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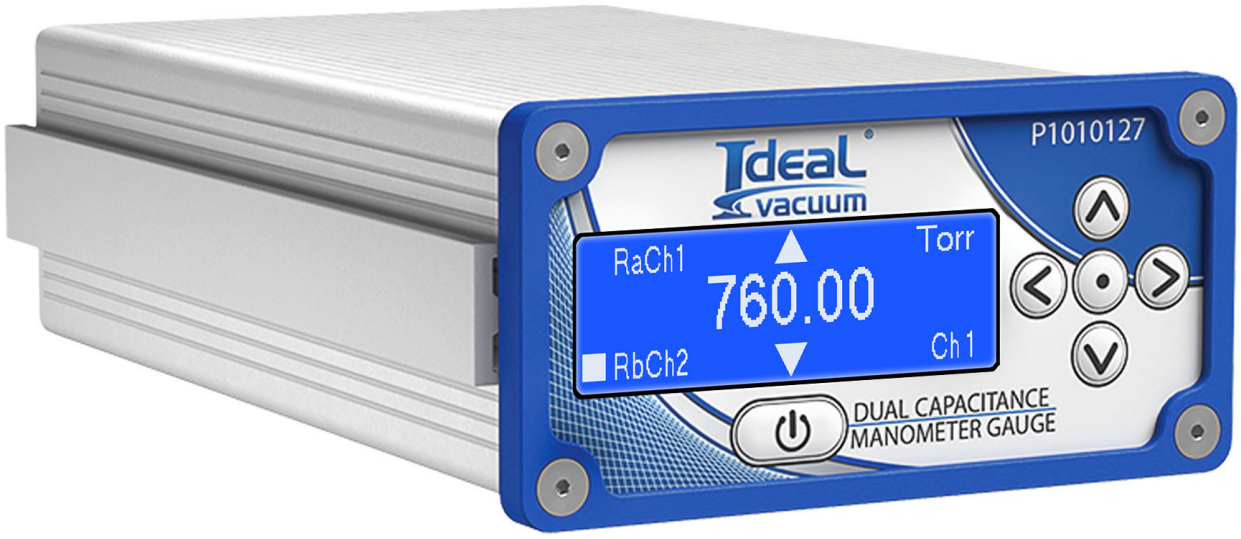
Dual Capacitance Manometer Gauge Controller (DCM)

USER MANUAL



Model XGC-520 (P1010127)

DCM-05222025 - V 1.2.3

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SAFETY

IMPORTANT SAFETY INFORMATION

Thank you for purchasing this equipment from Ideal Vacuum Products. We want you to operate it safely.

- **Read this manual before installing or operating this equipment. Failure to follow the warnings and instructions may result in serious injury or equipment damage.**
- **Keep this manual in a safe location for future reference.**
- **This equipment should only be installed and operated by trained, qualified personnel, wearing appropriate protective equipment.**
- **Follow all codes that regulate the installation and operation of this equipment.**

⚠ WARNING

Do not use the Dual Capacitance Manometer Gauge Controller to measure the pressure of flammable gases. Under certain unusual circumstances ignition leading to an explosion could occur.

⚠ WARNING

Do not use the Dual Capacitance Manometer Gauge Controller in the presence of toxic chemicals, such as organic solvents without proper ventilation.

⚠ WARNING

Do not use gauges with straight tubing and compression fittings in a system that may develop positive pressures. The tube could be rapidly forced out of the fitting causing equipment damage or injury to personnel.

1. GENERAL INFORMATION

1.1 INTRODUCTION

The Ideal Vacuum Products (IVP) XGC-520 Dual Capacitance Manometer Gauge Controller (DCM) is an inexpensive solution for pressure readout of up to two Capacitance Diaphragm Gauges (CDG's). The IVP DCM controller provides enhanced accuracy with intelligently designed features for simple user control and easy system integration.

The IVP DCM is designed to interface with the popular Baratron® CDG's from MKS and can read full scale absolute vacuum/pressure ranges from 20 mTorr (2 x 10^{-4} Torr) to as much as 10,000 Torr (1x10^{4} Torr). Because CDG's measure absolute pressure, they are gas type and composition independent. Lookup tables and conversion factors are not required.

The DCM controller can supply two gauges, heated or unheated, with dual polarity voltage (±15 VDC at 1A total).

The unit has two analog output relays, each of which can be assigned to either of the two gauge channels, and programmed to energize when a setpoint is reached. This flexibility allows the user to easily set up automated tasks, such as valve activation or energizing a turbomolecular pump when an appropriate backing pump pressure is achieved.

Pressure measurement units (Torr, mTorr, mBar or Pa) can be set individually for each of the two gauges.

All user defined settings are stored in non-volatile memory and do not have to be re-entered every time power is cycled.

Our DCM is conveniently housed in a compact 1/8-DIN extruded aluminum enclosure for benchtop or rack panel mounting.

The brilliant, blue LCD display is easy to read and displays vital system and controller information at a glance. The intuitive front panel membrane switch interface allows the user to access and adjust all parameters quickly.

Remote communication and control is achieved by RS-232 serial terminal software. Connection is made via the rear-mounted DB15 or USB-B connectors. A variety of sensor and serial cables are available.

The DCM has a built in universal power supply which accepts an input of 100-240 VAC, 50/60Hz though its standard C14 receptacle. Included is a 2 meter long (6 ft.) 115 VAC input power cord with US plug 5-15P to C13 Connector. For use in other countries, the user must supply a suitable power cord.

1.2 FEATURES

- Controls up to two (2) capacitive diaphragm sensor gauges (CDG)
- Interfaces with popular MKS Baratron sensor gauges with full scale measurement ranges from 20 mTorr to 10,000 Torr
- Gas type and composition independent – no need for lookup tables and conversion factors
- Compact 1/8-DIN enclosure for benchtop or rack panel mounting
- Brilliant Blue LCD readout display
- Intuitive interface makes setting parameters quick and easy
- Two setpoint output relays for automated control of other equipment
- User selectable pressure units (Torr, mTorr, mBar, and Pa)
- Serial communication for remote control through DB9 and USB-B ports

1.3 SPECIFICATIONS

PARAMETER	MEASURE/TYPE
Number of Gauges Controlled	Up to 2
Units of Measure	Torr, mTorr, mBar, Pa (default = Torr)
User Selectable Pressure Ranges	10 ($2x10^{-4}$ to $1x10^{4}$ Torr) (default = 1000 Torr)
Maximum Pressure	10^{4} Torr
Useful Measuring Range	4 decades
Numeric Display	2 digits after decimal. If value is > 1000 or < 1.00, display switches to E notation
Audible Beeper	On/off (default = on)
Voltage to Gauge(s)	±15 VDC
Max. Supplied Current to Gauge(s)	1A combined
Input Voltage to controller	0-10 VDC for full measuring range of gauge
Setpoints	2 (default=off)
Setpoint Relays	2A @ 30VDC, >10 K Ω, NO/NC
Rear Panel Connections	C14 power input wih 3A quick acting fuse DB9-F, for sensor gauge(s) USB-B for I/O serial communications DB15-F, RS-232 I/O serial and relay outputs
Serial Communications	9600 baud 8-N-1, no hardware handshake
Operating Temperature Range	0 to 50° C
Enclosure Size	1/8-DIN
Input Power	100-240 VAC, 50/60 Hz

