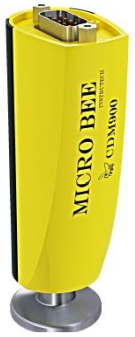
InstruTech®

Capacitance Diaphragm Vacuum Gauge
CDM900 Module
The Micro Bee™



User Manual

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p/n 002626-101

Important User Information

There are operational characteristic differences between solid state equipment and electromechanical equipment. Because of these differences, and because there are a variety of uses for solid state equipment, all persons that apply this equipment must take every precaution and satisfy themselves that the intended application of this equipment is safe and used in an acceptable manner.

In no event will InstruTech be responsible or liable for indirect or consequential damages that result from the use or application of this equipment.

Any examples or diagrams included in this manual are provided solely for illustrative purposes. Because of the many variables and requirements imposed on any particular installation, InstruTech cannot assume responsibility or liability for any actual use based on the examples and diagrams.

No patent liability is assumed by InstruTech with respect to use of information circuits, equipment, or software described in this manual.

Throughout this manual we use notes, notices and apply internationally recognized symbols and safety messages to make you aware of safety considerations.

Identifies information about practices or circumstances that can cause electrical or physical hazards which, if precautions are not taken, could result in death or serious injury, property damage, or economic loss.

Identifies information about practices or circumstances that can cause electrical or physical hazards which, if precautions are not taken, could result in minor or moderate injury, property damage, or economic loss.

Identifies information that is critical for successful application and understanding of the product.

Labels may be located on or inside the device to alert people that dangerous voltages may be present.

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1 Introduction / General Information

1.1 Description

The CDM900 *Micro Bee™ Capacitance Diaphragm* vacuum gauge is an economical, gas type independent absolute pressure sensor. The CDM900 provides excellent long term stability and performance. The sensor assembly is constructed of a compact ceramic and metal design resulting in a simple yet rugged sensor suitable for numerous industrial applications. The corrosion resistant sensor material provides excellent temperature compensation capability, thus enhancing the reliability of the pressure measurements.

The CDM900 *Micro Bee* vacuum gauge module provides the basic signal conditioning required to turn the sensor into a complete vacuum pressure measurement instrument. The combination of superior sensor design and enhanced signal processing provides optimal and stabile pressure readings by the instrument. The built-in controller provides a 0 to 10 Vdc analog output for pressure measurements and allows for local or remote zeroing of the instrument. The CDM900 provides various full scale ranges from 10 to 1,000 Torr.

1.2 Specifications

full scale (F.S.) ranges - Torr	1000, 500, 200, 100, 50, 20, 10
lowest reading	0.05% of F.S.
accuracy [(1)]	model A: 1% of reading model B: 0.5% of reading
temperature effect on zero	0.02% F.S./ °C
temperature effect on span	0.02% of reading/°C
resolution	0.05% F.S.
long term stability	0.5% F.S./yr aluminum oxide ceramic (Al_2O_3)
temperature compensated range	+10 to +50 °C
materials exposed to gases sensor, feedthrough flange, tube	 aluminum oxide ceramic (Al_2O_3) stainless steel AISI 316L
internal gauge volume	1/2 in. Tube: 0.219 in^3 (3.6 cm^3) KF16: 0.226 in^3 (3.7 cm^3) 4 VCR & 8 VCR: 0.342 in^3 (5.6 cm^3)
temperature compensation range	+ 10 to + 50 °C
temperature	operating: 0 to + 70 °C storage: -20 to + 85 °C
humidity	0 to 80% relative humidity, non-condensing
bakeout temperature (at flange)	≤ 110 °C (non-operating)
admissible pressure (absolute)	≥ 500 Torr F.S. = 58 psi (4 bar) 50 to 200 Torr F.S. = 43.5 psi (3 bar) 10 to 20 Torr F.S. = 29 psi (2 bar)
burst pressure	87 psi (6 bar)
weight	4 to 5.7 oz. (115 to 160 g) , flange/fitting dependent
housing (electronics)	aluminum extrusion
use	indoor only
mounting orientation	any
altitude	13,125 ft. (4000 m) max
analog output	linear 0 to 10 Vdc
output impedance	10 Ω, short-circuit proof
load impedance	>10 kΩ

