

# Pressure & Vacuum Measurement Solutions

## Advanced Vacuum Measurement Solutions

PRODUCT GUIDE FOR VACUUM GAUGES,  
CONTROLLERS, TRANSDUCERS, AND MODULES



## Advanced Vacuum Measurement Solutions

Users worldwide turn to MKS Granville-Phillips® for reliable, precise and dependable vacuum measurement technology.

MKS vacuum gauges, electronics, modular vacuum products, and tailored solutions provide the flexibility, reliability, and precise performance that are essential for your application. The MKS line of vacuum measurement products, that measure from  $10^{-11}$  to 1500 Torr, offers the best and broadest range of vacuum and pressure measurement solutions.

Our vacuum gauges, transducers, sensors and controllers are based on multiple pressure measurement technologies including Convector®, Micro-Ion®, MicroPirani™, Piezo hot

and cold cathode, Stabil-Ion®, and MEMS-based multi-sensor technology. These vacuum gauge and transducer products are used individually or integrated in combination, providing a wide variety of pressure and vacuum measurement options in terms of gas independence, covered pressure ranges and tolerance to aggressive gases.

If your vacuum systems are used for semiconductor process tools, analytical instruments, educational or governmental research, or industrial processes, you face an assortment of challenges. MKS is the solution—providing accuracy, stability and dependability to improve the quality and productivity of your vacuum processes.

### Stabil-Ion® Gauges, Controllers and Spinning Rotor Gauge

Stabil-Ion® products are the most accurate products in Bayard-Alpert (B-A) hot cathode gauge technology and electronics. They are used in vacuum research and manufacturing processes where accurate and repeatable vacuum pressure indication is critical. Stabil-Ion gauges are an all-metal B-A style gauge that was developed to provide and maintain long-term accuracy over the life of the product. Many patented design features have removed the inaccuracies and pressure indication changes that occur with typical B-A gauge products. The Spinning Rotor Gauge (SRG) line is a high-vacuum gauge that operates by measuring the amount of viscous drag on a magnetically-levitated spinning ball, which is directly related to the number of molecules in the chamber.



#### Series 360 and 370 Stabil-Ion® Gauges

- All-metal with precision-wound, stress-relieved anode retains shape for the life of the gauge
- Rugged stainless steel construction prevents grid and filament damage
- Tensioned dual filaments stay precisely positioned to maintain stability and calibration
- Vacuum-fired components prevent contamination and speed system pumpdown
- Unique design and precise manufacturing processes assure long-term, accurate measurement



#### Series 370 Stabil-Ion® Vacuum Measurement System

- Rack-mount controller for Stabil-Ion and Convector is noise-immune
- Provides accurate pressure measurement from the  $10^{-11}$  Torr range
- Dual convector gauge option extends pressure measurement to atmosphere and allows automatic turn on/turn off of the Stabil-Ion gauge
- Simultaneous 3-digit display pressure for three gauges
- RS-232 and RS-485 computer interface options



#### Spinning Rotor Gauge System

- Transfer standard for vacuum measurement
- Recognized transfer standard for calibration in  $10^{-2}$  to  $10^{-7}$  Torr (mbar) vacuum range, DKD traceable
- Insensitive to ionization effects from other vacuum gauges
- Long term stability
- Guaranteed precision from  $5 \times 10^{-7}$  to  $1 \times 10^{-2}$  mbar (Torr)



# Vacuum Measurement Products

## Micro-Ion® Gauges, Controllers and Modules

The Micro-Ion® gauge is the world's smallest B-A style gauge in an all-metal, rugged enclosure. Micro-Ion gauges are compact, reliable, cost-effective, and measure a wide range of vacuum pressure. Micro-Ion modules are available with dozens of different options and capabilities to meet any need for accurate pressure measurement from  $10^{-9}$  Torr to atmosphere.



