MIRION Connect 25

Annual Users' Conference

INNOVATION AT WORK

Connecting Visionaries in Radiation Safety, Science and Industry

Conrad Orlando Resort, FL –July 28th – August 1st

MIRION TECHNOLOGIES

Introduction to the IC3™ Ion Chamber

David Stewart

Director, PLM: Defense, Security, and Environmental

Mirion Connect | Annual Users' Conference 2025

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Introduction to the IC3™ Ion Chamber

The IC3 Ion Chamber is a critical component in radiation detection and measurement, widely used in various applications including medical imaging, nuclear power plants, and research laboratories. This one-hour seminar provides a comprehensive introduction to the IC3 Ion Chamber, covering its design, functionality, and practical applications. Participants will gain an understanding of the principles behind ion chamber operation, including the detection of ionizing radiation and the conversion of radiation energy into measurable electrical signals. The session will also explore the key features and advantages of the IC3 Ion Chamber, such as its high sensitivity, stability, and reliability with the added feature of no desiccant required. The seminar will also include a brief overview of the calibration and maintenance procedures necessary to ensure optimal operation of the IC3 Ion Chamber.

Agenda

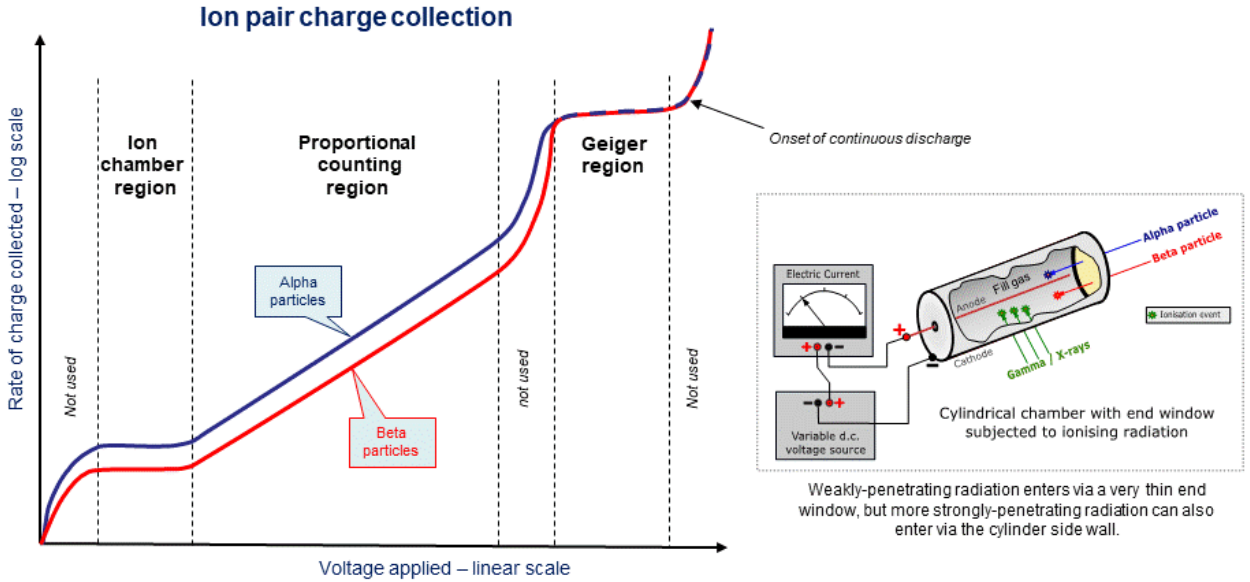
- Ion Chamber Detection
- Key Features of the IC3 Ion Chamber
- Operations
- IC3 Software and Calibration
- IC3 Maintenance and Service
- Summary

Ion Chamber Detection

What is a Portable Ion Chamber?

Practical Gaseous Ionisation Detector Regions

This shows an idealised plot of the three gaseous detection regions, using the concept of applying a variable voltage to a cylindrical chamber which is subjected to constant ionising radiation. Alpha and beta particles are separately plotted to demonstrate the effect of different radiation energies, but the same principles apply to all forms of ionising radiation.



In the ion chamber region gas ionisation is direct and results in a current flow proportional to overall ionisation. At higher field strengths gas multiplication effects can be used, allowing output of individual ionisation events as measurable pulses.
In the proportional region, pulse sizes are proportional to the energy of each ionisation event. In the Geiger region a fill gas at reduced pressure (1/10th atmosphere) allows greater multiplication but produces a uniform pulse for each ionising event regardless of its energy.

Brief Overview

- Key Components: gas filled chamber, electrodes, power supply, and display
- Ionizing radiation creates ion pairs
- Charge movement to anode/cathode induces small current
- Current proportional to quantity of ions produced
- No multiplication

Is an Ion Chamber the Right Choice?

Advantages

- No dead time like a GM tube
- Energy independence over wide range
- Durability and portability
- Large dynamic range
- High Accuracy
- Natural integration of pulsed radiation

Concerns

- High voltage to operate
- Design must consider sensitivity to temperature and pressure
- Limited spatial resolution
- Battery life

Is an Ion Chamber the Right Choice?

Features

- Accuracy/sensitivity
- Wide range of applications
- Beta, gamma, and x-ray sensitive
- Minimum training
- Opportunities for portability

Applications

- Medical
  - Leakage/scatter measurements
  - Diagnostic and therapeutic environments
- Industrial
  - Non-destructive testing
  - Quality assurance
  - Breaching/maintenance/accident
- Environmental
  - Public health
  - Safety/accident/transport assessment

Key Features of the IC3

IC3 Main Features

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

- **New Sealed Electrometer provides complete protection in high humidity areas - *NO DESICCANT REQUIRED***
- Large Color, Backlit Display (similar to Telepole 2 to reduce training)
- Automatic Pressure and Temperature compensation
- Ideal for NDT testing as well as Medical Radiology safety, providing accurate readings of Pulsed X-rays down to the 50 nanoseconds
- Wide measuring range of 1 µSv/hr to 1 Sv/hr (0.1 mR/hr to 100 R/hr)
- Can be set for US or SI units of measure

IC3 Features - Display

The IC3 Color Display

- The backlight has 6 brightness levels - see data even in bright sunlight
- Light sensor adjusts brightness for legibility and battery use
- Accelerometer enables sleep mode (blanks the screen) to optimize power consumption

- Even with the screen blank
  - IC3 is still operating and monitoring dose
  - If telemetry is active, it will continue to send wireless data

- Multiple threshold alarms:
  - Changes Color ring on display from Green to Yellow to Red
  - Separate User Threshold with Audible Alarm

IC3 Features - Basic

Basic features:

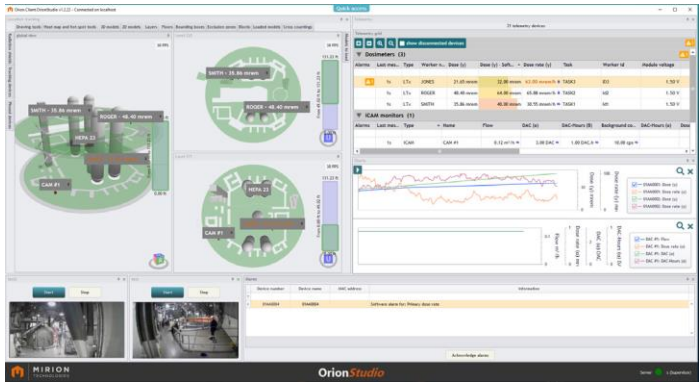
- Wide measuring range of 1 µSv/hr to 1 Sv/hr (0.1 mR/hr to 100 R/hr)
- Lightweight, easy-to-use, one hand operations
- Easily replaceable mylar beta window
- Electronically monitors beta window slide - displays on screen gamma or beta/gamma
  - Alarms/indicates if only partially open
- 4 standard AA batteries last up to 100 hours (brightness level)
- Accumulated / Integrated dose measurement
- Built-in memory to store data
- Automated Zero Function
- Includes Rings and shoulder strap to facilitate survey use

