

Agilent Precision Gas Flow Meter

Operating Manual



Agilent Technologies

Notices

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Safety Notices

CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

WARNING

A **WARNING** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a **WARNING** notice until the indicated conditions are fully understood and met.

Thank you for purchasing an Agilent Precision gas flow meter

Please take the time to read the information contained in this manual. This will help to ensure that you get the best possible service from your instrument.

Refer to the on-line Agilent Mass and Volumetric Precision Gas Flow Meter Reference Manual for information on:

- Operating principles
- RS-232 digital input/output information
- Technical data

You can find the reference manual (5973-1711) at www.agilent.com/chem.

Protect your warranty and extend the life of your product

CAUTION

Failure to follow general safety and operating procedures as presented in this manual violates the safety standards and intended use of this meter and may impair the functionality of the meter. The manufacturer assumes no liability for the user's failure to comply with these requirements.

IMPORTANT: This manual contains information critical to the proper operation and maintenance of your meter. The information contained in this manual should be read and understood by those responsible for the operation and maintenance of this meter. Save this manual for future reference.

Cautions for meter applications

CAUTION

Do not attempt to disassemble, substitute parts, or perform unauthorized modifications to this meter. Doing so will void the warranty. This meter contains no user serviceable components and should be serviced by authorized personnel only.

Do not use this meter in explosive, wet, or corrosive environments.

Do not flow any corrosive gases such as ammonia, propylene, HCl, SO₂, H₂S, NO₂, NO, silane, chlorine, etc.

Do not flow gas in conditions that can cause condensing water vapor to be trapped inside the meter as the pressure sensors can be destroyed.

Do not use this flow meter outside a range of 640 ml/min.

Cautions for meter installations

CAUTION

Do not use snap shutting/opening valves where the meter can be exposed to high pressure transients – this is especially important for low-flow range.

Do not expose the meter's outer surface to any liquids, the meter does not have a watertight electronics package.

Do power your meter with the correct polarity, voltage, and amperage.

Do carefully check your wiring hookups before power up when using a DC-61 or other blunt cut cable.

Advice for meter operation

NOTE

Do take note of what gas calibration setting is selected.

Do consider that changing or mixing gases can reduce accuracy and give unexpected results. Refer to “Gas Viscosity” in the Reference Manual for instructions on correcting to alternate gas viscosities.

Do tare the meter often, while making sure there is absolutely no flow during the tare.

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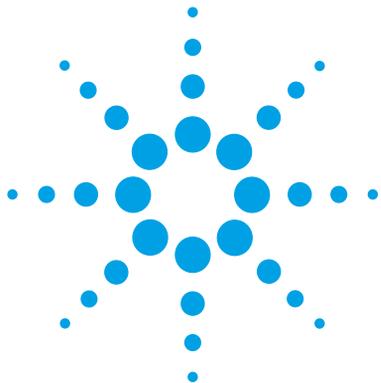
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Application

Maximum operating line pressure is 145 psig (1 MPa).

CAUTION

Exceeding the maximum specified line pressure may cause permanent damage to the solid-state differential pressure transducer.

If the line pressure is higher than 145 psig (1 MPa), a pressure regulator should be used upstream from the flow meter to reduce the pressure to 145 psig (1 MPa) or less, if possible. Although the meter's operation is unidirectional, reversing the flow direction will inflict no damage as long as the maximum specified limits are not exceeded.

CAUTION

Avoid installations that apply instantaneous high pressure to the meter (such as snap-acting solenoid valves upstream) as permanent damage to the differential pressure sensor could result from the imposition of more than 15 psi pressure differential across the meter. This damage is not covered under warranty.

Power and signal connections

The flow meter is equipped with a 9V battery.

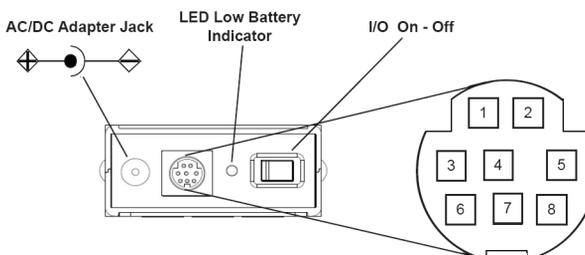


Figure 1 8-pin mini-DIN connector

Upon initial review of the pinout diagram in Figure 1, it is common to mistake pin 2 (labeled 5.12 Vdc Output) as the standard 0 to 5 Vdc analog output signal. In fact, pin 2 is normally a constant 5.12 Vdc that reflects the system bus voltage and can be used as a source for the set-point signal.

