

# Vacuum

# Technology

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## Series 943

### COLD CATHODE VACUUM GAUGE SYSTEM

The HPS® Series 943 Cold Cathode vacuum gauge system includes the Series 943 digital controller and two cold cathode sensors: the Series 421 sensor for UHV use, or a lower cost Series 423 I-Mag® sensor for OEM or industrial use. The Series 943 Cold Cathode vacuum gauge system is designed to be user-friendly and to provide fast, reliable pressure measurement from  $10^{-10}$  to  $10^{-2}$  Torr.

### Features and Benefits

- Wide pressure measurement range  $10^{-10}$  to  $10^{-2}$  Torr
- Digital LED display with set point status indicators
- Choice of two cold cathode sensors; Series 421 or Series 423 I-Mag®
- Fast system control with two setpoints
- Sensor tubes may be mounted in any position without affecting reading
- No filaments to burn out
- No need to degas the gauge
- No adjustment in emission current or filament voltage required
- Cleaning of sensor is easy with a demountable tube
- Sensor tube less susceptible to contamination due to isolated collector
- CE Compliant with EMC Directive 89/336/EEC and Low Voltage Directive 72/23/EEC

### Applications

The 943 Cold Cathode vacuum gauge system is well-suited for industrial, process and analytical applications including pressure measurement of high vacuum chambers and control of high vacuum systems.

Areas of applications may include high energy physics, analytical instruments, laser production, ion implantation, mass spectrometry, or PVD.

### Description

The 943 digital controller features two standard independent relay set points, which allows you to confidently control your process. Adjust the set points from the front panel while viewing the display. Red LEDs indicate set point activation status.

The Series 943 displays pressure from  $10^{-10}$  to  $10^{-2}$  Torr using a high visibility LED display. Two types of analog output are standard, for remote monitoring of pressure. An internal converter provides output that allows a simple log conversion from voltage to pressure over the entire operating range. A fast responding, buffered analog output is also provided through the 15 pin accessory connector on the rear panel.

Front panel functions allow the user to disable the high voltage, as well as set a pressure at which the cold cathode will automatically turn off. This prevents the controller from displaying incorrect readings when the pressure goes above the operating range of the sensor. The Series 943 has passed the requirements of the European Directives and is CE marked.



## Cold Cathode Sensors

Using an inverted magnetron design, the 423 I-Mag® and 421 sensor can operate at pressures much lower than a traditional Penning cold cathode sensor — as low as  $10^{-11}$  Torr with the proper controller. This increased pressure range makes the HPS® Cold Cathode sensors ideal for UHV use.

A unique design feature of the HPS® Cold Cathode sensors is a second feedthrough for ion collection. In an ordinary single feedthrough design, any current leakage between the anode and ground would result in pressure measurement errors. Only the ion current from the cathode contributes to a measurement reading in a dual feedthrough design, making it ideal for process monitoring.

With no filament to burn out, both the 423 I-Mag® and 421 sensors are not ruined by sudden inrushes of air and are resistant to vibration damage. Additionally, there is no need to adjust the emission current or to degas the gauge, reducing response time to pressure changes.

The 421 sensor should be selected when you want to bake the sensor to 250°C with the magnet in place. The sensor connectors need to be removed.

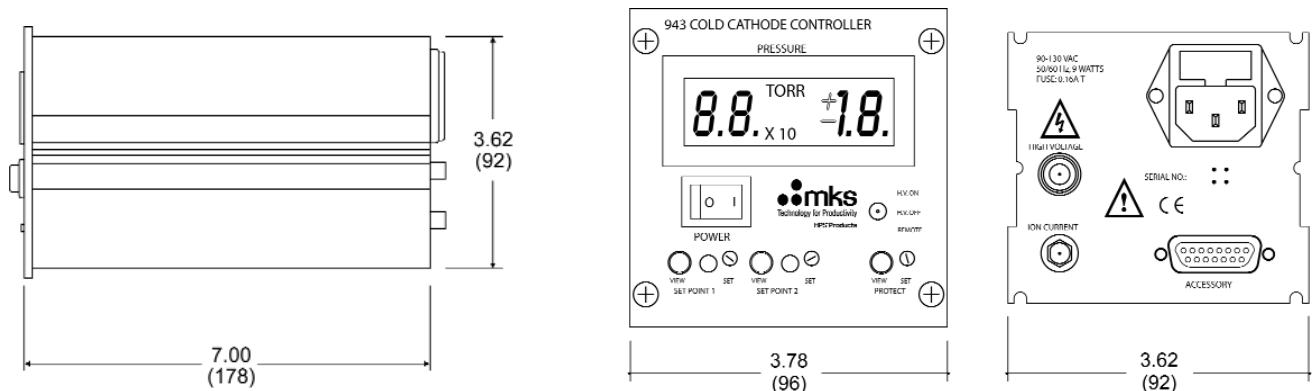
The 423 I-Mag sensor was created to provide a lower cost alternative to the 421. The sensor is more compact, less expensive and easier to maintain. If bakeout is required, the magnets and sensor connectors can be removed and the sensor can be baked to 400°C.

