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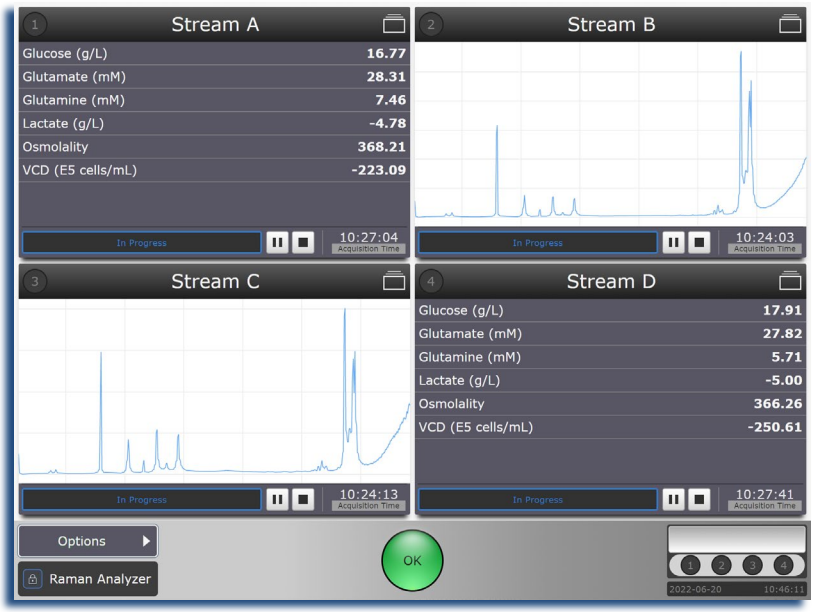
Operating Instructions

Raman RunTime v6.4



Endress+Hauser
People for Process Automation

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1 About this document

1.1 Warnings

Structure of Information	Meaning
⚠ WARNING **Causes (/consequences)** If necessary, consequences of non-compliance (if applicable) ▸ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid the dangerous situation can result in a fatal or serious injury.
⚠ CAUTION **Causes (/consequences)** If necessary, consequences of non-compliance (if applicable) ▸ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or more serious injuries.
NOTICE **Cause/situation** If necessary, consequences of non-compliance (if applicable) ▸ Action/note	This symbol alerts you to situations which may result in damage to property.

Table 1. Warnings

1.2 Symbols on the device

Symbol	Description
	The Laser Radiation symbol is used to alert the user to the danger of exposure to hazardous visible laser radiation when using the Raman Rxn system.
	The High Voltage symbol alerts people to the presence of electric potential large enough to cause injury or damage. In certain industries, high voltage refers to voltage above a certain threshold. Equipment and conductors that carry high voltage warrant special safety requirements and procedures.
	The ETL Listed Mark provides proof of product compliance with North American safety standards. Authorities having jurisdiction(AHJ) and code officials across the US and Canada accept the ETL Listed Mark as proof of product compliance to published industry standards.
	The WEEE symbol indicates that the product should not be discarded as unsorted waste but must be sent to separate collection facilities for recovery and recycling.
	The CE Marking indicates conformity with health, safety, and environmental protection standards for products sold within the European economic area (EEA).

Table 2. Symbols

1.3 Analyzer configurations

This Raman RunTime software manual is approved for use with the following analyzer configurations:

- Raman Rxn2 and Raman Rxn4 single channel and four channel embedded analyzers with 532, 785, or 1000 nm.
- Raman Rxn2 Starter single channel and four channel embedded analyzers with 785 nm.
- Raman Rxn2 Hybrid and Raman Rxn4 Hybrid embedded analyzers with 785 nm.
- RamanRxn2 and RamanRxn4 non-embedded analyzers with 785 nm.
- RamanRxn2 and RamanRxn4 non-embedded analyzers with 1000 nm.

⚠ CAUTION

▶ The performance of procedures, the use of controls, or the adjusting of the analyzer other than as specified in the manual may result in hazardous radiation exposure.

1.4 Glossary

Term	Description
AHJ	Authorities having jurisdiction
ALT	Alternate
BIS	Bureau of industry and security
CSM	Calibration switching module
EEA	European economic area
FC	Fiber channel
HCA	Raman calibration accessory
INTLK	Interlock
IP	Internet protocol
IPA	Isopropyl alcohol
LAN	Local area network
LED	Light emitting diode
NAT	Network address translation
nm	Nanometer
OPC	Open platform communications
PDF	Portable document format
RTU	Remote terminal unit
SOP	Standard operating procedure
SPC	Spectrum file format
TCP	Transmission control protocol
TLS	Transport Layer Security
UA	Unified architecture
UDP	User datagram protocol
USB	Universal serial bus

Table 3. Glossary

2 Safety

2.1 Safety and handling notice

- **Laser Safety Notice.** Raman Rxn2 and Rxn4 analyzers incorporate a 532 nm, 785 nm, or 1000 nm laser excitation source. Raman Rxn Hybrid and Raman Rxn2 Starter analyzers are only available with a 785 nm laser excitation source. When turning the laser power key (on front of the Raman Rxn) to **ON**, give the unit 2 hours to stabilize. Take the following precautions when handling the analyzer and probes when the laser is **ON**:
  - Turn **OFF** the laser power (key on the front of the Raman Rxn) before making fiber connections and probe inspections.
  - Turn the laser output shutter on the Rxn-10 probe to the **OFF** position before removal or attachment of optics.
  - Do not look directly into the fiber probe output (when the optic is disconnected) or the output (window) of any probes. If found with No Optic – Turn laser output shutter or laser power key to **OFF**.
- **Probe Handling Notice.** Handle probes and cables with care. Fiber cables should NOT be kinked and should be routed to maintain minimum bend radii (~6 inches). Permanent damage may result if these occur.
- **Export Compliance.** The policy of Endress+Hauser is strict compliance with the U.S. export control laws as detailed in the website of the U.S. Department of Commerce, Bureau of industry and security (BIS): https://www.bis.doc.gov.

2.2 Client system requirements

- Google Chrome or Microsoft Edge (for remote access)
- OPC UA client software (for OPC interface)
- OPC Classic client software (for OPC interface)
- Modbus client software (for Modbus interface)

3 Raman RunTime overview

NOTICE

- This manual provides details on configuring and using Raman RunTime for process applications, but it is not intended to replace Raman Rxn system analyzer installation and training from Endress+Hauser representatives.

Endress+Hauser's Raman RunTime embedded software is the control platform for its suite of Raman Rxn analyzers. Raman RunTime software is intended for easy integration with standard multivariate analysis and automation platforms to enable a real-time, *in situ* process monitoring and control solution. Raman RunTime presents an OPC and Modbus interface, which provides clients with analyzer data as well as analyzer control functions. Raman RunTime is fully embedded into Endress+Hauser's latest suite of Raman Rxn analyzers.

The main view of Raman RunTime displays four quadrants for four channel analyzers, one for each probe and a **Status** bar (bottom) for a quick view of warnings and acquisition status. Single channel analyzers display only one main channel/probe window, while Hybrid analyzers display two channel/probe windows, one for the Rxn-20 probe channel and one for the non-Rxn-20 Alternate (ALT) probe. Batch details are accessed and edited from each corresponding quadrant/probe window. To switch back and forth between the main view and batch detail views, click the **Title Bar** for each probe/quadrant. Views of current spectrum vs. process values (model results) can also be easily swapped by clicking on the **Quadrant/Probe** window display. Additional features, such as system settings, calibration and diagnostics, are found under the **Options** section on the lower left corner of the screen.

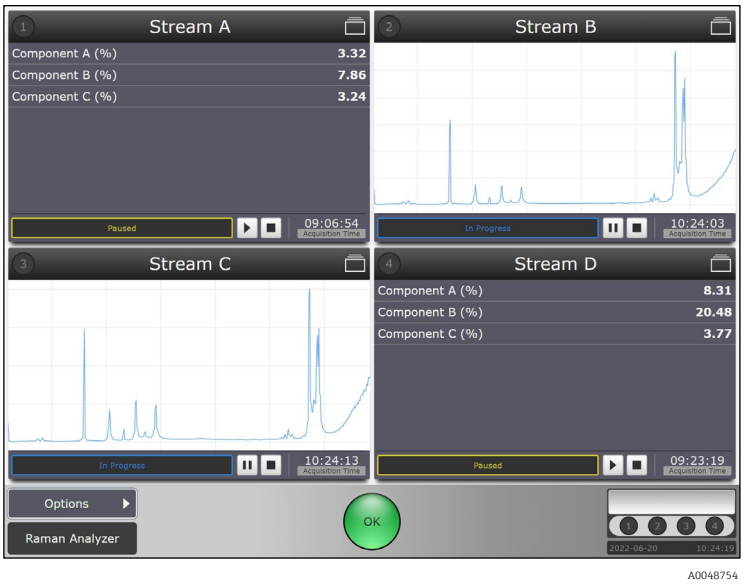


Figure 1. Raman RunTime's main view in a Raman Rxn four channel analyzer

⚠ WARNING

- When the Raman Rxn analyzer's main power switch and laser key are turned ON, probes should be shuttered, or covered. Laser safety must always be considered.

3.1 Raman Rxn embedded analyzers

Raman RunTime software is fully embedded into the latest suite of Raman Rxn analyzers including a Raman Rxn2 or Raman Rxn4 configured as a single or four channel embedded analyzer (532 nm, 785 nm, or 1000 nm wavelength laser), a Raman Rxn2 Starter single or four channel embedded analyzer (785 nm only), and a Raman Rxn Hybrid (Rxn2 Hybrid or Rxn4 Hybrid) analyzer (785 nm only).

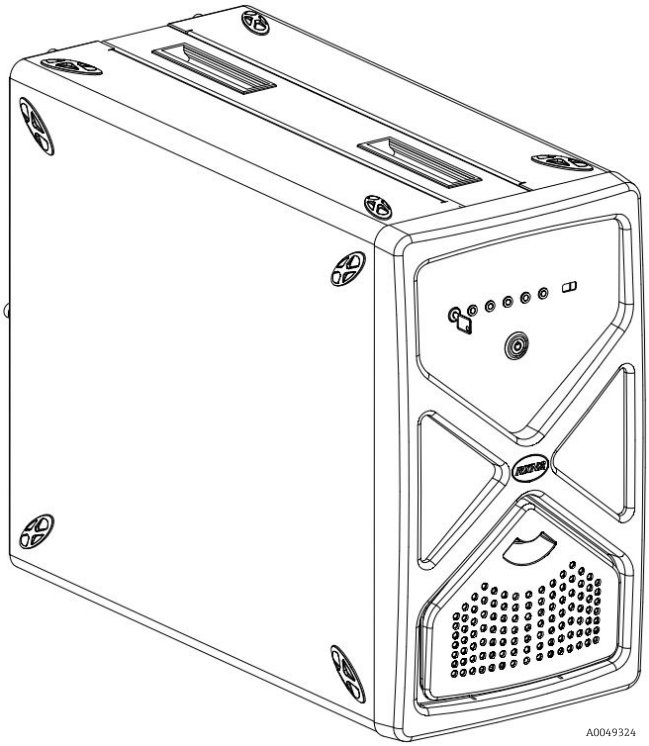


Figure 2. A Raman Rxn2 embedded analyzer

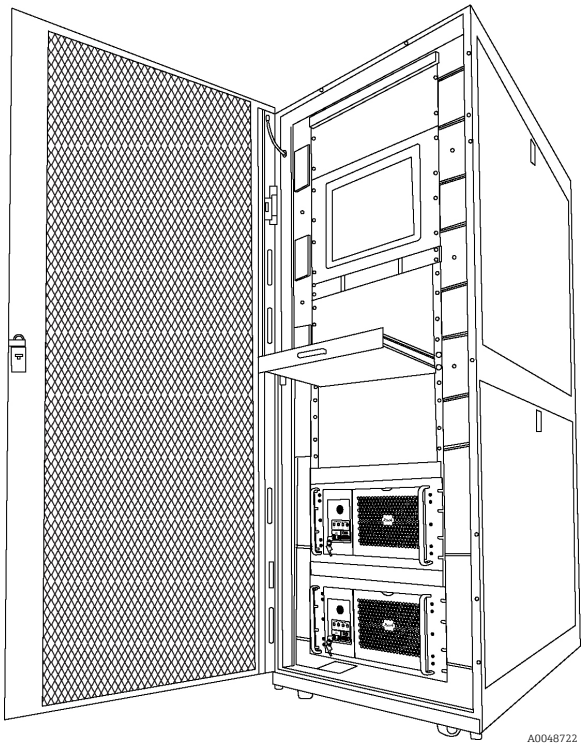


Figure 3. Two Raman Rxn4 four channel embedded analyzers in a rack

3.1.1 Front panel

On the front panel of the instrument are the standard user interfaces. These include the main **ON/OFF** power switch, the laser **ON/OFF** key switch, Light emitting diode (LED) indicators, and a Universal serial bus (USB) 3.0 port.

Figure 4. Front panel of a Raman Rxn2 four channel analyzer

#	Name	Description
1	Laser Key Switch	The laser key switch turns the laser on and off. The **Red** LED indicator adjacent to the laser key switch indicates the laser power status. To activate, turn the key to the **ON** position.
2	Main Power Switch	The main power switch turns the instrument on and off, which includes the laser regardless of the position of the laser key switch. The **Power** push button incorporates a **Blue** LED in the shape of a power symbol, which indicates the system power status. The **Power** push button will communicate error conditions using blink codes when embedded software is not able to communicate them. To turn the instrument on, press and release the **Power** button once. To turn a responsive instrument off, shut down using Raman RunTime. If the instrument is unresponsive, it may be powered down using a long 10 second press and hold of the **Power** button.
3	USB 3.0 Port	The USB 3.0 port is intended to obtain diagnostic exports from the instrument using a USB flash drive. Use for USB flash drive for external data collection.
4	Probe Connection Status Indicators	The bank of **Yellow** LED indicators between the laser key and USB 3.0 port indicate the physical connection status of the probes. While the Raman Rxn2 four channel analyzer front panel has four LED indicators, the front panel of the Raman Rxn2 Hybrid analyzer has only two LED indicators, and the front panel of the Raman Rxn2 single channel analyzer has only one LED indicator.

Table 4. Front panel of Raman Rxn2

3.1.2 Rear Panel

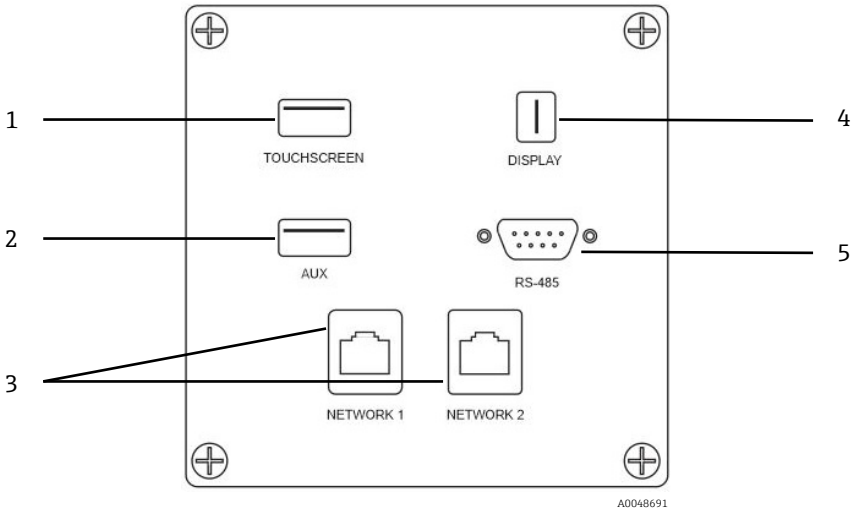


Figure 5. Rear external circuit input/output panel of a Raman Rxn embedded analyzer

#	Name	Description
1	Touchscreen USB Port	USB 3.0 port used to connect to the touchscreen.
2	USB Port (Auxiliary)	USB 3.0 backup port.
3	Ethernet Port (2)	Ethernet ports for the network connection.
4	Touchscreen Video Port	Touchscreen video port.
5	RS-485 Serial Port	RS-485 serial port.

Table 5. Raman Rxn2 ports

3.2 Raman Rxn non-embedded analyzers

Raman Rxn analyzer configurations currently available for use with Raman RunTime software are outlined in the table. New configurations are only available with Raman RunTime version 6.1+, while some are compatible with earlier software versions.

Raman RunTime software can be used for those customers wishing to continue using older versions of their existing Raman Rxn analyzers, namely the RamanRxn2 and RamanRxn4 non-embedded four channel analyzers configured with either 785 nm or 1000 nm. The 1000 nm non-embedded configuration has a single channel option, but the 785 nm does not.

Use with non-embedded analyzers can be accomplished by running Raman RunTime as the control platform via an optional external controller (the original HMI or the current HMI). Both external controllers are functionally equivalent. The current shipping HMI is referred to as either the current HMI or HMI2 in Endress+Hauser documentation which is what will be described hereafter.

