Ideal Vacuum



OUR PRODUCTS DEVELOP TOMORROW'S TECHNOLOGIES™

AUTOZ+™

Residual Gas Analyzer Software

USER MANUAL



For All

AnalyzaVAC™ Residual Gas Analyzer

Systems

AZP-08282025 - V 1.2.1.2

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1. OVERVIEW



Read the AnalyzaVac RGA and this AutoZ⁺ manual to completely familiarize yourself with the capabilities and operation of the instrument and software. Follow all safety instructions and warnings.

AutoZ⁺™ software by Ideal Vacuum (IVP) is a Windows® 10 and 11, touch screen enabled application and is delivered on a USB drive with all AnalyzaVac™ compact quadrupole residual gas analyzer instruments (RGAs). It allows any AnalyzaVac RGA to be controlled by a computer or laptop.

AutoZ⁺ gathers data generated by the AnalyzaVac RGA and produces real-time streaming mass spectra graphs based on ionic mass-to-charge ratio distribution.

When properly configured, AutoZ⁺ can provide both quantitative and qualitative information about the remaining gases. The software calculates the partial pressures of gases that it can definitively identify, and can discern the relative abundance of substances that have similar masses by each substance's unique fragmentation pattern (substance fitting).

AutoZ⁺ controls all AnalyzaVac RGA functions and allows the user to customize the information displayed and vary all settings to make it most useful for unique experiments and processes. It shows two graph types simultaneously and allows independent zooming so the user can better examine particular areas of interest.

The basic version of AutoZ⁺ (with lifetime software license) is included with every AnalyzaVac RGA. It includes a 90 day trial with premium features. After 90 days it reverts to the basic software. Basic AutoZ⁺ can be upgraded to the premium version at any time.

The basic version has dual graph capability, control settings for calibration and other RGA functions, the ability to export graphs, and includes the IVP basic substance library of 12 of the most common vacuum gases.

The premium version of AutoZ⁺ software is available on a yearly paid subscription basis and must be renewed annually or it will revert to the basic version. When purchased with the RGA, the software is preconfigured with a unique software license "key" which automatically installs with the software. If a premium upgrade is purchased separately, the software and license key is delivered as a download from idealvac.com. Your Ideal Vacuum sales representative is able to provide upgrade assistance.

The premium version adds the ability to baseline and overlay scans, data logging, and an expanded substance library of more than 80 additional chemicals with a substance editor for adding user specific chemicals.

Minor AutoZ⁺ software updates are available for download from idealvac.com when available.

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2. SOFTWARE INSTALLATION AND STARTUP

To install the software, insert the USB drive into the computer.

1. Find and double-click the AutoZ+ Setup.exe file.

2 Follow the on screen prompts.

3. An AutoZ+ shortcut is placed on the desktop.



4. Double-click the AutoZ+ shortcut to start the program.

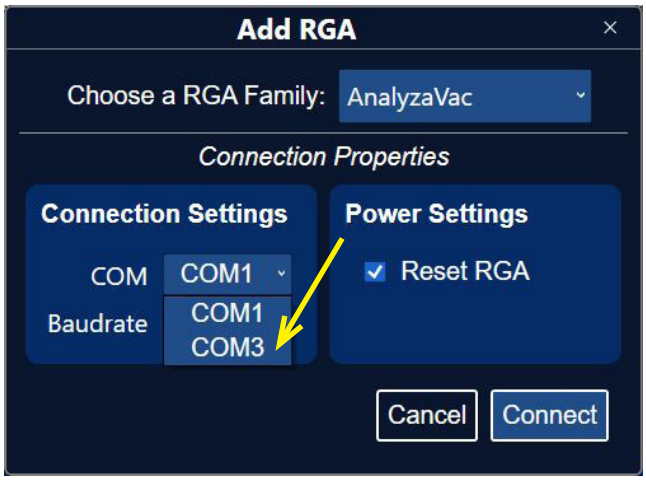
5. The AutoZ+ splash screen appears. Click Add RGA....

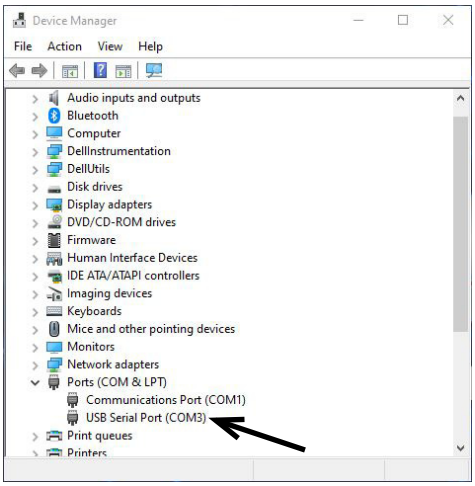


6. At the Add RGA popup, click the COM box.

7. Select the COM port for the RGA in the drop down. Here it is COM3.

   If you do not know the COM port, go to the Start Menu, select Device Manager and under Ports find the USB Serial Port.

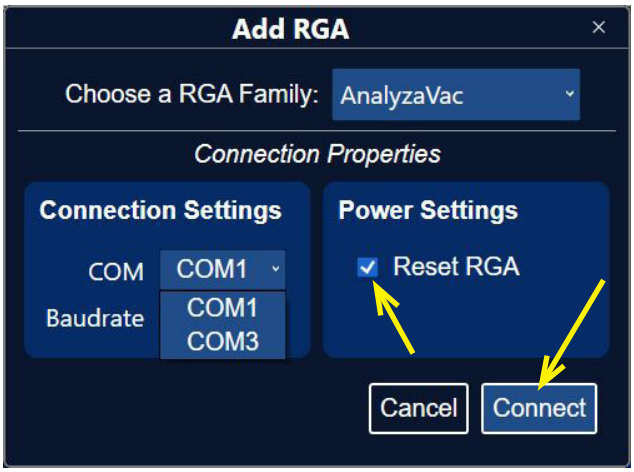




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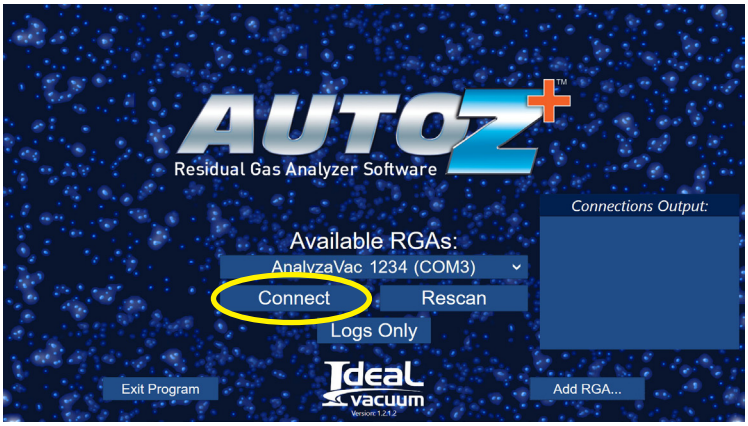
8. Make sure Reset RGA is checked. Set the baudrate to 115200.

   Click Connect.



9. The AnalyzaVac RGA appears under available RGAs.

   Press Connect.



10. After a few seconds the AutoZ⁺ home page appears.



NOTE **This startup procedure must be performed each time the RGA is power cycled (turned off and on).**

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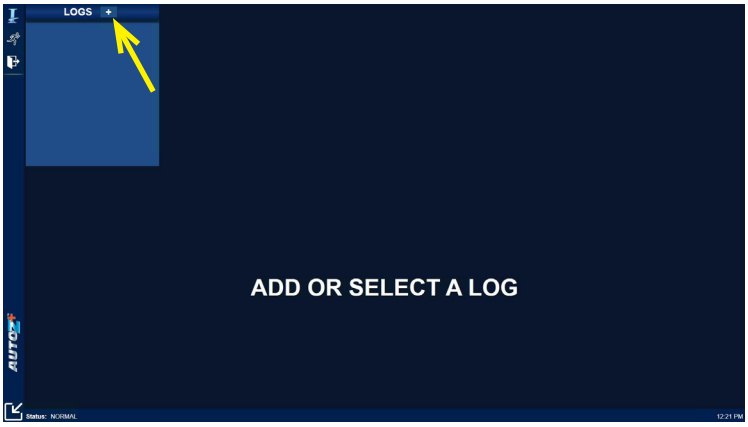
2.1 LOGS ONLY STARTUP (PREMIUM VERSIONS ONLY)

The Premium version of AutoZ+ includes a Logs Only button on the startup splash screen. When this button is selected, the user may open previously saved LOGS without starting the RGA, or even when no RGA is attached.



When the LOGS ONLY button is selected, the blank Logs section of the Logs page opens.

Click the (+) sign to view the list of files available.



For additional information about logs, see Chap.5.1, p. 42.

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3. HOME PAGE



When AutoExplor starts, the Home page is presented. This page has nine sections: (1) menus and audible annunciator, (2) controls, pressures, and basic scan settings (3) mass spectrum graphs, (4) graph functions, (5) substances, (6) masses, (7) baseline functions, (8) devices, and (9) status bar. The user can control the most common RGA functions from the Home page, including graph type selection, the substances that are displayed, and monitoring the RGAs working condition and system notifications.



3.1 MENUS

① The menus section, available on all AutoZ⁺ pages, allows the user to navigate from one screen to another. The speaker icon turns the audible alarm on and off.



- About AutoZ⁺

- Home Page

- Log Page (available on premium versions)

- Settings Page

- Exit program

- Audible annunciator on/off (Sec 3.5.5, p. 19)

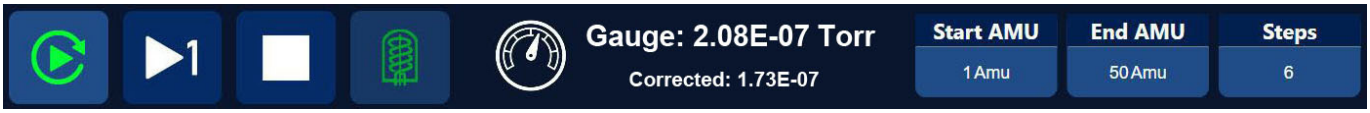


- Minimize program (bottom left of all pages)

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3.2 CONTROLS, PRESSURES, AND BASIC SCAN SETTINGS

② The controls, pressures, and basic scan settings section at the top of the screen allows you to turn RGA scanning on and off, shows gauge and corrected pressures of the system, and allows the user to select the scanning range and the number of scans per AMU.



3.2.1 CONTROL BUTTONS

The RGA is energized and on standby when the ECU is plugged in and the power supply has power. The RGA does not have a power button.

Control Buttons:

 - Continuous scan button (green when on, white when off)

 - Single scan button (green when on, white when off)

 - Stop scan button (white when scanning, red when scanning is off)

 - Filament button (green when on, white when off)

Scanning starts when either the continuous or single scan button is pressed and the pressure is below the upper failsafe range (Sec. 4.6.3, p. 38). The factory default is 1 x 10^{-6} Torr. If the continupous or single scan button is pressed when the pressure is above the failsafe, that button blinks green/white. Once the pressure threshold is met, scanning begins and the button turns green.

The stop button is white when scanning and red when continuous scanning is off or once a single scan is completed. Pressing the stop button while scanning immediately aborts the scan and the button turns red.

The filament button turns the filament on and off. It is green when on and white when off. The filament is turned on automatically when the continuous or single scan button is pressed and the pressure is at or below the upper pressure threshold. It blinks green/white if the pressure is above the failsafe and either of the scan buttons is pressed indicating it is waiting to turn on. It also blinks green/white if it is damaged. If the filament button is blinking, the status bar at the bottom of the screen informs the user of the reason. (Sec. 4.4, p. 24). If the filament is turned off while the system pressure is in high vacuum, it will turn orange to indicate it is turning off.

The filament should be on for about 30 minutes before scanning for the most accurate results. The filament does not turn off automatically, except when the pressure is too high or the program is exited. It must be turned off manually with the filament button. This allows the user to keep the filament on between runs. This extends its useful life by reducing the number of thermal cycles it undergoes.

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3.2.2 GAUGE AND CORRECTED PRESSURES



The gauge pressure in the top middle of the screen is the total chamber pressure (or the manifold pressure of the manual high pressure kit) measured by the RGAs built-in enhanced Pirani or Bayard-Alpert hot ion gauge. The Pirani gauge measures from atmosphere to 1 x 10^{-4} Torr. The hot ion gauge measures below that.

Both of these pressure gauges are factory calibrated for pure nitrogen gas, which is within 5% the same as air. Other gases, such as pure argon, behave differently than nitrogen and cause the total (gauge) pressure to be somewhat inaccurate. AutoZ^{+} automatically applies gas correction factors for the other gases (that it can identify) to produce more accurate pressure measurements. This is the “corrected” pressure measurement displayed under the gauge pressure.

If the chamber is under high vacuum and the filament is off, the pressure will read 1.00e-04 Torr. This is because the Pirani gauge is always on when the RGA is energized (plugged in) and will display its lowest pressure (1.00e-04 Torr). The Bayard-Alpert high vacuum gauge requires the filament to be on to provide readings.

3.2.3 BASIC SCAN SETTINGS



To the right of the pressures are the basic RGA scan settings. These include Start and End AMU and Steps per AMU.

Both the Start and End AMU settings are entered as positive integers beginning with one, and ending with 10 more than the model number of the RGA. For an AnalyzaVac model 100 RGA, the maximum End AMU is 110, and so on.

Scans start 0.5 AMU below the integer AMU, and end 0.5 AMU above the integer AMU. For example, if Start AMU is 1, scanning begins at 0.5 AMU. If the End AMU is set to 50, scanning completes at 50.5 AMU. The maximum AMU that can be scanned then is actually 10 + 0.5 AMU more than the model number. So, a 100 AMU model AnalyzaVac can scan up to 110.5 AMU.

