

EXOID USER MANUAL



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FCC Declaration of Conformance

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
- (2) This device must not accept any interference received, including interference that may cause undesired operation. Changes or modification not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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1 / DEFINITIONS AND WRITING CONVENTIONS

Make sure to follow the precautionary statements presented in this guide. Safety and other special notifications will appear in boxes and include the symbols detailed in [Table 1](#).

Table 1: Safety and Hazard Symbols



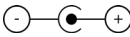

	This symbol indicates general advice on how to improve procedures or recommends measures to take in specific situations.
	This symbol indicates where special care should be taken.
	Direct Current (DC)
	Voltage polarity of the jack

Table 2: Terminology Used in this Manual

TERM	DEFINITION
Automatic Pressure System (APS)	A component of the Exoid which controls pressure to a limit of ± 2500 Pascals (Pa).
Delta	The stretcher unit consisting of a set of jaws with teeth that the nanopore fits on to.
Exoid Control Suite (ECS)	The software used to operate the Exoid.
Exoid lighting	Lighting halo located around the top of the Exoid.
Izon Data Suite (IDS)	The software used to process data produced by the Exoid.
Load position	The stretcher unit position that enables a nanopore to be fitted onto the teeth.
Nanopore	Flexible polyurethane membrane with a nanoscale size hole in the centre.
RMS noise	Root mean square: a real-time measure of the background electrical noise of the system.
Shielding lid	Hinged cap on the top face of the Exoid which opens to reveal the fluid cell and nanopore working area. Closing this will reduce noise from external sources such as large machinery and fluorescent lighting.
Voltage Clamp Amplifier (VCA)	A component of the Exoid which controls the voltage applied to the system in order to manipulate current.

2 / SAFETY AND HAZARDS

2.1 Safe Use Requirements and Specifications

Make sure to adhere to the safe use requirements as specified in Table 3. If the equipment is used in a manner not specified, protection provided by the equipment may be impaired.

Table 3: Safe Use Requirements and Specification of the Exoid

SAFE USE REQUIREMENT		SPECIFICATION
Operating Temperature	Indoor Use	Ambient temperature of 5-40 °C is safe for the instrument, however operation at 5-25 °C is recommended.
Altitude		Up to 2000 meters above sea level
Relative Humidity		20-80% relative humidity
Power Consumption		80 W
Pollution Degree Rating		2
Ingress Protection Rating		IP30 / Type 1 - UL50E
Power Supply Unit (TRH100A240-21E11 + CCCVI)	Input AC	100-240 V 1.5 A 47-63 Hz
	Output DC	24 V nom 4.17 A max current 100.08 W max power

2.2 Hazards

The Exoid is a laboratory product, however if any biohazardous samples are present then adhere to current Good Laboratory Practices (cGLPs) and comply with any local guidelines specific to your laboratory and location.

Fire or Electrical Hazard

The Exoid poses no uncommon electrical or fire hazard to operators if installed and operated properly without physical modification and connected to a power source of correct specification.

Chemical Hazards

The Exoid system contains no potentially hazardous chemical materials.

Mechanical Hazards

The Exoid stretcher unit contains automatically moving parts. Keep fingers and loose clothing clear while automatic processes are in operation.

Transport

To protect the Exoid during transport or storage, decontamination procedures must first be performed. To protect the instrument from damage, always use the packaging materials supplied when transporting the Exoid. Use appropriate heavy lifting techniques to avoid injury. If appropriate packing materials cannot be obtained then contact your local Izon Science office.

Disposal

The Exoid system contains electrical materials; it should be disposed of as unsorted waste and must be collected separately, according to the European Union Directive: Waste Electrical and Electronic Equipment. The user is fully responsible for ensuring that the obsolete Equipment and/or Consumables are recycled or disposed of in accordance with this and/or any other relevant laws and regulations in the countries where the instrument is being recycled or disposed of. Contact your local Izon Science representative for more information.

2.3 Intended Use

The Exoid is used to measure size, concentration and zeta potential of nanoparticles. The instrument is intended for use in research laboratories by professional personnel. The Exoid is not intended for diagnostic purposes and should not be used to make treatment decisions.

For verification of the entire system, it is recommended that cGLPs are followed to ensure reliable analyses.