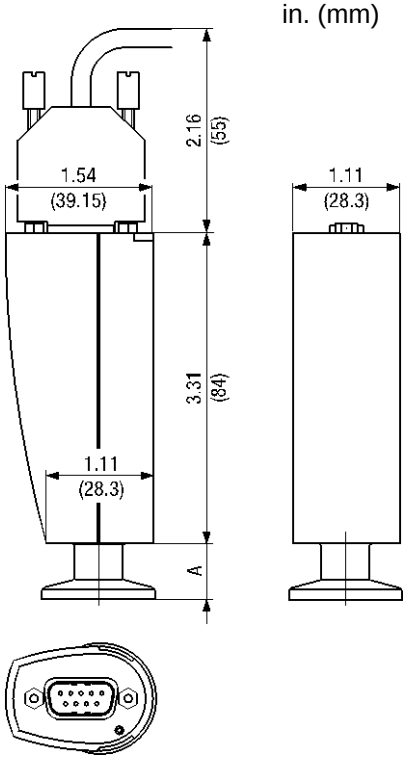
max output signal	+ 10.24 Vdc
response time	100 msec (from 10% to 90% F.S.)
input power [2]	13 to 30 Vdc, 0.3 W protected against power reversal
fuse required	1 AT (slow), automatic reset (Polyfuse)
supply voltage ripple	≤50 mVpp
connector	9-pin D-sub male
CE compliance	EMC (EN61000-6-2, EN61000-6-3, EN61010-1)
environmental	RoHS compliant

1) Non-linearity, hysteresis, repeatability at 25 Deg °C ambient temperature without temperature effects after 2 hours operation.

(2) ⚠ **WARNING!** The gauge may only be connected to power supplies, instruments, or control devices that conform to the requirements of a grounded protective extra-low voltage (SELV) and limited power source (LPS), Class 2. The connection to the gauge has to be fused.

1.3 Dimensions

in. (mm)



Fitting	dimension A
1/2 in. Tube	0.59 in. (15.0 mm)
NW16KF	1.20 in. (30.7 mm)
NW25KF	1.39 in. (35.5 mm)
1 1/3 in. Mini-CF	1.28 in. (31.1 mm)
1/4 in. Cajon 4VCR	2.43 in. (61.8 mm)
1/2 in. Cajon 8VCR	1.77 in. (45.0 mm)

1.4 Part Numbers

CDM900 # F # U # #

Accuracy
A= 1% accuracy
B= 0.5% accuracy

Full Scale (F.S.)
A = 10 Torr
B = 20 Torr
C = 50 Torr
D = 100 Torr
E = 200 Torr
F = 500 Torr
G = 1000 Torr

Fitting / Flanges
A= 1/2 in. Tube
B= NW16KF
C=NW25KF
E = 1 1/3 in. Mini-CF (NW16CF)
G = 4VCR Female
H = 8VCR Female

Units of Measure
T= Torr

Example: CDM900BFAUTB (CDM900, 0.5% accuracy, 10 Torr F.S, Torr units of measure, NW16KF fitting)

1.5 Options & Accessories

Optional Wall Mount AC-DC
PS901 Power Supply
Input: 100 - 240 Vac
Output: 24 Vdc @ 750 mA (18 W)
Various AC plugs, 6 ft. cable length

		Part Number
with North American AC Plug		PS901-A
with Universal European AC Plug		PS901-EU
with UK AC Plug		PS901-UK
with China AC Plug		PS901-C
with Australian AC Plug		PS901-SP

PS901-UX For Use With User Supplied AC Power Cord

PS901-UX

This variation of the PS901 power supply may be used when an AC plug that is not listed above is required. The conventional IEC60320 AC power entry receptacle allows use with any user supplied AC mains power cord set available worldwide.

Input: 100 - 240 Vac
Output: 24 Vdc @ 2.5 A (60 W)
Cable Length: 6 ft.

2 Important Safety Information

InstruTech has designed and tested this product to provide safe and reliable service, provided it is installed and operated within the *strict safety guidelines provided in this manual.* **Please read and follow all warnings and instructions.**

⚠ WARNING

To avoid serious injury or death, follow the safety information in this document. Failure to comply with these safety procedures could result in serious bodily harm, including death, and or property damage.

