# IC3 Ion Chamber

# Operating Manual



**Revision 4, June 2025**
**Firmware Version: 1.3**

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CE

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## Rotem Industries Ltd

## Return remarks @

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⇨ Title, reference and index of manual
⇨ Chapter, paragraph and page concerned

**REVSION LOG:    IC3 Ion Chamber**

| Revision | Dated | Page # | Description |
|---|---|---|---|
| 1 | 04/03/2025 | 1 and 3 | Added Power Adapter specs |
|  |  | 5 | Added New Pulse Operating Mode |
| 2 | 24/03/2025 | - | Removed Speaker Option from the menu |
|  |  | 16, 17 | Updated Menu |
|  |  | 8 | Added explanation on resetting Timer and Dose |
| **3** | 31/03/2025 | 38 | Added Section on Updating the Firmware procedure |
| **4** | 04/06/2025 | 12 | Added Section on Installing the WRM2 Transmitter |

*Rotem reserves the right to change specifications without advance notice*

# Table of Contents

# 1   Introduction

## 1.1  General Description

The **IC3** is a battery operated, auto-ranging, portable ion chamber survey meter designed for highly stable and accurate measurement of dose rates and accumulated dose of gamma, x-ray and beta radiation.

The meter covers a measuring range of 1 μSv/h to 1 Sv/h (0.01 mR/h to 100 R/h ) in the dose rate mode, and 0.01 μSv to 10 Sv (1uR to 999 R ) in the integrated dose mode. The auto ranging meter utilizes a combination display consisting of a smoothed digital readout for minimum fluctuation and a two-decade analog bar which displays raw radiation data and provides a fast response.

The **IC3** survey meter combines an ionization chamber vented to atmospheric pressure, and a micro-controller to offer optimal performances and special features. Furthermore, it is a compact hand-held, lightweight, rugged meter, easy to use and maintain.

## 1.2  Features

- Wide measuring range.
- Rugged, sturdy construction combined with low-cost replacement parts.
- Automatic Air Pressure (altitude) compensation.
- Automatic temperature compensation.
- Built-in WRM2 socket for use with a wide range of transmitters.
- Internal alarm thresholds for exposure rate.
- Color coded display according to field range.
- Dual-output display combines a digital dose rate display and the choice of bar graph or accumulated dose displays.
- Display backlight offers selection of illumination intensity.
- Special sleep mode enhances battery life and allows the instrument to remotely read and transmit data when the display is not required.
- Built-in USB Type C power and communication connection.
- Capability to provide online rate graph.
- Capability to store reading and download to PC.
- Easy to use, ergonometric menu which can be configured using external software.

## 1.3  Applications

- Survey instrument, with simple data storage and downloading to external software.

- Supports ALARA principles by allowing operators to obtain readings remotely from the radiation fields.
- Real-time exposure rate monitoring connected to a Wireless transmitter. Transmitted data conforms to existing Rotem monitoring software (i.e. WebiSmarts, RMVC).

Figure 1-1. IC3 Meter

# 2   IC3 Specifications

| | |
|---|---|
| Measuring Range | 1 μSv/hr to 1 Sv/hr (0.1 mR/hr to 100 R/hr) |
| Accuracy ($^{137}$Cs) | ±10% of reading within measuring range |
| Gamma Energy Dependence | Better than ± 20% from 20 keV to 3 MeV |
| Beta Energy Dependence | Better that ± 20% from 200 keV |
| Angular Dependence ($^{137}$Cs) | Less than ± 30% (for ±90° of front direction) |
| Ion Chamber Volume | 350 cm$^3$ |
| Chamber Wall and Cover Thickness | 1000 mg/cm$^2$ (tissue equivalent) |
| Window Thickness | 7 mg/cm$^2$ Mylar |
| X-Ray Pulse reading | From 50 nano-sec Pulses, 25 keV |
| Response Time | 2 sec's. for readings above 1 mR/h |
| | 5 sec's. for auto-ranging change, from Low Range to High Range (2 sec's. +3 additional seconds for auto ranging delay) |
| Power Source | USB Connector from Mains |
| | Four 1.5 Volt AA batteries - 120 hours of continuous operation |
| | Built in automatic battery check |
| Display | Color TFT Display |
| | 3 digits with auto ranging units of measurement |
| Data Logging | 200 data records (Requires TMV Software to retrieve data) |
| Temperature Range | Operation: -10°C to +50°C (15°F - 122°F) |
| | Storage: -20°C to +60°C (-5°F - 140°F) |
| Humidity Range | Up to 95% RH (noncondensing) |
| Dimensions | Width: 13cm (5.1"), length: 24cm (9.5"), height: 14cm (5.5") |
| Weight | 1,000 g (2.4lb) including batteries |
| Casing | High impact ABS |
| Data Connection | USB for calibration, configuration, upgrade firmware and download stored data points. |
| | Optional Internal 900 MHz or 2.4 GHz RF Radio/Wifi (WRM2) |
| Threshold Alarms | 2 x levels, User selectable |

# 3    Parts List

| BEN-0318 | Chamber RAM-ION IC3 Open Sensor |
|----------|--------------------------------|
| BEN-0159 | PCL R1031V2.0 Electrometer Board for ICꓱ |
| BEN-0321 | Base Cover RAM-ION ICꓱ |
| BEN-0099 | Handle RAM-ION ICꓱ  w lock |
| BEN-0322 | Top Shell RAMION ICꓱ |
| BEN-0156 | PCL R1034V2.0 Display With 3.2" TFT LCD For RAM-ION ICꓱ Meter |
| BEN-0157 | PCL R1033V3.0 MAIN CPU Board For RAM-ION ICꓱ Meter |
| BEN-2115 | Mesh with  mylar |
| MEC-0195 | Bumper V2 - RAM-ION ICꓱ Meter - RAM-ION ICꓱ Meter |

# 4    Ordering Information

BAK-0268                IC3 Ion Chamber – Lockable Battery Cover

BAK-0245                IC3 Ion Chamber – Battery Cover
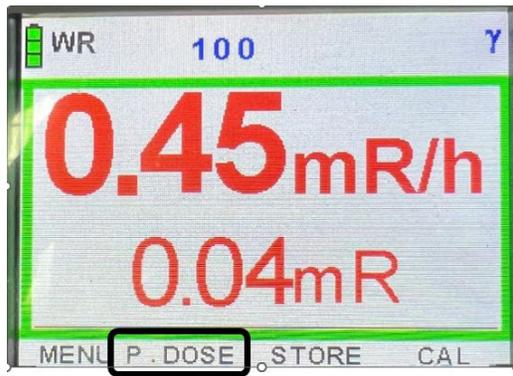
# 5    Pulsed Dose Mode

## A new Operating Mode

The IC3 has been modified to provide an instantaneous measurement of dose rate when subjected to pulsed radiation.

When measuring pulsed radiation, the exposure duration is very short, and the firmware of the instrument has been adjusted to display the average dose rate during the pulsed X-ray exposure since the most recent timer reset. The displayed dose rate is based on accumulated dose divided by the integration time (since instrument's turn-on or since the timer reset).

This feature enhances the capability of the IC3 to measure the low dose rates more accurately than the previous firmware versions.

**Pulsed Mode Display**

The Pulsed Mode display is activated by clicking on the **P.Dose** button in the menu.

The screen will now display two values in this mode: Pulse Dose Rate at the top and Cumulative Pulse Dose at the bottom. When entering **Pulse Dose Mode**, all metrics on the screen will appear in **red**, signaling the user that the device is operating in Pulse Dose Mode instead of regular Dose Mode.

A long press on the **P.DOSE** button will reset all displayed values and the timer. The meter will also automatically reset the Pulse Dose Mode after 24 hours.

If you want to continue using the previous method of calculating dose and rate, you can select the Dose/R option in the menu below

**Regular Dose Mode**



When pressing the DOSE/R button to enter "Dose Mode," the display will now show **Dose/R** instead of **Dose**. This change indicates that the device is in this specific mode. A long press of the **Dose/R** button will reset the current dose value.

# 6    HIGH & LOW Range Modes of Operation

The IC3 is a survey meter with auto ranging capabilities. To accurately measure the full radiation range, the electronics in the EM board contain two amplifiers for different

measuring ranges. The measuring mode switches into HIGH RANGE at 250 mR/h (2.5 mSv/h) and back into LOW RANGE at 170 mR/h (1.7 mSv/h). This switchover is performed automatically according to the radiation reading level.

High Range

Low Range

100 mR/hr    170 mR/hr    250 mR/hr    Dose Rates
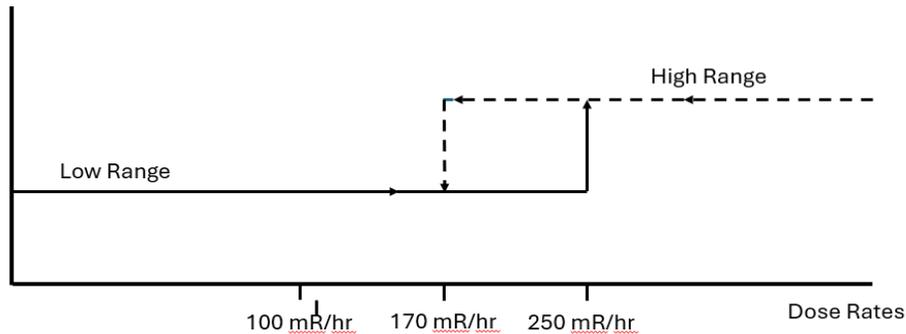
In the HIGH RANGE, the units are expressed in R/h; in LOW RANGE, the units are expressed in mR/h.

For increasing Dose Rate fields: The meter reading uses the factor F1 till 250 mR/h and F2 above 250 mR/h, and for decreasing dose rate fields: The meter reading uses the factor F2 till 170 mR/h and F1 below 170 mR/h

*NOTE:  THE AUTOMATIC SWITCHING FROM THE LOW RANGE TO THE HIGH RANGE MAY TAKE A COUPLE SECONDS, SIMILAR TO THE TIME TO SWITCH SCALES ON A MANUAL METER.  THIS WILL BE NOTED AS THE METER PAUSES AT THE UPPER END OF THE LOW RANGE (250 MR/HR) PRIOR TO SWITCHING.*

For entry into unknown high dose rates area, it is recommended that the Technician manually switch the IC3 to High Range mode prior to entry.