Table 1 - Technical specifications

1.4 DIMENSIONAL DRAWINGS

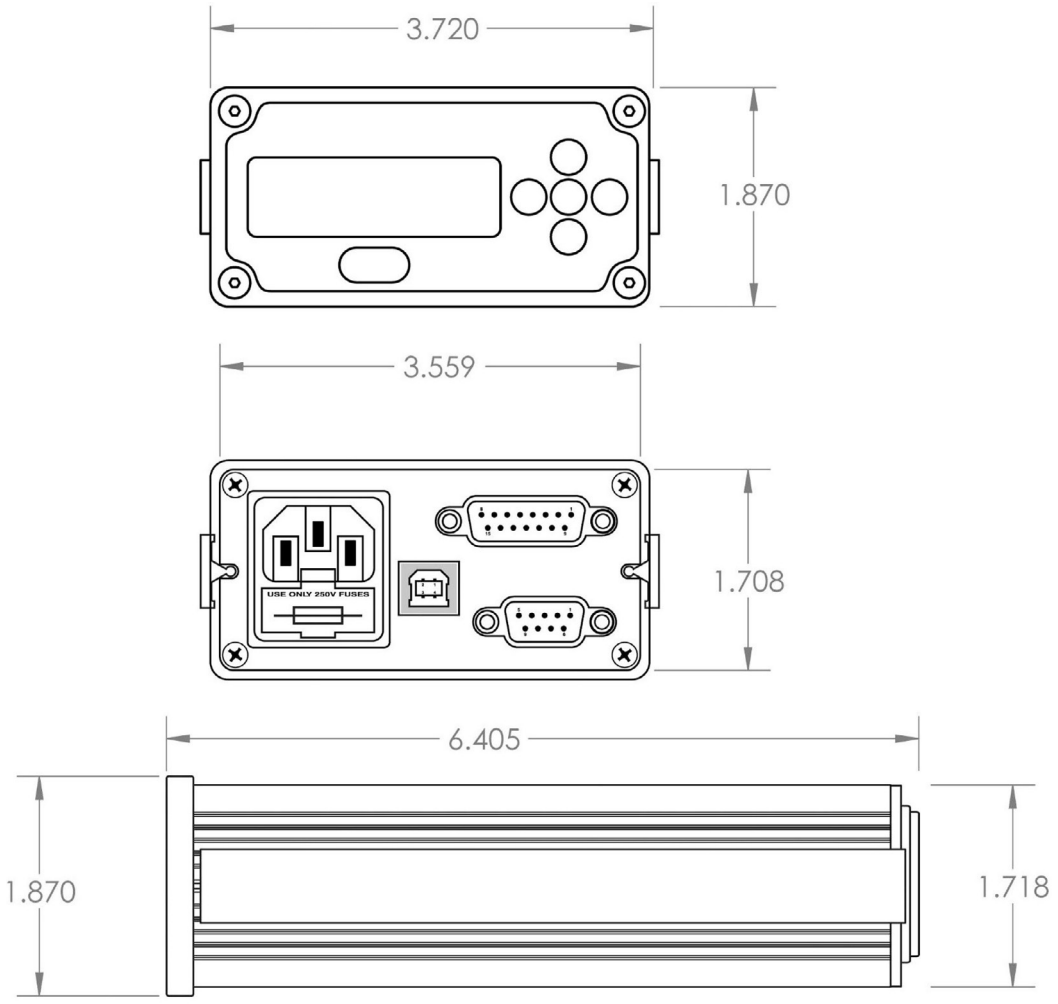


Figure 1 - Dimensional drawings

1.5 PANEL MOUNTING

Standard 1/8 DIN enclosure panel cut out dimensions are 1.772” x 3.622” (45mm x 92mm). Maximum panel thickness is 3/8” (10mm). To mount the DCM in a panel, unscrew the two 4-40 set screws at the back of the DCM Use a 0.050” hex wrench. Slide the rails out of the slots. Slide the DCM through the front of the panel, back first. Slide the two rails back into the slots. Replace the set screws and tighten until the rails hold the DCM snug in the panel.

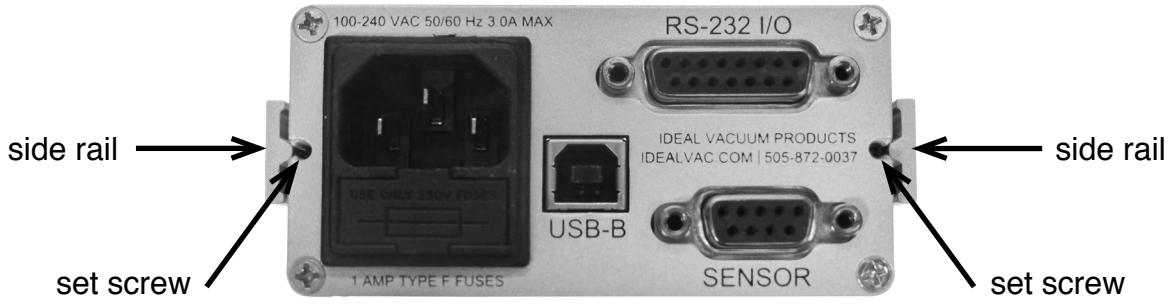


Figure 2 - Rails for panel mounting

1.6 FRONT PANEL DISPLAY AND CONTROLS

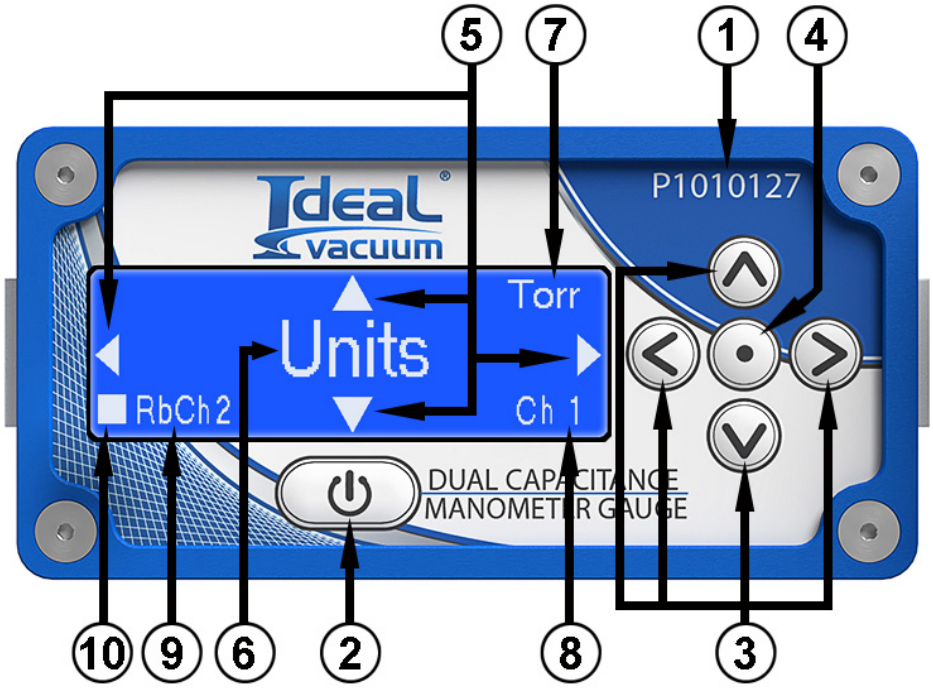


Figure 3 - Front panel features

ITEM No.	DESCRIPTION
1	Ideal Vacuum part number
2	Power on/off button
3	Navigation buttons
4	Select/enter button
5	Navigation direction arrows
6	Menu item or value
7	Current pressure units
8	Gauge channel
9	Saved setpoint indicator
10	Relay on indicator