	Base Unit		Channels		Controller		Version Compatibility		
Analyzer	**Rxn2**	**Rxn4**	**Four**	**Single**	**Embedded**	**HMI**	**Embedded**	**Original HMI**	**Current HMI**
Rxn 532	●	●	●	●	●	●	6.2+	6.2+	6.2+
Rxn Enclosure 532		●	●	●	●	●	6.2+	6.2+	6.2+
Rxn 785	●	●	●	●	●	●	6.0+	5.1+	6.2+
Rxn Enclosure 785		●	●	●	●	●	6.0+	5.1+	6.2+
Rxn Hybrid 785	●	●	—	—	●		6.2+	—	—
Rxn Hybrid Enclosure 785		●	—	—	●		6.2+	—	—
Rxn Hybrid Transmission 785	●	●	—	—	●		6.2+	—	—
Rxn Hybrid Transmission Enclosure 785		●	—	—	●		6.2+	—	—
Rxn Starter 785	●		●	●	●		6.2+	—	—
Rxn 1000	●	●	●	●	●	●	6.0+	5.1+	6.2+
Rxn Enclosure 1000		●	●	●	●	●	6.0+	5.1+	6.2+
RamanRxn 1000	●	●		●		●	n/a	5.1+	6.2+
RamanRxn Enclosure 1000		●		●		●	n/a	5.1+	6.2+

Table 6. Raman Rxn analyzer suite and Raman RunTime software compatibility

Non-embedded Raman Rxn analyzers have the following connections:

#	Name	Description
1	Power Button	Button that turns the device on and off.
2	Laser Key	Key used to unlock and activate the laser.
3	USB (Type-B)	USB Port required for connection to HMI.
4	Ethernet Port	Ethernet port for the network connection. Required for connection to HMI.
5	Interlock Connectors	Safety feature (1 or 4). To interrupt the laser, remove the black plug.
6	FC Style Fiber Connections	Match prongs on probe to plugs on EO (1 or 4). Pull latch down to secure probe in place.

Table 7. Non-embedded ports

The external HMIs (original or current) have the following connections:

#	Name	Description
1	Power Button	Button that turns the device on and off.
2	Ethernet Ports	Ethernet ports for the analyzer and network connections.
3	USB Port	USB port required for analyzer connection.
4	USB Auxiliary Ports	Three USB backup ports.

Table 8. External HMI ports

3.2.1 External Connections

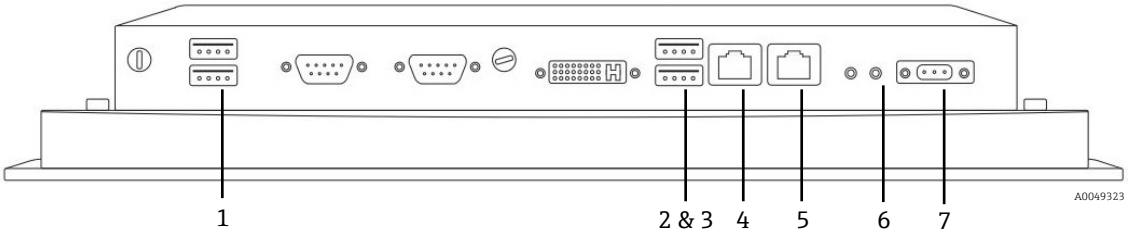


Figure 6. External connections for HMI for use with non-embedded Raman Rxn analyzer and RunTime

#	Name	Description
1	USB, Auxiliary	USB 3.0 backup ports.
2	USB, Extension for Flash Drives (Blue)	USB 3.0 flash drive port.
3	USB, Rxn Analyzer	USB 3.0 port for the Rxn Analyzer.
4	Ethernet – Customer LAN	Ethernet ports for the customer Local area network (LAN).
5	Ethernet – Rxn Analyzer	Ethernet ports for the Rxn Analyzer.
6	Power Button	On and off button.
7	Power Input Connector	Power jack adapter.

Table 9. Non-Embedded Raman Rxn ports

NOTICE

- For more details on non-embedded analyzer hardware, please refer to either the *RamanRxn2 Operating Instruction (BA02151C)* or the *RamanRxn4 Operating Instruction (BA02178C)*.

4 Basic set-up for Raman RunTime

4.1 Initial set-up procedure

1. Attach probe(s) after they have been cleaned (for more instructions on cleaning and connecting probes, see the appropriate Raman Rxn Operating Instruction and/or each probe's operation manual).
2. Plug in the analyzer's power cable.

The following three steps are applicable to Raman Rxn embedded analyzers:

1. Plug in the touchscreen USB cable and video cable.
2. Attach Ethernet cable for network access.
3. Turn the device **ON** by pressing the **Power** button on the front of the device. The button will blink once per second until Raman RunTime launches. The Laser Enable LED will illuminate **Red** and the power switch will illuminate a solid **Blue**.

The following three steps are applicable to RamanRxn2 and RamanRxn4 non-embedded analyzers:

1. Connect the required Ethernet and USB cables from the analyzer to the external HMI.
2. Plug in the external HMI power cable which will automatically power up the device.

   A small power switch is located next to the power cable connection which can be activated if the device does not power on automatically or needs to be shut down.
3. Turn the device **ON** by pressing the **Power** button on the front of the device. The LED next to the power switch will illuminate and stay lit.

Continue with the steps below for both embedded and non-embedded Raman Rxn Analyzers:

1. Turn the laser key to **ON**.
2. Customize the analyzer name (the default name is "Raman Analyzer"):
   - **Options > System > General.**
   - Enter a custom name, e.g. Raman Rxn2-785 SBAAAF12000, then press **Apply**.
   - This is a critical step – the analyzer name is how the system is identified via diagnostic exports and communication protocols.
3. Calibrate the touch screen (if needed):
   - **Options > System > General > Calibrate Touch Screen.**
   - Follow on screen prompts. A tip for achieving a better calibration is to use the edge of your fingernail when following on screen prompts and touching the requested touch points.
4. Connect to a network. View and customize network settings from:
   - **Options > System > Network**.
   - Set the date and time either manually or via network connection by specifying the time server address at **Options > System > Date & Time**.
   - If setting the date and time manually, first ensure the time zone is set up correctly before proceeding to other adjustments.
   - This is another critical step – spectral acquisition and resulting files and communication protocols are managed by the system's date/time.
5. Specify names for each probe/quadrant such as Probe 1, Probe 2, etc.
   - From the Raman RunTime main screen, click on the title bar of the appropriate probe window you wish to name.
   - **Probe Detail View > Settings Tab > Name > Apply**.

NOTICE

▶ Let the system stabilize for at least 2 hours before proceeding to calibration steps.

4.2 Remote access

Remote Access permits the Raman RunTime user interface to be accessed using a desktop web browser from a remote workstation, that meets the following requirements:

- Google Chrome and Microsoft Edge are supported web browsers.
- Network connectivity between the instrument and the remote workstation.

There are two ways to access the Raman RunTime user interface remotely:

- **Standard.** Navigate to *http://<IPaddress>:3593* or *http://<hostname>:3593* in a qualifying web browser to use Standard remote access.
- **Secure.** Navigate to *https://<hostname>:3594* in a qualifying web browser to use Secure remote access. The client must be able to resolve the analyzer hostname for secure connections. Refer to chapter 9 of this manual for a list of ports that need to be open on the network for secure remote access to function. Raman RunTime employs a dynamically generated self-signed TLS server certificate in support of encryption. Clients must accept and trust this certificate to successfully communicate with Raman RunTime.

The IP Address and hostname of the analyzer can be viewed and configured under **Options > System > Network**.

When first connecting through secure remote access, clients may be presented with a privacy warning. This warning is expected because the analyzer's self-signed certificate is not trusted by default. The remote client can bypass the warning to access the analyzer by following the steps shared below.

To eliminate the certificate warning from a particular remote workstation, trust can be granted to the analyzer by adding its certificate to the "Trusted Root Certification Authorities" store on the remote workstation. Instructions for this follow.

NOTICE

- ▶ When Security within Raman RunTime is enabled, an attempt to access Standard remote access will automatically be redirected to the Secure remote access URL.
- ▶ A new TLS server certificate will be generated each time the analyzer's hostname is changed.

To bypass the privacy warning:

1. Navigate to *https://<hostname>:3594* in a qualifying web browser.

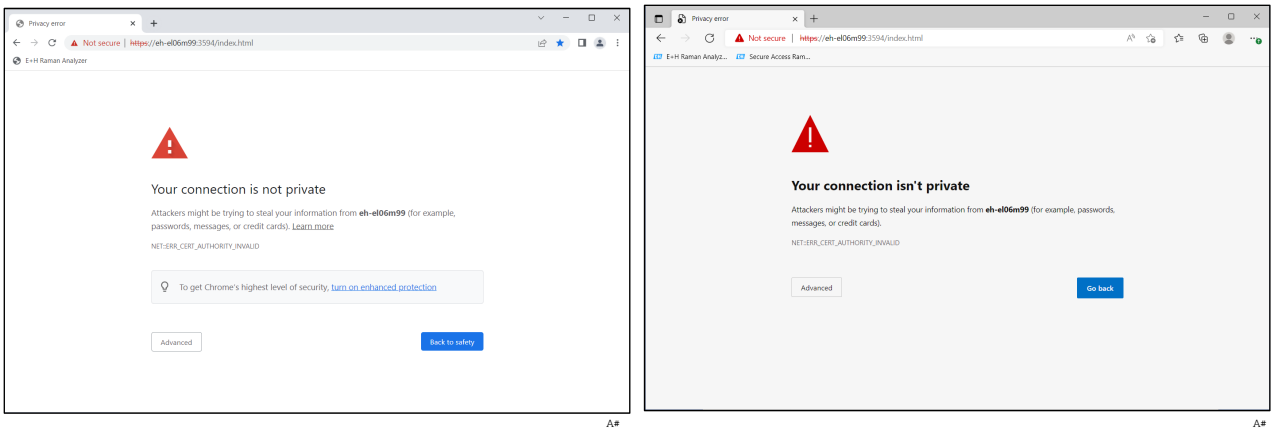


Figure 7. Google Chrome and Microsoft Edge browsers showing secure connection page

2. Click **Advanced**.

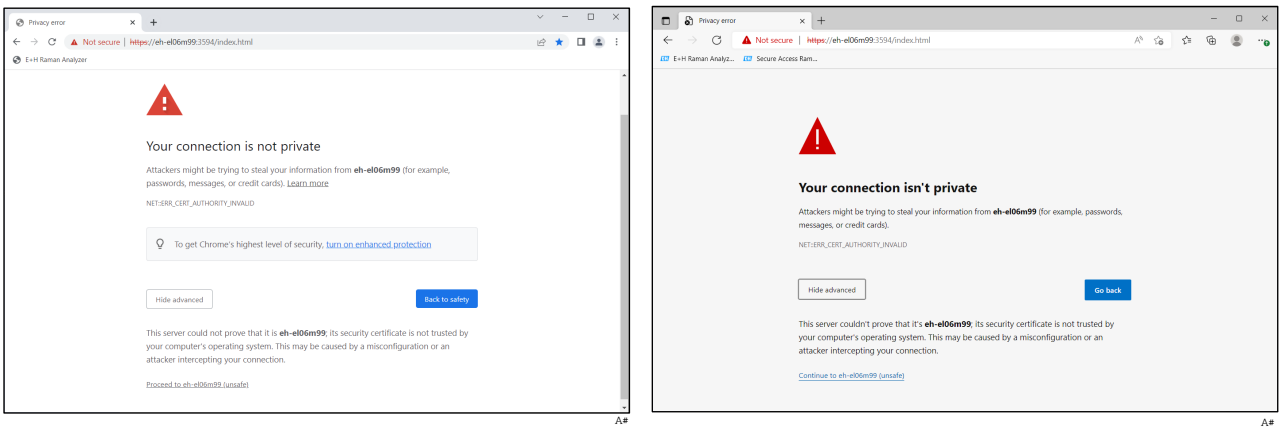


Figure 8. Google Chrome and Microsoft Edge browsers showing Proceed/Continue to <hostname> link

3. Click **Proceed/Continue to *<hostname>* (unsafe)** at the bottom of the page.
4. The remote interface will load and present the analyzer's home screen when finished.

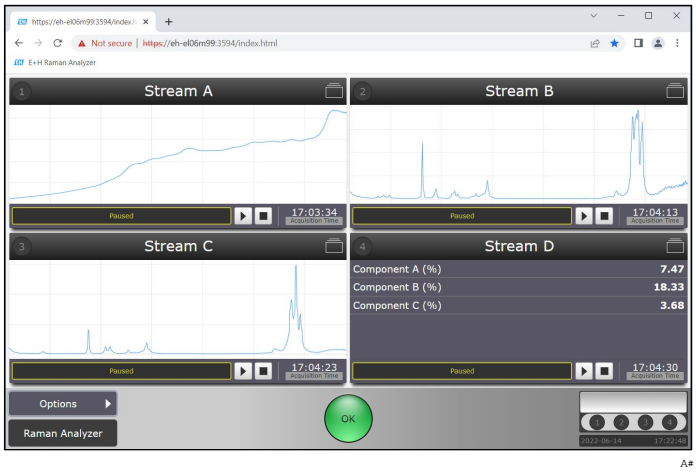


Figure 9. Remote access interface

To accept and trust the analyzer's server certificate on a remote workstation:

1. Navigate to *https://<hostname>:3594* with a qualifying web browser.
2. Click **Not secure** to the left of the URL address bar.
    - In Google Chrome, click **Certificate is not valid**.
    - In Microsoft Edge (shown below), click **Your connection to this site isn't secure**, then the certificate icon.

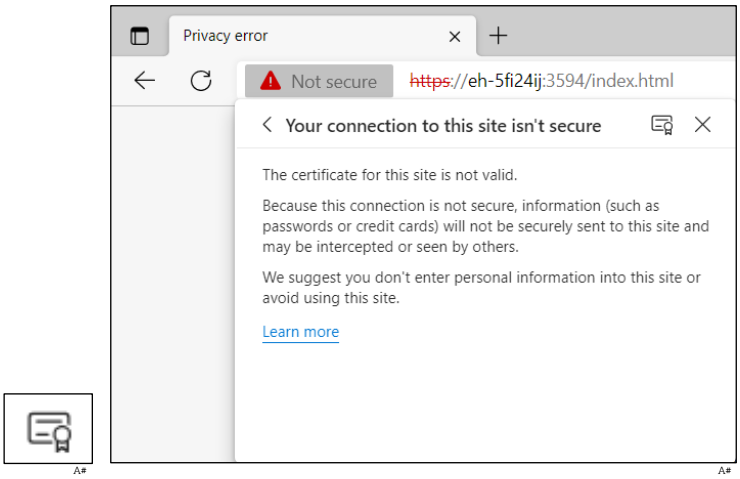


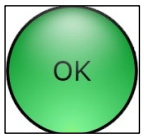
Figure 10. Microsoft Edge certificate icon

3. In the Certificate dialog, select the **Details** tab, and select **Copy to file**.
4. In the Certificate Export Wizard, click **Next** to proceed:
    - Select **DER encoded binary X.509 (.CER)** and click **Next**.
    - Specify the certificate file name and path to save the certificate then click **Next**.
    - Click **Finish** to close the wizard.
5. Double-click the exported certificate file.
6. In the Certificate **General** tab, click **Install Certificate**.
7. In the Certificate Import Wizard, select **Current User**, then **Next:**
    - Select the **Place all certificates in the following store** then click **Browse**.
    - Select **Trusted Root Certification Authorities**.
    - Click **Next**, and then **Finish**.
8. In the security warning dialog box, the Analzyer's hostname displays. Click **Yes** to install the certificate.

Granting trust to the analyzer's certificate is now complete. Upon restarting the compatible web browser and navigating to *https://<hostname>:3594*, the certificate will now show as installed and trusted.

4.3 Overview of status indicator

The circular **Status** button in the center of the main screen has three modes: **Green**, **Yellow**, and **Red**. When the **Status** indicator is **Green** with an **OK** in the center, it means there are no detectable problems.

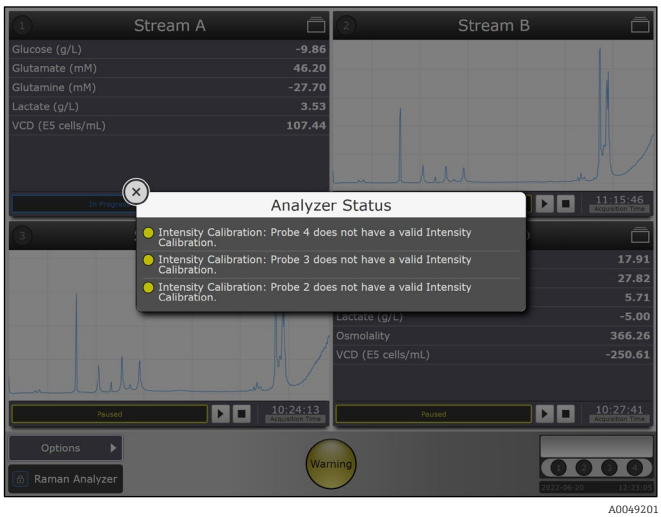


A0049199

Figure 11. Green OK status indicator

When the **Status** indicator turns **Yellow** with a flashing **Warning** in the center, it means there is a caution. Click the **Yellow** status indicator for an explanation for the warning.