3 / ASSEMBLY AND SETUP INSTRUCTIONS

3.1 System Components

The following components are provided in the box:

1	Exoid Instrument	5	Lower Fluid Cell
2	Shielding Cap	6	24 V Power Supply
3	Upper Fluid Cell	7	Power Lead
4	10 M Ω Reference Cell	8	USB-A to USB-C 3.0 Cable

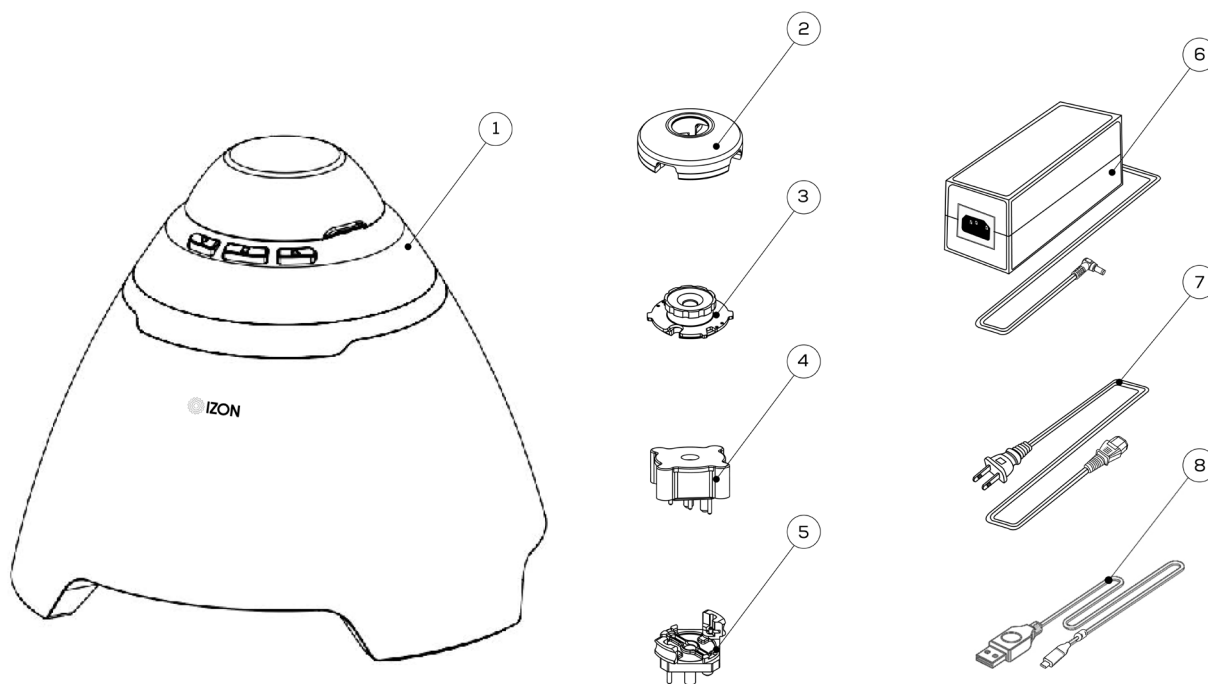


Figure 1: The Exoid and components with an Exoid.

3.2 Assembling and Installing the Exoid

1. Unpack the Exoid and box contents.



We recommend that you save the box and packaging materials in case the instrument needs to be returned for servicing.



If you decide to dispose of the packaging, first check that all components are present so as not to inadvertently throw anything away.

2. Place the Exoid onto a stable and level laboratory bench.
3. Ensure that the buttons near the top of the Exoid are facing the user.
4. Connect the power lead to the 24 V power supply.
5. Ensure the Exoid is switched off, and if the power socket at the wall has a switch, ensure the switch is turned off. Plug the power lead into a wall socket and connect the cable from the 24 V power supply to the rear of the instrument.
6. Connect the USB cable to the instrument and the computer.
7. Turn the instrument on first using the power switch at the wall socket (if applicable) and then the Exoid power switch.

3.3 Instrument Power and General Operation

- Make sure the power supply box is positioned away from fluids.
- To prevent heat buildup do not cover the power supply box.
- Position the unit so it can be quickly and easily disconnected from the mains power.
- Check the local supply meets the AC input requirement given in the specification.