# 7 Operating Instructions

## 7.1 Preparation for Use

Remove the instrument from the shipping container and inspect for any physical damage. In the case of damage, report it immediately to your local distributor.
*Do not attempt to install or operate damaged equipment since safety and performance may be affected.*

> *NOTE: The manufacturer recommends that the end user/owner perform periodic inspections (during daily performance checks) of the meter to ensure proper operational use and safety.*

### 7.1.1 General Inspections to be performed:

Check that the Beta Shield has not been damaged or disformed during shipment.
Check that the Battery Cover has not been damaged during shipment.
Shake the meter and check that there are no loose pieces in the instrument.

## 7.2 Starting-up

- Remove the battery compartment cover located on the handle of the Meter by lifting the locking catch upwards with your fingernail.  To close the cover simply press it into the handle. A battery cover with locking capabilities is available.



Opened Battery Cover

- Insert 4 x good quality 1.5 v AA battery cells into the battery compartment as per the polarity shown in the diagram.
- Press the **ON/OFF** push-button to turn the meter on by holding the **ON/OFF** button for five (5) seconds.

- If the initial screen shows the firmware version, serial number and battery icon, the connection is established.
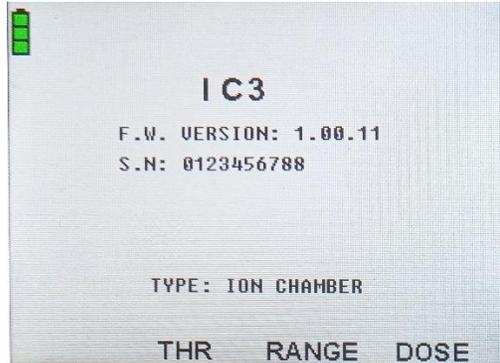


Note: In cases where the Instrument has been stored without batteries for more than a few days, the internal clock may have stopped and not be accurate. This inaccuracy may cause the M-Cal or D-Cal errors to be skipped. We recommend that after storing the instruments without batteries, the IC3 meter be connected to the RMVC Software which will automatically update the internal clock in the Meter.

Following a successful self-test startup and offset adjustment, the meter is ready for use. After successful Self-Test upon startup, the IC3 will go through an Offset adjustment (which is basically an electronic "zeroing" function) and then begin measurements.

Like all Ion Chambers the IC3 has a warmup time for the electronics which is listed as 10 minutes. This electronic warmup is only a concern for the minute current measurements from the very lowest dose rates.
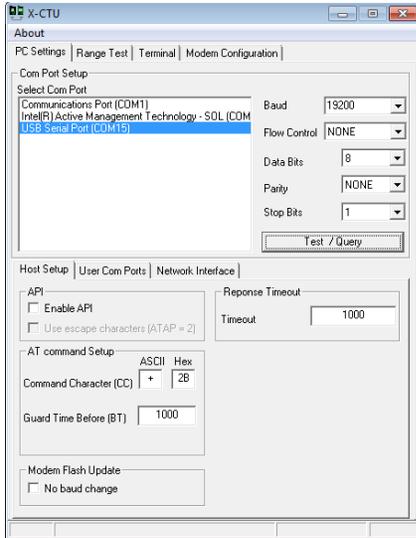
## 7.3  Installing the WRM2 Transmitter

### 7.3.1  WRM2 Radio Transmitter Characteristics

1. 10.25" L x 4.28" D  x 4.88 W
2. Transmit power output 100 mW (900 MHz), 50 mW (2.4 GHz), 3.5 mW  (868 MHz)
3. Receiver sensitivity -110 dBm (900 MHz) and –105 dBm (2.4 GHz)
4. 868 MHz, 900 MHz or 2.4 GHz spread spectrum hopper (FHSS)
5. Range for the 900 MHz unit 1500' indoors-industrial environment, 2 miles outdoors RF line-of-sight with standard dipole antenna, up to 20 miles with high gain directional antenna
6. Range for the 2.4 GHz unit 600' (200 m) indoors, 1.5 miles outdoors with RF line-of-sight w/ dipole antenna, up to 10 miles (16 km) with high gain antenna
7. Over the air data stream at 19,200 BAUD
8. Addressable from 0 to 65,000
9. FCC approved, IC Certified, 2.4 GHz and 868 MHz are CE marked
10. Programmable transmission intervals from 1 sec to 16 sec.

### 7.3.2  Configuring the WRM2 Module

The WRM2 Transmitter should be configured to the following parameters in order to enable it to be compatible to the IC3 Meter.
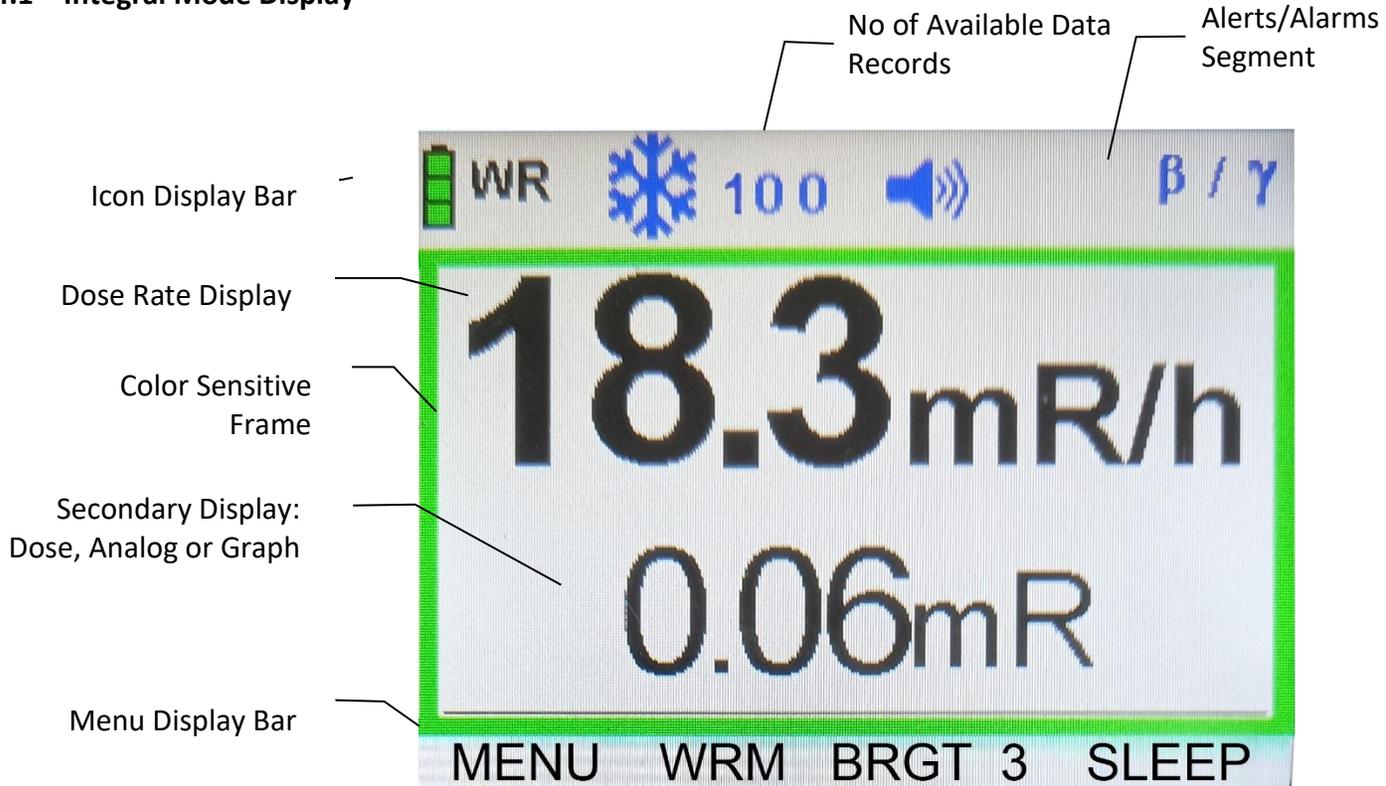


### 7.3.3  Inserting the WRM2 Module

1.  ⚠️ Under no circumstances can the WRM-2 transmitter be connected or disconnected to its mounting pads while the Unit is under power.
2.  Open the front cover of the Meter, which is located beneath the handle, and insert the WRM-2 transmitter onto its mounting pads.
3.  Close the front cover
4.  Activate the WRM2 from the Q-SETUP screen or from the RMVC Software program.

## 7.4   Display Information

### 7.4.1   Integral Mode Display

No of Available Data Records

Alerts/Alarms Segment

Icon Display Bar

Dose Rate Display

Color Sensitive Frame

Secondary Display: Dose, Analog or Graph

Menu Display Bar

### 7.4.2   Icon Display Bar

| ICON | Explanation | Indication |
|------|-------------|------------|
| 🔋 | Battery Condition | V > 5.2v — green<br>5.2v > V > 4.6v — Yellow<br>4.6v > V > 4.1v — Red<br>V < 4.1v — Empty Frame |
| **WR** | **Indication of active range**<br>**WR**- Wide Range (Auto ranging)<br>**HR** – High Range only<br>**LR** – Low Range only | The Menu enables the user to manually select one of the three options, and the active option will be displayed here. |
| ❄ | **Freeze Mode Activated** | The Menu enables the user to activate or deactivate the Freeze Mode. The highest dose rate of the detector will be frozen on the display. |
| **100** | **Available lines for stored records** | Capable of storing 100 data records. Each time the STORE button is pressed, the number of available lines will decrease. |

| | | Once the data is transferred to a P.C. via our RMVC software, the number will revert to 100. |
|---|---|---|
| ((ꝭ)) | **External Communication Activated** WRM2/BT/RTLS | The version provides only WRM2 communication capabilities |
| β / γ | **Beta Lid Position** | The Meter is capable of automatically detecting if the Beta cover is fully open (β/ γ), fully closed (γ) somewhere in the middle. In this case, the meter will display (DOOR) and provide an audio signal. |

### 7.4.3 Alarms Segment and priority

| ICON | Explanation |
|---|---|
| **M-O.F** | Overflow Condition on Meter(>4R/h) |
| **L.BAT** | Meter battery voltage too low, must be replaced. |
| **M-IC** | The Ion Chamber is malfunctioning |
| **M-HV** | High Voltage to the Ion Chamber is malfunctioning |
| **M-CAL** | The Calibration to the Detector is overdue |

### 7.4.4 Menu Display Bar

The IC3 Menu provides several lines containing operational functions. Upon power up the First Line is displayed. Each additional line is accessed by clicking with a short press on the MENU Command (POWER Button).