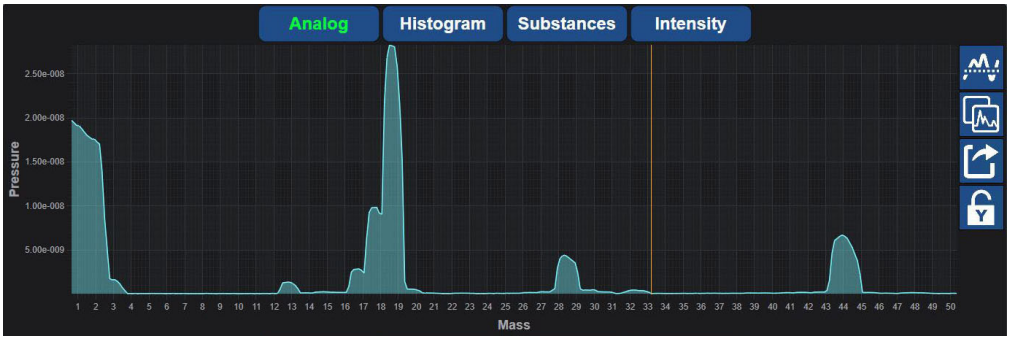
Steps is the number of divisions between each AMU that are scanned. The smaller the number of steps, the faster the scan. A larger number of steps improves resolution and increases the amount of data collected, but scans are slower.

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3.3 MASS SPECTRUM GRAPHS

③ AutoZ+ has four graph types, two of which can be displayed simultaneously. The graph type is selected by the four buttons above the graph. They are: Analog, Histogram, Substances, and Intensity. Use the mouse's scroll wheel to zoom. Left click and drag to move laterally. Click and drag the graph separator line between the graphs to vary the graph height.

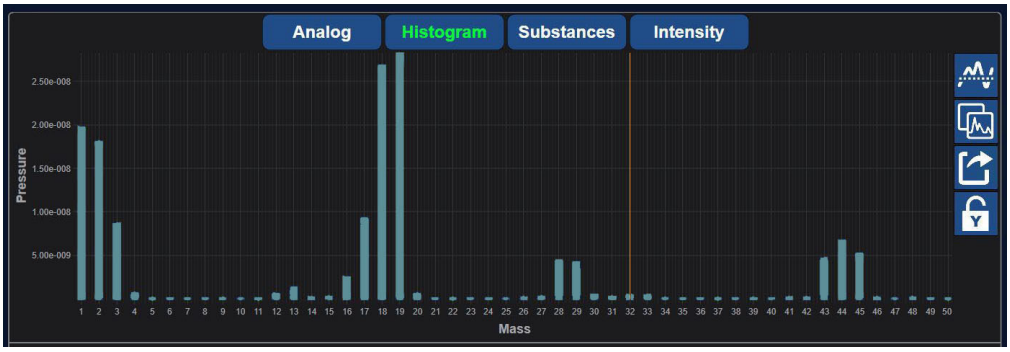
3.3.1 ANALOG GRAPH



The analog graph is a mass spectrum of ionic mass raw data versus pressure and shows the relative abundance of the different ions within the scanning range. The spectrum above is of air and significant peaks at 2, 12, 14, 16, 17, 18, 28, 40, and 44 AMU are expected. Because the ingredients of normal air are well known, it is safe to say that the peaks seen above correspond mainly to parent and fragment ions of nitrogen, oxygen, carbon dioxide, and water, air's four most abundant ingredients.

Notice that nearly all the peaks are skewed to the right of their expected AMUs and are overly wide. For example, there is a large peak at 19 AMU which should be at 18 AMU, and the large peak at 1 AMU is curious. This scan was made using a poorly calibrated RGA. Factory calibration is better and may be acceptable for general qualitiative analysis, but is not optimal for most studies. Peak heights, widths and alignments are all corrected by calibrating the RGA (Sec. 4.5, p. 28). The more that is known about the chemistry of the substances in the system and the better calibrated the RGA, the more useful the scans.

3.3.2 HISTOGRAM GRAPH



The histogram is simply a bar graph made from the analog graph data. Each bar is centered on an integer AMU. The bar's magnitude is determined by the maximum peak between -0.4 AMU and +0.4 AMU from the target AMU. For example, the 18 AMU bar is the value of the highest peak between 17.6 and 18.4 AMU.

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3.3.3 SUBSTANCES GRAPH

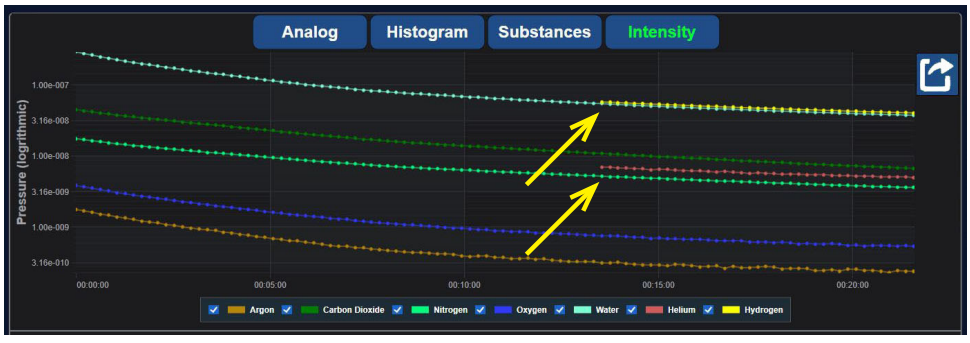


This graph is developed from the histogram graph. It is constructed by using the selected substance's ionization fragmentation ratios and the probability of the substance's to ionize (relative to nitrogen). This determines the theoretical partial pressure contribution of each ion at each AMU. AutoZ+ uses a least squares algorithm to find the pressures of the selected substances that would result in a spectrum that best fits the histogram spectrum. The calculated contributions of each substance to the spectrum are shown in the substances graph.

Above, the RGA was not perfectly calibrated which skewed the spectrum as mentioned in the analog graph section. Furthermore, the calculations performed are best approximations. The result is what appears to be a negative pressure of residuals at 17 AMU. Residuals are peak areas that are unaccounted for or are overcounted in the calculations. An overabundance of residuals should inform the user that either the RGA needs to be recalibrated (Sec. 4.5, p. 28) or that they have made a poor choice of which substances to track.

The group of possible substances and masses that can be displayed (tracked) in this graph are selected in the Substances and Masses section of the home page (Sec 3.5, p. 16). The bar color can also be changed there. Any tracked substance can be hidden by unchecking it at the bottom of the graph. When a substance is hidden from view, its partial pressure contribution is eliminated from the adjustment calculations, the substances graph is recalculated, and then redrawn.

3.3.4 INTENSITY GRAPH



The intensity graph shows the partial pressure trend of each tracked substance. Here, the pressures of all substances are decreasing. Like the substances graph above, all or some substances and masses can be displayed and their color changed for better viewing (Sec 3.5.1, p. 16). In the graph above, tracking of helium and hydrogen were added at about 00:13:30.

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3.4 GRAPH FUNCTION BUTTONS

④ Each graph may have up to four buttons on its right side. They are: baseline, overlay, export, and y axis lock.



- Apply baseline button (premium versions only)



- Apply overlay button (premium versions only)



- Export graph button



- Y axis lock button

3.4.1 BASELINE BUTTON (PREMIUM VERSIONS ONLY)



A baseline is a scan, or an averaged scan that can be used to eliminate electronic noise and substances from view which are not of interest or that cannot be entirely eliminated from the system (i.e., water) before an experiment or process is started.

The apply baseline button is white until a baseline scan is loaded (Sec 3.7, p. 20). When selected, the baseline button turns green and the baseline scan is subtracted from the current scan leaving only the difference. As seen below, this essentially zeroes the scan. When the baseline function is applied, it acts on analog, histogram, and substances graphs.

A baseline should be saved after the chamber pressure has stabilized at the ultimate vacuum pressure of the pump or at the intended process pressure. For best results, and if the user has premium AutoZ⁺, a baseline should be built from an averaged scan in the logs page. (Sec 5.3, p. 42).

The baseline scan should be made using the full range of the RGA (i.e., 1-100 AMU), the maximum steps per AMU (= 20), a slow scan speed (< 24) and Auto Zero on (Sec 4.6.3, p. 38). Alternatively, set the AMU to the maximum range of interest, the steps per AMU to the maximum number of steps per AMU you will use, and set Auto Zero to the same auto zero you will use. A full range baseline can be applied to a scan of lesser AMU range, but not the opposite.

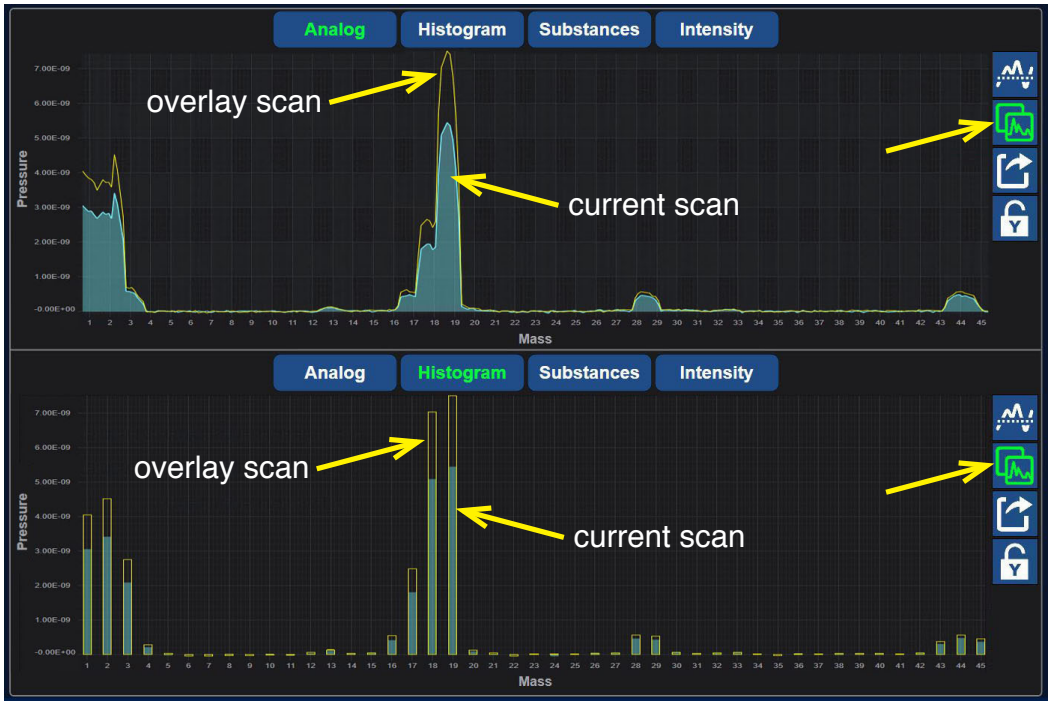


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3.4.2 OVERLAY BUTTON (PREMIUM VERSIONS ONLY)



The overlay function allows the user to compare two scans. An overlay can be a baseline scan (Sec 3.7, p. 20), or a view from a log file (Sec. 5.5, p. 44). When the overlay button is selected, it turns green and the current and overlay scans are superimposed. The current scan retains its fill color. The overlay scan is displayed as an outline. The overlay function can be applied to analog and histogram graphs (below). Note that the baseline and overlay functions may be used simultaneously.



3.4.3 EXPORT BUTTON



The export function is available in all Auto Z⁺ versions. It allows the current view to be saved as either a CSV file, normally opened in speadsheets, such as Excel, or a jpg image file, used in reports and presentations. When the export button is pressed, it turns green and opens a window where the user chooses a filename and selects a file type (csv or jpg). The default save location is the Windows Desktop.

The saved jpg file is a snapshot of the selected graph at that moment. The saved csv file differs between the four graph types. The analog and histogram csv files are substantially the same, only varying in data quantity. The substances graph exports substance data, and the intensity graph exports substances and time data. Exported files cannot be imported back into AutoZ⁺.

3.4.4 Y AXIS LOCK BUTTON



Normally, AutoZ⁺ automatically scales graph axes to best fit the data. The axes also automatically scale when the user zooms in or out on a graph. The y axis lock function prevents y axis scaling. When the y axis lock button is on (green), zooming acts only in the x axis, making peaks wider or thinner. The y axis lock function can be invoked at any time and locks the y axis at its current scale.

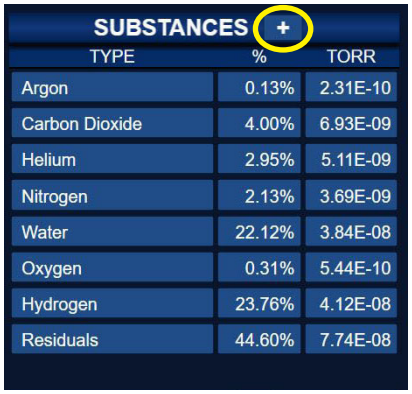
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3.5 SUBSTANCES

⑤ The substances section of the home page lists those library substances that AutoZ+ is currently tracking and analyzing. All AutoZ+ versions include the IVP basic substance library of the 12 most common vacuum gases. The premium version adds an expanded substance library of more than 80 additional chemicals and has a substance editor for adding user specific chemicals.

