MaxTrak™ 180 Series

Mass Flow Meters & Controllers

Models: 180, 180 + Flanges

Instruction Manual

Version IM-180 Series, Rev. N 7/22

SIERRA®

For Global Service Centers, go to http://www.sierrainstruments.com/facilities.html

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IMPORTANT CUSTOMER NOTICE: OXYGEN SERVICE

Sierra Instruments, Inc. is not liable for any damage or personal injury, whatsoever, resulting from the use of Sierra Instruments standard mass flow meters or controllers for oxygen gas. You are responsible for determining if this mass flow meter or controller is appropriate for your oxygen application. You are responsible for cleaning the mass flow meter or controller to the degree required for your oxygen flow application

TRADEMARKS

MaxTrak™, SmartTrak® 100 Series and Dial-A-Gas™ is a Registered Trademark of Sierra Instruments, Inc. Other product and company names listed in this manual are trademarks or trade names of their respective manufacturers.

Warnings in This Manual

"Warning," "Attention," and "Note" statements are used throughout this manual to draw your attention to important information.

Symbol Key		
Symbol	**Symbol Meaning**	**Descripition**
	Warning	"Warning" statements appears with information that is important to protect people and equipment from damage. Pay very close attention to all warnings that apply to your application. **Failure to comply with these instructions may damage the meter and cause personal injury.**
	Caution	"Attention" indicates that failure to comply with stated instructions **may result in damage or faulty operation of the meter.**
	Note	"Note" indicates that ignoring the relevant requirements or precautions may result in flow meter damage or malfunction.

Receipt of System Components

When receiving a Sierra mass flow meter, carefully check the outside packing carton for damage incurred in shipment. If the carton is damaged, notify the local carrier and submit a report to the factory or distributor. Remove the packing slip and check that all ordered components are present. Make sure any spare parts or accessories are not discarded with the packing material. Do not return any equipment to the factory without first contacting Sierra Customer Service.

Technical Assistance

If you encounter a problem with your flow meter, review the configuration information for each step of the installation, operation, and setup procedures. Verify that your settings and adjustments are consistent with factory recommendations. Installation and troubleshooting information can be found in the Chapter 2 (Installation) and Chapter 4 (Troubleshooting) of this manual.

If the problem persists after following the troubleshooting procedures outlined in Chapter 4 of this manual, contact Sierra Instruments by fax or by e-mail (see inside front cover). For urgent phone support you may call (800) 866-0200 or (831) 373-0200 between 8:00 a.m. and 5:00 p.m. PST. In Europe, contact Sierra Instruments Europe at +31 72 5071400. In the Asia-Pacific region, contact Sierra Instruments Asia at +8621 5879 8521. When contacting Technical Support, make sure to include this information:

- The flow range, serial number, and Sierra order number (all marked on the meter nameplate)
- The software version (visible at start up)
- The problem you are encountering, and any corrective action taken
- Application information (gas, pressure, temperature and piping configuration)

Register Your Product Today

Warranty Statement

All Sierra products are warranted to be free from defects in material and workmanship and will be repaired or replaced at no charge to Buyer, provided return or rejection of product is made within a reasonable period but no longer than one (1) year for calibration and non-calibration defects, from date of delivery. To assure warranty service, customers must register their products online on Sierra's website. Online registration of all of your Sierra products is required for our warranty process. Read complete warranty policy at www.sierrainstruments.com/warranty.

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Table of Contents

1 Introduction

The Sierra Instruments' MaxTrak Series 180 is an innovation from Sierra, a company that has designed and manufactured gas mass flow measurement instruments since the early 1970's. This manual is your guide to MaxTrak, our water-resistant series of mass flow meters and controllers. The Series 180 MaxTrak is the rugged industrial version of Sierra's popular Series 100 SmartTrak and the two products share many innovative features. Visit the Sierra Instruments website **www.sierrainstruments.com** any time for more information about both of these products.

The MaxTrak instruments offer a variety of features for ease of operation. Among these features:

- **Dial-A-Gas:** allows a user to change from among 10 gases while maintaining accuracy.
- **Digital Electronics**: maximum performance with minimum noise plus exceptional tuning capability.
- Choice of **4 Analog Communications Options and RS-232** with every MaxTrak instrument.
- **Flexible Design** with many functions that can be re-configured on-site by the user.
- **Choice of Electric Connections** including our water-tight plug-and-play option
- **The Optional Pilot Module:** control electronics that offers a large LCD display with convenient instrument configuration and trouble-shooting options at your fingertips.
- **And many more…visit www.sierrainstruments.com**

1.1 Using This Manual

This manual is organized into five chapters:

- **Chapter 1:** Introduction and Theory of Operation.
- **Chapter 2:** Installation, Plumbing & Wiring instructions.
- **Chapter 3**: Analog Operation.
- **Chapter 4**: Digital Operation & SmartTrak 100 Software
- **Chapter 5**: Digital Operation with RS-232 & MaxTrak Software.
- **Chapter 6**: Technical Support and Service.

There are also 6 Appendices:

- **Appendix A:** MaxTrak Pre-Programmed gases, Conversion Formula and Gas Tables.
- **Appendix B:** Product Specifications, useful Optional Parts & Accessories
- **Appendix D:** PIN Configuration of the mini-D connector
- **Appendix E**: Dimensional Drawings & Mounting Instructions.
- **Appendix F**: Warranty Policy
-

Throughout this manual, we use the word *instrument* as a generic term to represent all models of Sierra Instruments' **MaxTrak Series 180** mass flow meters and controllers.

