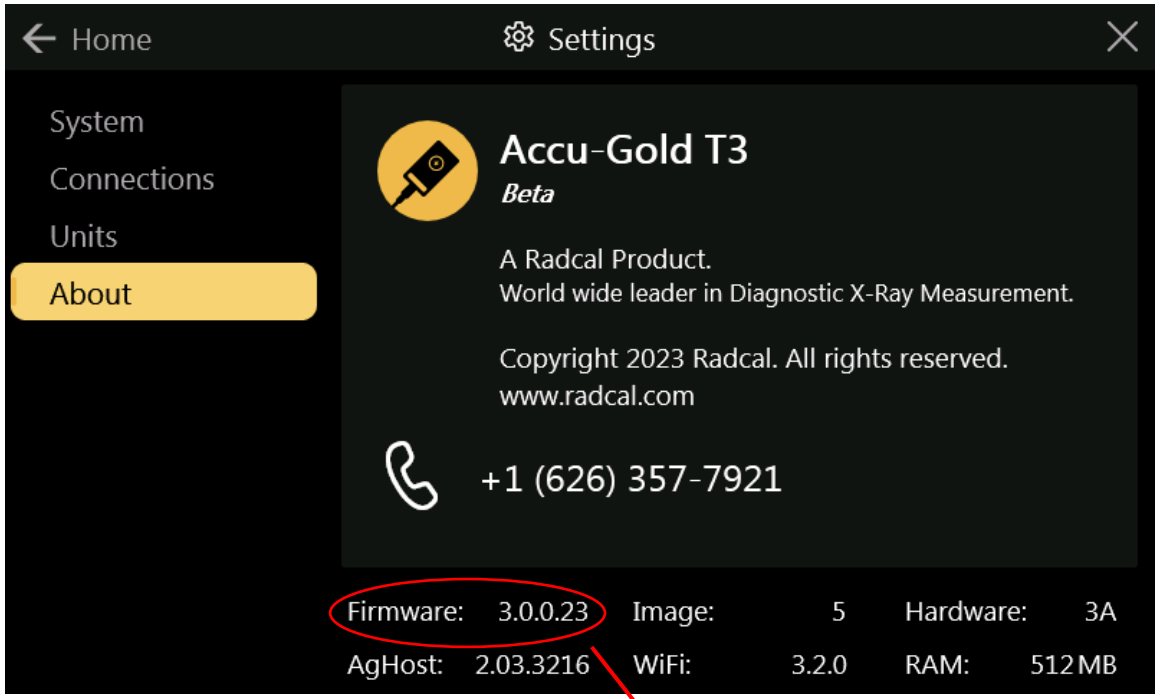
The Settings Menu - Units



Dose Area Product (DAPCHK or 10X6-60DAP) measurements can be displayed in cm or m units of area

Dose Length Product (CTDI chamber) measurements can be displayed in cm or m units

The Settings Menu - About



Firmware Version – when an update is available compare this number against the version listed on the update page: https://radcal.com/download-accu-gold-software/

Custom Profiles -

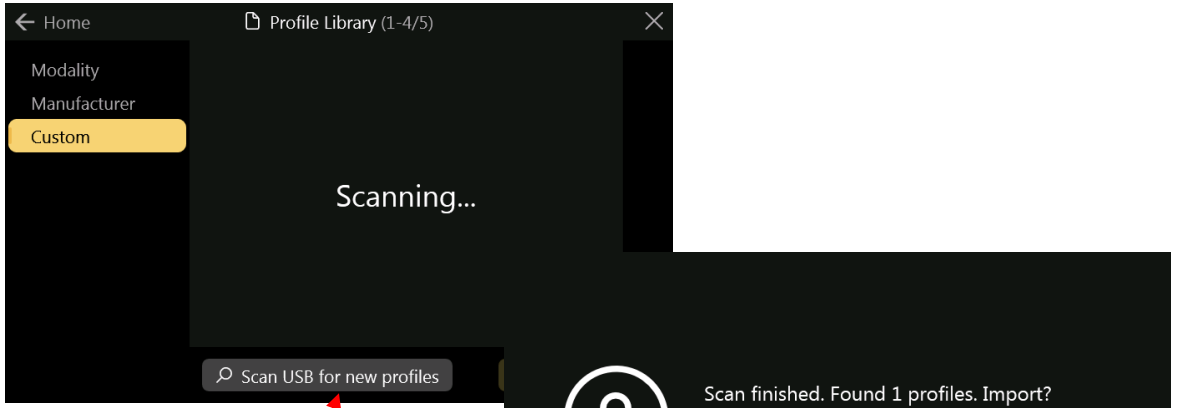
Profiles allow one to make highly technical measurements without the hassle of setting up the parameters each time. They tell the computer the calibration file to use, the timing required, the sensors to use and so on. The allow you to set a region of interest (ROI) which gives you details on certain areas of the measurement.

