835 VQM®
Vacuum Quality Monitor™ System

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The Vacuum Quality Monitor (VQM) combines the highest performance gas analysis technology with intelligent functional design to transform complex measurement into actionable information. The 835 VQM system is the world's fastest, lowest power, gas compositional analysis instrument with full data collection, spectral deconvolution, and data logging at 85 msec capture rates over the full 1–145 amu measurement range. The VQM can monitor a full 1-300 amu at 120 msec rates. Partial scans can be selected to allow even faster scanning.

In any vacuum system, it is critical to know the vacuum pressure. In many cases, it can be just as important to know the composition of the gases in the system. The 835 VQM is a mass spectrometer that operates from UHV to 1×10^{-5} Torr and accurately measures the gases in the vacuum chamber. The VQM system consists of an autoresonant ion trap mass spectrometer gauge, a VQM Controller and VQM Viewer software that converts raw data to actionable information. The system is ratiometric, meaning that it determines the ratio of each gas to other gases in a vacuum chamber. It is usually coupled with a total pressure gauge to provide partial pressures of each gas which provides an indication of the quality of the vacuum in a chamber.

Out-of-the-box you see your 10 most prevalent gases, total pressure trending (with optional total pressure gauge), partial pressure trending, spectral display, data logging, data capture, gas fitting library for 10 gases, and leak check. The Controller and Gauge only requires a maximum of 15 watts to operate and offers the flexibility to remotely mount the 835 VQM Gauge using a cable from 1 to 50 meters long.

Product Features

- 1–145 amu total and partial pressure measurement information in 85 msec, or 1–300 amu in 120 msec

- Instant information: 10 most prevalent gases in normalized, percentage and absolute values, total pressure and partial pressure trend graphs

- Accurate hydrogen and helium measurements (no zero blast)

- Data logging at all sample rates

Key Benefits

- Compact design and remotely mounted gauge using a cable from 1 meter to 50 meters long

- Low power - only 15 W

- Easy single-gas calibration using a gas already in your vacuum system

Revolutionary Approach

With the 835 VQM, MKS expands on its revolutionary next generation mass separation technology based on the electrostatic ion trap which:

- Scans more than 20 times faster
- Requires 80% less power
- Calibrates dramatically faster
- Accurately represents low masses
- Significantly smaller than legacy quadrupole or magnetic-sector technologies

835 VQM Technology and Uses

Autoresonant ion trap mass spectrometer technology represents an entirely new way of mass selectively ejecting ions from an electrostatic ion trap. The 835 VQM mass spectrometer gauge is natively a ratiometric measurement device that provides detailed compositional analysis of a gas mixture.

Theory of Operation

The ionizer is a filament assembly that generates ions directly inside the ion trap through electron impact ionization.

An electrostatic field traps the ions, and they oscillate at their natural frequency within the ion trap. The frequency of oscillation is inversely proportional to the square root of their mass-to-charge ratio – i.e. lighter ions oscillate at higher frequencies than heavier ions. The ions are ejected through an autoresonant energy pumping process using a low amplitude RF scan. An electron multiplier collects the ejected ions and produces a current proportional to the ion concentration.

VQM Ion Trap Mass Spectrometer Gauge

Common Uses

The 835 VQM is typically used for any manufacturing or experimentation process that occurs in a vacuum (glass coating, semiconductor manufacturing, beam line gas
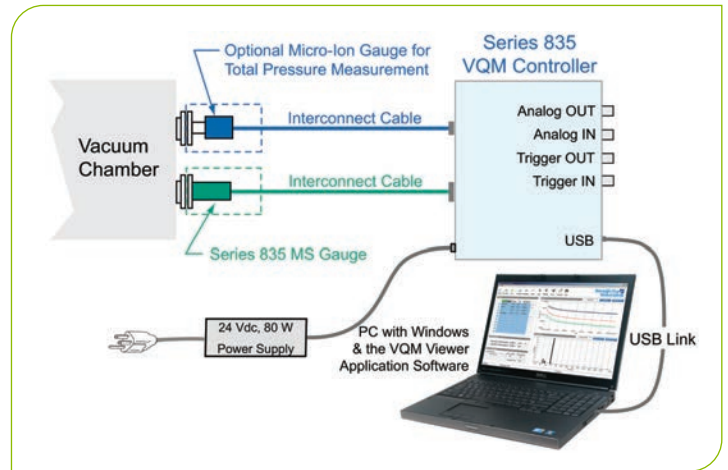
Typical VQM System Diagram

analysis, etc.). Primary usage includes system baselining, post chamber PM verification, leak detection, contamination monitoring, process monitoring, and checking the quality of the vacuum in the system.

