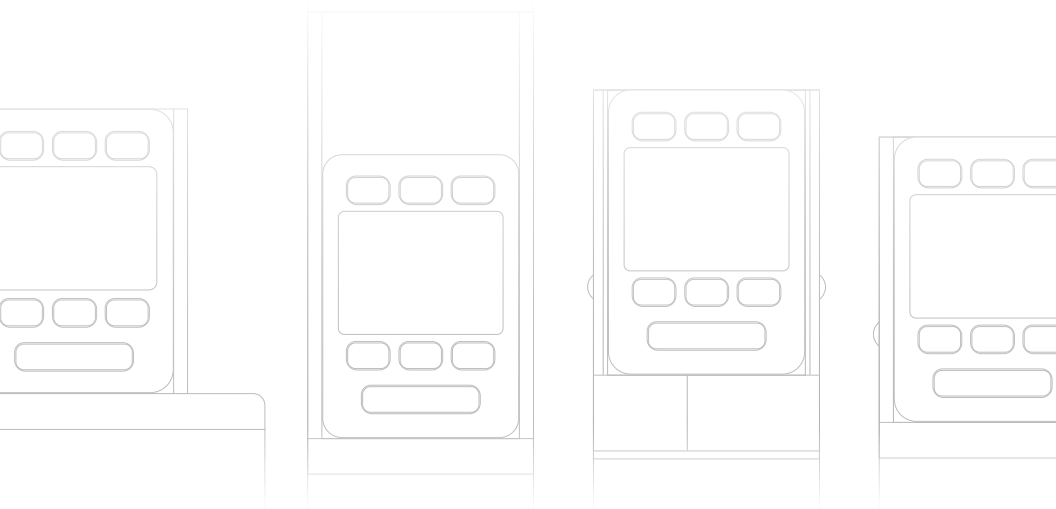
APEX



MASS FLOW METER OPERATING MANUAL

Thank you for your purchase.

If you have any questions about operating it, or if something is not working as expected, please contact support:

Apex Vacuum

222 Riverstone Drive
Canton, Georgia 30114
United States of America

Phone: (800) 331-2808

ApexVacuum.com

Serial Number: _____

Next Calibration (Month/Day) : _____

Recalibrate your flow meter every year.

Your flow meter should be calibrated every year in order to ensure the continued certainty of your readings and extend the Limited Lifetime Warranty.

NIST This device comes with a NIST traceable calibration certificate.

RoHS This device conforms to the European Union's Restriction of Use of Hazardous Substances in Electrical and Electronic Equipment (RoHS) Directive 2011/65/EU.

CE This device complies with the requirements of the Low Voltage Directive 2014/35/EU and the EMC Directive 2014/30/EU and carries the CE Marking accordingly.

This device complies with the requirements of the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC.

Introduction

Your new flow meter has a variety of innovative features:

- **High-accuracy performance for all your gases.** Use your flow meter with any of the 98 or more gases that are part of Gas Select, page 23.
- **1000 readings per second** ensures high resolution data, page 30.
- **Monitor pressure and temperature** during flow measurement. View internal stream absolute pressure and temperature, page 17.
- **Backlit display with adjustable contrast** is easy to read in direct sunlight. In dimly lit areas, press the large center button to turn on the backlight, page 8.
- **Change your STP** to match any standard temperature and pressure reference, page 27.
- **Log data to your PC**. Talk to the flow meter serially to capture all flow data for logging and analysis, page 31.

Please contact your vendor or view the contact information on the device (see page 21) if you have any questions regarding the use or operation of this device.

Contents

Quick Start Guide

Setup

- **Connect your flow meter.** Ensure that flow through your device will be in the same direction as the arrow on the flow body (usually left to right).
- **Tare your flow meter.** Before you connect the flow meter, ensure that no gas is flowing through the device and select **TARE FLOW** from the Main Display. **Note:** Low-pressure-drop flow meters are sensitive enough to measure the lightest of breezes, so ensure that one end is plugged before taring.
- **Choose your engineering units.** Press the button above or below any parameter to enlarge it in the middle of the display. If you select that same item a second time, you can change the engineering unit for that parameter. You can choose units for all of the parameters at once by selecting **MENU → BASIC CONFIG → DEVICE UNITS**.

Operation: Flow Verification

- **Monitor live flow readings.** You can monitor live readings of flow, pressure and temperature by viewing the screen. Readings are updated in real time. See page 17.
- **Tare your flow meter** before you begin another round of measurements. Ensure that no flow is passing through your meter, and select **TARE FLOW**. See page 20 for how to tare manually.
- (Optional) **Capture a totalized reading.** The totalizer option displays the total flow that has passed through the device since the last time the totalizer was reset. Press **TOTAL/MENU** to access the totalizer. See page 19.

Backlight

The monochrome display comes equipped with a backlight. **To toggle its power, press the bottom-center button on the front of your device.** For color displays, pressing this button will turn off the display to conserve power.

Maintenance and Care

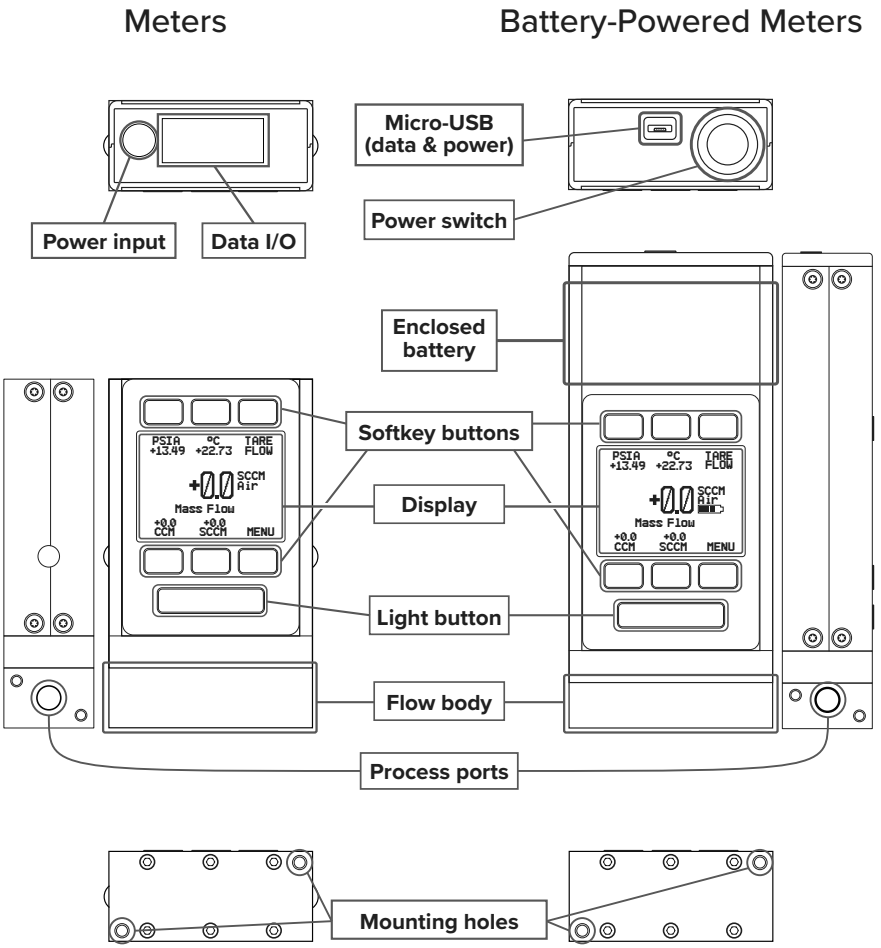
- Flow meters will require no periodic cleaning for clean gases. Read more on page 40.
- Calibrate your flow meter annually.

Getting Started

Getting to Know Your Mass Flow Meter

Connectors and Buttons

The drawings below represent typical configurations of a standard mass flow meter and a standard battery-powered mass flow meter. **Your flow meter's appearance and connections may differ.**

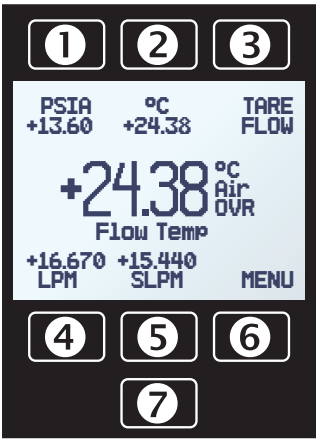


The Flow Meter Display

The figure below identifies the various features of the flow meter display. Press the bottom central button to toggle the backlight on and off.

Engineering units are used by the meter in its serial communications and calculations. These can be different from **button units**, which are the units being displayed. These are independently configurable. See page 18.

1. Highlights **pressure** in the center of the meter. Push a second time to choose the pressure parameter (if available), or to select pressure engineering units.
2. Highlights **temperature**. Push a second time to select temperature engineering units.
3. **TARE FLOW** **tare the flow rate** (see page 20).
4. Highlights **volumetric (actual) flow** rate. Push a second time to select volumetric flow rate engineering units.
5. Highlights **mass flow** rate. Push a second time to select a different mass flow (normal mass flow) or true mass flow engineering unit.
6. **TOTAL/MENU** Accesses the optional **flow totalizer** (page 19)**. MENU** enters the Menu system (page 20)
7. Toggles the backlight.



The Flow Meter Display

Status Messages

Status messages are shown to the right of the main readout number, in the example above as **OVR**.

ADC Analog-digital converter error

LCK Front display is locked

OVR Totalizer rolled over to zero

POV Pressure over range of device

MOV Mass flow over range of device

TMF Totalizer missed out of range flow

TOV Temperature over range of device

VOV Volumetric flow over range of device

Option: Charging Your Portable Flow Meter

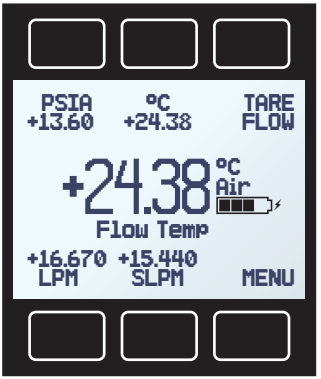
If you purchased a portable meter, it was fully charged at the factory, so you can use it right away. Typical battery life of a fully-charged battery is 18 hours with a monochrome display or 8 hours with a TFT color display, when the backlight is set to 10. Dimming the backlight will increase battery life.

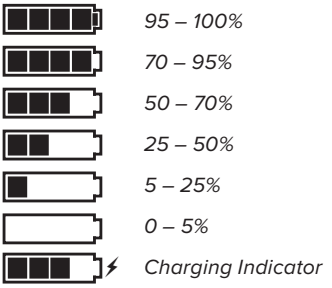
The battery indicator on the right side of the Main Display reflects the relative battery level. When the battery indicator is completely empty, approximately 15 minutes of battery life remains. Please charge the flow meter as soon as possible to maintain full device performance.