1.2 Definitions Used In This Manual

The following terms are used frequently in this manual. They are presented here with their definitions for your information.

Setpoint—The command or control signal supplied to a flow controller is called its setpoint. The controller will maintain the flow at this value.

Full scale—The highest flow that an instrument will meter within its specified accuracy. It is often possible for an instrument to measure a flow beyond its full scale value, but the accuracy of this measurement may be outside of published specifications.

Purge—The MaxTrak Mass Flow Controller is supplied with the ability to open the valve far beyond the full scale position to allow them to be cleaned. This is usually accomplished by blowing clean, dry nitrogen through the instrument. When the valve is opened to this cleaning position, it is said to be in the Purge mode.

LFE—Laminar Flow Element (LFE) or bypass generates pressure drop forcing a small fraction of the total flow to pass through the sensor capillary tube.

1.3 The MaxTrak Flow Sensing Principle

The operating principle of the MaxTrak instruments is based on heat transfer and the first law of thermodynamics. During operation process gas enters the instrument's flow body and divides into two flow paths, one through the sensor tube, the other through the laminar flow bypass. The laminar flow bypass (often called LFE which stands for "laminar flow element") generates a pressure drop, P1–P2, forcing a small fraction of the total flow to pass through the sensor tube (m1).

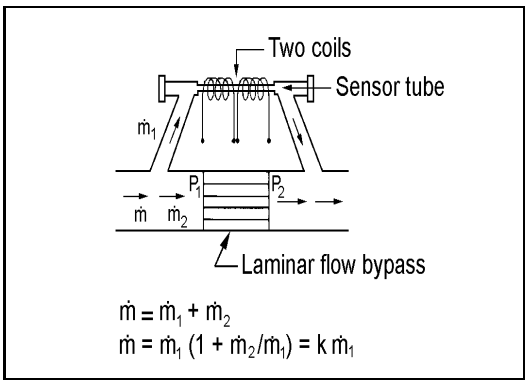

Figure 1. Flow Paths Through the Instrument.

Two resistance temperature detector (RTD) coils around the sensor tube direct a constant amount of heat (H) into the gas stream. During operation, the gas mass flow carries heat from the upstream coil to the downstream coil. The resulting temperature difference (ΔT) is measured by the MaxTrak microprocessor. From this, MaxTrak calculates the output signal. Since the molecules of the gas carry away the heat, the output signal is linearly proportional to gas mass flow.

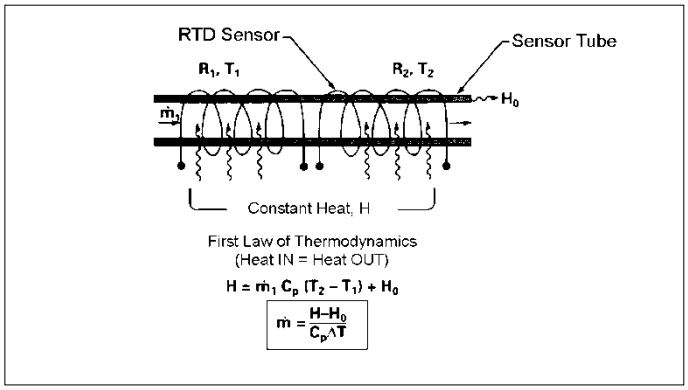

Figure 2. Flow Measuring Principle

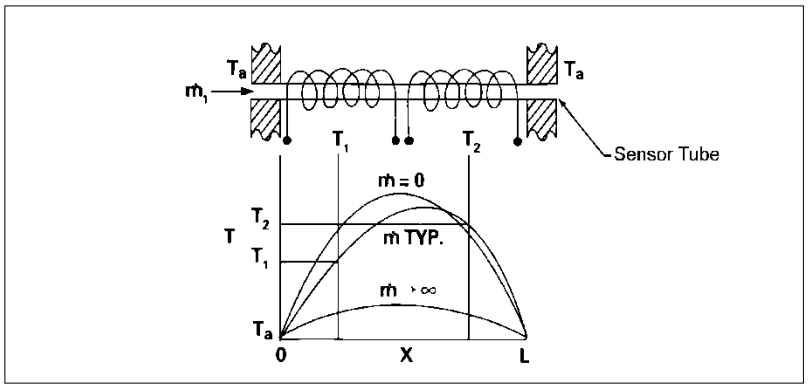

Figure 3. Sensor Temperature Distribution

Figures 2 and 3 show the mass flow through the sensor tube as inversely proportional to the temperature difference of the coils. The coils are legs of a bridge circuit with an output voltage in direct proportion to the difference in the coils' resistance; the result is the temperature difference (ΔT). Two other parameters, heat input (H) and coefficient of specific heat (Cp) are both constant. Through careful design and attention to these parameters, this output signal is made linear over the transducer's normal operating range (Figure 4). As a result, the measured flow through the sensor tube is directly proportional to the gas flow in the main body.

