

# UHV Vacuum Gauges for Accelerator Physics



Ideally suited for High Energy Physics (HEP) applications, the Series 937B ultra high vacuum gauging system incorporates the technologies of the cold cathode and

convection Pirani sensors. The 937B operates as many as six sensors simultaneously and measures pressures from  $10^{-11}$  to 760 Torr.

## Product Features

### Series 937B Controller

- Wide measurement range of  $10^{-11}$  to 760 Torr
- Easily operates up to 6 sensors via 3 gauge slots
- Displays up to 6 pressure readings simultaneously
- Repeatable measurements and 12 independent relay set points for improved process control
- Field upgradeable, modular design
- Easy to operate
- Fast response cold cathode option for system protection
- Computer interface: RS232, RS485 (built in) and Profibus<sup>®</sup> DPV1 (optional)

### Series 317 Bakeable Pirani Sensor

- Measures from atmosphere to  $1 \times 10^{-3}$  Torr
- Simple operation removes electronics for bakeout to 250°C
- Radiation resistant

### Series 422 Cold Cathode Sensor

- Inverted Magnetron design provides pressure measurement of  $10^{-2}$  to  $10^{-11}$  Torr
- Bakeable to 250°C while operating
- Radiation resistant
- Optional field emitter for improved UHV starting times
- UHV construction
- Dual feedthrough design provides accurate, repeatable measurement
- LEMO connectors allow for easy interchange of cables



## Applications

The UHV gauging system can be used for applications requiring any of the following: high temperature bakeout, radiation-resistance; or  $10^{-11}$  Torr measurements.

The vacuum measurement sensors can be installed on linear accelerators, booster rings, storage rings, beamlines and vacuum pumping systems.

The Series 937B combination vacuum gauge system is part of the family of vacuum gauges, and will operate as many as six sensors simultaneously. Every controller is configured to the user's exact requirements by selecting sensor type. Units of pressure are user configurable, in Torr, millibar, Pascal or microns. RS232 and RS485 are standard on the 937B, with Profibus as an option.

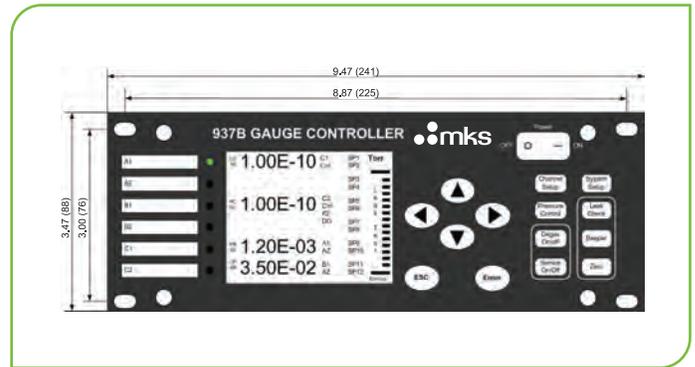
### Series 937 Controller

The 937B controller is designed for versatility, reliability and economy. The large, easy to read, backlit liquid crystal display provides readout for up to six sensors. Intuitive menus and simple push button front panel, allows for ease in setup of the 937B. The 937B allows the use of any sensor card in any card slot.

When used with the available dual convection card, the controller can display up to a maximum of six pressure inputs. Typical HEP configurations include two cold cathode cards with a dual convection card to provide simultaneous display and control of four pressure inputs.

### Fast Response Option

For applications requiring a fast response, for example valve interlocks, the 937B can be configured with a fast response cold cathode card that has an opto-isolated output. This output responds to pressure changes in less than 10 msec. A typical application would be at a synchrotron light source where the fast response option is used in conjunction with a cold cathode sensor installed on a beamline front end. In the event of a sudden pressure rise in a beamline, the fast response output is used to close an isolation valve while protecting the storage ring from possible damage.