Charge the meter using the supplied USB cable (micro-B to type A) or a similar cable. You may charge the flow meter using any USB outlet on a computer or portable power supply, but charging will be fastest (approximately 3.5 hours) when connected to the supplied 2.0A power supply.

The red indicator LED on top of the device lights up red to indicate that the unit is charging. The red LED turns off when the battery is charged.

Your flow meter may be used while it is charging. A small lightning bolt symbol ( ) will appear to the right of the battery symbol while the device is charging. If the battery has been fully depleted, you may need to charge the flow meter for a full minute before the device can be turned on.





Warning: *The safe charging temperature range is 0–45°C (32–113°F). If internal sensors detect temperatures outside of this range, the battery will not charge.*

Mounting

No straight runs of pipe are required upstream or downstream of the meter. For most flow meters, you can mount or hold the meter in any position, because it is internally compensated for any changes to its orientation during use. The flow meter is also minimally affected by vibrations, so it can on top of a vibrating instrument with little impact to measurement accuracy.

Device Ports

Your flow meter has been shipped with plastic plugs fitted into its ports. To lessen the chance of contaminating the flow stream, do not remove these plugs until you are ready to install the device.

Standard gas flow meters have female inlet and outlet ports. Welded VCR® and other specialty fittings may have male connections.

- If you are using a fitting that does not have a face seal, use thread-sealing Teflon tape to prevent leakage around the port threads, but do not wrap the first two threads. This will minimize the possibility of getting tape into the flow stream and clogging the laminar flow elements (LFE).
- If you are using a fitting that has a face seal, there is no need to apply Teflon tape to the threads.

Warning: *Do not use pipe dopes or sealants on the process connections, as these compounds can cause permanent damage to the meter should they get into the flow stream.*

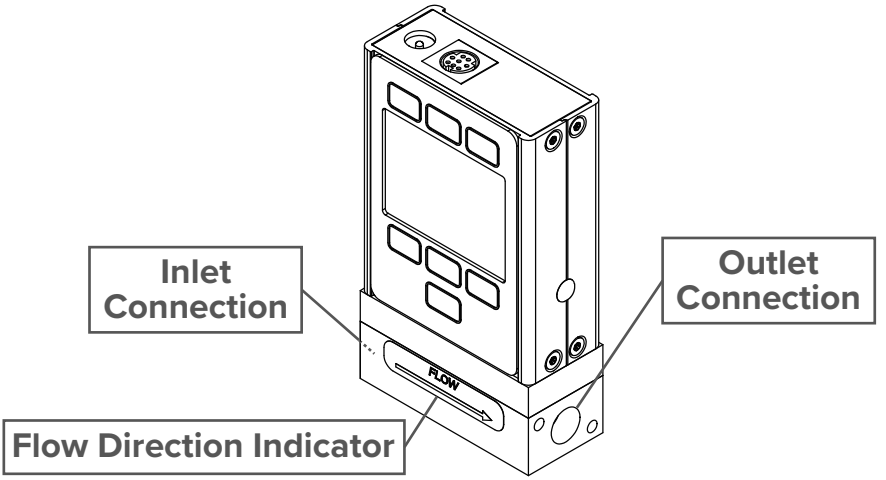
Filters

When pressure drop is not an issue, use in-line sintered filters to prevent large particulates from entering the flow meter. Suggested maximum particulate sizes are as follows:

- **5 microns** for units with flow ranges of 1 SCCM or less.
- **20 microns** for units with flow ranges between 2 SCCM and 1 SLPM.
- **50 microns** for units with flow ranges of 1 SLPM or more.

Connecting The Gas Flow Meter

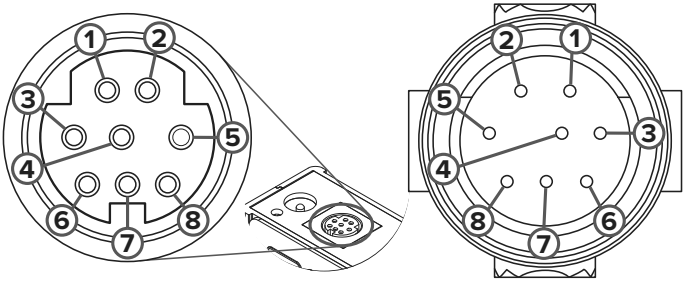
The flow meter can measure flow generated by positive pressure and/or suction. Connect the meter so that the flow travels in the same direction as the flow arrow, usually from left to right from in front of the device.



Model	Max Common Mode Pressure	Max Differential Pressure
Standard meters	175 PSIA	75 PSID
Low-pressure-drop meters	80 PSIA	10 PSID

Power and Signal Connections

Power can be supplied to your meter through either the power jack or the multi-pin connector on top of your device.



Female Connector: Device Male Connector: Cable

Meter power jacks require a 9–24 Vdc power supply with a 2.1 mm female positive center plug capable of supplying at least 50 mA. 4–20 mA analog signal outputs require at least 12 Vdc and 100 mA, and 0–10 Vdc outputs require at least 12 Vdc.

Standard 8-Pin Mini-DIN Pinout

Pin	Function	Cable color
1	Not Connected (or optional 4–20 mA Primary Output Signal)	Black
2	Static 5.12 Vdc Optional: Secondary Analog Output (4–20 mA, 0–5 Vdc, 1–5V dc, 0–10 Vdc) or Basic Alarm	Brown
3	Serial RS-232RX / RS-485(–) Input Signal (receive)	Red
4	Remote Tare (Ground to Tare)	Orange
5	Serial RS-232TX / RS-485(+) Output Signal (send)	Yellow
6	0–5 Vdc (or optional 1–5 Vdc or 0–10 Vdc) Output Signal	Green
7	Power In (as described in the note above)	Blue
8	Ground (common for power, digital communi-cations, analog signals and alarms)	Purple

Note: *The above pinout is applicable to all flow meters with the Mini-DIN connector. The availability of different output signals depends on the options ordered. Optional configurations are noted on the unit's calibration sheet.*

Caution: *Do not connect power to pins 1 through 6, as permanent damage can occur. It is common to mistake Pin 2 (labeled 5.12 Vdc Output) as the standard 0–5 Vdc analog output signal. Pin 2 is normally a constant 5.12 Vdc that reflects the system bus voltage. For 6-pin locking industrial connector, M12, DB9 and DB15 pinouts, see* page 45.

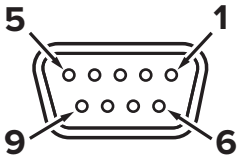
RS-232 / RS-485 Digital Input / Output Signal

To use the RS-232 or RS-485 digital signal, connect the RS-232 / RS-485 Output Signal (Pin 5), the RS-232 / RS-485 Input Signal (Pin 3) and Ground (Pin 8) to your serial port as shown below. (See “Serial Communication” on page 31 for details)

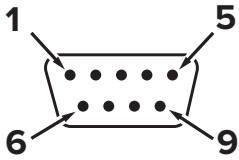
DB9 to 8-Pin Mini-DIN Connection for RS-232 / RS-485 Signals

9 Pin Serial Connection		8 Pin Mini-DIN Connection	
Pin	Function	Pin	Function
5	Ground	8	Ground
3	Transmit	3	Receive
2	Receive	5	Transmit

DB9 connections



Female Connector



Male Connector

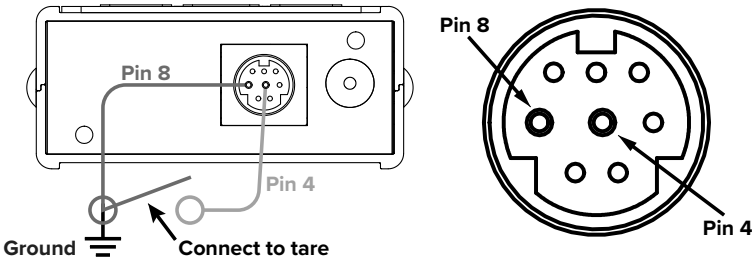
See also the M12 connector pinout on page 56.

Analog Signals

Primary Analog Output Signal

Most instruments include a primary analog output signal, which is linear over its entire range. For all analog output configurations, the lowest output indicates zero flow, and highest indicates full-scale flow. Depending on the quality of the grounding, a zero flow condition is in the range of 0.010 Vdc. For example, a 5 Vdc output from a 0–5 Vdc 100 SCCM unit would indicate a flow of 100 SCCM.

The default 8-pin mini-DIN connector places the primary analog output on Pin 6 for voltage signals and Pin 1 for 4–20 mA current signals. Ground for these signals is common on Pin 8.



Using Ground to Tare

You can tare your mass flow meter remotely by momentarily grounding Pin 4, as shown below. When the switch is closed, the device will tare, and resume operation once the switch has been released.

Option: Second Analog Output Signal

The default 8-pin mini-DIN connector places the secondary analog output on Pin 2 for both voltage and current signals. Your device's secondary analog signal may differ from its primary output signal.

See the calibration sheet that shipped with your meter to determine which output signals were ordered.

Option: 4–20 mA Current Output Signal

If your meter has a 4–20 mA current primary or secondary output signal, your flow meter will require 12–24 Vdc power.

Caution: *Do not connect 4–20 mA devices to "loop powered" systems, as this will destroy portions of the circuitry and void the warranty. If you must interface with existing loop powered systems, always use a signal isolator and a separate power supply.*

Option: Color TFT Display

Instruments ordered with a color display function the same as standard backlit monochrome instruments, but color is used to provide additional on-screen information.

Multi-Color Display Indicators

- **GREEN**: Parameter labels and adjustments associated with the button directly above or below the label are presented in green.
- **WHITE**: The color of each parameter is displayed in white while operating under normal conditions.
- **RED**: The color of a parameter is displayed in red when its value exceeds 128% of the device's specifications.
- **YELLOW**: Menu items that are ready to be selected appear in yellow. This color replaces the symbol (>) in selections on monochrome display.

Press the bottom center button to turn off the color display backlight. The flow meter remains in operation while the backlight is off.

LCD Contrast

LCD contrast is ranged from 0 to 11 on color displays, with 11 indicating the greatest contrast. See "Display Setup" on page 28.