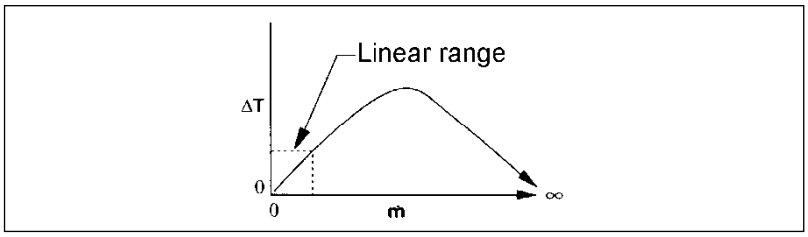

Figure 4. Linear Range of the Transducer's Output Signal

In the MaxTrak mass flow controllers, the gas which flows through the monitoring section is precisely regulated by the built-in electro-magnetic valve. The normally closed valve is similar to an on/off solenoid valve, except that the current to the valve coil, and hence the magnetic field, is modulated so that the ferromagnetic valve armature, or valve plug, assumes the exact height above the valve's orifice required to maintain the valve's command flow (set point). The result is excellent resolution.

2 Installation

2.1 Before You Begin

	**WARNING:** Injury can result if line pressure exceeds the maximum rating of 500 psig (34 barg).

Before installing the instrument, ensure that the installation site conforms to the specific operating parameters recorded on the instrument's Data Label. The Data Label is mounted on the back of the instrument electronics enclosure (see samples below). Should the data label on the back of the instrument become illegible due to exposure or age, a duplicate of this label in included INSIDE the enclosure for reference. Because each instrument is con-figured for a specific application range it is critical to verify these details be-fore operation. Please review the gas or gases, the mounting orientation, the maximum flow range(s), the inlet and outlet pressure(s), and the operating temperature(s). The line pressure should not exceed 500 psig (34 barg). The temperature should not exceed 50°C (122°F). The minimum operating gas temperature is 0°C (32°F) and ambient temperature must remain between -20 to 50°C. If your application exceeds any of these parameters, contact your Sierra Sales Agent before installation. You may also contact one of Sierra's Technical Support Centers. FACTORY USA: TOLL FREE: 800-866-0200 or PHONE: 831-373-0200 or FAX: 831-373-4402 or EMAIL: service@sierrainstruments.com.

SIERRA INSTRUMENTS, INC. THE MASS FLOW COMPANY CE

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Mass Flow Controller

Model		
C100L-L-DD-LE-5-OV1-SV1-PV1C-V1-S1		
Serial	**Order**	**Mfg. Date**
10067	10001	7/1/03
Gas		
Air		
Range & Units		**STP**
0-1 SLPM		70F / 1 ATM
Output Signal		**Set Signal**
0-5 Vdc		0-5 Vdc
Orientation		**Supply**
Horizontal		12-15 Vdc
Inlet Press.	**Outlet Press.**	**Max. Press.**
30 PSI	ATM	500 PSIG
Oper. Temp	**Max. Temp**	**Connections**
70F	122F	1/4" VCO
O-ring Material		**Valve Seat Material**
Viton		Viton
Technician	**Cal. Date**	**Recal. Date**

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SIERRA INSTRUMENTS, INC. THE MASS FLOW COMPANY CE

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800-866-0200
831-373-0200

Mass Flow Meter

Model		
M100L-L-DD-LE-5-OV1-SV1-PV2-V4-S4		
Serial	**Order**	**Mfg. Date**
10068	10001	7/1/03
Gas		
Nitrogen		
Range & Units		**STP**
0-1 NM3/hr		21C/760 mmHg
Output Signal		**Set Signal**
4-20 mA		4-20 mA
Orientation		**Supply**
Vertical Flow Down		24-30 Vdc
Inlet Press.	**Outlet Press.**	**Max. Press.**
2 BARG	ATM	35 BARG
Oper. Temp	**Max. Temp**	**Connections**
20C	50C	3/8 VCR
O-ring Material		**Valve Seat Material**
Viton		Viton
Technician	**Cal. Date**	**Recal. Date**

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Figure 5. Examples of Data Labels

2.2 Pre-Installation Check List

1. **Double-check to be sure that the o-ring material used in your instrument is compatible with the gas to be measured.** The o-ring material used in your MaxTrak can be found in the Data Label. See Appendix A for a table of elastomer compatibility with a wide variety of gases.
2. **Sierra strongly recommends you install an in-line filter upstream of the instrument.** Recommended filter size: 10 micron.
3. **Do not locate the instrument in areas subject to sudden temperature changes or near equipment radiating significant amounts of heat.** Be sure to allow adequate space for cable connectors and wiring. MaxTrak weighs up to 30 lbs (14 kg) so make certain mounting hardware is properly designed.
4. **For controllers, use a properly sized pressure regulator.** Make sure the pressure regulator is not too small or too big. There can be no restrictions (such as valves, tubing or pipe internal diameters, reducers, etc.) upstream or downstream of the controller with a dimension that is less than the valve orifice diameter. To determine orifice diameter, consult the calibration certificate included with your instrument.
5. **Output Signals:** The MaxTrak has two analog outputs that are linearly proportional to the gas mass flow rate. These are a 4-20 mA signal plus your choice of one voltage signal: 0-5 VDC or 0-10 VDC or 1-5 VDC. The voltage signal specified at time of order will be indicated on the data label. You may change between the current and the voltage output signal at your discretion after receipt of the instrument using the Remote Pilot Module or the SmartTrak Software (see Chapters 4 & 5). Changing the voltage output has no influence on the instrument's accuracy.
6. **The instrument has specific power supply requirements.** See the table later in this chapter for a complete listing of power requirements.

2.3 Installing the Instrument-Plumbing

MaxTrak instruments are supplied with compression, VCO®, VCR®, or female NPT process connections. To ensure a successful installation, inlet and outlet tubing should be in a clean state prior to plumbing the instrument into the system. The shipping caps covering the inlet/outlet fittings should not be removed until immediately before installation.

