

D3S Static Node User Manual



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Introduction

The D3S Static Node is a unique radiation detection solution which incorporates the Kromek D3S detector into a discreet, unattended device that can be mounted onto urban infrastructure.

The D3S Static Node blends the high sensitivity of the D3S detector with an additional electronics system which allows the stationary, unmanned device to communicate with the SIGMA network via a 3G/4G connection. In the event of a power outage, the device utilises battery power.

1 Regulations and Standards

Europe:


The product conforms with the relevant Community harmonisation legislation:

- Radio Equipment Directive 2014/53/EU
- Low Voltage Directive 2014/25/EU
- Restriction of the use of certain hazardous substances directive 2011/65/EU
- The WEEE Directive

2 Symbols




The following signal words and icons are used in this manual to indicate precautions when using the D3S Static Node. The indicated precautions provide information that is vital to safety. Always observe all precautionary information.

The signal words and icons are as follows:




	WARNING	Indicates a potentially hazardous situation which, if not avoided, will result in minor or moderate injury, or may result in serious injury or death. Additionally, there may be significant property damage.
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Where this symbol appears on the D3S Static Node, this manual must be consulted in order to find out the nature of the potential hazards and any actions which must be taken to avoid them.

- Meanings of Alert Symbols

	RISK OF ELECTRIC SHOCK	Indicates instructions that must be followed to mitigate risk of electric shock to OPERATOR or INSTALLER.
	EXPLOSION	Indicates the possibility of explosion under specific conditions.
	PROHIBITED	Indicates general prohibitions.

- Alert Statements in this Manual

	
	<p>A lithium battery is built into the D3S Static Node. Lithium batteries are made from HAZARDOUS MATERIALS and care must be taken to avoid serious injury due to combustion, explosion, or burning.</p> <p>If the battery is observed to swell in size, become excessively hot, or have very low capacity, then disconnect power, remove the device to an isolated safe place until battery replacement can be done by an authorised maintenance technician.</p>
	<p>A lithium battery is built into the D3S Static Node. Lithium batteries are made from HAZARDOUS MATERIALS and care must be taken to avoid serious injury due to combustion, explosion, or burning.</p>

	Never short-circuit the positive and negative terminals of a battery or charge, disassemble, apply deforming pressure, or expose the battery to fire.
	The D3S Static Node contains HAZARDOUS LIVE parts. The device must be installed with an external breaker so that power can be disconnected as required.
	The D3S Static Node contains HAZARDOUS LIVE parts. External power must be disconnected before opening the lid as this could expose HAZARDOUS LIVE parts.
	The wiring specification is designed for standard single phase 16A Mains supply. If the device is to be installed in a situation that does not have 16A current limitation, then a current limiting device must also be installed rated to 16A.
	The D3S Static Node contains HAZARDOUS LIVE parts. Follow all instructions outlined in the Installation section of this manual. Special care must be used to use the anchor points for the mains cable to prevent risk of electrical shock.

3 Precautions

3.1 Precautions for Safe Use

The following precautions should be observed to ensure that the product is being used safely:

- Do not use the product in environments subject to inflammable, explosive, or corrosive gases.
- Do not disassemble, repair, or modify the product in any way.
- Tighten the base mounting screws and terminal block screws securely.
- Use the specified sizes of crimp terminals for wiring.
- Always use cable restraints and anchor points where available.
- Confirm that the input voltage to be applied is within the rated power supply voltage (115V AC \pm 10%, 50-60Hz or 230V AC \pm 10%, 50-60Hz.) before using it.
- Do not allow water to enter the case. Fire or electric shock may result
- Always disconnect the power supply before opening the case.

- If you suspect that anything is wrong with the product at any time, stop using it immediately, turn OFF the power supply, and consult with your Kromek representative.
- If the battery is observed to swell in size, become excessively hot, or have very low capacity, then disconnect power, remove the device to an isolated safe place until battery replacement can be done by an authorised maintenance technician.
- When disposing of the product, dispose of it as industrial waste.
- Observe all other precautionary information provided in this manual.

3.2 Precautions for Correct Use

Please observe the following precautions to prevent failure to operate, malfunctions, or undesirable effects on product performance.