Specification	Meter
Supply Voltage	7–24 Vdc
Supply Current	80 mA at 12 Vdc 70 mA at 24 Vdc

Note: *Color displays will require an additional 40 mA when using a 12 Vdc power supply. All other device specifications from your device's specification sheet remain in effect.*

Navigation and Customization

Flow Meter Menu Outline

The Main Menu

Main Menu

Accessible from MENU on the Main Display

- **About** (page 2)
  - Device information
  - Device state
  - Manufacturer information
- **Tares** (page 20)
  - Tare pressure
  - Tare flow
- **Basic config** (page 22)
  - Gas configuration
    - Gas categories and gases
    - COMPOSER mix creation and management
  - Device units
    - Mass flow
    - Volumetric flow
    - Pressure
    - Temperature
  - STP/NTP
- **Advanced setup** (page 28)
  - Sensor setup
    - Display as zero (zero band)
    - Number of digits
    - Flow and pressure averaging
  - Communication setup
    - Unit ID
    - Baud
  - Display setup
    - LCD contrast
    - Power-up light
  - Display rotation
- **Main display** (page 17)

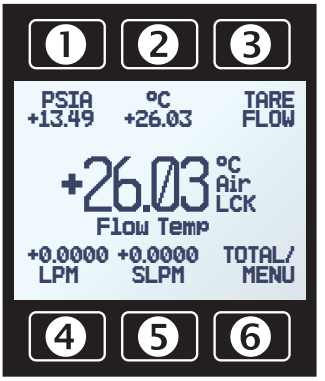
Collecting Live Flow Data

The Main Display has two primary functions:

- Collecting live temperature, pressure and flow data (see below)
- Changing engineering units for temperature, pressure and flow (page 18)

This screen displays live data for all flow parameters simultaneously. Live data is measured 1000 times per second and typically displayed 10 times per second on the device LCD screen. Press the button next to any of the four flow parameters once to highlight its value in the center of the screen. Press the same button again to enter the engineering unit selection menu for that parameter (page 18).

Main Display

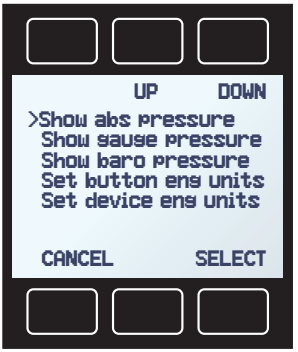


The Main Display

1. Highlights **pressure** in the center of the meter. Push a second time to select engineering units or the pressure parameter:
   - Internal absolute pressure
   - Internal gauge pressure (optional)
   - Barometric pressure (optional)
2. Highlights **temperature**. Push a second time to select temperature engineering units.
3. **TARE FLOW** Tares the **flow rate** (see page 20).
4. Highlights **volumetric (actual) flow** rate. Push a second time to select volumetric flow rate engineering units.
5. Highlights **mass flow** rate. Push a second time to select mass flow engineering units and switch between standardized, normalized, and true mass flow.
6. **TOTAL** accesses **flow totalizer** (optional) (page 19). **MENU** enters the Menu system (page 20).

Choosing Engineering Units

Press the button adjacent to any of the four measurement parameters twice to enter its unit selection menu. You can change units in two ways:



Engineering Unit Screen

Button engineering units (page 18) alter the display only, not the serial data:

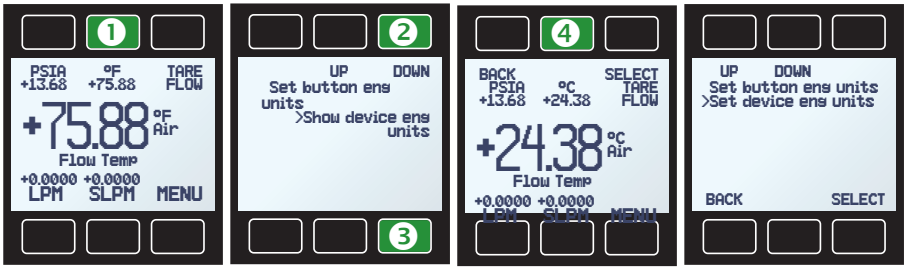
- Select **`Set button eng units`** and press **SELECT** to change the engineering unit on the display only. This does not alter the flow meter data frame.

Device engineering units alter both the display and the flow meter data frame:

- Select **`Set device eng units`** and then choose the engineering unit as above. An additional confirmation screen asks you to confirm the serial change.
- If the button engineering unit is different than the device engineering unit, **`Set device eng units`** will not appear. To change them:
- First select **`Show device eng units`** to revert the button to the current device unit for that parameter. Enter the unit selection menu again to change the device engineering unit.

Note: *The totalizer's set flow variable (mass flow or volumetric flow) cannot be altered directly. Please contact support (page 2) if you wish to change your totalizer from mass flow to volumetric, or vice-versa.*

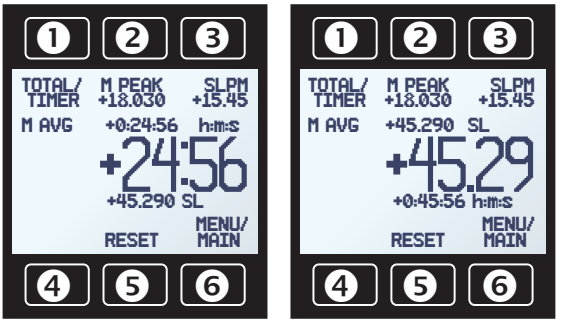
Changing the engineering units:



Option: Collecting Totalized Flow Data

Your flow meter may have been purchased with an optional flow totalizer. This displays the total amount of mass or volume that has flowed through the instrument since its last reset, like a gasoline pump. You can access the totalizer screen by pressing **TOTAL/MENU** on the Main Display.

Totalizer (Optional)



1. **TOTAL/TIMER** toggles between totalized flow and elapsed time as the parameter highlighted in the center
2. **M PEAK** or **V PEAK** displays the maximum flow rate since the last reset. Press to select engineering units.
3. Displays live flow rate. Press to select engineering units.
5. **RESET** clears all totalized data and immediately resets the timer to 0. Totalization of flow data continues immediately.
6. **MENU/MAIN** enters the menu system (page 20). From there, press **MAIN** to exit to the Main Display of live data.

- **M AVG**: Shows optional totalizer averaging, which displays average flow rate since last reset, updated live
- Main display shows either time since reset, or totalized flow

Totalizer Rollover Functions

Your flow totalizer has been configured to report a maximum of 7 digits. By default, the placement of the decimal is the same as the live flow rate. The totalizer can be configured at the time of order for the following behaviors.

- **Rollover** (default)**:** Totalizer resumes counting from 0 as soon as the maximum count has been reached.
- **Freeze:** Totalizer stops counting at max count, until it is reset manually.
- **Error:** Displays **OVR** status message when maximum count has been reached; compatible with Rollover and Freeze.

The time counter has a maximum value of 9999:59:59 (h:m:s) (416 days, 16 hours). If flow is still being totalized at that point, the timer freezes, regardless of totalized flow settings.

Menu

You can enter the menu system by pressing the **MENU** button from the Main Display.

- **ABOUT** (page 21), **TARES** (below), **BASIC CONFIG** (page 22), and **ADV SETUP** (page 28) enter their respective menus.
- **MAIN** exits to the Main Display (page 17).

Main Menu

Taring Your Flow Meter

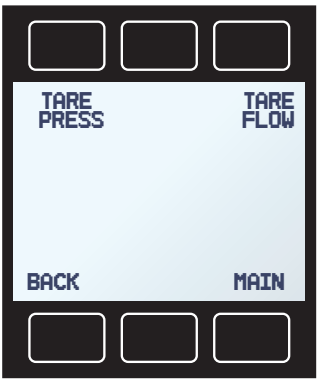
Taring is an important practice that ensures that your flow meter is providing the most accurate measurements possible. This function gives the flow meter a good zero reference for flow measurements. For meters with an optional barometer, taring can also be used to align the internal absolute pressure sensor with the barometric pressure reading.

How to Tare

First, ensure that nothing is flowing through the device.

Taring Flow

MENU → **TARES** → **TARE FLOW**. Flow tares should occur at the expected process pressure, as long as there is no flow. A message, "**ENSURE NO FLOW BEFORE PRESSING TARE**" will be displayed. Press **TARE** to complete the taring process.



Tare Menu

Taring Pressure

MENU → **TARES** → **TARE PRESS**. Absolute pressure tares must be done with the meter open to atmosphere (requires a barometer, which is included by default in portable devices). A message, "**PRESS TARE WHEN VENTED TO AMBIENT WITH NO FLOW**" followed by "**CURRENT PRESSURE OFFSET**:" If the absolute pressure sensor in the flow body disagrees with the internal barometer, the difference will be displayed. If there is no difference, it will display: **----- PSIA**.

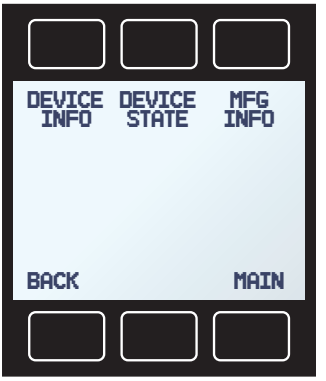
When to Tare

- Before every new flow measurement cycle
- After significant changes in temperature or pressure
- After dropping or bumping the flow meter.
- After installing the meter in a different orientation.

Device Info

If you run into trouble using your flow meter, the **ABOUT** menu contains information that can make the troubleshooting process easier. Select **MFG INFO** to look up the manufacturer phone number and web address. **DEVICE INFO** shows you the serial number and firmware version (**SW:**) for your specific device. It also gives you the original manufacturing date and the last calibration date, as well as the initials of the calibration technician.

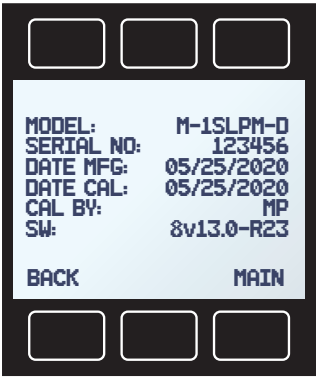
> **Note:** ***The MFG INFO screen can be used to find contact information to troubleshoot or configure the device.***



The About Screen

Menu → About

- **DEVICE INFO**, displays serial number, firmware revision, and calibration information.
- **DEVICE STATE** displays diagnostic information for troubleshooting (below).
- **MFG INFO** displays contact information.
- **BACK** returns to the top-level menu (page 20).
- **MAIN** exits to the Main Display (page 17).



Device Info Screen

Menu → About → Device State

Diagnostic Information

The **DEVICE STATE** screen displays live values for the internal device registers. Many of these values can help an applications engineer diagnose operational issues over the phone. Some register values clearly distinguish between hardware and operational problems, which speeds up the troubleshooting process.

Within the **DEVICE STATE** screen, press **PAGE** to advance to the next page of register values.

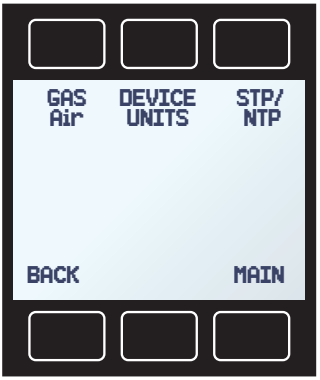
Device State Screen

Basic Configuration Menu

The Basic Configuration Menu contains options for choosing the gas calibration, device engineering units and STP/NTP mass flow references.