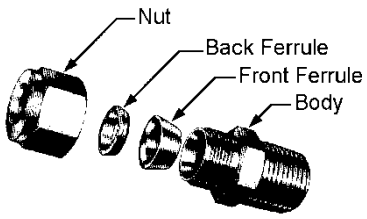
Follow the installation instructions that are applicable to your instrument's process connection. Ensure that the tubing is free from burrs, or sharp rims that may result from cutting.

CAUTION: Before use, all plumbing should be checked carefully for leaks, especially at the connecting fittings. All instruments are leak-tested prior to shipping. If you choose to leak-check your new instrument, you may either monitor pressure decay or use liquid leak detectors such as Snoop® to search for leaks.

2.3.1 Compression Fittings

1 Position the instrument with the flow direction arrow pointing in the direction of flow.
2 Verify the position of the front and back ferrule. Insert the tubing into the fitting. Be sure that the tubing rests firmly on the shoulder of the fitting and that the nut is finger-tight. Scribe the nut at the six o'clock position.

3 While holding the fitting body steady with a backup wrench, tighten the nut 1-1/4 turns, watching the scribe mark make one complete revolution and continue to the nine o'clock position. For 1/16-inch, 1/8-inch and 3/16-inch (2, 3 and 4 mm) sizes, tighten only 3/4 turns from finger-tight. **Do not over-tighten!**
4 If you use flexible tubing (Example: Polyflow) use an "Insert" (see www.swagelok.com)
5 Check the system's entire flow path thoroughly for leaks.



2.3.2 VCO Fittings

1 Position the instrument with the flow direction arrow pointing in the direction of flow.
2 Tighten the nut finger-tight, and then 1/8 turn tighter with a wrench. **Do not over-tighten!**
3 Check the system's entire flow path thoroughly for leaks.

2.3.3 Female NPT

1. Position the transducer with the flow direction arrow pointing the direction of flow.
2. Use a good quality Teflon tape. Apply to the male fittings. Alternatively, use a high quality paste pipe thread sealant suitable for the application and gas and apply this compound to the inlet and outlet fittings. Avoid getting the tape or the thread sealant onto the first two threads to keep it out of your process gas.
3. Tighten each fitting by hand. Then, tighten no more than one (1) turn. **Do not over-tighten.**
4. Check the system's entire flow path thoroughly for leaks

2.4 Installing Your Instruments-Mechanical Mounting

2.4.1 Mounting Your Instrument

The base plate or bottom of the instrument has 4 mounting holes. Two are SAE thread and two are metric thread. For location and dimensions, please see Appendix B. Remember to properly support the weight of your instrument.

2.5 Installing Your Instruments-Electrical Connections

	**WARNING:** Do not apply power to the output loop on units equipped and calibrated for a 4-20 mA output signal. This is **not** a loop-powered device. Damage will occur.

All electrical connections for your MaxTrak instrument are made on the left (inlet) side panel. There are 3 options

for making electrical connection which must be specified at time of order: a waterproof electrical connector (WT in the model code), a cable gland (GLAND in the model code) or an open port for conduit connection (COND in the model code). These will be discussed separately.

2.5.1 Using Water-Tight (WT) Cables

If your instrument has the WT option, attach the water-tight cable to the electrical connector on the inlet side of the instrument. Connect the wires in this cable per the diagram below. You do not need to open the instrument if you have ordered the WT option.

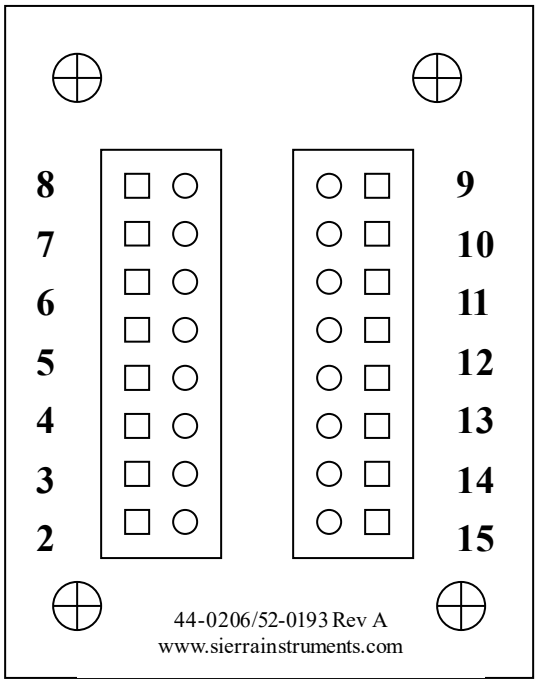
2.5.2 Using the Cable Gland or Conduit

If your instrument has our 1/2 FNPT conduit port (code COND) or a cable gland (code GLAND), you must remove the top of the instrument for installation. All electrical connections, including power, are applied via the terminal strip which is located INSIDE the waterproof enclosure. Access is through the port or cable located on the inlet side of the enclosure.