The order of the commands and the commands used in this menu can be configured using our RMVC software which is freely available off our website. The Menu provides for 4 lines with 3 commands on each line. There is one more command that is available and can be inserted in place of any of the commands below:

| | | | |
|---|---|---|---|
| MENU | FRZ | P.Dose | GRAPH |
| MENU | THR | RANGE | DOSE |
| MENU | WRM | BRGT 1 | SLEEP |
| MENU | STORE | CAL | ANALOG |

#### 7.4.4.1 Freeze [FRZ] Mode

This mode freezes the highest reading until the user clicks on FRZ again to release. A Freeze icon ❄ will be displayed to show the instrument is currently in the Freeze mode.

### 7.4.4.2 Pulsed Dose [P.Dose] Mode

This command provides an instantaneous measurement of dose rate when subjected to pulsed radiation. This option is useful for measuring very low dose rates because instead of acquiring low statistical readings of dose rate and smoothing out the value before displaying it, the meter continuously connects the count and interpolates the dose rate every second which is displayed on the screen.

### 7.4.4.3 GRAPH Mode

This command activates a graph in the lower part of the display. The highest value of the graph is displayed to the left of the graph. The graph displays data for a period of 30 minutes, updates every second from right to left.

### 7.4.4.4 THR (Threshold) Mode

This command displays the three threshold levels and associated colors. The threshold levels can be set either directly through the touch screen of the IC3 or by connecting the meter to our RMVC Software which is freely available off our website. See paragraph 7.5.5 Threshold Selection for instructions on how to use the touchscreen or paragraph 11 Using RMVC to interface with the IC3 meter.

### 7.4.4.5 RANGE Mode

This command allows the user to manually select either the HR (High Range), LR (Low Range) or WR (Wide Range) of the Detector. An Icon (HR. LR or WR) will be displayed according to the selected range. (Partially operational).

### 7.4.4.6 Dose Mode

This command will display the accumulated Dose of the detector since the instrument was powered up. The Dose will be cleared when the instrument is switched off.

### 7.4.4.7 WRM Mode

This command is used to activate the WRM2 transmitter in the instrument. A click will activate the WRM2. An appropriate icon  is displayed.

### 7.4.4.8 Bright (BRGT #) Mode

This command dims and brightens the screen. It will default to the second brightest selection upon power up. Using brighter screens will increase power consumption and reduce battery life.

### 7.4.4.9 SLEEP Mode

This command will activate the sleep mode of the instrument by closing the display. The IC3 will continue to measure the radiation levels and transmit data records to a remote station. The IC3 will activate the display if the instrument is moved. picked up or an alert/alarm occurs.

### 7.4.4.10 STORE Mode

This command will store up to 100 points of dose rate data.  The number will decrease each time the button is pressed **22** 🔊 - the displayed number represents the available points remaining.  This data may be obtained by RMC in the RMVC software.  Once the data is viewed through the software and the window closed – it will delete all data.  The data may be saved to the user's computer.

### 7.4.4.11 CAL Mode

This command will allow you to manually input calibration factors into each of the calibration points.

### 7.4.4.12 ANALOG Mode

The Analog mode displays an auto scaling bar graph for raw radiation intensity indication. The bar graph displays radiation levels before they are processed by smoothing algorithms and is therefore very useful for searching for hot spots or other irregularities in the area being surveyed.
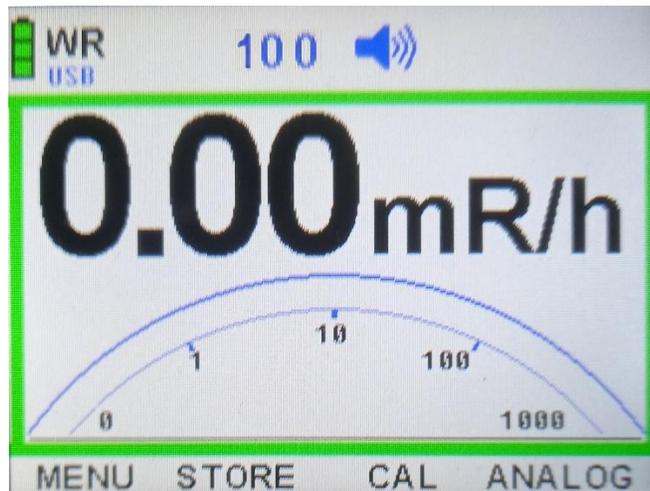


## 7.5   General Functions

### 7.5.1   Measuring Modes

The meter has two measuring modes:
1. Auto-Range – 1 µSv/hr to 2.5 mSv/h and 2.5 mSvh to 1 Sv/h
          (0.1 mR/h to 250 mR/h and 0.25 R/h to 100 R/h)
2. High Range Only 0.1 mSv/h to 1 Sv/h (0.01 R/h to 100 R/h )

### 7.5.2   Auto Range Mode

In this mode the meter's total measuring range is from 1 µSv/hr to 1Sv/h (0.1 mR/h to 100 R/h).

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For efficient measuring purposes, the total range is divided in two narrower ranges that are automatically switched:
Low Range: 1 uSv/h to 2.5 mSv/h (0.1 mR/h to 250 mR/h).
High Range: 2.5 mSv/h to 1 Sv/h (0.25 R/h to 100 R/h).

Switching from low range to high range is performed in a field of 2.5 mSv/h (250 mR/h).
Switching from high range to low range is performed in a field of 1.7 mSv/h (170 mR/h).

Response time in a field higher than 0.01 mSv/h (1 mR/h) is 2 seconds.

### 7.5.3 Dose Rate Display

Range: 1 µSv/hr to 1 Sv/hr (0.1 mR/hr to 100 R/hr)
The Display will change units of measurement according to the level of radiation being measured:

### 7.5.4 Measuring range in Dose mode

0.01 uSv/h to 9.99 Sv (1 uR to 999 R)

Readings are displayed digitally and updated every second.

### 7.5.5 Threshold Selection

The IC3 meter can store two dose rate threshold levels which are reflected in three colored frames (green, yellow and red) in the Display, and provide a visual indication to the user of the radiation levels detected by the detector.

These thresholds are set using the touch screen buttons on the Display or using the RMV software which is freely available off our website.

| | |
|---|---|
| **Above Threshold 2** | <span style="background-color:red"> </span> |
| **From Threshold 1 to Threshold 2** | <span style="background-color:yellow"> </span> |
| **From 0.00 mR/h to Threshold 1** | <span style="background-color:green"> </span> |
| **User Threshold (THR.U)** | <span style="background-color:blue"> </span> |
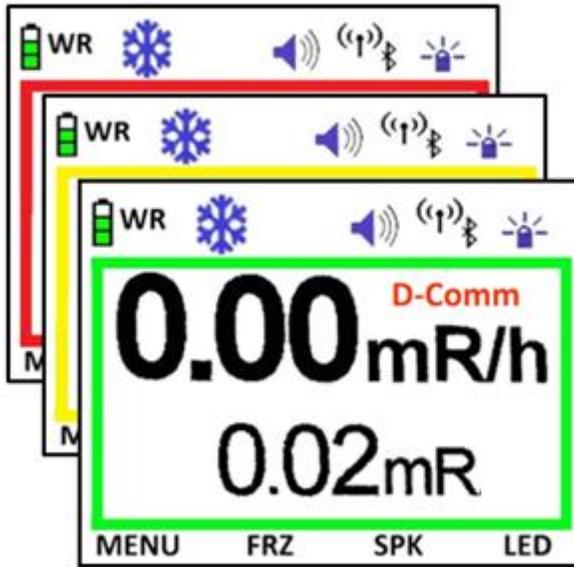


To see the current Threshold settings, click on the THR (Threshold) command in the Menu Display Bar. The black background marks the active thresholds.

The following will be displayed:   **THR < 1**   **THR < 2**   **THR > 2**   **THR. U = 3**

THR #1 is the first threshold to be selected.

The Menu changes to the following: **MENU   DOWN   UP   NEXT**

| | |
|---|---|
| **MENU** | Saves the current setting and displays the next MENU set. Once you have finished setting up the thresholds, click MENU. |
| **DOWN** | Reduces the value of the threshold by 1. You cannot reduce to less than 1. |
| **UP** | Increases the value by 1 until it reaches the value of the last threshold. |
| **NEXT** | Moves the black marker to the next threshold. |

The **User threshold** provides an Audio Alert without changing background color. The data record will provide the status as *User Threshold*.

## 7.6   Meter & Detector Alerts and Alarms

In case of malfunction in the meter or detector an audible and visual alarm will be displayed. Pressing on any push button will mute audible alarm.

| | |
|---|---|
| D-HV | High Voltage to the Meter is malfunctioning |
| M-O.F | Overflow Condition on Meter(>4R/h) |
| ALARM | Over threshold Condition, un latch alarm. |
| L.BAT | Meter battery voltage too low, must be re place. |
| M-IC | The Ion Chamber is malfunctioning |
| M-HV | High Voltage to the Internal Detector is malfunctioning |
| M-CAL | The Calibration to the Internal Detector is overdue |

## 7.7  Push-buttons Function Control

To power up the instrument, click on the On/Off Button
To switch off the instrument, click, with a long press on the On/Off Button
To switch between menu pages, a short press on the MENU (Power) Button

## 7.8  Meter display

The first big characters are used to display the Dose Rate reading.
The second smaller character is used to display different options according to operator's request.



| Threshold value | Graph | Accumulated Dose | Analog |
|---|---|---|---|

# 8    Battery Replacement Instructions

Remove the battery compartment cover located on the handle of the Meter by lifting the locking catch upwards.