### Series 355 Miniature Bayard-Alpert Gauges

- Rugged all-metal enclosure prevents grid and filament damage and eliminates the risk of glass breakage
- Measures pressure from  $5 \times 10^{-10}$  to  $5 \times 10^{-2}$  Torr
- Less than 5% of the volume of conventional glass B-A gauges
- Only 8% of the power consumption of typical glass or nude B-A gauges
- Dual tungsten or burn-out resistant yttria-coated iridium filaments provide long gauge life



### Series 358 Micro-Ion® Vacuum Gauge Controller

- Compact, reliable, rack-mount controller for optimum Micro-Ion gauge performance
- Vacuum pressure measurement from  $10^{-10}$  Torr range
- Dual Convectron gauge option extends pressure measurement to atmosphere and allows automatic turn on/turn off of the Micro-Ion gauge
- Process control options with up to six set point relays and manual override
- RS-232 or RS-485 computer interface options



### Series 355, 392, 390 Micro-Ion® Modules and Transducers

- **Series 355:** Micro-Ion transducer provides vacuum pressure measurement from  $5 \times 10^{-9}$  Torr to  $10^{-2}$  Torr
- **Series 392:** Combines Micro-Ion and Conductron® sensors to provide measurement from  $10^{-9}$  Torr to atmosphere
- **Series 390:** Combines Micro-Ion, Conductron and Piezo resistive sensors to provide measurement from  $10^{-9}$  Torr to atmosphere, along with gas independent atmospheric pressure indication

## Bayard-Alpert Vacuum Gauges and Controllers

Classic glass and nude B-A gauges provide good vacuum measurement at an economical cost. Nude B-A gauges for use in UHV systems are commonly used with the Series 307 and the Series 350 UHV vacuum gauge controller to measure pressures down to the  $10^{-11}$  Torr range. The Series 307 and 350 controllers are easy to use and offer optional pressure set points that allow control of various system functions such as switching valves, interlocks, alarms, etc.



### Series 274 Glass and Nude B-A Gauges

- Industry standard electrode voltages, wide range electron emission currents 10  $\mu$ A to 10 mA
- Available with burn-out resistant filaments and standard vacuum connections
- Can be degassed by electron bombardment (EB); some can be degassed by resistance ( $I^2R$ )
- Provides good vacuum pressure measurement from  $1 \times 10^{-9}$  to  $<1 \times 10^{-3}$  for economical cost
- Available in tubulated (glass) or nude models



### Series 307 and 350 UHV Controllers

- Lower measurement limit of  $<2 \times 10^{-11}$  Torr or the X-ray limit of a B-A gauge with 10 mA emission and gauge sensitivity of 25 Torr
- Upper measurement limit of  $1 \times 10^{-2}$  Torr with 0.1 mA emission and gauge sensitivity of 25 Torr
- Controlled, adjustable emission current from 0.01 to 10 mA
- Logarithmic analog output of 1 V/decade, 0 to 10 VDC
- Up to 6-channel process set points with SPDT relays that can be set over the entire pressure range with manual override switches
- RS-232 and RS-485 interfaces



# Vacuum Measurement Products

## Cold Cathode Gauges, Modules and Transducers

The Series 523 Wide Range Cold Cathode Vacuum Transducer provides a low-cost, wide-range cold cathode suitable for industrial coatings, analytical instruments and general vacuum applications. The design of the Series 523 is the right fit for applications requiring a low-cost product with limited accuracy. The 970 Series is a family of compact, low cost, general-purpose transducers that utilize from one to three sensors — cold cathode, MicroPirani™ and Piezo technologies. Combining these sensing technologies enables a wide measurement range from  $10^{-8}$  Torr to atmosphere. In addition to its small size, broad range and lower cost, the 970 Series can be operated via digital communication or as an autonomous analog unit. The family comprises of three transducer models, the 971B UniMag (cold cathode), 972B DualMag (MicroPirani/cold cathode) and the 974B QuadMag (Piezo/MicroPirani/cold cathode). Options include a local display and set point relays. The Series 500 CCG provides unsurpassed accuracy for a cold cathode gauge. Modern design techniques together with microprocessor monitoring and control deliver long life, high accuracy and predictive and easy maintenance.