Table 1 8-pin Mini-DIN pinout

Pin	Function	Mini-DIN cable color
1	Inactive	Black
2	Static 5.12 Vdc	Brown
3	RS-232 input signal	Red
4	Analog input signal = remote tare (ground to tare)	Orange
5	RS-232 output signal	Yellow
6	0 to 5 Vdc	Green
7	Power in	Blue
8	Ground (common for power, communications, and signals)	Purple

CAUTION

Do not connect power to pins 1 through 6 as permanent damage can occur.

Standard voltage output signal

The Agilent Precision gas flow meter has a 0 to 5 Vdc output signal available on pin 6. This is generally available in addition to other optionally ordered outputs. This voltage is usually in the range of 0.010 Vdc for zero flow and 5.0 Vdc for full-scale flow. The output voltage is linear over the entire range. Ground for this signal is common on pin 8.

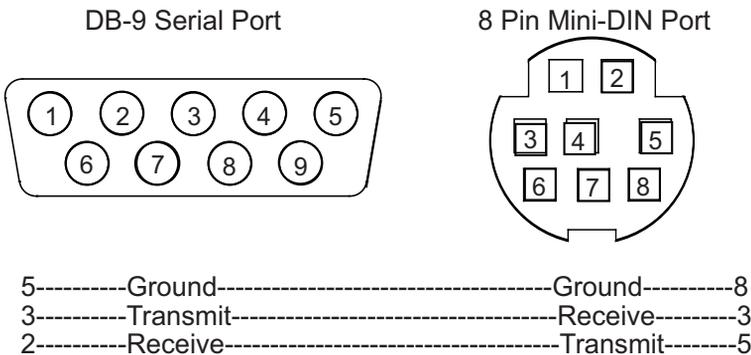


Figure 2 Mini-DIN to DB-9 connection for RS-232 signals

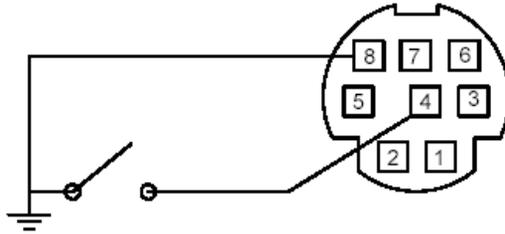
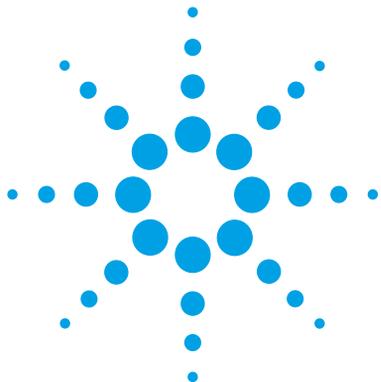


Figure 3 Proper set up for remote tare on meter (momentarily ground pin 4 to tare)



2 Flow Meter Operation

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Main mode

The Main mode screen defaults on power up with the mass flow on the primary display. The following parameters are displayed in the Main mode as shown in [Figure 4](#).

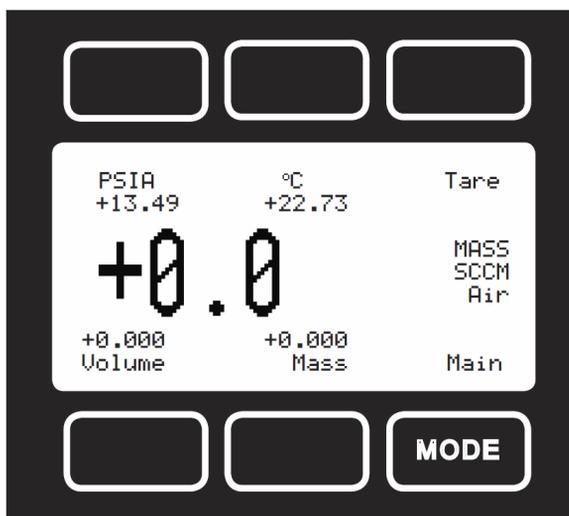


Figure 4 Main mode display

The **MODE** button in the lower right-hand corner toggles the display between the Main display, Totalizer display, and the Select Menu display.