3.2.1 Installation Location

Do not install the product in the following locations:

- Locations subject to corrosive gases, dust, dirt, metal powder, or salt.
- Locations where the specified ambient operating temperature is exceeded.
- Locations subject to extreme temperature changes that may result in condensation.
- Locations where the specified ambient operating humidity range is exceeded.
- Locations where the product would be directly subjected to vibration or shock exceeding specifications.
- Locations in direct sunlight should be avoided.
- Locations in easy reach of the general public should be avoided.
- Locations subject to submersion in water, oil, or other liquids.

3.2.2 Installation

- Wireless communication can have a carrier frequency between 1900 and 2100 MHz depending on service provider, if there are multiple transmitters at this frequency range nearby then connectivity may be impaired.
- For electrical safety, follow all instructions in the Installation section of this manual.
- Protective earth required

- Materials that block radiation such as lead or lithium will affect the performance of the device, avoid placing the device near such materials.

3.2.3 Storage

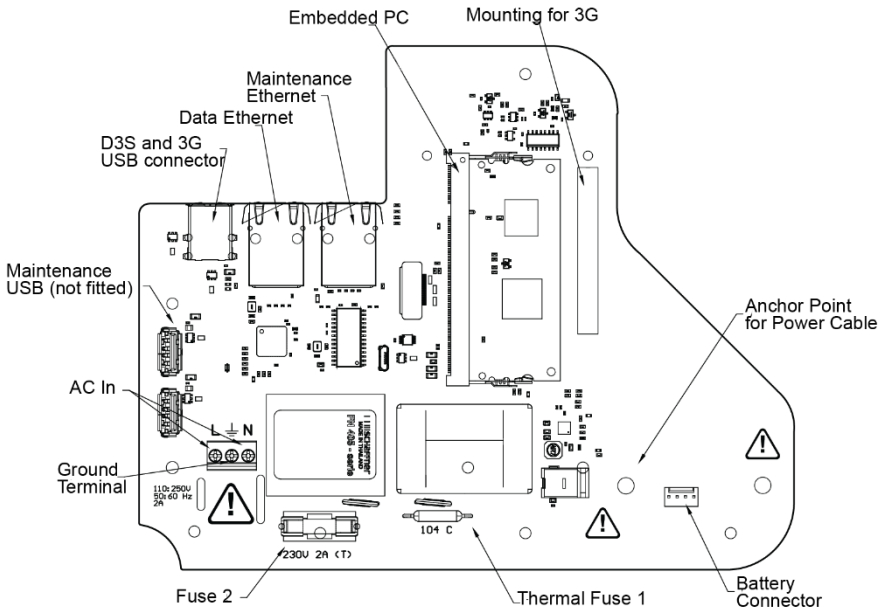
Do not store the product in the following locations:

- Locations subject to corrosive gases, dust, dirt, metal powder, or salt.
- Locations where the specified storage temperature range is exceeded.
- Locations subject to extreme temperature changes that may result in condensation.
- Locations where the specified storage humidity range is exceeded.
- Locations where the product would be directly subjected to vibration or shock exceeding specifications.
- Locations subject to contact with water, oil, or chemicals.

3.2.4 Cleaning

- Use soapy water to clean the casing.

4 Components



4.1 Power Supply and Ground Terminals

Name	Description
AC In	Mains Supply: <ul style="list-style-type: none">• 115V AC \pm 10%, 50-60Hz, 10VA• 230V AC \pm 10%, 50-60Hz, 10VA Product is ready to accept either with no modification.
Ground Terminal	This is used for line filtering, is not a safety critical part.

4.2 Fuses

Name	Description
Fuse F2	230V 2A (T) Fuse 5x20mm – Safety Critical
Thermal Fuse F1	Rated at 104 °C – Safety Critical

4.3 Battery Connector

Provides connection to battery backup. If battery needs replacement consult with your Kromek representative.

4.4 Maintenance Ethernet

Used for restoring factory settings and diagnosing faults.

4.5 Embedded PC

Manages the D3S Static Node and the communication with the Sigma network.