2.5.3 Opening the MaxTrak Instrument

1. Remove the top section of the enclosure by unscrewing the 4 mounting bolts on the top of the instrument (bolt size SAE 7/16"). Gently pry the top section off the instrument (not the complete cover, just the top section). Do not remove the O-ring seal around the perimeter of the enclosure.
2. If using conduit, run your wires through the conduit, connect the conduit to our ½" FNPT port on the inlet side of the instrument with Teflon tape or pipe thread sealant, then pass your wires into the instrument toward the terminal strip (at the top). If using the cable gland, run your shielded cable with a diameter of 0.20-0.35" (5-9 mm) through the special gland on the side of the enclosure (cable with a smaller ID may allow liquid to enter the instrument and cause permanent damage). Do not remove the cable gland.
3. Separate your individual wires (16-28 gauge required) and connect to the terminal strip on the top of the upper circuit board. Wire per the diagrams below. Note that this terminal strip is unique to the MaxTrak 180 Series instruments.
4. When wiring is completed, secure the conduit to the enclosure in a water-tight fashion or tighten the cable gland fitting so that it grasps your cable securely. Failure to seal the conduit to the enclosure or to tighten the fitting can permit liquid to enter the electronic compartment and damage the instrument.
5. Install the top section of the enclosure taking care not to pinch the O-ring seal or any of your wires. Insert and tighten the 4 mounting bolts. Failure to install these bolts correctly can permit liquid to enter the electronic compartment and damage the instrument.

Terminal Strip PCA Pin Configuration (inside the enclosure)



Wiring Functions, Locations and Color Codes		
#	**Function**	**Wire Color with Optional WT Cable**
1	Analog Ground	Brown
2	0-5 VDC Output (or 0-10, 1-5 VDC)	Red
3	Analog Ground	Orange
4	Valve Override (purge)	NOT CONNECTED
5	Power Return (-)	Yellow
6	Power Input (+)	Green
7	RS-232 Transmit (out)	Purple
8	Setpoint	Blue
9	Not Used	NOT CONNECTED
10	Analog Ground	Gray
11	Reference Voltage (5 VDC External Setpoint & Valve Purge)	NOT CONNECTED
12	Valve Override (close)	Black
13	RS-232 Receive (in)	Pink
14	4-20 mA Output	White
15	Chassis (Earth) Ground	Tan (Light Brown)
16	Not Used	NOT CONNECTED

NOTE: Sierra recommends individual wires from pins 1, 3, 5, and 10 to power supply ground.

2.6 Basic Analog Installation

WARNING: This instrument is not a loop-powered device! Do not apply power to the 4-20 mA output or input connections.

2.6.1 Instrument Power

The MaxTrak requires a 24 VDC power supply. If you are using the power supply supplied by Sierra, connect it as noted above. If you are supplying your own power source, it must be a regulated source with ripple not to exceed 100 mV peak-to-peak. Refer to the table below for voltage and current requirements. MaxTrak is polarity sensitive. If you reverse this wiring, the instrument will not be damaged, but it will not function.

Power Supply Requirements

Instrument Type	Recommended Input Voltage	Minimum Current Required (mA)
M180M Meter	15-24 VDC (+/- 10)	130
M180H Meter	15-24 VDC (+/- 10)	130
C180M Controller	24 VDC (+/- 10)	700
C180H Controller	24 VDC (+/- 10)	1260

2.6.2 *Output Signal-Voltage*

Measure the voltage output signal across the red (pin 2) wire and any of the analog grounds: brown (pin 1), orange (pin 3) or gray (pin 10). The minimum load is 1000 Ohms.

2.6.3 Output Signal-Current

Measure the current output signal, 4-20 mA across the white (pin 14) wire and any of the analog grounds: pin 1, 3, or 10. The maximum load is 500 Ohms.

2.6.4 Additional Features for Mass Flow Controllers

- **Setpoint:** To transmit an analog setpoint, supply the voltage or current signal (user selectable) across the blue (pin 8) wire and any of the analog grounds: pin 1, 3, or 10. Note that the setpoint signal you supply must match the signal type your instrument is configured for. See Chapters 4 for how to change the type of setpoint source.

- **Valve Close:** To force the valve closed, connect the black (pin 12) wire to one of the analog grounds.

- **Purge:** To force the valve to its maximum open position which we call "Purge," connect pin 4 to pin 11. Note that this will allow much greater flow than the rated full-scale value.

2.7 Configuring Your Instrument

The MaxTrak instruments have many features which can be changed by the user. You may wish to review these features and modify some of them prior to operation of your instrument. This must be accomplished using Digital Communication with the supplied SmartTrak software. If you prefer to use your instrument as delivered, please proceed to Chapter 3: Analog Operation.

2.7.1 Using SmartTrak Software to Configure Your Instrument

You can communicate with your instrument using the SmartTrak Software package (provided with your purchase) and your PC running the Windows operating system. Simply connect the purple (pin 7) wire, the pink (pin 13) wire and one of the analog grounds: brown, orange or gray wires (pin 1, 3, or 10) to a standard DB-9 connector according to the chart on the next page.

RS-232 Wiring Configuration		
RS-232 Transmit (pin 7)	To	DB-9 pin #2
RS-232 Transmit (pin 13)	To	DB-9 pin #3
Analog Ground (pin 1,3, or 10)	To	DB-9 pin #5

With the connections above in place, plug the DB-9 connector into an appropriate serial port on your PC. If you are in an environment with high RF interference, it may be necessary to shield these wires. Should your computer not have a serial port, you will need a serial to USB adapter. See Chapter 4 for details.

