Series 937B

Digital Combination Vacuum Gauge System

The Series 937B combination vacuum gauge system is part of the MKS family of vacuum gauges. It is the third generation of the very successful 937 Series. The 937B will operate and display as many as six sensors simultaneously, and each controller can be configured to the user's gauging requirements. This highly flexible product enables a wide range of gauging technologies, tailoring the system to each individual application. The Series 937B combines the sensor technologies of the cold cathode, hot cathode, standard Pirani, convection Pirani, MKS Baratron® capacitance manometer and absolute Piezo sensors to measure from ultra-high vacuum to above atmospheric pressure.

Product Features

- Provides simultaneous readout for a combination of up to six vacuum gauges
- Wide measurement range of 10^{-11} to 20,000 Torr
- Intuitive menu for ease of setup
- Large easy to read backlit display
- Configurable for up to six heated MKS Baratron capacitance manometers
- Twelve independent relay set points for improved process control with variable hysteresis
- Computer Interface: RS232, RS485 (built in) and Profibus DPV1 (optional)
- Independent, buffered, combined and standard analog outputs for each channel
- Gas-type sensitivity allows sensors to be used for rough leak detection
- Leak test function with bar graph display and audio alarm

Key Benefits

- User-configurable for units of pressure in Torr, millibar, Pascal, or microns
- Operates hot and cold cathodes, Baratron capacitance manometers, Piezo and Pirani sensors for maximum flexibility
- Fast response cold cathode card protects vacuum system in the event of a sudden pressure rise
- Field upgradeable
- Modular design

937B Controller

The 937B controller is designed for versatility, reliability and economy. The large, easy to read, liquid crystal display provides readout for up to six sensors simultaneously. The back lit LCD display, intuitive menus and simple push button front panel, allows for ease in setup of the 937B.

The 937B, enables the use of any sensor card in each of the sensor card slots. The 937B can be configured with up to three hot or cold cathode type gauges, or three dual sensor cards for a maximum of six gauge connections.

Set Points —Twelve independently adjustable set points are standard. This allows for the automation of process related functions. The set point values are nonvolatile and remain unchanged after power down or power failure. They are easily viewed and configured in the channel set up screen. The 937B also includes an adjustable control set point that turns the cold cathode or hot cathode gauges power off or on, at the desired pressures, extending the sensor's life.

Leak Test —The leak test mode includes a bar graph and variable audible alert to assist in locating leaks within a system. The function operates with the cold cathode, hot cathode, Pirani, and convection sensors. By taking advantage of differences in tracer gas sensitivity, this provides an excellent tool for helping locate coarse system leaks.

Analog Output Signals —The controller provides analog output signals accessible on the rear panel connector. Three types of analog signals are available. Unprocessed analog signals are used to provide the fastest response times. The logarithmic output voltages are scaled so that 0.6 Volts equals one decade of pressure. Combination output can be created by combining up to three sensors with a combined range from 10^{-11} to 20,000 Torr.

Digital Signals — In addition to analog outputs, the 937B communicates digitally for direct computer communication with built in connections for RS232 or RS485. A communication slot in the 937B chassis accepts an optional Profibus DPV1 board. The 937B can communicate with a host computer using either of these ports. Remote control of set points and cold cathode high voltage disable are some of the many features available with communications options.

Pirani Sensors

In Pirani-type sensors, vacuum measurement is based on thermal conductivity of the gas. The sensor tube contains a fine wire that is maintained at a constant temperature. Heat transferred from the wire relates to the amount of gas present and is used to indicate pressure. There are two types of Pirani tubes that can be run on the 937B. Both the standard and convection enhanced Pirani's are shielded and CE approved.

Convectron® Pirani Series 275 —MKS Convectron® gauges have been the world-standard convection-enhanced Pirani gauge for over 35 years—used in thousands of processes to accurately measure pressure from atmosphere to 10^{-3} Torr. To assure the highest level of accuracy and gauge-to-gauge reproducibility, every gauge is individually calibrated at the factory, thereby making controller adjustment unnecessary.