Nuclide (Avg. Beta Energy)	Instrument Reading (mR/hr)	True 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

IC3 - Connectivity

The IC3 will have more connectivity than any other instrumentation

- Optional WRM radio capability to allow data to be sent to your existing telemetry system
- Connect directly to a computer through its USB port and send data out through the RMVC software
- Once released, the BLE Option will replace the WRM2 Radio so you cannot use both at once
  - The BLE allows connection to the same APP as our RDS-32
  - This APP can send data to RadResponder during Drills or Emergencies
  - It also can send data to Mirion's SPIRView Mobile system
  - It can also send data via Text or Email.
  - Lastly it can connect to Connect Studio Software
- The Ultra Wideband (UWB) can send location data from the IC3 (1m Accuracy)
  - Adding WRM data can automate surveys and provide heat maps



NOTE: The IC3 Connectivity is all optional for those sites that cannot have any wireless capability in their instrumentation!

Mirion Connectivity Ecosystem

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IC3 Operations

Brief Operational Overview

General

- Auto-ranging or fixed for quicker response
- Main display always indicating dose rate
- Four button access supports one hand operational capability
- Advance through menus by short press (long menu button press = power)
- Features analog graph with no smoothing or integration (key for hot spot searches)
- Settable: green/yellow/red/blue indicators for clear go/no go considerations

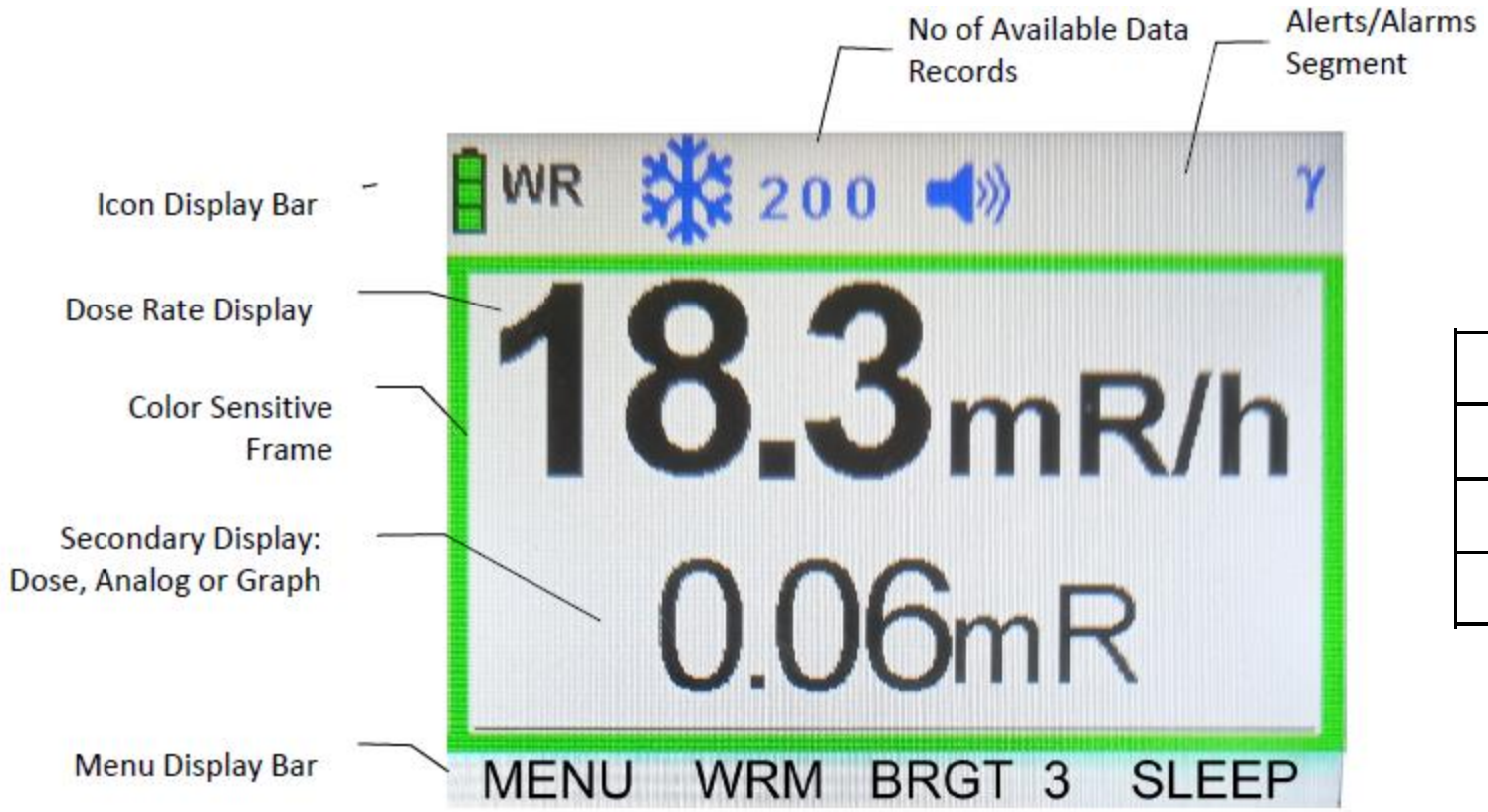
IC3 Features - Display

The Display Menu on the IC3 is customizable allowing up to 12 different functions to be made available.

- The menu setup is done in the RMVC software and only the functions specified will be available for the Technicians to use. Typically arranged in the priority of use.
- As seen below the first page of functions include:
  - WRM – This turns on the WRM2 radio for Telemetry
  - SPK – This turns on the speaker to hear dose rate changes without looking at the meter
  - BRGT – This sets the brightness of the display
- The next page and the other popular functions:
  - FRZ – This maintains the highest dose rate seen. It is often used for hot spots and shipping surveys
  - RANGE – IC3 in the auto-range or manual range mode (used for unknown or pulsed X-ray fields)
  - ANALOG – Analog scale displayed prior to any smoothing algorithm – very quick response