Field Replaceable Assemblies

The filament and electron multiplier are easily replaced by your own service technicians. Replacement kits provide everything needed – including an easy-to-follow instruction guide – to assure quick, simple, and cost effective replacement, as well as maximizing system uptime.

Field Replaceable Filament

Compact Size and Remote Mounting

The small size of the VQM gauge allows the system to be used in applications where space and weight limitations are crucial. The gauge is not mounted to the controller, thereby making the system ideal for use in harsh environments such as accelerators and beam lines where radiation is known to cause some electronics to malfunction. In addition, multiple gauges can be operated by just one VQM Controller by simply moving the interconnect cable to a different VQM gauge, thereby eliminating the requirement of multiple controllers on a process chamber or system.

UHV Compatibility

The materials, composition and construction of the 835 VQM Gauge are commensurate with standard ultra-high vacuum technology and UHV gauging including stainless steel, ceramics, and refractory materials.

High Resolution Low Mass Spectra

Unlike current quadrupole mass spectrometers, the VQM System accurately reports the spectra of low amu gases, such as helium and hydrogen, and includes hydrogen 1 in the spectra.
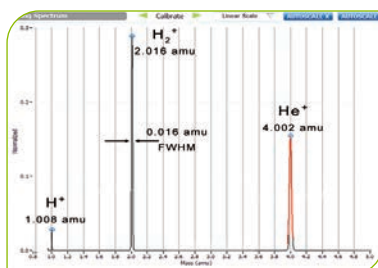
Super Fast Vacuum Quality Measurement

The VQM System provides full data collection, spectral deconvolution, and data logging at 85 msec capture rates over the full 1–145 amu range. Optionally, an entire 1-300 amu scan can be performed in 120 msec.

Ultra Low Power Requirement

The VQM Controller and Gauge system requires only 15 watts (maximum) to operate without the optional total pressure gauge. Using a low-power electrostatic field together with a small RF signal for ion ejection delivers a system that requires very low power.

Intuitive Operation

The easy-to-use 835 VQM Viewer application provides a full set of features and functions to enable quick vacuum quality measurement and data logging, flexible data presentation and viewing options, leak detection mode, and system configuration options.

Out-of-the-Box Functionality

The VQM System provides unparalleled ease of use with a clear listing of the 10 most prevalent (or user selected) gases with ratio (normalized), percent (%), and absolute amplitudes that are listed by amu or from a library of Reference Gases. You also get total pressure and partial pressure trend graphs, and full spectral data. A few mouse clicks gives you a log of the histogram data that is readable in the Viewer software or using Microsoft® Excel® or other common data analysis programs.

Hassle-Free Installation

The VQM mass spectrometer gauge is remotely mounted using interconnect cables up to 50 meters long. The VQM Controller can be used as a bench-top, rack-mount, or custom-mount solution.

Simple Calibration

Calibration can be completed in seconds with just a few clicks of the mouse using any single gas, including any gas that is already in your vacuum system.

Total Pressure Measurement Kit (Optional)

The 390802 provides accurate, continuous pressure measurement from 10^{-9} Torr to ATM. Integrating it with the ratiometric VQM system adds partial pressure data and automatic high pressure protection for the VQM gauge. For pressures below 10^{-9} Torr, a Series 370 Stabil-Ion® Gauge and Controller can be connected to the 835 VQM Controller with the 801202 cable.

The 835 VQM Controller is only 4.13" (W) x 7.03" (D) x 1.58" (H), making it an easy fit on nearly any system.

The VQM mass spectrometer gauge is the size of a typical ionization gauge – only 7.52 inches long including the cable connector. The mounting flange is the common 2.75 inch (NW35CF) ConFlat-type.

The VQM Controller-to-Gauge interconnect cable is available in 1, 3, 20, and 50 meter lengths.

Series 390

Series 835 VQM Controller

VQM mass spectrometer gauge

VQM interconnect cable

835 VQM Viewer Software Application

The 835 VQM Viewer Software Application provides the fastest and easiest way to access the full functionality and optimize the performance of the instrument. The Viewer Application is Windows-based and communicates with the VQM Controller through a USB 2.0 COM port.