Convection Enhanced Pirani Series 317 —The convection Pirani style sensor design enhances heat transfer through convection at higher pressures. This sensor will read continuously with full resolution from 1 x 10^{-3} Torr to 1,000 Torr, providing a continuous readout above 100 Torr. A 250°C bakeable version is available upon request.

Capacitance Manometers

Capacitance manometers supported by the 937B controller include the MKS Baratron® Series 722C, 626D and 627H. Capacitance manometers measure pressure directly by measuring the deflection of a thin Inconel® diaphragm. Capacitance manometers are widely known for their accuracy and reliability and are available in Full Scale ranges from 20,000 Torr to 0.02 Torr with three decades of reading when connected to the 937B.

Absolute Piezo Transducer

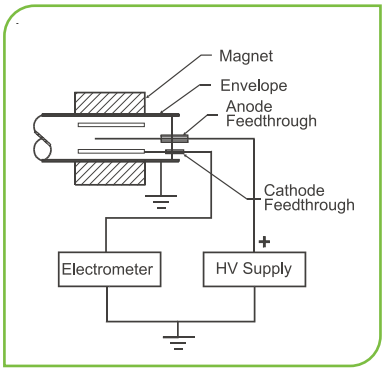
The Series 902B Piezo transducer combines the pressure measurement technology of a Piezo sensor with an integrated electronic control circuit. The 902B Piezo is an absolute direct reading sensor, allowing the measurement to be gas independent. The sensor includes a unique temperature compensation, allowing for high accuracy over a wide measurement range (10 to 1,000 Torr). The Series 902B Piezo is used in conjunction with the capacitance manometer card.

Hot Cathode Sensors

Hot cathode vacuum measurement is based on the ionization probability of a gas in a defined volume. Hot cathode sensors are Bayard-Alpert style, which utilizes a fine wire collector located in the center of a grid. Because of its small area, few x-rays hit the collector and the gauge can measure pressures to very low levels. The Series 937B operates the Low Pressure Nude Hot Cathode sensor. With a measurement range from 10^{-2} to 10^{-10} Torr and include dual filaments for reduced downtime.

Nude Hot Cathode Ionization Vacuum Sensor — The Low Power Nude Tube is available with a choice of yttria-coated iridium or tungsten filaments. Since the sensing portion of the tube is located within the vacuum system and experiences the system true pressure, nude tubes give a representative pressure measurement and respond more quickly to pressure changes than a glass envelope sensor. This minimizes the effects of tube pumping and outgassing as seen with glass tubes. The yttria-coated iridium filament is resistant to damage caused by high oxygen partial pressures and accidental exposure to atmosphere. The tube operates at lower temperatures, giving a lower chemical reaction rate and minimizing thermal interference. At low pressures, tubes with tungsten filaments have the advantage of low internal outgassing rates. The hot cathode gauge calibration depends on the gas type, because ionization probability differs for each gas. The dependence makes it possible to use the hot cathode gauge as a leak detector.