Combo-mode profiles allow you to quickly make the multiple measurements with a single exposure of the x-ray machine when the x-ray machine is changing anode-filters internally. This makes it possible to save precious time and hassle and gets you in and out in a hurry.

So what happens when there is no profile for what you need? Contact Radcal to discuss your needs and we will assess your situation. We will make a profile that is suited for your specific needs. If this is a general need, we will incorporate the profile in our profile library and release it in the next version of the software.

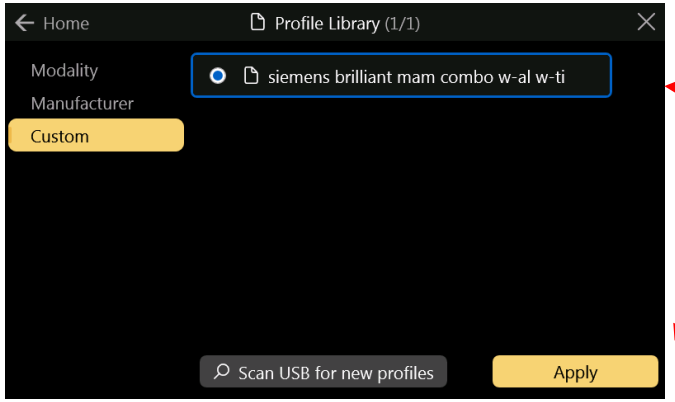
If it is a general profile that is added to the profile library, update the software and find it there. If it is a custom profile, the profile we send you will need to be loaded onto the T3 to be used.

To import the custom profile, load it on a removable USB drive (flash drive) and plug it into the T3. Select *Profile Library* from the Home menu, then select *Custom*:



Select *Scan*. All profiles, regardless of the folders they are in on the flash drive, will be considered.

Select *Yes*



Select the profile and then select *Apply*

Differences between T3 and AG3

T3 is a portable/wireless version of AG3 with a few exceptions. As T3 development continues, future releases will provide enhancements to minimize them. The major differences are:

- With AG3, it is possible to reanalyze a session recorded recently. Since the T3 does not yet save raw data, it does not have the ability to reanalyze.
- T3 limits the maximum amount of wave data that can be captured in a single exposure. When this limit is reached, the measurement continues but the wave data is lost. We expect that this limitation can be eliminated in a future release.

LED Color code

The label on the back of the unit summarizes the meaning of the different colors for the LED that is next to the USB connector. This table details the other possible combinations and their meaning.

LED Color	Meaning
GRN steady	Power On
GRN/RED blinking	Low Battery
YEL/GRN blinking	Charging OK
YEL/RED blinking	Charging/Power Low
YEL steady	Battery Charged
BLU steady	Error (Fuel Gauge)
RED steady	Error (Battery)
WHT steady	Saving Data

Specifications

Declaration of Conformity

See https://radcal.com/downloads-conformity/

Specifications

Ion Chambers
10X6-6
10X6-6M
10X6-10
10X6-60
10X6-60DAP
10X6-3CT
10X6-180
10X6-1800
10X6-0.18
10X6-0.6
10X6-0.6CT
10X6-500

Solid State Multisensors
Specifications
Dimensions

Solid State Dose Sensor
Current Sensors
Light Sensor
DAP Calibration Sensors

Making Low Level Measurements Using 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.

Automatic temperature and pressure compensation for the unsealed ion chambers is provided. Temperature-compensation accuracy is equivalent to 0.5°C (0.2%) between 15 and 35°C. Temperature is measured at the ion chamber connector. Pressure-compensation accuracy is equivalent to 0.5 kPa between 60 and 105 kPa. Pressure is measured in the digitizer module.