Vacuum and system technicians will immediately benefit from the data-mining functions built into the application, including mass peak finding and gas identification. There is no need for an advanced mass spectrometry expert to determine what gases are in your system. Simple, easy-to-understand screens instantly display which gases, percentages, ratios, and pressures are present. Advanced users will find that the full set of adjustments (advanced settings) and data available in the tune screens provide a very convenient way to characterize and optimize the performance of the system.

Easy Navigation

When the VQM System is connected to a Host/PC with the VQM Viewer Application, the displays on the computer monitor enable the user to select and view many functions and readouts. A row of icons across the top of the screen provide quick links to all of the operation and tuning functions.

The first group of icons (on the left side of the screen) are the primary functions used for connecting and powering the gauge and starting the spectral scan. The second group of icons control the data display, modes of operation, and system settings (preferences). The third group of icons are for logging and save functions. Context sensitive help is available to provide system operation guidance.

Viewer Application Highlights

- Intuitive graphical user interface
- Displays the top 10 gases in the chamber
- Single gas calibration
- Mass spectrum output
- Pressure vs. time trend display
- Leak detection with graphic display/audio
- DSP for noise reduction and peak finding
- Logging of data & playback
- Advanced settings and tuning functions
- VQI provides equation-based control of alarms and a digital output

Summary Screen

The Viewer software collects, analyses, and interprets mass spectra. The software averages the mass spectra, finds and quantifies the peaks, and displays that information on the computer monitor. Live displays of scan data show the gases in the vacuum chamber (up to 10 gases/masses), pressures, trends, total pressure, averaging, and the spectrum histogram.

Tuning Functions

The Tune Screen is used for calibration, electron multiplier gain adjustment, RF amplitude adjustment, and ion trap configuration. The tune screen provides access to the raw spectral output of the mass spectrometer and also to the header information which provides specific information on parameters, status, and hardware. The tune screen also provides access to the factory default and user settings. Advanced mass spectrometry experts can use the tune screen capabilities to customize the instrument for specific operating parameters. An Auto Tune function automatically determines the appropriate settings for optimum system performance.
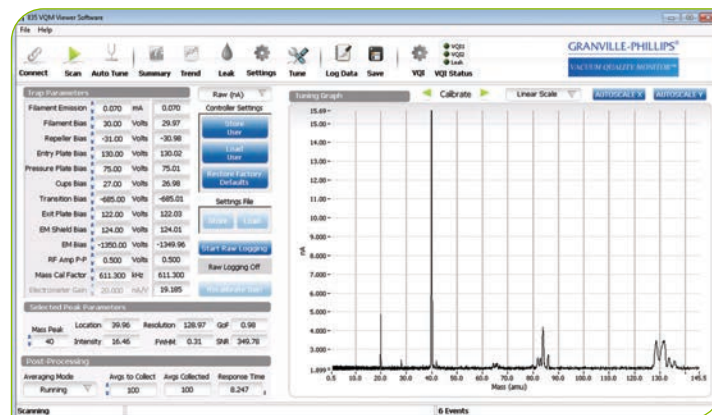
Displayed Results

Gas analysis results are displayed as ratios (normalized), percentages (%), and absolute values (with the optional total pressure gauge). Graphical screen displays show the total pressure, partial

Gas	Mass	Norm	%	Pressure	
Water		1.000	42.5	3.23E-9	∧
Nitrogen		0.480	20.4	1.55E-9	∧
CO2		0.254	10.8	8.20E-10	∧
Hydrogen		0.251	10.7	8.11E-10	∧
Oxygen		0.154	6.57	4.98E-10	∧
CO		0.032	1.37	1.04E-10	∿
26		0.031	1.32	1.00E-10	∿
30		0.031	1.31	9.94E-11	∿
17		0.031	1.31	9.90E-11	∿
27		0.028	1.21	9.17E-11	∿

pressure, and full spectral data. Partial pressure trend graphs and a leak testing screen allow monitoring specific gas concentrations and partial pressures as a function of time.