### Series 523 Wide Range Cold Cathode Transducer

- Wide measurement range of  $10^{-7}$  to Atmosphere
- Unique high pressure discharge cell
- Mountable in any orientation for ease of use and flexibility of design
- Easy sensor replacement
- Low cost replacement gauge assembly for low cost of repair



### Series 970B Cold Cathode Transducer Family

- Wide measurement range  $10^{-8}$  to 1000 Torr
- Low CCG turn on pressure ( $5 \times 10^{-4}$  Torr) for longer lifetime
- Small footprint design provides a compact solution saving tool real estate
- User-serviceable anode module designed to decrease downtime to save external repair costs
- All transducers include both analog and digital communication for ease of operation
- Simplified interface via single analog output combining individual sensor measurements



### Series 500 Cold Cathode Gauge Module

- Wide measurement range from  $10^{-10}$  to  $10^{-2}$  Torr
- Calibrated gauge option provides  $\pm 10\%$  accuracy
- Predictive and easy maintenance
- USB interface and GP connect software to setup and monitor gauge operation and usage
- Baffle keeps sputtered material from entering your process chamber



### 422, 423 & 431 I-Mag® Cold Cathode Vacuum Sensors

- Wide measurement range from  $10^{-11}$  to  $10^{-2}$  Torr
- Dual feedthrough ion collection for increased accuracy
- Optional radiation resistance and high temperature versions
- Cleaning of sensor is easy with a demountable tube
- Sensor tube less susceptible to contamination due to isolated collector



**PRESSURE MEASUREMENT RANGE**

| Pressure Range           | Measurement Range        |
|--------------------------|--------------------------|
| $10^{-11}$ to $10^{-10}$ | $10^{-11}$ to $10^{-10}$ |
| $10^{-10}$ to $10^{-9}$  | $10^{-10}$ to $10^{-9}$  |
| $10^{-9}$ to $10^{-8}$   | $10^{-9}$ to $10^{-8}$   |
| $10^{-8}$ to $10^{-7}$   | $10^{-8}$ to $10^{-7}$   |
| $10^{-7}$ to $10^{-6}$   | $10^{-7}$ to $10^{-6}$   |
| $10^{-6}$ to $10^{-5}$   | $10^{-6}$ to $10^{-5}$   |
| $10^{-5}$ to $10^{-4}$   | $10^{-5}$ to $10^{-4}$   |
| $10^{-4}$ to $10^{-3}$   | $10^{-4}$ to $10^{-3}$   |
| $10^{-3}$ to $10^{-2}$   | $10^{-3}$ to $10^{-2}$   |
| $10^{-2}$ to $10^{-1}$   | $10^{-2}$ to $10^{-1}$   |
| $10^{-1}$ to 1           | $10^{-1}$ to 1           |
| 1 to 10                  | 1 to 10                  |
| 10 to 100                | 10 to 100                |
| 100 to 1000              | 100 to 1000              |