MENU	WRM	SPK	BRGT 5
MENU	FRZ	RANGE	ANALOG
MENU	DOSE	GRAPH	THR
MENU	STORE	CAL	SLEEP

Brief Operational Overview



MENU	FRZ	SPK	GRAPH
MENU	THR	RANGE	DOSE
MENU	WRM	BRGT 1	SLEEP
MENU	STORE	CAL	ANALOG

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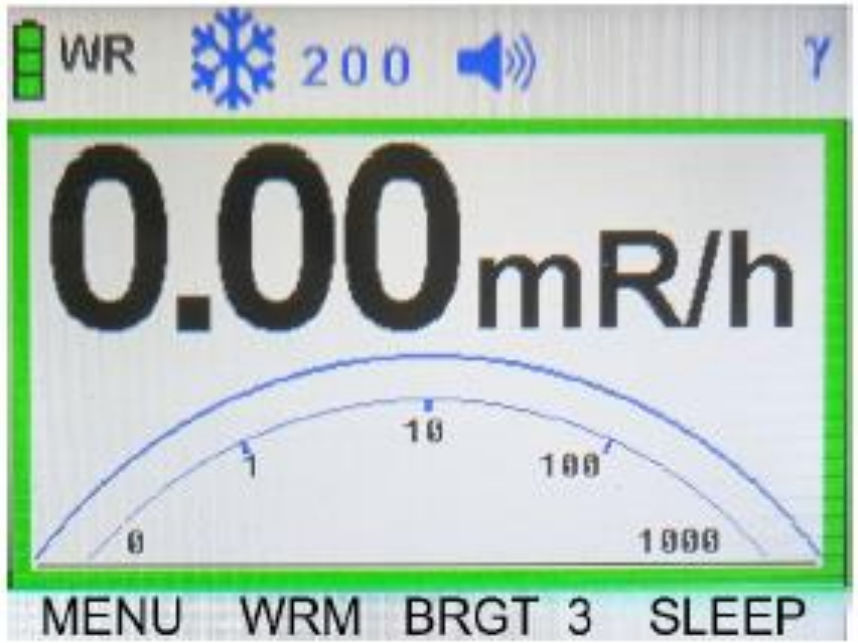
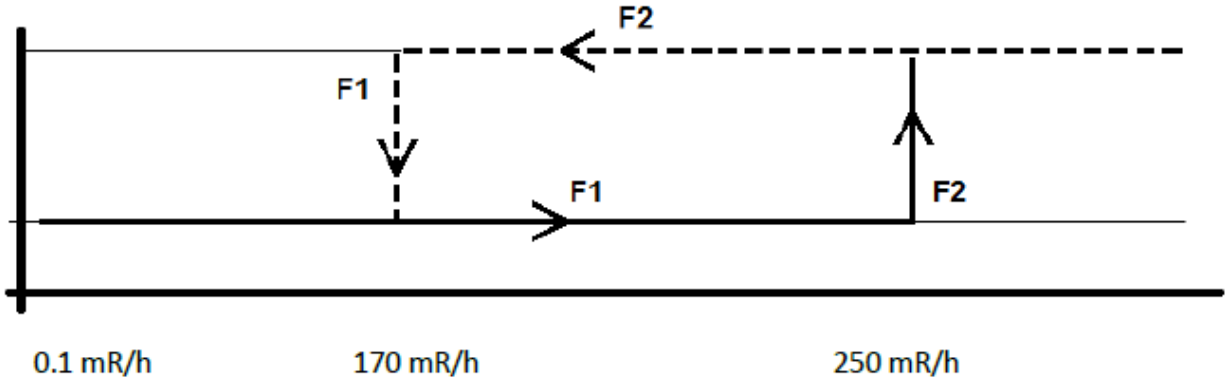
Items to Watch



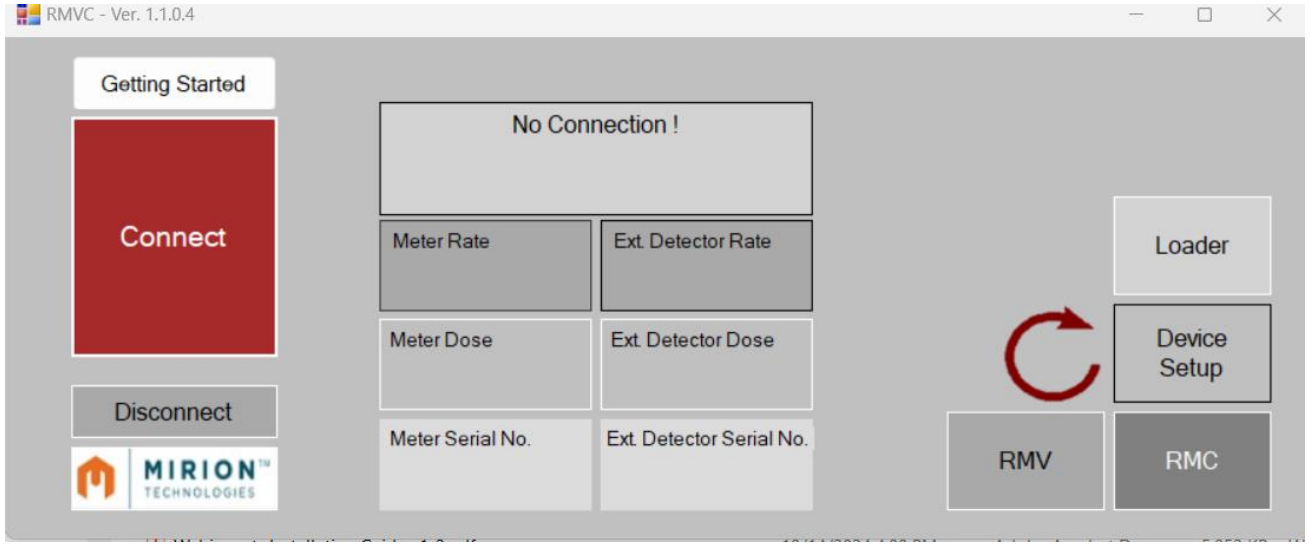


Things to know for demonstrations

- Switchover between ranges can be up to 3 seconds with additional 2 seconds to stabilize (equivalent to switching analog)
- Technically 10m warmup like other Ion Chambers (though demonstrated shorter)
- If breaching consider locking in high range (0.01R/h to 100R/h) and analog
- Recognize hysteresis during switchover

IC3 Software and Calibration

RMVC Software



RMVC Software

- Connection via USB-C
- Can power unit for continuous monitoring
- Supports calibration as well as viewing
- Same platform as Telepole II Systems
- Windows platform

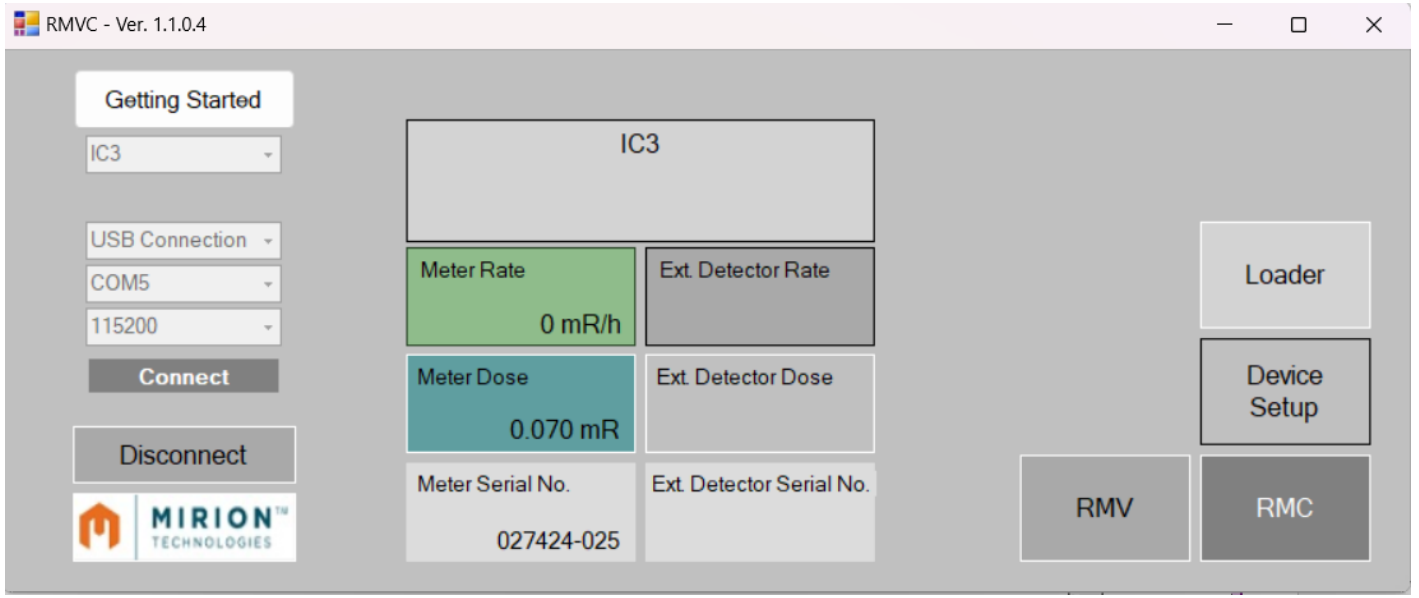
RMVC Software

Calibration and Viewing Software

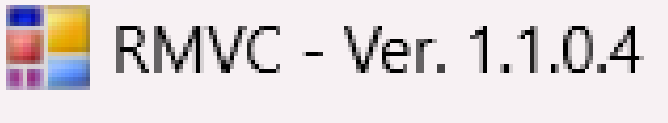
- RMV = Remote Meter Viewing software
- RMC = Remote Meter Calibration software
- RMVC = Remote Meter Viewing and Calibration software
- https://www.rotem-radiation.co.il/service2/rotem-meter-view-3000/
- Connect to device with USB to USB-C cable (ensure have correct drivers on your PC