Histogram

The Histogram displays the spectrum in a histogram format and can display either normalized values or partial pressure (if a total pressure gauge is connected).
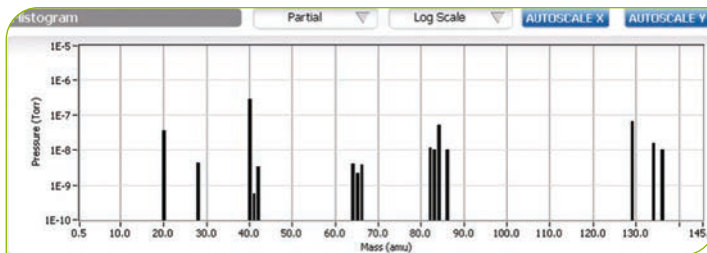

Leak Checking

The leak checking screen allows you to select from a list of leak-check gases (Hydrogen, Helium, Nitrogen, Argon, and Freon) and displays a graph showing the current leak limit and a trend graph of the partial pressure of the selected gas. An audible tone can also be used to track the leak gas.

Easy to Calibrate

The VQM System is very easy to calibrate using any gas (1–145 amu) already in the vacuum chamber. Simply select any known peak and click on the arrows to align the known peak to the proper amu setting. All other gases will also display correctly. A zoom function makes it easy to see the waveform of the selected peak.

VQI (Vacuum Quality Index)

Audible alarms and a digital output can be driven by custom equations which monitor the total pressure, partial pressures or preferences. The equations can use Boolean AND and OR functions together with less than, greater than, and equals operators. For the "equals" operation, a tolerance can be provided. The VQI equation can be manually entered or automatically created from a stored spectrum.

Trending

The Trend graph on the summary screen shows a 15 minute view of the top 10 gases in the system. The display can use either log or linear scale. A zoom function allows better visibility. There is also an infinite time period trend graph. To fit a longer time scale on the graph and keep the data storage size reasonable, the trend screen will drop intermediate data points as needed.
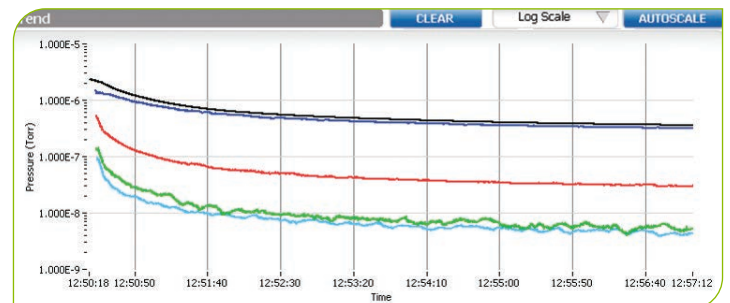
Data Logging

Raw data or processed data can be logged at full scan rates for a user selected length of time. The processed data is much smaller as it only saves the amplitude at each amu. Processed data logging allows you to select the logging interval to save disk space when recording for long periods of time. Logs can be displayed in the viewer software and raw logs can be played back to allow for further analysis of the data. There is also a save function that saves a snapshot of the raw, averaged data, plus the histogram and trend information for all species. Data is saved in a csv (comma-separated values) ASCII files.

Specifications

835 VQM Controller

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Mass Range/Scan Time	1–145 amu in 85 msec, 1–300 amu in 120 msec
Inputs and Outputs	
390802 Total Pressure Module	Rear panel connection, 1-meter or 3-meter long cable, RS-485; 50 msec response time for overpressure protection
835 VQM MS Gauge	Rear panel connection to the gauge
Data I/O, USB (Type B)	USB 2.0, full speed, 12 Mb/sec
Trigger In (BNC)	50 ohm, positive TTL edge trigger, 1 msec minimum
Trigger Out (BNC)	50 ohm, active high, TTL, frame scan, or VQI status
Analog In (BNC)	10K ohm, 0-10 V, 12 bit resolution
Analog Out (BNC)	0 to +5 V with 30 KHz 3 db bandwidth, raw data scan output LEDs, Front Panel EXT TP, USB, Trigger IN, Trigger OUT, Analog IN, Analog OUT
Power, Controller and MS Gauge Only	24 VDC, 8 watts typical, 15 watts maximum; a universal power supply is available
Power, with optional Total Pressure Module	24 VDC, 75 watts maximum
Input Power Plug	DC power jack, 5.5 mm OD x 2.5 mm ID x 11 mm long
Operating Temperature	0°C to 40°C (32°F to 104°F)
Non-Operating Temperature	0°C to 80°C (32°F to 176°F)
Relative Humidity	< 90%, non-condensing
Physical Dimensions	17.85 cm long x 10.49 cm wide x 4.01 cm. high (7.03 x 4.13 x 1.58 inches)
Weight	720 grams (25 ounces)
Compliance	CE