A0049200



A0049201

Figure 12. Explanation for why system has issued a yellow warning

NOTICE

- For analyzers with any unused channels/probes, the warning indicator will turn **Yellow** indicating there are uncalibrated channels. To resolve this erroneous warning, unused channels can be turned off.

When the **Status** indicator turns **Red** with an Error in the center, it signifies a more serious problem that needs immediate attention. Click the **Red** status indicator for an explanation of the error. The error message will disappear automatically once the problem is resolved.

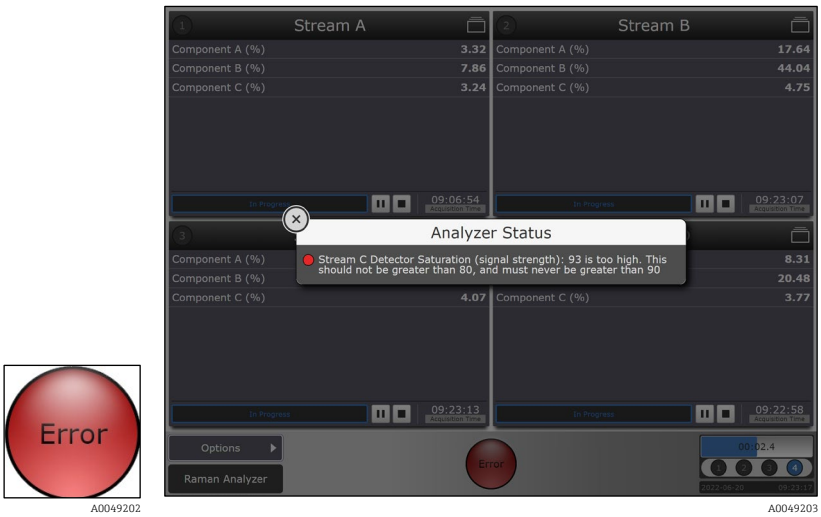


Figure 13. Explanation for why system has issued a red error

4.4 Calibration and verification

Follow these instructions to calibrate and verify your Raman Rxn analyzer for the first time. All calibrations are required prior to spectral acquisition. Raman RunTime will not allow spectra to be collected without passing internal and probe calibrations. Passing the verification step is not required but highly recommended.

Navigate to **Options > Calibration**. Different calibration window previews for the different Raman Rxn analyzer configurations are shown in Figures 10, 11, and 12.

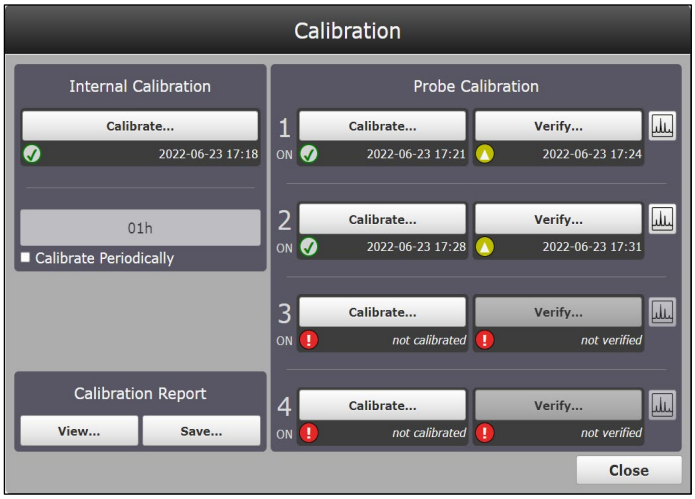


Figure 14. Calibration window with quick view buttons for a Raman Rxn four channel analyzer

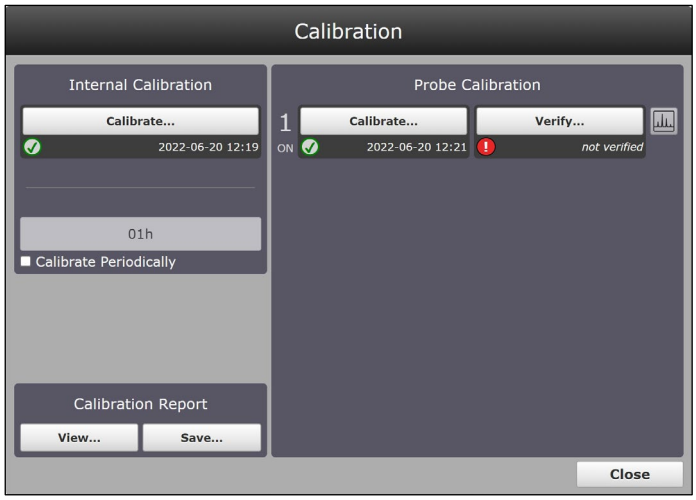


Figure 15. Calibration window with quick view buttons for a Raman Rxn single channel analyzer

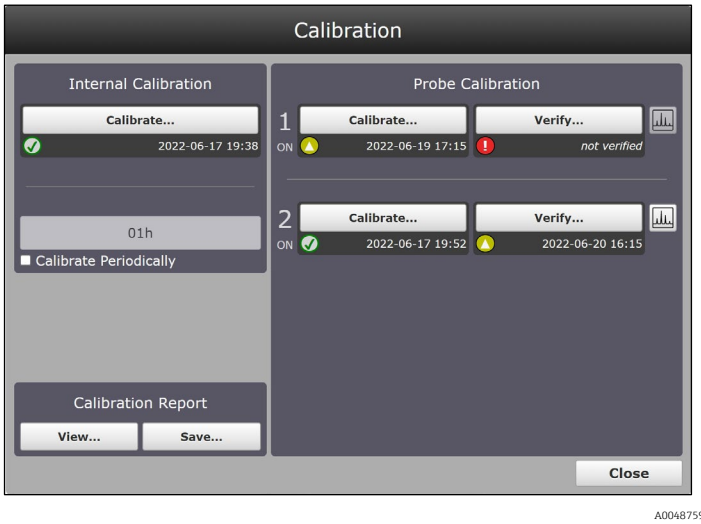


Figure 16. Calibration window with quick view buttons for a Raman Rxn Hybrid analyzer

4.4.1 Internal calibration

Raman Rxn analyzers have internal calibration standards for spectrograph and laser wavelength. There are several internal calibration options to choose from:

- **Automatic.** If the instrument is already calibrated, this will compare the current analyzer response to calibration specifications and will recalibrate if the spectrograph wavelength and/or laser wavelength is out of spec. If the analyzer is uncalibrated, this will perform an alignment calibration, followed by a full wavelength calibration and full laser wavelength calibration.
- **Recalibrate X Axis.** Forces full wavelength and laser calibrations without first checking whether the analyzer is within spec.
- **Recalibrate All.** This will cause the alignment calibration to be repeated prior to performing full spectrograph wavelength and laser wavelength calibrations. Note that when **Recalibrate All** completes, the intensity calibrations and verifications of all probes will be invalidated.

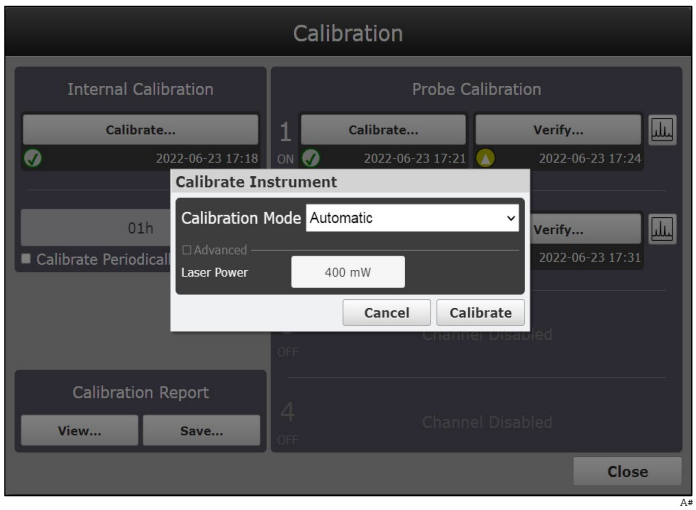


Figure 17. Internal calibration standards for spectograph and wavelength

Steps for Internal Calibration:

1. Ensure all probes are capped.
2. Click **Calibrate** under Internal Calibration.
   - For initial startup, click **Recalibrate All** from the Calibration Mode drop-down list and click **Calibrate**.
   - To change the laser power setpoint, select the **Advanced** drop-down list. Input the desired setpoint for Laser Power and click **Calibrate**.

NOTICE

- The **Recalibrate All** option is only required at initial start-up or when the analyzer is moved or serviced. For subsequent calibrations, select **Automatic**.
- For a new laser power setpoint to take effect, the user must click **Calibrate**.

3. Select **Calibrate Periodically** and set the frequency.
   - Setting is configurable in one-hour increments.
   - At least once per day (1d 00h) is recommended.

NOTICE

- For HCAs delivered after approximately 01-Nov-2017, the HCA intensity indicator light will blink until the halogen bulb warm-up period is complete. Wait to proceed with probe calibration until the light stops blinking.

4.4.2 Probe calibration – single channel, four channel, and hybrid (ALT Channel) analyzers

A Calibration accessory (HCA) with an appropriate optic adapter is required for probe calibration of single channel, four channel, and Hybrid (ALT channel or channel 2 only) Raman Rxn analyzers. Refer to the appopriate probe or optic manual for more information about product specific calibration accesssories. Ensure the HCA calibration has been calibrated within 1 year and has an accompanying Intensity Reference source spectral file (*.spc).

Probe calibrations can be executed during active experiments, e.g. if a probe needs to be set up while another probe is active. When a probe calibration is triggered, any acquisitions currently in progress will be aborted automatically, and the calibration will proceed. Upon completion of the calibration, active probes will automatically resume normal operation.

Steps for probe calibration:

1. Connect the HCA to the first (or only) probe. Use the set screw to hold the probe in place.

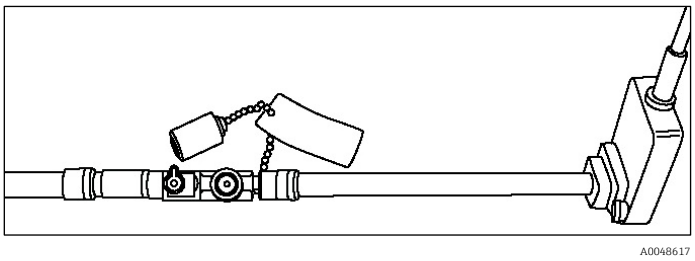


Figure 18. Example of the Rxn-10 probe with a bIO-Optic connected to the HCA

2. Turn on the HCA and set the switch to Intensity. The intensity indicator on the HCA will blink until the bulb warm up time is complete (15 minutes). Do not proceed until indicator stops blinking.
3. For Rxn-10 probes, be sure the laser shutter is set to ON (indicator parallel to probe body).
4. Load the HCA Intensity Reference spectral file (*.spc):
   - Attach the USB memory stick that came with the HCA kit to the USB Extension or USB port on the front of the analyzer. This is only required for new device setup or when the HCA is serviced or changed.
   - For single channel, Hybrid (ALT channel), or four channel analyzers, click **Calibrate** for the targeted probe. A pop-up window for loading the Intensity Reference spectral file displays. Click **Load** to browse to the correct Intensity Reference spectral file (*.spc) located on the memory stick. Click **Select File**.

NOTICE

- Loading multiple and distinct Intensity Reference spectral files (*.spc) for each available channel is supported. Before clicking **Calibrate**, click the drop down list and ensure that the correct spectral file is selected for the probe by matching the serial number and calibration date to the HCA.

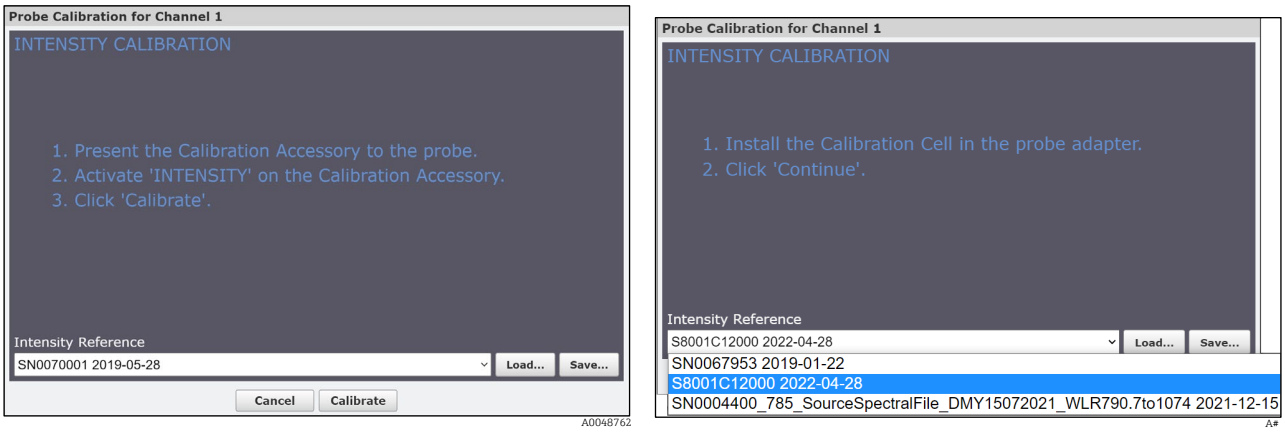


Figure 19. Intensity calibration window in Raman RunTime

5. Click **Calibrate** to start the calibration process on the selected probe:
   - **Four Channel Raman Rxn System.** Make sure the **Blue** indicator is active on the probe intended for calibration – cancel and recalibrate if needed. A countdown timer will start.
   - **Single Channel Raman Rxn System.** There is no **Blue** indicator and instead only a countdown timer will start, indicating probe calibration has begun.
   - **Hybrid Raman Rxn System.** Make sure the **Blue** indicator is on the ALT probe. Cancel and recalibrate if needed. A countdown timer will start.
6. Repeat the probe calibration for each active probe (if applicable).

NOTICE

- For analyzers with any unused channels/probes, the warning indicator will turn **Yellow** indicating there are uncalibrated channels. To resolve this erroneous warning, turn off unused probes/channels.
- Because not all probes use HCA for calibration, the Intensity Calibration window looks different for non-HCA calibrations. Please refer to the applicable probe, optic, or application product manual for additional information.

4.4.3 Probe calibration – Hybrid (Rxn-20 channel) analyzers

For the Rxn-20 channel (channel 1) on a Raman Rxn Hybrid analyzer, follow the steps below:

1. Connect the appropriate optic (3mm, 6mm) to the Rxn-20 probe.
2. Connect the appropriate extension tube to the optic. The 3mm optic uses the 3.0 in. long extension tube, while the 6mm optic uses the 8.0 in. long extension tube.
3. Connect the HCA lamp head to the extension tube. Use the thumb screw to hold the HCA lamp head in place.

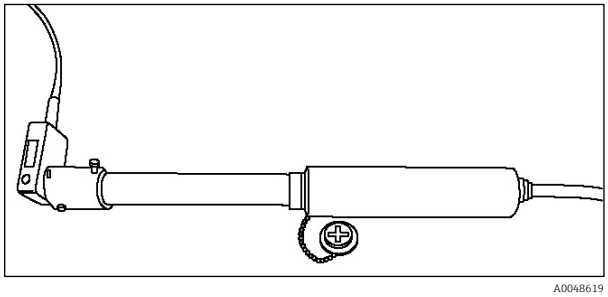


Figure 20. HCA lamp head and extension tube attached to Rxn-20 non-contact optic and probe

4. After powering on the HCA, set the switch to Intensity. Let the white light bulb warm up for approximately 15 minutes. Do not proceed until the indicator stops blinking.

   Loading the HCA Intensity Reference spectral file (*.spc):

   - Attach the USB memory stick that came with the HCA kit to the USB port on the front the analyzer. This is only required for new device setup or when the HCA is serviced or changed.
   - On the Probe Calibration section of the screen, click **Load** to browse to the correct Intensity Reference spectral file (*.spc) located on the memory stick. Click **Select File**.

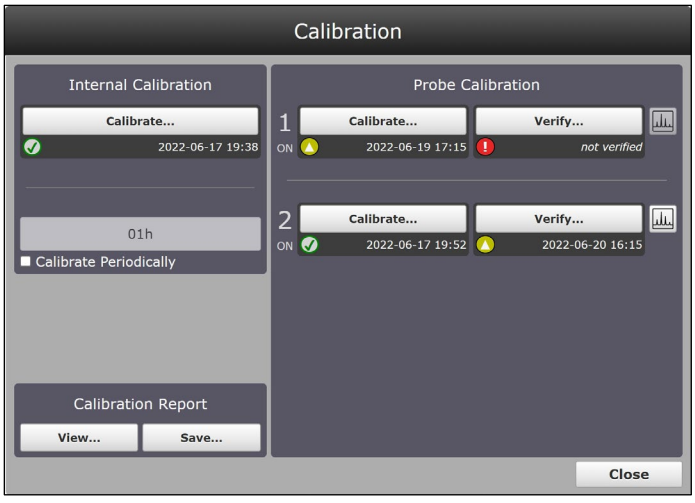


Figure 21. Calibration window for a Raman Rxn Hybrid analyzer

5. Click **Calibrate**.

   Make sure the **Blue** indicator is on the Rxn-20 probe. Cancel and recalibrate if needed. A countdown timer will start.