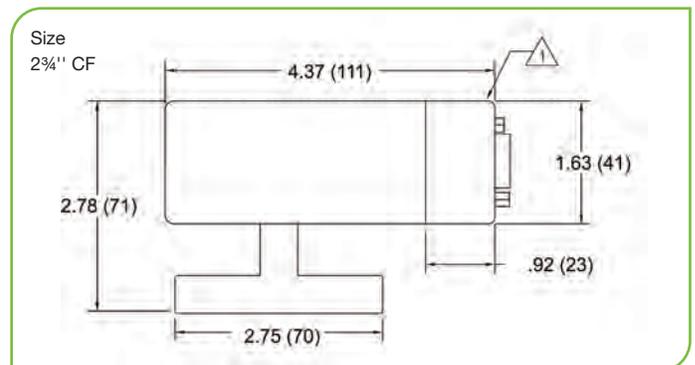


937B Dimensional Drawing

Note: Dimensions are nominal values in inches (mm referenced).

### 317 Bakeable Convection Pirani Sensor

With a measurement range from atmospheric pressure to  $1.0 \times 10^{-3}$  Torr, the 317 can be used to control the ignition of a cold cathode sensor when used in conjunction with the 937B. With the electronic module removed, the sensor is bakeable to 250°C. The electronics slide off the sensor housing after removing two screws and remain attached to the cable. The sensor is radiation resistant making it an ideal choice for high pressure measurements and interlocks on particle accelerators.



Series 317 Convection Pirani Dimensional Drawing

Note: Dimensions are nominal values in inches (mm referenced).

### 422 Cold Cathode Sensor

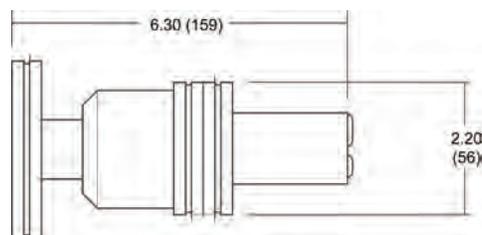
The internal design of the 422 has been carefully constructed using only materials suitable for UHV conditions. Combined with Inverted Magnetron technology, this sensor has the capability of measuring down to  $1 \times 10^{-11}$  Torr.

The 422 Cold Cathode Sensor incorporates LEMO connectors, these connectors use PEEK for the insulators which allows a sensor to be both bakeable and radiation resistant. Maximum bakeout temperature is  $250^{\circ}\text{C}$  while operating. In addition, MKS offers cables that are bakeable and radiation resistant (no Teflon<sup>®</sup>).

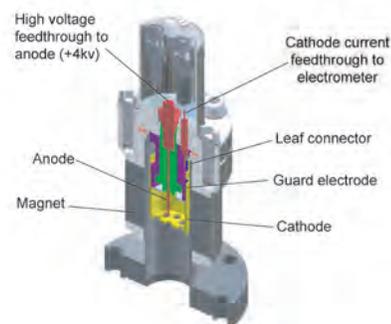
### 422 Inverted Magnetron Measurement Circuit

The IMG Measurement Circuits offer a dual feedthrough design instead of single feedthrough. The disadvantage of a single feedthrough design is that it measures all currents including unwanted currents, such as cable leakage. MKS's dual feedthrough design measures only the gauge current. This is especially important when measuring extremely small ion currents. This ensures the best accuracy and repeatability under UHV conditions and permits reliable measurement into the  $10^{-11}$  Torr decade.

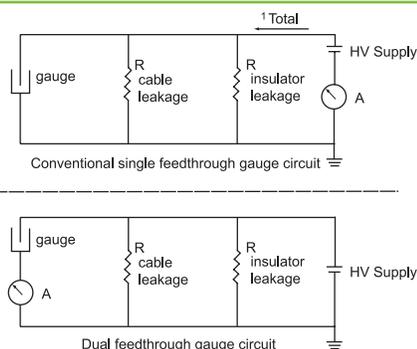
Size  
2 3/4" CF  
LEMO  
Connectors



Series 422 Cold Cathode Sensor Dimensional Drawing  
Note: Dimensions are nominal values in inches (mm referenced).