Insert 4 x 1.5 v AA battery cells into the battery compartment as per the polarity shown in the diagram.

Press the **ON/OFF** push-button to turn the meter on by holding the ON/OFF button for five (5) seconds.

If the initial screen shows the firmware version, serial number and battery icon, the connection is established.

# 9   Communication

## 9.1   USB Port

This USB port is used for several purposes:

1. Provides Power to the IC3 Meter to enable it to operate without batteries and be a temporary area monitor.
2. Connects between the IC3 Meter and our RMVC Software to allow you to:
   - Setup the Parameters of the IC3 Meter.
   - Calibrate the IC3 Meter.
   - Download data online and produce graphs.

## 9.2   WRM2 Communication

The IC3 Meter can support a WRM2 transmitter which is installed into the Control Box and activated via a Menu Selection

## 9.3   Ultra Wide Band (UWB) Communication

The IC3 Meter is designed to have the ability to utilize an a UWB board inside the meter.  This allows it to send 3D location data to Mirion's Orion system as well as telemetry Dose Rate data.  This would allow surveys to be done without paper and provide the ability to generate "Heat" maps based on the information received.

# 10 Calibration

## 10.1 Purpose

Provide guidance for calibration of the IC3 Meter.

## 10.2 References

ANSI-323, American National Standard for Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments

## 10.3 Calibration via the Touch Panel on the instrument

The IC3 Meter can be calibrated in the field without using any external programs. The calibration is achieved by clicking on the Menu pushbutton till the CAL. Command appears.
The CAL button should be setup (Using the RMVC software) to be the last Command in the Menu.

Click Cal, the Instrument will require the user to click Cal again to avoid activating the calibration function unintentionally, the following display appears:

Note that the Calibration Date will update immediately to a year from the time you clicked on the Cal command. Even if no modifications were made to the Factors.

The two Calibration Factor F1 and F2 are the gamma calibration factors (beta slide closed).



The DOWN and UP commands are used to change the F1 Factor. The reading above will automatically update according to the modifications and each time you click on DOWN or

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UP a new calibration factor is saved. You can exit this Display at any time by clicking the MENU command.

The NEXT command is used to change the next factor. Each time you click on DOWN or UP a new calibration factor is saved. You can change the next factor by clicking NEXT or exit this Display at any time by clicking the MENU command.
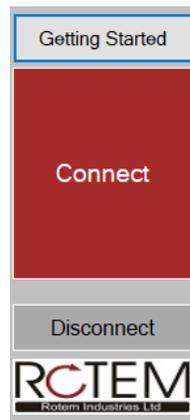
## 10.4 Calibration via RMVC Software

NOTE:  RMVC version 1.1.0.4 or higher is required for calibration.

### 10.4.1  Setup

Connect a USB C cable from the IC3 Meter to the RMVC software.
Start up the RMVC software.
Click Connect in the main menu:



:

NOTE – if this is the first time connecting the IC3 Meter to the user computer, you will need to establish which com port is to be used.  To do this go to the Device Manager and check the com ports.  The user should see a port like the one shown below



Note: If the correct port is not shown, follow the instructions below

Click on the Getting Started Button in RMVC to display the HELP screen and select the Getting Started option
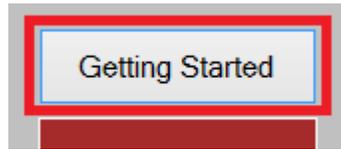
Follow the onscreen instructions and download the VCP driver from the provided link. Unzip and launch the appropriate .EXE.  Launch the .EXE and follow the prompts to install the driver.



Once the drive is installed, Click the Connect button on the main menu, then select or verify the correct Com Port and the correct baud rate (should be 115200). Click Connect to establish the connection to the meter.
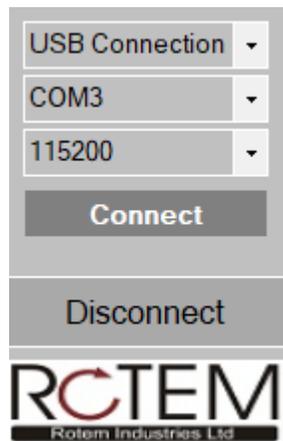


Select or verify the correct Com Port and the correct baud rate (should be 115200).  Click Connect.

---

Prior to clicking on RMC, ensure that the IC3 Meter is communicating to the software (radiological information is displayed in Meter Rate / Meter Dose and Meter Serial No. is displayed).  Once this information is displayed click on RMC.
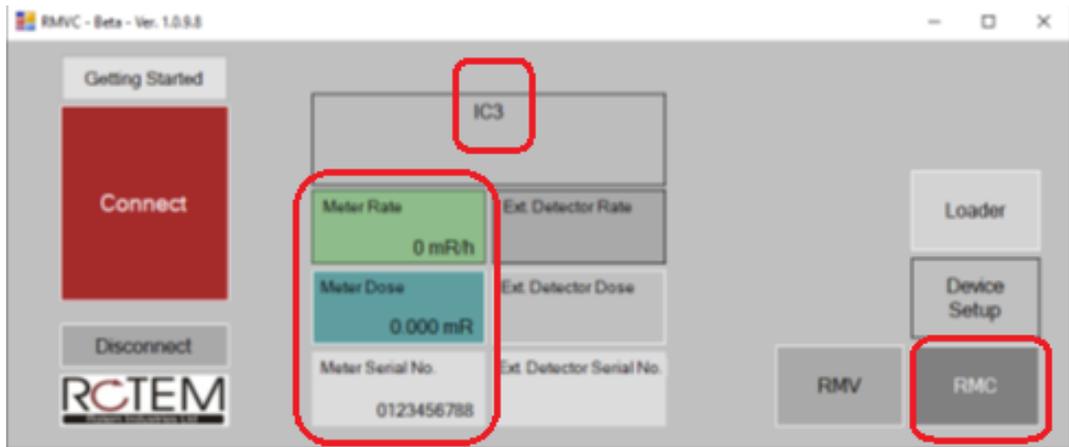


Enter login information, User Name (this is user defined and this name will appear on the calibration certificate) and password – **ram**.

The following screen will appear after logging into RMVC.

The Accuracy Information may be updated per site procedures or protocols.  Source information is per site procedure or protocols.  Once updated; select OK.  Note:  The Calibration Due will track when the Calibration is Due and show a Calibrate Alarm (D-CAL) when overdue.

Select the Load Template button and navigate to where the templates are stored.
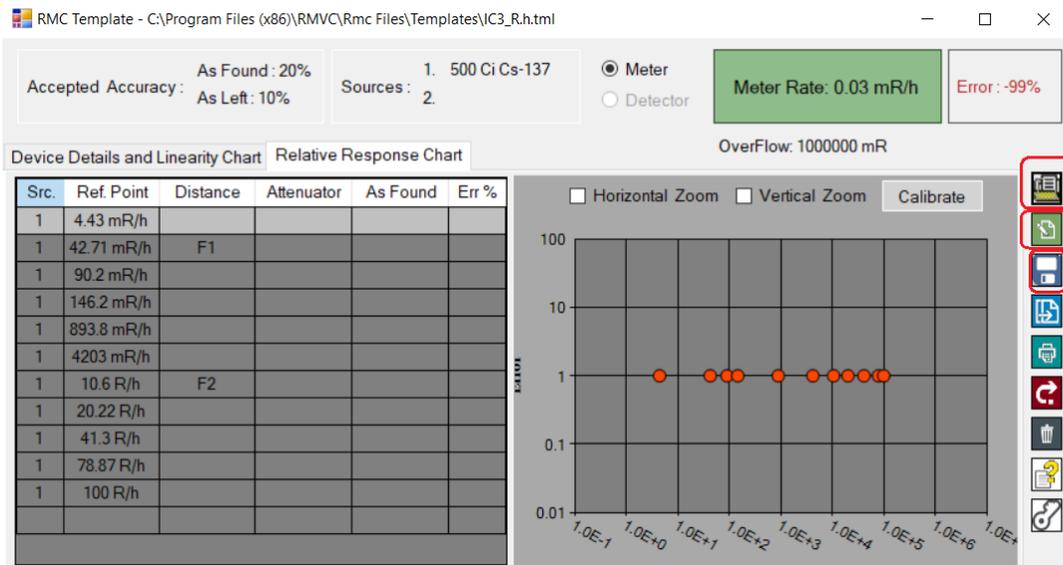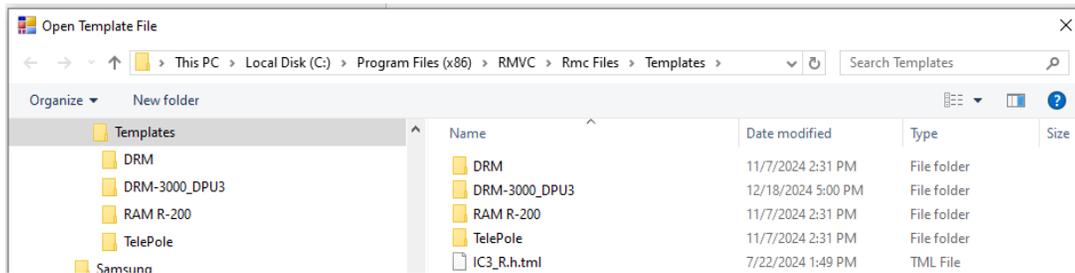
NOTE: − *If you don't have an IC3 template you can use a similar template and update to the new name when you Save it.*

If this template has not been previously setup, you will need to select Edit Sources and Accuracy button. Select the IC3 template and add the other Information as needed per site procedures or protocols. Once updated; select OK, then select Save and save as a "tml" format.