Failure to comply with these warnings violates the safety standards of installation and intended use of this instrument. InstruTech disclaims all liability for the customer's failure to comply with these instructions.

Although every attempt has been made to consider most possible installations, InstruTech cannot anticipate every contingency that arises from various installations, operation, or maintenance of the module. If you have any questions about the safe installation and use of this product, please contact InstruTech.

2.1 Safety Precautions - General

⚠ **WARNING!** Do not modify this product or substitute any parts without authorization of qualified InstruTech service trained personnel. Return the product to an InstruTech qualified service and repair center to ensure that all safety features are maintained. Do not use this product if unauthorized modifications have been made.

⚠ **WARNING!** Source power must be removed from the product prior to performing any servicing.

⚠ **WARNING!** The gauge may only be connected to power supplies, instruments, or control devices that conform to the requirements of a grounded protective extra-low voltage (SELV) and limited power source (LPS), Class 2. The connection to the gauge has to be fused.

After servicing this product, ensure that all safety checks are made by a qualified service person. When replacement parts are required, ensure that the parts are specified by InstruTech. Substitutions of non-qualified parts may result in fire, electric shock or other hazards. Use of unauthorized parts or modifications made to this product will void the warranty.

To reduce the risk of fire or electric shock, do not expose this product to rain or moisture. These products are not waterproof and careful attention must be paid to not spill any type of liquid onto these products. Do not use these products if they have been damaged. Immediately contact InstruTech to arrange return of the product if it is damaged.

Due to the possibility of corrosion when used in certain environmental conditions, it is possible that the product's safety could be compromised over time. It is important that the product be periodically inspected for sound electrical connections and equipment grounding. Do not use if the equipment grounding or electrical insulation has been compromised.

2.2 Safety Precautions - Service and operation

Ensure that the vacuum port on which the CDM900 is mounted is electrically grounded.

Use an appropriate power source of 13 to 30 Vdc, 0.3 W minimum.

Turn off power to the unit before attempting to service the module.

Turn off power to the unit if a cable or plug is damaged or the product is not operating normally according to this instruction manual. Contact qualified InstruTech service personnel for any service or troubleshooting condition that may not be covered by this instruction manual.

Do not use if the unit has been dropped or the enclosure has been damaged. Contact InstruTech for return authorization and instructions for returning the product to InstruTech for evaluation.

Gauge failures due to contamination or wear and tear are not covered by the warranty. We recommend checking the zero at regular intervals.

2.3 Electrical Conditions

⚠ **WARNING!** When high voltage is present in any vacuum system, a life threatening electrical shock hazard may exist unless all exposed electrical conductors are maintained at earth ground potential. This applies to all products that come in contact with the gas contained in vacuum chambers. An electrical discharge within a gaseous environment may couple dangerous high voltage directly to any ungrounded conductor of electricity. A person could be seriously injured or killed by coming in contact with an exposed, ungrounded electrical conductor at high voltage potential. This condition applies to all products that may come in contact with the gas inside the vacuum chamber (vacuum/pressure containment vessel).

2.3.1 Proper Equipment Grounding

⚠ **WARNING!** Hazardous voltages that could seriously injure or cause death are present in many vacuum processes. Verify that the vacuum connection port on which the gauge is mounted is electrically grounded. Consult a qualified Electrician if you are in doubt about your equipment grounding. Proper grounding of your equipment is essential for safety as well as intended operation of the equipment.

The CDM900 must be electrically connected to the grounded vacuum chamber. The connection must conform to the requirements of a protective connection according to EN 61010:

- ➔ VCR® connections fulfill this requirement.
- ➔ For gauges with a KF connection, use a conductive metallic clamping ring.

⚠ **WARNING! In order to protect personnel from electric shock and bodily harm, shield all conductors which are subject to potential high voltage electrical discharges in or around the vacuum system.**

2.3.2 Electrical Interface and Control

It is the user's responsibility to ensure that the electrical signals from this product and any connections made to external devices, for example, relays and solenoids, are used in a safe manner. Always double check the system set-up before using any signals to automate your process. Perform a hazardous operation analysis of your system design and ensure safeguards and personnel safety measures are taken to prevent injury and property damage.