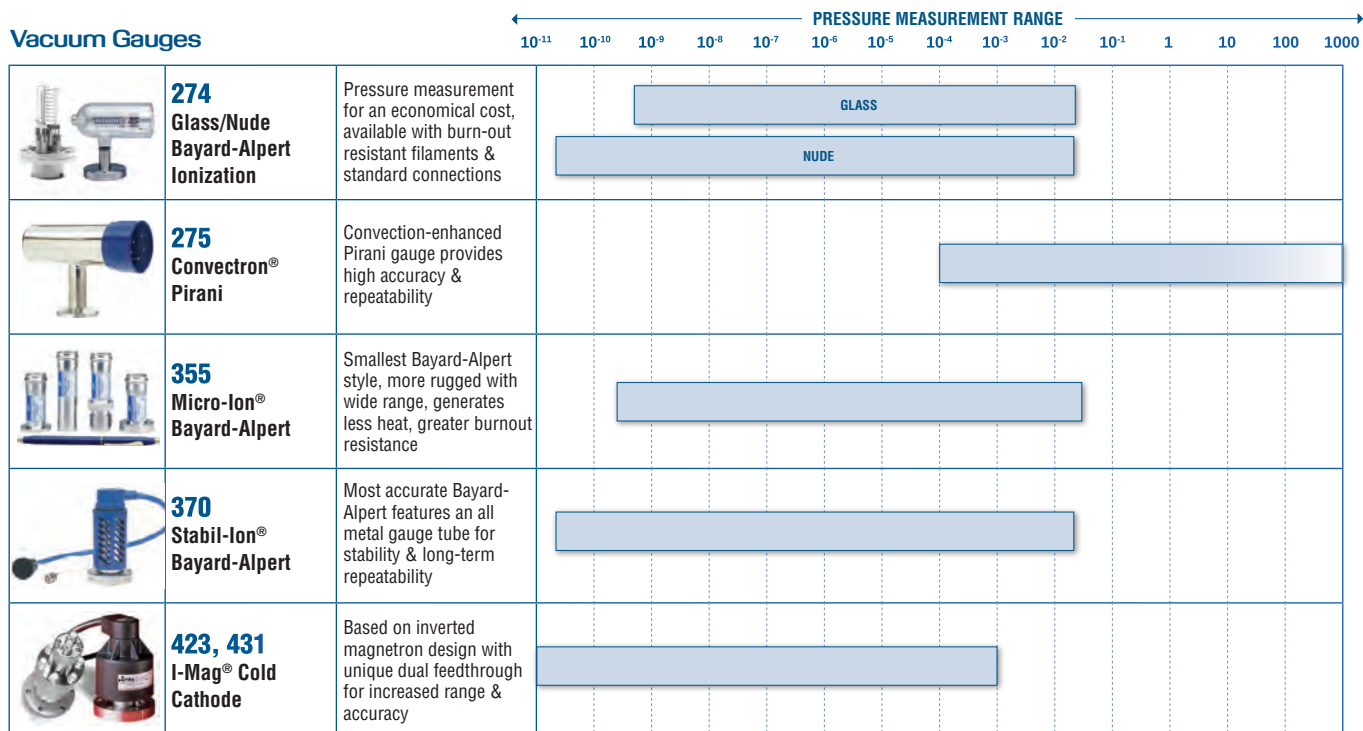
**Vacuum Quality Monitor (VOM®) Systems**