Series 422 Cold Cathode Sensor  
Cross-section of a modern inverted magnetron cold cathode sensor showing the MKS dual feedthrough design



Cold Cathode Schematics  
Circuit comparison between single and dual feedthrough designs used on cold cathode sensors

## Controller Specifications

### Series 937B Controller Specifications

<b>Measurement Range</b>	<ul style="list-style-type: none"><li>• <math>1.0 \times 10^{-11}</math> to 760 Torr (higher with optional cm card)</li><li>• <math>1.0 \times 10^{-11}</math> to <math>1.3 \times 10^{-4}</math> mbar</li><li>• <math>1.0 \times 10^{-9}</math> to <math>1.3 \times 10^{-6}</math> Pascal</li></ul>
<b>Operating Temperature</b>	5° to 40° C (41° to 104°F)
<b>Storage Temperature</b>	-10° to 55°C (14° to 131°F)
<b>Relative Humidity</b>	80% max for temperatures less than 31°C, decreasing linearly to 50% maximum at 40°C
<b>Power Requirement and Consumption</b>	150 watts maximum, 100-240 VAC, 50/60Hz - universal
<b>Set Point Relays</b>	Twelve pressure dependent set points; SPST relays, contact rating 2 amps @ 30 VAC, IEC 950 safety rating: 2A @ 50 VAC
<b>Output</b>	Buffered, log linear & linear output for each channel
<b>Front Panel Controls</b>	Power on-off switch, setup and operational commands can be accessed via the keypad
<b>Display</b>	320x240 color QVGA TFT LCD with back lighting. Up to 6 pressure displays. Display indicators for unit of measure, calibration functions, user calibration, set points, gauge position indicators
<b>Leak Test</b>	Relative logarithmic bar graph display and variable rate audio signal
<b>Electrical Connection (Sensors)</b>	<ul style="list-style-type: none"><li>• Cold Cathode (422) card BNC/SHV</li><li>• Convection Pirani (317) 9 Pin D sub</li></ul>
<b>Controller Weight</b>	8 lbs (3.6 kg)
<b>Compliance</b>	CE

## Sensor Specifications

Sensor Specifications	422 Cold Cathode	317 Convection Pirani
<b>Measurement Range</b>	<ul style="list-style-type: none"> <li>• <math>1.0 \times 10^{-11}</math> to <math>1.0 \times 10^{-2}</math> Torr</li> <li>• <math>1.3 \times 10^{-11}</math> to <math>1.3 \times 10^{-2}</math> mbar</li> <li>• <math>1.3 \times 10^{-9}</math> to 1.3 Pascal</li> </ul>	<ul style="list-style-type: none"> <li>• <math>1.0 \times 10^{-3}</math> to <math>1.0 \times 10^{+3}</math> Torr</li> <li>• <math>1.3 \times 10^{-3}</math> to <math>1.3 \times 10^{+3}</math> mbar</li> <li>• <math>1.3 \times 10^{-1}</math> to <math>1.3 \times 10^{+5}</math> Pascal</li> </ul>
<b>Resolution</b>	1% of indicated decade, except 10% below $10^{-10}$ Torr and above $10^{-3}$ Torr	1% of indicated decade
<b>Set Point Response</b>	120 ms (<10ms with CL card)	120 ms
<b>Set Point Range</b>	<ul style="list-style-type: none"> <li>• <math>2.0 \times 10^{-10}</math> to <math>9.5 \times 10^{-3}</math> Torr</li> <li>• <math>2.7 \times 10^{-10}</math> to <math>1.2 \times 10^{-2}</math> mbar</li> <li>• <math>2.7 \times 10^{-8}</math> to 1.2 Pascal</li> </ul>	<ul style="list-style-type: none"> <li>• <math>2.0 \times 10^{-3}</math> to <math>9.5 \times 10^{+2}</math> Torr</li> <li>• <math>2.7 \times 10^{-3}</math> to <math>1.2 \times 10^{+3}</math> mbar</li> <li>• <math>2.7 \times 10^{-1}</math> to <math>1.2 \times 10^{+5}</math> Pascal</li> </ul>
<b>Reproducibility</b>	5% of indicated pressure	5% of indicated pressure
<b>Cables and Connectors*</b>	Maximum length is 300 ft. Connector LEMO with PEEK insulator*	Maximum length is 500 ft. 9 pin D-sub connectors
<b>Operating Temperature</b>	0° to 250°C (32° to 482°F)	0° to 50°C (32° to 122°F)
<b>Bakeout Temperature</b>	0° to 250°C (32° to 482°F)	250°C (482°F) with cable and electronics removed
<b>Sensor Construction (materials exposed to vacuum)</b>	Stainless steel, silver-copper brazing alloy, alumina ceramics, aluminum AL 6061, Elgiloy®, OFHC® copper	304 stainless steel, nickel 200, glass, platinum
<b>Weight</b>	2.9 lbs. (1.3 Kg) w/ 2¾" CF	1.34 lbs (0.52 kg) w/ 2¾" CF
<b>Volume</b>	1.8 in. <sup>3</sup> (30 cm <sup>3</sup> ) max	0.5 in. <sup>3</sup> (8.0 cm <sup>3</sup> ) maximum