The Exoid is to only be used with power supplies and leads provided by Izon. Failure to use the correct power supply may result in invalid operation.

Make sure the power supply is placed away from and to the rear of the instrument to avoid coming into contact with any spills or fluid.

3.4 General Operating Procedures

- For indoor use only and to be used within the rated conditions specified.
- Take care not to spill fluids on electrical parts during operation.



The Exoid must be installed into Earth Grounded Protected Outlets ONLY. To minimise the influence of external noise from the environment, position equipment away from electrical switching gear and interfering equipment.

3.5 Computer Setup



Devices connected to the Exoid should be compliant with a relevant safety standard such as IEC 60950-1 for IT equipment or IEC 61010-1 for laboratory equipment and should provide double or reinforced insulation from hazardous voltage sources. Always use USB cables supplied by Izon to connect the Exoid to the computer.

Minimum Computer Specifications

For the Exoid and ECS to work effectively, the minimum PC requirements must be in place. These are as follows:

- 16 GB RAM
- i7 processor
- 256 GB SSD
- Dedicated graphics processor (GPU) with at least 1 GB graphics memory
- Windows 10 Pro

Windows Home is not suitable for the installation of the ECS. Ensure that the computer is installed with Windows Pro.



An onboard graphics card is not suitable for the operation of the Exoid. Ensure that the connected computer has a dedicated GPU with at least 1 GB of memory and that the computer will use this GPU while the ECS is running. Visit support.izon.com/why-does-the-ecs-lag for instructions on how to do this.

To operate the Exoid, there are two software suites that must be installed:

- Exoid Control Suite (ECS): used to control the Exoid and gather data.
- Izon Data Suite (IDS): required to analyse the data collected in the ECS.

Software packages for **non** 21 CFR Part 11 installations can be downloaded from:

support.izon.com/how-can-i-get-the-latest-exoid-control-suite-software-release

support.izon.com/how-can-i-get-the-latest-izon-data-suite-software-release

4 / OPERATING INSTRUCTIONS

The Exoid is a Tunable Resistive Pulse Sensing (TRPS) instrument, and requires an understanding of the principles of TRPS to be able to effectively operate the instrument and interpret the data outputs. Information on the principles of TRPS can be found in the Fundamentals of Tunable Resistive Pulse Sensing Theory Manual at support.izon.com and via free online courses at academy.izon.com

4.1 Required Materials

In addition to the Exoid and the control computer, the following materials are required to complete a TRPS measurement. Items indicated with an asterisk (*) are provided in the TRPS Training Kit, which can be requested supplementary to the Exoid.

- Calibrated micropipettes: 1 μ L to 1 mL
- Pipette tips
- Lint-free tissues for drying
- Powder-free disposable gloves
- Nanopore*
- 15 mL tubes*
- 1.5 mL tubes*
- 10 mL luer lock syringes*
- Freshly prepared reagents
- Diluted calibration particles
- Processed and diluted sample

4.2 Exoid Lighting

The ring of LED lights located below the buttons provides visual indications on the state of the Exoid, as described in Table 4.

Table 4: Description of Exoid State as Indicated by the Halo Lighting

HALO COLOUR	EXOID STATE
White	Connected, idle.
Red	Disconnected, see Section 5 .
Blue	System requires user input.
Purple	System performing an operation.

4.3 Fluid Cell

The fluid cell is comprised of an upper and lower component (upper fluid cell and lower fluid cell) that are positioned above and below the nanopore respectively, as well as a shielding cap that reduces external noise which may interfere with measurements. The upper and lower fluid cells each contain an electrode, and provide a containment for the electrolyte solution required to measure your sample. **Figure 2** provides a visual guide for normal operation of the system.