Operating Pressure Range

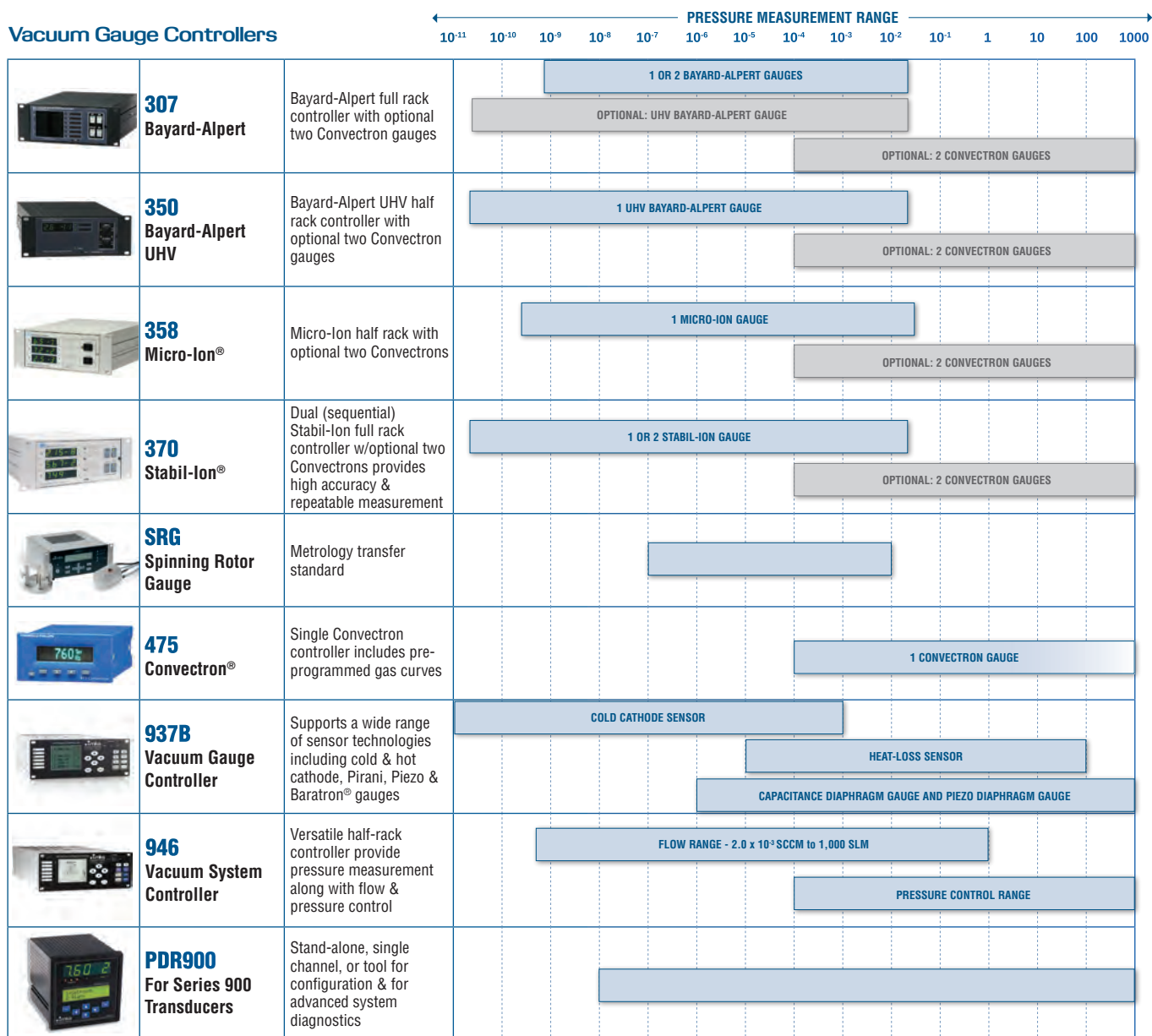
10<sup>-11</sup> 10<sup>-10</sup> 10<sup>-9</sup> 10<sup>-8</sup> 10<sup>-7</sup> 10<sup>-6</sup> 10<sup>-5</sup> 10<sup>-4</sup> 10<sup>-3</sup> 10<sup>-2</sup> 10<sup>-1</sup> 1 10 100 1000

|                                                                                     |                                                          |                                                                                                              |                                                                                     |                                                                                      |
|-------------------------------------------------------------------------------------|----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|  | <b>835</b><br><b>Vacuum Quality Monitor (VQM) System</b> | World's fastest, lowest power mass spectrometer; full data collection, spectral deconvolution & data logging |  |                                                                                      |
|  | <b>835</b><br><b>VQM Differential Pump System</b>        | Extends pressure range of VQM for process monitoring & control applications up to 3 Torr                     |                                                                                     |  |

## Vacuum Gauges



## Vacuum Gauge Controllers



## Mini-Convectron®, Convectron® Gauges, Controllers and Modules

Convectron gauges have been the world-standard convection-enhanced pirani gauge for over three decades and are used in thousands of vacuum processes to accurately measure pressure from  $10^{-4}$  Torr to atmosphere. Every Convectron gauge is individually calibrated before shipping from the factory. The Series 475 Convectron gauge controller incorporates the latest technological advances in electronics and design. Mini-Convectron modules combine the Convectron gauge with electronics in a compact modular design and are available with dozens of different options and capabilities to meet any need for accurate pressure measurement from  $10^{-3}$  Torr to atmosphere.



### Series 275 Mini-Convectron® Module

- DeviceNet digital interface facilitates easy system integration
- Wide range pressure measurement from  $10^{-3}$  Torr ( $10^{-3}$  mbar,  $10^{-1}$  Pa) to atmosphere
- Individually calibrated gauges assure highest measurement performance
- Compact, rugged, RF and noise-immune module
- Two software-controlled set point relays provide safety interlocking



### Series 275 Convectron® Vacuum Gauge

- Wide range vacuum pressure measurement from  $1 \times 10^{-4}$  Torr to atmosphere
- Individually calibrated gauges assure the highest measurement performance
- Easy installation in space-restricted locations
- Wide selection of vacuum fittings simplifies installation on your vacuum system
- Rugged construction