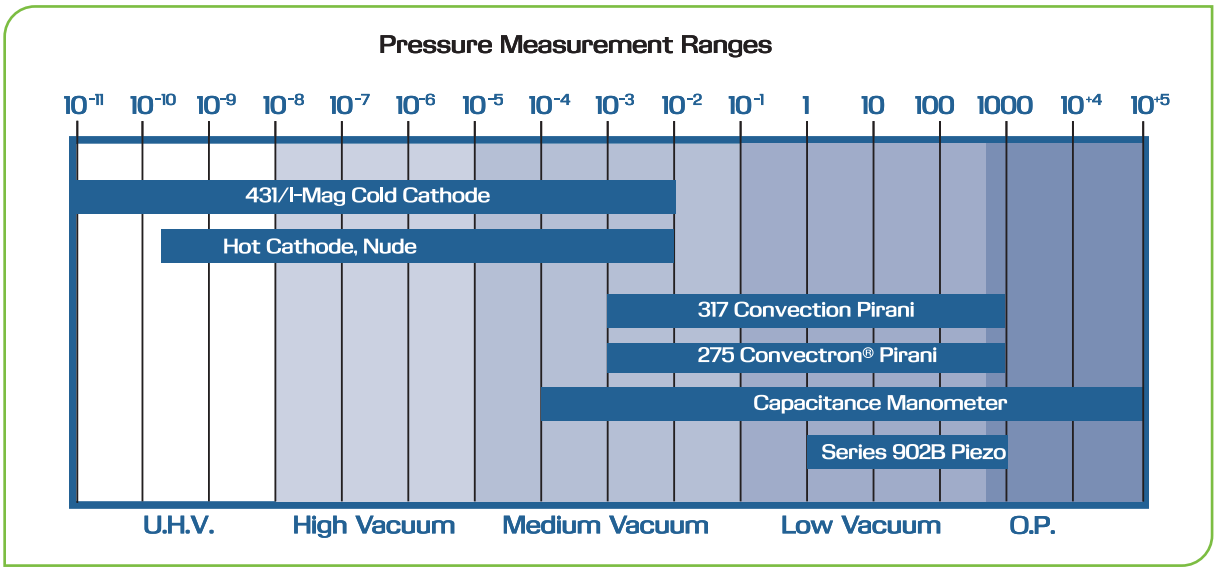
Cold Cathode Sensors



In a cold cathode gauge, ionization is the result of a high voltage discharge of electrons. Sensitivity is enhanced by a magnetic field. Cold cathode gauges are rugged sensors without filaments to break or burnout. There are two cold cathode gauges: the Series 431 and the I-Mag®. All inverted magnetron designs include an isolated collector. This dual feed through approach makes the MKS cold cathode less susceptible to contamination and allows for a wide pressure measurement range.

The I-Mag Cold Cathode Sensor provides a lower cost alternative to the 431 where high operating temperature is not important. 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, we provide 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 431 that will operate at 250°C or that can be used in high radiation environments.

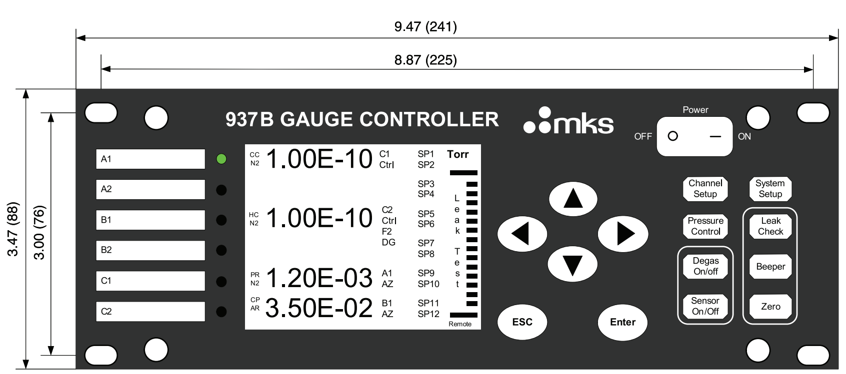


937B Specifications

Measurement Range	• 1.0 x 10^{-11} to 20,000 Torr • 1.0 x 10^{-9} to 2.7 x 10+6 Pascal • 1.0 x 10^{-11} to 2.7 x 10+4 mbar • 1.0 x 10^{-8} to 2.0 x 10+7 microns
Operating Temperature	5° to 40° C (41° to 104°F)
Storage Temperature	-10° to 55°C (14° to 131°F)
Relative Humidity	80% max for temperatures less than 31°C, decreasing linearly to 50% maximum at 40°C
Power Requirement and Consumption	150 watts maximum; 100 - 240 VAC 50/60 Hz
Set Point Relays	Twelve pressure dependent set points; SPDT relays, contact rating 2 amps @ 30 VAC
Output	Buffered, log linear & linear output for each channel & channel combinations
Front Panel Controls	Power on-off switch, setup and operational commands can be accessed via the keypad
Display	• 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
Leak Test	Relative logarithmic bar graph display and variable rate audio signal
Insulation Coordination	Over voltage Category II, Pollution Degree 2
Controller Weight	8 lbs (3.6 kg)
Compliance	CE