Tare

Pushing the dynamically labeled **Tare** button in the upper right-hand corner tares the flow meter and provides it with a reference point for zero flow. This is a simple but important step in obtaining accurate measurements. It is good practice to

“zero” the flow meter each time it is powered up. If the flow reading varies significantly from zero after an initial tare, give the meter a minute or so to warm up and re-zero it.

If possible, zero the meter near the expected operating pressure by positively blocking the flow downstream of the flow meter prior to pushing the **Tare** button. Zeroing the meter while there is any flow will directly affect the meter’s accuracy by providing a false zero point. If you are in doubt about whether a zero flow condition exists, remove the meter from the line and positively block both ports before pressing the **Tare** button. If the meter reads a significant negative value when removed from the line and blocked, it is a good indication that it was given a false zero. It is better to zero the meter at atmospheric pressure and at confirmed no flow conditions than to give it a false zero under line pressure.

NOTE

A remote tare can be achieved by momentarily grounding pin 4 to tare as shown in [Figure 3](#).

Gas absolute pressure

The Agilent Precision gas flow meter uses an absolute pressure sensor to measure the line pressure of the gas flow being monitored. This sensor references hard vacuum and accurately reads line pressure both above and below local atmospheric pressure. This parameter is located in the upper left corner of the display under the dynamic label **PSIA**. This parameter can be moved to the primary display by pushing the button just above the dynamic label (top left). The engineering unit associated with absolute pressure is pounds per square inch absolute (psia). This can be converted to gauge pressure (psig = the reading obtained by a pressure gauge that reads zero at atmospheric pressure) by simply subtracting local atmospheric pressure from the absolute pressure reading:

$$\text{psig} = \text{psia} - (\text{local atmospheric pressure})$$

The flow meter uses the absolute pressure of the gas in the calculation of the mass flow rate. For working in metric units, note that 1 psi = 6.89 kPa.

Gas temperature

The gas flow meter also uses a temperature sensor to measure the line temperature of the gas flow being monitored. The temperature is displayed in engineering units of degrees Celsius ($^{\circ}\text{C}$). The flow meter uses the temperature of the gas in the calculation of the mass flow rate. This parameter is located in the upper middle portion of the display under $^{\circ}\text{C}$. This parameter can be moved to the primary display by pushing the top center button above $^{\circ}\text{C}$.

Volumetric flow rate

The volumetric flow rate is determined using the Flow Measurement Operating Principles described elsewhere in this manual. This parameter is located in the lower left corner of the display over **Volume**. This parameter can be moved to the primary display by pushing the **Volume** button (lower left). In order to get an accurate volumetric flow rate, the gas being measured must be selected (see “[Gas Select mode](#)” on [page 23](#)). This is important because the meter calculates the flow rate based on the viscosity of the gas at the measured temperature. If the gas being measured is not what is selected, an incorrect value for the viscosity of the gas will be used in the calculation of flow, and the resulting output will be inaccurate in direct proportion to the ratio between the two gases’ viscosities.

Mass flow rate

The mass flow rate is the volumetric flow rate corrected to a standard temperature and pressure (typically 14.696 psia and 25 °C). This parameter is located in the lower middle portion of the display over **Mass**. This parameter can be moved to the primary display by pushing the button located below **Mass** (bottom center). The meter uses the measured temperature and the measured absolute pressure to calculate what the flow rate would be if the gas pressure was at 1 atmosphere and the gas temperature was 25 °C. This allows a solid reference point for comparing one flow to another.

Flashing error message

The Agilent Precision gas flow meter displays an error message (MOV = mass overrange, VOV = volumetric overrange, POV = pressure overrange, TOV = temperature overrange) when a measured parameter exceeds the range of the meter's sensors. When any item flashes on the display, neither the flashing parameter nor the mass flow measurement is accurate. Reducing the value of the flashing parameter to within specified limits will return the meter to normal operation and accuracy.

Select Menu mode

Pushing **MODE** twice will bring up the **Select Menu** display. Push the button nearest your selection to go to the corresponding screen. Push **MODE** again to return to the **Main** mode display.