The instruments connect to the Computer using the following baud rates:

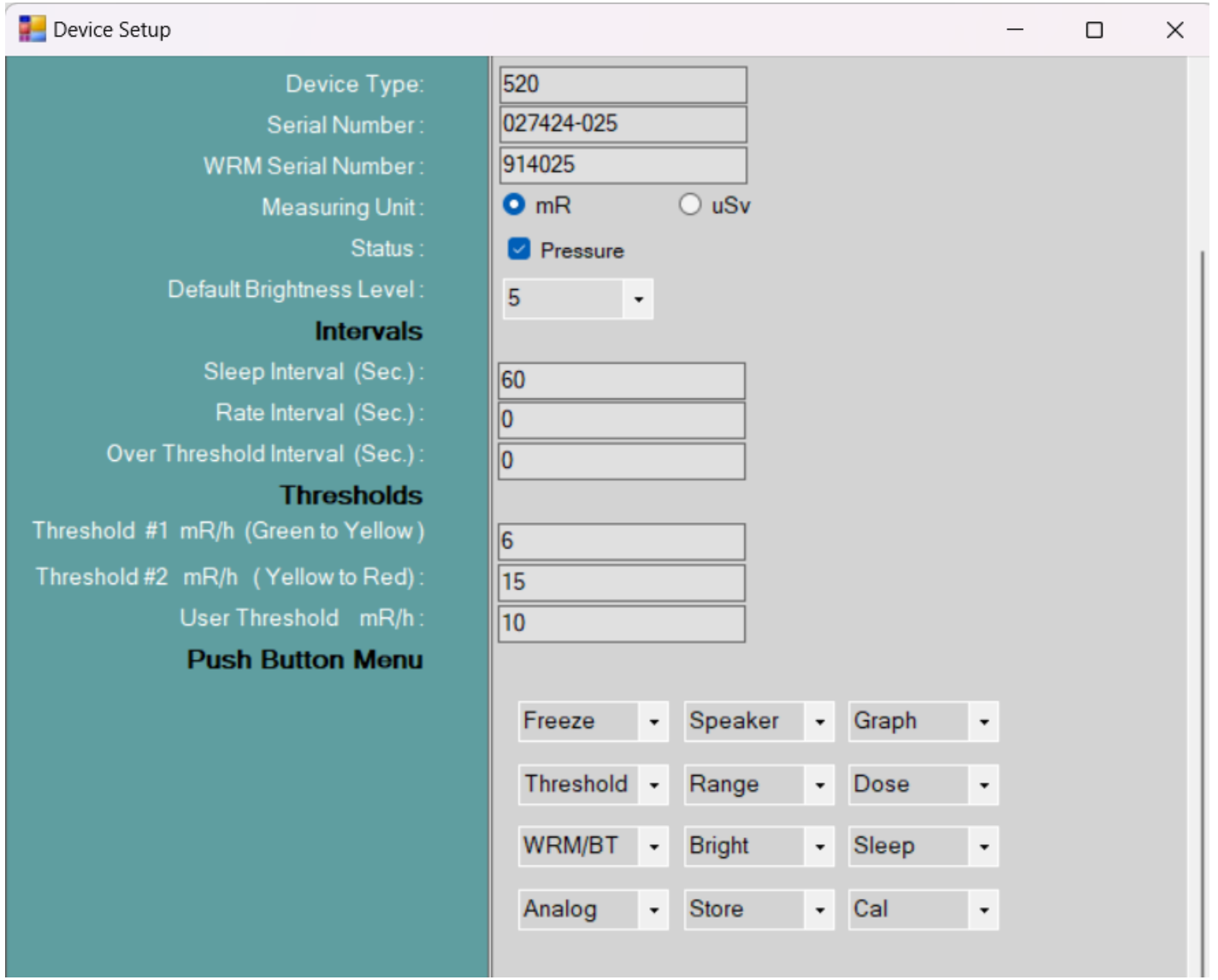
DRM-3000 / DPU-3 Meter	115200
IC-3 Meter	115200
AMP Family	300, 4800 or 9600
TelePole	19200
TelePole II	115200
RAM DA-2000	9600
RAM R-200	9600
RAM ION	19200
RAD ION - RI-02	19200