Menu → Basic Configuration

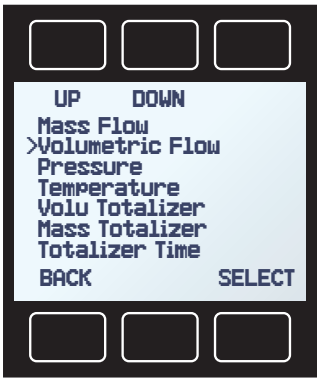
- **GAS** enters Gas Select and COMPOSER menus (page 23). The currently-selected gas is displayed below the button.
- **DEVICE UNITS** changes device engineering units for any parameter: flow (mass, volumetric), pressure, temperature, and totalizers (volume, mass and time).
- **STP/NTP** defines standard (STP) and normal (NTP) temperature and pressure conditions (page 27).
- **BACK** returns to the top-level Menu (page 20).
- **MAIN** exits to the Main Display (page 17).



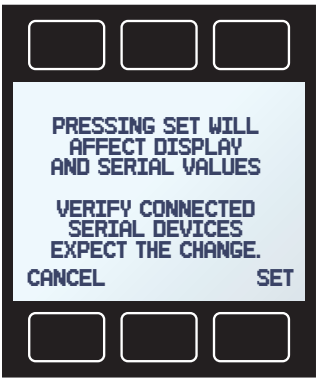
The Basic Configuration Menu

Choosing Engineering Units from the Basic Configuration Menu

Changing device engineering units alters both the display and the data frame. First choose the parameter whose unit you want to change, and then select your desired engineering unit, confirming the change on the last screen. If your meter has been configured with a flow totalizer, this screen will also include units for totalized volumetric and mass flow, plus elapsed time.



Choosing device units



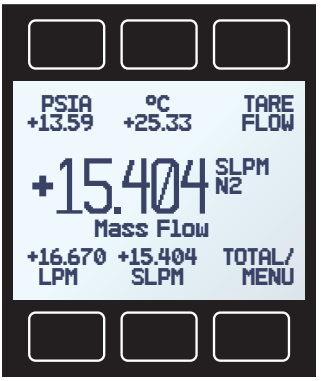
Confirming a unit change

Gas Select

In most cases, your flow meter was physically calibrated on air at the factory. Gas Select allows you to reconfigure the flow meter to flow a different gas without sending it back for a physical recalibration.

To use Gas Select, simply choose a gas or gas mix from one of the listed categories. As soon as you press **SELECT** from the gas listing, your flow meter will reconfigure its calculations to flow your chosen gas. There is no need to restart the flow meter.

Your current gas selection appears just below the unit's indicator on the right side of the Main Display. In the example to the right, the gas is set to nitrogen gas (**N2**).

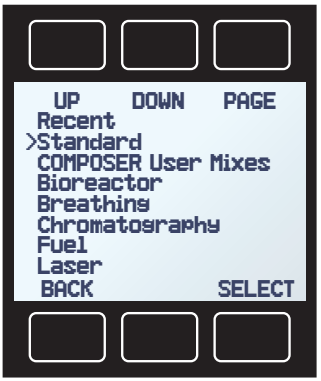


A meter set to measure N_2

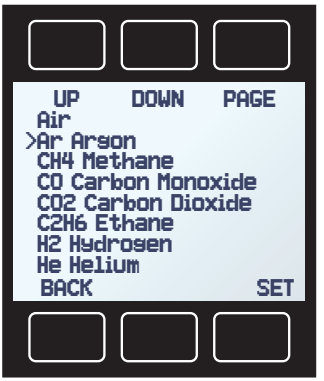
Menu → Basic Config → Gas

Category and Gas Listings Controls

- **UP/DOWN** moves the selection arrow up or down the listing of gas categories (in the Category Menu) or gases (Gas Listing Menu).
- **PAGE** advances the view to the next page of categories.
- **BACK** returns to the Basic Configuration Menu (page 20).
- **SELECT** (in the Category Listing Menu) opens a list of gases in that category.
- **SET** (in the Gas Listing Menu) immediately loads the gas measurement properties and exits to the Main Display (page 17).



Category Listing Menu



Gas Listing Menu

Gas List

Your device has data for the following gases (see page 41 for Gas Select index numbers):

Pure Non-Corrosive Gases

Acetylene (C_2H_2)
Air (Clean Dry)
Argon (Ar)
Isobutane (i-C_4H_{10})
Normal Butane (n-C_4H_{10})
Carbon dioxide (CO_2)
Carbon monoxide (CO)
Deuterium (D_2)
Ethane (C_2H_6)
Ethylene (Ethene) (C_2H_4)
Helium (He)
Hydrogen (H_2)
Krypton (Kr)
Methane (CH_4)
Neon (Ne)
Nitrogen (N_2)
Nitrous Oxide (N_2O)
Oxygen (O_2)
Propane (C_3H_8)
Sulfur Hexafluoride (SF_6)[1]
Xenon (Xe)

Breathing Gases

Metabolic Exhalant

EAN-32	EA-80	Heliox-50
EAN-36	Heliox-20	Heliox-60
EAN-40	Heliox-21	Heliox-80
EA-40	Heliox-30	
EA-60	Heliox-40	Heliox-99

Bioreactor Gas Mixes

5%–95% CH_4/CO_2 in 5% increments

Refrigerants[2]

R-11[3]	R-116	R-152a
R-14	R-124[3]	R-318
R-22[3]	R-125[3]	R-404A[3]
R-23[3]	R-134a[3]	R-407C[3]
R-32[3]	R-142b[3]	R-410A[3]
R-115[3]	R-143a[3]	R-507A[3]

Welding Gases

C-2	C-25	He-75
C-8	C-50	He-90
C-10	C-75	A 1025
C-15	He-25	
C-20	He-50	Stargon CS

Chromatography Gas Mixes

P-5 P-10

Oxygen Concentrator Gas Mixes

89% O_2, 7% N_2, 4% Ar
93% O_2, 3% N_2, 4% Ar
95% O_2, 1% N_2, 4% Ar

Stack/Flue Gas Mixes

2.5% O_2, 10.8% CO_2, 85.7% N_2, 1% Ar
2.9% O_2, 14% CO_2, 82.1% N_2, 1% Ar
3.7% O_2, 15% CO_2, 80.3% N_2, 1% Ar
7% O_2, 12% CO_2, 80% N_2, 1% Ar
10% O_2, 9.5% CO_2, 79.5% N_2, 1% Ar
13% O_2, 7% CO_2, 79% N_2, 1% Ar

Laser Gas Mixes

4.5% CO_2, 13.5% N_2, 82% He
6% CO_2, 14% N_2, 80% He
7% CO_2, 14% N_2, 79% He
9% CO_2, 15% N_2, 76% He
9.4% CO_2, 19.25% N_2, 71.35% He
9% Ne, 91% He

Fuel Gas Mixes

Coal Gas 50% H_2, 35% CH_4, 10% CO, 5% C_2H_4
Endothermic Gas 75% H_2, 25% N_2
HHO 66.67% H_2, 33.33% O_2
LPG HD-5 96.1% C_3H_8, 1.5% C_2H_6, 0.4% C_3H_6 , 1.9% n-C_4H_{10}
LPG HD-10 85% C_3H_8, 10% C_3H_6, 5% n-C_4H_{10}

Natural Gases

93% CH_4, 3% C_2H_6, 1% C_3H_8, 2% N_2, 1% CO_2
95% CH_4, 3% C_2H_6, 1% N_2, 1% CO_2
95.2% CH_4, 2.5% C_2H_6, 0.2% C_3H_8, 0.1% C_4H_{10}, 1.3% N_2, 0.7% CO_2

Synthesis Gases

40% H_2, 29% CO, 20% CO_2, 11% CH_4
64% H_2, 28% CO, 1% CO_2, 7% CH_4
70% H_2, 4% CO, 25% CO_2, 1% CH_4
83% H_2, 14% CO, 3% CH_4

Pure Corrosive Gases[2]

Ammonia (NH_3)	Dimethylether (DME)
Butylene (1-Buten)	Hydrogen Sulfide (H_2S)
Cis-Butene (c-Buten)	Nitrogen Trifluoride (NF_3)
Isobutane (i-Buten)	Nitric Oxide (NO)
Trans-Butene (t-Buten)	Propylene (C_3H_6)
Carbonyl Sulfide (COS)	Silane (SiH_4)
Chlorine (Cl_2)	Sulfur Dioxide (SO_2)

1 *Sulfur hexafluoride is a highly potent greenhouse gas monitored under the Kyoto Protocol.*

2 *S-series units only*

3 *Under the Montreal Protocol and Kigali Amendment, the production and consumption of these ozone-depleting substances (ODS) is being or has been phased out. It is recommended you ensure compliance with this universally ratified treaty before attempting to use these gases, in addition to R113, R-123, and R-141b.*

Using COMPOSER to Personalize Mixed Gas Compositions

To remain accurate, your flow meter needs to know the viscosity of the gas you are flowing through it. The more closely you can define your actual gas composition, the more accurate your flow readings will be. COMPOSER is an included feature of Gas Select that lets you define new mixed gas compositions to reconfigure your flow meter on the fly.

COMPOSER uses the Wilke's semi-empirical method to define a new gas mixture based on the molar (volumetric) ratios of the gases in the mixture. You can define these gas compositions to within 0.01% for each of up to five constituent gases in the mixture. Once you define and save a new COMPOSER gas mix, it becomes part of the Gas Select system and is accessible under the gas category **`COMPOSER User Mixes`**. You can store 20 COMPOSER gas mixes on your flow meter.

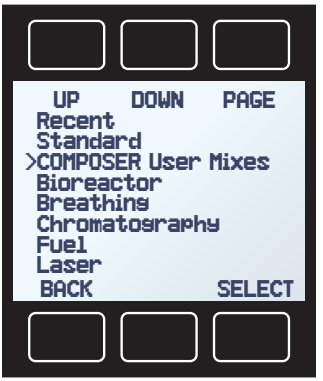
Note: *COMPOSER does not physically mix any gases for you. It reconfigures your flow meter to report flow readings more accurately based on the constituents of your defined gas mixture.*

Menu → Basic Config → Gas → COMPOSER User Mixes

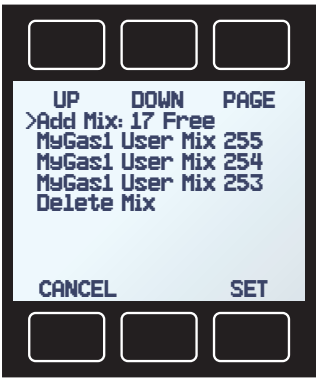
To access COMPOSER, select **`COMPOSER User Mixes`** from the Gas Select category listing (for more information on the category listing, see page 23). Select any existing mix to reconfigure your flow meter to measure that gas mixture.

Select **`Delete Mix`** to permanently remove a gas mix.

Press **`SET`** to confirm your selection. The setting will be applied immediately, and exit to the Main Display (page 17). Otherwise, **`CANCEL`** will return to the Gas Select Menu.