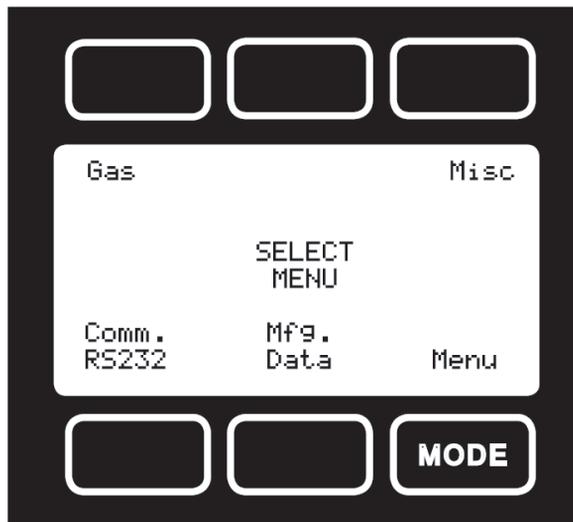


Figure 5 Select Menu display

Communication Select mode

The Communication Select mode is accessed by pressing the button below **Comm. RS-232** on the **Select Menu** display. The screen will appear as shown in [Figure 7](#).

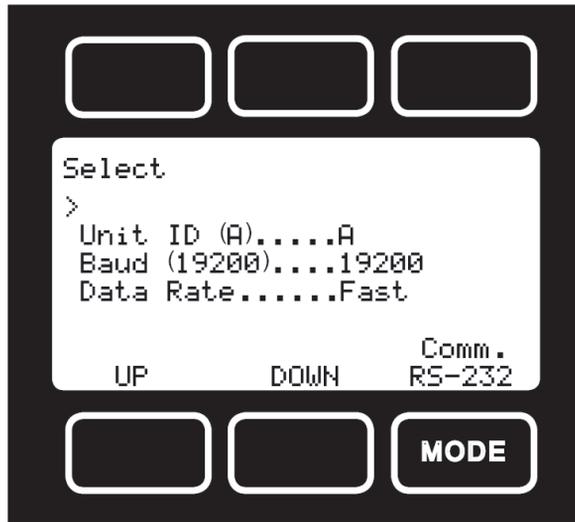


Figure 7 Communication Select display

Meter identification

Valid meter identifiers are letters A to Z and @ (see following Note). This identifier allows the user to assign a unique address to each device so that multiple meters can be connected to a single RS-232 port on a computer. The Communication Select mode allows you to view and/or change a meter's unique address. To change the meter's ID address, press the **Select** button in the upper left corner of the display until the cursor arrow is in front of the word **Unit ID**. Then, using the **UP** and **DOWN** buttons at the bottom of the display, change the meter ID

to the desired letter. **Any ID change will take effect when the Communication Select Screen is exited by pushing the MODE or Main button.**

NOTE

When the symbol @ is selected as the meter ID, the meter will go into Streaming mode when the Communication Select mode is exited by pushing the **MODE** or **Main** button. See [Chapter 3](#) for information about the Streaming mode.

Baud

The baud rate (bits per second) determines the rate at which data is passed back and forth between the instrument and the computer. Both devices must send/receive at the same baud rate in order for the devices to communicate via RS-232. The default baud rate for these devices is 19,200 baud, sometimes referred to as 19.2 K baud. To change the baud rate in the Communication Select mode, press the **Select** button in the upper left corner of the display until the cursor arrow is in front of the word **Baud**. Then, using the **UP** and **DOWN** buttons at the bottom of the display, select the required baud rate to match your computer or PLC. The choices are 38400, 19200, 9600, or 2400 baud. **Any baud rate change will not take effect until power to the meter is cycled.**

Data rate

Changing the Data Rate affects the rate at which the instrument dumps its data. Slow is half the Fast rate. The speed of the Fast rate is determined by the selected baud rate. It is sometimes desirable to reduce the data rate if the communication speed bogs down the computer's processor (as is not uncommon in older laptops), or to reduce the size of data files collected in the Streaming mode. To change the data rate in the Communication Select mode, press the **Select** button in the upper left corner of the display until the cursor arrow is in front of the words **Data**