User Name	Password
{anything}	RAM



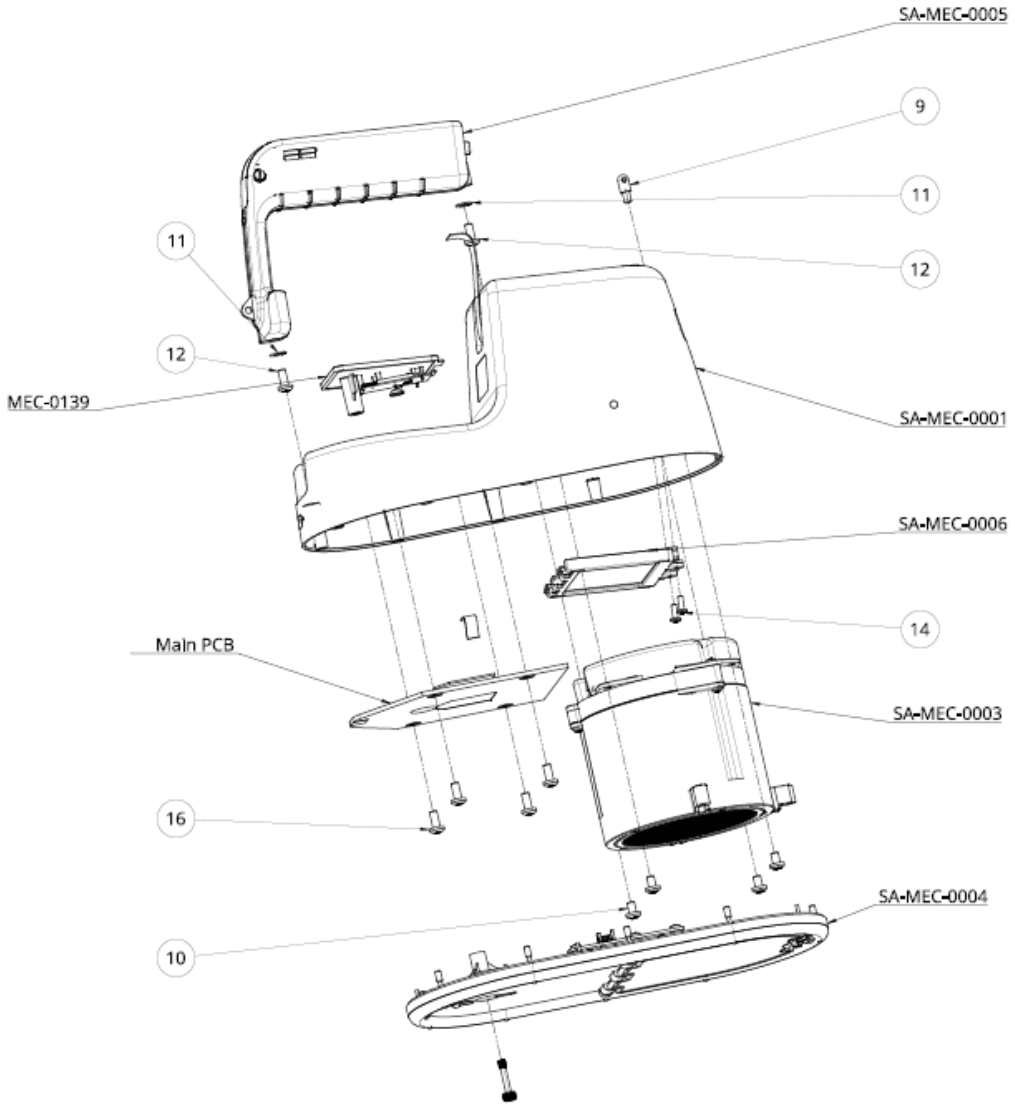
RMVC Software



IC3 Maintenance and Service

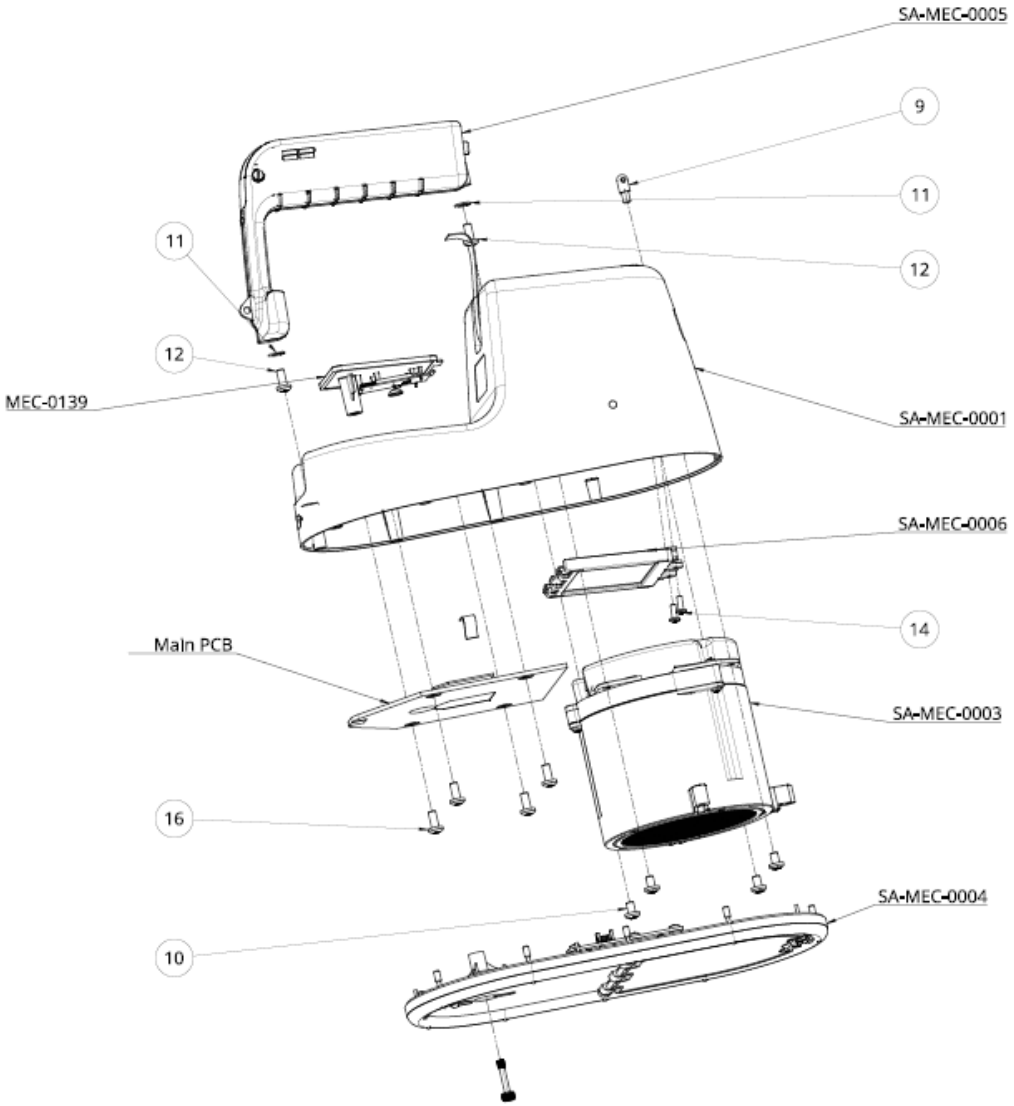
Live Demonstration and Disassembly

IC3 Spare Parts Summary



Part Number	Description
BEN-0318	Detector, Ion Chamber, Vented, for IC3
BEN-0159	PCB, Electrometer, for IC3
BEN-0321	Cover, Base, Housing, for IC3
BEN-0099	Handle, with lock and wiring for IC3
BEN-0322	Cover, Top Shell, Housing for IC3
BEN-0156	Display, PCB and 3.2" color TFT LCD for IC3
BEN-0157	PCB, Main CPU, for IC3
BEN-2115	Mylar, inclusive of protection mesh, for IC3
MEC-0195	Ring, Bottom Bumper, with screw mounting, for IC3

IC3 Maintenance/Service



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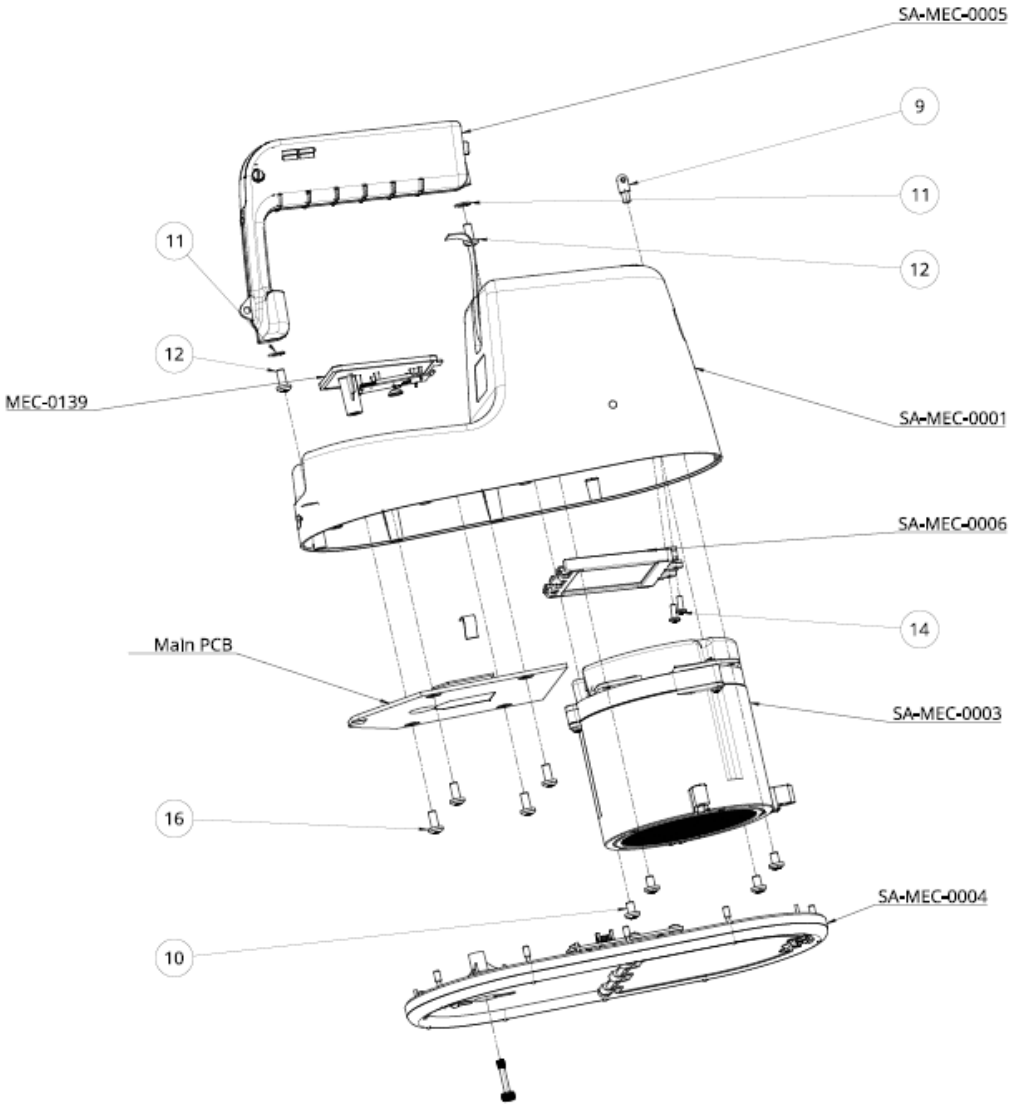

