

# Advanced Vacuum Measurement Solutions

## Product Selection Guide



Users worldwide turn to MKS Instruments 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 Convectron<sup>®</sup>, Micro-Ion<sup>®</sup>, MicroPirani<sup>™</sup>, Piezo hot and cold cathode, Stabil-Ion<sup>®</sup>, 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.

### Vacuum Measurement Products

- Stabil-Ion Gauges, Controllers and Spinning Rotor Gauge
- Micro-Ion Gauges, Controllers and Transducers
- Bayard-Alpert Vacuum Gauges and Controllers
- Cold Cathode Gauges and Transducers
- Mini-Convectron, Convectron Gauges, Controllers and Transducers
- MicroPirani and Piezo Transducers
- Combination Gauge/System Controllers



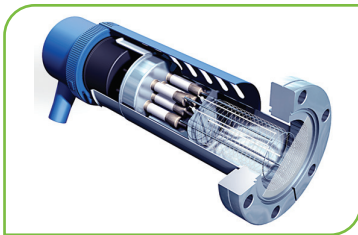
### Key Benefits

- Precise performance
- Integrated technology providing a wide variety of measurement
- Ideal for semiconductor, analytical, research and industrial applications

## 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. The SRG is an industry calibration standard, often used in a metrology department.



### 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)

## Micro-Ion® Gauges, Controllers and Transducers

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. Analog, RS-485, DeviceNet™ and EtherCAT®\* interface options available.
- **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. Analog, RS-485, DeviceNet and EtherCAT\* interface options available.

## 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

## Cold Cathode Gauges and Transducers

MKS Instruments offers a wide range of cold cathode products. The 970B 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 970B 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.



### Series 971 UniMag™ Cold Cathode Transducer

- Absolute measurement range from  $1 \times 10^{-8}$  to 0.005 Torr
- Cold cathode anode module design is user serviceable to decrease downtime
- Ease of operation via analog output, RS-232, or RS-485
- Three user configurable relays for process control
- Small footprint design provides a compact transducer solution



### Series 972 DualMag™ Cold Cathode and MicroPirani™ Transducer

- Absolute measurement from  $10^{-8}$  Torr to atmosphere
- Cold cathode anode module design is user serviceable to decrease downtime
- Ease of operation via analog output, RS-232, RS-485 or EtherCAT\*
- MEMS based MicroPirani sensor for low auto cold cathode turn-on pressure
- MicroPirani is automatically zeroed during pump down cycle for improved accuracy
- Small footprint design provides a compact transducer solution



### Series 974 QuadMag™ Cold Cathode Transducer

- Absolute measurement from  $10^{-8}$  Torr to atmosphere
- Cold cathode anode module is user serviceable to decrease downtime
- MEMS based MicroPirani sensor allows low auto cold cathode turn-on pressure
- Ease of operation via analog output, RS-232, and RS-485
- Small footprint design provides a compact transducer solution



### 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

\* For additional information on EtherCAT models, see the MKS EtherCAT Selection Guide, highlighting our comprehensive portfolio of EtherCAT-compatible products.

## Vacuum Gauge Transducers & Modules

← PRESSURE MEASUREMENT 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

	<p><b>901P MicroPirani™/Piezo Loadlock</b> MicroPirani &amp; differential Piezo for fast, accurate, gas-independent atmospheric measurement on loadlocks</p>	<p style="text-align: right;">HEAT-LOSS SENSOR      ABSOLUTE / DIFFERENTIAL DIAPHRAGM SENSOR</p>
	<p><b>902B Absolute Piezo</b> MEMS based Piezo sensor for gas-independent measurement</p>	<p style="text-align: right;">ABSOLUTE / DIFFERENTIAL DIAPHRAGM SENSOR</p>
	<p><b>910 DualTrans™ MicroPirani™/ Absolute Piezo</b> MicroPirani &amp; Absolute Piezo for increased accuracy &amp; gas-independent measurement at higher pressures</p>	<p style="text-align: right;">HEAT-LOSS SENSOR      ABSOLUTE DIAPHRAGM SENSOR</p>
	<p><b>925 MicroPirani™</b> MicroPirani provides measurement 1 – 2 decades lower than standard Pirani gauges</p>	<p style="text-align: right;">HEAT-LOSS SENSOR</p>
	<p><b>275 Mini-Convectron®</b> Convection enhanced Pirani is factory calibrated</p>	<p style="text-align: right;">HEAT-LOSS SENSOR</p>
	<p><b>355 Micro-Ion®</b> Micro-Ion transducer provides high sensitivity for low noise &amp; higher accuracy</p>	<p style="text-align: right;">HOT CATHODE ION SENSOR</p>
	<p><b>390 Micro-Ion® ATM</b> Micro-Ion, Conductron, and two Piezo sensors provide extended range &amp; gas-independent high pressure measurement</p>	<p style="text-align: right;">HOT CATHODE ION SENSOR      HEAT-LOSS SENSOR      ABSOLUTE / DIFFERENTIAL DIAPHRAGM SENSOR</p>
	<p><b>392 Micro-Ion® Plus</b> Micro-Ion &amp; Conductron are combined for full range measurement</p>	<p style="text-align: right;">HOT CATHODE ION SENSOR      HEAT-LOSS SENSOR</p>
	<p><b>971B UniMag™</b> Stand-alone compact cold cathode</p>	<p style="text-align: right;">COLD CATHODE ION SENSOR</p>
	<p><b>972B DualMag™</b> Combination cold cathode, MicroPirani</p>	<p style="text-align: right;">COLD CATHODE ION SENSOR      HEAT-LOSS SENSOR</p>
	<p><b>974B QuadMag™</b> Combination cold cathode, MicroPirani, differential Piezo</p>	<p style="text-align: right;">COLD CATHODE ION SENSOR      HEAT-LOSS SENSOR      ABSOLUTE / DIFFERENTIAL DIAPHRAGM SENSOR</p>