4.6 Mounting for 3G

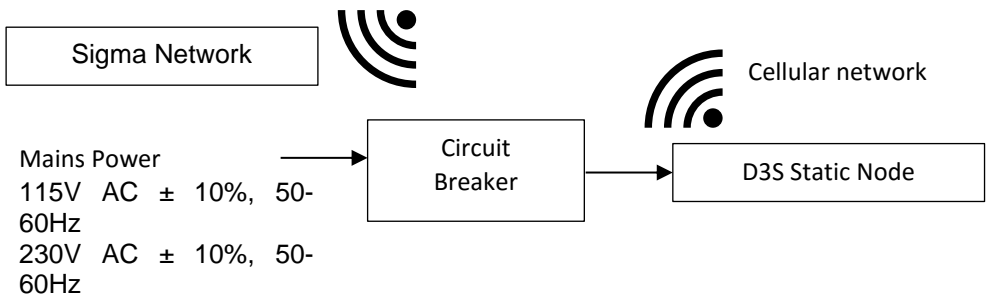
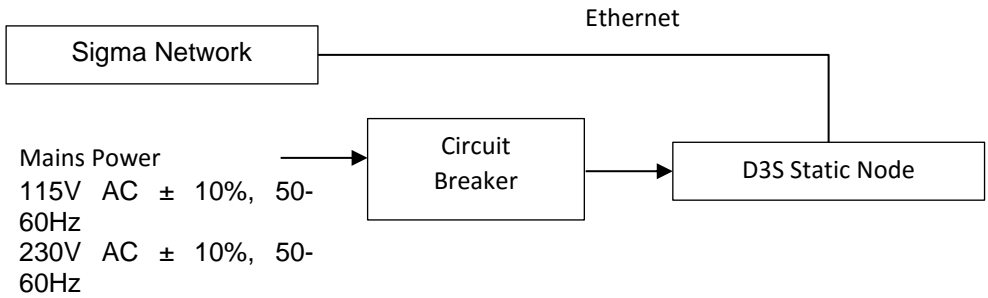
Where the 3G module is fixed. Module itself uses a USB connection to the Embedded PC.

4.7 Anchor Points

Used to restrain the power cable for safety. Also holds in place the D3S. See the Installation section of this manual for more information.

5 System Configuration

Show how system is configured i.e. connected to the internet and power.



6 Installation and Wiring

Observe the following precaution when installing the D3S Static Node to ensure safe and proper performance.

	<p>The safety of any system incorporating the equipment is the responsibility of the assembler of the system.</p>
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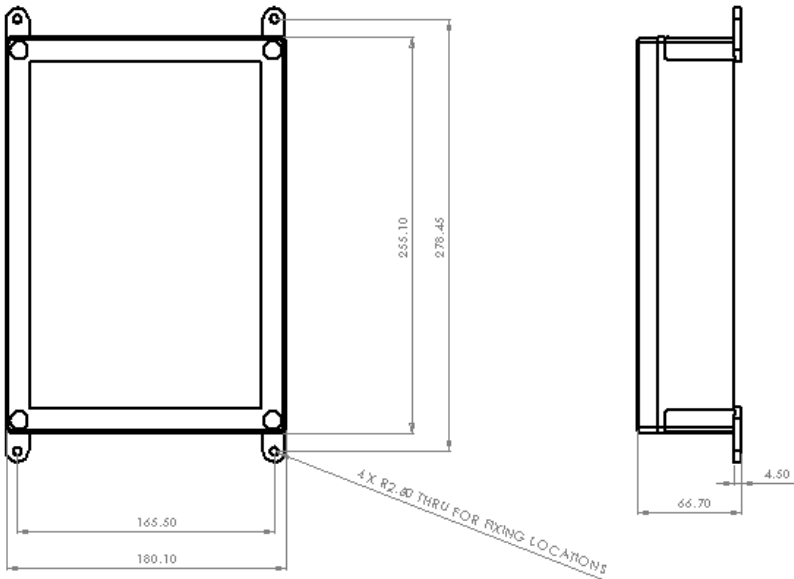
6.1 Installation Environment

Do not install the D3S Static Node in the following locations:



- Locations where the ambient operating temperature is not between 0 and 50°C.
- Locations subject to corrosive or inflammable gases, powder, or salt.
- Locations subject to direct vibration or shock.
- Locations subject to direct sunlight.
- Locations subject to submersion in water, oil, or chemicals.