2 Flow Meter Operation

Rate. Then, using the **UP** and **DOWN** buttons at the bottom of the display, select either **Fast** or **Slow**. **Any data rate change will be effective immediately upon changing the value between Fast and Slow.**

Totalizing mode

This option adds an additional mode screen that displays the total flow (normally in the units of the main flow screen) that has passed through the meter or controller since the last time the totalizer was cleared. The **Totalizing Mode** display shown below is accessed by pushing the **MODE** button until the label over it reads **Total**. If your meter is ordered with Totalizing Mode option, pushing the **MODE** button once will bring up the **Totalizing Mode** display, and pushing it twice will bring up the **Select Menu** display. Pushing the **MODE** button a third time will return you to the Main Mode screen.

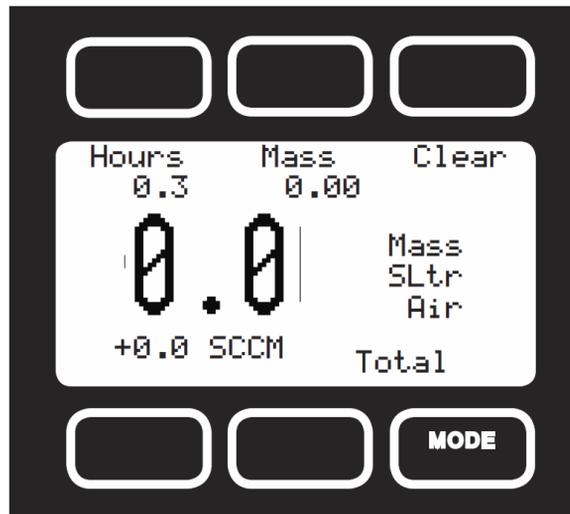


Figure 8 Totalizing Mode display

- **Counter.** The counter can have as many as six digits. At the time of order, you must specify the resolution of the count. This directly affects the maximum count. For instance, if a resolution of 1/100ths of a liter is specified on a meter that is totalizing in liters, the maximum count would be 9999.99 liters. If the same unit were specified with a 1-liter resolution, the maximum count would be 999999 liters.
- **Rollover.** You can also specify at the time of order what the totalizer is to do when the maximum count is reached. The following options may be specified:
 - **No Rollover.** When the counter reaches the maximum count, it stops counting until the counter is cleared.
 - **Rollover with Notification.** When the counter reaches the maximum count it automatically rolls over to zero, displays an overflow error, and continues counting until the counter is cleared.
- **Hours.** The display will show elapsed time since the last reset in 0.1-hour increments. The maximum measurable elapsed time is 6553.5 hours (about nine months). The hours count resets when the **Clear** button is pushed, an RS-232 is executed, or on loss of power.
- **Clear.** The counter can be reset to zero at any time by pushing the dynamically labeled **Clear** button located above the upper right side of the display. To clear the counter via RS-232, establish serial communication with the meter or controller as described in the Reference Manual. To reset the counter, enter the following commands:
 - **In Streaming Mode:** \$\$T <Enter>
 - **In Polling (addressable) Mode:** Address\$\$T <Enter> (e.g., B\$\$T <Enter>)

Manufacturer Data mode

Manufacturer Data is accessed by pressing the **Mfg. Data** button on the **Select Menu** display (Figure 5). The **Mfg 1** display shows the name and telephone number of the manufacturer. The **Mfg 2** display shows important information about your flow meter, including the model number, serial number, and date of manufacture.

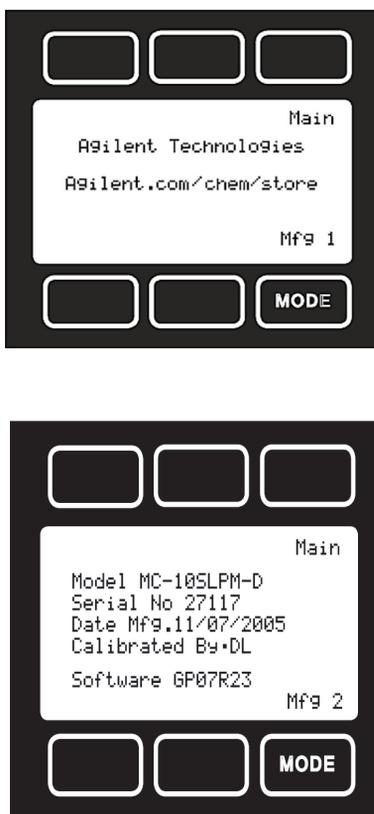


Figure 9 Manufacturer data displays

Miscellaneous mode

The Miscellaneous mode is accessed by pressing the button above the **Misc** label in the upper right-hand corner of the **Select Menu** display. The screen will appear as shown in [Figure 10](#). Push the button above **Select** to move the cursor even with the item you wish to adjust. Then use the **UP** and **DOWN** buttons to make the adjustment.