NOTICE

- For analyzers with any unused channels/probes, the warning indicator will turn **Yellow** indicating there are uncalibrated channels. To resolve this erroneous warning, turn off unused probes/channels.

4.4.4 Probe verification

For any Raman Rxn analyzer, probe verification will verify the calibration results using a standard reference sample, such as 70% IPA, cyclohexane, or acetone. This step is not required to collect a Raman spectrum, but it is highly recommended.

NOTICE

- Do not use cyclohexane for verification with bIO-Optics, bIO-Lab Rxn-45, and single-use adapters.
- Bioprocessing probes, such as Rxn-45 probes and the Rxn-10 probehead with a bIO-Optic or Raman optic system for single use, should only use 70% IPA. Only 70 percent by volume (%v/v) will work. Endress+Hauser recommends using CiDehol 70 by Decon Laboratories. All other (non-bio) probes can use cyclohexane.
- Acetone is only used with LNG applications.

For bIO-Optics, Rxn-45, and single-use adapters, use a bIO Sample Chamber for verification:

1. Connect the bIO sample chamber at the white Teflon end to the first probe and fill it about half-way with 70% IPA.
2. While holding the attached sample chamber for support (to keep it upright), tilt the probe/optic to a 15-30° angle and tap the sample chamber to ensure any bubbles in the 70% IPA rise to the top.
3. Click **Verify** under the Probe Calibration section and select 70% IPA as the verification standard.
4. Repeat the probe verification for each active probe.

For all other (non-bioprocess) probes use a sample container appropriate for the probe connection:

1. Click **Verify** under the Probe Calibration section and select cyclohexane, 70% IPA, or acetone as the verification standard.
2. Repeat the probe verification for each active probe.

How to interact with the probe verification results:

1. Access the **Spectrum Viewer** button to display the current verification spectra and allow for addition of previous spectra.
2. Click **Spectrum Viewer** to view the current verification spectrum.
3. Click the spectrum's name at the top of the window (click the **Date** and **Time** of the spectrum which appears in **Blue**). Click **Add** to include previous spectra on the plot.
4. Spectra can also be exported as *.spc files (to a USB memory stick) from this view.
5. Additionally, the symbols under the **Calibrate** and **Verify** buttons can be clicked for details about the recent calibration/verification.

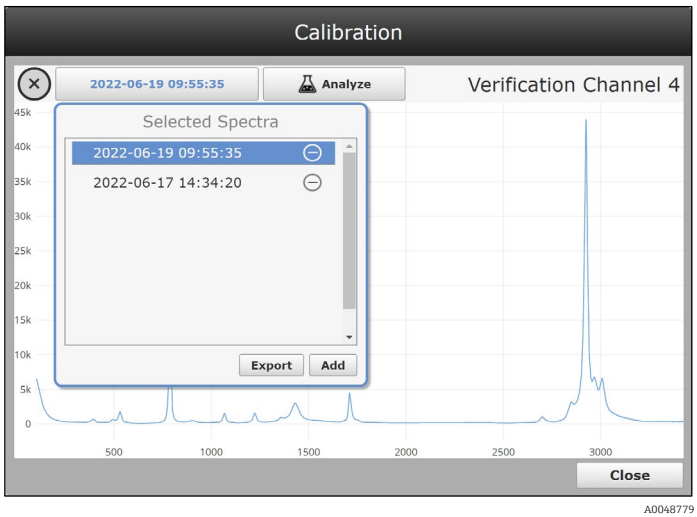


Figure 22. Probe verification spectrum viewer

6. Click **Export** to save the verification spectrum to an external USB memory stick that can be inserted in auxiliary USB ports on the front and rear of the device. A network connected drive can also be used for *.spc file export.

4.4.5 Calibration and verification reports

1. On the lower left of the screen under **Calibration Report**, click **View** to see the calibration and verification report. A summary of the internal calibration report appears at the top of the screen.

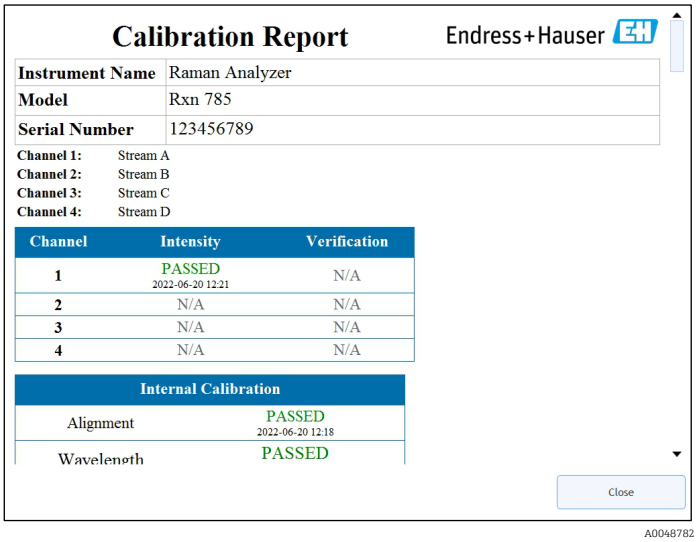


Figure 23. Calibration and verification report

2. The full calibration and verification report can be viewed on screen by clicking the **Black Arrow** above the **Close** button to scroll down.
3. Click **Close** at the bottom of the report window to exit.
4. Click **Save** to save the full calibration and verification report locally as a *.pdf file (to a USB memory stick). The calibration report can also be accessed remotely via network Raman RunTime connection or via OPC.

5 Data collection

There are several collection modalities available in Raman RunTime including Manual, Continuous, Periodic, Focus, and Snapshot.

Exposure Length and Count (sometimes referred to as accumulations) need to be specified for each collection option, except Focus. Focus may be used to determine exposure length.

- **Exposure Length.** How long the laser will be exposed to the sample.
- **Count.** The number of times the exposure will be repeated for a single spectrum.

The goal of determining an appropriate length and count combination is to maximize the signal-to-noise ratio within the time allotted for sampling without overexposing the detector.

- Ideal detector saturation is between 40% – 70%.
- Avoid detector saturation below 10% and above 80%.

5.1 Data collection with Raman RunTime

- Batch settings for Collection Mode and Exposure Settings are remembered. This makes it very easy to start a new batch that is like the previous.
- It is not necessary to use the same collection mode for each probe. Collection mode differences and how they affect sampling sequence are further described in corresponding sections below.
- Active batches can be paused or stopped at any time using the corresponding buttons.
    - Pausing a batch can be used to not disturb the sample/spectrum while interrupting the experiment, such as exposing a reactor to room light or extracting a sample.
    - It is best to pause at the start of a new sample since the current spectrum/sample will terminate.
    - When collection is paused or stopped, Raman RunTime will automatically proceed to the next probe in sequence (or wait until the next periodic acquisition for another probe). Stopping acquisition of a Raman RunTime batch means the same experiment cannot be restarted – new spectra will need to be stored under a new “batch” name and collection of spectra. If there is a chance the user might need to return to the experiment, be sure to pause rather than stop the acquisition process.
- Exposure settings can also be changed during an active experiment. It is not necessary to pause to change exposure settings. New settings will take effect on the next sample acquisition.

NOTICE

▶ Batch names can be up to 60 characters maximum.

5.2 Dark exposures

Dark exposures are used to reduce noise in spectra by accounting for the noise arising from the detector. For example, 532 nm and 785 nm detectors naturally have low noise, so dark exposure requirements for these systems are minimal and mostly automatic. However, 1000 nm detectors have intrinsically high noise levels and require extra dark exposure attention.

Dark handling for Raman Rxn2 532 nm and 785 nm analyzers:

- There is only one user initiated dark setting for 532 nm and 785 nm systems, located from the **Advanced** button under Exposure Settings.
- Leave the **Force New Dark** check box deselected which should be the default setting for 532 nm and 785 nm systems. Selecting this check box will collect and apply a new dark every time a spectrum is collected. Therefore, this is not recommended for most applications since it will double the collection interval time.
- Dark exposures are automatically collected at the beginning of acquisition whenever an Exposure or Count setting has been changed.
    - There is an exception if a dark exposure has already been collected and stored for the same Length and Count setting, e.g. for another probe or during a previous experiment. Then the system will use the stored dark.

- To expire an old dark and force a new one at any length and count interval, select the **Force New Dark** check box for at least one interval, then turn it off.

- If a dark exposure is needed when acquiring in continuous or periodic mode, one will be collected at the start of the first acquisition and used for all subsequent spectra.
  - This will cause the first spectral collection interval to take double the time of subsequent intervals.
  - The **Status** indicator specifies when a dark exposure is active and how long is remaining.

NOTICE

▶ It is best to collect a dark after the system has stabilized for about 2 hours after start up. To collect a dark to be stored and used repeatedly, such as for routine exposure settings, allow the analyzer and laser to remain on for 2 hours prior to dark collection if the laser has been turned off. If the analyzer has been relocated, then it should stablize for at least one day with the laser on before collecting a new dark. Note that this is not applicable to moving short distances on a Raman Rxn2 cart.

Dark handling for Raman Rxn-1000 nm single channel and four channel analyzers:

- On 1000 nm systems, dark exposures are collected automatically at the end of every acquisition.
- The number of dark exposures collected at the end of each acquisition is determined by the Dark Exposures setting under the **Advanced** button.
- Typically, dark subtraction is effective at mitigating the non-sample contributions in the measurement due to "dark current" when the Dark Exposures setting is approximately one half the count setting.
- In processing the final spectrum, the "trailing" dark exposures taken after the sample is measured are combined with "leading" dark exposures taken before the sample is measured.
- Typically, trailing dark exposures from one acquisition are used as the leading dark exposures for the next acquisition. This reduces the time needed to collect the requisite number of dark exposures for a given acquisition.
- Alternatively, new leading dark exposures are collected at the beginning of every acquisition if any of the following conditions are met:
  - The length setting has changed since the most recent dark collection.
  - The most recent dark collection completed more than 10 minutes prior.
  - The Force New Dark option is selected under the **Advanced** button.
- Due to the conditional nature of leading dark collection, there is the potential for inconsistent acquisition times, especially on the first acquisition after starting a new experiment or rebooting the instrument, or generally when using periodic or manual collection. Selecting the Force New Dark option can be used to achieve consistent acquisition times, when doing so is more beneficial than minimizing acquisition time.

5.3 Focus mode

Focus mode is used to position probes (typically non-contact optics) and/or determine appropriate collection settings for a given sample or process. No spectra are saved from Focus mode – focus spectra are for visual evaluation only.

NOTICE

▶ For the Rxn-20 probe with the Raman Rxn Hybrid analyzer, be sure to use the appropriate extension tube for the Rxn-20 optic to help in locating the sample to the focal plane.

1. Position probe to sample and click **Focus** under the probe details view.

   A Suggested Exposure will be displayed. The example below shows 1.7s – 3.0s for a sample of 70% IPA.

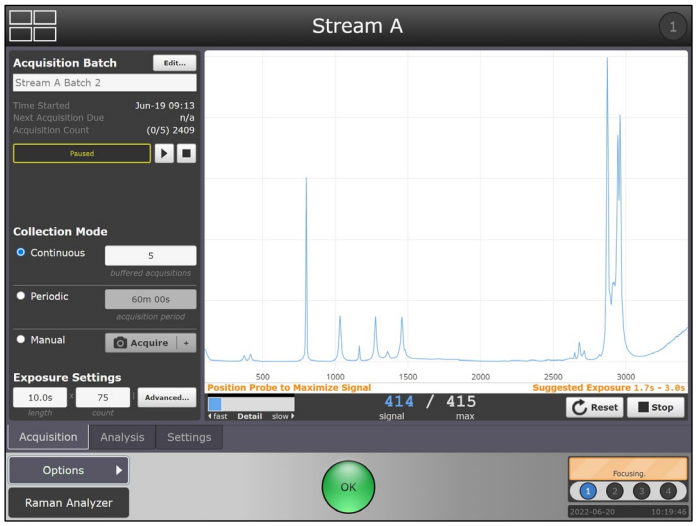


Figure 24. Focus mode example

2. Move the **Detail** bar to the “slow” position to increase the focus time as needed. Samples yielding weaker signal features may not be obvious with the “fast” focus setting.

   The current signal vs. max signal is displayed so that the current probe/sample positioning can be compared to the max observed signal. The current signal will change with repositioning of the probe/sample.

3. Reposition the probe or sample to achieve the best focus/signal-to-noise.
4. Click **Reset** to reset the remembered max signal.
5. Click **Stop** to exit focus mode.

5.4 Snapshot mode

Snapshot mode is similar to Focus, in that no spectra are saved. Snapshot is intended for quick acquisitions to measure laser power, try out different length and count settings for a sample, or more commonly to quickly assess spectral quality either visually or by applying a model.

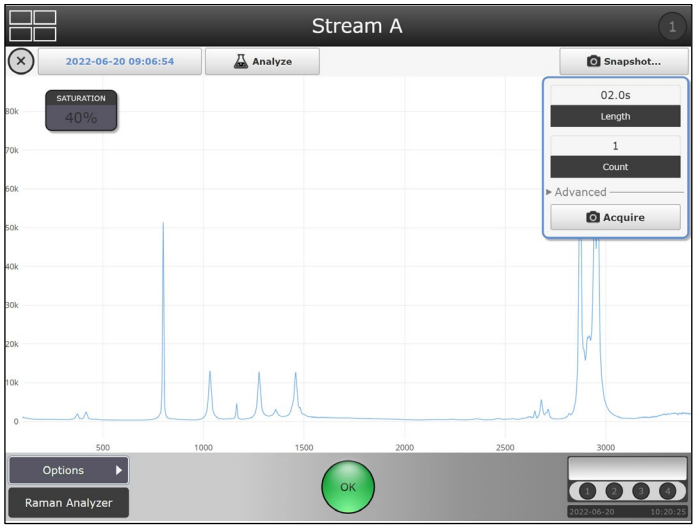


Figure 25. Snapshot mode and options

1. To access Snapshot mode, click anywhere within the spectral plot from one of the probe detail views. The spectra overlay plot/Snapshot view will appear.
2. Select an exposure length and count, then click **Acquire**:
   - The snapshot spectrum will be overlaid with the most recent spectrum if an experiment is already in progress, such as shown below.

- It will not be stored with the current batch data; a snapshot spectrum is for onscreen tests only.

3. Spectra from previous batches/experiments can be overlaid with the snapshot spectrum by clicking the spectrum name (the **Blue** date and time appearing in the top right header). Then click **Add** and browse to select the reference spectra:
   - Multiple spectra can be added to the overlay, but only a single spectrum is distinguished as the "principal" spectrum by displaying it in **Blue** and listing its name in the header.
   - When a new snapshot is collected, it automatically becomes principal, so is shown in **Blue**. The spectrum is principal and can be changed by selecting/highlighting it in the spectrum list.
   - This list is viewable by clicking **Primary File Name** (located at the top, to the left of **Analyze** button) to display a selected spectra drop-down list.
4. Additionally, a model can be applied by clicking **Analyze** and selecting a model. Ad hoc analysis only applies to the principal spectrum.

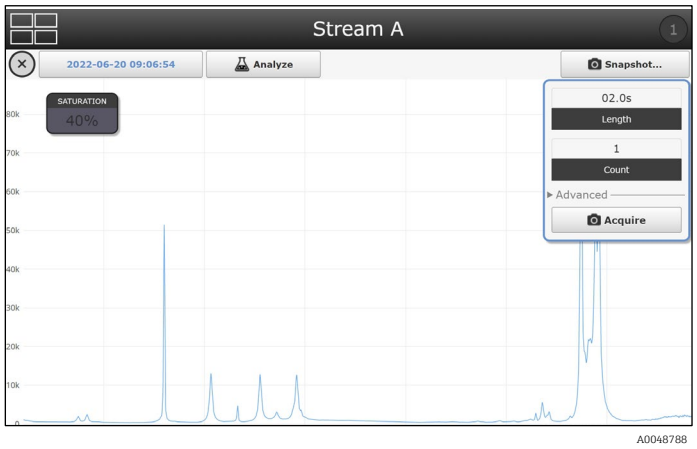


Figure 26. Analyze function in snapshot mode

It is recommended to use Snapshot mode for in situ verification of starting materials, especially for long experiments like bioprocesses. Using this method, verification spectra can be collected quickly without needing to adjust batch exposure settings. To exit the spectra overlay view, click anywhere on the quadrant name or the click **Exit** located in the upper left of the display window.