2.4 Overpressure and use with hazardous gases

⚠ **WARNING!** Install suitable protective devices that will limit the level of pressure inside your vacuum chamber to less than what the vacuum chamber system components are capable of withstanding. For example, a quick-connect, O-ring compression fitting may forcibly release a mounted device from the vacuum chamber fitting with only a few psi over local uncorrected barometric (atmospheric) pressure.

In cases where an equipment failure could cause a hazardous condition, always implement fail-safe system operation. For example, use a pressure relief device in an automatic backfill operation where a malfunction could result in high internal pressures if the pressure relief device was not installed on the chamber.

⚠ **WARNING!** Overpressure in the vacuum system > 14.5 psia (1 bar)
Injury caused by released parts and harm caused by escaping process gases can result if clamps are opened while the vacuum system is pressurized. Do not open any clamps while the vacuum system is pressurized. Use the type of clamps which are suited to overpressure.

⚠ **WARNING!** Overpressure in the vacuum system > 29 psia (2.5 bar)
KF connections with elastomer seals (O-rings) cannot withstand such pressures. Process media can thus leak and possibly damage your health. Use O-rings provided with an outer centering ring.

⚠ **CAUTION!** If the internal pressure of a vacuum measuring device is allowed to increase above local uncorrected barometric pressure (atmospheric pressure side), vacuum fittings may release and possible overpressure conditions may cause leaks that would allow the gas inside the tube to release into the atmosphere of the surrounding environment. Toxic, pyrophoric and flammable gases are examples of hazardous gases that if allowed to leak out of the vacuum/pressure containment vessel into the atmospheric environment, could cause bodily injury and possible damage to equipment. Never expose the vacuum measuring device internal volume to pressure above local atmospheric pressure when using hazardous gases.

3 Installation

3.1 Mechanical Installation

⚠ **WARNING!** Fragile components. The ceramic sensor may be damaged by impacts. Do not drop the product and prevent shocks and impacts.

⚠ **CAUTION!** Dirt and damage can impair the function of the vacuum component. Take appropriate measures to ensure cleanliness and prevent damage. Touching the product or parts with bare hands increases the desorption rate. Always use clean, lint free gloves as well as clean tools when working with this product.

Mount the gauge so that no vibrations occur. Should gauge adjustments become necessary in the future, be sure to install it so that the adjustment button can be accessed with a pin.

Mount the CDM900 as close as possible to the pressure you want to measure. Long or restricted, small diameter tubing will create a pressure difference between your process chamber and the gauge. This may cause a delay in response to pressure changes. Mounting the CDM900 too close to a gas source inlet may also cause measurement and control instability.

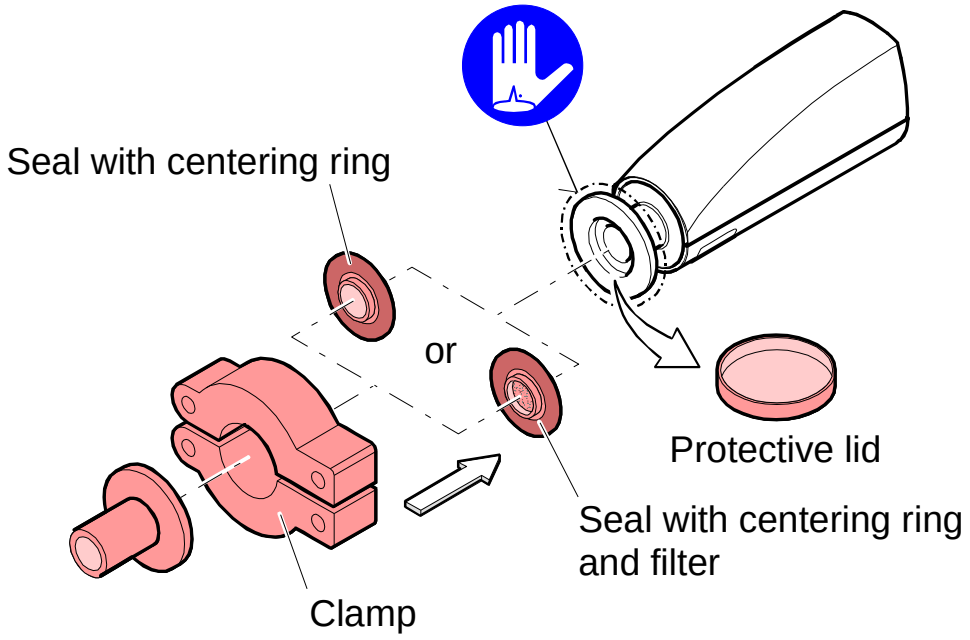
The CDM900 can be mounted in any orientation, however, if possible, mount the gauge with port down to help minimize the effect of any particles or condensation collecting in the gauge.