NOTE

All Miscellaneous changes are recorded when you exit the Miscellaneous display.

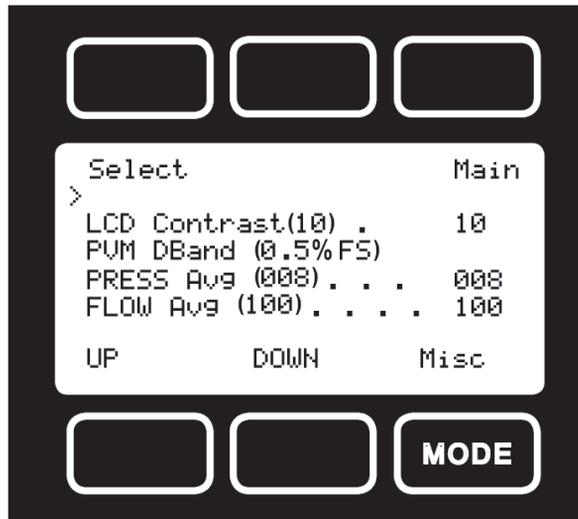


Figure 10 Miscellaneous Display

LCD contrast

The liquid crystal display contrast can be adjusted between 0 (lightest contrast) and 30 (darkest contrast). To change the contrast, press the **Select** button in the upper left-hand corner of the display until the cursor arrow is in front of the words **LCD Contrast (X)**. Then using the **UP** and **DOWN** buttons at the bottom of the display, change the contrast value as desired. The change is immediate and the effect can be monitored as the value is changed.

Display zero deadband

Zero deadband refers to a value below which the display simply jumps to zero. This deadband is often desired to prevent electrical noise from showing up on the display as minor flows or pressures that do not actually exist, especially in high noise (electrical) environments. This display deadband does not affect the analog or digital signal outputs – there is no zero deadband on the output signals. The display zero deadband can be adjusted between 0 and 3.2% of the Full Scale (FS) of the sensor. PVM refers to Pressure, Volumetric Flow, and Mass Flow, the three parameters to which the deadband applies. To adjust the display zero deadband, press the **Select** button in the upper left-hand corner of the display until the cursor arrow is in front of the words **PVM DBand (X %F.S.)**. Then, using the **UP** and **DOWN** buttons at the bottom of the display, change the display zero deadband value as desired.

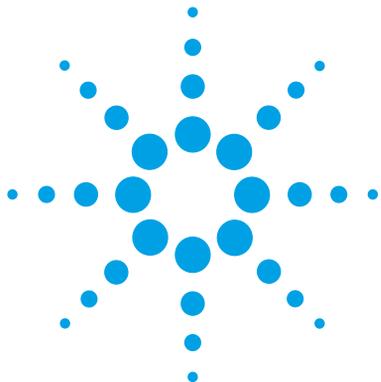
Pressure averaging

It is sometimes advantageous to apply an averaging factor to the pressure output (and display) to make it easier to read and interpret rapidly fluctuating pressures. Pressure averaging can be adjusted between 1 (no averaging) and 256 (maximum averaging). This is a geometric running average where the number between 1 and 256 can be considered very roughly

equivalent to the response time constant in milliseconds. This can be very effective at “smoothing” high-frequency process oscillations such as those caused by diaphragm pumps. To adjust the pressure averaging, press the **Select** button in the upper left-hand corner of the display until the cursor arrow is in front of the words **PRESS Avg (XXX)**. Then using the **UP** and **DOWN** buttons at the bottom of the display, change the pressure averaging value as desired.