You are now ready to configure your MaxTrak instrument. Proceed to Chapter 4 for a discussion of the use of the SmartTrak software

3 Analog Operation

Your MaxTrak instrument may be operated in two different ways:

1. Analog Input/Output Operation (this chapter): Using analog input/output signals at the 15-pin mini-D connector.
2. Digital Operation with RS-232 and SmartTrak Software (Chapter 4): Using the RS-232 link, the supplied SmartTrak Software package and a PC-style computer running the Windows operating system.

This chapter will discuss the first of these—Analog Operation. Please see Chapter 4 for digital operation.

Regardless of control options, the standard output for all MaxTrak instruments are two linear analog output signals corresponding to 0% to 100% of the mass flow full-scale range. Please note that one of these output signals is always a current signal of 4-20 mA. The other is a user-configurable voltage signal of 0-5 VDC, 0-10 VDC or 1-5 VDC.

For mass flow controllers, one input signal of 4-20 mA, 0-5 VDC, 0-10 VDC or 1-5 VDC (selectable by user) may be chosen to set the gas mass flow rate to any desired value within the range of the device. This input signal must be a direct linear representation of 0% to 100% of the desired gas mass flow full-scale value.

For the location of these signals on the WT connector or the Terminal Strip, refer to Chapter 2.

3.1 Analog Operation, Mass Flow Meters

After your instrument is installed and the system has undergone a complete leak check as discussed in detail in Chapter 2, you are ready to supply power.

3.1.1 Power Your Instrument

Apply power using Sierra's power supply or your own power source. See Chapter 2 for complete power supply requirements. Let the instrument warm up for at least 15 minutes for optimal performance. Check the configuration of your instrument by reviewing the data label details.

WARNING: The MaxTrak is not a loop-powered device. Do not apply power to the 4-20 outputs.

If the configuration is not correct for your present application, you can alter it. See Chapter 4 or 5 for details on how to change the configuration of your MaxTrak instrument.

If the configuration is correct, your MaxTrak instrument is now ready for use.

3.2 Analog Operation, Mass Flow Controllers

After your instrument is installed and the system has undergone a complete leak check as discussed in detail in Chapter 2, follow these steps:

1. The valve will remain closed until power is supplied. See Chapter 2 for wiring instructions. Remember that the valve in the Max-Trak is not a positive shut-off device. When power is applied, the flow control valve will operate per any instructions it receives. When the MaxTrak is delivered, the valve will be in the Automatic (Normal) state and the analog or digital command signal will pro-vide the correct zero setpoint reference for the instrument. As a result, the valve will be closed. However, upon subsequent power-ups, the valve will return to the state it was in the last time the instrument was operated.

WARNING: If you do not know the value of the setpoint or the valve state given to the MaxTrak when it was last operated, you must assume that the valve will open when power is applied. Take necessary precautions. You may use the MaxTrak Software to check the setpoint or the valve state currently on your instrument. See Chapter 4 for information on Setpoint and Valve State.

2. Power Your Instrument: Apply power using Sierra's power sup-ply or your own power source. See Chapter 2 for complete Power Supply requirements.

3. Adjust the controller setpoint to the desired flow rate by supplying an appropriate signal (mA or VDC). The effective control range of the unit is 2% to 100% of the calibrated full scale flow range. Automatic shut-off occurs at 1.9% of the factory full scale calibrated range. MaxTrak will immediately begin accurately monitoring and controlling the gas mass flow rate. Let the instrument warm up for at least 15 minutes for optimal performance.

NOTE: You must supply the setpoint in the configuration the MaxTrak is looking for. If the instrument does not respond to your setpoint, check the configuration on the data label and re-configure the instrument as needed (see Chapter 4).

4. Your MaxTrak instrument is now ready for use.

3.3 MaxTrak Analog Features

3.3.1 *Setpoint Adjustment (flow controllers only)*

The setpoint (command) input signal you supply to MaxTrak must be a direct linear representation of 0% to 100% of the mass flow full-scale value. Apply the setpoint signal from pin 8 to any of the analog grounds (see Chapter 2 for wiring details). A setpoint value of 0 VDC (or 1 VDC or 4 mA) will regulate the flow to 0% and a setpoint value of 5.00 VDC (or 10 VDC or 20 mA) will adjust the flow to 100% of the instrument's full scale range.

When the setpoint (command) signal is applied, the flow controller will reach the setpoint value within two seconds to within ±2% of the selected flow rate.

WARNING: Do not leave a setpoint applied for an extended period of time to a controller when the gas supply is shut off or blocked. This will overheat your instrument which will become hot to the touch and damage may result. Instead, drive the set point to zero or use the "Valve Close" feature which allows you to disable the valve while maintaining the current setpoint signal. Valve Close may be activated from an external analog signal (see below) or digitally (see Chapter 4).

3.3.2 Changing the Output or Setpoint Signals

To modify the analog output or setpoint signals (from 4-20mA to 0-10Vdc, for example), you must use the SmartTrak Software. The data label will indicate the form these signals had when the instrument was last calibrated. We strongly recommend that you modify the data label if the configuration is changed for future reference. See Chapter 4 for the necessary procedure. Remember that the MaxTrak will always output a current signal of 4-20mA. The other output signal and the setpoint signal may be changed using this procedure.

3.3.3 Over-Range Condition

If the mass flow rate exceeds the full-scale range listed on the MaxTrak data label (see samples of the data label in Chapter 2), the output signal will measure above full-scale. However, the device has not been calibrated for flows in excess of the calibrated full scale value and the resulting output will be both non-linear and inaccurate if an over-range condition exists. Please be aware that the analog outputs can exceed full scale by as much as 20%, or more.