835 VQM Viewer Software

Supported Hardware	835 VQM Controller 835 VQM MS Gauge 390802 Micro-Ion ATM Total Pressure Monitor Interface, USB Port, USB 2.0, full speed (12 Mb/s)
Vacuum Quality Monitor	
Top Ten Gases Display Table	Automatic listing by amu or gas type (user selectable)
Gas Recipe Fit	Correlation fit against expected gas spectrum
Gas Recipe Fit Response Time	85 msec, 1–145 amu, 10-gases, with the recommended PC
Total Pressure Response Time	85 msec - including overpressure protection
Pressure Trend of User Selected Gases	10 maximum plus total pressure, user selection in display table
Sensor Spectrum	Displayed, 1–145 amu or 1–300 amu
Data Capture & Logging	
Capture, Display Information	1–145 amu scan, total pressure, timestamp, status
Logging, VQM Data	Comma delimited text format (MS Excel Compatible) 1–145 amu scan (1-300 amu optional), total pressure, timestamp, status per scan, 85 msec logging rate using the recommended PC
835 VQM Controller Configuration	Acquisition Modes via application control or external trigger control, calibration, ON/OFF, run/stop, gauge settings, user configuration, save and restore, factory setting restore
Other Features	
Leak Detection	User assigned limit and leak gas detection, audible tone relative to the quantity of leak
Software Interface	API, LabVIEW Vis

835 VQM Mass Spectrometer Gauge

Measurement Range	UHV to 1 x 10^{-5} Torr
Mass Range	1 to 145 amu or 1 to 300 amu
Mass Separator Type	Autoresonant Ion Trap
Resolution (m/Dm)	120 Full Width Half Maximum (FWHM) for 1-145 amu gauge
	180 Full Width Half Maximum (FWHM) for 1-300 amu gauge
Dynamic Range	2 decades for single scan, 4 or more with averaging
Response Time	85 msec (1–145 amu) or 120 msec (1-300 amu)
Filament	Single Yttria-coated Iridium, field replaceable
Detector Type	Electron Multiplier, field replaceable
Operating Temperature	0°C to 50°C (32°F to 122°F), non-condensing
Bakeout Temperature	200°C maximum, non-operating, cable disconnected
Mounting Flange	NW35CF 2.75 inch ConFlat® type
Interconnect Cables	1 meter long / 3 meters / 10 meters / 20 meters / 50 meters
Physical Dimensions	19.10 cm long (including connector) x 3.81 cm dia. (7.52 x 1.5 inches)
Weight	420 grams (14.8 ounces)
Materials Exposed to Process Environment	304 L Stainless Steel, 316 L Stainless Steel, Alumina Ceramic, Al_2O_3 98% Min., Nickel, Molybdenum, Ag/Cu eutectic braze, Gold, Iridium, Yttria, Y_2O_3 99.95%, Lead Glass (multiplier body), Chromium