6.2 Mounting Method

The casing design presents 4 x 2.6 mm holes for the installer to use as necessary. M3 bolts should be used with a minimum length of 55mm. Grade 8.8 bolts are recommended. The details are shown below.




6.3 Wiring

	<p>The D3S Static Node contains HAZARDOUS LIVE parts.</p> <p>The device must be installed with an external all pole breaker so that power can be disconnected as required. It is recommended that the circuit breaker be installed near to the equipment. The equipment should be positioned such that there is no difficulty in disconnecting the D3S Static Node</p>
	<p>The D3S Static Node contains HAZARDOUS LIVE parts.</p> <p>External power must be disconnected before opening the lid as this could expose HAZARDOUS LIVE parts.</p>


6.3.1 Recommended Wiring

The wiring specification below is designed for standard single phase 16A Mains supply. If the device is to be installed in a situation that does not have 16A current limitation, then a current limiting device must be installed rated to 16A.

Number of Cores	3
Voltage Rating	450V
Current Rating	20A
Cross Sectional Area	1.5mm ²
Outer Diameter	9.2mm
American Wire Gauge	15
Example Supply	RS Components 744-0981

	<p>The wiring specification above is designed for standard single phase 16A Mains supply. If the device is to be installed in a situation that does not have 16A current limitation, then a current limiting device must also be installed rated to 16A.</p>
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6.3.2 Anchor Points

	<p>The D3S Static Node contains HAZARDOUS LIVE parts.</p> <p>Follow all instructions outlined in the Installation section of this manual. Special care must be used to use the anchor points for the mains cable to prevent risk of electrical shock.</p>
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There are three anchor points in the D3S Static Node. One is near the terminal block and two are near the bottom right side of the board. They are all labelled with the caution label.

In order to prevent any risk from the power cable being ripped free, it is mandatory to use the anchor point at the terminal block, and one of the two located at the bottom right hand side.

Every unit is shipped with a cable restraint and cable clamp that should be used for this task. If these restraints are missing or appear damaged, any off the shelf cable restraint can be used, but a unit must not be installed without them.







Every unit is shipped with restraints that should be used for this task. If these restraints are missing or appear damaged, any off the shelf cable restraint can be used, but a unit must not be installed without them.

6.3.3 Ethernet

A standard ethernet cable can be connected, but for IP65 to be maintained it is recommended to use an RJ45 cable sheath such as the RJF TV series from Amphenol.

7 Maintenance

Maintenance must only be performed by a Kromek approved maintenance engineer.

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	<p>A lithium battery is built into the D3S Static Node. Lithium batteries are made from HAZARDOUS MATERIALS and care must be taken to avoid serious injury due to combustion, explosion, or burning.</p> <p>Never short-circuit the positive and negative terminals of a battery or charge, disassemble, apply deforming pressure, or expose the battery to fire.</p>
	<p>The D3S Static Node contains HAZARDOUS LIVE parts.</p> <p>External power must be disconnected before opening the lid as this could expose HAZARDOUS LIVE parts.</p>

7.1 Maintenance Inspection Procedure

- Disconnect the Mains Breaker before opening the device.
- Inspect the battery for swelling or high temperature. If battery appears unusual disconnect it from the device immediately.
- Replace the battery only with a Kromek approved alternative.

- Examine the enclosure for water ingress. If water is pooling in the device discontinue use immediately and consult with your Kromek representative.
- If the fuses need replacing, the ratings are as follows:
 - F1: Thermal Fuse 104°C
 - F2: 2A(T), 250V, 5 x 20mm
- Return the cover to the device before restoring power via the Mains Breaker.