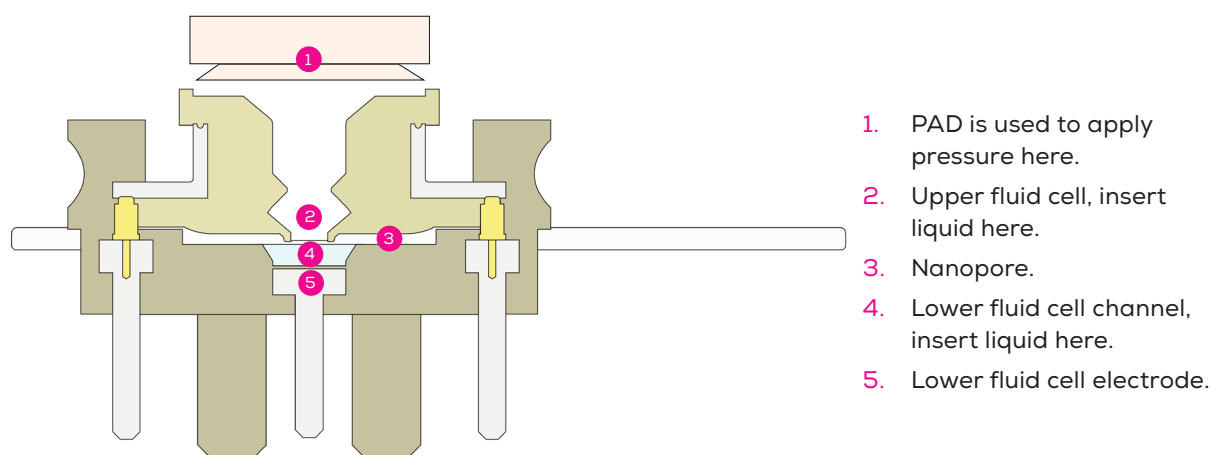


Figure 2: A cross section of the Exoid fluid cell, showing the upper and lower fluid cells, the nanopore, the lower fluid cell electrode, and the electrolyte holding areas for normal operation. The pressure application device (PAD) is used to top or plunge when stabilising the system; it is shown in (1) with the plunging side in use.

There are two pogo pins positioned on the lower fluid cell which fit into sockets on the underside of the upper fluid cell when twisted into place correctly. To assist with this, the upper fluid cell has two position indicators on each side which, when installed correctly, will be partially obscured by the lower fluid cell so that only one indicator on each side is visible (**Figure 3**).



Figure 3: The upper fluid cell has four dots (left) used to lock the cell in position. When the cell is locked in place only one dot on each side will be visible (right).

4.4 Exoid Control Suite Software

If using a laptop to operate the Exoid, ensure that the laptop charging cable is plugged in and providing power at all times during operation of the instrument.

Once the instrument is connected to the computer and switched on, open the Exoid Control Suite (ECS). A welcome splash screen followed by the home screen will be displayed, showing a render of the instrument with the word “CONNECTED” beneath it. There are several internal mechanics of the Exoid which need to have completed their start-up process before this will occur. A successful connection of all components will also be indicated by activation of the Exoid lighting. If either the lights are red or “DISCONNECTED” is displayed, please refer to the troubleshooting guide in [Section 5](#). Notifications about system updates appear on the bell icon.