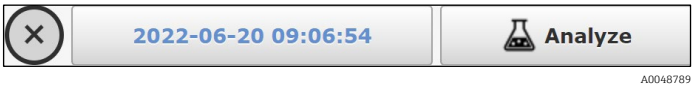


Figure 27. Exit button to exit the spectra overlay

5.5 Manual mode

Use the Manual collection mode to acquire spectra that are triggered manually by the **Acquire** button. A batch/experiment name can be specified to group manual samples together for spectra storage and sample names can be specified for each spectrum.

1. First create a new name by clicking **Edit > New** from the Probe Detail view – the example screen shown below shows the manual batch name as “Off-line Samples.”

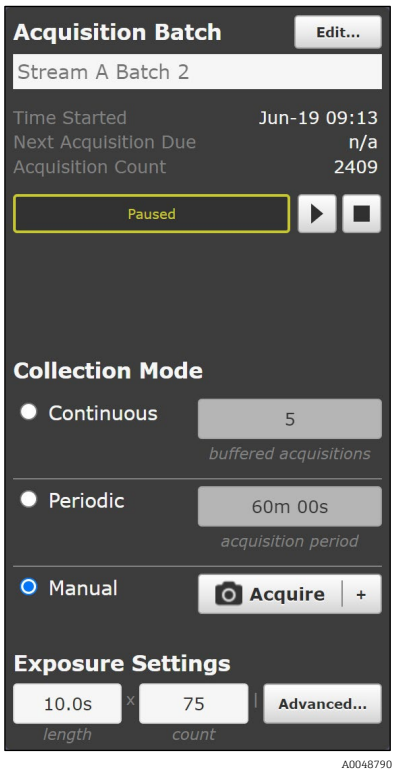


Figure 28. Manual collect mode options

2. Set the Collection mode to **Manual**.
3. Click **Play**. The Acquisition Batch will show “In Progress” but no spectra will be collected yet until triggered (by clicking **Acquire** in a later step below).
4. Use the **Up** or **Down** arrows to adjust Exposure Settings set the Exposure Settings, both length and manual collect mode options count.

Figure 29. Exposure settings as described with length and count boxes

5. If a custom sample name is desired, click the **+** option next to **Acquire** to enter a sample name, such as the Sample 1 example shown here:

Figure 30. Keyboard that pops up to rename the sample

6. Click **Acquire** to collect a spectrum.
   - To collect another spectrum, specify a new sample name (if desired), change Exposure Settings as needed, then click **Acquire** again.
   - Or click the **Stop** symbol to end the sequence of manual samples stored together.

5.6 Continuous mode

1. To set up a continuous batch, first create a batch under **Edit > New** and specify a new batch name.
2. Set the collection mode to **Continuous**.
3. Set the exposure and buffer settings desired.

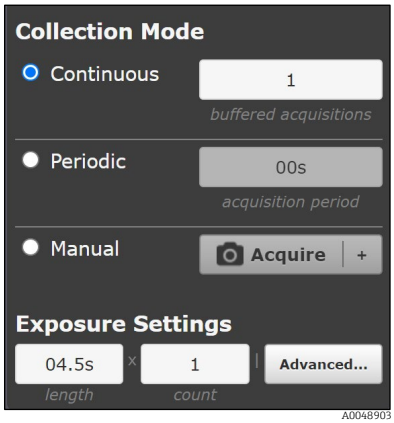


Figure 31. Collection mode details for continuous mode

4. Repeat for all active probes and click **Play** in the desired probe sequence.

Pausing, stopping, adding new batches, rebooting, etc. could affect the probe sampling sequence in continuous mode. If cycle order matters, periodic mode is recommended.

- Continuous collection mode cycles through each active probe as quickly as possible. It is recommended for method development when collecting frequent reference samples, and for monitoring and control when models are active.
- Continuous mode includes a buffered acquisition option.
- Buffered acquisition provides a way to receive updated spectra and model values more frequently, without sacrificing accuracy or repeatability.
- The buffered acquisitions setting specifies the number of consecutive acquisition cycles to combine in each reported spectrum by adding together the individual acquisition spectra.
- The spectrum and model values are updated at the end of each acquisition cycle.
- Only the combined spectrum is reported, the individual acquisition spectra are not.
- Active models operate on the combined spectrum, not on the individual acquisitions.
- Setting buffered acquisitions to a value of 1 (the default) effectively disables the feature, resulting in conventional acquisition in which each spectrum is independent of previous spectra.
- To configure buffered acquisition that achieves the same total target collection time as non-buffered acquisition, reduce the count setting and increase the buffered acquisitions setting, keeping their product the same. For example:
  - If exposure settings of 10s x 60 with 1 buffered acquisition are used, spectra and process values will update only at the end of the full spectrum collection cycle, approximately every 10 minutes.
  - But if settings of 10s x 6 with 10 buffered acquisitions are used, then spectra and process values will update approximately every 1 minute.
  - Each reported spectrum will still include 10 minutes of total acquisition time, because each update adds together the ten most recent acquisitions of 10s x 6.

NOTICE

- For applications requiring long collection intervals, buffered acquisition is not recommended when more than one probe is active.
- As collection alternates among multiple probes, combining consecutive acquisitions on a given probe runs the risk of including outdated process spectra if other active probes have long intervals.

5.7 Periodic mode

Periodic collection mode acquires spectra at specified intervals and is typically used during method development to allow spectra to sync with samples being drawn from reactors or other timed process events. Buffered acquisitions are not an option in periodic mode.

- In the example shown here, periodic acquisition is scheduled for 60 min.
- The batch details show when the next acquisition is due and how many counts (spectra) have been collected for the current batch.
- If spectral acquisition is active in periodic mode, the Next Acquisition Due will read “now.”

1. To set up a periodic batch, first create a batch under **Edit > New** and specify a new name.
2. Set the collection mode to **Periodic**.

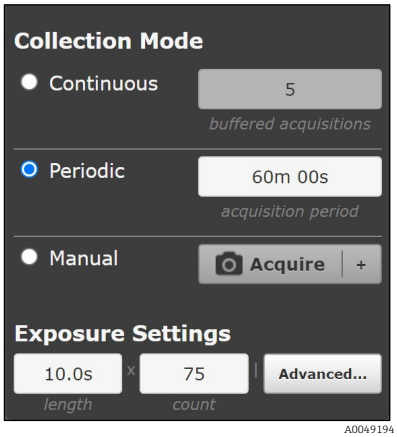


Figure 32. Periodic mode batch details

3. Set the exposure settings and acquisition period.
4. Repeat for all active probes and click **Play** in the desired probe cycle order (1, 2, 3, 4 or 1, 3, 2, 4, etc.).

6 Using models

Raman RunTime supports executing models generated in SIMCA® (Sartorius), GRAMS IQ™ (Thermo Fisher Scientific), PEAXACT (S-Pact), Unscrambler™ (Camo Analytics, An Aspen Technologies Company), Solo (Eigenvector), and Data Library. These multivariate models are typically based on in-line Raman spectra correlated to off-line analytical measurements and can be used to turn raw spectra into meaningful process values in real time. Model results can be viewed on-screen as well as communicated via OPC and Modbus.

Raman RunTime supports the following model file versions:

- SIMCA® version 13, 14, 15, 16, and 17
- GRAMS IQ™ versions 9.3 and previous
- PEAXACT version 4 , 5, 5.4, 5.6, and 5.7
- Unscrambler™ version 11
- Solo/PLS_Toolbox version 8.9 and 9.0

6.1 Loading models into Raman RunTime

1. Save the desired project files from the modeling package to a USB memory stick and connect it to the USB port on the front of the Raman Rxn2. Alternately, models can be loaded from a network connected folder.
2. Select **Options > System > Analysis > Add Model** and browse to the appropriate model file. Repeat for additional files.
3. The file name(s) will appear in the Analysis window. Select a file name to turn model components and properties on/off. Repeat for additional files.

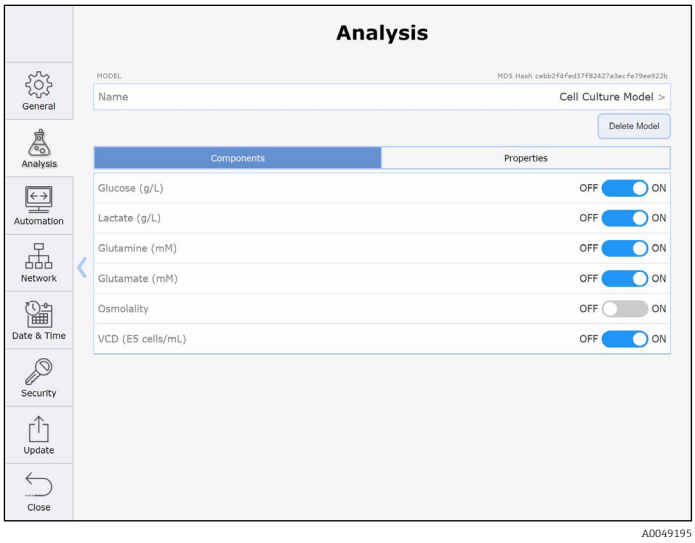


Figure 33. Analysis screen to select model(s)

4. Return to the main view and go to the Details section for one probe.
5. Press the **Analysis** tab in the lower left and enable the model file(s) on or off. Repeat for additional probes.

6.2 Viewing model results

1. From the main view during active experiments, process values will automatically be displayed instead of the current spectra.
2. To view the most recent spectrum instead of process values from the main view, click the quadrant display.

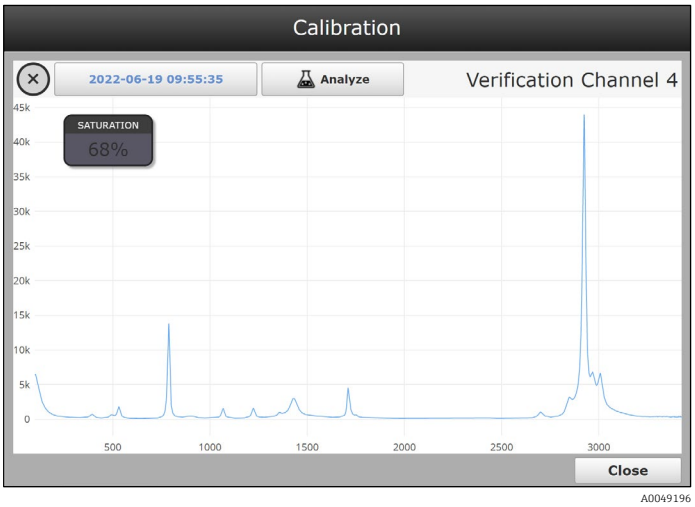


Figure 34. View of spectrum for probe 1

- For Hybrid analyzers, the current spectrum and process values are both automatically displayed, there is no need to click the window to change views.
- For single channel analyzers, there is no quadrant view. Process values will be displayed under the Analysis tab.
- Model results will update each time a new spectrum is complete, or after each buffer cycle in continuous mode.
- If models are not active for a probe/batch, then “No Analysis” will appear when the spectral plot is clicked.

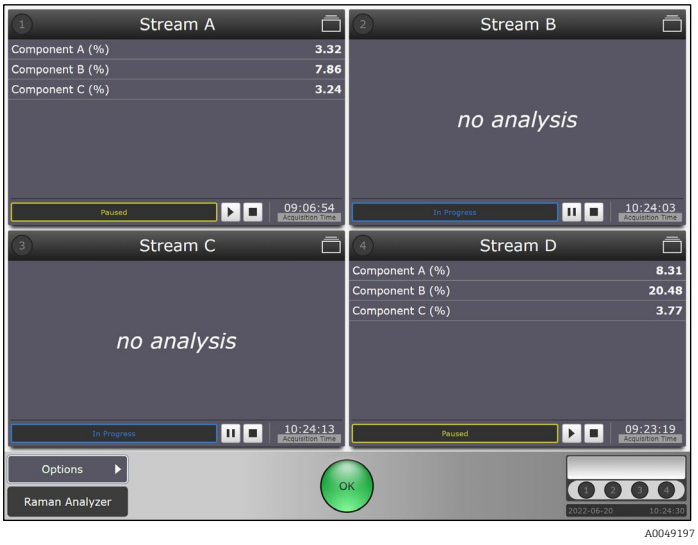


Figure 35. Results for a Rxn2 four channel analyzer with models active for probe 1 and probe 4

To access additional model result information (which is the only way to view model results for single channel analyzers):

3. From a probe details view, click the **Analysis** tab.
4. Click **Expand** and **Collapse** to show more or less model details.

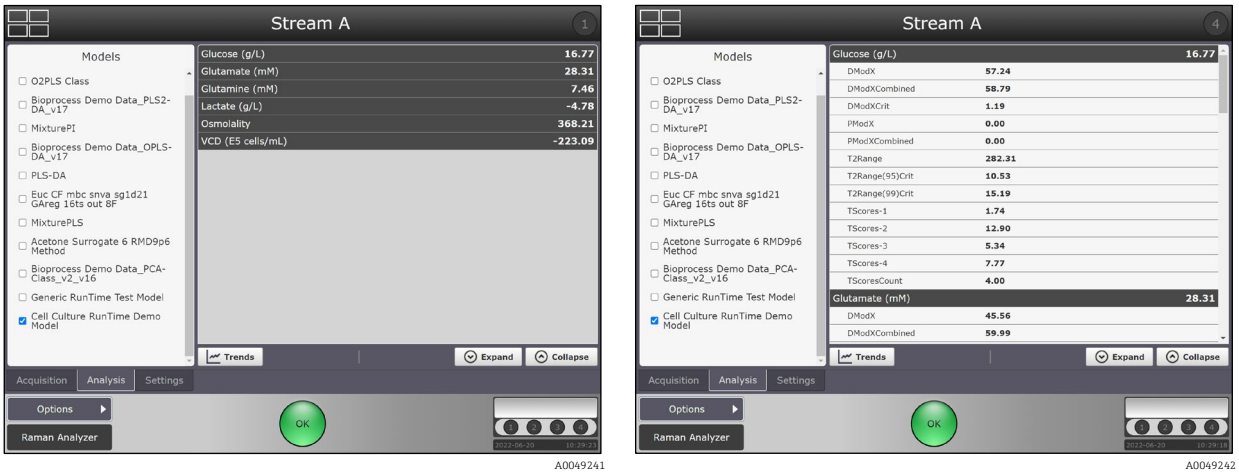


Figure 36. Probe details view of model process values and properties

5. Click **Trends** to enter the trend viewer.
6. Select a **Principal Trend** and, if desired, a **Comparison Trend**.

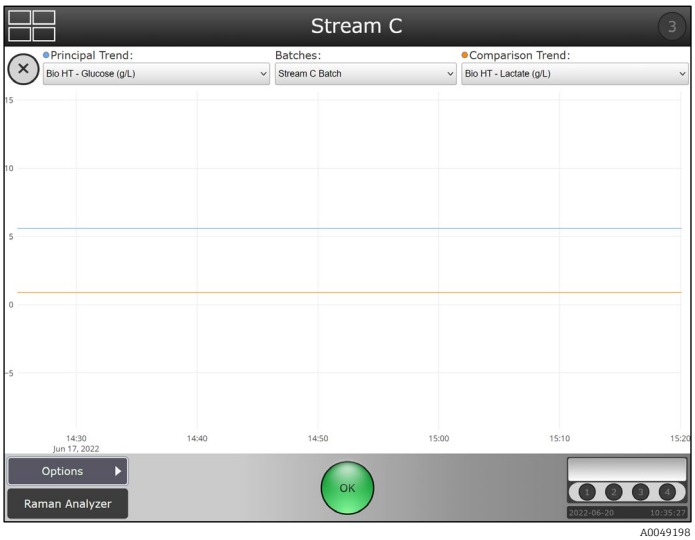


Figure 37. Model results in the trend view

6.3 Saving model results

Stored model results are included in exported data and are also available via OPC or Modbus if Client connections are established.

7 Data Transfer

Raman RunTime offers two ways to transfer or export spectral batch data in *.spc format. One method is manually and locally exporting on to a USB memory stick. The second is automatically (once configured) exporting *.spc files over the local network.

7.1 Batch data export

Spectra (*.spc format) and model results (*.csv format) for collected batches can be exported locally from the Raman Rxn2 onto a USB Memory Stick.

1. Connect a USB memory stick to the USB port on the front of the Raman Rxn2.
2. From the probe detail view, click **Edit**, check the batches to export, then click **Copy**.
3. Browse to the USB memory stick and desired folder, and click **Select Folder**.

NOTICE

- Two *.csv files (processvalues.csv and allproperties.csv) containing model results will also be included in the export, ONLY if models were active and predicting during collection.

7.2 SPC file network export

If the Raman Rxn is connected to a network, Spectrum (SPC) files are automatically published in network-accessible folders. A common file share is available on the Raman Rxn at \\<*computer-name*>*DataLibraryBatchExport*. This directory contains distinct subfolders corresponding to each acquisition batch:

1. Batch folder names are of the form *Probe* <#>_<*batch*>_<*YYYYmmdd-HHmmss*>, where <#> is the instrument collection channel, <*batch*> is a user-specified batch name, and <*YYYYmmdd-HHmmss*> encodes the date and time the batch was started.
2. Spectrum file names are of the form <*batch*>_<*YYYYmmdd-HHmmss*>, which encodes the time the individual acquisition completed.