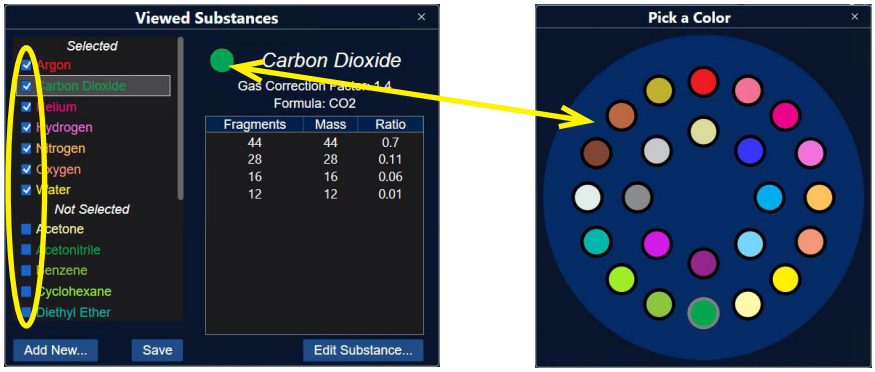
The name, percent of corrected total pressure, and corrected partial pressures for each tracked substance are columnated in this section. AutoZ+ automatically calculates and applies gas correction factors at the end of a scan to provide more accurate pressure measurements.

3.5.1 VIEWED SUBSTANCES



Click the plus sign (+) on the substances bar to bring up the Viewed Substances window (shown below). Here, the user chooses which substances are tracked on the home page, displayed in the substance graph, and included in the partial pressure calculations.

Each substance in the library has gas correction factor (GCF) and fragmentation data. Substances with a GCF ratio greater than 1 are more likely than nitrogen to ionize. Therefore, their corrected partial pressures are reduced. The inverse is also true.

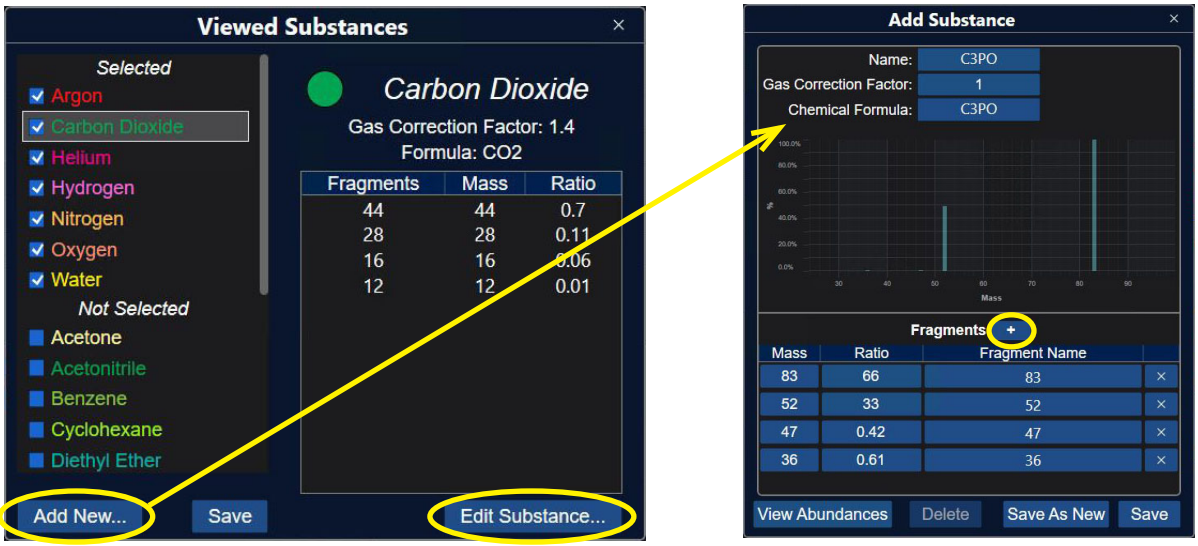


All substances, whether in a basic or premium substance library or defined by the user are listed here. Check and save a substance to include it in the tracked substances list . All selected substances are listed alphabetically at the top of the viewed substances list. Uncheck a substance, then save to exclude it from tracking and analysis. Click on a substance name on the left to view its fragment data. Click the fragments, mass, or ratio column header on the right to sort or reverse sort. Change a substance's graph color at any time by clicking on the colored dot to the left of the substance name. Choose a color from the Pick a Color popup.

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3.5.2 SUBSTANCE EDITOR (PREMIUM VERSIONS ONLY)

The substance editor in premium versions of AutoZ+ allows the user to add or modify library substances. From the viewed substances window, select Add New... or Edit Substance to bring up the Add or Edit Substance window. Below, Add New... was chosen.



Here, a new substance, C3PO, is added. Its GCF (gas correction factor) is 5.01 and is entered along with its chemical formula. The GCF is the ratio of ions produced per unit pressure relative to nitrogen. Knowing the GCF is necessary to produce an accurate partial pressure measurement. If a GCF isn't entered, it is assigned a value of 1. For information about generating new library substances see Chapter 6, p. 47.

The chemical formula is written in a simplified chemical SMILES format (Simplified Molecular-Input Line-Entry System) and is optional. For example, chloroform, whose chemical formula is $CHCL_3$, is entered as CCl3 or ClC(Cl)Cl. If it had only the C-13 isotope the formula would be [13C]Cl3.

The Add or Edit Substance window includes a zoomable histogram so all the peaks of the chemical can be seen. The histogram is peak normalized meaning that the largest peak is assigned a value of 100%. All other peak values are displayed in relation to the largest peak.

In the Add or Edit substance window, click the fragments plus sign to add ion fragments. Fill in each row with the ion's name (optional), mass, and ratio. The ratio may be entered as a normalized value (all ratio values sum to 1 or 100%), as peak normalized (the largest peak is assigned a value of 1 or 100% and all other ratio values are calculated in relation to the largest peak), or the observed partial pressures for each ion fragment may be entered as ratio values.

For the purposes of quantitative analysis, AutoZ+ normalizes the substance ratio values internally.

Click the 'X' to the right of the fragment name to delete that ion.

Click Save to overwrite an edited substance with the same name. IVP library substances can be overwritten and even deleted, but it is discouraged. It is best to keep the original library substances unaltered. Click Save as New to keep an entirely new or an edited substance from the library. AutoZ+ checks that the new substance has a unique name.

Click Delete to eliminate a substance entirely.

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3.5.3 ISOTOPES ABUNDANCE CALCULATOR (PREMIUM VERSIONS ONLY)

The isotopes abundance calculator tool automatically applies branched polynomial probablities to determine the relative abundance (in %) of a substance's primary mass-to-charge ratios (the molecular ions or M^+) based on the naturally occuring abundance of isotopes of the pure chemicals that make up that molecule[1].



Invoke the calculator by selecting View Abundances from the Add or Edit Substances windows.

This tool can aid the scientist with a starting point whereby once a molecular structure (chemical SMILES format) has been entered, the calculator returns an isotope pattern that typically matches the primary peaks of that chemical. It does not account for fragmentation so it is not useful for lower mass value peaks.

For example, carbon exists in nature mainly as two isotopes (carbon-12 and carbon-13). Carbon-12 constitutes about 98.8% and carbon-13 about 1.1% of all naturally occuring carbon. As a result, methane (CH_4) exhibits mass spectrometer peaks at 16 AMU with intensity 99%, and at 17 AMU with intensity of 1%. More complex molecules may have molecular ions with many peaks.

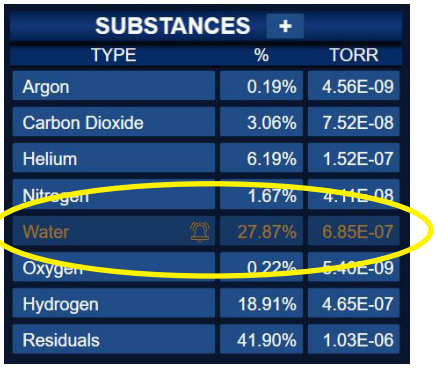
While this tool can assist in building a new entry in the substance library, it is useful only as a guide. Fragmentation and the effect of ionization on chemical bonds is beyond the scope of this document.

1 - The percent natural abundance data is derived from the 1997 report of the IUPAC Subcommittee for Isotopic Abundance Measurements, K.J.R. Rosman, P.D.P. Taylor Pure Appl. Chem. 1999, 71, 1593-1607.

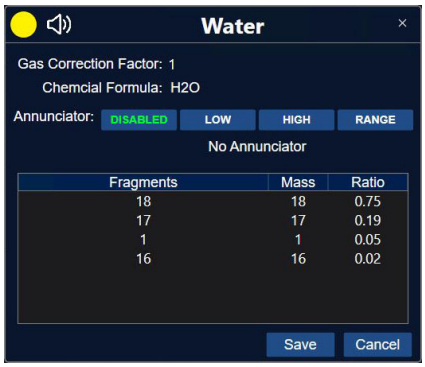
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3.5.4 TRACKED SUBSTANCES

Each library substance that is being tracked and graphed is listed in the Substances section.



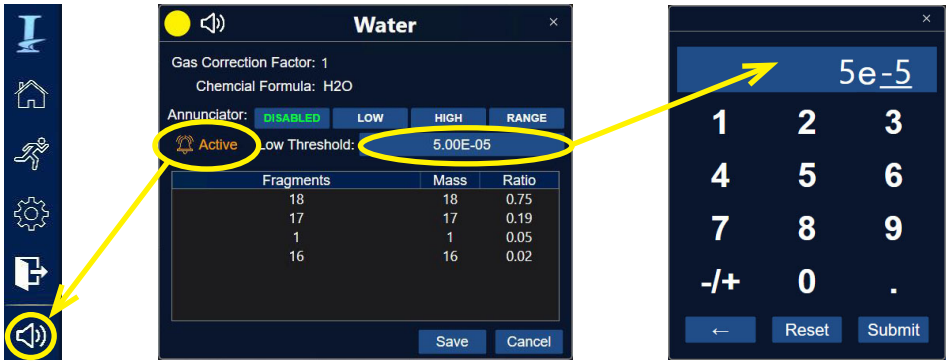
Click on any tracked substance to see its substance card. This card shows its name, its current (corrected) concentration, its ionization probability, chemical formula, and ionic fragmentation.



3.5.5 ANNUNCIATOR

Each substance card on the home page includes a programmable annunciator with a low and high pressure limit for activation (below). When an annunciator threshold is exceeded, AutoZ+ makes an audible warning tone, changes the substance color to red and displays a bell icon indicator in the substances list (above, first image) and the substance card of that substance (above, center image). The annunciator tone is silenced by pressing the speaker icon in the substance card, or on any screen at the top left of the screen.

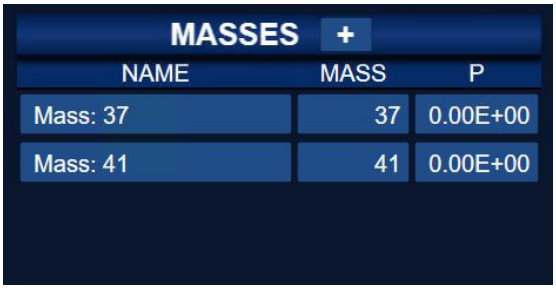
To add an annunciator value, click on low, high, or range. Click on the threshold field. A popup appears that allows the user to enter a pressure value. Click Submit to save the value.



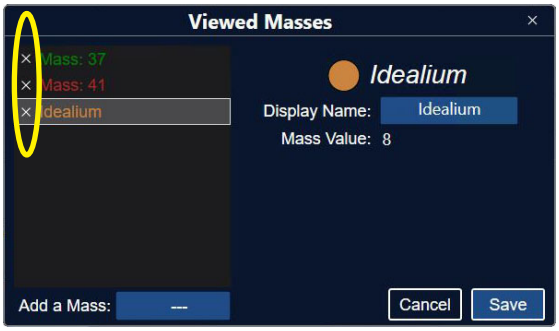
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3.6 MASSES

⑥ The Masses section of the home page, located below the Substances section on the right side of the home page, allows the user to add and track a substance of a single mass. The mass could be from a chemical of unknown composition, or a known one that is not in the substance list.



Adding a new mass is similar to adding a substance. Click the plus sign (+) at the top of the section to bring up the Viewed Masses window where a mass size (AMU) added. Once a mass has been added it can be named and a graph color chosen for it. Below, a mass of 8 AMU, called Idealium, is added. Each mass is shown on the home page and displayed on the graphs. Note that masses are used to track peaks only. They are not included in the analyses. To delete a mass, click on the X next to its name.



3.7 BASELINE

⑦ The ability to make and use baselines is available only in premium versions of Auto Z+. A baseline is a single scan saved from a current or log scan (Sec. 5.1, p. 42). The baseline functions allow the user to save, load, and overlay a baseline scan onto a graph. A baseline loaded from the home page is applied only to the home page scan.



When the home page Save Baseline button is selected, the current analog scan can be named and saved as a baseline file in the RGAbaselines folder (Sec. 4.3, p. 24). Any number of baselines can be stored for later use.

A saved baseline can be loaded at any time by selecting the Load Baseline... button. Once a baseline scan has been loaded, the baseline button can be activated (Sec. 3.4.1, p. 14). A loaded baseline can also be used as an overlay (Sec 3.4.2, p. 15). The loaded baseline can be applied as both a baseline and an overlay simultaneously.