Table 2 - Front panel feature descriptions

1.7 BACK PANEL POWER AND I/O CONNECTIONS

The back of the DCM has the power, communication, and sensor gauge connections. The DCM has a built-in universal power supply rated for 100-240 VAC, 50/60 Hz. The DCM accepts a C13 plug. The RS-232 I/O (multi purpose) connector is a 15 pin D-Sub. It is used for both serial communication and for the two analog relay outputs. The USB-B connector is used for remote serial communications and for software updates. The 9 pin D-Sub connector is used to connect the CDG sensor gauges.

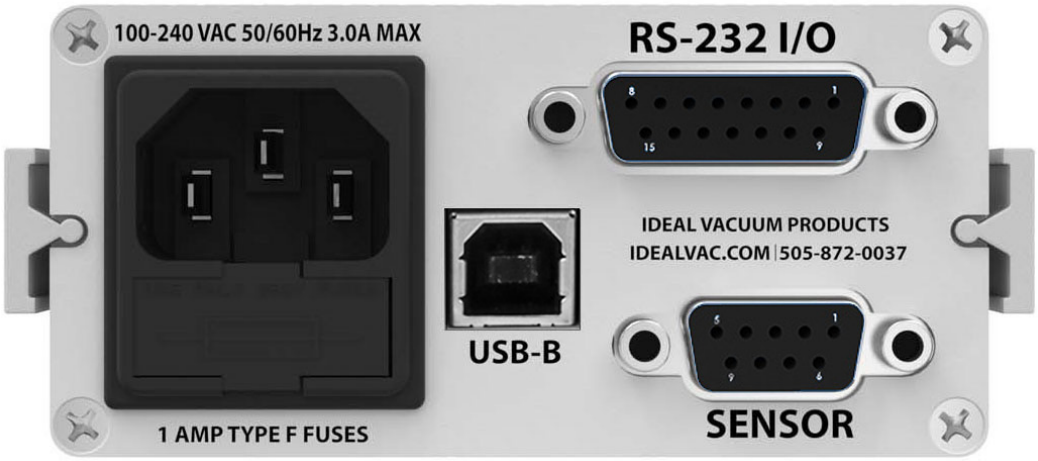


Figure 4 - Back panel connectors

1.8 READY-MADE CABLES AND ADAPTERS

PART #	DESCRIPTION
P102063	Sensor cable, connects two gauges to DCM,10 ft., DB9 -M to two DB15-F
P102061	Sensor cable, connects two gauges to DCM, 10 ft. DB9-M to two DB9-F
P1011364	Serial cable, connects remote computer to DCM, 10 ft., DB15-M to DB9-F
P1012796	USB cable, connects remote computer to DCM, 10 ft. USB-A to USB-B
P1012800	DB15-M to terminal block breakout for splitting out relays and RS232 cables

Table 3 - Available ready-made cables and adapters

1.9 CUSTOM CABLES

If you are making your own sensor cables, follow these guidelines:

- Use only quality, metal braided, fully shielded, cables between the controller and gauge(s).
- Foil or spiral shielded cables perform worse than braided, and signal degradation may occur.
- Cables must be properly grounded at both ends.
- Connectors must have a metal case or be fully shielded.
- The cable's shield must contact the case on its entire circumference.
- The shield wire must be grounded before the signal wires exit the connector.
- The ground wire should be the absolute minimum length within the connector.

1.10 SENSOR CONNECTOR PINOUTS (DB9)

Connector pinouts are shown looking at the female connector on the back of the DCM.

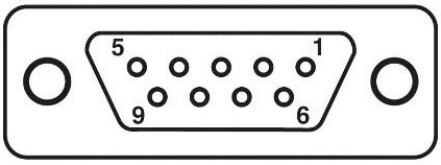


Figure 5 - DB9 sensor connector on back of DCM

PIN #	DESCRIPTION
1	Gauge channel 1 signal
2	Gauge channel 2 signal
3	Gauge channel 2 signal return
4	+15 Volts gauge 1
5	+15 Volts gauge 2
6	-15 Volts gauge 1
7	-15 Volts gauge 2
8	Gauge channel 1 signal return
9	Power common & signal ground

Table 4 - DCM DB9 sensor connector pinouts

1.11 RS-232 I/O & RELAY CONNECTOR PINOUTS (DB15)

Connector pinouts are shown looking at the female connector on the back of the DCM.

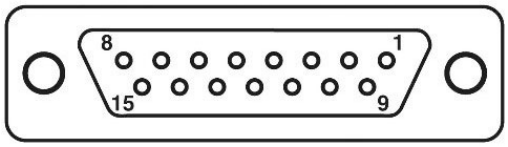


Figure 6 - DB15 RS-232 I/O connector on back of DCM

Figure 7 - DB15 male to breakout board adapter

PIN #	DESCRIPTION
1	Relay a, NC
2	Relay a, common
3	Relay a, NO
4	Relay b, NC
5	Relay b, common
6	Relay b, NO
7	Tx RS-232 signal out
8	Rx RS-232 signal in
9	Ground, RS-232 common
10	Not used
11	Channel 2 buffered analog signal, 1K output
12	Not used
13	Reserved
14	Not used
15	Channel 1 buffered analog signal, 1K output

Table 5 - DB15 RS-232 I/O connector on back of DCM

To make it easier to wire relay and serial cable connections, we recommend using a DB-15 male to terminal block breakout board adapter (P1012800).

2. INSTALLATION

2.1 MOUNT THE GAUGE

Connection of a sensor gauge to the DCM is straightforward. First, mount the capacitance diaphragm gauge mechanically into your system:

1. Follow all instructions for installation that were provided with your gauge(s).
2. Although CDG gauges will function in any orientation, it is best to mount the gauge vertically with the inlet port facing down. Port-down vertical mounting helps keep the diaphragm clean by allowing any foreign matter which enters the port to fall away from the diaphragm. It also keeps condensation from collecting on it.
3. For threaded port connections (e.g., VCR or 1/8" MPT), make sure to properly tighten the fitting. Use appropriate thread sealant on 1/8" NPT threads and tighten to hand-tight.
4. Isolate the CDG from vibration as much as possible.

NOTE

When using two gauges, they must both have the D-Sub connector (9 or 15 pins), unless a custom cable is made. Heated and non-heated gauges may be mixed.