For electrical safety purposes the housing of the gauge must be grounded to the vacuum chamber. When using KF flanges, metal clamps must be used to ensure proper grounding. Do not attempt to modify your flange in order to use non-metallic-type flange clamps.

Use all metal vacuum fittings with metal seals when operating pressures are expected to be below 1.00×10^{-7} Torr (1.33×10^{-7} mbar, 1.33×10^{-5} Pa).

For potentially contaminating applications and to protect the measurement system against contamination, installation of the optional seal with centering ring and filter is recommended.

Remove the protective lid and install the product to the vacuum system following manufacturer's recommendations for different flanges and fittings. Keep the protective lid for future maintenance.



3.2 Electrical Installation

3.2.1 Grounding

⚠ **WARNING!** Be sure the vacuum gauge and the rest of your vacuum system are properly grounded for safety as well as intended operation of the equipment. When using KF flanges, metal clamps must be used to ensure proper grounding.

⚠ **WARNING!** The gauge may only be connected to power supplies, instruments or control devices that conform to the requirements of a grounded protective extra-low voltage (SELV) and limited power source (LPS), Class 2. The connection to the gauge has to be fused.

Ground loops, differences of potential, or EMC problems may affect the measurement signal. For optimum signal quality, please do observe the following:

- Use an overall metal braided shielded cable. The connector must have a metal case.
- Connect the cable shield to ground at one side via the connector case. Make sure the connector case has direct contact to the cable's shield on its whole circumference. Do not connect the other side of the shield.
- Connect the supply common with protective ground directly at the power.
- Use differential measurement input (signal common and supply common conducted separately).
- Potential difference between supply common and housing ≤16 V (overvoltage protection).

3.2.2 Connector

Good, recommended practice is to remove power from any cable prior to connecting or disconnecting it.

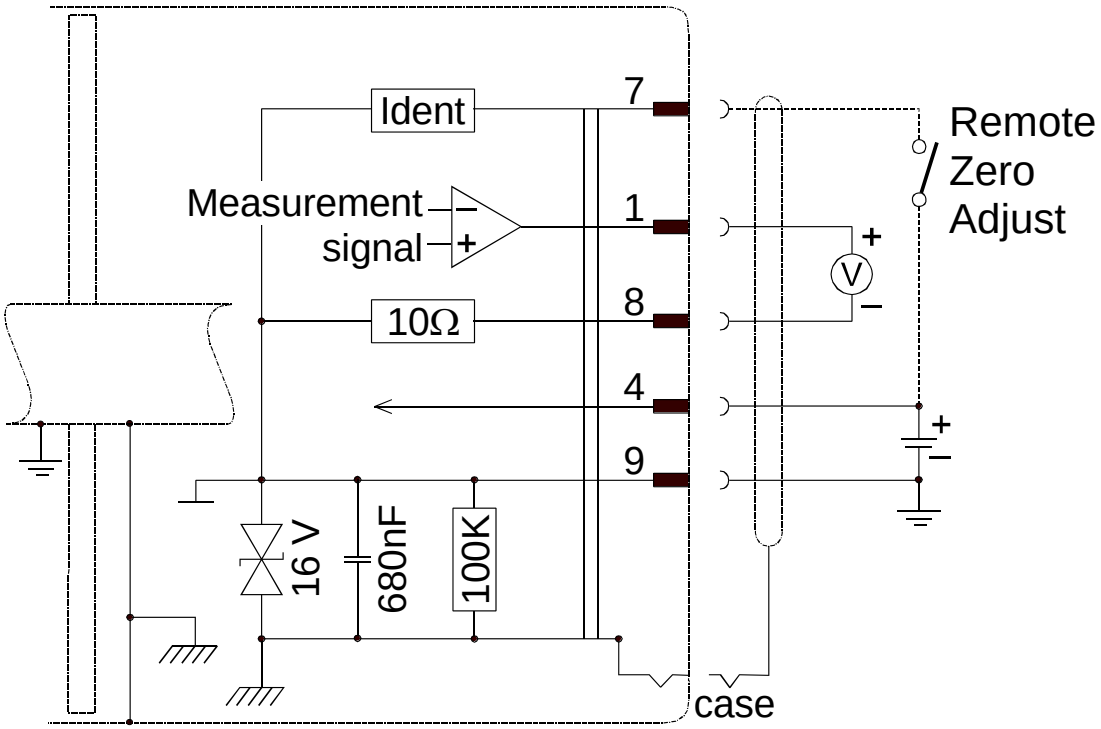
1) The CDM900 is provided with one 9-pin D-sub male connector used for the I/O interface. Fabricate a cable to connect to the vacuum gauge as shown below:

3.2.3 Connector pin-out

9-pin D-sub (DE-9P) male connector (used for analog output and digital I/O)

PIN NUMBER	PIN DESCRIPTION
1	Analog output (Linear 0 to 10 Vdc)
2	Not assigned
3	Not assigned
4	Power Input (13 to 30 Vdc, 0.3 W) protected against power reversal and transient over-voltages
5	Not assigned
6	Not assigned
7	Remote zero adjust
8	Analog output common
9	Power common GND
case	Connector case

Wiring Diagram



4 Setup and Operation

4.1 Gauge start up and operation

Read this user manual in its entirety before operating the instrument.

The signal output is available when power is applied to the gauge. Allow for a Warm-up time of approx. 1 minute.

4.2 Zeroing the Gauge

- The gauge is factory calibrated while "standing upright". It requires no maintenance.
- Due to mounting orientation, operation over long period of time or contamination, a zero drift could occur and zero adjustment may become necessary.
- For adjusting the zero, operate the gauge under the same constant ambient conditions and in the same normal mounting orientation.

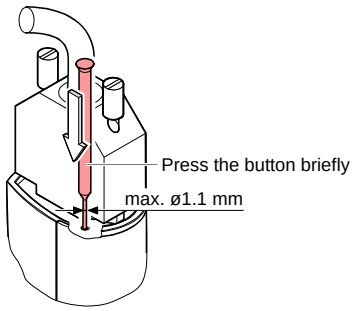
The zero can be adjusted via one of the following methods:

- the button on the gauge
- the digital input "Remote zero adjust " (briefly apply the supply voltage to pin 7 of the D-Sub connector)

❶ Evacuate the vacuum system to a pressure according to the table below:

F.S.	Recommended final pressure for zero adjustment		
1000 Torr	$<5\times10^{-2}$ Torr	$<5\times10^{-2}$ mbar	$<6.65\times10^{0}$ Pa
500	$<2.5\times10^{-2}$ Torr	$<3.33\times10^{-2}$ mbar	$<3.33\times10^{0}$ Pa
200	$<10^{-2}$ Torr	$<10^{-2}$ mbar	$<1.33\times10^{-0}$ Pa
100	$<5\times10^{-3}$ Torr	$<5\times10^{-3}$ mbar	$<6.65\times10^{-1}$ Pa
50	$<2.5\times10^{-3}$ Torr	$<2.5\times10^{-3}$ mbar	$<3.33\times10^{-1}$ Pa
20	$<10^{-3}$ Torr	$<10^{-3}$ mbar	$<1.33\times10^{-1}$ Pa
10	$<5\times10^{-4}$ Torr	$<5\times10^{-4}$ mbar	$<6.65\times10^{-2}$ Pa