\* Cables connected with LEMO connectors on sensor end and bayonet connectors on controller end. High temperature and radiation resistant materials available.

## Ordering Information

### Series 937B Controller Ordering Information

Base Controller	Country Code	"A" Gauge Slot	"B" Gauge Slot	"C" Gauge Slot	Communication Port
937B	US	CC Cold Cathode	CC Cold Cathode	CC Cold Cathode	PF Profibus
	EU	CL Fast Response Cold Cathode	CL Fast Response Cold Cathode	CL Fast Response Cold Cathode	NA* Blank
	UK	CT Dual Convection Pirani	CT Dual Convection Pirani	CT Dual Convection Pirani	* RS232/485 provided in base configuration
	JP		NA Blank	NA Blank	
	CA (Canada)				

Sample part number: 937B-US-CCCCCT-NA.

Also available with optional Dual Capacitance Manometer Card.

## Ordering Information

Plug-In Controller Boards	Part Number
Cold Cathode (CC)	100018446
Dual Convection Pirani (CT)	100015132
Profibus (PF)	100015940
Fast Cold Cathode (CL)	100018448

*Use these part numbers when purchasing boards separately for retrofit.*

Sensors	
422 Cold Cathode Sensor, 2¾" CF, LEMO Connectors, 250°C	104220006
422 Cold Cathode Sensor, 2¾" CF, LEMO Connectors, 250°C, with field emitter	104220008
Convection-Enhanced Pirani Sensor, 2¾" CF, 250°C	103170024SH
Convection-Enhanced Pirani Sensor, 2¾" CF, 250°C, with Port Screen	103170034SH

*Consult factory for additional configurations.*

Cable Assemblies (Complete)	
Cold cathode cable, radiation resistant, LEMO/BNC/SHV, 10 ft. (422 to 937B)	100014318-10
Cold cathode cable, 250°C, LEMO/BNC/SHV, 10 ft. (422 to 937B)	100012372
Pirani cable, shielded, 10 ft. (317 to 937B)	103170006SH

*Consult factory for longer cables.*

Cable Stock and Connectors	
Cold cathode cable, radiation resistant, sold on 1,000 ft. spools	100006170
Pirani cable, radiation resistant, sold on 1,000 ft. spools	100003451
Cold cathode connector set, sensor end LEMO, controller end BNC/SHV, use only with 100006170	100012644
Pirani connector set, comprises two D-type connectors, 1 x male, 1 x female, use only with 100003451	100012643
Cold cathode, fast response, 2 pin LEMO connector for CL card	100016757

*The above cables and connectors are intended for end-user assembly.*