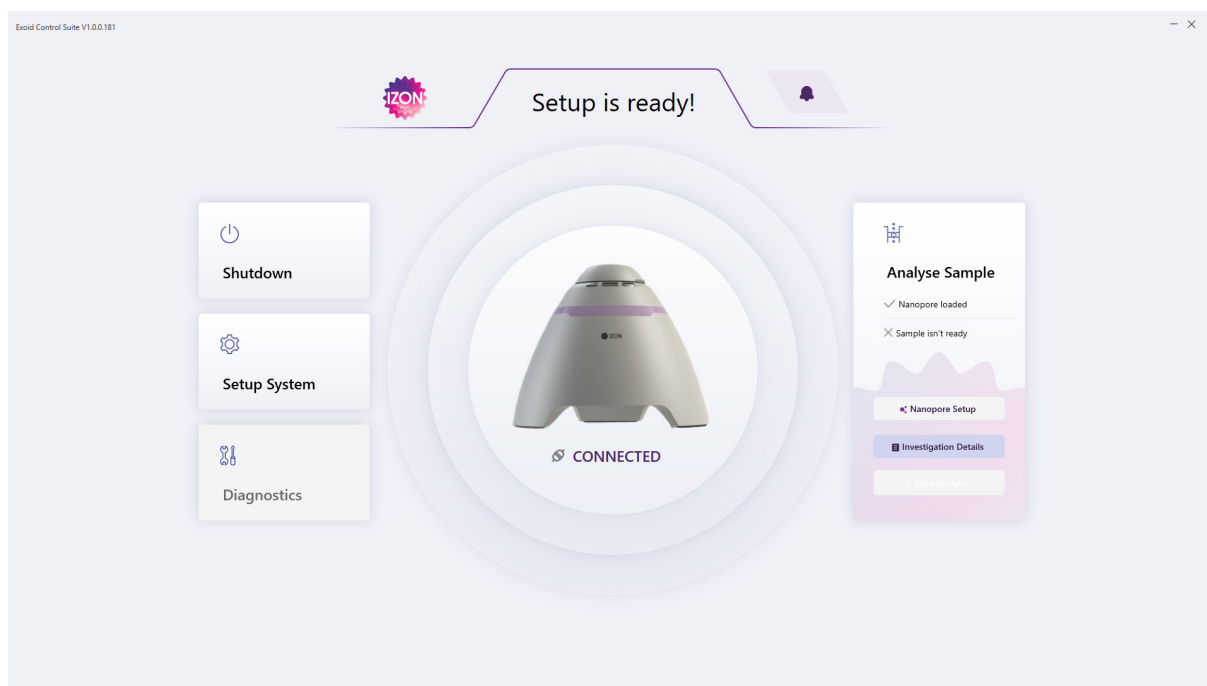


Figure 4: The Exoid Control Suite (ECS) home screen display when an instrument has been successfully connected.

Nanopore Loading

A correctly loaded nanopore has all four arms fitted securely onto the “teeth” of the stretcher unit at the load position, with its serial number facing upwards.

Investigation Details

This must be selected and populated for the other two options to become available.

Nanopore Setup

This section guides the user through all the appropriate procedures required to prepare the nanopore for sample analysis.

Start Analysis

This section guides the user through all the appropriate procedures required for sample analysis. Within this section the user has the option to select if they wish to measure size and concentration or size and zeta potential. To enter this section, nanopore setup is recommended but it is not required.

Controlling the Exoid

The Exoid has three components that require interaction to achieve a successful sample measurement; the APS which controls pressure, the VCA which controls voltage, and the Delta which controls stretch. All three of these components can be controlled from within the ECS by clicking on the displayed parameter in the device summary panel, entering the desired value and selecting the check-mark or pressing Enter.

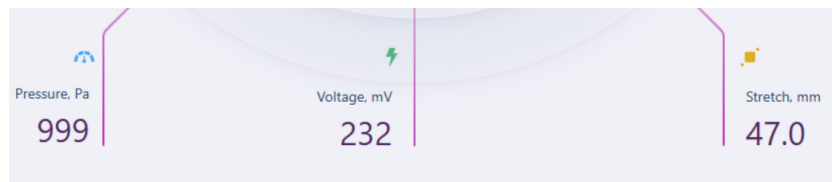


Figure 5: The device summary panel displaying current system parameters.

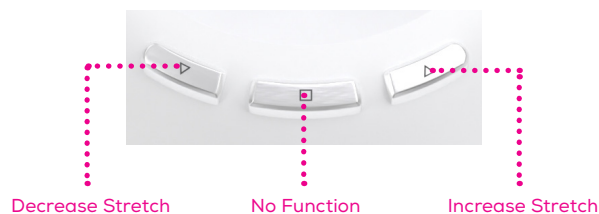


Figure 6: The stretch control buttons near the top of the Exoid.

Additionally, the Delta can be controlled via the stretch control buttons near the top of the Exoid above the halo. The Exoid has built-in limit switches to prevent the stretcher being moved to a position that will damage the winding mechanism, these are located at ~41 and ~51 mm. The user will not be able to stretch beyond these values.

Guide to Real-Time Data

When using the ECS to operate the instrument, the signal trace, particle size plot and the particle size distribution histogram provide a real-time visualisation of particles being measured by the system.

- Signal trace plot: displays the baseline current as well as individual blockades when a particle transverse the nanopore.
- Particle size plot: displays each significant blockade as a dot, plotted on a relative particle size scale in nanoamperes (nA). Also visualised on the particle size plot is the particle rate, displayed as a line.