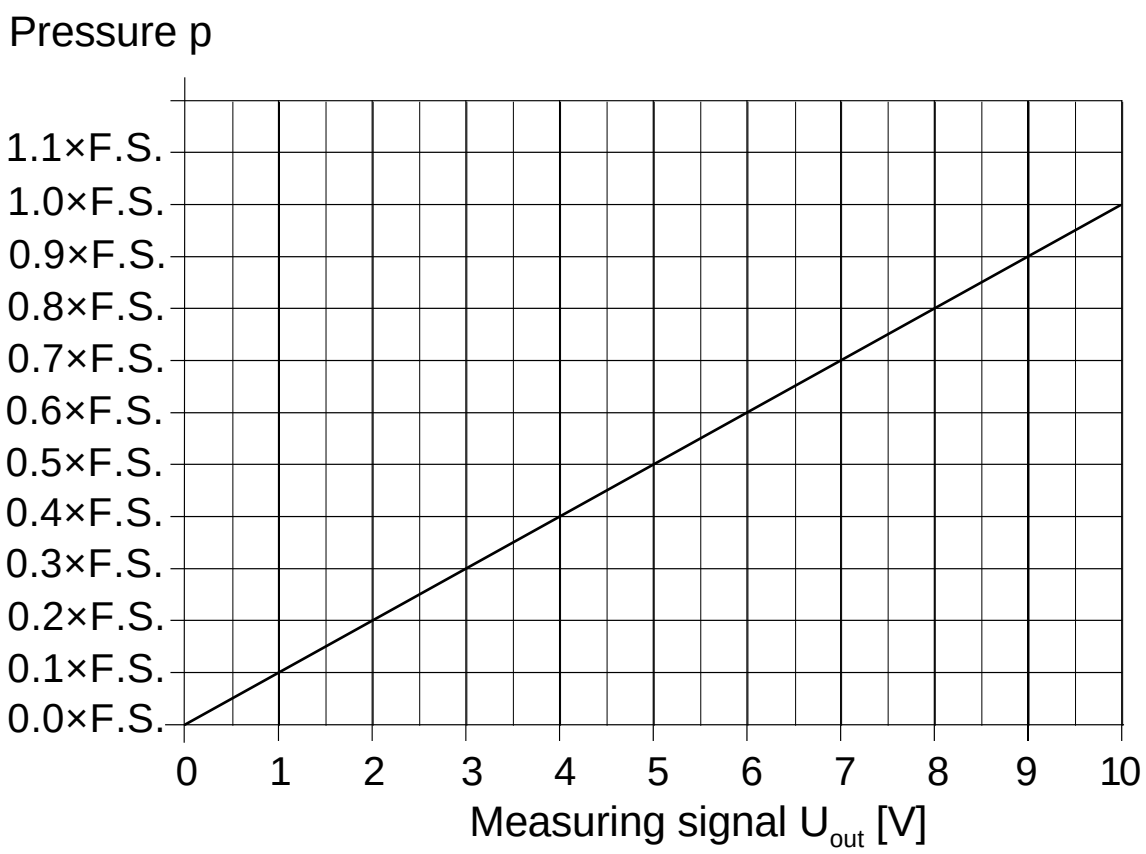
❷ Briefly press the <ADJ> button with a pin (max. ø1.1 mm) or briefly apply supply voltage to pin 7 of the D-Sub connector to set zero. The zero adjustment runs automatically (duration ≤8 s).



After zero adjustment the gauge automatically returns to normal measurement mode.

5 Analog Output

The CDM900 provides a 0 to 10 Vdc linear signal proportional to pressure.



$$p = (U_{out} / 10\ V) \times p\ (F.S.)$$

Conversion Torr ↔ Pascal

	Torr	mbar [1)]	Pa [1)]
c	1.00	1013.25 / 760 = 1.3332…	101325 / 760 = 133.3224…

Example: Gauge with 10 Torr F.S.
Measuring signal U_{out} = 6 V

$$p = (6\ V / 10\ V) \times 10\ Torr$$
$$= 0.6 \times 10\ Torr = \mathbf{6\ Torr}$$

[1)] Source: NPL (National Physical Laboratory)
Guide to the Measurement of Pressure and Vacuum, ISBN 0904457x / 1998

6 Service

6.1 Maintenance, Repair

In general, the CDM900 requires no maintenance.