Base Controller	Country Code	Base Gauge Slot "A"	Gauge Choice Slot "B"	Gauge Choice Slot "C"	Communication Port
937B	US EU UK JP CA (Canada)	CC/CL Cold Cathode CT Dual Convection Pirani/ Standard Pirani CM Dual Baratron/ Piezo HC Hot Cathode Nude NA Blank	CC/CL Cold Cathode CT Dual Convection Pirani/ Standard Pirani CM Dual Baratron/ Piezo HC Hot Cathode Nude NA Blank	CC/CL Cold Cathode CT Dual Convection Pirani/ Standard Pirani CM Dual Baratron/ Piezo HC Hot Cathode Nude NA Blank	PF Profibus NA Blank

The basic Series 937B includes the controller, a power cable, accessory connector kit, and instruction manual. Space is provided for up to three gauge modules and one communication module. Sample part number: 937B-US-CCCCCT-NA.

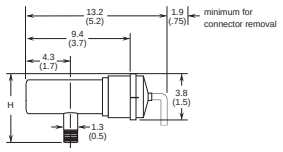


Dimensional Drawing — Unless otherwise specified, dimensions are nominal values in inches (mm referenced).

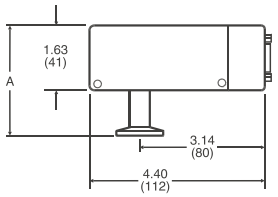
	Cold Cathode	Hot Cathode	Convectron/Convection Enhanced Pirani	Absolute Piezo	MKS Baratron® Capacitance Manometer
Models	Series 431 & I-Mag®	Nude Hot Cathode Ionization Vacuum Sensor	Series 317/Series 275	Series 902B	722C, 626D and 627H
					