2.2 ELECTRICAL CONNECTIONS

⚠ CAUTION

To minimize a possible ground loop which could affect the performance and stability of the system, the ground of the DCM and the gauge(s) should be the same (chassis ground).

1. Properly ground the gauge and controller.
2. Connect the sensor cable between the CDG and the DCM.
3. Plug in the DCM's power cord.
4. Press the Power button on the DCM.

Figure 8 - Simplified DCM installation

3. OPERATION

3.1 PRINCIPLE OF CAPACITANCE DIAPHRAGM GAUGE OPERATION

A capacitance diaphragm gauge (CDG) is an electro-mechanical sensor that can measure both pressure and vacuum. It translates changes in pressure into an electrical signal which is linear and proportional to the pressure.

Vacuum or pressure is introduced through an inlet tube into a closed chamber on the system side of the gauge. A round, elastic metal diaphragm is exposed to the gas whose pressure is to be measured.

On the back side of the diaphragm is a closed high vacuum (reference) chamber. Two concentric electrodes, mounted in a fixed ceramic disk, face the back side of the diaphragm. The reference side is permanently evacuated, its vacuum maintained with a chemical getter pump (for absolute manometer gauges). The diaphragm and each of the fixed electrodes make up the two conductors of a capacitor.

The diaphragm is deflected towards or away from the fixed electrodes with changing absolute pressure, independent of gas type or composition.

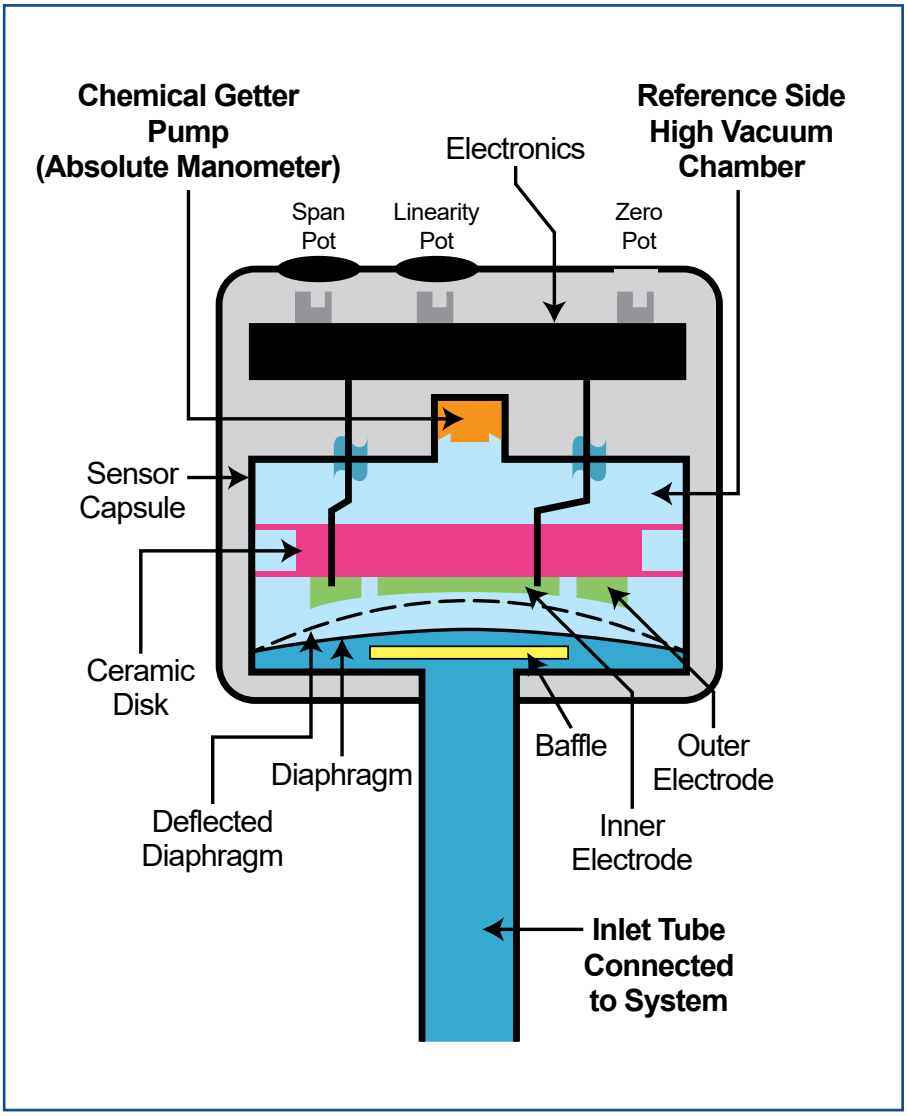


Figure 9 - Inside a capacitance diaphragm gauge

The diaphragm deflection causes a capacitance difference between the two electrodes since the distance to the diaphragm is now different for each of them. The measured capacitance imbalance is converted into an amplified DC output voltage signal by the gauge's onboard electronics, whose power is supplied by a connected controller. A precise 0 to 10 VDC signal, scaled to the full measuring range of the gauge, is output to the controller. The controller translates the voltage signal into pressure units which are displayed on the controller screen. Different diaphragm materials and thicknesses set the gauge to a specific pressure measuring range.

Capacitance diaphragm gauges are among the fastest and most accurate vacuum pressure measurement sensors because very small capacitance changes can be accurately and quickly measured. Accuracy is generally within 0.25% to 0.50%. They are often used in the rough vacuum measurement range in process applications where the gas composition and concentration can change rapidly. CDG's, due to their robust construction and materials, are resistant to corrosive gases. Since a CDG measures direct force applied from the vacuum pressure, its pressure measurement is independent of the gas-type. This eliminates the need for lookup tables and gas conversion calculations. These gauges offer short warm up times, great signal stability, and fast recovery from atmosphere which reduces process cycle times.

CDG's are, however, susceptible to process applications which generate materials that could deposit on the diaphragm surface. In order to keep the diaphragm clean and free of process debris, CDG's are preferably mounted vertically, port-down, and a baffle is often installed directly between the sensor's vacuum inlet and the diaphragm. Heated CDG models are available which help keep process gases from condensing inside the gauge tube and on the diaphragm.

3.2 NAVIGATING MENUS AND SETTING PARAMETERS

Familiarize yourself with the Menu Flowchart (Figure 12, next page).

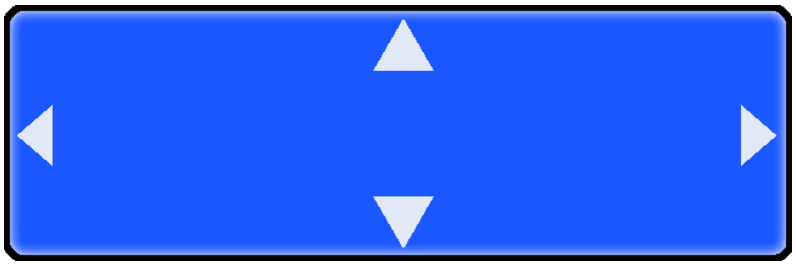


Figure 10 - Display arrows

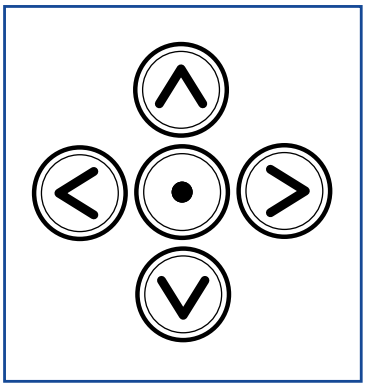


Figure 11 - Navigation buttons

Arrows on the LCD screen indicate the available navigation options and mimic the four navigation arrow buttons (Figures 10 and 11). The center button is the SELECT/ENTER button.