NOTICE

- When Security in Raman RunTime is enabled, only authenticated users have access to the SPC file network export as well as Read and Delete privileges within the network folder.

8 Automation connection

Raman RunTime provides network-connected clients with analyzer data as well as analyzer control functions. OPC UA is the recommended protocol because it allows transfer of large data (full spectral data and diagnostics in this case) and is a more reliable connection than OPC Classic. However, legacy support for OPC Classic (DCOM, also called OPC DA) clients is also built-in.

NOTICE

- The Raman Rxn system must be connected to a network for OPC functionality. Network settings can be viewed and configured in **Options > System > Network**.

8.1 Basic connectivity

To access the OPC server, all clients must authenticate with the name and password of an authorized user.

- **Automation.** The built-in user with the name 'kaiser-opc' is always authorized for OPC access. The password for 'kaiser-opc' is 'opc' by default; this password can be changed under **Options > System > Automation**.
- **Security.** Additionally, the OPC server can be accessed with user credentials created and managed under **Options > System > Security**.
- **OPC UA (recommended).** OPC UA clients access the OPC server using UA's binary protocol to connect to opc.tcp://<computer-name>, providing the name and password of an authorized user. The "computer name" can be viewed or changed under **Options > System > Network**.

  The Basic128Rsa15, Basic256, and Basic256Sha256 algorithm suites are supported for signing and optionally encrypting OPC communications.
- **UA Certificates.** The first time that a given UA client connects to a Raman RunTime system, it is necessary for that client to accept or "trust" the certificate that the OPC server provides to identify itself. The mechanisms for accepting the server's certificate vary by client.

  The OPC server provides a "self-signed" certificate; accordingly, it is common for the client to display a warning that the server's identity cannot be verified. Such a warning is normal, and the server's certificate must be accepted to enable the client to connect.

  The OPC server's certificate is tied to the computer name of the Raman RunTime system. Any time the computer name is changed, a new certificate will be generated automatically, and UA clients will need to accept the new certificate before they can connect again.
- **OPC Classic (deprecated).** Full OPC functionality is available to OPC Classic clients. However, OPC Classic entails additional set-up requirements, and many opportunities exist for client-side configuration to interfere with successful communication, often in ways that are challenging to diagnose. Also, the underlying technology of OPC Classic can limit installation flexibility. For these reasons, it is recommended to use OPC UA instead of OPC Classic whenever possible.
- The OPC Classic client program must be executed using credentials that exactly match (name and password) an authorized user on the Raman RunTime system.
- This implies that a Windows user account must be created on the client workstation with a name matching that of a Raman RunTime user, and that their passwords must be kept in sync.

8.2 Asynchronous updates

In addition to responding to polling requests from clients, the OPC server is capable of providing asynchronous updates in which the server notifies clients of changes in the values of subscribed tags without the need for clients to continually poll the server.

NOTICE

- Many clients will fail to connect unless asynchronous updates are enabled.

To enable asynchronous updates, the 'kaiser-opc' user must exist on the client workstation with a password that matches the Raman RunTime system, regardless of whether the client program accesses the server using the 'kaiser-opc' user credentials.

NOTICE

- If the 'kaiser-opc' password is changed under **Options > System > Automation**, the Raman RunTime system must be restarted under **Options > System > General** for the new password to take effect.
- Client workstations must reside in the same TCP/IP subnet as the analyzer, with no intervening Network address translation (NAT).

8.3 OPC connection troubleshooting

Endress+Hauser cannot support connection to user specific OPC clients. Endress+Hauser uses a free OPC Client, UaExpert for testing server-to-client connections. An Endress+Hauser Service Engineer can provide instructions for the UaExpert Client to run Raman RunTime OPC Server tests. If problems persist, check the following items:

- Confirm whether the current version of Raman RunTime is operating.
- Verify the **Status** of “Connected” under **Options > System > Network**.

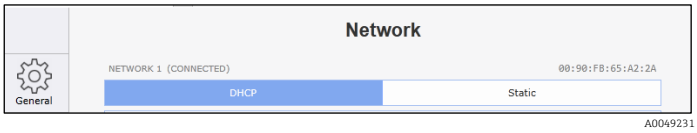


Figure 38. Network screen showing connected

- Make sure the correct Ethernet port is used.
- Check whether the Ethernet port is active with link/activity lights.
- Make sure a valid IP Address is shown.
- Test the ping from a direct connected laptop and ensure both are configured properly.
- Validate the OPC UA communication by using a test client such as UaExpert.
- Check port configuration on client.

8.4 OPC tags

NOTICE

- See *Raman RunTime Automation OPC v6.4 (p/n 4005297)* to view the current list and history of OPC Tags for Raman RunTime.

8.5 Modbus map

The Raman Rxn analyzers provides automation data via Modbus TCP (Ethernet) or Modbus RTU (RS-485 serial). If models are running on the instrument, the prediction values available over Modbus may be configured at **Options > System > Automation > Modbus**. In addition to prediction values, other instrument diagnostic values are available over Modbus.

NOTICE

- See *Raman RunTime Automation Modbus v6.4 (p/n 4005298)* to view the current Modbus Map for Raman RunTime.

8.6 HTTPS automation

NOTICE

- See *HTTPS Automation Interface v6.4 (p/n 4005306)* to view details on using HTTPS protocol to transfer supported file types to Raman RunTime.

9 Network configuration

The table below summarizes the ports relevant to specific features. Ports for OPC Classic are assigned dynamically in the indicated range; fixed-port behavior is only available for OPC UA.

It is only necessary to open firewall ports for the features intended to use. Ports in bold should be regarded as mandatory for the associated protocol; other ports are recommended for full functionality (e.g. discovery services).

Protocol	**Ports**
OPC UA	TCP 4840, 4843, 52601, and **62886**
OPC Classic	TCP **135** and **49152-65535**
Modbus	TCP **502**
File Sharing	TCP **139** and **445**
Remote Access	TCP **3594** and **4526** for Secure connection; TCP **3593**, **4525**, and 5674 for Standard connection; UDP 3702

Table 10. Raman RunTime network configuration

10 Security

Security can be enabled to block non-authorized users from performing Raman RunTime functions. By default, security is set to **OFF**.

1. To turn security settings on browse to **Options > System > Security**.
2. Move the Security setting to **ON** and select **OK** for the Administrator password notice.
3. Enter a password for the Administrator user and then verify the password in the second password step. Be sure to record the Administrator password. It is required to turn on/off security and create new users.

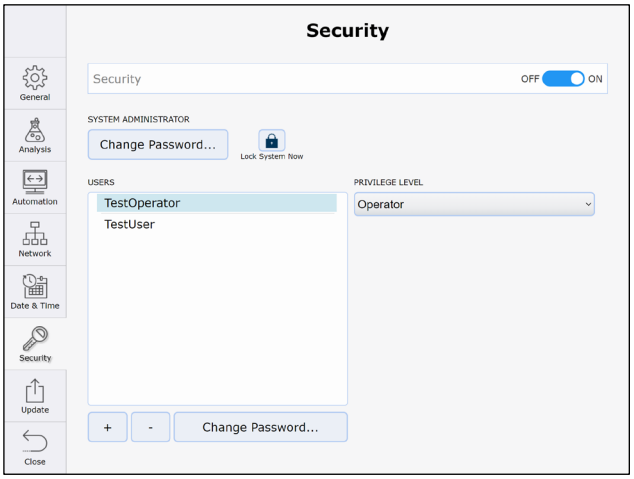


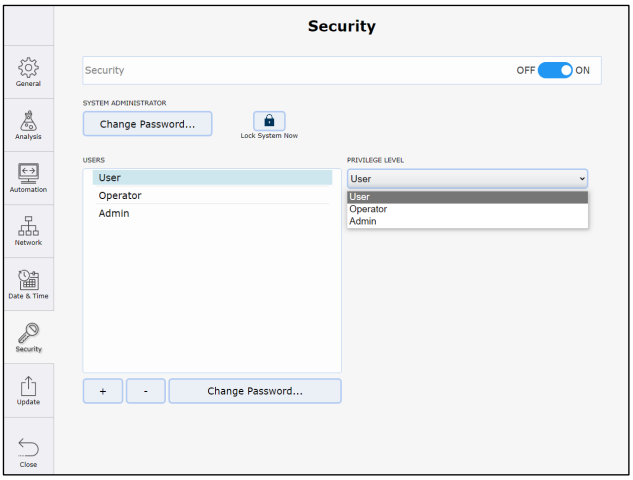
Figure 39. Setting up security

4. Once the Administrator password is verified, the system security will switch to **ON**.

   The Administrator password can be provided to all users, or multiple user accounts with different access levels can be added.
5. Click **New** to add a new user.
6. Create and verify the new user's password.
7. Specify the **Privilege Level** for the user by selecting User, Operator, or Administrator from the drop down. See below for privilege level definitions. Once security is **ON**, access to restricted functionality will require the name and password of an authorized user.
8. To lock the system immediately after enabling security, click **Lock System Now**.
9. Click **OK** when the Lock System? confirmation message appears, and then **OK** again when the System locked message appears.

Upon returning to the main Raman RunTime quadrant/probe window view, a **Blue** lock symbol will appear over restricted features.

On this main Raman RunTime view, note that the system can also be locked by clicking **Lock** in the lower left corner next to the Raman Analyzer name.



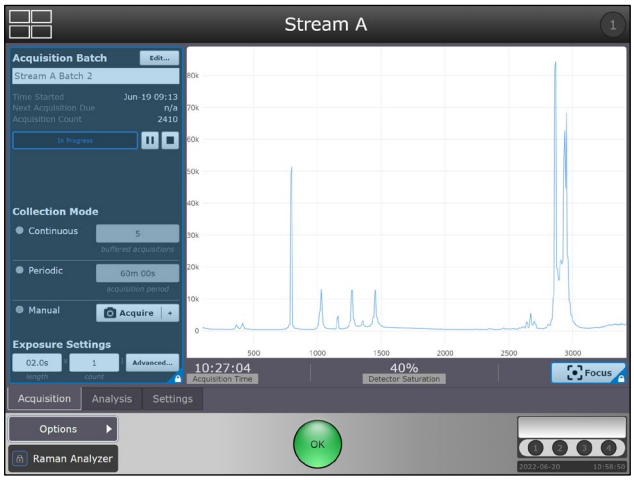


Figure 40. Security settings, adding users, and restricted access

NOTICE

- When the security feature within Raman RunTime is enabled, the system will automatically lock itself after 15 minutes of inactivity.

10.1 User privilege levels

There are three user privilege levels: User, Operator, and Admin. The User level is the most basic, followed by Operator with more privileges, and then Admin which can perform all actions. These privileges are detailed below:

User Level	Action
User	▪ Change subject (channel) display name ▪ View summary and detail of active batch acquisitions ▪ View calibration information ▪ View diagnostics ▪ Perform exports (Basic, Diagnostic, Full)
Operator	User level actions plus: ▪ View active batch acquisitions ▪ Perform calibration and view calibration information ▪ Perform verification and view verification results ▪ Start/stop batch acquisitions ▪ Focus ▪ Snapshot ▪ Ad hoc analysis ▪ Change system display name ▪ Configure date and time ▪ Select from pre-loaded models and enable/disable prediction on specific channels ▪ Restart
Admin	No Restrictions Operator level restrictions plus: ▪ Add/remove models ▪ Configure models (display name, enable/disable components and properties) ▪ Configure network ▪ Configure Open platform communications (OPC) ▪ Change security settings and manage users ▪ Apply embedded software updates

Table 11. User privileges

10.2 Password management and issues

It is a common best practice to routinely change user passwords. In order to do so, an assigned user with varying privilege levels can click **Change Password** in the bottom left corner of the login keyboard screen. Raman RunTime system administrators can also change their passwords in the same way.

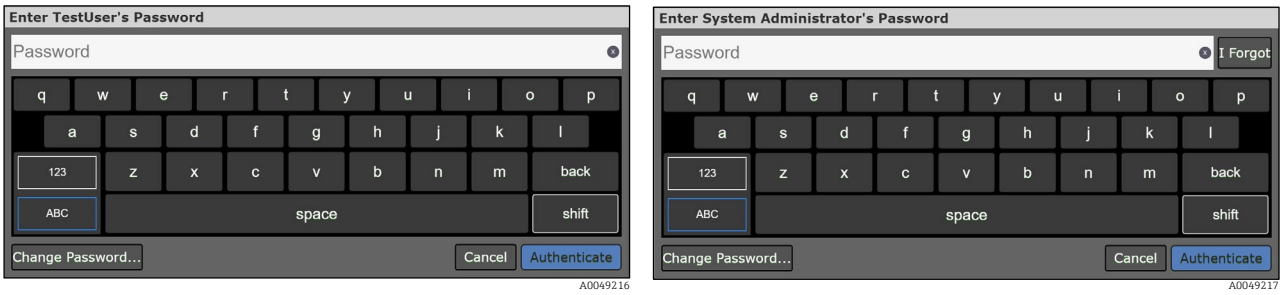


Figure 41. Enter user password screen and enter system administrator password screen

To recover a lost or forgotten password for an assigned user, a user will have to contact their Raman RunTime system administrator to help reset their password. The system administrator will be able to do so by navigating to **Options > System > Security**, then by logging into their system administrator account on this screen. From here, they can select one of the individual assigned users and select **Change Password** at the bottom of the screen.

Furthermore, if the Raman RunTime system administrator forgets their own password, they can select the **I Forgot** icon in the top right corner of their system administrator password entry screen.

After doing so, they will be provided with a code and will be instructed to contact Endress+Hauser Support and share this code. In response, they will receive a reset code to enter at their prompted screen. They can then select **Authenticate** and proceed to set their new password on the screen that follows:

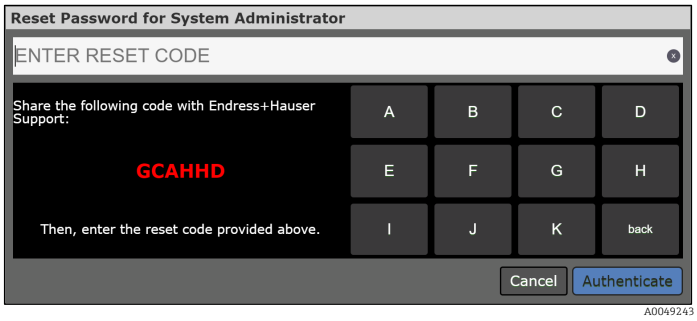


Figure 42. Password recovery screen for a Raman RunTime system administrator

10.3 Additional security features

In addition to creating users for password protection of system functionality, the Raman RunTime system has additional security features to protect against unauthorized usage, such as:

- Customized embedded system presents non-standard attack surface.
- For-purpose operational profile eliminates risky user behaviors.
- Network accessibility limited to analyzer core services.
- Only authenticated updates digitally signed by Endress+Hauser can be applied.
- No facility for running non-Endress+Hauser software.

Unauthorized system modifications are automatically purged upon reboot.

11 Troubleshooting and maintenance

11.1 System warnings and errors

When the system is fully calibrated and operating as expected, the **Status** button in the middle of the main view **Status** bar will read **OK** and appear **Green**.

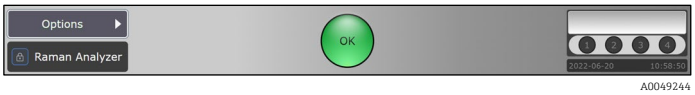


Figure 43. Status bar

Symbol	Description
 A0049200	If a system warning is encountered, the display will change to **Yellow**. Warnings should be acknowledged but immediate action may not be necessary. Click **Status** to view details of the warning. The button will pulse incessantly until the problem is resolved. Click **Status** to view details about the warning.
 A0049202	If a system error is encountered, the display will change to **Red**. An error requires immediate action to restore system performance. Click **Status** to view details about the error.

Table 12. Warning and errors

In some cases, users may choose not to utilize all available channels on a Raman Rxn analyzer. These unused/uncalibrated channels may result in warnings generated, thereby putting the whole system in a warning state (yellow indicator). To resolve these erroneous warnings about unused channels not being calibrated, the user can individually turn off unused probes/channels in the **Options > Calibration** screen and selecting the **ON/OFF** marker beneath each probe's number as shown below.