### Series 475 Convectron® Gauge Controller

- High-performance, compact controller for bench top or panel mount applications
- Wide range vacuum pressure measurement from  $1 \times 10^{-4}$  Torr to atmosphere
- I/O options including an analog output, set point relays, serial communication interface
- Pre-programmed gas curves for  $N_2$ , Ar, He,  $CO_2$ , and  $O_2$
- Intuitive menu control for simplified configuration, calibration, and parameter setup
- Self diagnostics
- RS-232 and RS-485 interfaces



# Vacuum Measurement Products

## Series 900 Transducers

The Series 900 vacuum transducers are microprocessor-based, stand-alone gauges that offer ultra compact design and a wide pressure measurement range. Designed for system integration, the Series 900 transducers offer both analog and digital communication and incorporate MEMS-based (Micro Electro-Mechanical Systems) technologies including MicroPirani™ and Piezo sensors. These transducers are mountable in any orientation without loss of accuracy for ease of installation. Common features and functions of the Series 900 include:

- $1 \times 10^{-5}$  to 1500 Torr
- Up to 3 set point relays for process control
- RS-232 or RS-485 digital interface
- Analog voltage output
- Integrated display



### Series 901P MicroPirani™/Piezo Loadlock Transducer

- Accurate absolute measurement from  $10^{-5}$  to 1000 Torr, gas independent (60 to 1000 Torr)
- Fast, accurate, and repeatable pressure measurements reduces process cycle time
- Ease of integration via analog output and digital communication



### Series 902B Absolute Piezo Transducer

- Measurement range of 0.1 to 1000 Torr Full Scale
- Low cost transducer alternative to more expensive conventional transducers
- Gas independent pressure measurement for accurate, total pressure measurement
- Sensor is suitable for harsh processes due to robust design and stainless steel construction
- Solid state Piezo sensor resistant to damage from air inrush and vibrations



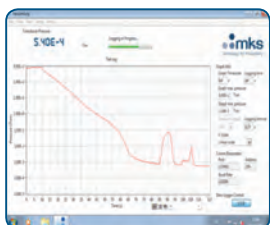
### Series 910 DualTrans™ MicroPirani™/Absolute Piezo Transducer

- Two sensors in a single transducer for space savings and wide measurement range
- Absolute pressure measurement from  $10^{-5}$  to 1500 Torr
- Gas independent absolute pressure measurement from 11 to 1500 Torr
- Fast, accurate and repeatable pressure measurements reduces process cycle time



### Series 925 MicroPirani™ Transducer

- Measurement range from  $10^{-5}$  Torr to atmosphere, 2 decades beyond a standard Pirani
- High accuracy for improved process control
- Pre-programmed gas curves for  $N_2$ , Ar, He,  $H_2$ ,  $H_2O$ , Xe and  $CO_2$



### Series 900 VacuumLog Software

- Datalogger software for Series 900 transducers
- Diagnostic tool
- Pump down curve plotting
- Freeware, no license
- Rate of rise leak testing



## Combination Gauge/System Controllers

MKS offers highly flexible vacuum gauge controllers that enable a wide range of gauging technologies, tailoring the system to each individual application. These versatile vacuum controllers provide power and simultaneous readouts for up to six different vacuum gauges and/or mass flow controllers, with options for controlling pressure, calibration, and system diagnostics. These instruments set new standards in vacuum gauge control for OEM applications.



### Series 937B Digital Combination Vacuum Gauge System

- Provides simultaneous readout for a combination of up to six vacuum gauges
- Wide measurement range of  $10^{-11}$  to 10,000 Torr
- Intuitive menu for ease of setup
- Large easy to read backlit display
- User-configurable for units of pressure in Torr, millibar, Pascal, or microns
- Configurable for up to six heated MKS Baratron® capacitance manometers
- Twelve independent relay set points for improved process control with variable hysteresis



### Series 946 Vacuum System Controller

- Simultaneous control and readout for up to six vacuum gauges and/or six mass flow controllers for ultimate versatility
- Provides pressure measurement, flow, valve, and pressure control
- Closed-loop pressure control option for use with MKS valves eliminates the need for separate pressure control electronics
- RS-232/485 computer control standard in all configurations for ease of system interfacing