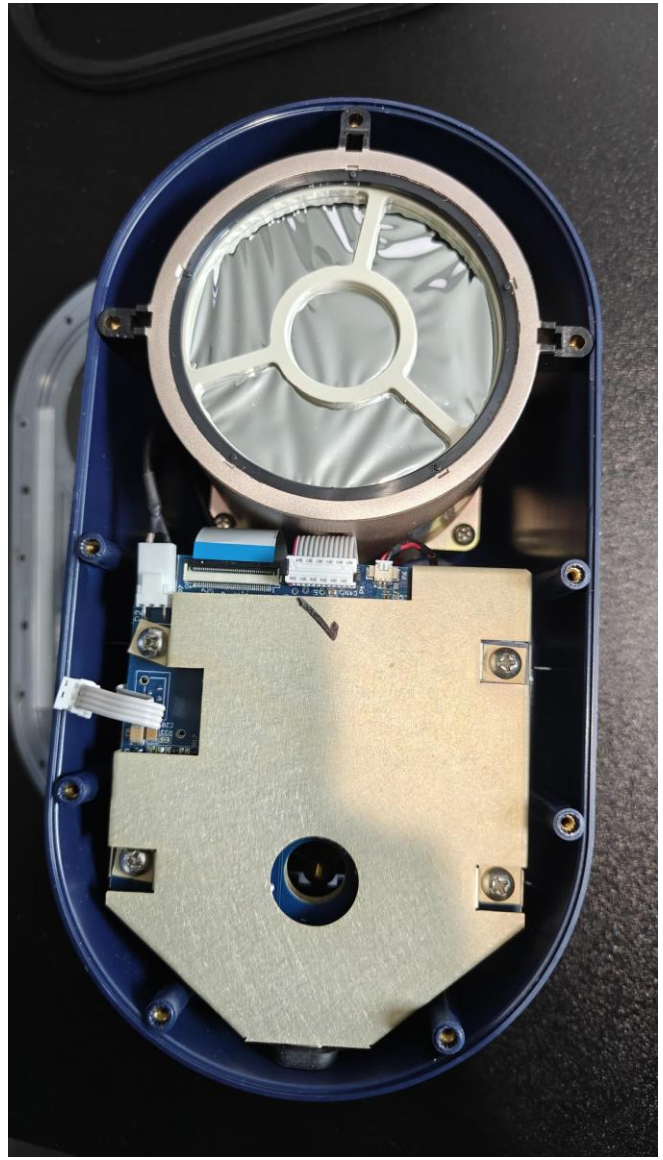

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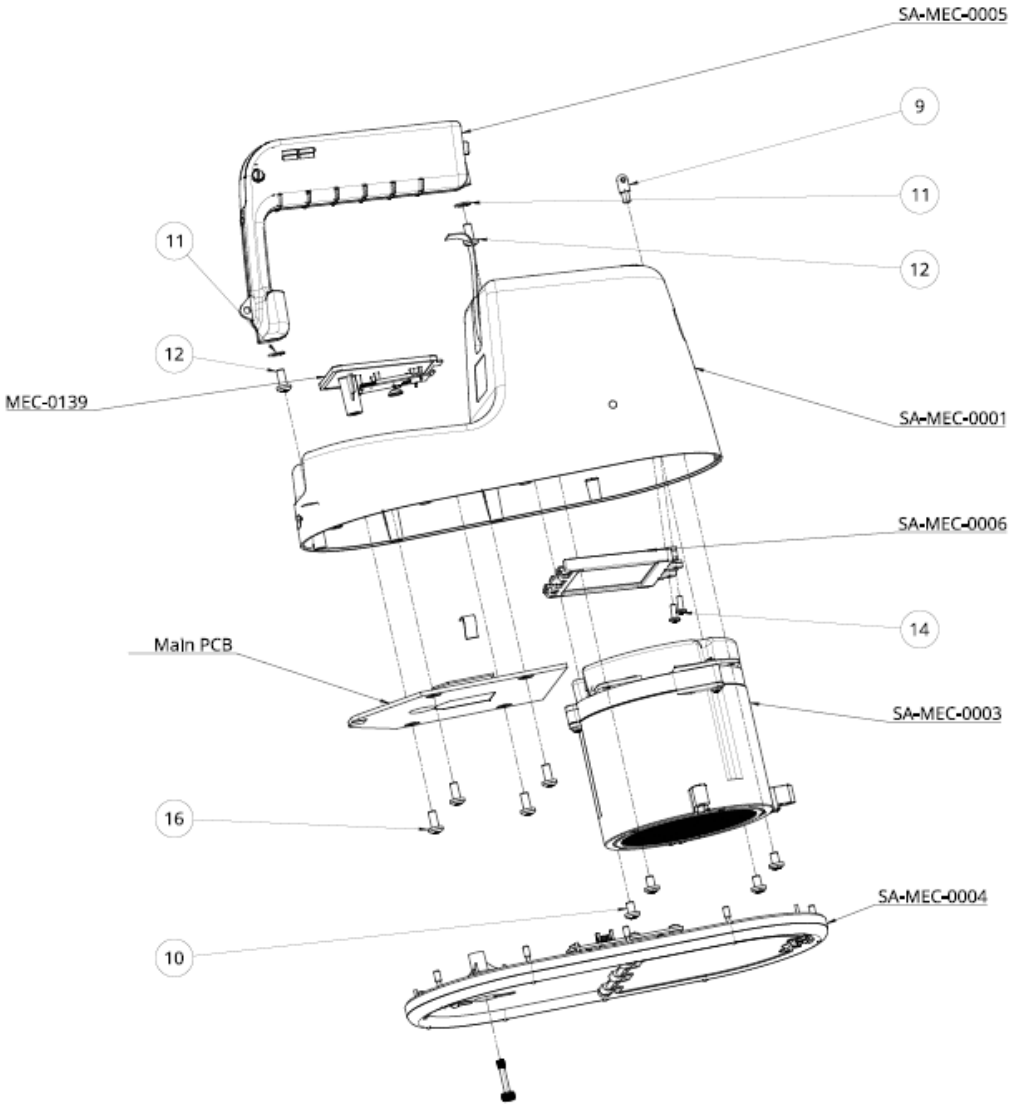