This may also be the best time (if needed) to change or enter the reference points from the source as well as the distance and shielding.
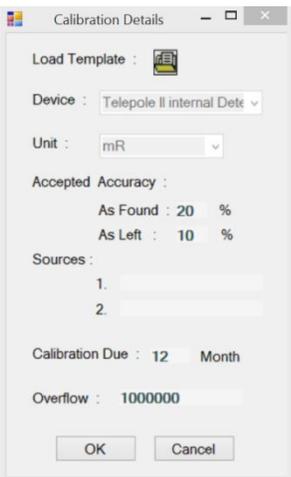


## 10.5 Calibration

Click Meter detector selection for calibration.
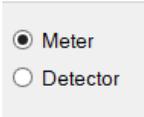


NOTE:  In the table below, it is recommended to include a notation in the distance value to identify the points for calibration factors (F1, F2, etc.) – e.g. 58*F1.

Sample entry below

| 1 | 248.5 | 250*F1 | 0 |
|---|---|---|---|

If this is not the initial calibration skip this step.  Enter Source information into the provided chart in the software (Src. – Source Number; Ref. Point – Defined Dose Rate; Distance – Defined Distance from Source; Attenuator – user applied shielding factor for source – if none is utilized enter 0.  See paragraph 10.7 below for an example of a calibration certificate.

### 10.5.1 Recommended Calibration Points

| Meter | |
|---|---|
| **DOSE RATES** | **CALIBRATION FACTORS** |
| 427.10 µSv/h (42.71 mR/h) | F1 (Gamma) Closed Shield |
| 85.70 mSv/h (8.57 R/h) | F2 (Gamma) Closed Shield |
| 1,090 mSv/h (109 R/h) | OFLO  test |

Higher calibration points may be used if the customer verifies acceptability of high range response in switchover range.

The above entered information may be saved as a template to be used for future calibrations.  Click the save icon and name for later use.

Select the Load Template Icon, then navigate to the storage location and select Open.
Expose the detector to a radiation field appropriate for the desired point.
In the associated point – click in the As Found Block.  This will insert the dose rate information.

| As Found |
|---|
| 4.95 mR/h |
| |
| |
| |
| |
| |

> NOTE: − *If you don't have an IC3 template you can use a similar template and update to the new name when you Save it.*

If this template has not been previously setup, you will need to select Edit Sources and Accuracy button. Select the IC3 template and add the other Information as needed per site procedures or protocols. Once updated; select OK, then select Save and save as a "tml" format.

This may also be the best time (if needed) to change or enter the reference points from the source as well as the distance and shielding.

## 10.6 Calibration Process

---

> *NOTE: Because the IC3 has a sensor that verifies when the beta window is open, ensure the beta window is closed for the standard gamma calibration. The IC3 was designed to allow a beta calibration to be done and automatically apply a beta correction factor to an Open Window reading. Because it cannot automatically remove the gamma component, it is not applicable in a mixed beta/gamma fields and so it will not be part of this manual.* **Appendix A** *explains why and will have information on the tested beta response of the IC3.*

In the Relative Response Chart below it is recommended to include a notation in the distance value to identify the points for calibration factors (F1, F2, etc.) – e.g. 58*F1.

**Sample entry below:**

| 1 | 50.7 mR/h | 58*F1 | 0 |
|---|-----------|-------|---|

If not already done, enter Source information into the provided chart:

Src. (Source Number)
Ref. Point (Defined Dose Rate)
Distance (Defined Distance from Source)
Attenuator (user applied shielding factor for source – if none is utilized enter 0).
Below is an example of an IC3 Calibration including linearity checks.

Device Details and Linearity Chart | Relative Response Chart

| Src. | Ref. Point | Distance | Attenuator | As Found | Err % |
|------|-----------|----------|------------|----------|-------|
| 1 | 4.43 mR/h | | | | |
| 1 | 42.71 mR/h | F1 | | | |
| 1 | 90.2 mR/h | | | | |
| 1 | 146.2 mR/h | | | | |
| 1 | 893.8 mR/h | | | | |
| 1 | 4203 mR/h | | | | |
| 1 | 10.6 R/h | F2 | | | |
| 1 | 20.22 R/h | | | | |
| 1 | 41.3 R/h | | | | |
| 1 | 78.87 R/h | | | | |
| 1 | 100 R/h | | | | |
| | | | | | |
| | | | | | |

**Recommended Calibration Points**

| IC3 Meter | |
|-----------|-----------|
| **DOSE RATES** | **CALIBRATION FACTORS** |
| 0.1 to 1 mSv/h (10 to 100 mR/h) | F1 |
| 50 to 150 mSv/h (5.0 to 15.0 R/h) | F2 |
| > 1.5 Sv/h (150. R/h) | OFLO test |

*NOTE:  Each calibration factor should be set within the range mentioned above (e.g. 10 mR/h to 100 mR/h).  However, it is recommended that, if possible, both the Linearity points and the Calibration points (F factors) be set in the middle of each range. (Example:  for the range of 10 mR/h to 100 mR/h, we recommend that the meter is placed in a dose rate field of 50 mR/h).*

*When complete, click the Save Icon*  *to store the data for future use.*

---

Select the Load Template Icon , then navigate to the storage location and select Open.

Expose the Detector to a radiation field appropriate for the desired point.

In the associated point – click in the As Found Block.  This will insert the dose rate information.



If a value was incorrectly entered into the wrong block; the user may select a different block and then click on the correct block again to update, or the following icon may be

clicked Remove Measure Points (Caution – this removes all the data). 

Continue exposing the meter to the required points until all As Found fields are populated.

If the As Found data is within the site's requirements, then the Calibration is complete, and the calibration sheet may be created  and printed  .
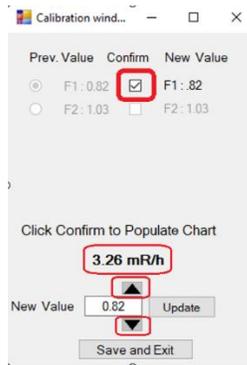
> Note:  If the Calibration sheet is not setup already see **Appendix** B for instructions.

If As Found is not within tolerance, then proceed to the next step.

To adjust the F Factors – click the calibrate button.
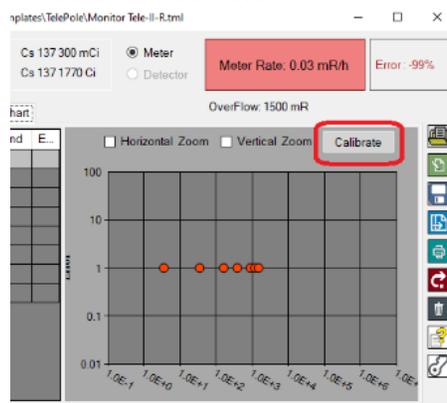


A window similar to the following will be displayed for the calibration:

---

1.1.1. Exposed the Meter to the appropriate dose rates (the dose rate value will be displayed above the adjustment bar). To adjust to the reference dose rate, click on either the up or down arrows.

1.1.2. Once the desired meter dose rate is obtained; click on the Confirm check box for the associated Calibration Point (e.g., F1).

1.1.3. The Cal. Point Value will populate in the Relative Response Chart:
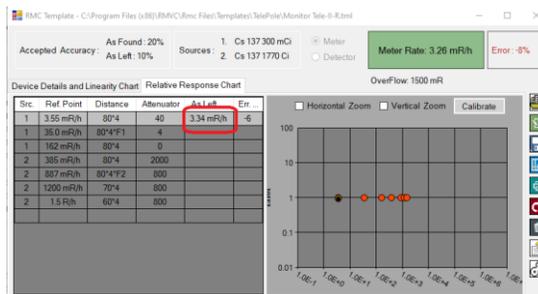


1.1.4. Expose the meter to the F2 dose rate and repeat the process and then select Save and Exit from the Calibration window.

1.1.5. Now that adjustments are done, complete the Calibration by updating the remaining Linearity Values in the Cal. Point Column. (Expose the meter / detector to the appropriate value and click in the Cal. Pint block of that point to update.)

| Src. | Ref. Point | Distance | Attenuator | As Found | Err % | Cal. Point | Err. % |
|------|-----------|----------|------------|----------|-------|-----------|--------|
| 1 | 5.07 mR/h | 58 | 10 | 4.72 mR/h | -7 | 5.29 mR/h | 4 |
| 1 | 50.7 mR/h | 58*F1 | 0 | 53.66 mR/h | 6 | 50.42 mR/h | -1 |
| 1 | 356.5 mR/h | 20 | 0 | 346.47 mR/h | -3 | 360.01 mR/h | 1 |
| 1 | 736.5 mR/h | 13*F2 | 0 | 694.59 mR/h | -6 | 733.06 mR/h | 0 |
| 1 | 1115.8 mR/h | 10 | 0 | 1093.09 R/h | -2 | 1182.1 R/h | 6 |

1.1.6. Once completed; click on the icon for Create Calibration  to verify the information and then Print  and or Save the Calibration Sheet.

The dose rate value will be displayed above the adjustment bar(s). To adjust the meter to the reference dose rate click on either the up or down arrows.

Once the desired meter dose rate is obtained; click on the associated Calibration Point (e.g., F1) update and then exit.