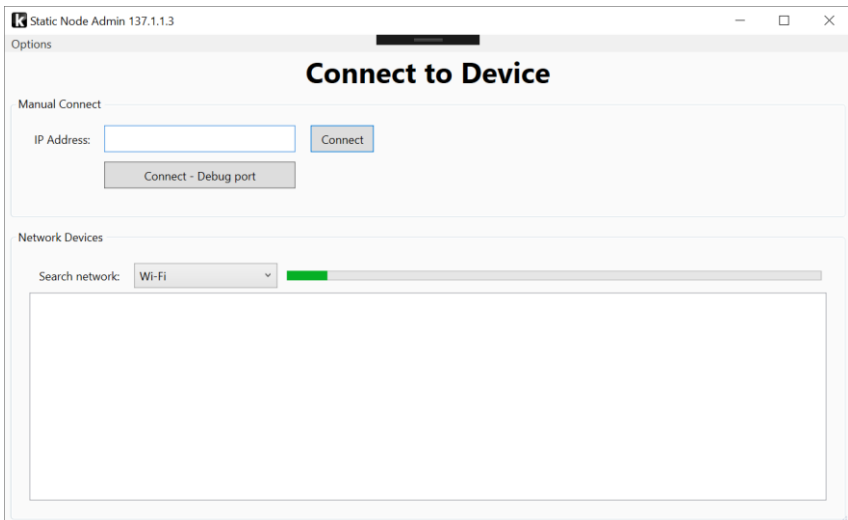
8 Configuring Communications

Static Node Admin is designed for Kromek’s range of static node devices giving easy connection and setup functions tailored to the detectors and their applications.

Static Node Admin allows for the configuration of static node devices including provision the device for Sigma network integration.

Configuration can be performed via direct connection to the primary network port.

8.1 Connecting to a device



If the static node is already deployed and connected to an established network, then configuration can be performed across the primary ethernet connection.

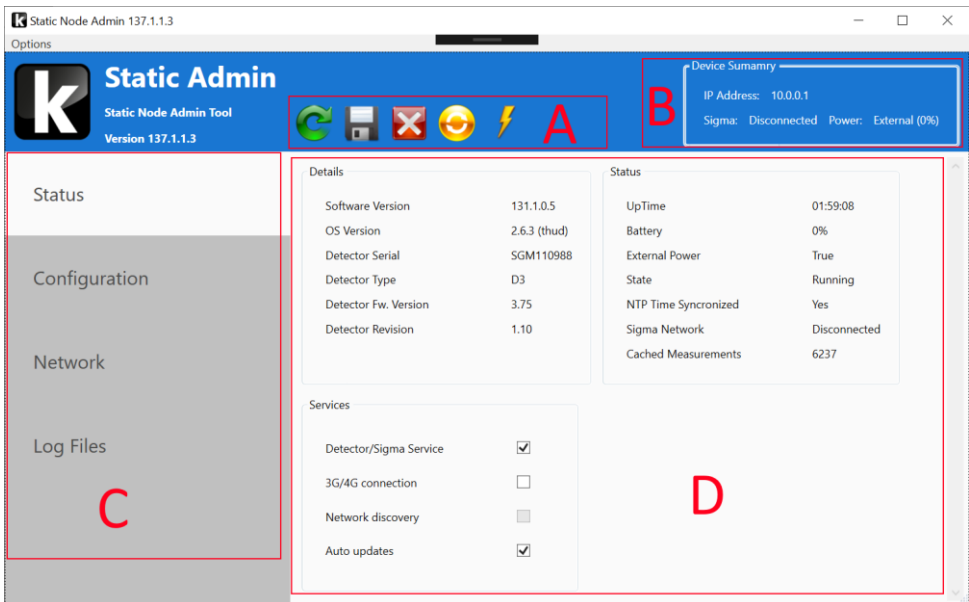
If the IP address of the device is known, then a direct connection can be made by entering the IP address and clicking 'Connect'.

The software also supports finding networked devices by a broadcast-based network discovery system. If the network allows for broadcast-based messages, then all devices on the network should appear in the list after a few seconds. Click the appropriate device in the list to connect.

Section 8.10.1 can be referred to if the device needs to be provisioned.