Use these rules to move about the menus:

- **The LEFT arrow button always moves you to a higher tier in the heirarchy.**

  Pressing the LEFT arrow button moves you to the left on the flowchart. New settings are not saved unless the SELCT/ENTER button is pressed. (See SELECT/ENTER below).

  The RIGHT ARROW button always switches the gauge Channel.

  The channel can be toggled if there is a right arrow on the screen.
  “CHn” on the flowchart means Channel 1 or 2, whichever is currently selected.

- **The UP and DOWN arrow buttons let you scroll through the available options on the same hierarchy level.**

- **The center SELECT/ENTER button has a dual function:**

  1. **Pressing the SELECT/ENTER button always takes you to the next deeper hierarchy level (if there is a lower level).**

     Pressing the SELECT/ENTER button moves you to the right on the flowchart.

  Or,

  2. **Pressing the SELECT/ENTER button saves a value or selection you have made.**

     A “SAVED!” screen message confirms that the new value or selection has been stored.

After a save, you are automatically returned to the originating sub-menu (i.e., Units, Full Scale, Setpoints, etc.).

3.3 MENU FLOWCHART

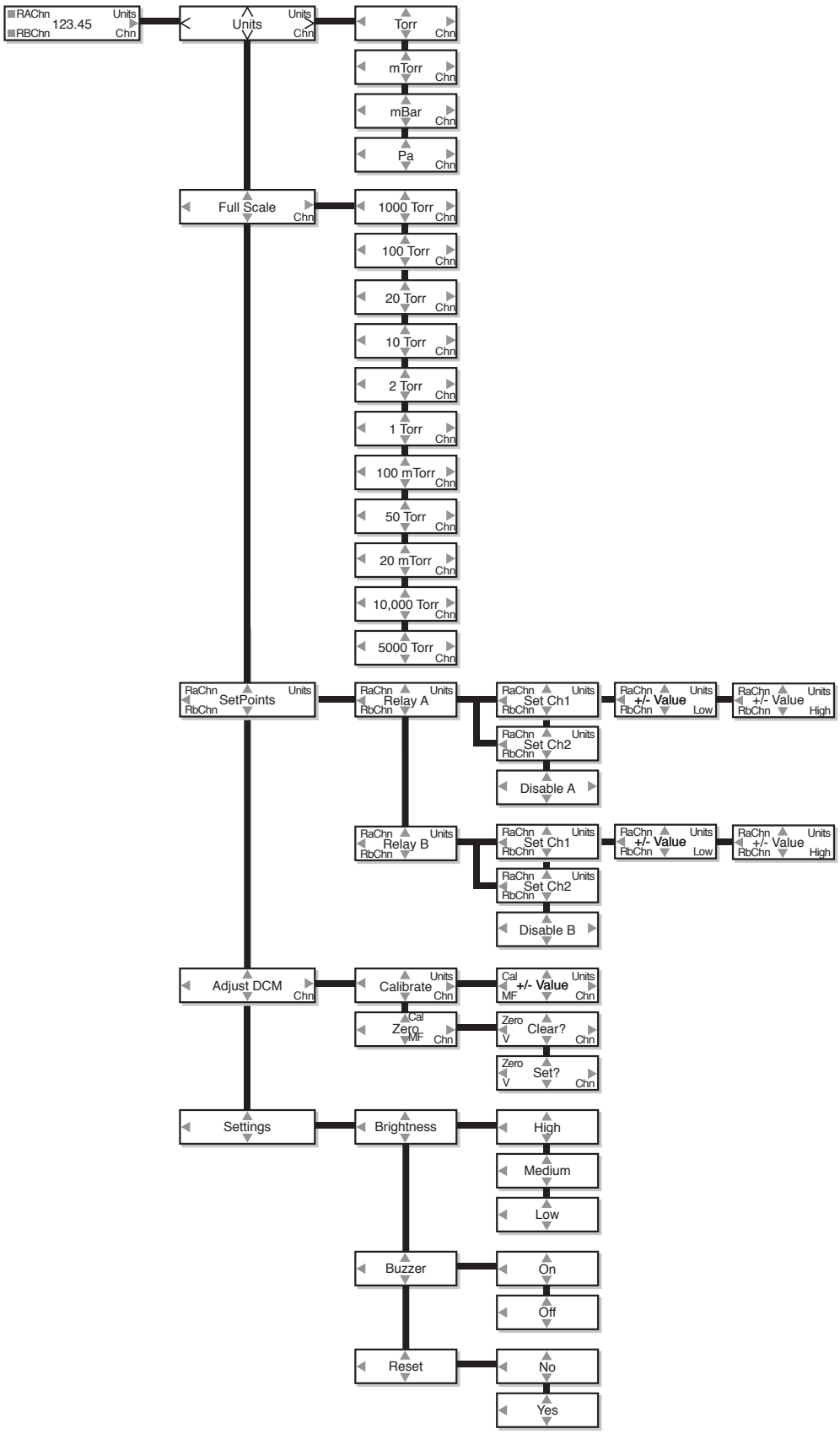


Figure 12 - Menu flowchart

3.4 STARTUP

After the gauge is physically mounted, sensor cable(s) and a power cord are connected, turn on the DCM by pressing the power button below the screen.

Figure 13 - Power button

The Ideal Vacuum splash screen will appear, then show the firmware version number.

After initializing, the DCM shows gauge pressure in the center of the home screen. The current Channel is displayed in the bottom right of the screen. Below, the DCM example shows that the gauge on Channel 1 has a pressure reading of 760.00 Torr (ambient atmosphere at sea level).

Press the right arrow button to switch to the other channel. Below the screen now shows that the gauge on channel 2 is at 234 mTorr (rough vacuum).

The screen shows N.C. (Not Connected) if no sensor gauge or a faulty gauge or cable is connected to the DCM. The display also shows N.C. if the pressure is too low for the gauge to reliably resolve (<0.01% of full scale value). See Sec. 3.11, p. 23 for more information about zeroing the gauge. The screen below indicates that one of these conditions exists on channel 2.

NOTE

If the system pressure is above the full scale of the gauge, the DCM will display the gauge's full scale value. See Sec. 3.6, p. 19 for more information about setting the gauge's Full Scale value.

3.5 CHANGING PRESSURE MEASUREMENT UNITS

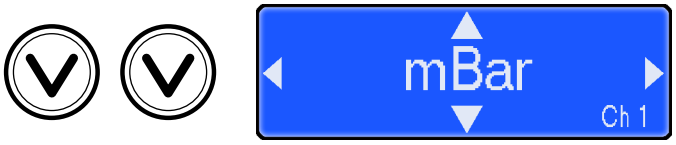
The Units parameter allows a user to see gauge pressure measurements in Torr, mTorr, mBar or Pa. Below is an example of how to change the controller's pressure units from Torr to mBar for a gauge on Channel 1. Each gauge can show a different pressure unit.