The Cal. Point Value will populate when the update box is checked:

| Src. | Ref. Point | Distance | Attenuator | As Found | Err % | Cal. Point | Err. % |
|---|---|---|---|---|---|---|---|
| 1 | 5.07 mR/h | 58 | 10 | 4.7 mR/h | -7 | | |
| 1 | 50.7 mR/h | 58*F1 | 0 | 51.48 mR/h | 2 | 51.86 mR/h | 2 |
| 1 | 356.5 mR/h | 20 | 0 | | | | |
| 1 | 736.5 mR/h | 13*F2 | 0 | | | | |

Repeat the steps for the 2nd Calibration Point.  Once both Calibration Factors (F Values) are completed, close the Calibration Window and measure the remaining points to prove linearity by exposing the meter to the appropriate value and click in the Cal. Point Block of that point to update.)

| Src. | Ref. Point | Distance | Attenuator | As Found | Err % | Cal. Point | Err. % |
|---|---|---|---|---|---|---|---|
| 1 | 5.07 mR/h | 58 | 10 | 4.72 mR/h | -7 | 5.29 mR/h | 4 |
| 1 | 50.7 mR/h | 58*F1 | 0 | 53.66 mR/h | 6 | 50.42 mR/h | -1 |
| 1 | 356.5 mR/h | 20 | 0 | 346.47 mR/h | -3 | 360.01 mR/h | 1 |
| 1 | 736.5 mR/h | 13*F2 | 0 | 694.59 mR/h | -6 | 733.06 mR/h | 0 |
| 1 | 1115.8 mR/h | 10 | 0 | 1093.09 R/h | -2 | 1182.1 R/h | 6 |

Once completed, click on the icon for Create Calibration Certificate.

Once the Calibration Certificate is open, the user may add a custom Header or Footer to the document prior to printing.  Select either Add Company Header or Add Footer, and select the file to be utilized.



Calibration Certificate

Add Company Header | Add Footer | Save as PDF | Print Preview | Print
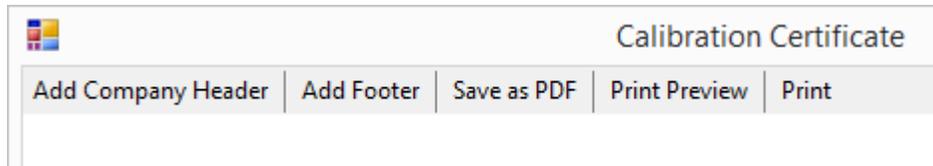
## IC3 Calibration Certificate

**Serial Number :** 027424-005

**Date :** 06/18/2024

**Accepted Accuracy :**

    As left : 10 %

    As found : 20 %

**Sources :**

    1 = Cs137 4GBq(110mCi)

    2 = Cs137 40TBq(916Ci)

| Src | Measuring Point | Distance | Attenuators | As Left | Err% |
|---|---|---|---|---|---|
| 1 | 4.35 mR/h | 905 | *10/20 | 4.46 mR/h | 3 |
| 1 | 42.71 mR/h | 905*F1 | *1/0 | 43.46 mR/h | 2 |
| 2 | 90.72 mR/h | 950 | *3162/70 | 90.24 mR/h | -1 |
| 2 | 297 mR/h | 950 | *1000/60 | 295.24 mR/h | -1 |
| 2 | 905 mR/h | 950 | *316/50 | 925.45 mR/h | 2 |
| 2 | 2.8 R/h | 950 | *100/40 | 2.96 R/h | 6 |
| 2 | 8.57 R/h | 950*F2 | *32/30 | 9.03 R/h | 5 |
| 2 | 26.07 R/h | 950 | *10/20 | 27.35 R/h | 5 |
| 2 | 80.3 R/h | 950 | *3/10 | 78.12 R/h | -3 |
| 2 | 109 R/h | 850 | *3/10 | Overflow | OK |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**Calibrated by :** Roman

**Calibration Date :** 06/18/2024

**Reviewed by :** ................

**Result :** PASSED

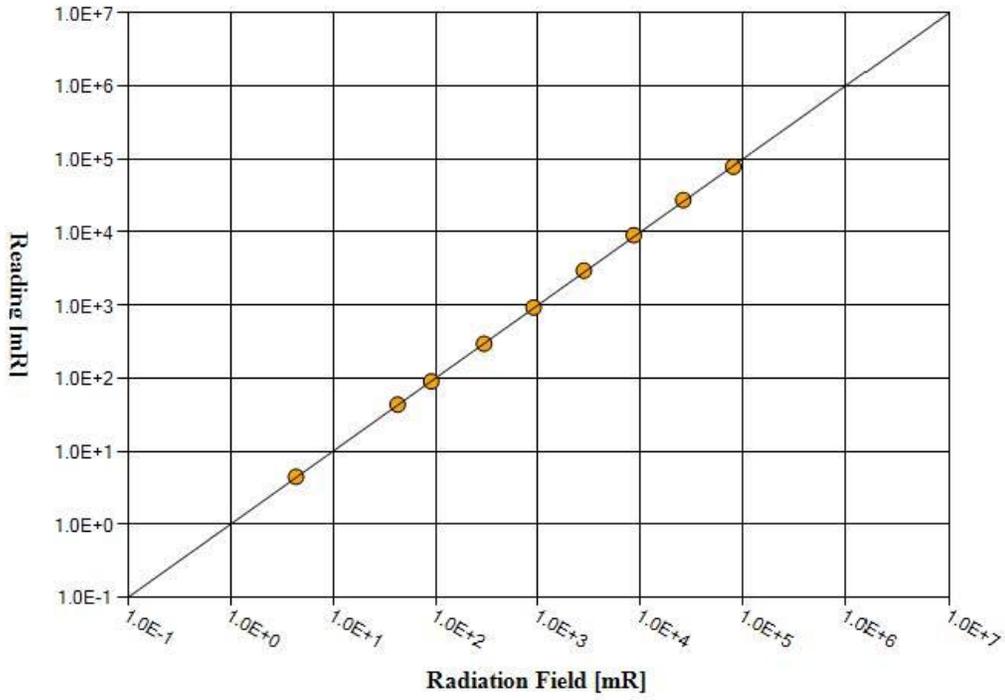F1 : 0.88

F2 : 0.93

F3 : 1.00

F4 : 1.00

The actual exposure rate was measured by calibration of the SSDL reference ionization chambers at Physikalisch-Technishe Bundensanstalt PSDL (6.62 30/04k) and in compliance with the US NCRP 112 requirements.

## Linearity Chart
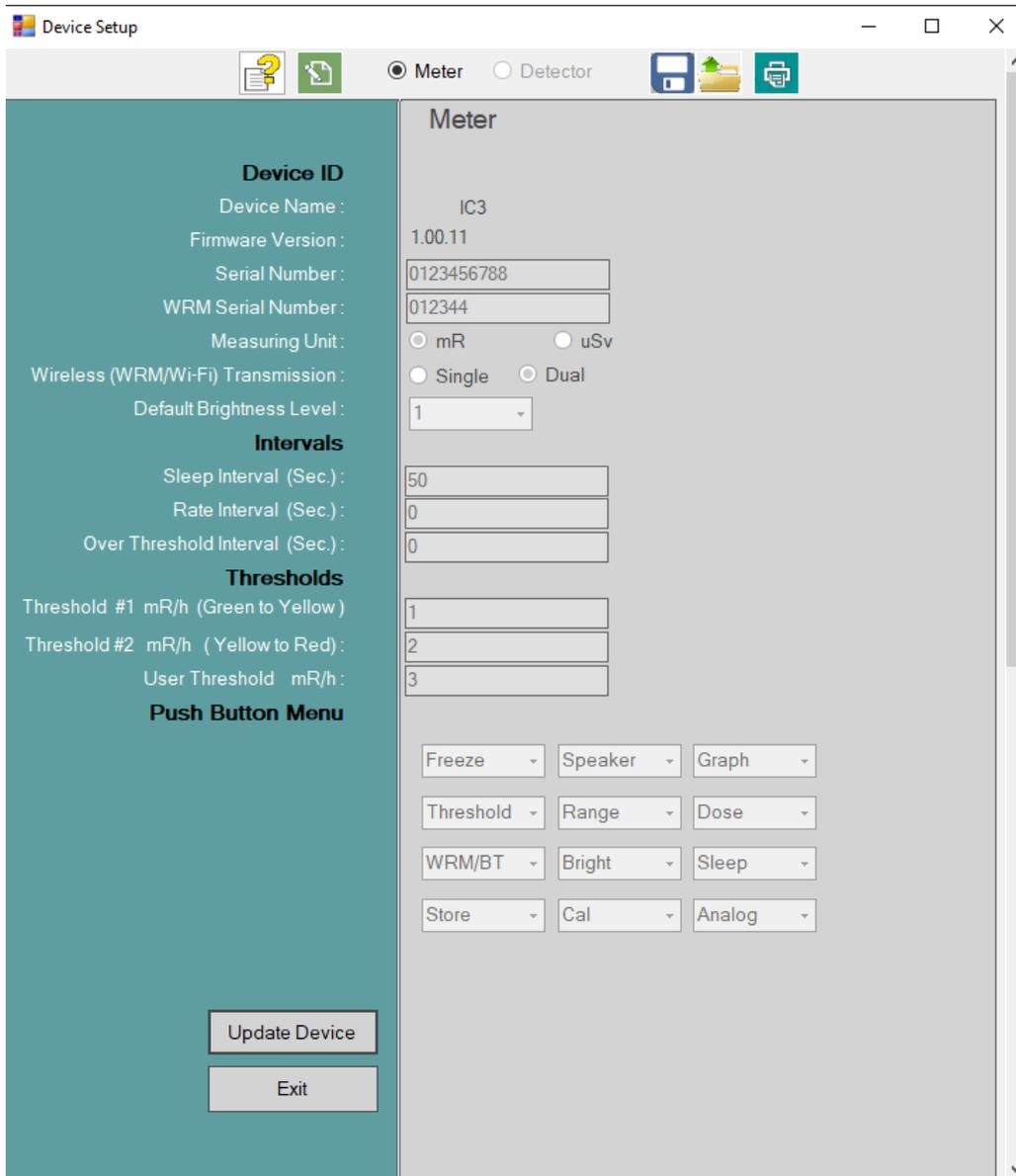
# 11 Using RMVC to interface with the IC3 meter.

The RMVC Software Interface, along with the manual is freely available to be downloaded from our website at https://www.rotem-radiation.co.il/service2/rotem-meter-view-3000/

After Connecting the RMVC to the IC3 Meter, click Device Setup to see the following screen:



## 11.1 Settings

**Device Name:**      Read from the Instrument

| | |
|---:|:---|
| **Firmware Version:** | Read from the Instrument |
| **Serial Number:** | Read from the Instrument and can be modified. Appears on the calibration Certificate and other hard copies of data generated from this software. |
| **WRM Serial Number:** | Used, when sending data to a remote station, to identify the origin of the data string |
| **Measuring Unit:** | User Selectable between Roentgen or Sievert units. |
| **Wireless Transmission:** | User Selectable |
| **Default brightness level:** | User Selectable, the dimmer the display, the larger the battery life span |
| **Intervals:** | |
| **Sleep Interval (Sec.):** | User Selectable to define the period time to pass before the display turns off. The instrument will continue to measure radiation, send data to a remote station and in case of an alert or alarm, the display will light up. |
| **Rate Interval (Sec.):** | Period of time between transmissions to PC and WRM2 Receiver. |
| **Threshold Interval (Sec.):** | Period of time between transmissions to PC and WRM2 Receiver when the instrument is in Over threshold interval status. |
| **Thresholds:** | |
| **Threshold #1 (Green to Yellow):** | User selectable, the Display outline will change color and an audio signal will be sounded. |
| **Threshold #2 (Yellow to Red):** | User selectable, the Display outline will change color and an audio signal will be sounded. |
| **User Threshold:** | Activates buzzer only. No color change, RMVC will display User threshold. |
| **Push Button Menu:** | User Selectable. Used to set up the menus in the display. See details in the table below |

### 11.1.1 Push Button Menu

| | |
|---|---|
| **FREEZE:** | Freeze the dose rate reading at the highest value |
| **GRAPH:** | Display/Hide a graph of the dose rate |
| **THR:** | Display/Hide threshold settings |
| **RANGE:** | Display which detector is currently operating (High Range - HR or Low Range - LR) |
| **DOSE:** | Display/Hide Accumulated Dose |
| **WRM:** | Activate WRM2 communication |
| **BRGT #:** | Change the brightness of the display |
| **SLEEP:** | Activate Sleep mode |
| **STORE:** | Used to Store date records in the meter |
| **ANALOG:** | Displays/Hides an Analog Display for the External Detector along with reading |
| **CAL:** | Used to calibrate the two calibration points. |

Once a command has been modified it will appear in red until the Update Device button is pressed.

## 11.2 Updating the Firmware

This section explains the process of updating the firmware of the ionization chamber IC3.

To perform the update, you will need:

1. USB Type-C DATA cable
2. The latest version of the RMVC application and Driver (can be downloaded from our website at https://www.rotem-radiation.co.il/service2/rotem-meter-view-3000/
3. Firmware file (in *.bin format)

**The Procedure**

1. Connect the IC3 to your computer. The Device Manager shows which COM port the IC3 is connected to.
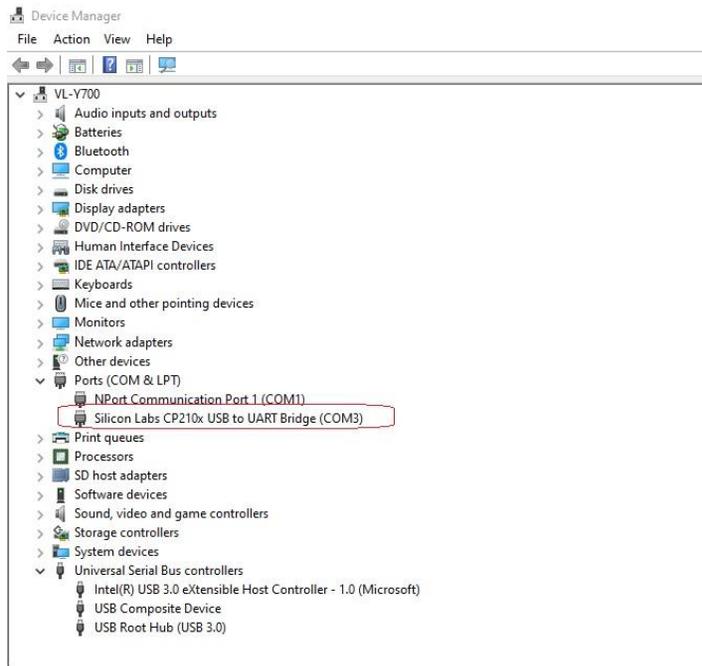
2. Upon connection, the meter will issue a sound signal and will display "USB."
3. Launch the RMVC application as administrator and click **Connect**
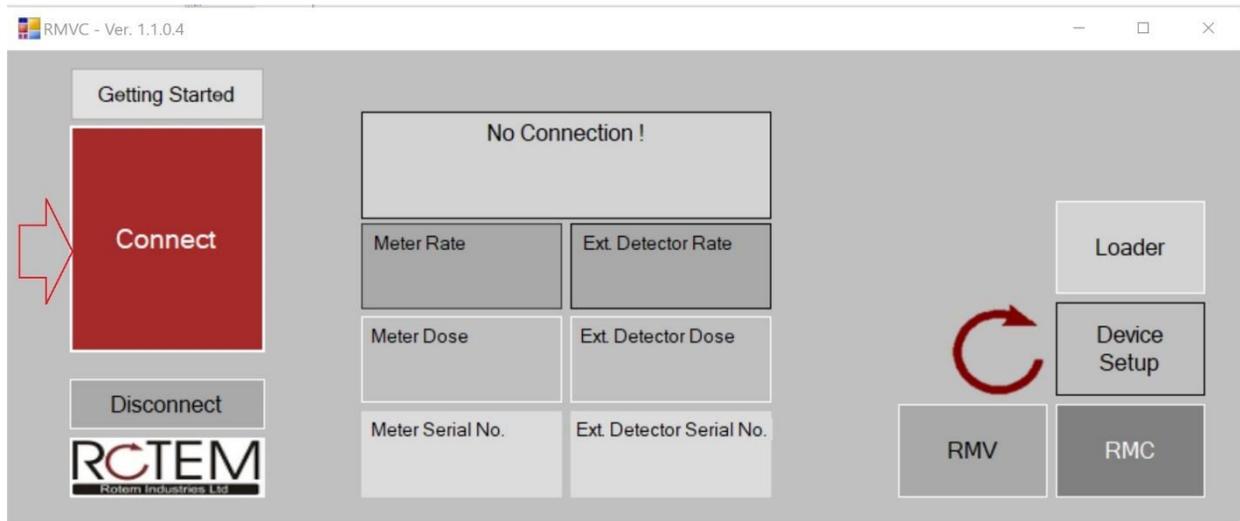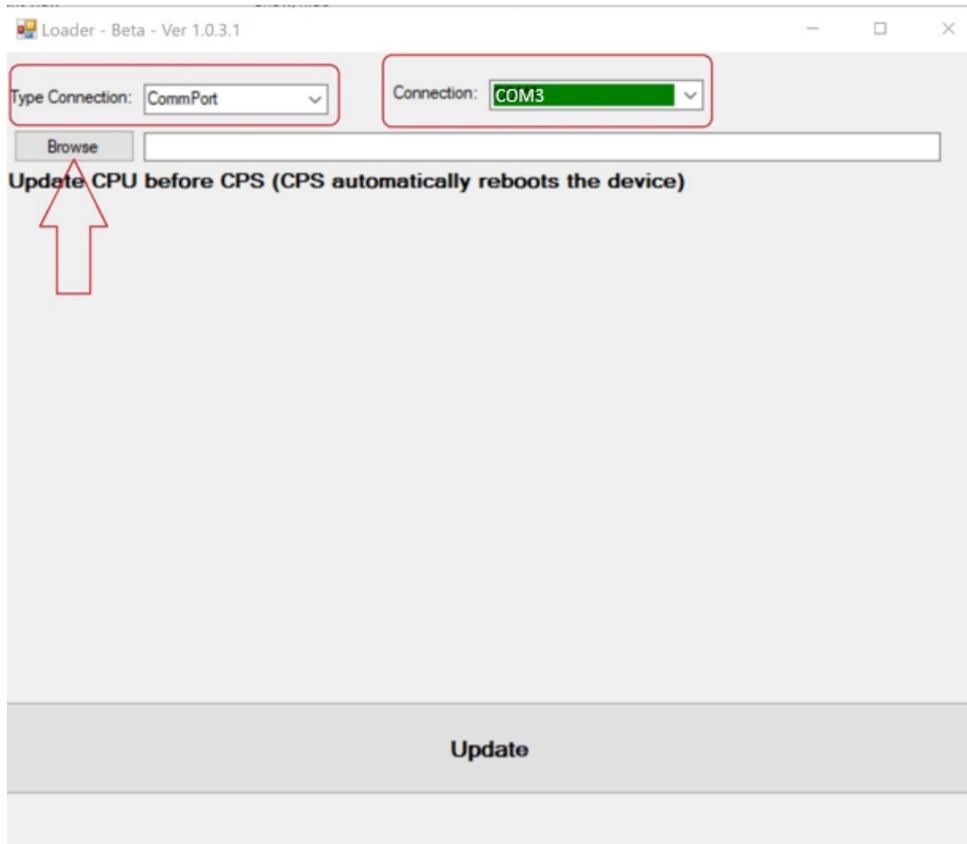