In addition, HPS provides a variety of customized gauges to suit specific customer needs. This includes special sensors for many semiconductor processes as well as high energy physics facilities. We have special versions of the 421 that will operate at 200°C or others that can be used in high radiation environments.

## Series 943 Controller Specifications

<b>Measurement Range</b>	1.0 x 10 <sup>-10</sup> to 1.0 x 10 <sup>-2</sup> Torr 1.3 x 10 <sup>-10</sup> to 1.3 x 10 <sup>-2</sup> mbar 1.3 x 10 <sup>-8</sup> to 1.3 Pa
<b>Set Point Range</b>	2.0 x 10 <sup>-9</sup> to 9.0 to 10 <sup>-3</sup> Torr 2.7 x 10 <sup>-9</sup> to 1.2 x 10 <sup>-2</sup> mbar 2.7 x 10 <sup>-7</sup> to 1.2 Pa
<b>Operating Temperature</b>	5° to 40°C (41° to 104°F)
<b>Storage Temperature</b>	-10° to 55°C (14° to 104°F)
<b>Relative Humidity</b>	80% maximum for temperatures less than 31°C, decreasing linearly to 50% maximum at 40°C
<b>Altitude</b>	2000 m maximum
<b>Power Requirements</b>	100 to 120 VAC, 50/60 Hz, 9 W 220 to 240 VAC, 50/60 Hz, 9 W
<b>Resolution</b>	1% of indicated decade
<b>Set Points</b>	2 independently set, SPDT contacts, resistive load; 1 A @ 30 VAC or 24 VDC
<b>Set Point Response</b>	50 msec for pressures >10 <sup>-8</sup> Torr
<b>Output Voltage</b>	Analog: 0 to 9 VDC Logarithmic Analog: 1 to 9 VDC, 1 V per decade
<b>Front Panel Controls</b>	Power on/off; set point and protect view buttons, LED set point indicators, set point and protect adjust potentiometers, high voltage on/off/remote toggle switch
<b>Display</b>	Red LED, 7 segments digits 14 mm in height, ±60° viewing angle, 2 digits (1 leading) with 1½ digit signed exponent, Units shown in either Torr, mbar or Pascal, update rate: 250 msec
<b>Weight</b>	2.5 lbs. (1.1 kg)
<b>CE Certification</b>	89/336/EEC EMC Directive 73/23/EEC Low Voltage Directive

## Series 943 Cold Cathode Controller Dimensions



# Dimensions & Specifications

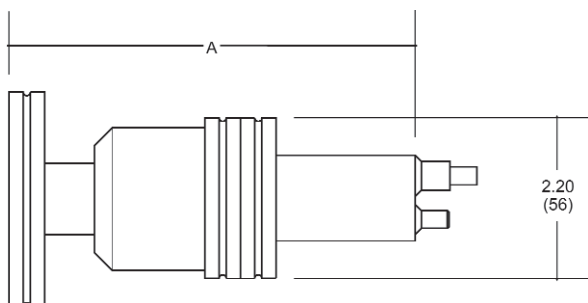
## 421 Sensor Specifications

<b>Measurement Range</b>	1.0 x 10 <sup>-11</sup> to 1.0 x 10 <sup>-2</sup> Torr 1.0 x 10 <sup>-11</sup> to 1.0 x 10 <sup>-2</sup> mbar 1.0 x 10 <sup>-9</sup> to 1.0 Pa
<b>Materials Exposed to Vacuum</b>	Stainless steel, silver-copper brazing alloy, alumina ceramics, aluminum AL 6061, Elgiloy®, OFHC® copper
<b>Reproducibility</b>	5% of reading at constant temperature
<b>Cables and Connectors</b>	Cables connected via bayonet and threaded type coaxial connectors
<b>Bakeout Temperature</b>	250°C connectors off 125°C connectors on
<b>Operating Temperature</b>	0° to 125°C (32° to 257°F)
<b>Calibration Gas</b>	Air/nitrogen
<b>Installation Orientation</b>	Any
<b>Internal Volume</b>	1.8 in. <sup>3</sup> (30 cm <sup>3</sup> ) maximum
<b>Weight with CF</b>	2.8 lbs. (1.3 kg) w/ CF

## 423 I-Mag® Sensor Specifications

<b>Measurement Range</b>	1.0 x 10 <sup>-11</sup> to 1.0 x 10 <sup>-2</sup> Torr 1.0 x 10 <sup>-11</sup> to 1.0 x 10 <sup>-2</sup> mbar 1.0 x 10 <sup>-9</sup> to 1.0 Pa
<b>Materials Exposed to Vacuum</b>	Stainless steel, 6061 aluminum, Inconel®, glass and alumina ceramic
<b>Reproducibility</b>	5% of reading at constant temperature
<b>Cables and Connectors</b>	Tube Side: molded connector with a positive locking bolt Controller Side: bayonet connector and threaded coaxial connector
<b>Bakeout Temperature</b>	to 400°C (752°F) with CF flanges, with magnet and cable removed
<b>Operating Temperature</b>	0° to 70°C (32° to 158°F)
<b>Calibration Gas</b>	Air/nitrogen
<b>Installation Orientation</b>	Any
<b>Internal Volume</b>	0.9 in. <sup>3</sup> (15 cm <sup>3</sup> ) maximum
<b>Weight with CF</b>	2.0 lbs (0.8 kg) w/ CF