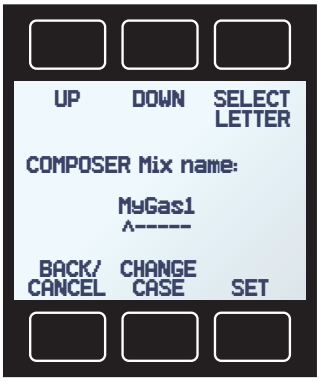
Category Listing Menu



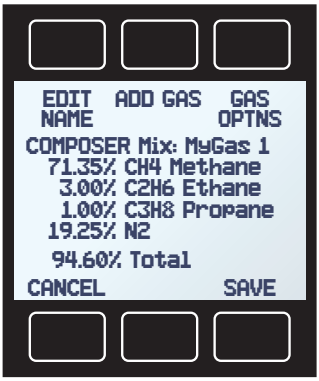
A list of existing mixes

Navigating and Customizing Your Flow Meter

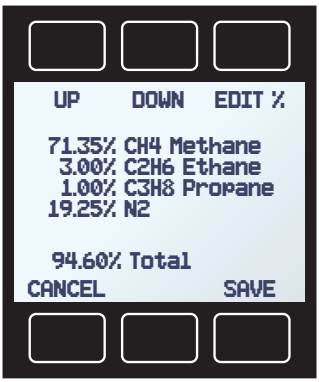
Creating Gas Compositions in COMPOSER



Step 1: Naming your mix



Step 2A: Mix summary menu



Step 2B: Gas Options Menu

Create your gas in 3 steps:

1. Name the Mix.

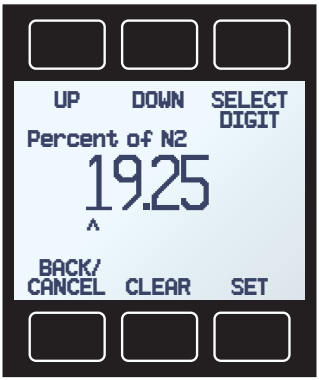
- **UP/DOWN** will change the character. Any six-character name may be used with A–Z, 0–9, punctuation (. , -), and space.
- **NEXT LETTER** will move to the next character, and cycle to the beginning from the end.
- **BACK/CANCEL** exits to the COMPOSER Menu.
- **CHANGE CASE** toggles upper- and lower-case letters.
- **SET** accepts the name and moves to the Mix Definition Menu in Step 2.

2. Define the Mix.

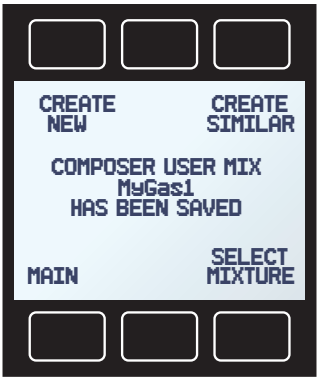
- **EDIT NAME** returns to Step 1.
- **ADD GAS** enters the Gas Select listing to choose up to five component gases, then asks to set its composition percentage.
- **GAS OPTNS** edits the non-final gas mix composition. Use **UP/DOWN** to select the gas, and **EDIT %** to change its percentage. You will need the mixture to total 100% when selecting **SAVE**.

3. Save the Mix.

- **CREATE NEW** creates a new mix.
- **CREATE SIMILAR** duplicates the current mix.
- **MAIN** exits to the Main Display without activating the new mix. **SELECT MIXTURE** exits and activates the mix.



Step 2C: Editing gas percentage

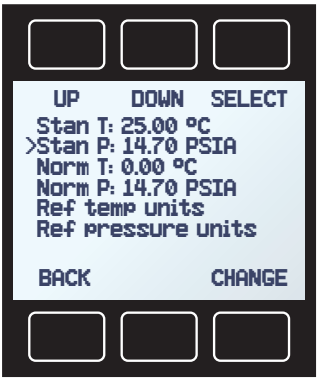


Step 3: Saving the mix

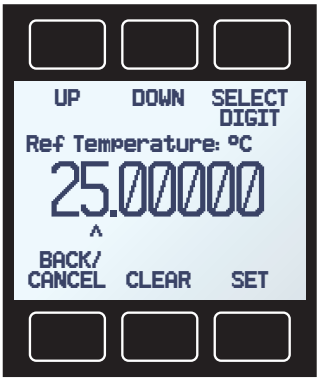
Defining STP/NTP Reference Values

Standardized flow rates are reported in “standard” or “normal” volumetric flow units that reference a given temperature and pressure combination. This reference is called an STP (standard temperature and pressure) or, typically in Europe, an NTP (normal temperature and pressure).

Menu → Basic Config → STP/NTP



STP/NTP menu



Selecting a standard

Stan T: Standard Temperature

Stan P: Standard Pressure

Norm T: Normal Temperature

Norm P: Normal Pressure

Ref temp units changes the temperature units used for STP and NTP calculations.

Ref pressure units changes the pressure units used for STP and NTP calculations

Using the **STP/NTP** menu, you can independently change the temperature or pressure references for STP and NTP. Your flow meter ships with a default STP of 25°C and 1 atm (which affects flow units beginning with “S”), and an NTP of 0°C and 1 atm (which affects flow units beginning with “N”).

To make changes, follow these steps:

1. Select the desired pressure or temperature reference engineering unit by selecting **Ref temp units** or **Ref pressure units** and pressing **CHANGE**. Both normal and standard references use the same engineering units.
2. Select the value you wish to modify, and press **CHANGE**.
3. At the confirmation screen, press **SET** to confirm your change.

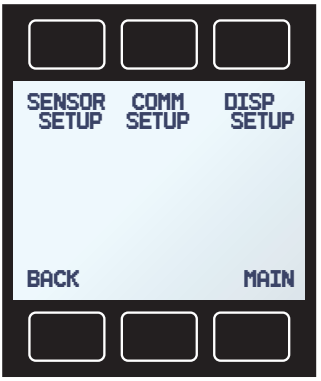
Caution: *Changes to* **STP/NTP** *references will alter your mass flow readings.*

Advanced Setup

The Advanced Setup Menu lets you configure the display, zero band, averaging (for flow and pressure), and serial communications.

Menu → Advanced Setup

- **SENSOR SETUP** enters the Sensor Setup menu (page 29).
- **COMM SETUP** enters the Communications Menu (page 30).
- **DISP SETUP** enters the Display Setup Menu (page 28).
- **BACK** returns to the top-level menu (page 20).
- **MAIN** exits to the Main Display (page 17).



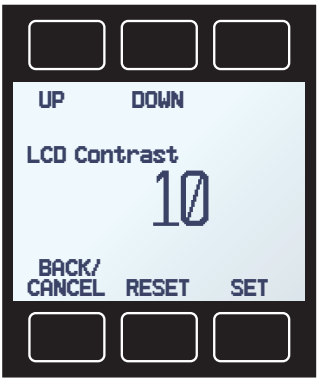
The Advanced Setup Menu

Display Setup

The options in the Display Setup Menu adjust the contrast of the display and enable screen rotation.

- **LCD CONTRAST** sets the contrast level of the display. Press reset to revert to the default contrast level.
- **POWER UP –DARK–** or **–LIT–** toggles whether the back light of the unit will be on or off when the device powers on.
- **ROTATE DISP** displays a sub-menu to select a screen orientation. Available orientations vary by model.
- **BACK** returns to the top-level menu (page 20).
- **MAIN** exits to the Main Display (page 17).

The Display Setup Menu



The LCD Contrast Menu

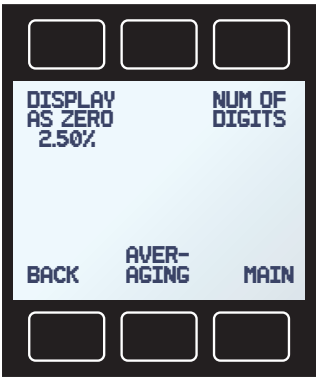
Sensor Setup

The Sensor Setup Menu contains advanced settings that govern how the flow and pressure sensors report their data.

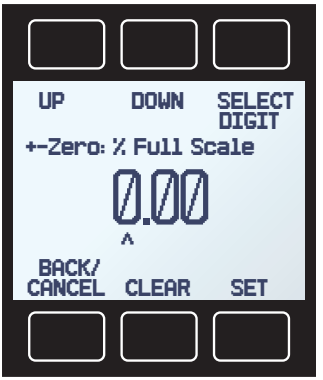
Menu → Advanced Setup → Sensor Setup

- **DISPLAY AS ZERO** defines the zero band threshold under which flow values are displayed as 0, and the current setting. The maximum zero band is **6.38%**. This function also applies to gauge pressure readings when using the optional barometer. For example, a 20-SLPM meter with a zero band value of 0.25% would display as 0 SLPM for all readings below 0.05 SLPM.
- **NUM OF DIGITS** sets the number of digits to display flow readings on-screen and in the serial data frame. Older devices typically had one less significant digit, and newer devices can be set to match.
- **BACK** returns to the top-level menu (page 20).
- **AVERAGING** adjusts the time constants of the geometric running averages for flow and pressure. These are changed independently via **PRESS AVG** and **FLOW AVG** in the Averaging Menu, which also displays the current settings. Values roughly correspond to the time constant (in milliseconds) of the averaged values. Higher numbers generate a greater smoothing effect on rapidly fluctuating readings (maximum 255 ms).
- **MAIN** exits to the Main Display (page 17).

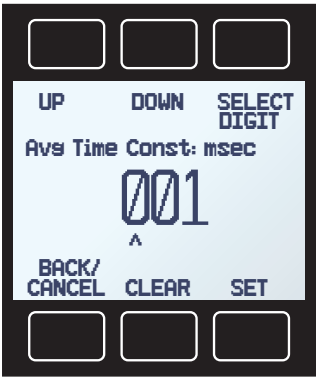
Note: *Deadband settings do not affect the values reported in the serial data.*



The Sensor Setup Menu.



The Display as Zero Menu.

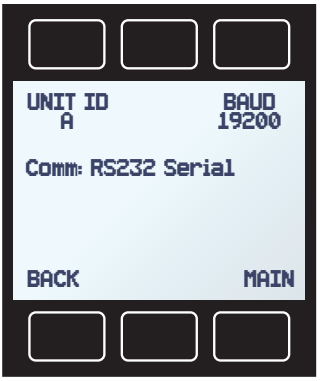


The Averaging Menu.

Configuring Serial Communications

You can operate the flow meter remotely via its data connection for easy streaming and logging of all data. Before connecting the flow meter to a computer, ensure that it is ready to communicate with your PC by checking the options in the **COMM SETUP** menu.