Sensor Construction (materials exposed to vacuum)	**Series 431:** Stainless steel, silver-copper brazing alloy, alumina ceramics, aluminum AL 6061, Elgiloy®, OFHC® copper **I-Mag:** Stainless steel, 6061 aluminum, Inconel®, glass and alumina ceramic	Tungsten or yttria-coated iridium (filament), nickel, Inconel® X-750, 304 stainless steel, glass, tungsten, platinum	**Series 317**: 304 stainless steel, nickel 200, glass, platinum **Series 275:** 304 stainless steel, borosilicate glass, Kovar®, Alumina, NiFe alloy, polyimide	316 stainless steel	Inconel
Measurement Range	1.0 x 10^{-11} to 1.0 x 10^{-2} Torr 1.3 x 10^{-11} to 1.3 x 10^{-2} mbar 1.3 x 10^{-9} to 1.3 Pascal 1.0 x 10^{-8} to 10 micron	1.0 x 10^{-10} to 1.0 x 10^{-2} Torr 1.3 x 10^{-10} to 1.3 x 10^{-2} mbar 1.3 x 10^{-8} to 1.3 Pascal 1.0 x 10^{-8} to 1.0 x 10 micron	1.0 x 10^{-3} to 1.0 x 10^{+3} Torr 1.3 x 10^{-3} to 1.3 x 10^{+3} mbar 1.3 x 10^{-1} to 1.3 x 10^{+5} Pascal 1.0 x 10^{+6} micron	0.1 to 1000 Torr 0.13 to 1.3 x 10^{+3} mbar 13 to 1.3 x 10^{+5} Pascal	Three decades of measurement below Full Scale
Resolution	1% of indicated decade, except 10% below 10^{-10} Torr and above 10^{-3} Torr	1% of indicated decade	1% of indicated decade	1% of indicated decade	1 x 10^{-4} of Full Scale
Set Point Response	120 milliseconds	120 milliseconds	120 milliseconds	100 milliseconds	120 milliseconds
Set Point Range	2.0 x 10^{-10} to 9.5 x 10^{-3} Torr 2.7 x 10^{-10} to 1.2 x 10^{-2} mbar 2.7 x 10^{-8} to 1.2 Pascal 2.0 x 10^{-7} to 9.5 micron	5.0 x 10^{-10} to 9.5 x 10^{-3} Torr 6.5 x 10^{-10} to 1.2 x 10^{-2} mbar 6.5 x 10^{-8} to 1.2 Pascal 5.0 x 10^{-8} to 9.5 x 10^{-1} micron	2.0 x 10^{-3} to 9.5 x 10^{+2} Torr 2.7 x 10^{-3} to 1.2 x 10^{+3} mbar 2.7 x 10^{-1} to 1.2 x 10^{+5} Pascal 2.0 to 9.5 x 10^{+5} micron	1.0 to 1.0 x 10^{+3} Torr 1.3 to 1.3 x 10^{+3} mbar 1.3 x 10^{+2} to 1.3 x 10^{+5} Pascal	Dependent on Full Scale range
Reproducibility	5% of indicated pressure	5% of indicated pressure	5% of indicated pressure	0.3% of indicated pressure	*
Cables & Connectors	Maximum length is 300 ft **Series 431:** Cables connected via bayonet type coaxial connectors **I-Mag Tube Side:** molded connector with a positive locking bolt Controller Side: bayonet connector and threaded coaxial connector	Molded tube connector, custom D subconnector to controller, maximum length is 50 ft	**Series 317:** Maximum length is 500 ft 9 pin D-sub connectors, multiconductor shielded cable **Series 275:** 9 pin D-sub connectors, multiconductor shielded cable	Maximum length is 500 ft 9-pin D-sub to 9-pin D-sub	Maximum length is 50 ft. 9-pin D-sub with polarized key to 15-pin D-sub
Operating Temperature	0° to 70°C (32° to 158°F) A high operating temperature version of the Series 431 is available. Call for information.	0° to 60°C (32° to 140°F)	**Series 317:** 0° to 50°C (32° to 122°F) **Series 275:** 4° to 50°C (39° to 122°F)	0° to 40°C (32° to 104°F)	*
Bakeout Temperature	**Series 431:** 100°C (212°F) cables removed 250°C version available **I-Mag:** to 400°C (752°F) with CF flanges, with magnet and cable removed	60°C with cable attached, 300°C with CF, 150°C with KF	**Series 317:** 100°C (212°F) shielded version *Special order version available to 250°C. **Series 275:** 150°C (302°F)	100°C (212°F), non-operating	N/A
Weight	**Series 431:** 2.8 lbs. (1.3 Kg) w/ CF **I-Mag:** 2.0 lbs (0.8 Kg) w/ CF	0.9 lb (400 g) CF flange	**Series 317:** 0.5 lb (200 g) **Series 275:** 3 oz (85 g)	5.9 oz (170 g)	Dependent on selected sensor*
Xray Limit		3 x 10^{-10} Torr			
Sensitivity		9 $Torr^{-1}$ (±20%)			
Degas Power		20W			
Emission Current		1 mA at < 1 x 10^{-4} Torr, 100 µA at > 1 x 10^{-4} Torr, regulated to ±3%			
Volume	**Series 431:** 1.8 $in.^3$ (30 cm^3) max **I-Mag:** 0.9 $in.^3$ (15 cm^3) max	Zero	**Series 317:** 2.0 $in.^3$ (33 cm^3) maximum **Series 275:** 2.14 $in.^3$ (35 cm^3) maximum	0.06 $in.^3$ (1.02 cm^3)	Dependent on selected sensor*

**For Baratron Capacitance Manometer information, please visit the MKS website at www.mks.com.*

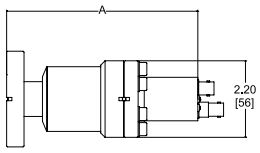
275 Convectron® Pirani Sensor

Size	A (in/mm)	Drawing
NW 16 KF	2.70 (6.86)	
NW 25 KF	2.70 (6.86)	
NW 40 KF	2.70 (6.86)	
1 1/3" CF	2.50 (6.35)	
2 3/4" CF	2.50 (6.35)	
1/8"/1/2" tubulation	2.50 (6.35)	
1/4" VCR-F	2.80 (7.11)	
1/2" VCR-F	3.20 (8.13)	
3/8" VCO-M	3.10 (7.11)	

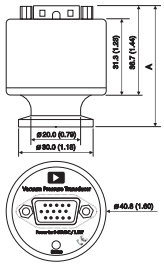
317 Convection Enhanced Pirani Sensor

Size	A (in/mm)	Drawing
NW 16 KF	2.76 (70)	
NW 25 KF	2.76 (70)	
1 1/3" CF	3.06 (78)	
2 3/4" CF	2.73 (69)	
8 VCR-F*	2.83 (72)	
4 VCR-F*	2.51 (64)	
1/8" NPT-M	2.93 (74)	
15 & 18 mm	3.19 (81)	