Once the over-range condition has been removed, it may take up to 30 seconds for the MaxTrak to recover and resume normal operation. An over-range condition will not harm the instrument.

3.3.4 Manual Valve Override-Valve Close

WARNING: The MaxTrak valve is not a positive shut-off device.

Manual valve override is provided for all Sierra mass flow controllers. This feature includes both a valve close command and a valve maximum open command (called purge). When the valve is directed to close or to purge, it will no longer respond to a setpoint command.

For Valve Close, connect pin 12 (black wire with WT cable) to one of the analog grounds.

The controller will return to normal automatic operation about 4 seconds after pin 12 is left floating.

3.3.5 Manual Valve Override-Valve Purge Function

The purge function opens the controller valve completely for the purpose of quickly flushing unwanted gas from the flow path. When the valve is opened for purging, it allows flows far in excess of the rated full scale of the controller.

For valve purge, connect pin 4 to pin 11.

	**NOTE**: With the WT option, this feature is disabled at the factory. If you want to use this feature, you must select 2 wires not currently in use and connect them as indicated at the terminal strip INSIDE the instrument. See Chapter 2 for more details.

3.4 Important Notes About Purging

	**WARNING:** Always fully neutralize any toxic gas trapped inside the instrument be-fore removing it from the gas line

3.4.1 Purging Non-Reactive Gases

	**WARNING:** Purge your MaxTrak with clean, dry nitrogen for a minimum of 2 hours.

3.4.2 Purging Reactive Gases:

	**CAUTION:** One of the following methods may be used: • Cycle purge. This is done by alternately evacuating and purging the instrument for 2 to 4 hours with clean, dry nitrogen. • Purge the instrument with clean, dry nitrogen for 18 to 24 hours. • Evacuate the instrument for 18 to 24 hours.

3.5 Safety Notes When Purging

	**WARNING:** When toxic or corrosive gases are used, purge unit thoroughly with inert dry gas before disconnecting from the gas line to prevent personnel from being injured when coming in contact with the instrument. Chapter 3 discusses how to purge your instrument.
	**WARNING:** If an instrument used with a toxic or corrosive gas is returned to the factory, a Material Safety Data Sheet (MSDS) must be enclosed & attached to the outside of the box to alert Sierra personnel of the potential hazard. Also, make sure the inlet & outlet are securely sealed.

4 Digital Operation RS-232 & SmartTrak Software

Your SmartTrak instrument may be operated in two different ways:

Two Control Options:

1. Analog Input/Output Operation (Chapter 3): Using analog in-put/output signals at the 15-pin mini- D connector.

2. Digital Operation with RS-232 and SmartTrak Software (This Chapter): Using the RS-232 SmartTrak Software package and a PC-style computer running the Windows operating system

This chapter will discuss "C" above—Digital Operation with your computer via RS-232 and SmartTrak Software. Although you have chosen to use the RS-232 option, please note that all the Analog control functions are still available on your instrument. Consult Chapter 3 for details on Analog operation.

If you prefer to write your own software to communicate with the SmartTrak over the RS-232 link, this is certainly possible. Sierra Instruments will provide the Source Code including the Command Set upon request. Unfortunately, this is the limit of software Technical Support we can extend.

4.1 Summary of the SmartTrak Features

Your SmartTrak instrument may be easily monitored and adjusted using the supplied SmartTrak Software package. You should note that the SmartTrak Software was designed with all the same functions as the Pilot Module. The software allows you to see all changes & parameters at a glance and will allow you to make changes quickly and easily. For review, the features of the SmartTrak include:

1. Top Level Screens that display information. In our software, these screens appear as yellow boxes. They include:
    - Mass flow rate
    - Gas (10 options pre-programmed, one must be AIR)
    - Engineering units (mass per unit time)
    - Current Setpoint with units
    - Source of Setpoint (analog or digital and type)
    - Valve operation mode (normal, valve shut or purge)
    - Current meter full scale value with units (user selectable)
2. Lower level Screens that permit changes to instrument operation In our software, these screens appear as white boxes. They include:
    - Setpoint value
    - Engineering units
    - Gas
    - Valve operation
    - Source of the setpoint signal
    - Form of the output signals
    - Full scale of the instrument
    - Zero meter
    - Span meter

3. Additional Features include:
    - Re-boot the SmartTrak microprocessor
    - Change the Communication Port
    - Links to Sierra Instruments' Web Site
    - Specifications

4.2 Power Up Your Instruments

WARNING: The SmartTrak is not a loop-powered device. Do not apply power to the 4-20 outputs.

After your instrument is installed and the system has undergone a complete leak check (discussed in detail in Chapter 2), apply power using Sierra's power supply or your own input power source. See Chapter 2, for power supply requirements. The green LED at the top of the left side will light. If your instrument has a Pilot Module, it will begin its start-up cycle. See Chapter 4 for details on Pilot Module operation.

If you have a Mass Flow Controller, the valve will remain closed until power is supplied. Remember that the valve in the SmartTrak controller is not a positive shut-off device. When power is applied, the flow control valve will operate per any instructions it receives. When the SmartTrak is delivered, the valve will be in the Automatic (Normal) state and the Pilot Module will provide the correct zero setpoint reference for the instrument. As a result, the valve will be closed. However, the valve will return to the state it was in the last time the instrument was operated.