Menu → Advanced Setup → Comm Setup



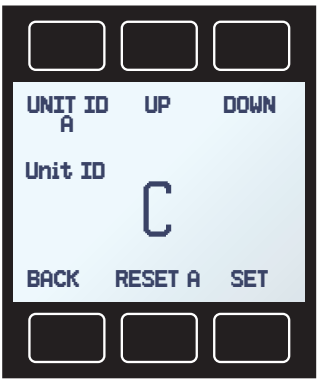
The Comm Setup Menu

Unit ID

The unit ID is the identifier that a computer uses to distinguish your flow meter from other similar mass flow devices when it is connected to a network. Using the unit ID letters **A–Z**, you can connect up to 26 devices to a computer at the same time via a single COM port. This is called polling mode (page 36). Unit ID changes take effect when you select **SET**.

If you select @ as the Unit ID, the flow meter enters streaming mode when you exit the menu (see page 33).

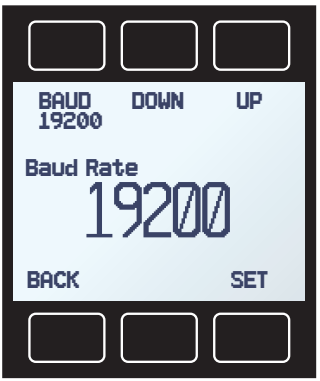
NOTE: *Devices equipped with Modbus RTU will also have a Modbus ID that can be set separately from the unit ID.*



Setting the serial unit ID

Baud Rate

Baud rate is the speed at which digital devices transfer information. The flow meter has a default baud rate of 19200 baud (bits per second). If your computer or software uses a different baud rate, you must change the flow meter baud rate in the **BAUD** menu to match them both. Alternatively, for computers with Microsoft Windows® operating systems, you can change your a computer's baud rate in Device Manager. Baud rate changes take effect immediately for the device once you press **SET**, but you may need to restart your software.



Setting the baud rate

Serial Communication

Connecting your flow meter to a computer allows you to log the data that it generates. The flow meter communicates digitally through its communications connector using a real or virtual COM port on your computer. This section of the manual shows you how to operate the flow meter using ASCII commands.

Establishing Communication

After connecting your flow meter using a communications cable, you will need to establish serial communications through a real or virtual COM port on your computer or programmable logic computer (PLC).

- If you have connected your device to a serial port, note its COM port number. This can be found in Windows Device Manager.
- If you have used a USB cable to connect your device to your computer, in most cases the computer will recognize your device as a virtual COM port. If it does not, download the appropriate USB device driver and note the COM port number as found in Windows Device Manager. Drivers may be found at https://www.ftdichip.com/Drivers/D2XX.htm.
- The meter will be configured with the following settings:
  - **Baud:** 19200 (default; others can be used if the computer, its software and the meter are set for the same rate)
  - **Data bits:** 8
  - **Parity:** none
  - **Stop bits:** 1
  - **Flow control:** none

Communication Programs

Although the meter will communicate with any compatible terminal program over RS-232, here are two common programs: PuTTy and HyperTerminal®.

Configuring HyperTerminal®

1. Open your Windows HyperTerminal® program (under "Accessories" menu on Microsoft Windows® operating systems).
2. Select "Properties" from the file menu.
3. Click on the "Configure" button under the "Connect To" tab. Be sure the program is set to match the settings above.
4. Under "Settings", set Terminal Emulation to ANSI or Auto Detect.
5. Click on "ASCII Setup" and verify that "Send Line Ends with Line Feeds" box is **not** checked, and "Echo Typed Characters Locally" box and "Append Line Feeds to Incoming Lines" boxes **are** checked. Other settings are normally OK in the default position.
6. Save the settings, close HyperTerminal® and reopen it.

Configuring PuTTy

1. Download PuTTY from putty.org and run the installer.
2. Open PuTTY; it will start on the Configuration screen.
3. Click on the Terminal category. The changes we make here will cause PuTTY to act like a normal serial terminal, such that pressing enter will move the cursor to the next line and both what you type and what gets returned stay on the screen:
   - Check the box that says “Implicit LF in every CR.”
   - Select the “Force on” radio button in the “Local echo” section.
4. Click Connection, and then the Serial subcategory.
   - Set the Speed (baud) to 19200.
   - Set the Data bits to 8.
   - Set the Stop bits to 1
   - Ensure “None” is selected for both Parity and Flow control.
5. Click on the Session category.
   - Select the “Serial” radio button under “Connection type”.
   - Check that the COM port and baud rate (Speed) are correct.
6. Save your settings so they can be recalled again later.

Note: *In what follows, ↵ indicates an ASCII carriage return (decimal 13, hexadecimal D). Serial commands are not case-sensitive.* `[unit ID]` *indicates to type the unit ID, which defaults to* `A`.

Polling Mode vs. Streaming Mode

In the **Streaming Mode**, the HyperTerminal® screen is updated approximately 10–60 times per second, depending on the amount of data on each line.

It is sometimes desirable to limit reponses to when they are requested, which is called **Polling Mode**. This is necessary when using more than one unit on a single RS-232 line. Each unit can be given its own unique letter identifier or unit ID, from A through Z.

*Unless otherwise specified, each unit is shipped in **polling mode** with a **default Unit ID of capital A**.*

Polling Mode

Polling the flow meter returns a single line of data each time you request it. To poll your flow meter, type **A**↵. This does an instantaneous poll of unit A and returns the values once. You may type **A**↵ as many times as you like.

Poll the device: `[unit ID]`↵
Example: **a**↵ (polls unit A)

You can change the unit ID of a polling device by typing:

Change the unit ID: `[current unit ID]@=[desired unit ID]↵`
Example: `a@=b↵` (changes unit A to unit B)

You can also do this via the menu: **MENU → ADV SETUP → COMM SETUP → UNIT ID** (page 31). Valid unit IDs are letters A–Z, and up to 26 devices may be connected at any one time, as long as each unit ID is unique.

Taring

Before collecting flow data, be sure to tare your flow meter. This can occur serially through two separate commands. Taring flow sets the zero flow reading and must be done when no flow is passing through the flow meter:

Tare flow: `[unit ID]v↵`
Example: `av↵` (sets flow reading to zero)

For devices equipped with a barometer, the second tare aligns the internal absolute pressure sensor with the current barometer reading and must be done with the flow meter open to atmosphere:

Tare absolute pressure: `[unit ID]pc↵`
Example: `apc↵`
(aligns internal pressure to barometer)

Addressing All Units

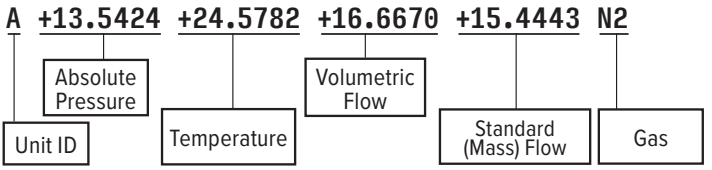
Using an asterisk (*) will address all units on an RS-232 line, but be aware that all units will reply back, leading to a garbled response.

Taring all devices: `*v↵`

Do not to use this to assign an ID, as all of devices would have the same ID. Instead, each should be individually attached to the RS-232 line, given an ID, and taken off. After each unit has been given a unique ID, they can all be put back on the same line and polled individually.

Collecting Flow Data

Collect live flow data by typing the `[unit ID]↵` command or by setting your flow meter to streaming. Each line of data for live flow measurements appears in the format below, but Unit ID is not present in streaming mode.



Single spaces separate each parameter, and each value is displayed in the chosen device engineering units, which may differ from the engineering units visible on the flow meter display (see page 18). You can query the engineering units of the instant data frame by typing:

Query live data info: `[unit ID]??d*↵`
Example: `a??d*↵`
(returns the data frame descriptions)

Additional columns, including status codes (page 8), may be present to the right of the gas label column.

Streaming Mode

In the default polling mode, the screen should be blank except for a cursor.

Begin streaming: `[unit ID]=@↵`
Example: `a=@↵`

Once you have established communication, and have a stream of information:

Stop the stream: `@@=A↵`
(or using the RS-232 communication select menu, select A as identifier and exit the screen)
Resume streaming: `A@=@↵`

The flow of information will not stop while typing, and you will not be able to read what you have typed. Also, the unit does not accept a backspace or delete in the line, so it must be typed correctly. If in doubt, hit enter and start again. Any command that is not understood will be ignored.

The device can also be set to streaming mode from the device front panel by setting its Unit ID as `@` from the Comm Setup Menu (see page 30).

Streaming Mode – Advanced

The streaming data rate is controlled by register 91. The recommended default rate is 50 ms, but it can be changed to a value from 1–65,535 ms, or slightly over once per minute.

Below approximately 40 ms, data provision will depend on how many parameters are selected. Fewer parameters will stream more quickly.

Reading register 91: `[unit ID]r91↵`
Modifying register 91: `[unit ID]w91=n↵`
(where n is a positive integer from 1 to 65535)

Using Gas Select and COMPOSER

To reconfigure your flow meter to flow a different gas, look up its Gas Number (page 41). Then type:

Choose a gas: `[unit ID]g[Gas Number]↵`
Example 1: `ag8↵` (reconfigures to flow nitrogen)
Example 2: `ag206↵` (reconfigures to flow P-10)

COMPOSER user mixes are selected in the same way. All COMPOSER gas mixes are numbered between 236 and 255, starting at 255.

Choose a user mix: `[unit ID]g[Gas Number]↵`
Example: `ag255↵` (reconfigures for user mix 255)

Defining a new COMPOSER gas mix is faster using serial commands than using the front panel. The basic formula for this is:

`[unit ID] gm [Mix Name] [Mix Number] [Gas1 %] [Gas1 Number] [Gas2 %] [Gas2 Number]…↵`

- `[Mix Name]` Use a maximum of 6 letters (upper case and/or lower case), numbers and symbols (space, period or hyphen only).
- `[Mix Number]` Choose a number from 236–255. If a user mix with that number already exists, it will be overwritten. Use the number `0` to assign the next available number to your new gas. **COMPOSER gas numbers are assigned in descending order from 255.**
- `[Gas1 %] [Gas1 Number]…` For each constituent gas, enter its molar percentage (using up to 2 decimal places) and then its Gas Number (page 41). You must have 2–5 gases in your COMPOSER mix.