4. Set the parameters as shown in the image below and click "Connect."
The device name (IC3), current measurements, and serial number will appear on the RMVC screen.
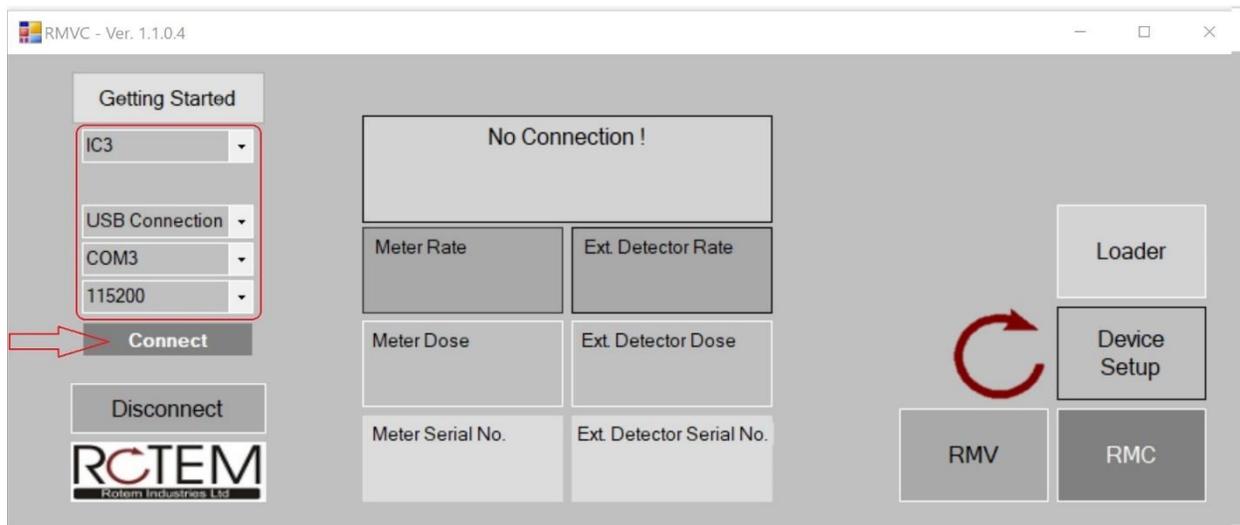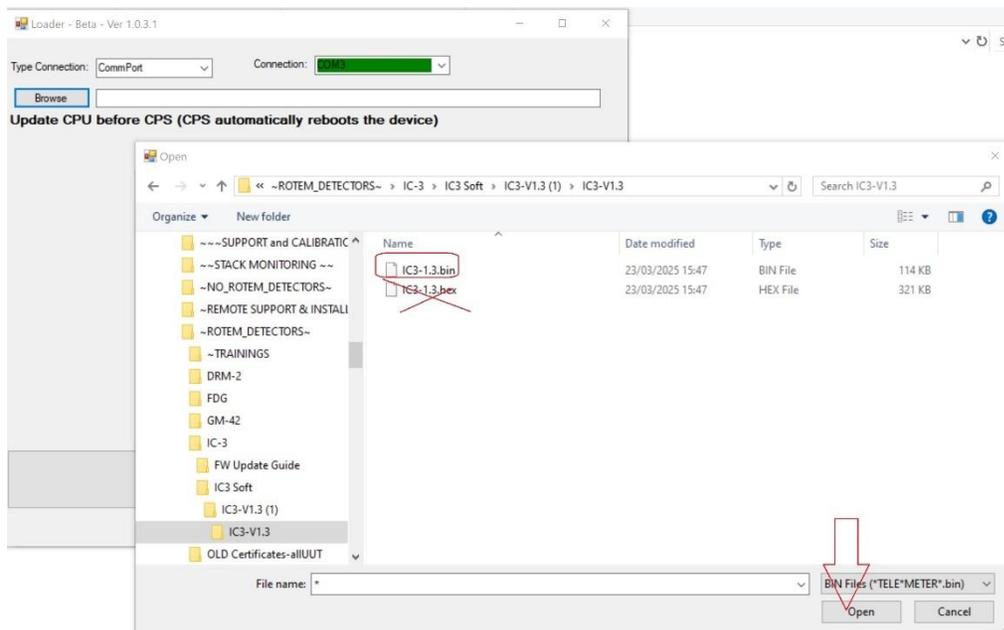
5.  Click the "Loader" button, then enter the username (RAM) and password (RAM).
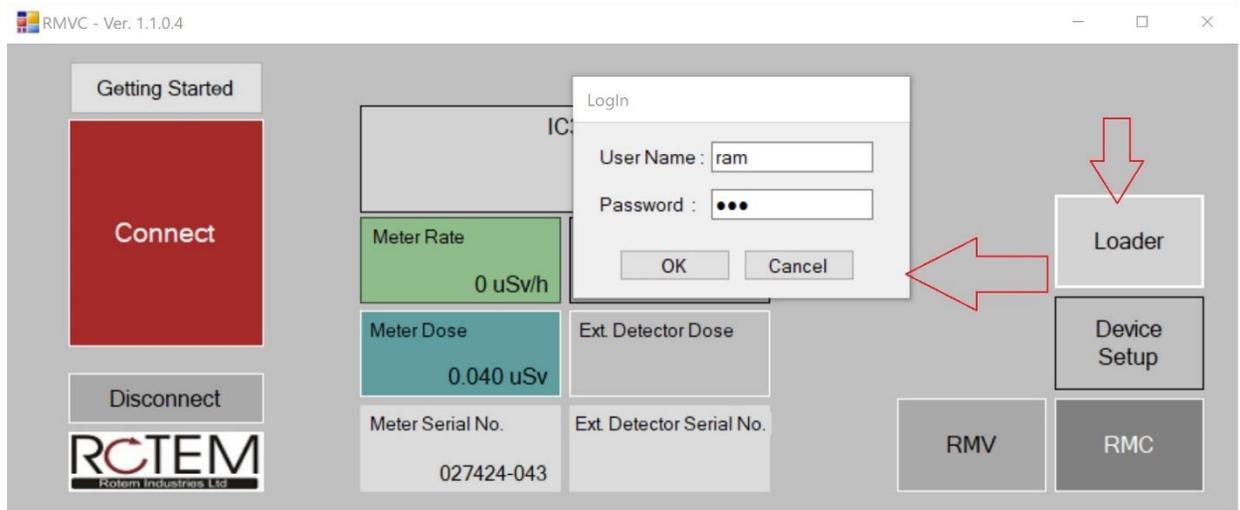


6.  Select the Type Connection (CommPort) and port number. Press the Browse button

7. Select the update file.
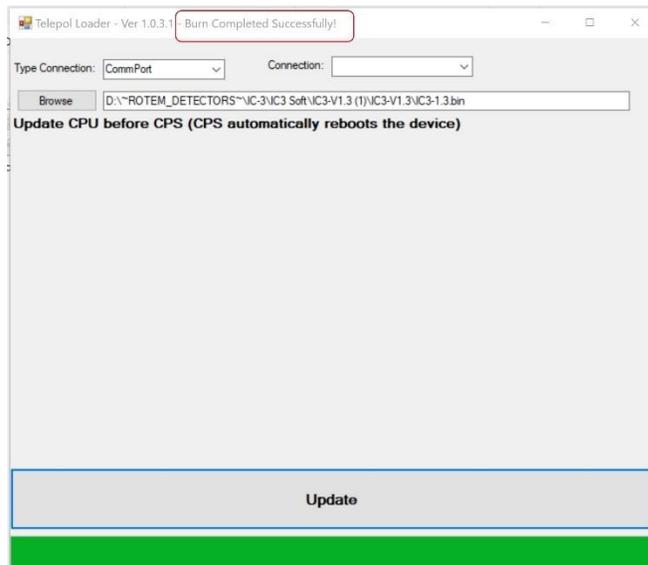   (Attention: only choose a binary format file! *.bin)



8. Click the "Update" button at the bottom of the screen.
   The green progress bar will indicate the update process. The device screen will display a message.

---
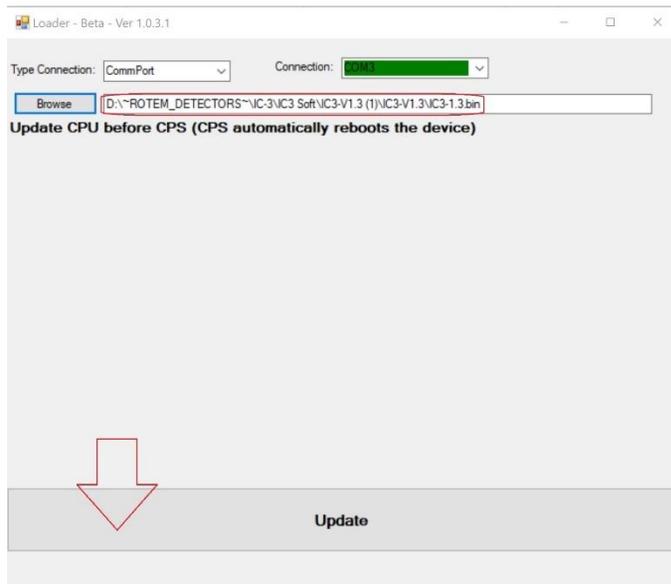
The Meter will display the message **IC3 LOADER**



The RMVC Software will display **Burn Completed Successfully**

Upon successful completion of the procedure the IC3 will restart. The new firmware version will be shown on the device screen, and a confirmation message will appear in the loader.

# 12 Appendix A

## 12.1 *IC3 Beta Measurements*

- As noted in the calibration portion, there is a possibility to calibrate for the beta readings. However, because there is no way to automatically subtract out the gamma component of an Open Window reading before applying the beta correction factor, this function would only be accurate in an almost pure beta dose rate situation (minimal gamma reading).  This is why it is currently not described or recommended in this manual.

> *NOTE:  Subtracting the gamma reading after obtaining the beta reading modified with the betta correction factor applied can result in a lower net beta reading.  (Ex. CW is 20 mr/hr, OW is 100 mr/hr or using a 4.0 beta correction factor 400 mRad/hr).  The true beta dose would be 100 mr/hr-20 mr/hr (80) x 4 which equals 360 mRad/hr).*

- Below is a chart describing the response to different energies of beta radiations:

| Nuclide (Avg. Beta Energy) | Instrument Reading (mR/hr) | Trude Dose Rate (mR/hr) | Response (Absorbed Dose) | Beta Correction Factor |
|---|---|---|---|---|
| Sr/Y-90 (565 Kev) | 1200 | 2738 | 0.438 | 2.3 |
| Kr-85 (250 Kev) | 2900 | 13280 | 0.218 | 4.6 |
| Pm-147 (62 Kev) | 38.7 | 256 | 0.151 | 6.6 |