835 VQM Viewer Software Computer Requirements

Processor/Memory	Intel® Core™ 2 Duo T7250 @ 2 GHz with 2.56 GB RAM or equivalent
Display Resolution	Minimum: 1024 x 768 pixels, larger to take advantage of resizing
Operating System	Windows® 7 (32 or 64 bit) / Windows® XP (32 bit) SP2, .NET 3.5 Framework SP1
Disk Space	Minimum: 1.6 GB (More needed for large log files.)
Optional Development	LabVIEW™ 2011 required to use LabVIEW VIs.
Environment	.NET development platform required to use API. (Tested with Visual Studio 2010.)
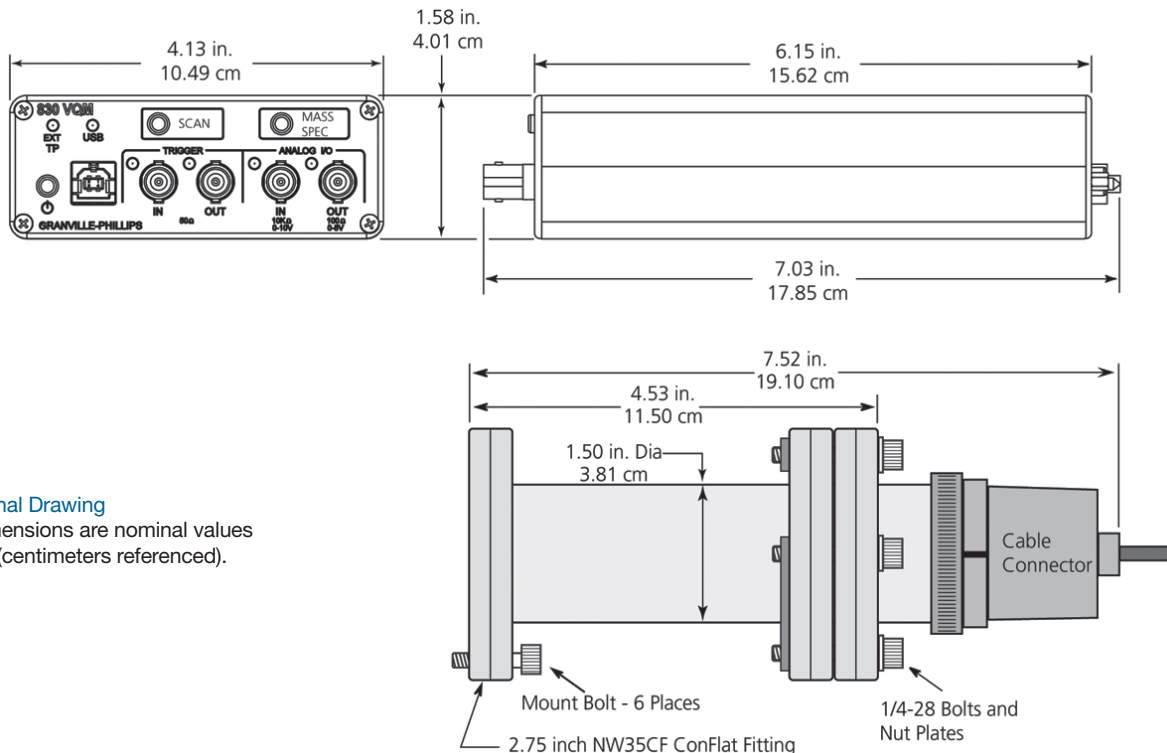
Dimensional Drawing
Note: Dimensions are nominal values in inches (centimeters referenced).

Ordering Information

835 VQM Controller and Software

VQM Controller for one MS Gauge, benchtop mount, USB 2.0, 1-145 or 1-300 amu, with power supply and cord.		835500-U#-#(*)
Cable, VQM Controller to Mass Spectrometer Gauge	1 = 1-145 amu; 3 = 1-300 amu	835300-##M(**)
835 Software Suite (Viewer Application, LabVIEW VI)		835400

835 VQM Mass Spectrometer Gauge

835 MS Gauge, Channel Electron Multiplier Detector, Yttria-coated Iridium filament, 2.75-inch (NW35CF) ConFlat®-type flange	1 = 1-145 amu (120 resolution) 1-300 amu (180 resolution N = Nude D = in demountable envelope	835100-YG-# X

VQM Total Pressure Measurement Kit

Total Pressure Micro-Ion® ATM Module Absolute Pressure, 10⁻⁹ to ATM, RS-485, dual Yttria-coated Iridium ion gauge filaments, gauge filament protection, digital display with total pressure, 2.75-inch (NW35CF) ConFlat-type flange, Torr (can be changed to mbar or Pa using the 835 Viewer Application Software)	390802-2-YG-T
Cable, VQM Controller to Mass Spectrometer Gauge	802301-##M(***)

Accessories

Field Replaceable Filament Assembly Kit	830105-Y-K
Field Replaceable Electron Multiplier Kit	835110-K
Cable, for log/linear analog output (1/8" miniature phone jack) from an MKS Ion Gauge Controller (such as a Series 370 Stabil-Ion) to the analog input (BNC) on the 835 VQM Controller, 10 meters (32.8 ft)	801202-10M
Demountable Envelope (Nipple) for Nude Gauge, 2.75 inch (NW35CF) flange, includes port screen	801270
T-Flange, 2.75 inch (NW35CF) flanges	801272
Hardware/Bolt Kit, includes 6 flange bolts and washers, 3 plate nuts, and 1 copper gasket	801274-1
Wrench, 1/4", 12 pt.	801275

(*) # -1 = North American 115 VAC & Japan 100 VAC, -2 = North American 240 VAC, -3 = Universal European 220 VAC, -4 = United Kingdom 240 VAC
(**) # -01 = 1 meter (3.28 ft), -03 = 3 meters (9.84 ft), -10 = 10 meters (32.8 ft), -20 = 20 meters (65.6 ft), -50 = 50 meters (164 ft)
(***) # -01 = 1 meter (3.28 ft), 03 = 3 meters (9.84 ft)