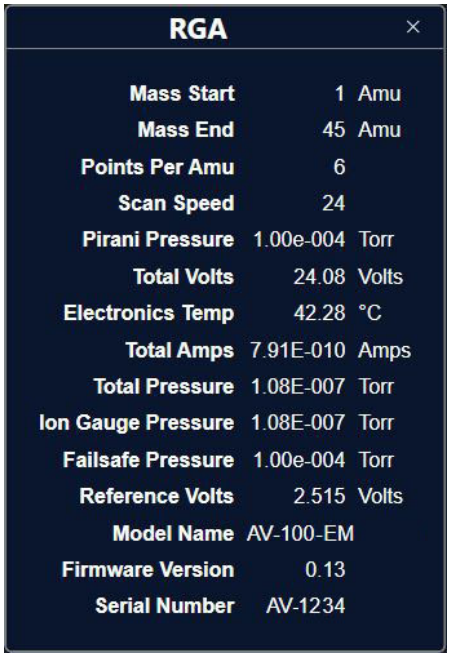
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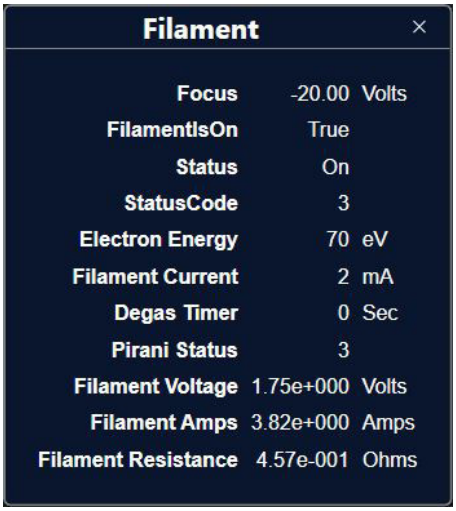
3.8 DEVICES

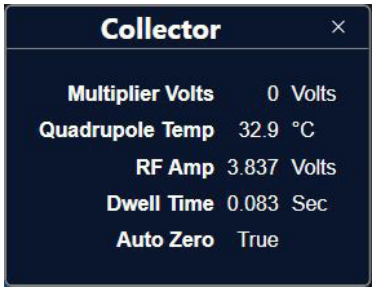
⑧ The current state of the RGA, filament, Faraday cup collector, and electron multiplier (if installed) are displayed in this section. When a device is on, its icon is green.



Each device has an associated data card which shows useful information. Press or click on a device tile to bring up its data card.









3.9 STAUS BAR

⑨ The status bar section is located at the bottom of every AutoZ⁺ menu page. Whenever there is a service message, error, warning, or failure, the software displays a messge on this line.

Go to the settings page/notifications for more information about the anomoly (Sec. 4.4, p. 24).

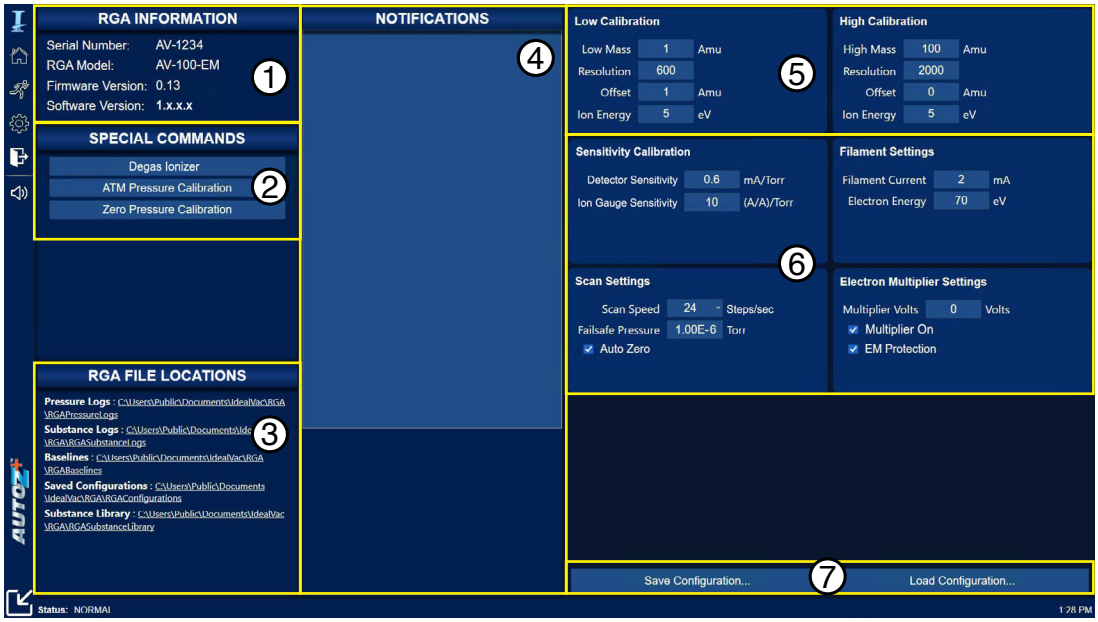


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4. SETTINGS PAGE

The Settings page is accessed through the menus on any page. It is where all the electronic adjustments to the RGA are made and where the user finds the storage location of baseline, overlay, and log files. Additionally, this page displays detailed information about any notifications the software generates. The Settings page has six major sections: (1) information, (2) special commands, (3) file locations, (4) notifications, (5) scan calibration, (6) other settings, and (7) save and load configurations.

Quick calibration instructions for experienced mass spectroscopists are in Sec. 4.5.1, p. 28.



4.1 RGA INFORMATION

① The information section has the model and serial number of the AnalyzaVac RGA instrument. It also has the current firmware and software versions that are operating the RGA.

This information will be needed if you require cutomer support.

AutoZ⁺ software updates and bug fixes are downloadable from idealvac.com when available.



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4.2 SPECIAL COMMANDS

② The special commands section contains the degas function and Pirani gauge calibration.



NOTICE

Do not scan or manipulate other settings while one of these functions is operating.

4.2.1 DEGAS IONIZER

The purpose of the degas function is to clean the ionizer. Degas increases the filament's electron energy, electron emission, and ion energy to "burn off" contaminants. When the degas ionizer box is clicked, the degas function runs for 5 minutes. While degassing, all other RGA functions are disabled.

If the ionizer becomes contaminated, the RGA experiences a loss of sensitivity and decreased spectrum peak heights. It may also cause a difference between the total pressure and the sum of the partial pressures of an order of magnitude or more. Contamination occurs when the filaments, grid cage, and other ionizer parts get coated with some type of insulating compound. The causes of contamination could include, but are not limited to, exposure to an oxidizing environment for long periods, oil back streaming of a rotary vane pump, or from a deposition system that deposits insulating compounds on the ionizer. If the contamination is not severe, the ionizer's sensitivity can often be restored by degassing the ionizer. If sensitivity does not improve after one or two degassing cycles, then the filament or ionizer might need to be replaced. Repeated degassing can shorten filament life by depleting its thoria layer.

4.2.2 PIRANI GAUGE CALIBRATION

The Pirani gauge measures between atmosphere and 1 x 10^{-4} Torr. Calibration is semi-automatic and only needs to be performed occassionally as the system ages.

While the chamber is at ambient atmosphere, click ATM Pressure Calibration under the Special Commands header (above). The Pirani is calibrated for atmospheric pressure (760 Torr). This is likely not the actual atmospheric pressure in your location, but since the RGA functions only in high vacuum and the Pirani gauge is used solely to ensure that the filament turns on only below the Pirani's lower measuring limit, any atmospheric pressure difference is inconsequential.

Turn on roughing and high vacuum. Go to the Home page. When the Gauge pressure reads below 1 x 10^{-4} Torr, go back to the settings page and click "Zero Pressure Calibration". The Pirani's lower limit is set. It does not matter how far below the Pirani's pressure limit the zero calibration is made. This calibration is simply finding the Pirani's low voltage threshold internally.

Pirani calibration is complete.

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4.3 FILES

③ The Files section displays the locations of the pressure logs, substance logs (premium versions only), baseline files, saved configuration files, and substance library files. These are CSV files and AutoZ⁺ cannot directly open, modify, or change their location from here. If the user attempts to open a log file from here, it will open in applications like Excel®.

This section is provided solely so the user can find the directory location where the saved files reside. Click the file directory, then copy the file location.

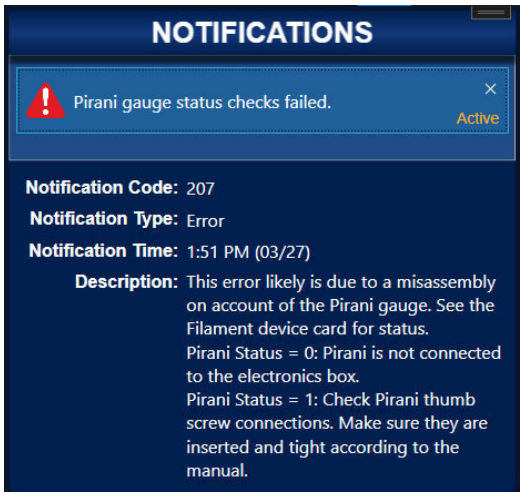
Pressure and substance files are opened from the log page (Sec. 5.1, p. 42). Baselines can be opened from both the home and log pages. Configuration files are loaded and saved from the settings page (Sec. 4.7, p. 41).



4.4 NOTIFICATIONS

④ The Notifications section, in the middle of the settings page, shows service messages, errors, warnings, and failures.

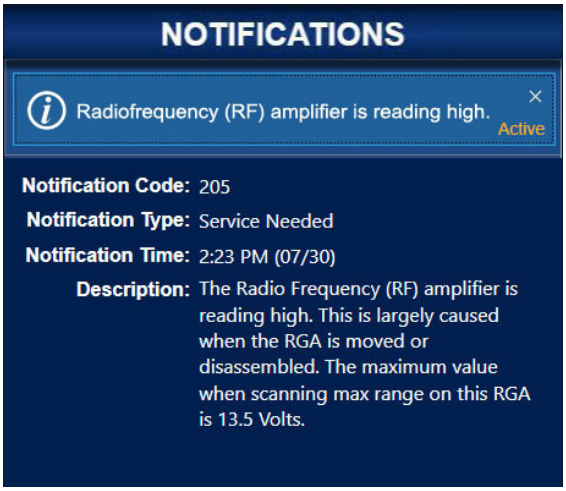
The top portion of the notifications section has a short description of the issue, mimicked in the status bar at the bottom of every menu page (Sec. 3.9, p. 21). The bottom portion of this section supplies more detailed information about the issue and may provide suggestions for how to correct it. A notification could indicate something like an overcurrent limit was reached, or that there is a hardware failure.



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4.4.1 RADIO FREQUENCY AMPLIFIER SERVICE NOTIFICATION

The RGA electronics control unit (ECU) supplies the RGA probe with a radio frequency (RF) voltage which allows it to separate ions by mass-to-charge ratio. The necessary voltage is lower at small AMU values and higher at large AMU values. At the factory, the ECU is adjusted to be in resonance with its associated probe. This minimizes the voltage required to drive the probe. If the probe is later placed in an environment different than its factory calibration, if it is bumped or jostled during shipping, or if the entire probe is replaced due to damage, the probe will have different electrical properties than when originally delivered. This will cause the ECU and probe to be out of resonance and the voltage required to drive the probe will increase.The maximum voltage the ECU can generate is dependant on the RGA model (9V for an AV-100, 13.5 V for an AV-200, or 20 V for an AV-300). If the voltage needed exceeds the ECU's limit, AutoZ+ will generate a service notification: "Radio frequency (RF) amplifier is reading high."



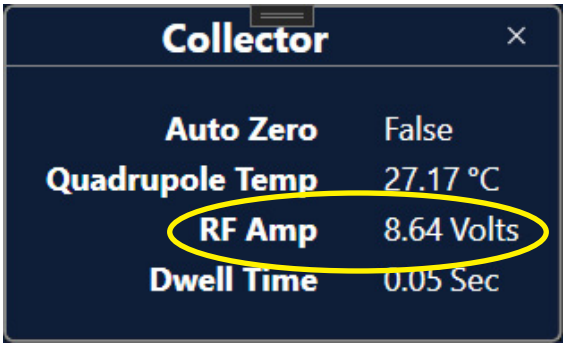
The ECU and probe are capable of sustaining slightly higher voltages than the service notification threshold without significantly impacting the performance or lifespan of the RGA. If the notification only occurs transiently for a few moments at AMU values > 90% of the full range, it can be safely ignored temporarily. However, if the notification is persistent, the RGA will not properly separate or locate peaks at high AMU values. There will be a non-linear shift in peak locations, with larger shifts and absent peaks at high AMU. Continued use of the RGA at or beyond its useful operating limit may result in shortened probe and ECU life and excessive heat generation.

It is best practice to resonate the ECU and probe whenever this service notification occurs. This ensures good results and long device life. Follow the procedure described on the following page.

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Procedure to resonate the ECU and probe:

1. Install the RGA in a vacuum chamber.
   If you have a high pressure kit, using the leak valve is good enough.
2. Turn on the RGA's filament.
3. Bring the chamber pressure down to the RGA's operating range (~ 3 x 10^{-6} Torr).
4. Set the scan limits to scan a 1 AMU range at the upper end of the RGA range.
   For example set the limits to 99-100 AMU for an AV-100).
5. Turn off auto zero in the settings page.
6. Turn on scanning.
7. Scan continuously for at least 15 minutes to allow the electronics to reach a steady state.
   The service notification will likely occur during this time.
8. Open the Collector device card (bottom right of home page) and view the RF Amp value.
   The RF Amp value updates at the end of every scan. If the scan results in a refresh rate slower than once every 3 seconds, increase the scan speed.



8. Remove the black plugs on either side of the RGA's ECU. Use a blade if necessary.



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9. While monitoring the RF Amp value, use the blue plastic screwdriver supplied with the RGA to adjust the pot on the right side of the RGA.
   a. Adjust the screw 1/16 turn clockwise.
   b. If RF amp decreases, continue to turn the screw clockwise to find a minimum value.
   c. If RF amp increases, turn the screw counterclockwise to find a minimum value.



10. Once the minimum value is found on the right side pot, adjust the left side pot similarly until a minimum is achieved.
11. Repeat the previous two steps until no further decrease in RF Amp value can be obtained.
12. Replace the plugs on either side of the ECU.
13. Check the RGA calibration against a known standard (air is an acceptable standard).
14. Recalibrate the RGA if necessary.

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4.5 SCAN CALIBRATION

4.5.1 QUICK CALIBRATION INSTRUCTIONS

These quick calibration instructions are for the scientist or technician who has mass spectroscopy experience. The pages that follow provide a more in-depth discussion about properly calibrating the RGA.