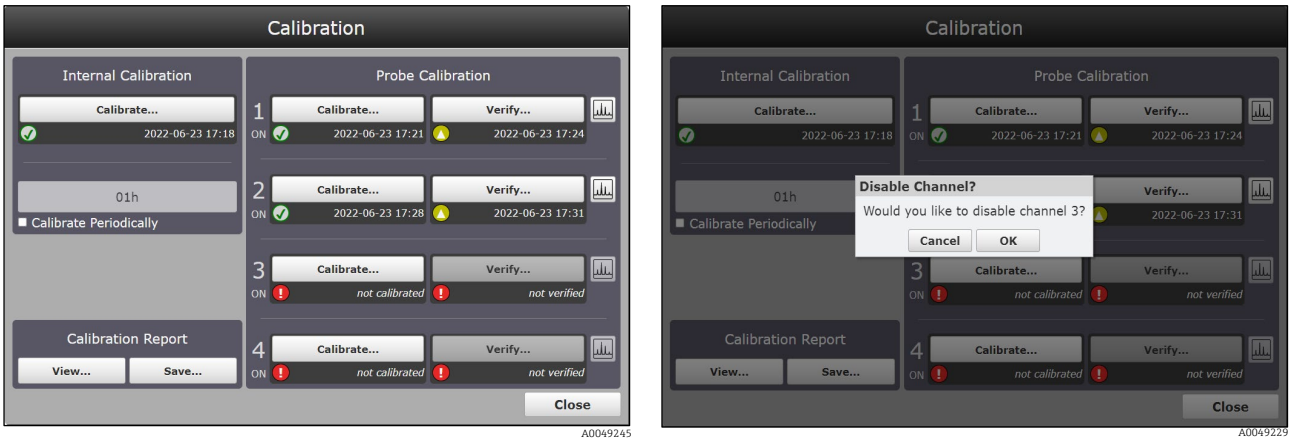


Figure 44. Channels 3 and 4 shown unused/uncalibrated and the disable channel 3 prompt

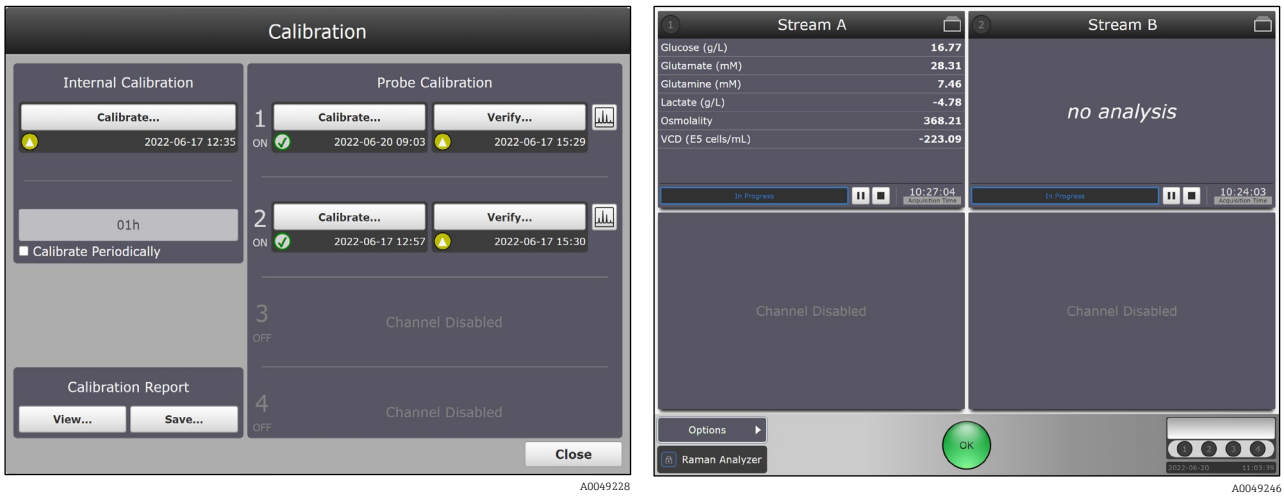


Figure 45. Channels 3 and 4 shown disabled and warning indicator resolved to green OK state

If a system error is encountered, the display will change to **Red**:

1. Click the **Red** status indicator to view details about the warning or error.

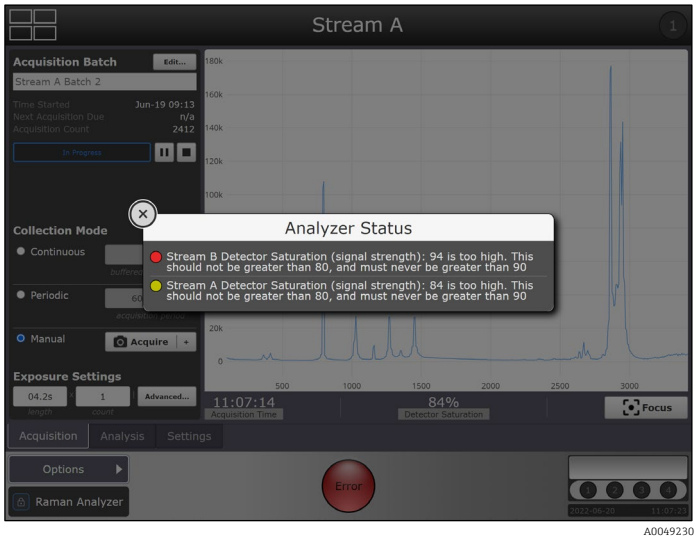


Figure 46. Analyzer status details

2. In the event the analyzer stops communication with the interface, go to **Options**, select **System**, choose **Restart** and the analyzer will reboot. This will re-establish camera/interface communication.

A full list of system warnings and errors appears in the table below:

Diagnostic Title	**Faults when...**
Internal Calibration	Internal calibration missing on multi-channel instrument.
Wavelength Calibration	Wavelength calibration missing on single-channel instrument.
Laser Calibration	Laser calibration missing on single-channel instrument.
Intensity Calibration	Intensity calibration missing on channel.
Detector Temperature	Camera temperature out of tolerance.
Detector Locked	Camera temperature not stable.
Detector Saturation	Camera saturation < 2% or > 80%.
CSM Diamond Heater Temperature	Laser calibration standard temperature out of tolerance.
CSM Laser Interlock Alarm	Laser interlock interrupted, e.g. probe cable broken or improperly connected
Laser Interlock Status	Laser disabled, e.g. due to being turned off.

Laser Diode Current	Laser diode drive current approaches maximum.
Laser Cooler Open Circuit	Error received from laser.
Laser Diode Current Error	Error received from laser.
Laser Diode Temp Error	Error received from laser.
Laser Diode Temp Startup	Error received from laser.
Laser Diode Temp Warning	Error received from laser.
Laser Power Feedback	Error received from laser.
Laser Power Feedback Error	Error received from laser.
Laser Unit Temp Error	Error received from laser.
Laser Unit Temp Startup	Error received from laser.

Table 13. System warnings and errors

11.2 Restarting the system

In Raman RunTime, navigate to **Options > System > General** and click **Restart**. Only users with administrative privileges can restart the device if security is enabled.

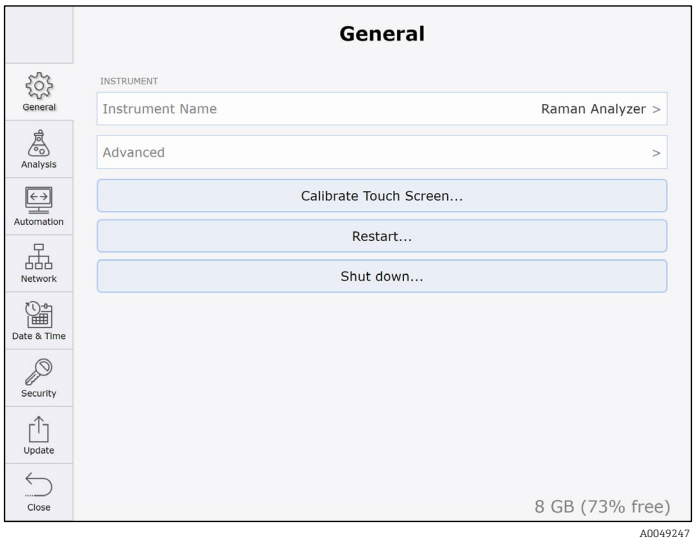


Figure 47. Restart

11.3 Power button emitting signal

The **ON/OFF** power button on the front of the analyzer emits a flashing blink code to communicate a problem when the embedded software is unavailable.

Figure 48. Power button on front of the analyzer

If the **ON/OFF** power button appears to flash in quick succession, refer to the table below:

Sign	Problem	Solution
2 - blinks in quick succession followed by a solid long pause.	Indicates a problem with the main power supply. Could indicate power has been interrupted. Flashing will cease when the reserve power is depleted, if not replenished.	Check security of power cord and its connection. If there is no facility power outage, problem could be with the power unit and a replacement is necessary. Contact Support.

6 - blinks in quick succession	The internal temperature of the analyzer is too high.	Confirm the ambient temperature around the analyzer is within the specification as outlined in the Raman Rxn Analyzer Operating Instruction and check the air filter. Contact Support.

Table 14: Codes for flashing ON/OFF button

11.4 Powering down the system

⚠ CAUTION

- The procedures described in this section do NOT apply to Raman Rxn4 analyzers with enclosures. The only supported method of powering down a Raman Rxn4 with enclosure is by using the main power switch on the right side of the enclosure.

There are two ways to properly power down a Raman Rxn analyzer. One of these two methods should always be used to power down the analyzer unless it is unresponsive.

1. In Raman RunTime, navigate to **Options > System > General** and click **Shut Down**. The analyzer will power down after about 5 seconds.

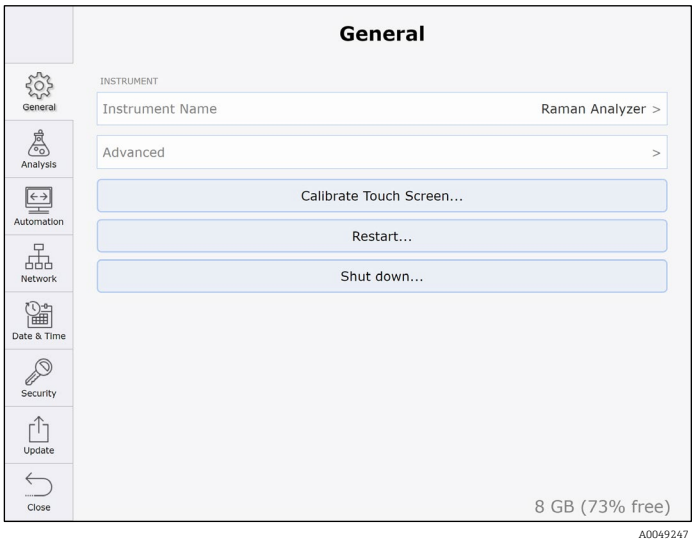


Figure 49. Shut down

Or

2. Click and hold the **Push** button power switch until it starts to blink (2 seconds). Release the **Push** button. A power down message is sent to Raman RunTime, and it will begin power down activities. The analyzer will power down after about 5 seconds.

To perform a hard shutdown, there are two methods that can be used. They should only be used if Raman RunTime is unresponsive.

1. Click and hold the **Push** button power switch for at least 12 seconds until the analyzer powers down. Then release the **Push** button.

NOTICE

- After 2 seconds, the power switch will begin to blink; ignore and continue to hold down the **Power** button until analyzer powers down. Release the button.

Or

1. Unplug the analyzer.

11.5 Recovery console

The Recovery Console appears if Raman RunTime is unable to initiate. Raman RunTime will produce a prompt to enter recovery console after trying to initiate five times. There are several options for resolving the problem.

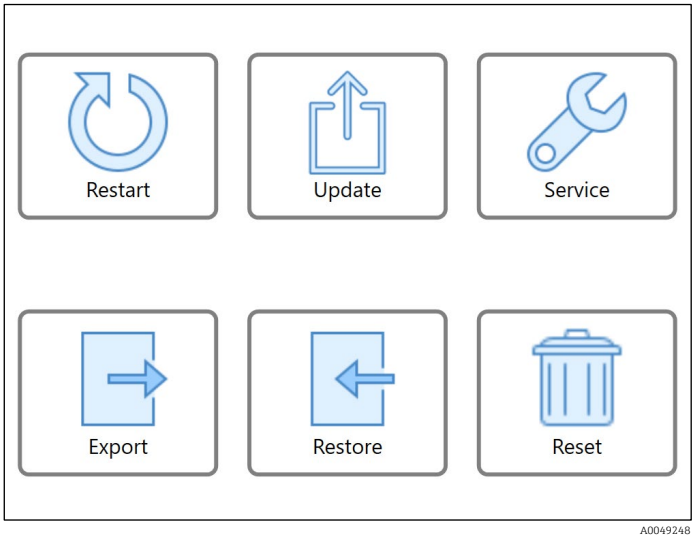


Figure 50. Recovery console menu

The Recovery Console consists of the following functions:

- **Restart.** This button will restart the system.

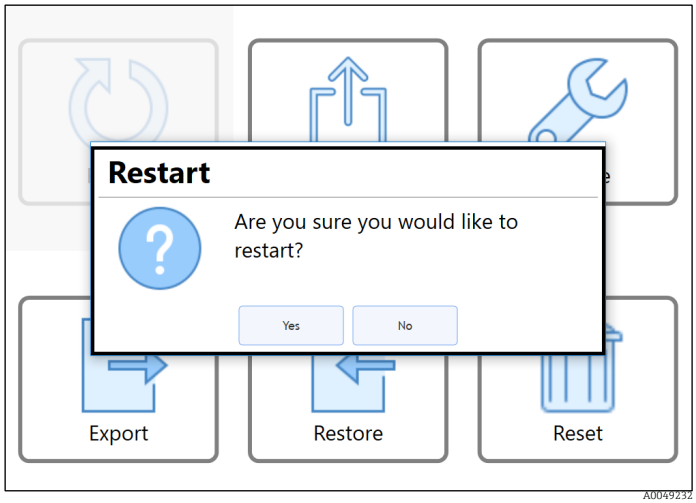


Figure 51. Restart warning

- **Update.** This button is used to update the Raman RunTime embedded software that is provided on a USB stick. Put the USB flash drive in the USB slot and follow menu prompts to find the file and initiate the update.

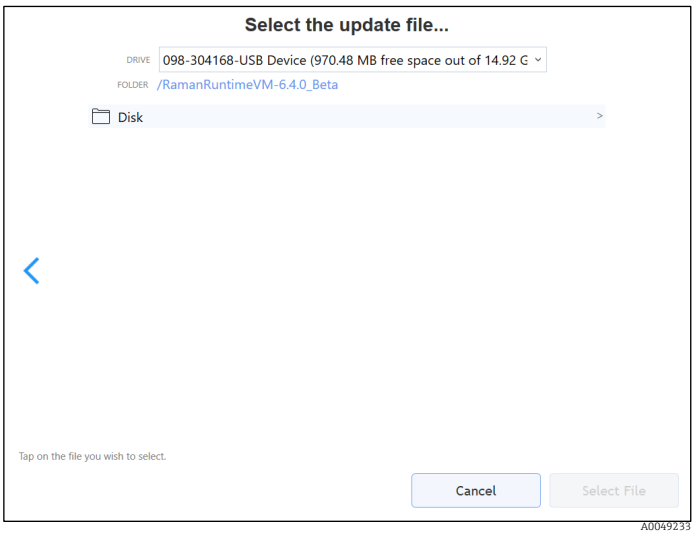


Figure 52. Update mode menu

- **Service Mode.** The Service Mode option is only available to qualified service personnel. Contact Endress+Hauser Support for more information about its use.

Figure 53. Service mode menu

- **Export.** This button is used to download data, settings, or configurations of the analyzer, and only from when it is in an error state. This export is intended for Endress+Hauser Support to investigate problems. In order to Restore the analyzer, a user can ONLY use a previously generated and saved (to a USB drive) Export file from within Raman RunTime. The last generated and saved export file will also reside on the system's onboard memory.

NOTICE

▶ The recovery console generated export is ONLY intended for Endress+Hauser Support to investigate problems. This export file CANNOT be used to restore the analyzer.

Figure 54. Exporting a file

- **Restore.** This button can restore Raman RunTime to an earlier state of the analyzer that was saved at an earlier time from within Raman RunTime, and exists on the onboard storage or on a USB drive. This is the recommended solution to restoring Raman RunTime to an operational mode.

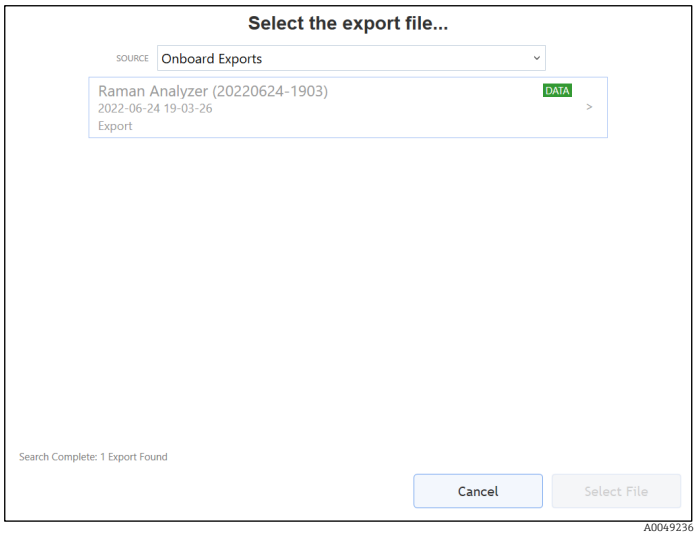


Figure 55. Restoring Raman RunTime to an earlier version using export stored on the analyzer storage

1. If the export file is on a USB drive, search through folder structure to find the needed file to restore settings and configuration. Please choose a Full level export file to restore the settings, configuration, models and data. If an export is Full level and contains the aforementioned content for a full restore, this is indicated by the **Green** DATA tag next to the export file as shown below.