### Vacuum Gauges



	<b>274 Glass/Nude Bayard-Alpert</b> Pressure measurement for an economical cost, available with burn-out resistant filaments & standard connections	GLASS NUDE
	<b>275 Convector® Pirani</b> Convection-enhanced Pirani gauge provides high accuracy & repeatability	
	<b>355 Micro-Ion® Bayard-Alpert</b> Smallest Bayard-Alpert style, more rugged with wide range, generates less heat, greater burnout resistance	
	<b>370 Stabil-Ion® Bayard-Alpert</b> Most accurate Bayard-Alpert features an all metal gauge tube for stability & long-term repeatability	
	<b>423, 431 I-Mag® Cold Cathode</b> Based on inverted magnetron design with unique dual feedthrough for increased range & accuracy	

### Vacuum Gauge Controllers



	<b>307 Bayard-Alpert</b> Bayard-Alpert full rack controller with optional two Convector gauges	1 OR 2 BAYARD-ALPERT GAUGES OPTIONAL: UHV BAYARD-ALPERT GAUGE OPTIONAL: 2 CONVECTOR GAUGES
	<b>350 Bayard-Alpert UHV</b> Bayard-Alpert UHV half rack controller with optional two Convector gauges	1 UHV BAYARD-ALPERT GAUGE OPTIONAL: 2 CONVECTOR GAUGES
	<b>358 Micro-Ion®</b> Micro-Ion half rack with optional two Convector gauges	1 MICRO-ION GAUGE OPTIONAL: 2 CONVECTOR GAUGES
	<b>370 Stabil-Ion®</b> Dual (sequential) Stabil-Ion full rack controller w/optional two Convector gauges provides high accuracy & repeatable measurement	1 OR 2 STABIL-ION GAUGE OPTIONAL: 2 CONVECTOR GAUGES
	<b>SRG Spinning Rotor Gauge</b> Metrology transfer standard	
	<b>475 Convector®</b> Single Convector controller includes pre-programmed gas curves	1 CONVECTOR GAUGE
	<b>937B Vacuum Gauge Controller</b> Supports a wide range of sensor technologies including cold & hot cathode, Pirani, Piezo & Baratron® gauges	COLD CATHODE SENSOR HEAT-LOSS SENSOR CAPACITANCE DIAPHRAGM GAUGE AND PIEZO DIAPHRAGM GAUGE
	<b>946 Vacuum System Controller</b> Versatile half-rack controller provide pressure measurement along with flow & pressure control	FLOW RANGE - 2.0 x 10 <sup>-3</sup> SCCM to 1,000 SLM PRESSURE CONTROL RANGE
	<b>PDR900 For Series 900 Transducers</b> Stand-alone, single channel, or tool for configuration & for advanced system diagnostics	

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

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® Transducers

- 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

- 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



## MicroPirani™ and Piezo 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.



### 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 reduce process cycle time
- Ease of integration via EtherCAT\*, RS-232 or RS-485 and analog user interfaces



### 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
- Ease of integration via EtherCAT\*, RS-232 or RS-485 and analog user interfaces



### 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 reduce 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  $CO_2$
- Ease of integration via EtherCAT\*, RS-232 or RS-485 and analog user interfaces

\* For additional information on EtherCAT models, see the MKS EtherCAT Selection Guide, highlighting our comprehensive portfolio of EtherCAT-compatible products.

## 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

## Comparison Chart

		307	350	358	370	475	937B	946	PDR900
<b>Gauges and Transducers</b>	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)	
<b>Features</b>	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.

## WHY MKS?

### CRITICAL TECHNOLOGIES

World-class technology and development capabilities for leading-edge processes



### PROVEN PARTNER

Recognized leader delivering innovative, reliable solutions for our customers' most complex problems



### OPERATIONAL EXCELLENCE

Consistent execution across all aspects of our business



### COMPREHENSIVE PORTFOLIO

Extensive offering of products and services for the markets we serve



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**MKS INSTRUMENTS** enables technologies that transform our world. We deliver foundational technology solutions to leading edge semiconductor manufacturing, electronics and packaging, and specialty industrial applications.

We apply our broad science and engineering capabilities to create instruments, subsystems, systems, process control solutions and specialty chemicals technology that improve process performance, optimize productivity and enable unique innovations for many of the world's leading technology and industrial companies.

Our solutions are critical to addressing the challenges of miniaturization and complexity in advanced device manufacturing by enabling increased power, speed, feature enhancement, and optimized connectivity. Our solutions are also critical to addressing ever-increasing performance requirements across a wide array of specialty industrial applications.

Additional information can be found at [www.MKS.com](http://www.MKS.com).

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