1. Go to the settings page. Set the high and low mass calibration range.



2. Adjust the resolution.

   The peak heights at ±0.5 AMU from the peak centers should be 10% of the total peak magnitude.

3. Adjust the sensitivity (ion energy).

   If the signal-to noise ratio is good (sensitivity is satisfactory), do not adjust the ion energies.

   If the signal-to-noise ratio is not good, increase the low and high ion energies equally then readjust the resolution and ion energies until resolution and sensitivity are good.

   New RGAs should not need the ion energies adjusted.

4. Adjust offset.

   Adjust the high and low offset values to set the peaks in the right locations. Adjust the low calibration offset first, then the high calibration offset. Repeat up to 3 times as necessary.

5. Get a known calibration gas mixture of at least two components.

   It will be used to make sure the calculated values are correct.

   If you do not have a known gas mixture, air may be used since the composition is always approximately $N_2 \approx 78\%$, $O_2 \approx 21\%$. Even better, measure nitrogen and argon whose compositions (worldwide) are $N_2 \approx 78\%$, $Ar \approx 0.9\%$.

6. Add the mixture (or air) to the RGA.
7. Measure the total pressure.

   Adjust the detector sensitivity in the sensitivity section (Sec. 4.6.1, p. 36) so that the Gauge pressure on the home page is equal to the Corrected pressure. The Corrected pressure is equal to the sum of the partial pressures of the calibration gas mixture components.

8. Save the Configuration at the bottom right of the Settings page (Sec. 4.7, p. 41).

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4.5.2 CALIBRATION PROCEDURE - OVERVIEW

⑤ The main parameters used for calibrating the RGA are located in the settings page scan calibration section (below).



Some users find the factory calibration acceptable for basic qualitiative analysis. For most, recalibration of the RGA is beneficial to improve the ability to perform quantitative analysis and to take full advantage of AutoZ⁺'s advanced substance analytics.

It is suggested to recalibrate the RGA as soon as the hardware and software are installed. Recalibration may be needed as the RGA ages, or to customize the calibration for improving resolution in a particular mass range or for a particular process. Recalibration is required whenever any RGA parts are replaced.

The purpose of recalibrating the RGA is twofold: First, to allow the best possible qualitative analysis by having the spectrum peaks at the correct locations with sufficient separation (resolution) for the human eye to be able to distinguish peaks that are separated by 1 AMU. The second is to improve the scan resolution and enhance sensitivity so a computer program AutoZ⁺) is able to differentiate between separate peaks and calculate correct peak magnitudes. This allows analysis of compounds with overlapping peaks to be distinguished from each other.

The most important calibration parameters are: resolution, sensitivity, and offset.

Resolution:

Resolution adjustments effect the width of individual mass peaks. Resolution is considered excellent when the bases of all substance masses have equal widths and the peak heights at ±0.5 AMU from the peak centers are 10% of the total peak magnitude. The resolution parameters control the quadrupole's selectivity to individual mass-to-charge ratios. As resolution values increase, the width of peaks decrease. Peak heights also decrease slightly.

Sensitivity (Ion Energy):

Sensitivity adjustments change the height of the individual peaks. Sensitivity is considered excellent when the peak heights of all the different substances are in correct proportion to their actual concentration. Sensitivity is primarily adjusted by changing the ion energy in the low and high calibrations. The ion energy is the potential difference between the grid cage and faraday cup collector which controls how fast the electrons move through the quadrupole. Factory ion energy settings for new RGAs are between 5 and 6 eV and do not normally need adjustments until the RGA has aged. Sensitivity is also affected by the filament electron energy (Sec. 4.6.2, p. 37) and the detector sensitivity in the sensitivity calibration settings (Sec. 4.6, p. 36).

Offset:

Offset adjustments change peak locations on the mass scale and are mostly independent of resolution. When set correctly, all peak vertices are aligned on their respective AMUs.

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4.5.3 CALIBRATION PROCEDURE - CONSIDERATIONS

Before you begin:

-> Calibration is best performed when the system is clean, at high vacuum (≤ 5 x 10^{-7} Torr), and stable for at least 30 minutes.

-> When any calibration parameter is changed, it affects more than one peak attribute.

For example, a change in resolution value changes peak widths, but also causes peak heights to change, albeit to a lesser degree. Therefore, it often takes several iterations, going back and forth between resolution, ion energy (when needed), and offset for optimal peak adjustment.

-> Change calibration values in small increments.

Small changes in any calibration parameter may cause significant changes to the peaks. For example, increasing the resolution too much causes the peaks to be overly thin, reduces peak heights, and causes substance partial pressures to be out of proportion to their actual concentrations. The calibration is said to be over-resolved in this case.

-> Changes to low calibration parameters effect the entire scan more than changes to high calibration parameters. Always adjust low calibration parameters first.

-> Changes take effect after the current scan is completed.

-> Multiple calibrations can be stored and loaded at any time (Sec. 4.7, p. 41).

1. Press the continuous scan button to begin scanning.



2. Go to the settings page.



3. In the low and high calibration sections, set the low and high mass AMU range. The maximum high calibration value is 300 AMU, even if the RGA has a lesser range. Usually the low and high mass AMU range is set for either the maximum range of the RGA, or just outside the AMU range of the substances of interest. For example, if the user wants to look at air, they might set the range between 1 and 45 AMU so that hydrogen (2 AMU) and carbon dioxide (44 AMU) are included. Below, the range is set for 1 to 100 AMU, the range of the RGA being used.



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4.5.4 CALIBRATION PROCEDURE - INITIAL SCAN

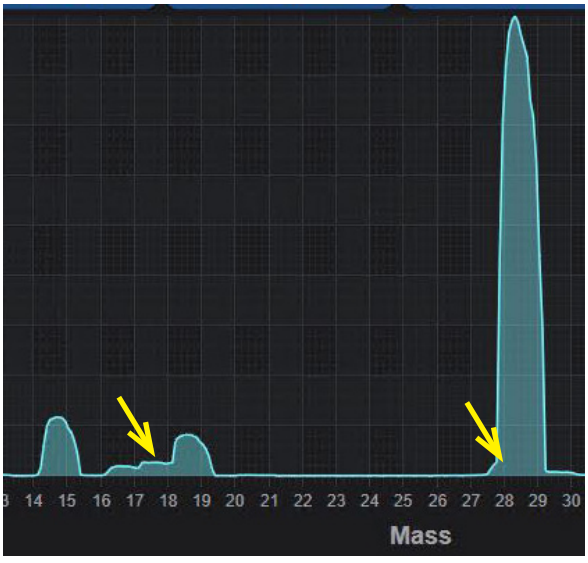
4. At the home page, examine the scan in progress.

   Below is a scan of air with a poorly calibrated RGA. A range of 1 to 50 AMU is selected for viewing. Note that the calibration range is independent of the graphing range.



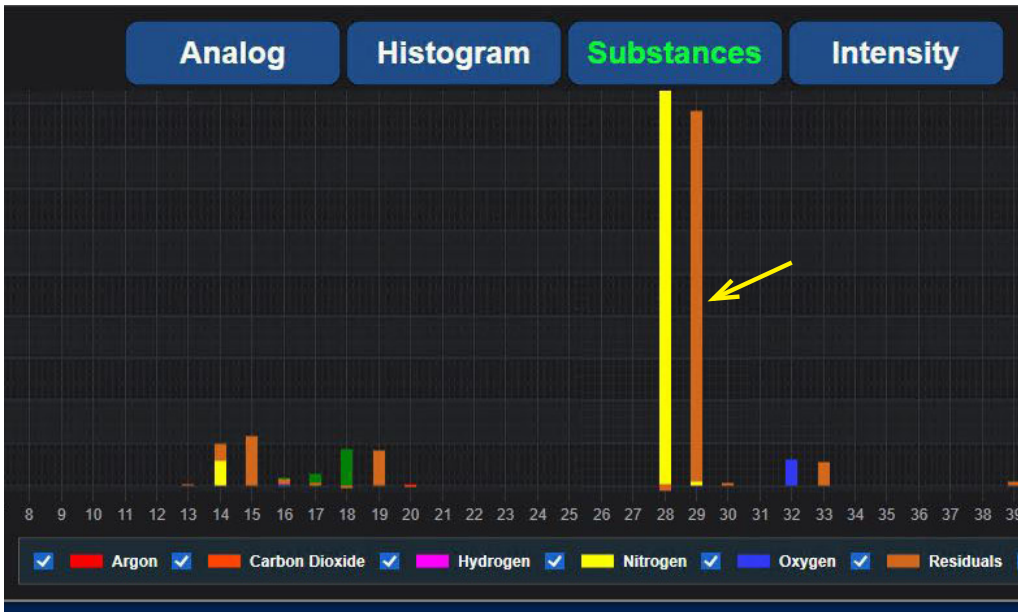
   Above, in the analog scan, all the peaks are very wide, all but the smallest AMUs are skewed nearly 1 AMU to the right of where they should be, and there is little-to-no distinction between close peaks.

   The close-up, below, better illustrates some of the issues. There is no differentiation between peaks at 17-19 AMU and these peaks should be at 16-18 AMU. At 28 AMU, the peak is very wide and is also shifted to the right.

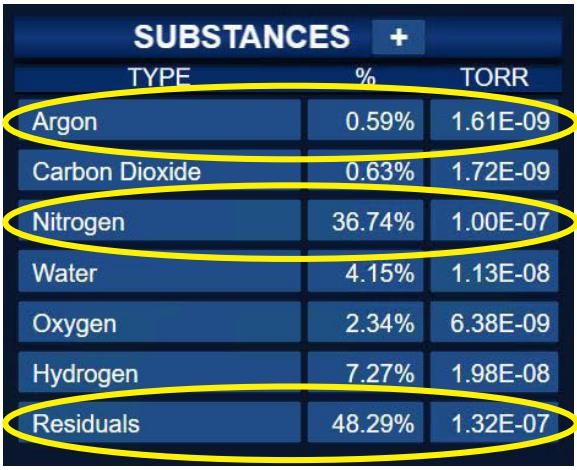


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The substances graph shows a large residual spike at 29 AMU. This indicates that the software is unable to correctly analyze the data due to the poorly calibrated RGA.



The substances list confirms this large residual and the rest of the substances are out of proportion to expectations (below). In particular, the concentration of argon and nitrogen in the air, no matter the location worldwide, is about .9% argon and 78% nitrogen. Here, the percentages of argon and nitrogen differ considerably.



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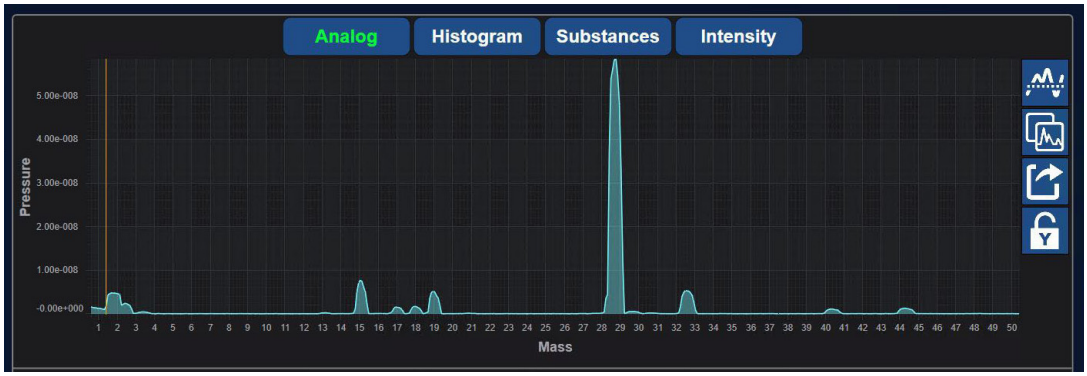
4.5.5 CALIBRATION PROCEDURE - ADJUST RESOLUTION

5. Go to the settings page to start adjusting the resolution.

   Begin by changing the low calibration resolution. By increasing the low resolution value the peak widths across the entire AMU range are decreased. The smallest AMU peaks are affected most. Once the smallest AMU peak widths have been adjusted, the result is that the larger AMU peaks may become over-resolved. In that case, the high calibration resolution must be decreased to increase the larger AMU peak widths. This is the situation in this example.

   Go back and forth between the settings page and the home page to see how the resolution changes effect the peaks. It may require several iterations to correct the peak widths across the entire AMU range.

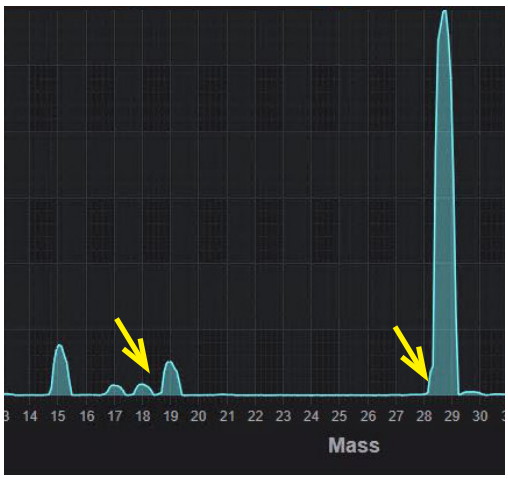
   Below, the resolution has been optimized.



   The low resolution was increased slightly from 600 to 625. The high resolution was decreased significantly from a starting value of 2000 to 1225.



   Notice below in the scan close-up the improved peak differentiation at 17-to-19 AMU and how the large peak at 28 AMU, although still offset to the right, is more well-defined.