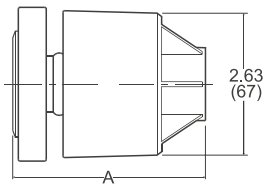
431 Cold Cathode Sensor

Size	A (in/mm)	Drawing
NW 25 KF	6.72 (171)	
NW 40 KF	6.32 (161)	
2 3/4" CF (non-rotatable)	6.27 (159)	
1" Tube	6.22 (158)	
8 VCR-F*	7.59 (193)	

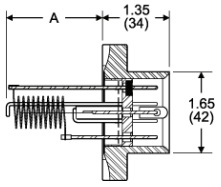
902B Absolute Piezo Diaphragm Sensor

Size	A (in/mm)	Drawing
NW 16 KF	1.93 (49.1)	
1/8" NPT-F	3.50 (89.0)	
4 (1/4") VCR-F*	3.20 (81.4)	
8 (1/2") VCR-F*	3.24 (82.4)	

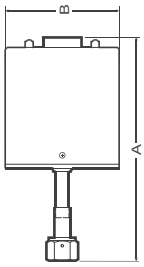
I-Mag® Cold Cathode Sensor

Size	A (in/mm)	Drawing
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)	

Nude Hot Cathode Ionization Vacuum Sensor

Size	A (in/mm)	Drawing
NW 40 KF	1.89 (48)	
2 3/4" CF	1.94 (49)	

Baratron® Capacitance Manometer

A (in/mm)	626D/627H	722C	Drawing
NW 16 KF	5.18 (132)	4.70 (119)	
1 1/3" CF	5.05 (128)	4.57 (116)	
1/2" Tube	4.93 (125)	4.75 (121)	
8 VCR-F* (low range)	6.05 (154)	5.57 (142)	
8 VCR-F* (high range)	6.14 (156)	5.66 (144)	
8 VCO-F*	6.05 (154)	5.57 (142)	
Dimension A Weld Stub		3.94 (100)	
Dimension B	2.56 (65)	1.50 (38)	

* *VCR® or VCO®-compatible parts may be used.*

275 Convectron Pirani Sensors

275203	NW 16 KF
275071	1/8" NPT-M 1/2" tube
275282	8 VCR-F*
275256	1 1/3" CF
275238	2 3/4" CF
275196	NW 25 KF
275185	4 VCR®-F*

275 Cables

100016980	10 ft (3.0 m)
100016981	25 ft (7.6 m)
100016982	50 ft (15.2 m)

317 Convection Enhanced Pirani Sensors

103170010SH	NW 16 KF
103170011SH	1/8" NPT-M 1/2" tube
103170012SH	8 VCR-F*
103170013SH	1 1/3" CF
103170014SH	2 3/4" CF
103170016SH	15 mm. Tube
103170018SH	18 mm. Tube
103170027SH	NW 25 KF
103170029SH	4 VCR-F*

317 Cables

103170006SH	10 ft (3.0 m)
103170007SH	25 ft (7.6 m)
103170008SH	50 ft (15.2 m)
103170009SH	Custom (max length 500 ft.)

431 Convection Enhanced Pirani Sensors

104310004	NW 25 KF
104310001	NW 40 KF
104310002	2 3/4" CF
104310003	1" Tube
104310005	8 VCR-F

431 Cables

100016217	10 ft (3.0 m)
100016218	25 ft (7.6 m)
100016219	50 ft (15.2 m)
100016220	100 ft (30.5 m)
100016221	Custom (max length 300 ft.)

902B Absolute Piezo Transducers

902B-12010	NW 16 KF, RS485
902B-42010	4 VCR-F*, RS485
902B-52010	8 VCR-F*, RS485
902B-11010	NW 16 KF, RS232
902B-41010	4 VCR-F*, RS232
902B-51010	8 VCR-F*, RS232

902B Cables

100011869	10 ft (3.0 m)
100011870	25 ft (7.6 m)
100011871	50 ft (15.2 m)
100011872	Custom (max length 50 ft.)