1. Start at the home screen. The current pressure of the gauge on Channel 1 is 760.00 Torr.

2. Press the SELECT/ENTER button to go to the Units screen.

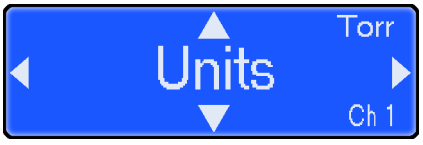
3.Press the SELECT/ENTER button again to go to the pressure unit (Torr) screen.

4.Press the DOWN arrow button (twice) until the mBar screen appears.



5.Press the SELECT/ENTER button. The selection is Saved! into memory.

6.The screen reverts to Units, the originating sub-menu (second tier in the flowchart).



7. Press the LEFT arrow button to go back to the home screen (first tier in the flowchart). The Channel 1 pressure now reads in mBar.

3.6 FULL SCALE

The Full Scale parameter is where the maximum measuring pressure of the sensor gauge is entered into the DCM. The correct full scale pressure of the gauge must be selected or the DCM will show incorrect pressure readings and setpoints will be off.

The DCM's full scale gauge options are in Torr only, since the full scale pressure of capacitance diaphragm gauges is most often specified in Torr.

Setting the gauge's Full Scale is similar to setting the Units parameter:

1. At the Home screen, press SELECT/ENTER. The Units screen appears.
2. Press the DOWN arrow button to go to the Full Scale screen.
3. Press SELECT/ENTER.
4. Press the UP or DOWN arrow button to scroll through the available full scale choices.
5. When the correct full scale value is displayed, press SELECT/ENTER.
6. The selected full scale pressure is SAVED!
7. Press the LEFT arrow button to go back to the home screen.

NOTE

If system pressure is too low for the gauge to reliably resolve, the screen displays: N.C. If the pressure is above the full scale of the gauge, the DCM will display the gauge's full scale value.

3.7 GLOBAL SETTINGS AND DEFAULTS

The DCM has several useful global parameters, chosen in the Settings menu:

- Screen brightness: Three levels are available: Low, medium, and high.
- Beeper On/Off: Whether the beeper sounds when a navigation button is pressed.
- Reset: Erases all user defined parameters and resets the DCM to factory defaults.

PARAMETER	FACTORY DEFAULT
Pressure Units	Torr
Full Scale	1000 Torr
Setpoints	Off
Calibrate	Multplying Factor = 1.00
Zero	Additive Factor = 0.00
Screen Brightness	Medium
Button Beeper	On

Table 6 - Factory defaults

NOTE

When reconfiguring a system, or preparing a new experiment, always unplug, then reset the DCM.

3.8 CHANNELS, RELAYS, AND SETPOINTS OVERVIEW

A channel is defined as the conduit through which sensor gauge information is sent to the DCM. The DCM has two channels, Channel 1 (Ch 1) and Channel 2 (Ch 2). Each channel may have a corresponding sensor gauge. The DCM displays the gauge pressure on the selected channel.

The DCM has two output relays, designated Relay a (Ra) and Relay b (Rb), which provide switching for external system components, such as solenoid operated valves or other automated process controls. Each relay is capable of supplying up to 60W (2A@30 VDC).

The relays are activated and de-activated when user defined pressure thresholds (setpoints) are reached. Each relay is programmed with a low and high pressure value such that:

- When the pressure drops **below the low value**, the relay is **energized**.
- When the pressure rises **above the high value**, the relay is **de-energized**.

A setpoint is correctly programmed only when both the low and high threshold values are defined and saved. This allows the user to have considerable control of hysteresis. Like all other parameters, setpoints are stored in non-volatile memory so they don't need to be re-entered every time power is cycled. See Section 3.9, p.21 for specific instructions on programming setpoints.

Either or both relays can be assigned to either channel. For example, if both relays are assigned to Channel 1, then two vacuum components (i.e., valves) could be activated using just one sensor gauge. Or, one valve could be opened while another is closed (one valve normally open, one normally closed). Alternatively, in a two sensor gauge system, Relay a could be assigned to one setpoint, and Relay b assigned to another. The DCM's channel/relay mapping flexibility allows the user to automate a system for their unique process requirements.

After a setpoint is programmed, the relay and assigned channel are indicated on the left side of the screen. Below, setpoints for both relays have been saved and assigned to Channel 1.

If a setpoint is not properly saved, then that relay/channel indicator will not appear. Below, only Relay a has been correctly input and stored. Here, Relay a is now assigned to Channel 2.

To provide the operator with real-time useful system information, an energized relay is indicated with a square to the left of the relay/channel indicator. Below, the (low) setpoint thresholds for both relays have been reached and the screen shows that both relays are energized.

3.9 PROGRAMMING SETPOINTS

NOTE

The Units and Full Scale of the gauge(s) MUST be set BEFORE programming setpoints.

Different pressure units can be used to input each setpoint. The DCM will automatically convert setpoint values into whatever pressure unit is currently selected.

Setpoints can be changed while a relay is energized. The DCM will reset the relay to off, then it will set the new values.

The following example shows how to enter the low and high setpoint thresholds for Relay b on Channel 2. Before proceeding, we set the Units to Torr and arbitrarily set the example gauge to a Full Scale of 1000 Torr.

Note that a setpoint has already been saved for Relay a on Channel 1 (RaCh1), indicated at the top left of the screen.

1. Press SELECT/ENTER to go to the Units screen.

2. Press the DOWN arrow button twice to go to the Setpoints screen.

3. Press SELECT/ENTER to select the Relay. The screen shows Relay a.

NOTE

To DISABLE (remove) an existing setpoint, you must select the relay corresponding to the setpoint to be removed. For example, to remove RaCh1 (above), you must select Relay a. At the Set Channel screen (next page), press the DOWN arrow button twice. At the Disable screen, press the SELECT/ENTER button. The setpoint will be deleted.

4. Press the UP or DOWN arrow button to switch to Relay b:

5. Press SELECT/ENTER to go to the Channel select screen.

6. Press the DOWN arrow to switch to Channel 2.

7. Press SELECT/ENTER. Relay b is now set to Channel 2. The Low pressure setpoint threshold is entered now. If a setpoint has not been set, the low pressure default value is 50% of the gauge's full scale. The starting value is the low saved value for pre-existing setpoints. The Low value cannot be less than 1%, or greater than 99% of the gauge's full scale. Use the UP or DOWN arrow button to change the value. With each UP or DOWN arrow button press, the value changes by 1% of full scale. If the button is held down, the value changes slowly at first, then more rapidly. Here we set the Low threshold to 100 Torr.

8. Press SELECT/ENTER. The Low threshold value is stored and the High pressure setpoint threshold is now entered. For a new setpoint, the High pressure threshold starting value is the Low value just entered. The starting value is the High saved value for pre-existing setpoints. The High value cannot be less than the Low value. The maximum High value is the gauge's full scale. Use the UP or DOWN arrow button to change the value. Here, we set the High threshold to 400 Torr.