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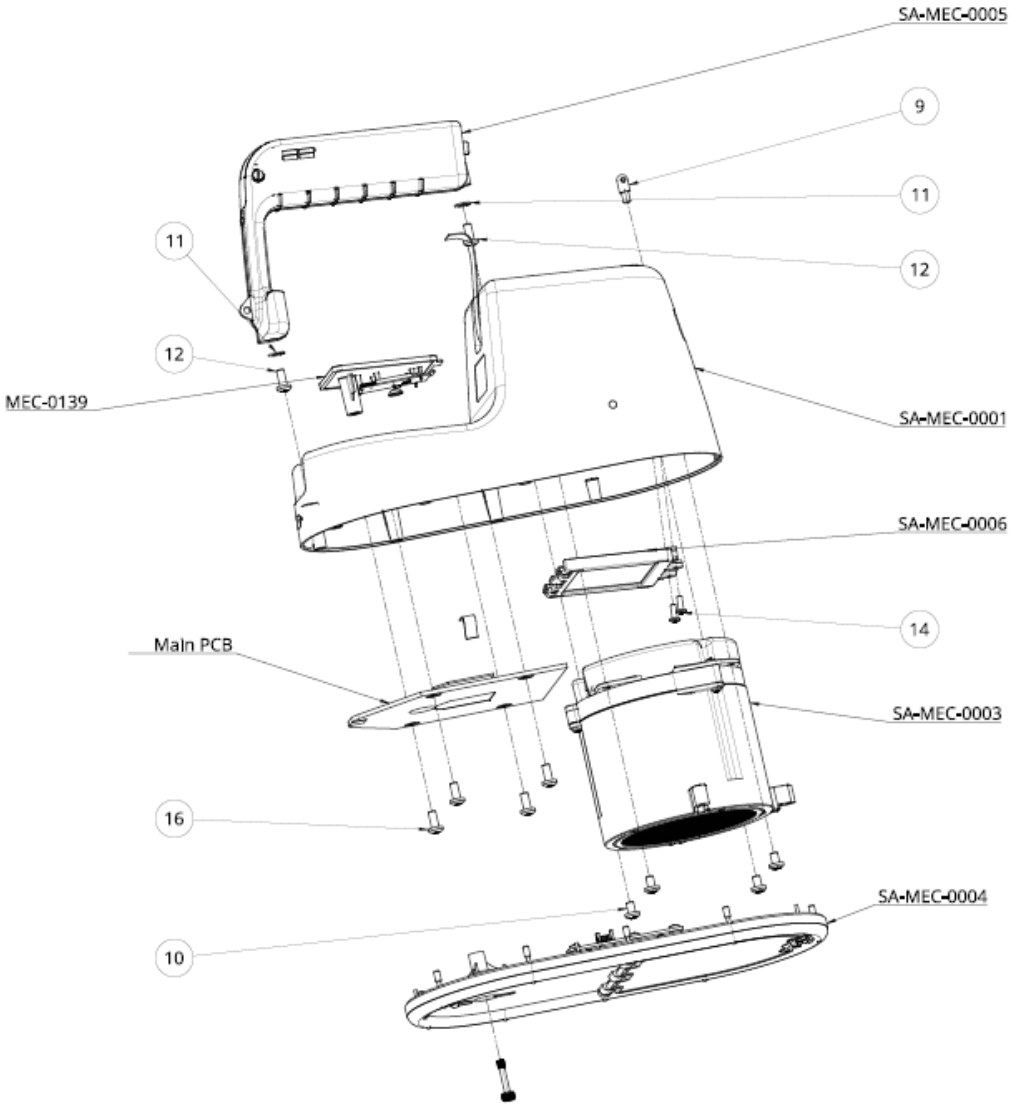