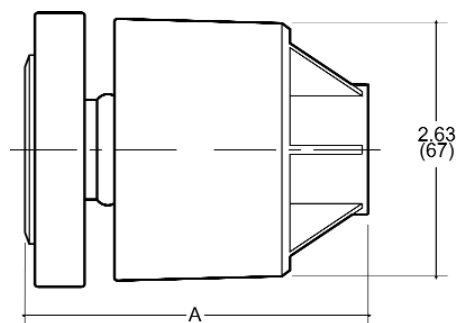
## 421 Sensor Dimensions



Type	A
NW 25 KF	6.72 (171)
NW 40 KF	6.32 (161)
2 3/4" CF, nonrotatable	6.27 (159)
1" Tube	6.22 (158)
1/2" VCR®-F¹	7.59 (193)

Dimensions: inches (mm)

## 423 I-Mag® Sensor Dimensions



Type	A
NW 25 KF	3.41 (87)
NW 40 KF	3.41 (87)
2 3/4" CF, rotatable	3.47 (88)
1" Tube	3.26 (83)

Dimensions: inches (mm)

\* Special high operating temperature 421 sensors are available, call HPS Products in Boulder for more information.

# Ordering Information

## Series 943 Controller \* †

943-A-120V50-TR-PC	Series 943 Controller, Torr readout, 50 Hz, 100-120 volts
943-A-120V60-TR-PC	Series 943 Controller, Torr readout, 60 Hz, 100-120 volts
943-A-220V50-TR-PC	Series 943 Controller, Torr readout, 50 Hz, 220-240 volts
943-A-220V60-TR-PC	Series 943 Controller, Torr readout, 60 Hz, 220-240 volts
943-A-120V50-MB-PC	Series 943 Controller, mbar readout, 50 Hz, 100-120 volts
943-A-120V60-MB-PC	Series 943 Controller, mbar readout, 60 Hz, 100-120 volts
943-A-220V50-MB-PC	Series 943 Controller, mbar readout, 50 Hz, 220-240 volts
943-A-220V60-MB-PC	Series 943 Controller, mbar readout, 60 Hz, 220-240 volts
943-A-120V50-PA-PC	Series 943 Controller, Pascal readout, 50 Hz, 100-120 volts
943-A-120V60-PA-PC	Series 943 Controller, Pascal readout, 60 Hz, 100-120 volts
943-A-220V50-PA-PC	Series 943 Controller, Pascal readout, 50 Hz, 220-240 volts
943-A-220V60-PA-PC	Series 943 Controller, Pascal readout, 60 Hz, 220-240 volts

## 423 I-Mag® Cold Cathode Sensor

104230004	423 I-Mag Cold Cathode Sensor, NW 25 KF
104230001	423 I-Mag Cold Cathode Sensor, NW 40 KF
104230002	423 I-Mag Cold Cathode Sensor, 2 $\frac{3}{4}$ " CF
104230003	423 I-Mag Cold Cathode Sensor, 1" Tube

## 421 Cold Cathode Sensor

104210004	421 Cold Cathode Sensor, NW 25 KF
104210001	421 Cold Cathode Sensor, NW 40 KF
104210002	421 Cold Cathode Sensor, 2 $\frac{3}{4}$ " CF
104210003	421 Cold Cathode Sensor, 1" Tube
104210005	421 Cold Cathode Sensor, 8 VCR®-F <sup>1</sup>

## 423 I-Mag® Cold Cathode Cables

100002505	2 ft. (0.6 m)
100007873	10 ft. (3.0 m)
100007874	25 ft. (7.6 m)
100002395	50 ft. (15 m)
100008759	Custom Cable

## 421 Cold Cathode Cables

100006171	10 ft. (3.0 m)
100006172	25 ft. (7.6 m)
100006173	50 ft. (15.2 m)
100006174	100 ft. (30.5 m)
100006175	Custom Cable

## Accessories

103150001	Power Cord, 115 VAC
100005087	Series 943 Output Connector Kit
100005021	Mounting Hardware
100006734	Rebuild Kit for Series 421 Cold Cathode Sensor (6 bolt, 1/4-28)
100002353	Rebuild Kit for Series 423 I-Mag Sensor
100005279	Wrench for Series 421 Sensor Rebuild Kit
100009887	Series 943 Cold Cathode Manual

\* Includes controller, power cord, manual and output connector.

† Controller also available without power cords. NA is inserted into the part number instead of PC



Bulletin 01/08 - Series 943 Cold Cathode  
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Due to continuous development, pricing and specifications are subject to change without notice.

<sup>1</sup> VCR®-compatible parts may be used. HPS® and I-Mag® are registered trademarks of MKS Instruments, Inc. Viton® is a registered trademark of E.I. DuPont Co. Inc. U.S. Patent # 6,756,785. Foreign patents pending.