NOTE

Note that the setpoint will not be stored if the LEFT arrow button is pressed at the Low or High screen.

9. Press SELECT/ENTER. The setpoint is SAVED! Press the LEFT arrow button to go to the home screen. The home screen now shows that both relays have programmed setpoints (RaCh1 and RbCh2). Neither relay is currently energized.

3.10 DCM ADJUSTMENT

The Adjust DCM menu allows you to calibrate and/or zero a gauge. Changing calibration or zero ONLY changes the DCM display, it does not change the output of the gauge. It is recommended to zero the gauge before adjusting its calibration. Make sure to warm up the gauge according to the manufacturer's recommendations before adjusting gauge calibration or zero.

3.11 ZEROING A GAUGE

NOTE

The CDG's zero is factory set and should not be adjusted unless necessary. However, long-term operation and contamination of the CDG can lead to zero shift and may require peroidic zero adjustment of the DCM, the CDG, or both.

When system pressure is sufficiently low, the output of a CDG falls below 10 mV, a typical CDG's lower resolution limit, and it cannot reliably supply the DCM with an accurate voltage. This is considered the gauge's zero and the DCM displays "N.C." (not 0) since system pressure can never be zero. If the DCM displays a numerical value when system pressure is below 0.1% of full scale (gauge output is <10mV), the DCM requires re-zeroing. To adjust the DCM to zero (N.C.), a voltage value offset, equal and opposite the current gauge voltage, is automatically applied. This forces the DCM to display N.C. when the gauge's output is <10mV. Like calibration, adjusting zero on the DCM only changes the DCM display, it does not change the gauge's output. Warm up the gauge per the manufacturer's recommend duration before adjusting zero. Note that the Zero function may ONLY be adjusted when CDG pressure is stable and less than 10% of full scale. The screen displays "High" if system pressure is too great.

1. Go to the Adjust DCM screen. Press the SELECT/ENTER button.
2. At the Calibrate screen, press the UP or DOWN arrow button to go to Zero.
3. Press the SELECT/ENTER button.
4. At the Clear? screen (below), notice that there is a value (>0.00) in the lower left. This is the voltage above zero that the DCM is receiving from the gauge. It is the voltage offset required to zero the gauge. Below, the value is 1.46 Volts. You can remove (clear) any entered zero offset by pressing the SELECT/ENTER button at the Clear? screen.

5. To zero the gauge, press the UP or DOWN arrow button to go to the Set? screen.
6. At the Set? screen, press SELECT/ENTER. The DCM automatically subtracts the voltage offset required to obtain zero volts, which then forces the home screen to display "N.C."

3.12 CALIBRATING A GAUGE

The Calibrate function is used to adjust a guage's displayed pressure on the DCM, either for a gauge that is not reading true compared to a reliable standard, or to set the display to a value that is unique to an experiment. Each of the two gauges can be calibrated separately.

The DCM will not display the same reading as a local weather radio or TV broadcast. This is because the CDG is an absolute pressure gauge, whereas weather broadcasts report pressure that is altitude adjusted to global average sea level. For example, at an altitude of 5000 ft., the actual (absolute) pressure is ≈ 25 inHG (≈ 635 Torr). The local weather station reports an (adjusted) pressure of ≈ 30 inHg (≈ 760 Torr). For more information about absolute vs. altitude adjusted pressure visit: https://www.weather.gov/bou/pressure_definitions.

NOTE

CDG's are calibrated by the manufacturer and re-calibration is not normally necessary. Setpoints do not change if the DCM is recalibrated.

Calibration is achieved by applying a Multiplying Factor (MF) to the gauge's voltage output received by the DCM. Since the CDG's output voltage is directly proporational to pressure, the MF shifts the DCM's pressure reading linearly across the gauge's entire pressure range. The Calibrate function should only be changed when CDG pressure is stable. For optimal results, we recommend that calibration be adjusted only when the gauge pressure is greater than 50% of full scale. Gauge pressure is shown in the user's selected units.

The MF can have a value between half (.50) and two (2.00). When the UP or DOWN arrow button is pressed the MF will change in .01 increments. Holding the button down for more than a few seconds makes the MF change rapidly. If the gauge cannot be recalibrated within the MF range, a gauge with a different full scale value is needed.

1. At the Home screen, press SELECT/ENTER.
2. At the Units screen, press the UP or DOWN arrow button to go to the Adjust DCM menu.
3. Press SELECT/ENTER to go to the Calibrate screen.
4. Make sure you are adjusting the correct gauge. Press the RIGHT arrow to switch channels.
5. Press SELECT/ENTER to go to the Calibration Value screen.
6. Use the UP or DOWN arrow button to change the MF as needed. As the MF is changed, the current pressure changes accordingly.
7. Press the SELECT/ENTER button.

Below is an example of how the re-calibration of the DCM behaves. Below, our gauge (left image) reads 710 Torr, but our certified reference standard reads 730 Torr. To calibrate our gauge to equal our reference, we increase the MF to 1.03 (710 x 1.03 ≈ 730). Below, the right image shows the re-calibrated gauge pressure, which is as close as possible using the DCM screen. For more precise calibration, use the **setcal1** serial command (p.28), which allows four digits after the decimal.

To remove calibration offset and show true (absolute) pressure, set the MF on the DCM to 1.00 (the default) or use the **rstcal1** serial command (p.28).

4. REMOTE OPERATION

Communication between the DCM and a remote computer are made using terminal software, such as Termite (compuphase.com/software_termite.htm) through a serial cable (P1011364) connected to the DCM's DB15 connector, or with a standard USB-A to USB-B cable (P1012796).

Parameters set by serial commands may be more precise than those entered on the DCM screen.

4.1 RS-232 SERIAL COMMANDS

Table 7 below is a summary of serial commands available for remote DCM operation. Note that all commands are case sensitive. Section 4.2 in the following pages describe in detail the use of and syntax for each command.

Type	Command	Function
Status	***IDN?**	Returns product identifcation/model number (VISA)
	version	Returns firmware version
	v	Returns gauge voltage on Channels 1 & 2
	p	Returns gauge pressure (in current units) on Channels 1 & 2
	f	Returns gauge full scale values on Channels 1 & 2
	u	Returns gauge measurement units on Channels 1 & 2
	c	Returns gauge calibration values on Channels 1 & 2
	ra	Returns setpoint threshold values (low and high) for Relay a
	rb	Returns setpoint threshold values (low and high) for Relay b
	sn	Returns the serial number of the DCM
Inputs	**setu1**	Sets Channel 1 measurement units
	setu2	Sets Channel 2 measurement units
	setsf1	Sets Channel 1 full scale value
	setsf2	Sets Channel 2 full scale value
	setcal1	Sets Channel 1 multiplying factor (MF) calibration
	setcal2	Sets Channel 2 multiplying factor (MF) calibration
	setspa	Sets low and high setpoint thresholds for Relay a
	setspb	Sets low and high setpoint thresholds for Relay b
	setz1	Sets Channel 1 zero voltage offset to the current gauge voltage
	setz2	Sets Channel 2 zero voltage offset to the current gauge voltage
Resets	**rstcal1**	Resets Channel 1 calibration (MF) to 1.00
	rstcal2	Resets Channel 2 calibration (MF) to 1.00
	rstz1	Resets Channel 1 zero to 0.00V
	rstz2	Resets Channel 2 zero to 0.00V
	***RST**	Resets DCM to all factory defaults (VISA)
Power	**on**	Turns the DCM on
	off	Turns the DCM off and de-energizes relays

Table 7 - Remote serial commands

4.2 SERIAL COMMAND USAGE

4.2.1 STATUS QUERY COMMANDS

Below are listed all the serial commands which simply return stored DCM parameter information.