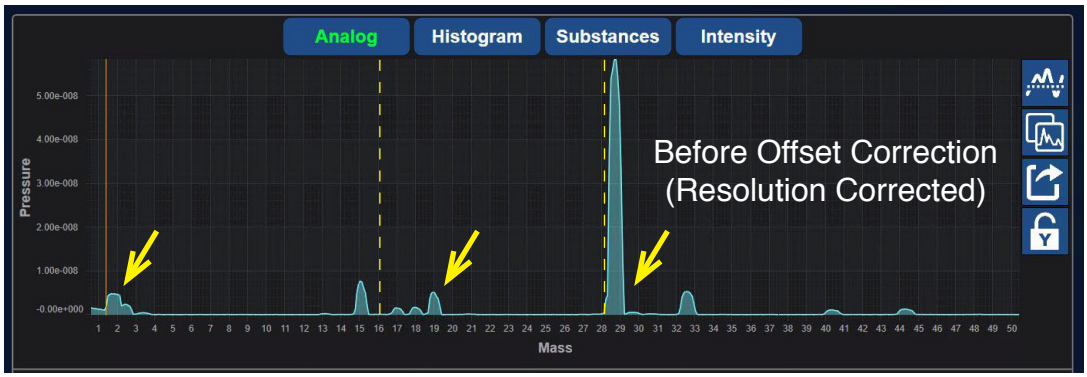


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4.5.6 CALIBRATION PROCEDURE - ADJUST OFFSET

6. Once the scan resolution is corrected, start adjusting the offset.

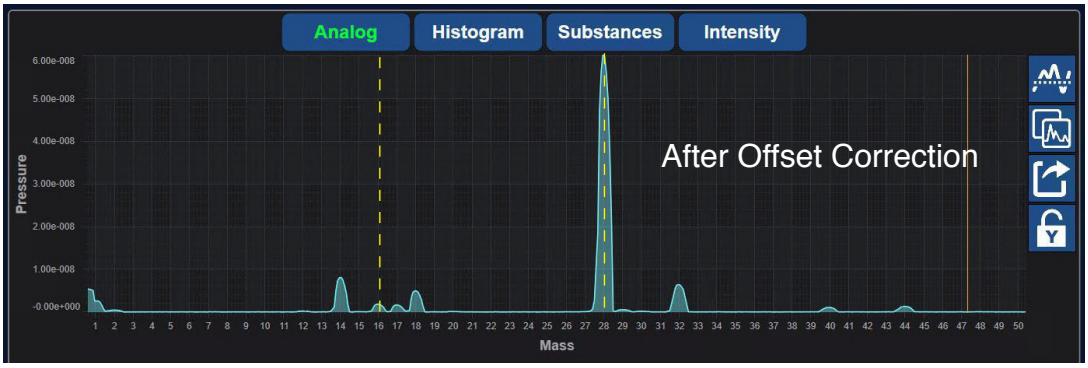
   The scan from the previous page (duplicated below) shows that all the peaks are shifted to the right. The beginning offsets values are low offset = 1 AMU, high offset = 0 AMU.



   First, zero the low calibration offset to reposition all peaks to the left. Then, increase the low offset value incrementally until the smallest AMUs are located at the correct mass. It can be useful to zoom into the analog graph to better view the peak offsets.

   In this example, once the peaks of the small AMUs were properly located, the larger AMUs were still offset to the left. The high calibration offset was then increased (from 0) to reposition the larger AMU peaks. The high calibration offset acts on the larger masses much more than the smaller ones, so after several iterations, all the peaks were located in their correct positions.

   Below, the offsets have been corrected. Yellow dashed lines were added to 16 and 28 AMU in both graphs to make the results of the offset correction easier to see.

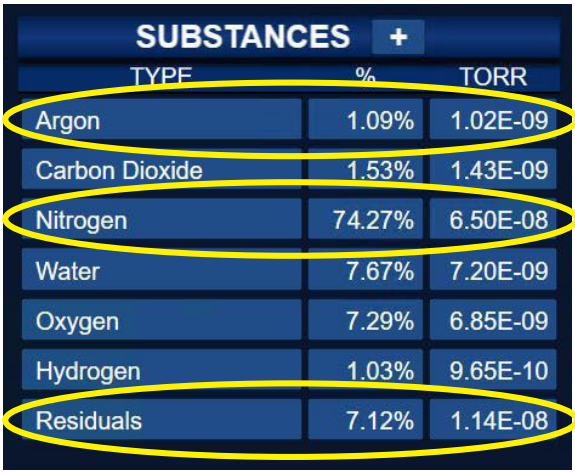


   In this example, the low calibration offset was decreased from its initial value of 1 to 0.35 AMU. The high calibration was increased from 0 to 0.51 AMU.



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Notice that the argon/nitrogen ratio is now very close to what is expected (Ar=1%, N2=78%), and the residuals have been reduced to less than 7%.



4.5.7 CALIBRATION PROCEDURE - ADJUST ION ENERGY

7. The ion energy parameters control the speed of ions through the quadrupole.



As the ion energy is increased, the probablility of an ion passing through the quadrupole is increased and more ions are detected at the Faraday cup. Therefore, varying the high and low ion energy settings is a way to control peak heights. When the RGA is new, the factory ion energy settings are normally satisfactory and should not need adjustment. This is true for the calibration example discussed in this chapter. If the argon/nitrogen ratios were very much different from expectations after resolution and offset had been adjusted, the ion energy setting could be varied to adjust the peak heights to where they should be. Ion energy adjustments are normally only needed as the RGA ages.

As a general rule, if the signal-to-noise (S/N) ratio is ok, then the ion energy does not need adjustment. If the substance peaks are very much larger than the noise peaks, leave the ion energy settings as they are. Alternatively, if the S/N ratio is not good, then both the low and high calibration ion energies should be increased the same amount and the resolution and ion energy settings should be readjusted until the substance peak heights are satisfactory.

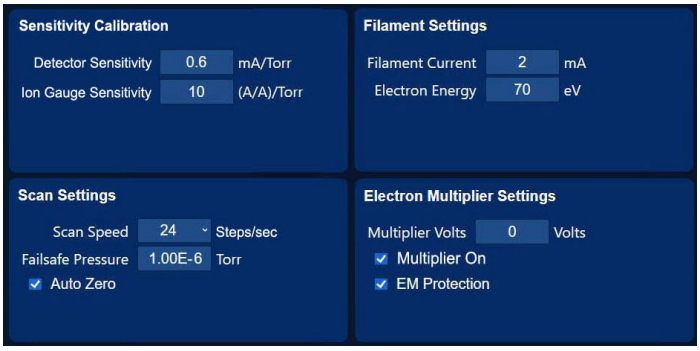
Since the signal-to-noise ratio looked good in our calibration example and the peak heights were consistent with expected gas percentages, the ion energy was not adjusted.

The final part of the calibration is the adjustment of the detector sensitivity (Sec. 4.6.1. p. 36).

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4.6 OTHER SETTINGS

⑥ This section contains all the other user adjustable RGA parameters. These include sensitivity calibration, filament, scan, and electron multiplier settings.



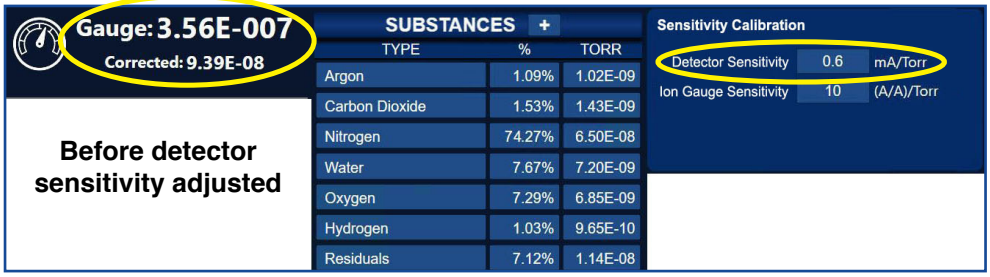
4.6.1 SENSITIVITY CALIBRATION SETTINGS

The sensitivity calibration settings section has two parameters: detector and ion gauge sensivity.

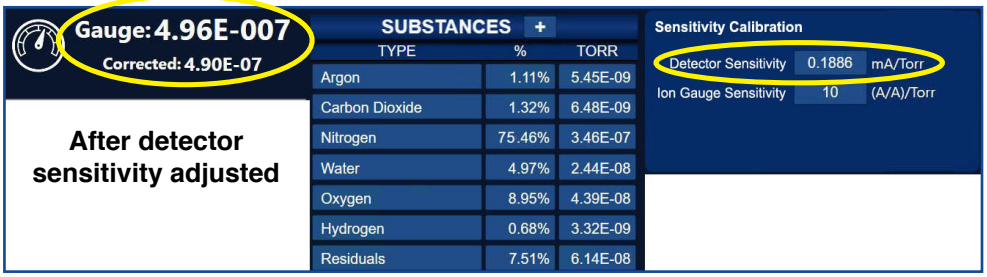
Detector Sensitivity:

This parameter controls the scaler that converts the Faraday cup detector's measured ion current to a partial pressure. As the detector sensitivity parameter is varied, the peak heights and partial pressure of each ion changes (sensitivity). The sum of all the partial pressures is the corrected pressure displayed at the top of the home page. When the chamber is filled with only air or nitrogen and when the sensitivity is good, the corrected pressure will be equal, or nearly equal to the (uncorrected) gauge pressure. Note that the percentage of each substance does not significantly change when the detector sensitivity parameter is changed.

The initial values for gauge and corrected pressures, substance partial pressures, and detector calibration are shown below.



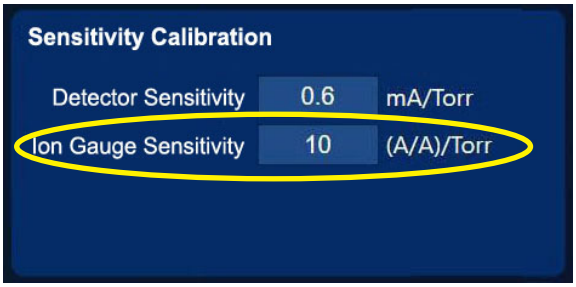
Below, the detector sensitivity parameter was adjusted. The gauge and corrected pressures are now nearly equal. The partial pressures have changed significantly, but not the percentages.



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Ion Gauge Sensitivity:

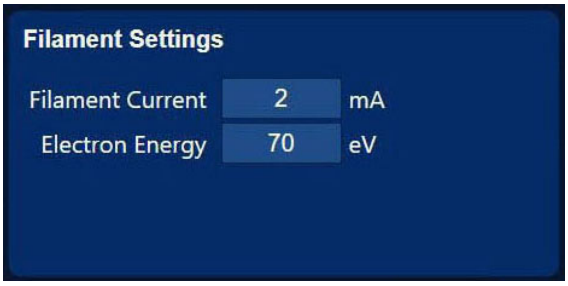
This parameter is used to calibrate the RGA's Bayard-Alpert hot ion gauge which displays the (uncorrected, total) gauge pressure in the chamber.



The only way to determine if the gauge pressure needs to be recalibrated is to compare it to a separate, known reference gauge. If a reference gauge is not available, do not change this value.

4.6.2 FILAMENT SETTINGS

The filament settings section contains the two parameters that control the number and energy of electrons emitted by the probe's ionizer filament.



Filament Current:

The filament current controls the number of electrons emitted by the filament. A higher current produces more electrons and therefore a greater signal strength, but increases the filament's sensitivity to damage.

As the filament ages or becomes contaminated, the current may need to be increased to maintain the same signal strength.

Electron Energy:

The electron energy, measured in electron volts (eV), is the amount of energy each electron has when it is emitted by the ionizer filament. As the electron volts are increased, more ions are produced, including more parent ions (molecular ions - M^+) and more ionic fragments.

The greater the electron energy, the more small mass ionic fragments and doubly charged ions that are produced. If one wanted to examine a substance's molecular ions only, they would decrease the electron energy.

The electron energy default value is 70 eV. This is the academic standard and is the setting used to generate all the substances in the IVP libraries (Sec. 3.5, p. 16).

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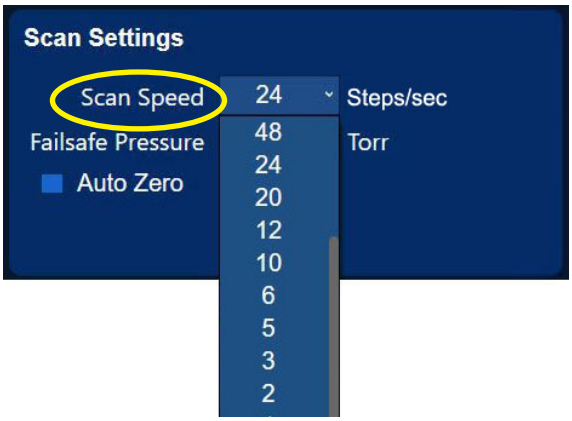
4.6.3 SCAN SETTINGS

The scan settings section contains three parameters: scan speed, failsafe pressure, and auto zero.

Scan Speed:

Scan speed is the number of steps the RGA scans per second, (the inverse of the dwell time). The default is 24 steps/sec (dwell time = 1/24 ≈ .04 sec.). The number of steps is selected at the top of the home page. A higher scan speed reduces the time it takes to make a complete scan across the entire mass range at the expense of a reduction in scan quality.

The scan speed is selected from the values offered in the dropdown box.



The time required to make one complete sweep of the scan range is approximately:

$$\text{Scan Time (sec.)} \approx \frac{(\text{Number of Steps})(\text{End AMU - Start AMU +1})}{\text{Scan Speed}}$$

Note that the scan range is increased by one since the RGA scans from -0.5 AMU below the start AMU setting to +0.5 AMU above the end AMU setting.

Due to electronic switching, actual observed scan times will be somewhat longer than calculated. When Auto Zero is on, scan time is doubled and electronic switching is slower because the quadrupole is set so that no ions pass through it between each scan step (Sec. 4.6.3, p. 39).