I-Mag Cold Cathode Sensors

104230004	NW 25 KF
104230001	NW 40 KF
104230002	2 3/4" CF
104230003	1" Tube

I-Mag Cables

100016295	10 ft (3.0 m)
100016296	25 ft (7.6 m)
100016297	50 ft (15.2 m)
100016298	100 ft (30.5)
100016299	Custom (max length 300 ft.)

Nude Hot Cathode Ionization Vacuum Sensors

100005987	Tungsten, NW 40 KF
100005980	Tungsten, 2 3/4" CF
100006841	Y_2O_3 coated Ir, NW 40 KF
100006842	Y_2O_3 coated Ir, 2 3/4" CF

Nude Hot Cathode Cables

100010909	10 ft. (3.0m)
100010910	25 ft. (7.6m)
100010911	50 ft. (15.2m)

Plug-In Controller Modules**

20057716-001	Cold Cathode Sensor (CC)
20057717-001	Cold Cathode Sensor, TTL (CL)
20057715-001	Dual Convection Pirani Sensor (CT)
20057714-001	Dual Capacitance Manometer/Piezo (CM)
20057718-001	Hot Cathode Nude (HC)
20107276-001	Profibus Card

626D and 627H Baratron® Capacitance Manometer Cables

100007555	10 ft (3.0 m)
100007556	25 ft (7.6 m)
100007557	50 ft (15.2 m)

Accessories

103150001	USA power cable
RM-13	Half rack mounting kit
100006734	Rebuild kit for 431 cold cathode tube
100002353	Rebuild kit for I-Mag cold cathode
100005279	Spanner wrench for 431 rebuild
100007700	Full rack mounting kit
100016120	Adapter, SMA – F to BNC – M
100016121	Adapter, Connector, SMA – M to BNC – F

722C Baratron® Capacitance Manometer Cables

100016951	10 ft (3.0 m)
100016952	25 ft (7.6 m)
100016953	50 ft (15.2 m)

* *VCR® or VCO®-compatible parts may be used.*

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

Ordering Code Example: 626DXXXYZ: 626D with male Type D connector 627HXXXYZ: 627H with male Type D connector	Code	Configuration
Model		
626D Baratron® Absolute Capacitance Manometer 627H Baratron® Absolute Capacitance Manometer	626D 627H	626D
Ranges (Torr) (XXX)		
0.1 0.25 1 2 10 20 100 500 1000 10000 (627H only) 20000 (627H only)	.1T RET 01T 02T 11T 21T 12T 52T 13T 14T 24T	11T
Fittings (Y)		
1/2" tube Swagelok 8 VCR female Mini-CF, rotatable NW 16 KF Swagelok 8 VCO® female 2 3/4" CF, rotatable NW 25 KF	A B C D E L Q	D
Accuracy (Z)		
Standard: 0.25% of Rdg. (optional 0.10 Torr) Standard: 0.50% of Rdg. (0.10 Torr) Optional: 0.15% of Rdg. (10, 100, 1000 Torr ranges only)	E F D	F

Ordering Code Example: 722CXXXYYWGZ: 722C Baratron® Compact Absolute Capacitance Manometer	Code	Configuration
Model		
722C Baratron® Compact Absolute Capacitance Manometer	722C	722C
Ranges (Torr) (XXX)		
10 100 1000 10000 25000	11T 12T 13T 14T RCT	13T
Fittings (Y)		
1/2" tube Swagelok 4 VCR female Swagelok 8 VCR female Swagelok 8 VCO female NW 16 KF Mini-CF, rotatable	BA CD CE DA GA HA	CE
Input/Output (W)		
+13 to +32 VDC input, 0-10 VDC output	2	2
Accuracy (G)		
Standard: 0.5% of Rdg.	F	F
Connector (Z)		
9-pin Type "D"	A	A

NOTE: High pressure units are not available with NW 16 KF fittings. Consult High Pressure Fitting matrix or contact MKS Applications Engineering.

For complete product specifications and Baratron capacitance manometer datasheets, please visit the MKS website at www.mks.com.
Contact Applications Engineering for other capacitance manometer options.

www.MKS.com

937B_09/25