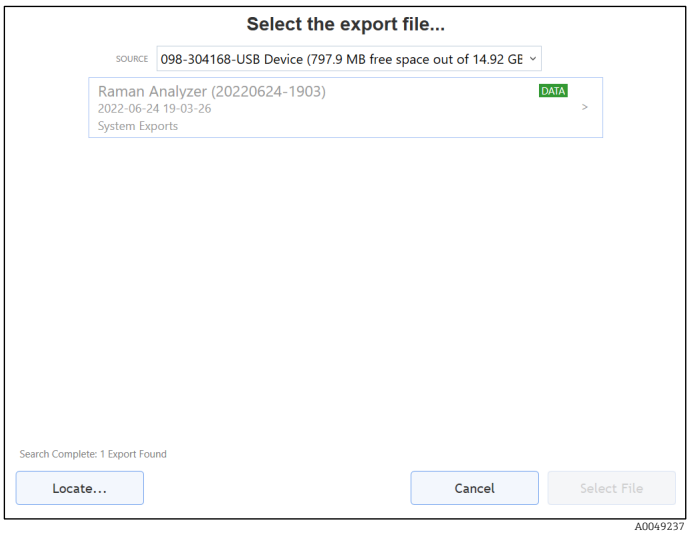


Figure 56. Restoring Raman RunTime to an earlier version using export stored on a USB drive

While the settings and configuration will always be restored, Raman RunTime will prompt and ask whether the user also wants to restore data as well if a Full export (with a **Green** DATA tag) is available and selected.

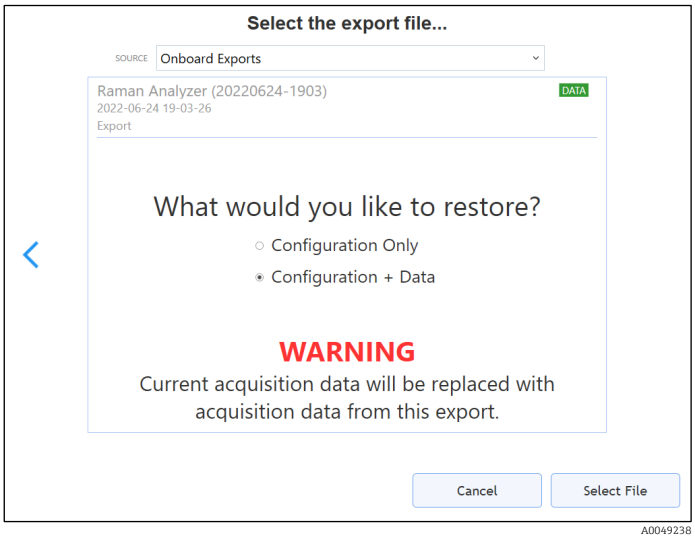


Figure 57. Warning menu to select level of restore for Raman RunTime

2. Select the file to restore the analyzer. Once the file is selected, a new menu will appear to confirm the action. Click **OK**.

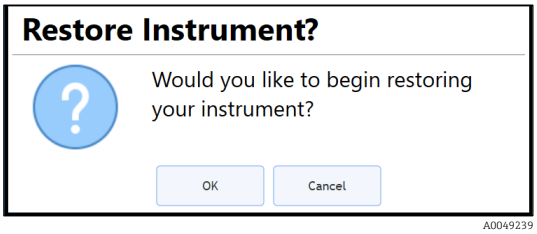


Figure 58. Menu to confirm restore

3. The system will now Restart and Restore. This can take a while, so DO NOT shut down the analyzer. Once the Restore is finished, the instrument will Restart, and Raman RunTime will Launch.

Reset. By clicking the **Reset** button, and then **Continue**, the system will reboot and delete all of the calibrations, models, acquisitions, logs, and other data.

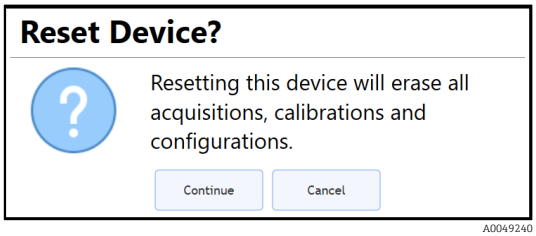


Figure 59. Menu to confirm resetting the device

12 Diagnostics

System diagnostics can be viewed from **Options > Diagnostics > Environment** tab. The purpose of the system's Diagnostics section is for the user to view system environment data, trend historical environment data, and to save an export file to perform a system restore, if necessary. Regular system exports should be done to ensure the system configurations and calibrations are backed up for future use.

NOTICE

- System exports are intended for Endress+Hauser Support to investigate problems or restore analyzers. The contents are subject to change with new RunTime versions and should not be treated as user accessible files. Full exports can be very large. A Full export is recommended for regular archival of system info and logs and is required for a system restore.

12.1 Trends

1. To view system diagnostics, go to **Options > Diagnostics** from the main Raman RunTime menu. This will bring you to the Environment tab within the Systems Diagnostics dialog box where you can see system data.

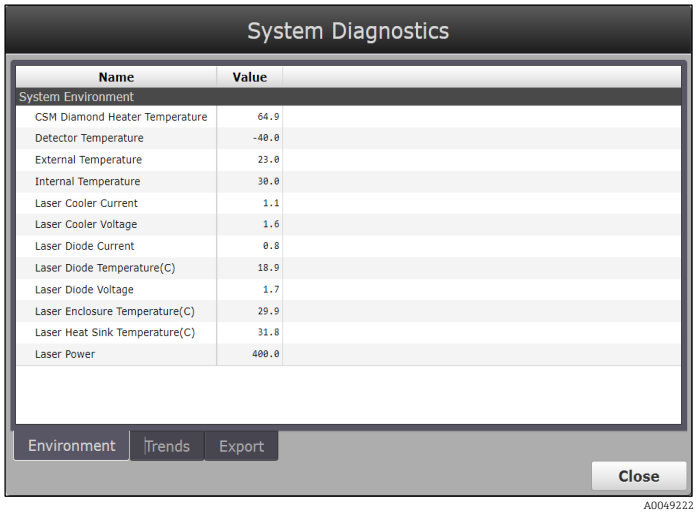


Figure 60. Environment tab to view system data

2. To display Trends of diagnostic values, click the **Trends** tab. Within the Trends tab, users can access the Principal Trend, History, or Comparison Trend as shown below.

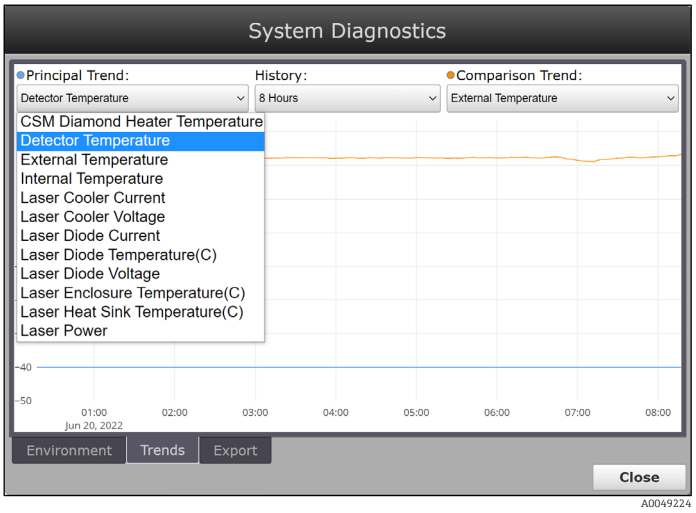


Figure 61. Choices with the trends tab

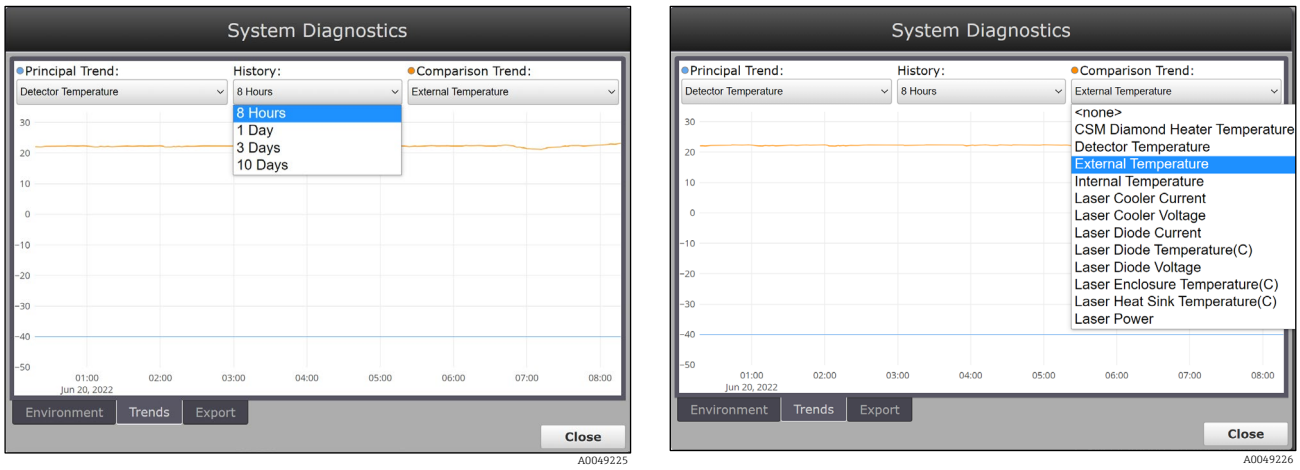


Figure 62. More choices with the trends tab

12.2 Diagnostic exports

It is an Endress+Hauser advised best practice to export user/spectral data, custom settings and configurations frequently. A full system Export is also recommended to be generated and saved onto external media periodically. This should be considered for inclusion in the local site Standard operating procedure (SOP).

NOTICE

- A Full level Export file is required to fully restore the system (including settings, configuration, models and data) to an earlier state, if necessary.

On the system interface, go to **Options > Diagnostics > Export** tab. To create a new export file, click **New**. The user can opt between Basic, Diagnostic, and Full exports. Click **Export** to create the file.

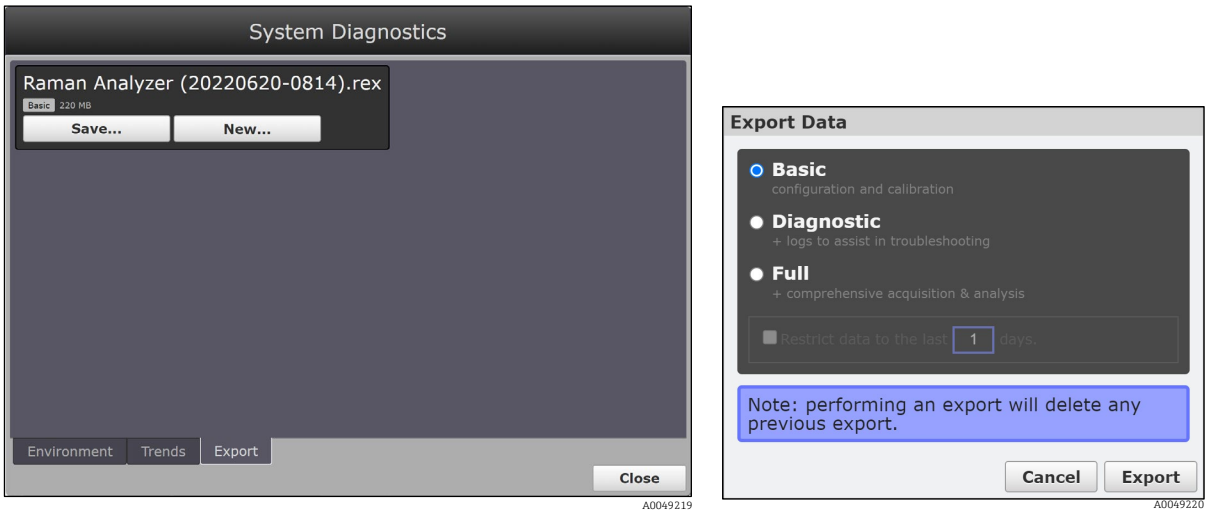


Figure 63. Steps to create a new export file

NOTICE

- While the last generated export file is saved onto the onboard analyzer storage, it is only saved there until a newer export file is generated which overwrites the old one. As such, the generated export files should be periodically backed up onto a USB drive for backup and restore purposes.

The Basic option contains the configuration and calibration information, while the Diagnostic option provides logs to assist in troubleshooting with Endress+Hauser. The Full option contains all comprehensive acquisition and analysis information in addition to information available in the Basic and Diagnostic options.

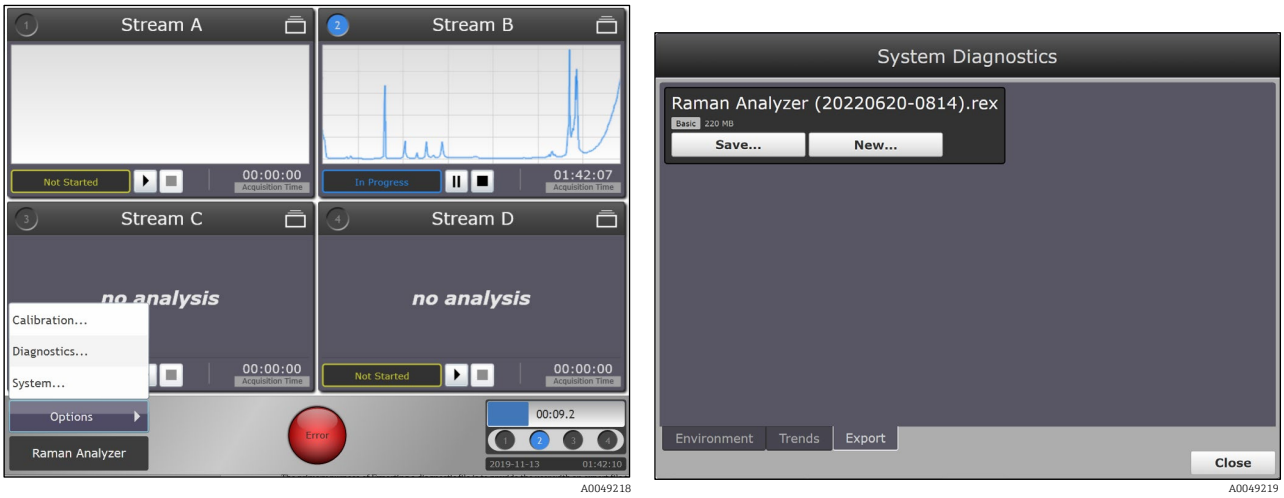


Figure 64. Steps to save an export file

After creating a new export, it will be saved and held on the onboard analyzer storage until overwritten by a newly created one. The Save option on the same screen allows you to either save the created export file to a USB drive or download it to the network computer accessing the remote interface of the Raman RunTime software.

To perform a diagnostic export:

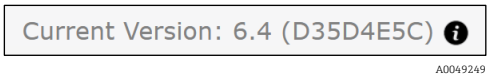
1. Navigate to the **Options > Diagnostics > Export** tab. Click **New**.
2. Insert a USB flash drive into the USB port on the front of the Raman Rxn2 analyzer.
3. Select **Basic**, **Diagnostic**, or **Full** (descriptions are shown on screen).

   Full exports are usually very large in file size. A Full export is recommended for regular archival of system information and logs. A Full export may be requested when working with Endress+Hauser Support.
4. Once the export archive has been generated, click **Save** to save the created export file to a USB drive or download it to the network computer accessing the remote interface of the Raman RunTime software.

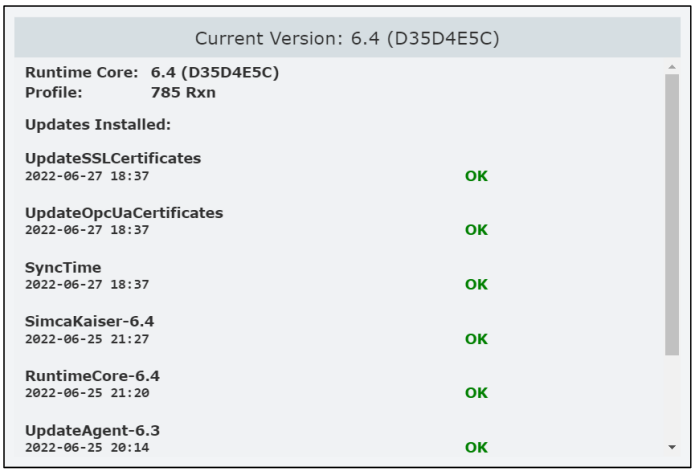
13 Support

Diagnostic exports and the current Raman RunTime version number will be needed for Endress+Hauser Support. The version can be viewed from **Options > System > Update**.

Click **Information** to display additional details about the versions and updates applied.



A0049249



A0049250

Figure 65. Current version

13.1 Contact information

For Technical Service, refer to our website (https://endress.com/contact) for the list of local sales channels in your area.

14 Copyright information

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