Accu-Gold T3 Specifications –

Display Specifications
Resolution: 800 x 480
Touch Type: Capacitive Touchscreen
Type: LCD TFT TN equipped with chemically tempered float glass, pencil hardness 7H, LED backlighting
Orientation: 35° or 60°. Display automatically flips based on unit orientation.

Environmental Specifications
Operating temperature: 15 °C to 35 °C
Pressure: 60 to 105 kPa
Humidity: Up to 80% RH or 20 g/m^3
Storage: Temperature 0 °C to +60 °C

USB ports
Flash drive: Standard USB A 2.0
Charger/USB mode(T3 Pro): Standard USB B 2.0 micro

Wireless Communication Specifications (T3 Pro)
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 secure encryption
Networking Protocol: TCP
Regulatory Approvals: EU (ETSI), FCC, IC (Industry Canada), China (CMITT), KC (Korea), Japan (MIC)

Power Specifications
Battery: 5.5 Ah Li-Poly (single-cell) – not user serviceable
Battery Life: > 8 Hours under normal usage
Charging Time: <5.5 Hours (maximum to fully recharge)
Charger: Radcal part number PRS/PSA10F-050 (5V, 2.0A)
Input: 90 to 264 VAC, 47 to 63 Hz
AC power supply blades (international kit) PRS/PSA10F-Q (D)

Compliance (see https://radcal.com/downloads-conformity/ for Declaration or Conformity)
The Accu-Gold T3 Basic and Pro models conform to ISO/IEC/UKCA requirements: Electromagnetic Compatibility Regulations, Electrical Equipment (Safety) Regulations, the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations.
Performance: IEC 61674, IEC 61676

Environmental Directives:
1. Radcal meets the requirements of the 2002/06/EC (WEEE) Directive, category 9, and has implemented full compliance. (Manuals are available on request.)
2. Radcal meets the requirements of the 2015/863/EU (RoHS3) Directive.
3. The Accu-Gold/Rapid-Gold/Accu-Dose+ comply with China RoHS marking and EFUP pursuant to clause 6.2 of SJT/11364:2006 for Electronic Information Products.
4. Radcal meets the requirements of the EC1907/2006 (REACH) Directive

Caution
Do not dispose of product in heat, fire or water. Misuse, dropping, or excessive force may cause product damage.
(Recycling manual available on request)

T3 Wireless Radio Regulatory Information

Wireless Radio Information –
WiFi Module ESP32-C3-WROOM-02
Espressif Systems
Operating at 2.4GHz

FCC:
Contains FCC ID: 2AC7Z-ESP32C3WROOM
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

EU (ETSI):
This device is intended for home and office use in all EU countries and other countries following the EU directive 2014/53/EU.

China PRC (CMIIT)
The equipment contains the RF modules of which Type Approval code is CMIIT ID: 2021DP3225

Industry Canada Statement:
Contains: IC: 21098-ESPC3WROOM
This device complies with RSS-210 of the Industry Canada Rules.

Japan (MIC)
Contains: Telec Construction Certification Number 201-220555
This equipment contains specified radio equipment that has been certified to the Technical Regulation Conformity Certification under the Radio Law.

Korea (KC)
R-C-es5-ESP32C3WROOM02

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.

Software Limitations

- Maximum disk / flash space reserved for raw data recordings
  - AG3: **512MB** *(oldest ones will be deleted when reaching limit)*
  - T3: **128MB** *(currently disabled-future feature)*
- Maximum measurement length, due to configuration measurement profiles:
  - AG3: **120s**
  - T3: **120s**
- Maximum measurement length with wave data:
  Because of a limitation in underlying protocol code, there is a limit to the maximum amount of wave data for one exposure. When limit is reached, measurement continues but wave data is lost. This limitation is planned to be eliminated.
  - AG3: **1m with 5 channels, 5m with 1 channel**
  - T3: **2m with 5 channels, 10m with 1 channel**
  - T3 (Wi-Fi): **1m with 5 channels, 5m with 1 channel**
- Maximum measurement count per session:
  - AG3: **Unlimited (theoretically)**
  - T3: **Unlimited - but 300 measurements per session are displayed**
- Maximum session count:
  - AG3: **Depending on disk space** (ca. 150KB/Session/Measurement)
  - T3: **last 75 sessions displayable,** all others are kept on SD-Card, complete management of all sessions comes later as feature of AG3 (ca. 150KB/Session/Measurement)

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