8.2 Main Screen Overview

Once connected to a device the main screen is displayed:



- A) Command bar. Commands are applied to the connected device.
- B) Device summary. A summary of details about the currently connected device. More in-depth details can be found on the 'Status' page.
- C) Configuration Pages. Settings are split up into user friendly configuration pages. Click the page name to move to the appropriate page.
- D) Main application area. Contents change depending on the page currently highlighted on the left

8.3 Command Bar (A)



Reload Configuration – Reload the entire configuration by reading it off the attached hardware device. Be aware reloading the configuration will lose all unsaved changes to the devices' configuration.

Save Changes – Save all changes to the attached hardware device. Once applied it cannot be undone.

Disconnect – Disconnect from the device and return to the connection screen. Note any unsaved changes will be lost.

Reboot Device – Reboot the device. When the device is restarted you will automatically be disconnected. Any unsaved changes will be lost on disconnection.

Apply Software Update – Apply a software update to the connected device from a file.

8.4 Device Summary (B)

A summary of the currently connected device is always shown on screen:

- **IP Address** – The IP address of the device currently connected. This will always be 10.0.0.1 when connecting via the Debug Port.
- **Sigma** – Status of the connection to the Sigma network. When connected the device will automatically upload measurements to the network.
- **Power** – Whether the device is currently running on external (mains) or battery power including battery estimated charge %

8.5 Application Sections (C)

Application functionality is split up into several sections displayed on the left side of the screen:

Status – Display useful information about the current state of the device.

Configuration – Main configurable options for the device. Editing values will not automatically be saved to the hardware device. You must click the ‘Save Changes’ button in the command bar for the settings to be applied.

Network– Configure the primary network interface.

Log Files (Advanced mode only) – Displays the application logs to aid in resolving issues.

8.6 Status Page

Displays the overall status of the device including software and hardware versions, uptime and Sigma network details:

The screenshot displays the Static Admin web interface for a Static Node Admin Tool (Version 137.1.1.3). The interface is divided into several sections:

- Navigation Sidebar (Left):** Contains links for Status, Configuration, Network, and Log Files.
- Header (Blue Bar):** Displays the 'Static Admin' logo, version '137.1.1.3', and a 'Device Summary' box showing IP Address: 10.0.0.1, Sigma: Disconnected, and Power: External (0%).
- Details Panel:**

Software Version	131.1.0.5
OS Version	2.6.3 (thud)
Detector Serial	SGM110988
Detector Type	D3
Detector Fw. Version	3.75
Detector Revision	1.10
- Status Panel:**

UpTime	02:25:01
Battery	0%
External Power	True
State	Running
NTP Time Synchronized	Yes
Sigma Network	Disconnected
Cached Measurements	7790
- Services Panel:**

Detector/Sigma Service	<input checked="" type="checkbox"/>
3G/4G connection	<input type="checkbox"/>
Network discovery	<input type="checkbox"/>
Auto updates	<input checked="" type="checkbox"/>

1. Details

- a. **Software Version / OS Version** – Versions of the currently installed software on the Static Node device.
- b. **Detector Serial, Type, F/W and revision** – Details of the D3 device included inside the Static Node. Firmware revision (F/W version) will automatically be updated via the main Static Node software to ensure it is running a compatible release.

2. Status

- a. **Uptime** – Overall uptime of the Static Node since the device was first powered on / last restarted.
- b. **Battery** – Battery charge state as an estimated percentage.
- c. **External Power** – Whether the device is currently being powered by a mains supply voltage. If this is 'False' then the device is currently running off its internal battery.
- d. **State** – Whether measurements are currently being recorded by the Static Node. If no connection to the Sigma network is available, then measurement data will be cached on the device until a valid connection is established (see 'Cached Measurements')
- e. **NTP Time Synchronized** – Whether the device has acquired a valid time from an internet-based time server. In order to upload data to the Sigma network and ensure it is displayed correctly the device must have a valid time. No data will be uploaded to the Sigma network until it has a validated time. If the time is not synchronized, then measurements will be cached rather than uploaded to the Sigma network.
- f. **Sigma Network** – The current state of the connection to the Sigma network. If connected, then measurements will be uploaded to the network automatically. If disconnected, then measurements will be cached locally until a connection is established. Connection can be established either via the primary network or GPRS mobile network.
- g. **Cached Measurements** – In order to avoid lost measurement data when a connection to the Sigma network is unavailable all measurements will be cached locally to the device. The maximum cache size can be configured in the Configuration page. Once a valid connection is established to the Sigma network all cached measurements will be uploaded. Cached measurements will be uploaded in chronological order (Oldest first).