These plots can be enlarged by selecting **Full Size** in the top right of the signal trace plot, similarly this can be reversed by selecting **Reduced Size**. Enlarging the plot will cause the particle size distribution histogram to be visible, which displays a live population histogram of all the blockades detected during a particular phase.

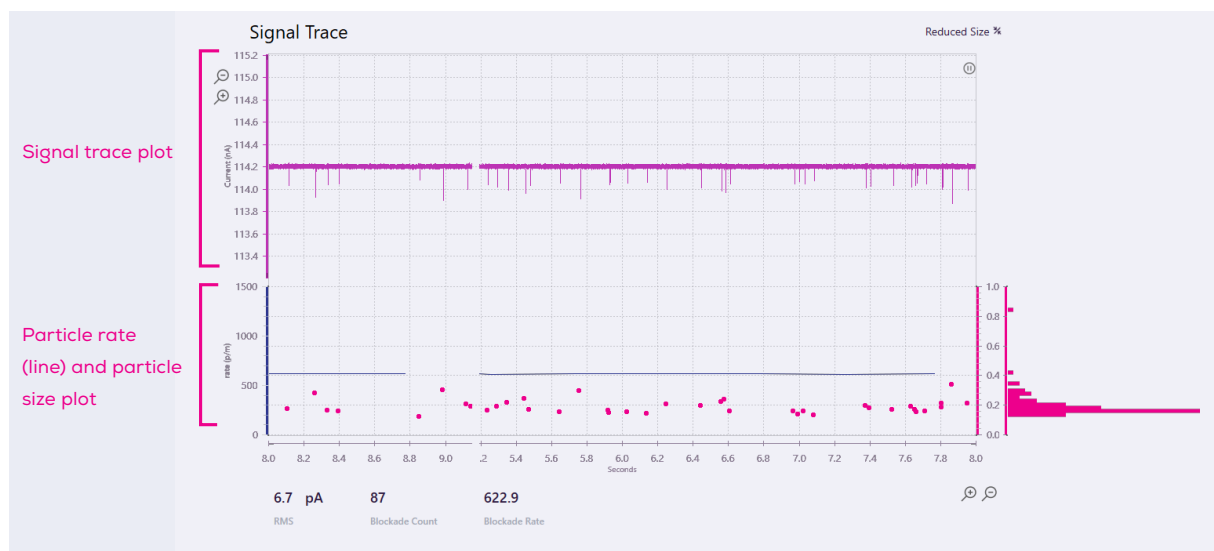


Figure 7: The ECS signal trace plot in a “Full Size” state with the particle size distribution histogram visible.

5 / TROUBLESHOOTING

Short circuits

Electrolyte can infiltrate metal connection points inside or around the fluid cell, causing significant noise fluctuations. Troubleshoot this by pipetting out the liquid in the upper fluid cell and observing the current. If the current does not change from pre-liquid removal or it is a non-zero (± 3 nA) value then there is liquid somewhere causing a short circuit. Remove the upper fluid cell, then wash and dry it, making sure all the metal parts of the fluid cell are dry. Remove any residual liquid from the lower fluid cell area and re-setup the nanopore.

Always ensure that you do not pipette more than 35 μ L into the upper fluid cell, or more than 75 μ L into the lower fluid cell, or the fluid may leak between connection points and cause the noise to gradually increase.

Instrument Connection

If some time has passed and instrument connection is still not complete, proceed to support.izon.com/why-are-none-of-the-exoid-modules-connected to resolve the issue.

APS Leaking

If the APS is frequently leaking, or struggling to hold pressure, check the o-ring for damage and replace (3 mm x 1 mm, silicone) if any damage is observed. If there is still a leak check the connector tubing for damage or loosening, also check the bottom of the upper fluid cell for damage to the seal.

External/Environmental Noise

50/60 Hz noise from nearby laboratory equipment and ungrounded power supplies can interfere with the instrument signal. To reduce influence from external noise, do not operate in close proximity to large appliances with high power draw, and ensure the fluid cell cap and shielding lid are used.