Gauge failures due to contamination or wear and tear are not covered by the warranty. We recommend checking the zero at regular intervals (see section 4.2)

InstruTech assumes no liability and the warranty becomes null and void if any repair work is carried out by the end-user or third parties.

6.2 Removing the gauge from service

⚠ **WARNING!** Contaminated parts can be detrimental to health. Before beginning work, find out whether parts are contaminated and adhere to the relevant regulations and precautions for handling contaminated parts.

⚠ **CAUTION!** Dirt and damage impair the function of the vacuum component. Take appropriate measures to ensure cleanliness and prevent damage. Touching the product or parts with bare hands increases the desorption rate. Always use clean, lint free gloves as well as clean tools when working with this product.

1) Vent the vacuum system and turn off power to the gauge.
2) Unplug the cable and remove the gauge from the vacuum system.
3) Re-install the protective lid.

7 Factory Service and Support

If you need help setting up, operating, troubleshooting, or obtaining a return materials authorization number (RMA number) to return the module for diagnosis, please contact us during normal business hours (8:00am to 5:00pm Mountain time) Monday through Friday, at 303-651-0551. Or e-mail us at support@instrutechinc.com.

⚠ **WARNING!** Contaminated products (e.g. radioactive, toxic, caustic or microbiological hazard) can be detrimental to health and environment. Products returned to InstruTech should be free of harmful substances.

For the safety of our employees, you must download, complete and submit a material disclosure form from our website at www.instrutechinc.com Please use this form to provide a history of the product detailing what gases have been used. We cannot accept products that have been exposed to hazardous materials.

8 Warranty

SELLER warrants that its products are free of defects in workmanship and material and fit for the uses set forth in SELLER's catalog or product specifications, under the normal use and service for which they are intended.

The entire warranty obligation of SELLER is for the repair or replacement, at SELLER's option, of products or parts (examination of which shall disclose to SELLER's satisfaction that it is defective) returned, to SELLER's plant, properly identified within twenty four (24) months (unless otherwise noted) after the date of shipment from InstruTech Plant. BUYER must obtain the approval of SELLER and a return authorization number prior to shipment.

Alteration or removal of serial numbers or other identification marks renders this warranty void. The warranty does not apply to products or components which have been abused, altered, operated outside of the environmental specifications of the product, improperly handled or installed, or units which have not been operated in accordance with SELLER's instructions. Furthermore the warranty does not apply to products that have been contaminated (user assumes the responsibility in conjunction with the process media used), or when the product or part is damaged during the warranty period due to causes other than ordinary wear and tear to the product including, but not limited to, accidents, transportation, neglect, misuse, use of the product for any purpose other than that for which it was designed.

THIS WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. THIS WARRANTY EXTENDS ONLY IN FAVOR OF THE ORIGINAL BUYER. THE BUYER'S SOLE REMEDY SHALL BE THE REPAIR OR REPLACEMENT, AS IS EXPRESSLY PROVIDED HEREIN, OF ANY WARRANTED DEFECTIVE PRODUCT OR PART, AND UNDER NO CIRCUMSTANCE SHALL SELLER BE LIABLE TO BUYER OR ANYONE ELSE FOR ANY CONSEQUENTIAL DAMAGES TO PERSONS OR PROPERTY, FOR INCIDENTAL DAMAGES OR LOSS OF TIME, FOR ANTICIPATED OR LOST PROFITS, OR ANY OTHER LOSS INCURRED BY THE BUYER RELATED TO THE PRODUCT COVERED BY THIS WARRANTY. THIS EXCLUSIVE REMEDY SHALL NOT BE DEEMED TO HAVE FAILED OF ITS ESSENTIAL PURPOSE SO LONG AS SELLER IS WILLING AND ABLE TO REPAIR OR REPLACE DEFECTIVE PARTS IN THE PRESCRIBED MANNER. THIS LIMITED WARRANTY MAY NOT BE MODIFIED BY SELLER UNLESS SUCH MODIFICATION OR WAIVER IS IN WRITING, EXECUTED BY AN AUTHORIZED OFFICER OF SELLER.

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