After creating your COMPOSER mix, your flow meter will confirm the new gas:

Example 1: Create a mix of 71.35% helium, 19.25% nitrogen and 9.4% carbon dioxide as Gas 252, called “MyGas1”.
`a gm MyGas1 252 71.35 7 19.25 8 9.4 4↵`
Response: `A 252 71.35% He 19.25% N2 9.40% CO2`

Example 2: Create a mix of 93% methane, 3% ethane, 1% propane, 2% N_2 and 1% CO_2, using the next available gas number, called “MyGas2”.
`a gm MyGas2 0 0 93 2 3 5 1 12 2 8 1↵`
Response: `A 253 AIR 93.00% CH4 3.00% C2H6 1.00% C3H8 2.00% N2 1.00%`

Note: *The sum of all gas constituent percentages must equal 100.00%.*

Quick Command Guide

Note: *Serial commands are not case-sensitive. For simplicity, we assume that the unit ID of the flow meter is A in the listing that follows.*

Change unit ID:	`a@=[desired unit ID]↵`
Tare flow:	`av↵`
Tare absolute pressure with barometer:	`apc↵` (optional)
Poll the live data frame:	`a↵`
Begin streaming data:	`a@=@↵`
Stop streaming data:	`@@=[desired unit ID]↵`
Set streaming interval:	`aw91=[number of milliseconds]↵`
Query gas list info:	`a??g*↵`
Choose a different gas:	`ag[Gas Number]↵`
Create a COMPOSER mix:	`agm [Mix Name] [Mix Number] [Gas1 %] [Gas1 Number] [Gas2 %] [Gas2 Number]…↵`
Delete a COMPOSER mix:	`agd [Mix Number]↵`
Query live data info:	`a??d*↵`
Manufacturer info:	`a??m*↵`
Firmware version:	`a??m9↵`
Lock the front display:	`al↵`
Unlock front display:	`au↵`

If you have need of more advanced serial communication commands, please contact support (**page 2**).

Troubleshooting

If you run into any trouble with your meter's installation or operation, please contact support (page 2).

General Use

Issue: My meter does not turn on or has trouble staying on.
Action: Check power and ground connections. Please reference the technical specifications to assure you have the proper power for your model.
Portable flow meters run on a rechargeable battery, but you can also connect to a wall outlet or computer using a micro-USB cable. If the battery has been fully depleted, it may take a minute or so to acquire enough charge to turn back on. If your flow meter will not power on after being plugged in for at least 5 minutes, please contact support (page 2).

Issue: The buttons do not work, and the screen shows LCK.
Action: The flow meter buttons were locked out via a serial command. Press and hold all four outer buttons to unlock the interface, or use the serial command `[Unit ID]U`.
See page 31 for more serial commands.

Issue: I can't read the display easily.
Action: During the day, you can increase the visibility of the display by increasing the contrast (**MENU** → **ADV SETUP** → **DISP SETUP** → **LCD CONTRAST**). If you are working under low-light conditions, push the large central button (located below the display) to turn on the backlight.

Issue: The analog output signal indicates values lower than what appears on my instrument's display.
Action: Analog signal voltage degrades over long distances. You can minimize this effect by using wires with a heavier gauge, especially in the ground wire.

Issue: How often do I need to calibrate my meter?
Action: Annual recalibrations are recommended. Check your flow meter's last calibration date by selecting **MENU** → **ABOUT** → **DEVICE INFO**.
If it is time to recalibrate, request a recalibration (page 2).

Issue: I dropped my meter. Is it OK? Do I need to recalibrate?
Action: If it turns on and appears to respond normally, then it is probably OK. It may or may not need a recalibration. Compare it against a known-good flow standard. If it checks out, keep using it, but tell support about the drop at your next annual recalibration so we can check it out for you.

Issue: How can I see temperature, pressure or flow in different units?
Action: From the main menu, select **BASIC CONFIG** → **DEVICE UNITS**. From this menu, you can adjust temperature, pressure or flow units. For more information, see page 18.

Flow Readings

Issue: The live flow readings won't settle down.
Action: The flow meter is very fast, so it can detect subtle variations in flow that may go unnoticed by your other flow devices. This sensitivity can help detect problems with pumps or flow controllers. You can lessen this sensitivity by increasing the flow averaging press **MENU** → **ADV SETUP** → **SENSOR SETUP** → **FLOW AVG**. See page 29.

Issue: My flow readings are negative.
Action: If your flow meter is not connected to anything, it may be reading a small flow that is entering its outlet. Plug one end to see if the flow returns to 0. Under conditions of no flow, a negative flow reading can indicate a poor tare. Ensure that the flow meter has no flow passing through it, and select **TARE FLOW** from the Main Display to give it a fresh tare.

Issue: My flow readings jump to 0 when flow rates are low.
Action: Your flow instrument is equipped with a programmable zero band that is preset at the factory. Reduce your deadband threshold by selecting **MENU** → **ADV SETUP** → **SENSOR SETUP** → **ZERO BAND**. Note: The zero band threshold has no effect upon the serial data.

Issue: Does the meter work if it is laying down? Will it be accurate?
Action: Yes to both! The flow meter is internally compensated for any changes in orientation, so you can use it sideways, on its back, or upside-down. S-series devices should be tared again after changing their orientation.

Issue: Can I put the meter on top of a vibrating device? Will it be accurate?
Action: Yes, and yes! The flow meter is internally compensated for any changes in orientation, including rapid vibrations. Sensor noise will increase if the flow meter is vibrating.

Issue: My meter does not agree with another meter I have in line.
Action: Check the STP or NTP settings (**MENU → BASIC CONFIG → STP/NTP**) to ensure that your standardized temperature and pressure references match those of your other flow calibrator. Also check that your device's Gas Select is set to the right gas or mixture.

Issue: My flow readings won't change when flow changes.
Action: If your flow readings won't change regardless of actual flow, your flow sensor may be damaged. Please contact support to troubleshoot (page 2).

Issue: My volumetric flow readings don't match another flow calibrator I use.
Action: If you are flowing dry gas, the differences in flow readings are likely the result of pressure drop. Every flow meter has some amount of pressure drop, especially those that use differential pressure as the measurement method. For example, volumetric flow readings taken with a standard flow meter may differ from those taken with low pressure drop flow meters.

Issue: Can I use the meter with other gases?
Action: Yes! Your flow meter is designed specifically to work with many different gases. Gas Select (**MENU → BASIC CONFIG → GAS**) includes up to 130 preloaded gases and gas mixes, or you can define your own using COMPOSER. If your desired gas is not listed (page 24), please contact support to ensure compatibility.

Serial Communications

Issue: I can't communicate to the meter when it is connected to my computer.
Action: **1.** Make sure the baud rate and other serial settings of your software and COM Port require is the one your meter is using (**MENU → ADV SETUP → COMM SETUP → BAUD**).
2. Check the flow meter unit ID (**MENU → ADV SETUP → COMM SETUP → UNIT ID**) to make sure you are addressing it properly with your serial commands.
3. Check the pinout (see page 45)
4. Make sure the COM number matches the one your software is using to connect to the flow meter (page 30).

Still experiencing issues?

Issue: None of the above helped.
Action: Contact support. See the contact information on page 2.

Maintenance

Cleaning

Your flow meter requires no periodic cleaning, provided that it has been flowing clean, dry gas. If necessary, the outside of the device can be cleaned with a soft dry cloth.

If you suspect that debris or other foreign material has entered your device, do not take apart the flow body to clean it, as this will negate its NIST-traceable calibration. Please contact support for cleaning (page 2).

Recalibration

The recommended period for recalibration is once every year. A label located on the back of the device lists the most recent calibration date. This date is also stored inside your flow meter and is visible by selecting **MENU** → **ABOUT** → **DEVICE INFO**.

When it is time for your flow meter's annual recalibration, contact support (see page 2). You will need your device's serial number and your contact information.

Gas List

#	Short Name	Long Name
0	Air	Air (Clean Dry)
1	Ar	Argon
2	CH4	Methane
3	CO	Carbon Monoxide
4	CO2	Carbon Dioxide
5	C2H6	Ethane
6	H2	Hydrogen
7	He	Helium
8	N2	Nitrogen
9	N2O	Nitrous Oxide
10	Ne	Neon
11	O2	Oxygen
12	C3H8	Propane
13	nC4H10	Normal Butane
14	C2H2	Acetylene
15	C2H4	Ethylene (Ethene)
16	iC4H10	Isobutane[2]
17	Kr	Krypton
18	Xe	Xenon
19	SF6	Sulfur Hexafluoride[1]
20	C-25	25% CO_2, 75% Ar
21	C-10	10% CO_2, 90% Ar
22	C-8	8% CO_2, 92% Ar
23	C-2	2% CO_2, 98% Ar
24	C-75	75% CO_2, 25% Ar
25	He-25	25% He, 75% Ar
26	He-75	75% He, 25% Ar
27	A1025	90% He, 7.5% Ar, 2.5% CO_2
28	Star29	Stargon CS (90% Ar, 8% CO_2, 2% O_2)
29	P-5	5% CH_4, 95% Ar
30	NO	Nitric Oxide[2]
31	NF3	Nitrogen Trifluoride[2]
32	NH3	Ammonia[2]
33	Cl2	Chlorine[2]
34	H2S	Hydrogen Sulfide[2]
35	SO2	Sulfur Dioxide[2]
36	C3H6	Propylene[2]
80	1Buten	1-Butylene[2]
81	cButen	Cis-Butene (cis-2-Butene)[2]
82	iButen	Isobutylene
83	tButen	Trans-2-Butene[2]
84	COS	Carbonyl Sulfide[2]
85	DME	Dimethylether (C_2H_6O)[2]
86	SiH4	Silane[2]
100	R-11	Trichlorofluoromethane (CCl_3F)[2,3]
101	R-115	Chloropentafluoroethane (C_2ClF_5)[2,3]
102	R-116	Hexafluoroethane (C_2F_6)[2]
103	R-124	Chlorotetrafluoroethane (C_2HClF_4)[2,3]
104	R-125	Pentafluoroethane (CF_3CHF_2)[2,3]
105	R-134A	Tetrafluoroethane (CH_2FCF_3)[2,3]
106	R-14	Tetrafluoromethane (CF_4)[2]
107	R-142b	Chlorodifluoroethane (CH_3CClF_2)[2,3]
108	R-143a	Trifluoroethane ($C_2H_3F_3$)[2,3]
109	R-152a	Difluoroethane ($C_2H_4F_2$)[2]
110	R-22	Difluoromonochloromethane ($CHClF_2$)[2]
111	R-23	Trifluoromethane (CHF_3)[2,3]
112	R-32	Difluoromethane (CH_2F_2)[2,3]
113	R-318	Octafluorocyclobutane (C_4F_8)[2]
114	R-404A	44% R-125, 4% R-134A, 52% R-143A[2,3]
115	R-407C	23% R-32, 25% R-125, 52% R-143A[2,3]
116	R-410A	50% R-32, 50% R-125[2,3]
117	R-507A	50% R-125, 50% R-143A[2,3]
140	C-15	15% CO_2, 85% Ar
141	C-20	20% CO_2, 80% Ar
142	C-50	50% CO_2, 50% Ar
143	He-50	50% He, 50% Ar