Using the Reference Cell

If the user suspects there is an issue with their fluid cell that is not nanopore related, i.e. non-zero current with 0 mV applied, non-zero current with voltage applied but no electrolyte in the system, then the 10 M Ω reference cell can be used to diagnose this. It should be noted that it is often difficult to diagnose the difference between a nanopore issue, a setup issue, or a fluid cell issue. Contact Izon support for advice if unsure.

Remove the fluid cell from the Exoid and replace the lower fluid cell with the reference cell. At 0 mV the current should be 0 ± 3 nA, at 1000 mV the current should be 100 ± 3 nA, and at -1000 mV the current should be -100 ± 3 nA. Contact Izon support if this is not the case.

Power Cycling

Follow these instructions carefully when the need to power cycle the instrument arises.

1. Turn off the switch on the Exoid. The off position is where the full "O" symbol is pressed down as indicated in **Figure 8**.
2. Unplug the USB and power cables from the Exoid.
3. Wait 5 full seconds.
4. Plug the USB and power cables back in to the appropriate sockets.
5. Turn on the Exoid's power switch.

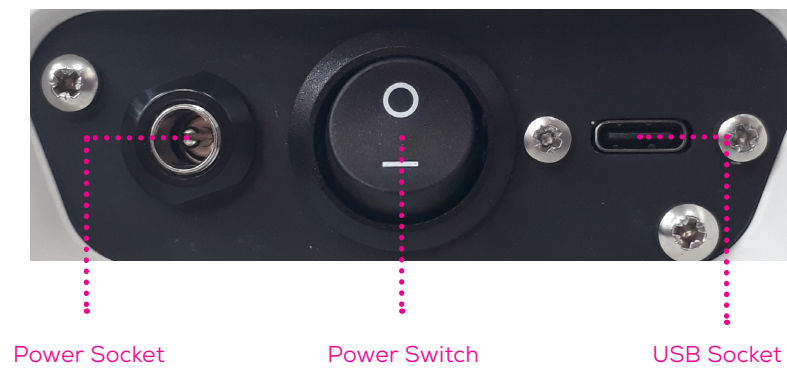


Figure 8: Switches and sockets on the Exoid.

6 / FURTHER SUPPORT

Device Cleaning

When cleaning the exterior of the instrument do not use solvent-based cleaners or UV light as this can affect the integrity of the powder coating; instead use warm soapy water. The fluid cell must be removed before cleaning can take place. First remove the fluid cell cap and upper fluid cell. Then remove the lower fluid cell by pulling directly up on the “arms” firmly until it releases from the fluid cell mount.



DO NOT GET ANY SUBSTANCE INSIDE THE PIN HOLES IN THE FLUID CELL MOUNT. This will cause major functional issues and should be remedied immediately by blow drying extremely well with compressed air.

The components of the fluid cell which have now been removed (the fluid cell cap, the upper fluid cell, and the lower fluid cell) can be cleaned carefully with 70% Ethanol. **DO NOT** use isopropyl alcohol on any part of the fluid cell as this will cause damage. Make sure to dry everything thoroughly, with compressed air if available, before re-assembling the fluid cell. Any liquid that remains on the pins underneath the lower fluid cells will cause major issues when the pins are pushed back into the lower fitting. **DO NOT** soak any part of the fluid cell.

Repair and Servicing

There are no user-serviceable parts. Return equipment to Izon for service.

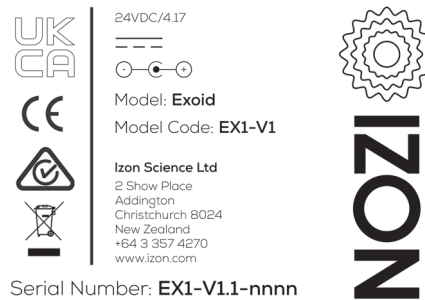


Figure 9: Compliance label attached to the Exoid with CE and UKCA marking.

CONTACT US

Additional support material is available at support.izon.com

If you have any questions that are not answered on the support portal, or your instrument requires repairs/maintenance please contact our support staff via the online support portal by raising a support ticket. When reporting Exoid issues to Izon support, please provide the serial number of the Exoid (**Figure 10**).



Figure 10: The serial number can be found either on the back of the Exoid or, as pictured: inside the back leg of the Exoid.