3. Services (Advanced mode only)

- a. **Detector/Sigma service** - Enable / Disable the service that records and uploads measurements. Disabling this service essentially stops the device from taking and sending any measurements. It is recommended to keep this service running all the time unless advised by Kromek Support to disable it
- b. **3G/4G connection** – Enable / disable the mobile GPRS service. If no mobile connection is possible (no signal for example) then this service will appear disabled. The device will continue to try and connect every 30 seconds.
- c. **Network Discovery** – Whether the device is listening and responding to multicast network discovery requests from the Static Node Admin software. If this is not enabled then the device will never appear automatically on the connection screen. Connection can still be established by using the IP address or connecting direct via the debug port.
- d. **Auto Updates** – Enable / disable the automatic checking and installation of software updates to the Static Node device.

8.7 Configuration Page

Main configuration for the device is performed on the configuration page. All changes will only be applied when the 'Save Changes' button is clicked.

1) Main Settings

- a) **Device Serial** – The serial number of the Static Node. Please note that changing this will prevent the device connecting to the Sigma Network until it is re-provisioned. This should never be changed unless advised by a member of the Kromek support team. Changing of this value and provisioning the device is only available in Advanced mode.
- b) **GPS** – GPS coordinates of the device for displaying correctly on the Sigma network map. This is always manually configured.
- c) **Max Data Age (minutes)** – Maximum time to cache measurements when not connected to the Sigma Network. It is recommended that this value is left at its default of 10080 minutes (7 days)
- d) **Sigma URL**- URL to use to connect and upload to the Sigma network. Must include port of :5569 at the end.

2) **Updates**

- a) **Check Interval** – Time between checks for new updates (in hours)
- b) **Update URL** – URL of server containing updates

3) **GPRS**

Configure the GPRS (mobile data) network. Select from a preconfigured list or enter your mobile networks details in the relevant boxes.

8.8 Network Page

Enter details to configure the primary network connection. Settings are available for both IPV4 and IPV6.

The debug port available for direct connection is non-configurable

8.9 Log Files Page (Advanced mode only)

The log file page is only displayed in advanced mode. This provides log file output for all the main services running on the device and can be used to diagnose issues.

8.10 Advanced Mode

An option to enable and disable 'Advanced Mode' is available from the options menu. Advanced mode allows for the display and editing of some additional details that are only required by advanced users.

8.10.1 Provisioning the Device

A provisioned device will be connected to the SIGMA network. All devices should arrive already provisioned, but this can also be completed in advanced mode if required.

To provision a device, the user must first ensure that the device and PC/laptop being used are connected to the same network as described in Section 8.1. The user can then undertake the following steps:

1. On the Static Admin software, click on the "Configuration" tab.
2. Type in the serial number of the device and be sure to save the changes. If the serial number is not able to be edited, ensure that you are working in advanced mode and try again.
3. Click "Provision Device".

4. Go to the SIGMA software and click on the “Inventory” tab. Please note that the SIGMA software must be accessed via the Google Chrome browser.
5. Click on the “Add” button
6. A box will appear with three drop down menus. Leave the first two drop down menus blank but on the third menu, labelled “Instance”, select “Kromek”.
7. A QR code will be generated. To copy, simply right click and copy the code. This code changes approximately every 15 minutes, or when the code has been used. To generate a new QR code at any time, press F5.
8. Paste the code into the Static Admin software.
9. When the QR code has been pasted, click on the device. It should be recognisable by the known serial number.
10. To check that the device is correctly provisioned, click on the “Status” tab and ensure that the device is shown to be connected to the SIGMA network. This could take around 30 seconds to update.

9 Technical Appendix

9.1 List of D3S Detectable Isotopes

The table below lists all the isotopes available in the SIGMA isotope library.