#	Short Name	Long Name
144	He-90	90% He, 10% Ar
145	Bio5M	5% CH_4, 95% CO_2
146	Bio10M	10% CH_4, 90% CO_2
147	Bio15M	15% CH_4, 85% CO_2
148	Bio20M	20% CH_4, 80% CO_2
149	Bio25M	25% CH_4, 75% CO_2
150	Bio30M	30% CH_4, 70% CO_2
151	Bio35M	35% CH_4, 65% CO_2
152	Bio40M	40% CH_4, 60% CO_2
153	Bio45M	45% CH_4, 55% CO_2
154	Bio50M	50% CH_4, 50% CO_2
155	Bio55M	55% CH_4, 45% CO_2
156	Bio60M	60% CH_4, 40% CO_2
157	Bio65M	65% CH_4, 35% CO_2
158	Bio70M	70% CH_4, 30% CO_2
159	Bio75M	75% CH_4, 25% CO_2
160	Bio80M	80% CH_4, 20% CO_2
161	Bio85M	85% CH_4, 15% CO_2
162	Bio90M	90% CH_4, 10% CO_2
163	Bio95M	95% CH_4, 5% CO_2
164	EAN-32	32% O_2, 68% N_2
165	EAN	36% O_2, 64% N_2
166	EAN-40	40% O_2, 60% N_2
167	HeOx20	20% O_2, 80% He
168	HeOx21	21% O_2, 79% He
169	HeOx30	30% O_2, 70% He
170	HeOx40	40% O_2, 60% He
171	HeOx50	50% O_2, 50% He
172	HeOx60	60% O_2, 40% He
173	HeOx80	80% O_2, 20% He
174	HeOx99	99% O_2, 1% He
175	EA-40	Enriched Air-40% O_2
176	EA-60	Enriched Air-60% O_2
177	EA-80	Enriched Air-80% O_2
178	Metab	Metabolic Exhalant (16% O_2, 78.04% N_2, 5% CO_2, 0.96% Ar)
179	LG-4.5	4.5% CO_2, 13.5% N_2, 82% He
180	LG-6	6% CO_2, 14% N_2, 80% He
181	LG-7	7% CO_2, 14% N_2, 79% He
182	LG-9	9% CO_2, 15% N_2, 76% He
183	HeNe-9	9% Ne, 91% He
184	LG-9.4	9.4% CO_2, 19.25% N_2, 71.35% He
185	SynG-1	40% H_2, 29% CO, 20% CO_2, 11% CH_4
186	SynG-2	64% H_2, 28% CO, 1% CO_2, 7% CH_4
187	SynG-3	70% H_2, 4% CO, 25% CO_2, 1% CH_4
188	SynG-4	83% H_2, 14% CO, 3% CH_4
189	NatG-1	93% CH_4, 3% C_2H_6, 1% C_3H_8, 2% N_2, 1% CO_2
190	NatG-2	95% CH_4, 3% C_2H_6, 1% N_2, 1% CO_2
191	NatG-3	95.2% CH_4, 2.5% C_2H_6, 0.2% C_3H_8, 0.1% C_4H_{10}, 1.3% N_2, 0.7% CO_2
192	CoalG	50% H_2, 35% CH_4, 10% CO, 5% C_2H_4
193	Endo	75% H_2, 25% N_2
194	HHO	66.67% H_2, 33.33% O_2
195	HD-5	LPG: 96.1% C_3H_8, 1.5% C_2H_6, 0.4% C_3H_6, 1.9% n-C_4H_{10}
196	HD-10	LPG: 85% C_3H_8, 10% C_3H_6, 5% n-C_4H_{10}
197	OCG-89	89% O_2, 7% N_2, 4% Ar
198	OCG-93	93% O_2, 3% N_2, 4% Ar
199	OCG-95	95% O_2, 1% N_2, 4% Ar
200	FG-1	2.5% O_2, 10.8% CO_2, 85.7% N_2, 1% Ar
201	FG-2	2.9% O_2, 14% CO_2, 82.1% N_2, 1% Ar
202	FG-3	3.7% O_2, 15% CO_2, 80.3% N_2, 1% Ar
203	FG-4	7% O_2, 12% CO_2, 80% N_2, 1% Ar
204	FG-5	10% O_2, 9.5% CO_2, 79.5% N_2, 1% Ar
205	FG-6	13% O_2, 7% CO_2, 79% N_2, 1% Ar
206	P-10	10% CH_4 90% Ar
210	D-2	Deuterium

1 *Sulfur hexafluoride is a highly potent greenhouse gas monitored under the Kyoto Protocol.*

2 *S-series units only*

3 *Under the Montreal Protocol and Kigali Amendment, the production and consumption of these ozone-depleting substances (ODS) is being or has been phased out. It is recommended you ensure compliance with this universally ratified treaty before attempting to use these gases, in addition to R113, R-123, and R-141b.*

Engineering Units

True Mass Flow Units

Label	Notes
mg/s	milligram per second
mg/m	milligram per minute
g/s	gram per second
g/m	gram per minute
g/h	gram per hour
kg/m	kilogram per minute
kg/h	kilogram per hour
oz/s	ounce per second
oz/m	ounce per minute
lb/m	pound per minute
lb/h	pound per hour

Temperature Units

Label	Notes
°C	degrees Celsius
°F	degrees Farenheit
K	Kelvin
°R	degrees Rankine

Time Units

Label	Notes
h:m:s	hours:minutes:seconds
ms	milliseconds
s	seconds
m	minutes
hour	hours
day	days

Flow Units

Volumetric	Std.	Normal	Notes
uL/m	SuL/m	NuL/m	microliter per minute
mL/s	SmL/s	NmL/s	milliliter per second
mL/m	SmL/m	NmL/m	milliliter per minute
mL/h	SmL/h	NmL/h	milliliter per hour
L/s	SL/s	NL/s	liter per second
LPM	SLPM	NLPM	liter per minute
L/h	SL/h	NL/h	liter per hour
US GPM			US gallon per minute
US GPH			US gallon per hour
CCS	SCCS	NCCS	cubic centimeter per second
CCM	SCCM	NCCM	cubic centimeter per minute
cm^3/h	Scm^3/h	Ncm^3/h	cubic centimeter per hour
m^3/m	Sm^3/m	Nm^3/m	cubic meter per minute
m^3/h	Sm^3/h	Nm^3/h	cubic meter per hour
m^3/d	Sm^3/d	Nm^3/d	cubic meter per day
in^3/m	Sin^3/m		cubic inch per minute
CFM	SCFM		cubic foot per minute
CFH	SCFH		cubic foot per hour
CFD	SCFD		cubic foot per day
	kSCFM		1000 cubic feet per minute
count	count	count	setpoint count, 0–64000
%	%	%	percent of full scale

Pressure Units

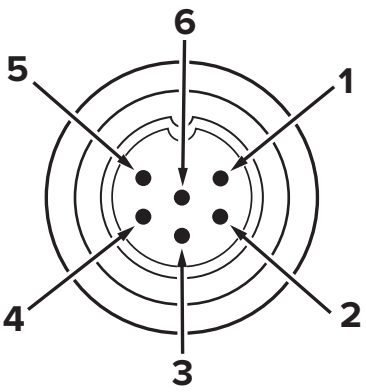
Absolute or Barometric	Gauge	Notes
PaA	PaG	pascal
hPaA	hPaG	hectopascal
kPaA	kPaG	kilopascal
MPaA	MPaG	megapascal
mbarA	mbarG	millibar
barA	barG	bar
g/cm²A	g/cm²G	gram force per square centimeter
kg/cmA	kg/cmG	kilogram force per square centimeter
PSIA	PSIG	pound force per square inch
PSFA	PSFG	pound force per square foot
mTorrA	mTorrG	millitorr
torrA	torrG	torr
mmHgA	mmHgG	millimeter of mercury at 0°C
inHgA	inHgG	inch of mercury at 0°C
mmH_2OA	mmH_2OG	millimeter of water at 4°C (NIST conventional)
mmH_2OA	mmH_2OG	millimeter of water at 60°C
cmH_2OA	cmH_2OG	centimeter of water at 4°C (NIST conventional)
cmH_2OA	cmH_2OG	centimeter of water at 60°C
inH_2OA	inH_2OG	inch of water at 4°C (NIST conventional)
inH_2OA	inH_2OG	inch of water at 60°C
atm		atmosphere
m asl		meter above sea level
ft asl		foot above sea level
V		volt
count	count	setpoint count, 0–64000
%	%	percent of full scale

Pinout

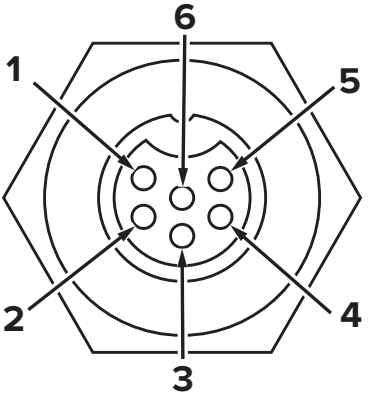
M12 Connector Pinout

If your meter was ordered with the M12 connection, please be sure to reference the following pin-out diagram.

Pin	Function
1	0–5 Vdc (or optional 0–10 Vdc) Output Signal



Male Connector: Cable



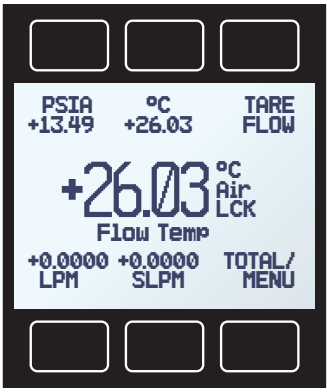
Female Connector: Device

2	Power In +24 VDC, 1 A recommended for most models
3	Serial RS-232 RX / RS-485(–) Input Signal (receive)
4	Remote Tare (Ground to Tare)
5	Serial RS-232 TX / RS-485(+) Output Signal (send)
6	Static 5.12 Vdc [or optional Secondary Analog Output (4–20 mA, 5 Vdc, 10 Vdc) or Basic Alarm]
7	Ground (common for power, digital communications, analog signals and alarms)
8	Inactive (or optional 4–20 mA Primary Output Signal)

Note: *The above pin-out is applicable to all the flow meters with the M12 connector. The availability of different output signals depends on the options ordered. Optional configurations are noted on the unit's calibration sheet.*

Due to variance in cable manufacturing, please identify proper wiring/pins via continuity check & color when using blunt cut multi-strand cables.

See also the 8-pin Mini-DIN pinout on **page 11.**



Main Display

Main Menu

Apex Vacuum

222 Riverstone Drive
Canton, Georgia 30114
United States of America

Phone: (800) 331-2808

ApexVacuum.com

Main Menu Quick Guide

Accessible from MENU on the Main Display

- **About** (page 2)
  - Device information
  - Device state
  - Manufacturer information
- **Tares** (page 20)
  - Tare pressure
  - Tare flow
- **Basic config** (page 22)
  - Gas configuration
    - Gas categories and gases
    - COMPOSER mix creation and management
  - Device units
    - Mass flow
    - Volumetric flow
    - Pressure
    - Temperature
  - STP/NTP
- **Advanced setup** (page 28)
  - Sensor setup
    - Display as zero (zero band)
    - Number of digits
    - Flow and pressure averaging
  - Communication setup
    - Unit ID
    - Baud
  - Display setup
    - LCD contrast
    - Power-up light
  - Display rotation
- **Main display** (page 17)