*IDN?

Description: Gets the (VISA) unique identifier for the DCM.

Reply : “IdealVac XGC-520” or “IdealVac XGC-520P”

version

Description: Gets the DCM’s firmware version.

Reply : *<#.#.#>*

v

Description: Gets the raw gauge voltage outputs from Channels 1 and 2, delimited by a space.

Reply : <#.##> <#.##> (0.00 indicates no gauge attached)

p

Description: Gets the raw gauge pressures on Channels 1 and 2, delimited by a space.

The raw gauge voltage outputs are converted into pressure values. Pressure is displayed in E notation in the current pressure units for each gauge.

Reply : <#.##e±#> <#.##e±#> (0 indicates no gauge attached)

f

Description: Gets the full scale gauge setting on Channels 1 and 2.

Reply : <#> <#> per the full scale gauge chart:

Reply	Gauge’s Full Scale
0	No gauge
1	20 mTorr
2	50 mTorr
3	100 mTorr
4	1 Torr
5	2 Torr
6	10 Torr
7	20 Torr
8	100 Torr
9	1000 Torr
10	5000 Torr
11	10,000 Torr

u

Description: Gets the current pressure measurement units on Channels 1 and 2.

Reply: <Torr, mTorr, mBar, or Pascal> <Torr, mTorr, mBar, or Pascal>

Gauges do not have to be attached

c

Description Gets the gauge calibration values on Channels 1 & 2

Reply : *<#.##> <#.##>* (1.00 is default)

While the return shows two digits, the actual MF could be more precise

(see ***setcal1*** *and* ***setcal2****, p. 28)*

ra

Description: Gets the setpoint threshold values of Relay a in E notation.

Reply : *<#.##e±#> <#.##e±#> <#> <#>* or <0> if no Relay a setpoint is saved.

<high value> <low value> <relay status> <channel>

Relay status: 0 = relay off; 1 = relay on

rb

Description: Gets the setpoint threshold values of Relay b in E notation.

Reply : *<#.##e±#> <#.##e±#> <#> <#>* or <0> if no Relay b setpoint is saved.

<high value> <low value> <relay status> <channel#>

Relay status: 0 = relay off; 1 = relay on

sn

Description: Gets the serial number of the DCM.

Reply : *<######>*

4.2.2 INPUT COMMANDS

Below are listed all the serial commands which allow DCM parameters to be changed. A command followed by at least one argument (separated by a space) is required. After an input command is entered, the terminal provides feedback to indicate if the new parameter value has been saved, if the command syntax is incorrect, or if there is another issue.

setu1 <#>

Description: Sets the pressure measurement units for Channel 1.
Argument: per the units chart to the right
Example: *setu1 2* (sets the Channel 1 units to millitorr)
Reply: 0 = success, 1 = invalid input

Argument	Units
1	Torr
2	mTorr
3	mBar
4	Pascals (Pa)

setu2 <#>

Description: Sets the pressure measurement units for Channel 2.
*Behaves similar to **setu1** (above).*

setfs1 <#>

Description: Sets the full scale value of the gauge on Channel 1.
Argument: per the full scale chart to the right
Example: *setfs1 3* (sets the Ch 1 gauge full scale to 100 mTorr)
Reply: 0 = success, 1 = invalid input

Argument	Full Scale
0	No gauge
1	20 mTorr
2	50 mTorr
3	100 mTorr
4	1 Torr
5	2 Torr
6	10 Torr
7	20 Torr
8	100 Torr
9	1000 Torr
10	5000 Torr
11	10,000 Torr

setfs2 <#>

Description: Sets the full scale value of the gauge on Channel 2.
*Behaves similar to **setsf1** (above).*

setcal1 <#.####>

Description: Sets the calibration adjustment Multiplying Factor (the MF) on Channel 1.
Note that this command allows 4 significant digits after the decimal point allowing for much more precise calibration than making the adjustment on the DCM screen.
Argument: allowed values are 0.5000 - 2.0000 (1.00 is default)
Example: *setcal1 1.028*
Reply: 0 = Success, 1 = invalid input, 2 = voltage is too low

setcal2 <#.####>

Description: Sets the calibration adjustment multiplying factor (the MF) on Channel 2.
*Behaves similar to **setcal1** (above)*

NOTE

The DCM stores and uses the setcal1 and setcal2 values internally as entered, but rounds off their values for display on screen.

setspa <#> <###.##> <###.##>, or <#> <#.##e#> <#.##e#>

Description: Sets the low and high setpoint thresholds for Relay a in standard or E notation.

Argument: *<channel#> <high value> <low value>*

Example 1: *setspa 1 622.45 121*

sets Relay a to Channel 1

sets high threshold setpoint value = 622.45 (units)

sets low threshold setpoint value = 121.00 (units)

Example 2: *setspa 2 6.22e2 1.21e-5*

sets Relay a to Channel 2

sets high threshold setpoint value = $6.22 \times 10^{2} = 0.00622$ or (units)

sets low threshold setpoint value = $1.21 \times 10^{-5} = 0.0000121$ (units)

Reply: 0 = success, 1 = invalid input

setspb <#> <###.##> <###.##>, or <#> <#.##e#> <#.##e#>

Description: Sets the low and high setpoint thresholds for Relay b.

*Behaves similar to **setspa** (above).*

setz1

Description: Sets Channel 1 zero voltage offset to the gauge's current output voltage.

Argument: none, the DCM automatically calculates the value

Example: *setz1*

Reply: 0 = Success, 2 = voltage is too high

setz2

Description: Sets Channel 2 zero voltage offset to the gauge's current output voltage.

*Behaves similar to **setz1** (above)*

4.2.3 RESET COMMANDS

Below are listed the commands which reset a parameter to factory defaults.

Once a reset command has been entered, the terminal replys with a “0” to confirm that the selected parameter has been reset successfully.

rstcal1

Description: Resets Channel 1 to MF = 1.00 (no calibration offset).

Reply: 0 = success

rstcal2

Description: Resets Channel 2 to MF = 1.00 (no calibration offset).

Reply: 0 = success

rstz1

Description: Resets Channel 1 zero to 0.00V.

Reply: 0 = success

rstz2

Description: Resets Channel 2 zero to 0.00V.

Reply: 0 = success

*RST

Description: Resets all DCM parameters to factory defaults (VISA).

Reply: 0 = success

4.2.4 POWER COMMANDS

on

Description: Turns the DCM on.

off

Description: Turns the DCM off and de-energizes relays.

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