### Series PDR900 Controller

- Single channel controller for use with 900 Series transducers
- LCD menu display for easy user interface
- Easy to read 5 digit LED display
- Three high power set point relays for process control
- Auto setup enables plug and play functionality
- Leak detection tool for system diagnostics
- Data logging tool for process monitoring
- Simplified setup and configuration of transducer parameters
- Front panel indicators provide clear, concise overview of set point relay status



# Vacuum Measurement Products

|                        |                                   | Vacuum Gauge Controllers |      |      |      |      |       |       |                                     |
|------------------------|-----------------------------------|--------------------------|------|------|------|------|-------|-------|-------------------------------------|
|                        |                                   | 307                      | 350  | 358  | 370  | 475  | 937B  | 946   | PDR900                              |
| Gauges and Transducers | Cold Cathode Gauge                |                          |      |      |      |      | Y(3)  | Y(3)  | For Use with Series 900 Transducers |
|                        | Stabil-Ion UHV Gauge              |                          |      |      | Y(2) |      |       |       |                                     |
|                        | Micro-Ion Gauge                   |                          |      | Y(1) |      |      |       |       |                                     |
|                        | Convectron Gauge                  | Y(2)                     | Y(2) | Y(2) | Y(2) | Y(1) | Y(6)  | Y(6)  |                                     |
|                        | B-A Glass or Nude Gauge           | Y(2)                     | Y(1) |      |      |      | Y(3)* | Y(3)* |                                     |
|                        | Nude UHV Ionization Gauge         | Y(2)                     | Y(1) |      |      |      |       |       |                                     |
|                        | Baratron® Capacitance Manometer   |                          |      | Y(1) | Y(1) |      | Y(6)  | Y(6)  |                                     |
|                        | Mass Flow Controllers             |                          |      |      |      |      |       | Y(6)  |                                     |
| Features               | Adjustable Process Control Relays | Y(6)                     | Y(6) | Y(6) | Y(6) | Y(2) | Y(12) | Y(12) | Y(3)                                |
|                        | Analog Output(s)                  | Y                        | Y    | Y    | Y    | Y    | Y     | Y     | Y                                   |
|                        | RS-232 Interface                  | Y                        | Y    | Y    | Y    | Y    | Y     | Y     | Y                                   |
|                        | RS-485 Interface                  | Y                        | Y    | Y    | Y    | Y    | Y     | Y     |                                     |
|                        | IEEE 488 Interface                | Y                        |      |      | Y    |      |       |       |                                     |
|                        | Profibus Interface                |                          |      |      |      |      | Y     |       |                                     |

Y= Yes Y + (#) = possible number of gauges or set points.

\* Low power nude gauge only.



# Vacuum Quality Monitor™

## Vacuum Quality Monitor (VQM®) Systems

Vacuum Quality Monitor systems are used by research labs and production facilities to monitor the quality and composition of the gases in their vacuum system. Typical usage includes system baselining, post chamber PM verification, leak detection, contamination checking, and monitoring the overall quality of the vacuum in the system. The sensor used in the VQM system is an auto-resonant ion trap mass spectrometer gauge – the newest and fastest technology in use today.



### Series 835 VQM® Mass Spectrometer System

- 1-145 amu total and partial measurement information in 85 ms, or 1-300 amu in 120 ms
- Instant access to 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)
- Easy single-gas calibration using a gas already in your vacuum system
- Low power requirement - only 15 W
- Remotely mounted gauge using a 1-meter to 50-meter long cable



### Series 835 VQM® Differential Pump System

- All the benefits of the 835 VQM with an extended operating range from  $5 \times 10^{-9}$  to 3 Torr
- Gate valve with orifice designed for operation at base and process pressures
- Scan range from 1-145 amu or optionally 1-300 amu
- Process control through software API, LabVIEW VIs, or dedicated output

Please contact your local MKS sales representative or visit [www.mksinst.com](http://www.mksinst.com) for more information.



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