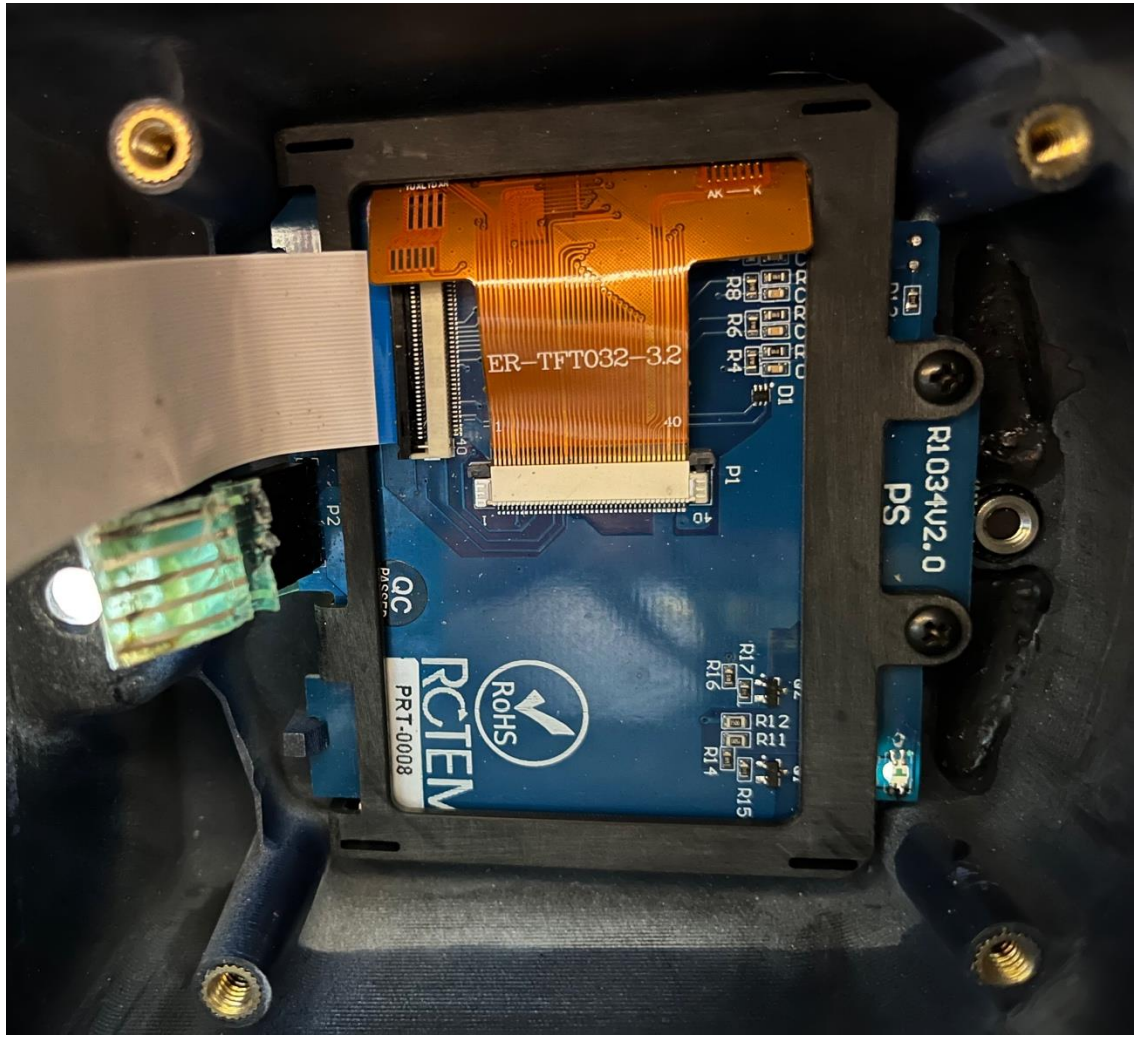

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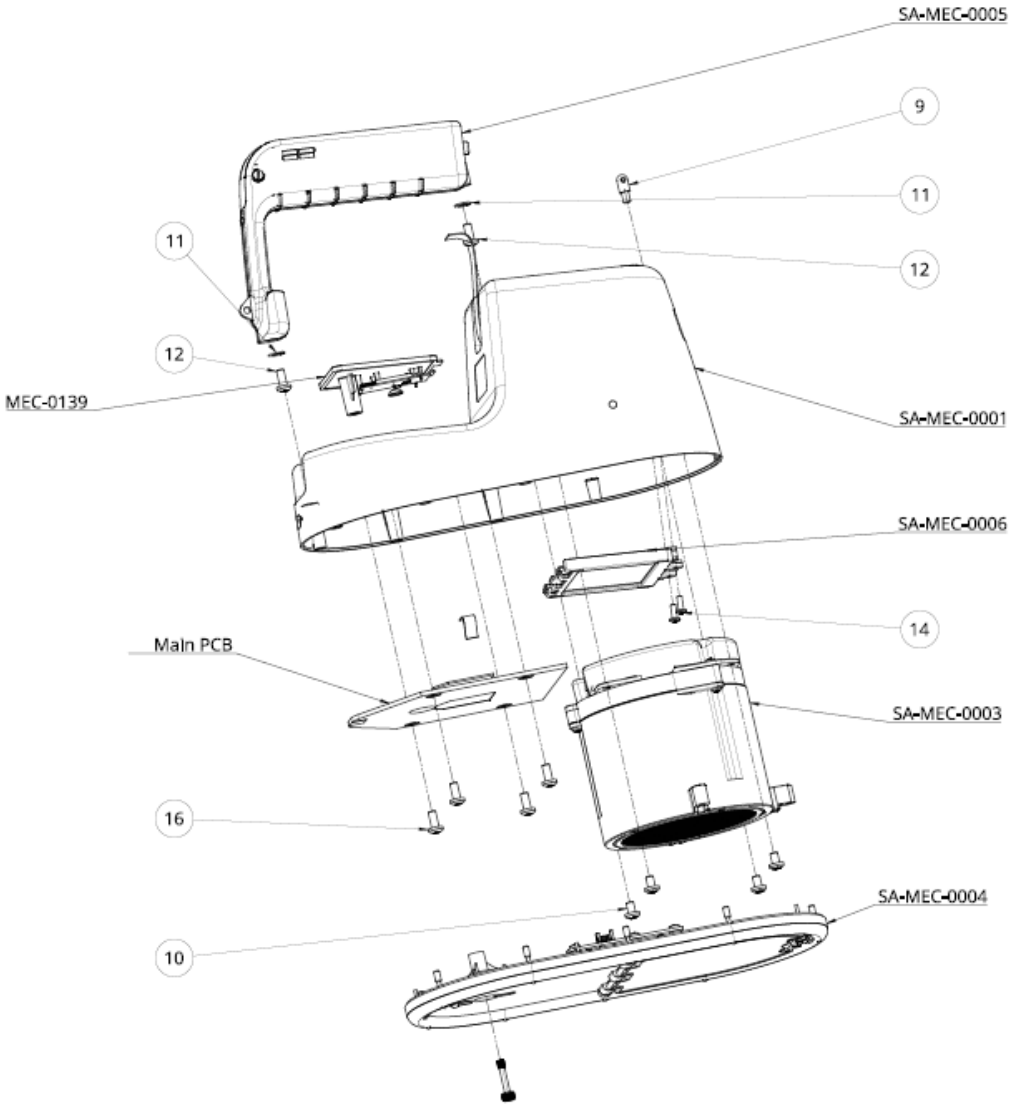

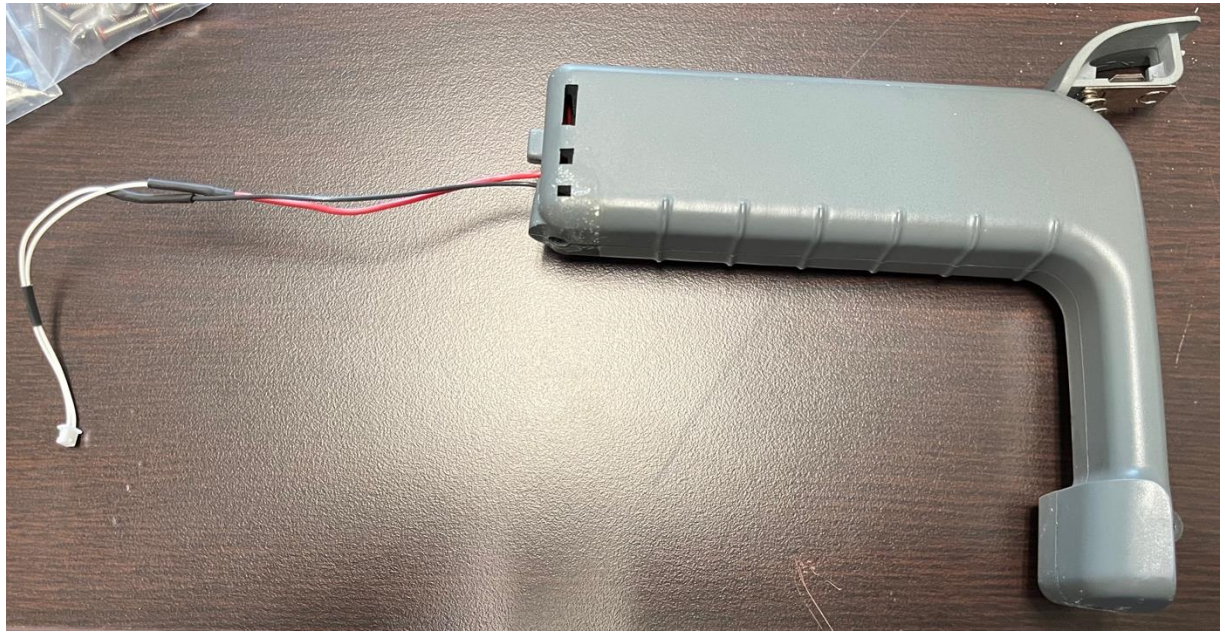

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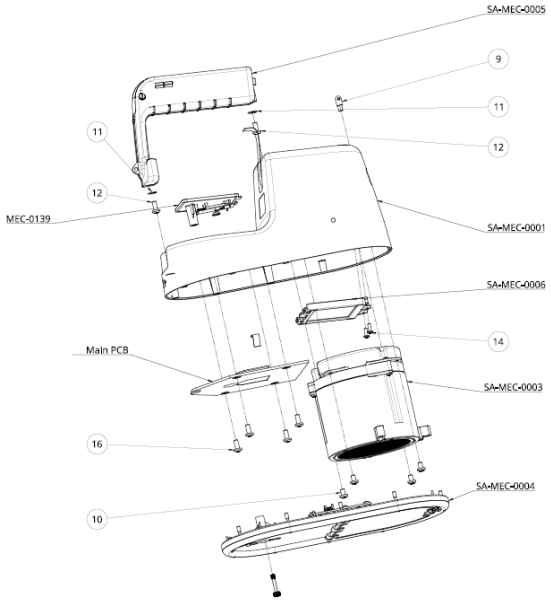
Summary

IC3 Specifications

- Accuracy (137Cs): ±10% of reading within measuring range
- Gamma Energy Dependence: Better than ± 20% from 20keV to 3MeV
- Beta Energy Dependence: Better than ± 20% from 200keV
- Angular Dependence (137Cs): Less than ± 30% (for ±90° of front direction)
- Ion Chamber Volume: 350 cm3
- Chamber Wall and Beta Slide Thickness: 1000 mg/cm2 (tissue equivalent)
- Window Density: 7 mg/cm2 Mylar
- Response Time: - 3 sec. for readings above 1 mR/h - 5 sec. for auto-ranging change, from Low Range to High Range (2 sec. +3 additional seconds for auto ranging delay)
- Data Logging: 200 data records
- 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 (non-condensing)
- Dimensions: Width 13 cm (5.1"), Length 24 cm (9.5"), Height 14 cm (5.5")
- Weight: 1000 g (2.2 lb) including batteries
- Units: Switchable US or SI



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Thank you