Failsafe Pressure:

The failsafe pressure is the pressure above which the RGA will not allow scanning to occur. This helps protect the probe from premature failure.The factory default is set to 1.00 x 10^{-6} Torr and may be varied between 1 x 10^{-4} to 1x 10^{-7} Torr.

Click on the failsafe box to change the value.



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Auto Zero:

The auto zero feature improves overall scan accuracy by reducing residual noise.



When auto zero is on, the quadrupole is set so that no ions pass through it between each scan step. The RGA's electronics calculate the average current for the step then subtracts the residual noise (dark current) that exists while the quadrupole is off. The quadrupole is reenergized after each zero for the next step. When Auto Zero is on, scan quality is improved but scan time is doubled and electronic switching is slower because the quadrupole voltage swing is more dramatic between each step.

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4.6.4 ELECTRON MULTIPLIER SETTINGS

The three settings in this section control the behavior of the electron multiplier.



Multiplier Volts:

The multiplier volt parameter controls how many secondary electrons are generated in the multiplier. The range is from 0 to 3000 volts. More volts generates more electrons. The default is 0 volts.

As the electron multiplier ages, less secondary electrons are generated and the voltage may need to be increased for the same signal strength. The multiplier should not be used above 1 x 10^{-7} Torr.

NOTICE

Use the lowest voltage required to differentiate substance peaks from the noise floor. Excessive electron multiplier voltage will cause an immediate failure.

Multiplier On:

This parameter turns the electron multiplier on and off. The default is off.

EM Protection:

When checked, this is a failsafe that limits the multiplier to a maximum of 700 volts and an upper pressure limit of 1 x 10^{-7} Torr. If EM protection is turned off (unchecked), the entire voltage range becomes available and the pressure limit is removed (1 x 10^{-4} Torr is the upper pressure limit in all cases).

It is very easy to instantly kill the multiplier by supplying too much voltage at too high a pressure. It is recommended to leave EM protection on at all times and engage the multiplier only when absolutely required. If the electron multiplier breaks, the RGA can still be used normally.

The electron multiplier is a replaceable component for an RGA that initially included the multipler option. An electron multiplier cannot be added to an RGA that did not have one originally.

NOTICE

Unless operating in the ultra-high or extreme ultra-high vacuum range, EM protection should be left on (checked).

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4.7 SAVE AND LOAD CONFIGURATIONS

⑦ This section at the bottom right of the settings page, allows the user to save and load configuration files. A configuration includes all user adjustable parameters in the settings page and the home page basic scan settings (Sec. 3.2.3, p. 11). A configuration also contains the home page list of substances selected for tracking (Sec. 3.5.1, p. 16) and any changes the user may have made to the substance library (Sec. 3.5.2, p. 17).



Any number of different configuration files can be saved in the Configurations folder (Sec. 4.3, p. 24). A saved configuration can be loaded at any time.

Custom configurations with special calibrations for improving resolution or sensitivity in a particular mass range or for a particular process are possible. The last used configuration is automatically applied when the RGA is power cycled, or reconnected.

If the configuration currently in use is modified during scanning, the new parameters are applied immediately after the current scan is completed.

If a saved configuration is loaded then modified, the original, unchanged, file is retained. The modified configuration is automatically saved when AutoZ^{+} is exited and applied upon restart.

The original factory configuration is stored in the Configurations folder and may be reloaded at any time. Selecting the factory configuration resets the RGA to the factory calibration.

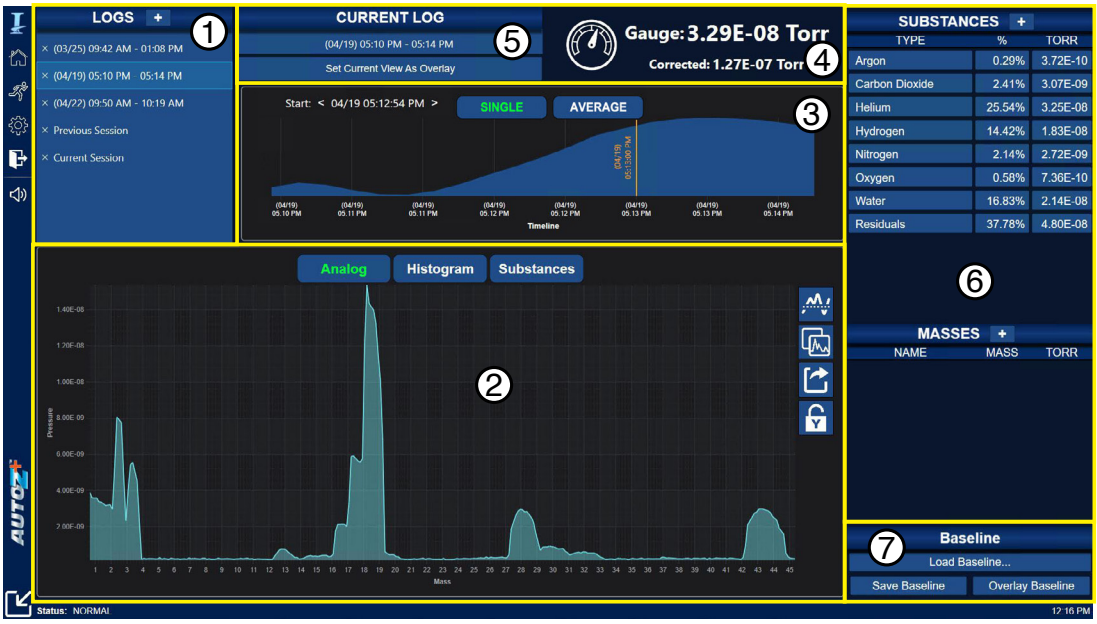
If the original factory configuration file is modified, it is necessary to uninstall, then reinstall AutoZ^{+} to get the original configuration back.

When AutoZ+ is reinstalled, IVP library substances that may have been modified are restored to their original state and modifications are lost. However, user defined substances are retained.

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5. LOG PAGE (PREMIUM VERSIONS ONLY)

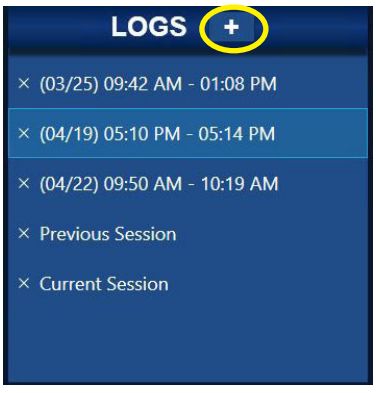
The Logs page is accessed through the menus. It is where the current scan or a previously stored scan (a log) is viewed. The logs page has seven major sections: (1) log list (2) log graph, (3) scan selector, (4) pressures, (5) current log, (6) substances and masses, and (7) baseline.



A new pressure and substances log is created every time scanning is turned on and continually updates in real time until scanning is turned off. Logs are automatically saved as standard CSV files so the user can open them in applications like Excel®. Longer, continuous scans generate more extensive logs with improved data accuracy. This maximizes the analytic capability of AutoZ+.

5.1 SAVED LOGS

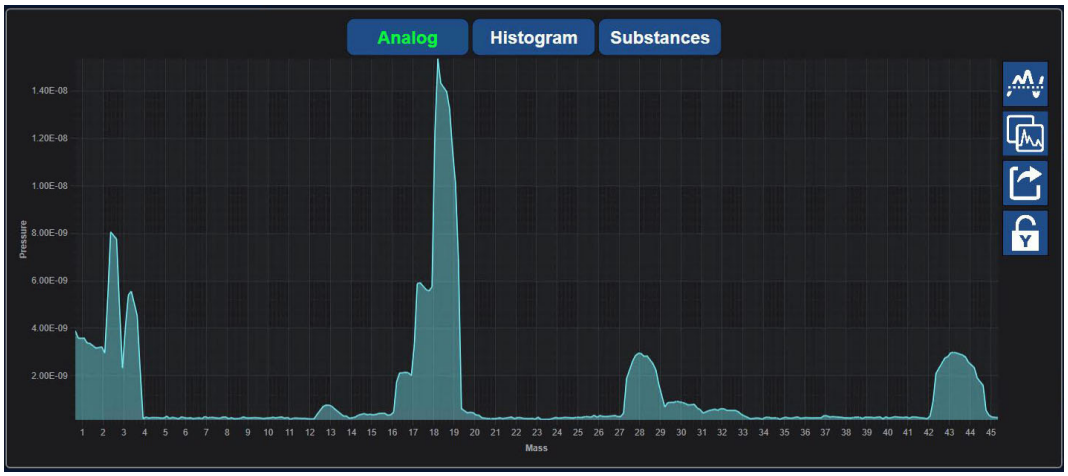
① Saved logs are accessed through the Logs section. Click the plus sign (+) on the Logs bar to open saved logs. Open logs are displayed in a list. Any number of logs may be opened, although having many large, open logs should generally be avoided. The selected (highlighted) log is graphed. If the RGA is scanning, the current session log is listed and is continuously updated in real time. If the current session log is highlighted, the log graph replicates the home page graph. If scanning is stopped then resumed, a previous session log is also listed. Click the X left of the log to close an open log.



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5.2 LOG GRAPH

② The graph section displays the currently selected log. All home page graphs and features are available on the log graph except for the intensity graph.

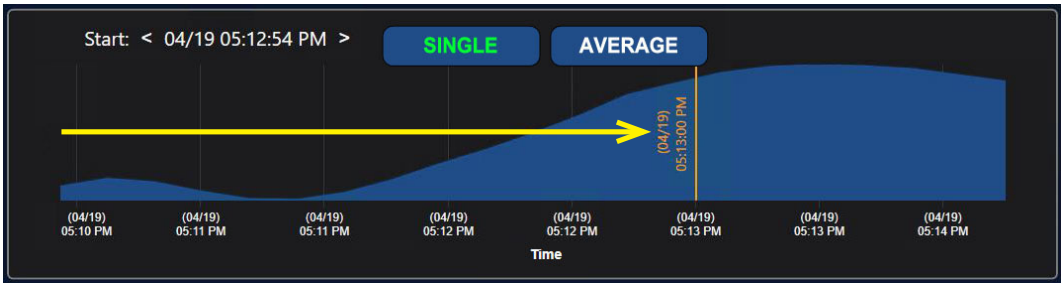


5.3 SCAN SELECTOR

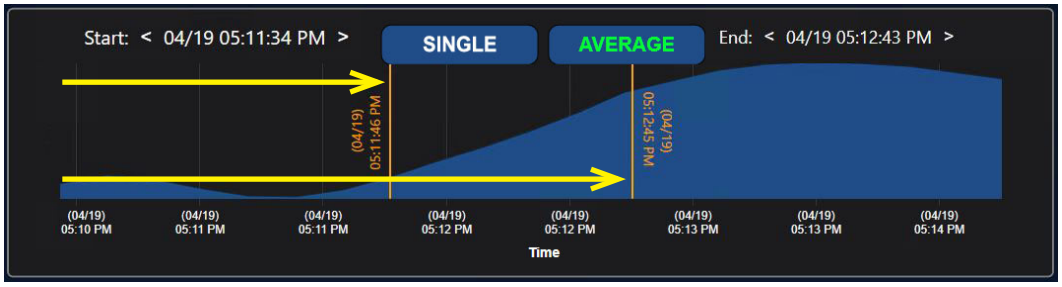
③ This section displays a graph of the chamber pressure trend versus time and has two modes: Single and Average. These modes allow the user to choose what part of a log they want to view on the log graph.

The Single mode allows the user to select and view a single scan from the log. The Average mode allows the user to average all scans during a selected period and view that result on the log graph. Click the Single or Average button to select the mode.

In the Single mode, drag the single vertical orange line to the time of interest.



In the Average mode, there are two orange lines. Drag them to the beginning and ending times of interest. If the user has premium AutoZ⁺, a baseline should be taken from an average scan to eliminate electronic noise between scans (Sec. 3.4.1, p. 14).



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5.4 PRESSURES

④ The pressures shown in this section depend on the mode selected in the scan selector section (Sec. 5.3, p. 43).

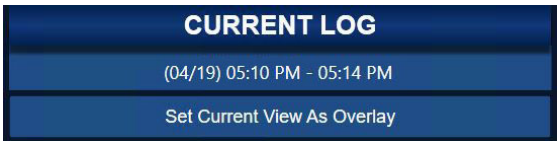


If the scan selector section is set to Single mode, the gauge and corrected pressures shown are that of the chamber when the selected single scan was made.

If the scan selector section is set to Average mode, the gauge and corrected pressures shown are an average over the time range selected.

5.5 CURRENT LOG

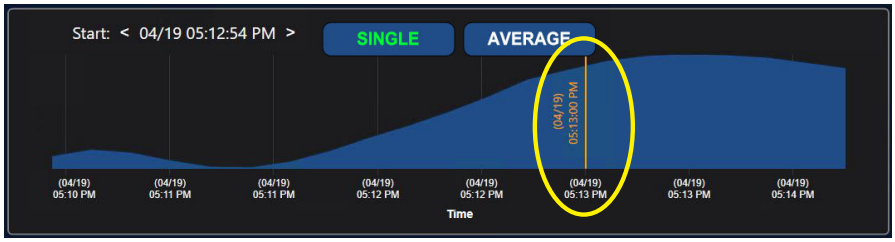
⑤ The current log section has two items: the name of the currently selected log and Set Current View as Overlay.