Americium-241*	Indium-111	Radium-226*
Antimony-124	Iodine-123	Scandium-46
Barium-133*	Iodine-131*	Selenium-75
Bromine-82	Iridium-192 in various shielding*	Sodium-22
Caesium-134	Lutetium-177	Strontium-90***
Caesium-137 in various shielding*	Lutetium-177m	Technetium-99m*
Californium-252****	Manganese-55	Thallium-201*
Chromium-51	Molybdenum-99	Thorium-232*
Cobalt-57*	Neptunium-237	Tin-113
Cobalt-60 in various shielding*	Palladium-109	Uranium-235*
Europium-152	Plutonium-239*	Uranium-238*
Fluorine-18**	Plutonium, reactor grade in various shielding*	Uranium, depleted in various shielding*
Gallium-67*	Plutonium, weapons grade in various shielding*	Uranium, highly enriched in various shielding*
Gold-198	Potassium-40*	Yttrium-88

Notes:

*Mandatory radionuclides as defined in ANSI N42.34

**Beta+ emitting radionuclide

***Beta- emitting radionuclide

****Neutron emitting radionuclide

10 Specification

The D3S Static Node technical specification and regulations met are detailed below.

Device Specification	
Communications	Cellular, Ethernet
Operational battery life	~1 hour UPS back up
Humidity	Up to 93% RH ANSI N42.32 section 7.3 *
Moisture/dust protection	IP55
Weight	3.37 lbs (1530 g)
Power input	90-264 VAC, UPS enabled with 1-hour battery backup
Power consumption	~9W
Mounting	Wall mounting: screws supplied Pole mounting: Universal band clamp fixture for poles up to 7.5 in diameter (194 mm)
Cellular	3G/4G/LTE
Mains Supply	115V AC \pm 10%, 50-60Hz, 10VA 230V AC \pm 10%, 50-60Hz, 10VA Product is compatible with either voltage range with no further modification needed.
Safety	EN62368-1
EMC	EN 61326-1:2013
RED	EN 301 511 V12.5.1 EN 301 908-1 V11.1.1 EN 301 908-2 V11.1.2 EN 303 413 V1.1.1
Physical (H x W x D)	Plastic Enclosure Size: 180 x 255 x 66.7
Temperature Range	Operation: -20 to 50° C (max 90% RH, non-condensing) Storage: -20 to 70° C
IP/NEMA Rating	Plastic enclosure: IP55
Inputs/Outputs	Ethernet GSM/3G

Detector Specification	
Detector type	Gamma and Neutron detection
Gamma detector material	CsI(Tl)
Gamma detector volume	1 in ³ (16 cm ³)
Gamma energy range	30 keV to 3 MeV
Gamma sensitivity for Cs137	5 cps/μR/h (500 cps/μSv/h) Photo peak 1.2 cps/μR/h (120 cps/μSv/h)
Maximum throughput for gamma channel	10,000 cps
Maximum dose rate	2.0 mR/h (20 μSv/h) at 662 keV (spectroscopic) 100 R/h (1 Sv/h) at 662 keV with high dose module
Neutron detector material	Non- ³ He
Neutron detector	9 cps in a 1 neutron per cm ² field
Neutron detector gamma rejection	Better than 10 ⁻⁷ , meets ANSI N42.34 section 6.7
Maximum throughput for neutron channel	5,000 cps
SIGMA Network Specification	
Spectra storage	ANSI N42.42 compliant
Isotope ID	Special isotope(s) detection. Classification of isotopes (industrial, medical, NORM, SNM)
False Alarm Rate	Superior false alarm rejection (ANSI N42.32) for the gamma and neutron channels independently

11 Disclaimer

To the best of its knowledge Kromek has made all reasonable efforts to ensure the information in this manual is without error and complete. Kromek shall not be held liable for any errors or omissions contained within this document, or for incidental, special or consequential damages related to the use of this document.

The information contained in this document shall be subject to change without notice.

11.1 FCC Warning

The D3S Static Node device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. The device may not cause harmful interference.
2. The device must accept any interference received, including interference that may cause undesired operation.



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