Flow averaging

It is sometimes advantageous to apply an averaging factor to the flow output (and display) to make it easier to read and interpret rapidly fluctuating flows. Flow averaging can be adjusted between 1 (no averaging) and 256 (maximum averaging). This is a geometric running average where the number between 1 and 256 can be considered very roughly equivalent to the response time constant in milliseconds. This can be very effective at “smoothing” high-frequency process oscillations such as those caused by diaphragm pumps. To adjust the flow averaging, press the **Select** button in the upper left-hand corner of the display until the cursor arrow is in front of the words **FLOW Avg (XXX)**. Then using the **UP** and **DOWN** buttons at the bottom of the display, change the flow averaging value as desired.



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General

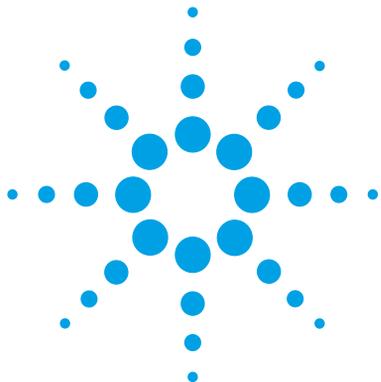
The Agilent Precision gas flow meter requires minimal maintenance. They have no moving parts. The single most important thing that affects the life and accuracy of this meter is the quality of the gas being measured. The meter is designed to measure **clean, dry, and noncorrosive** gases. Moisture, oil, and other contaminants can affect the laminar flow elements and/or reduce the area that is used to calculate the flow rate. This directly affects the meter's accuracy.

Recalibration

The recommended period for recalibration is once every year. Providing that the **clean, dry, and noncorrosive** mantra is observed, this periodic recalibration is sufficient. A label located on the back of the meter lists the recalibration due date. For repairs, recalibrations, or recycling of this product, contact Agilent Technologies at www.agilent.com/chem/repair. Please note the serial number on the back of the meter. The serial number, model number, and date of manufacture are also available on the **Mfg 2** screen ([page 27](#)).

Cleaning

The Agilent Precision gas flow meter requires no periodic cleaning. If necessary, the outside of the meter can be cleaned with a soft dry rag. Avoid excess moisture or solvents.



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The Agilent Precision Gas Flow Meter uses a common 9 volt battery located in the top section of your meter.

Output signals from the flow meter are passed through the female connector on top of the flow meter. Turn the switch on top of the flow meter “off” when the meter is not in use.

Normal (9 volt alkaline) battery life is approximately 8 hours (30 to 40 hours with a 9 volt lithium battery); however, many factors can affect this.

Replace the battery as often as required. A yellow LED indicates low voltage and that the battery should be replaced.

A false signal can result when the voltage drops below its normally regulated level.



Replacing the battery

- 1 Remove the four Phillips head screws from the front cover and gently remove it as shown in Figure 11.
- 2 Remove the 9 volt battery, pulling the top of the battery out first.
- 3 Remove the old battery from the harness and replace it with a new battery.
- 4 Install the new battery bottom end first and replace the back cover so that the cushioning pad presses directly down on the battery.
- 5 Replace the four Phillips head screws.

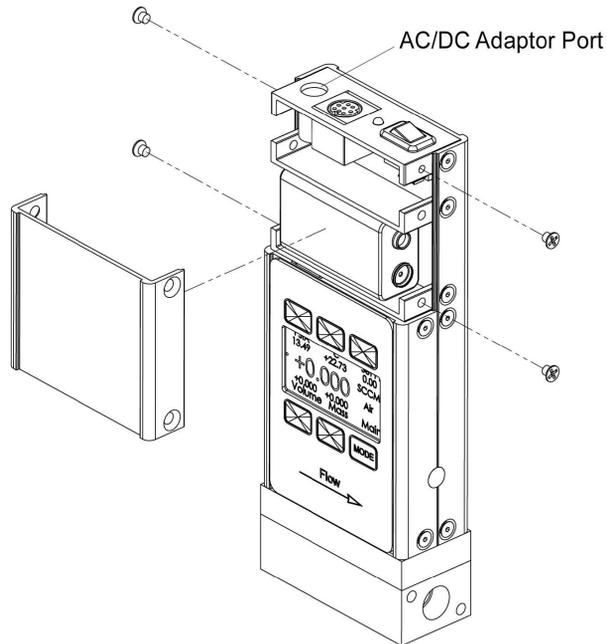


Figure 11 Battery cover removal

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