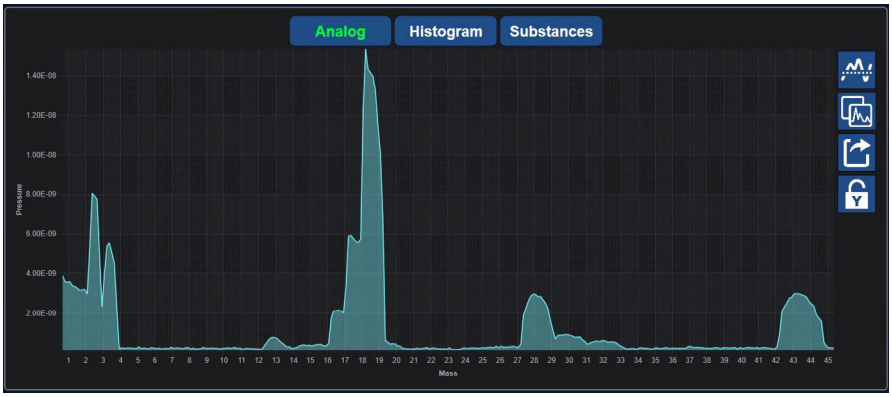


Either the single scan or the average scan of a selected period may be used as an overlay.

After the single scan is chosen in the Single mode, or the time period is chosen in the Average mode, click the Set Current View as Overlay button.

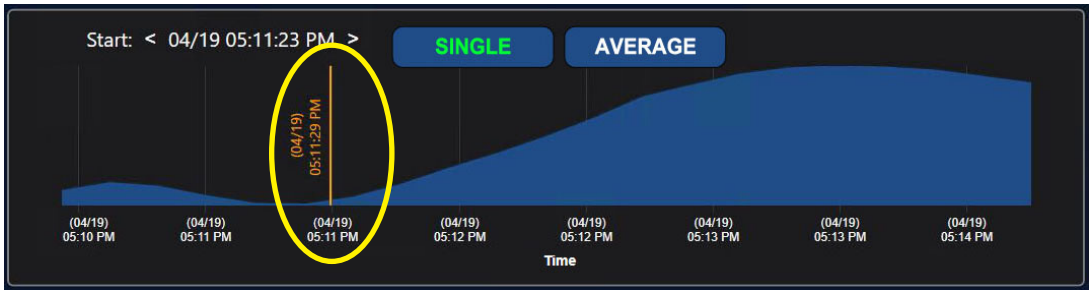
In the example below, the scan at 5:13 PM was being viewed in the Single mode. The Set Current View as Overlay button was pressed.

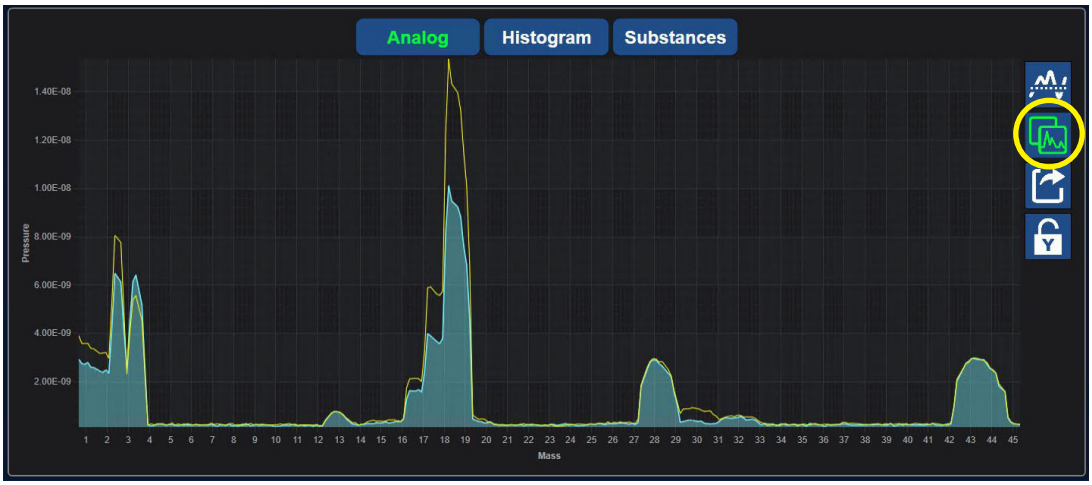




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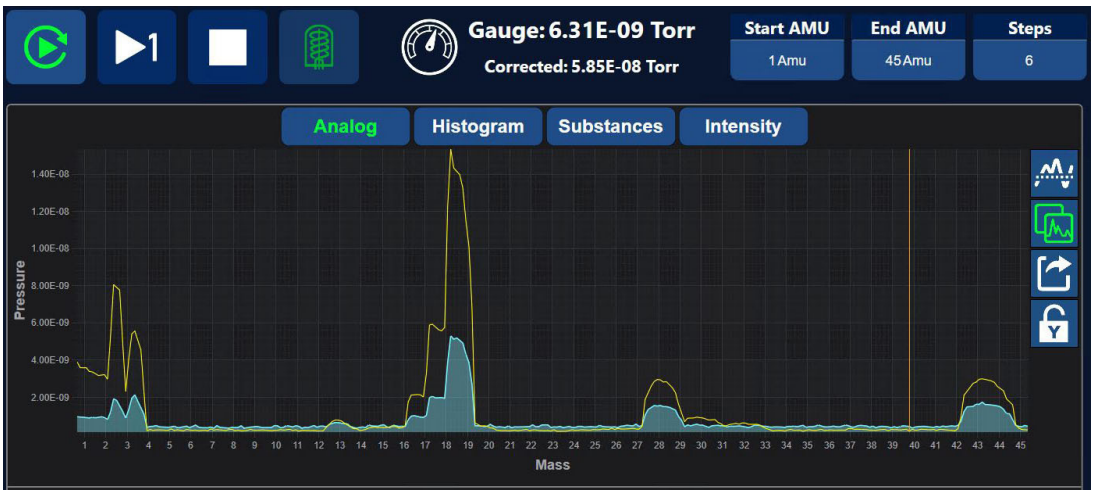
The scan was then changed to 5:11 PM and the 5:13 PM overlay applied. The log graph below shows how the spectrum changed in those 2 minutes.





An overlay obtained from one log may be used on any other open log, including the current session on the logs page.

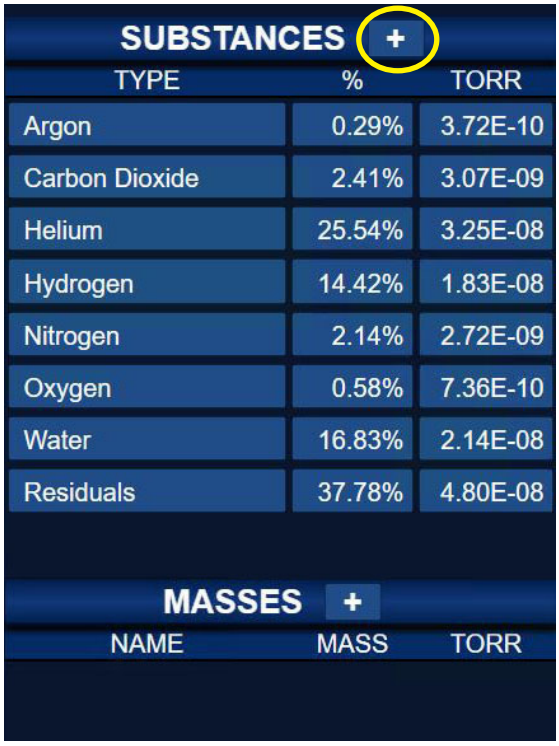
Note that an overlay made from a log scan can also be applied to the current scan on the home page, as shown below.



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5.6 SUBSTANCES AND MASSES

⑥ This section lists the substances and masses tracked on an open log on the log page (only) and work similarly to those on the home page (Sec. 3.5, p. 16).



A substance may be included or excluded from tracking and analytics by clicking on the substance or mass header plus sign (+), then checking or unchecking the substance. The results are only visible in the substances graph on the logs page.

5.7 BASELINE

⑦ The log page baseline functions work similarly to those in the home page (Sec. 3.7, p. 20). They allow the user to save, load, and overlay a baseline scan on to a log graph. A baseline loaded from the log page is applied only to the log page scan.



When the log page Save Baseline button is selected, the current analog scan can be named and saved as a baseline file in the RGAbaselines folder (Sec. 4.3, p. 24). Any number of baselines can be stored for later use.

A saved log baseline can be loaded at any time from either the log page or the home page by selecting the Load Baseline... button. Note that a loaded baseline is only applied to the page and session from which it is opened.

Once a baseline scan has been loaded from either the log or home page, the baseline and overlay buttons on that page are available for use (Sec. 3.4.1, p. 14) and (Sec 3.4.2, p. 15).

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6. IVP LIBRARY SUBSTANCES

Basic AutoZ+ includes IVP's library of 12 of the most common vacuum substances. Premium AutoZ+ versions have more than 80 additional substances including those found in the vacuum, chemical, semiconductor, plastics, coating, and aerospace industries. The premium library also includes spectra of chemically pure substances and several common pump oil mixtures.

The 12 basic and 12 premium IVP compounds have accurate, experimentally determined gas correction factors, and include all peaks (full spectrum). The 71 other premium IVP library compounds were obtained from SRS (Stanford Research System) data, have the 10 most intense peaks (partial spectrum) listed as they appear on an RGA similar to the AnalyzaVac. Additionally, gas correction factors for all the SRS compounds were calculated and extrapolated so that AutoZ+ could provide more accurate quantitative analytics. Methodology for performing the complex gas correction factor calculations is found in the Ideal Vacuum white paper:

https://www.idealvac.com/files/manuals/RGA_Library_Generation_White_Paper.pdf.

If it is necessary to uninstall AutoZ+, the uninstall program prompts the user to keep the substance library. The default is to remove it.

When AutoZ+ is reinstalled, any IVP library substance that has been edited is replaced with the factory data. However, all user added substances are retained. In order to keep the entire substance library intact upon reinstallation, including all user modifications and new substances, copy the entire substance library folder (*RGASubstanceLibrary*) to a temporary location, then paste it back into the *C:\Users\Public\Documents\IdealVac\RGA* directory after reinstallation.

6.1 IVP LIBRARY SUBSTANCES

Below are listed the IVP library substances included in the basic and premium AutoZ+ versions along with their chemical formulas.

IVP Basic Library Compounds (Full Spectrum)

Name	Formula
Acetone	C_3H_6O
Argon	Ar
Carbon dioxide	CO_2
Carbon monoxide	CO
Ethanol	C_2H_6O
Helium	He
Hydrogen	H_2
Isopropanol	C_3H_8O
Krypton	Kr
Nitrogen	N_2
Oxygen	O_2
Water	H_2O

IVP Premium Library Compounds (Full Spectrum)

Name	Formula
Acetonitrile	C_2H_3N
Benzene	C_6H_6
Cyclohexane	C_6H_{12}
Diethyl ether	$C_4H_{10}O$
Dioxane	$C_4H_8O_2$
Ethyl acetate	$C_4H_8O_2$
Hexane	C_6H_{14}
Methanol	CH_4O
n-Propanol	$C_3H_8O_2$
Pentane	C_5H_{12}
Tetrahydrofuran	C_5H_8O
Toluene	C_7H_8

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6.2 SRS LIBRARY SUBSTANCES

Below is the list of SRS library substances included in AutoZ+ premium version software along with their chemical formulas (if available).

SRS Premium Library Substances (Partial Spectrum - Include Top 10 Peaks Only)					
Name	**Formula**	**Name**	**Formula**	**Name**	**Formula**
1,3-Butadiene	C_4H_6	Formamide	CH_3NO	Octane	C_8H_{18}
2-Butanone	C_4H_8O	Formic acid	CH_2O_2	*o*-Xylene	C_8H_{10}
Acetic Acid	$C2H_4O_2$	Freon 11	CCl_3F	*p*-Cresol	C_7H_8O
Acetophenone	C_8H_8O	Freon 12	CCl_2F_2	Pentane	C_5H_{12}
Acetylene	C_2H_2	Freon 13	$CClF_3$	Phenol	C_6H_6O
Ammonia	NH_3	Hydrogen bromide	HBr	Phosgene	CCl_2O
Aniline	C_6H_7N	Heptane	C_7H_{16}	Phosphine	PH_3
Anisole	C_7H_8O	Hydrazine	H_4N_2	Propane	C_3H_8
Benzoic acid	$C_7H_6O_2$	Hydrochloric acid	HCl	Propene	C_3H_6
Butane	C_4H_{10}	Hydrogen isocyanide	CHN	Propenoic acid	$C_3H_4O_2$
Butanoic acid	$C_4H_8O_2$	Hydrogen sulfide	H_2S	Propyne	C_3H_4
Carbon tetrachloride	CCl_4	*m*-Cresol	C_7H_8O	*p*-Xylene	C_8H_{10}
Carbon tetrafluoride	CF_4	Methane	CH_4	Pyrrole	C_4H_5N
Chlorobenzene	C_6H_5Cl	Methyl acetate	$C_3H_6O_2$	Silane	SiH_4
Chloroform	$CHCl_3$	Methyl chloride	CH_3Cl	Silicon tetrafluoride	SiF_4
Cyclopentane	C_5H_{10}	Methyl fluoride	CH_3F	Sulfur dioxide	SO_2
Diborane	B_2H_6	Methylamine	CH_5N	Sulfur hexafluoride	SF_6
Dichloromethane	CH_2Cl_2	*m*-Xylene	C_8H_{10}	Trichloroethylene	C_2HCl_3
Dimethylamine	C_2H_7N	Neon	Ne	Mechanical pump oil	
Ethane	C_2H_6	Nitric oxide	NO	DC705 diffusion pump oil	
Ethene	C_2H_4	Nitrobenzene	$C_6H_5NO_2$	Fomblin diffusion pump oil	
Ethylbenzene	C_8H_{10}	Nitrogen dioxide	NO_2	PPE diffusion pump oil	
Fluorobenzene	C_6H_5F	Nitrous oxide	N_2O	Turbopump oil	
Formaldehyde	CH_2O	*o*-Cresol	C_7H_8O		

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