WARNING: If you do not know the position of the valve before it was shut down, you must assume that the valve will open when power is applied. Take necessary precautions. The SmartTrak is not a loop-powered device. Do not apply power to the 4-20 outputs.

4.3 Power Up Your Computer

Apply power to your computer per the manufacturer's recommendations. The SmartTrak Software is compatible with any computer running the following Windows Operating Systems:

Windows 7

Windows 98, 2nd Edition

Windows XP

Windows XP Professional

Windows 2000

4.4 Loading the SmartTrak Software

If you are using your SmartTrak instrument or your computer for the first time, it is necessary to install the SmartTrak Software into your computer. If this software is already installed, skip this section. If you want to upgrade the SmartTrak Software because you have a higher revision, continue below.

	**CAUTION:** Exit out of any open applications before running software on your computer.

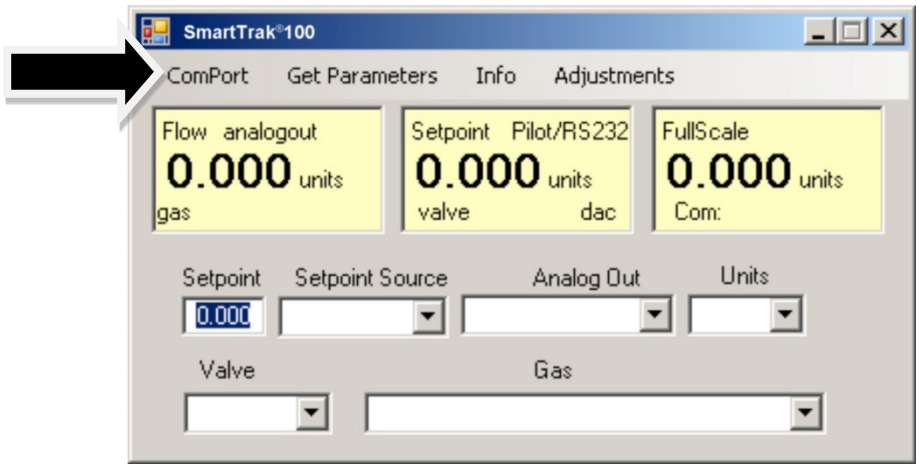
PROCEDURE:

1. Download software to your computer. Use the default direct C-drive:\Program Files.
2. Run "setup.exe"
3. Follow the instructions on screen.

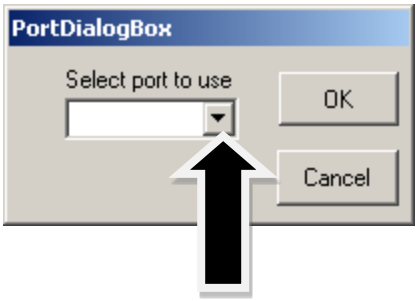
	**CAUTION:** It is recommended that you do not change the default installation directory for this software. The default directory is: **C-drive:\ Program Files.** Changing the installation directory may lead to malfunctions in the software.

4.5 Running the SmartTrak Software

Locate the file named "SmartTrak" and open it. You will see the following screen: This is the main data screen. First, you must select the proper comport.



Select the comport pull down menu:

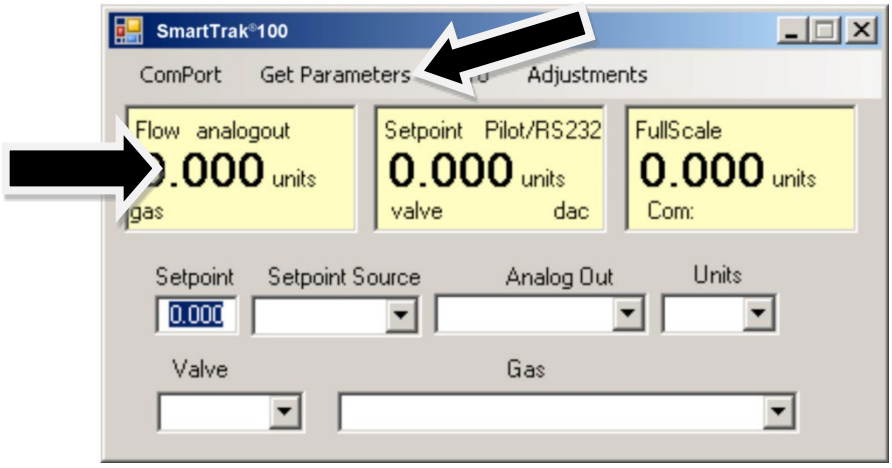


Use the pull-down menu to choose the port number that corresponds to the serial port channel your SmartTrak is connected to (from 1 to 255). If you have only one serial port, select "Comm Port 1." When finished, click on the box marked "OK."

You will be returned to the SmartTrak Master Screen. The screen is the same for both meters and controllers. Controller functions will not be active for meters and vice versa.

4.5.1 Establishing Communication

If the Screen appears with all the yellow and white boxes full, the SmartTrak instrument has established communication with your computer.



Proceed to the next section.

If the screen appears, but the yellow and white boxes are all empty, you have selected the wrong "Com Port number." See the section titled "Com Port" on page 5-16 for instructions on how to change the communication port number.

If the screen appears, but only the Mass Flow box shows a value, you are using the correct Com Port, but your computer is not talking to the SmartTrak. To begin communication, move the mouse pointer to the top center screen and left click on the words "Get Parameters." Then values will fill all the boxes on the screen. Communication has been established. Your computer is now able to control your SmartTrak instrument.

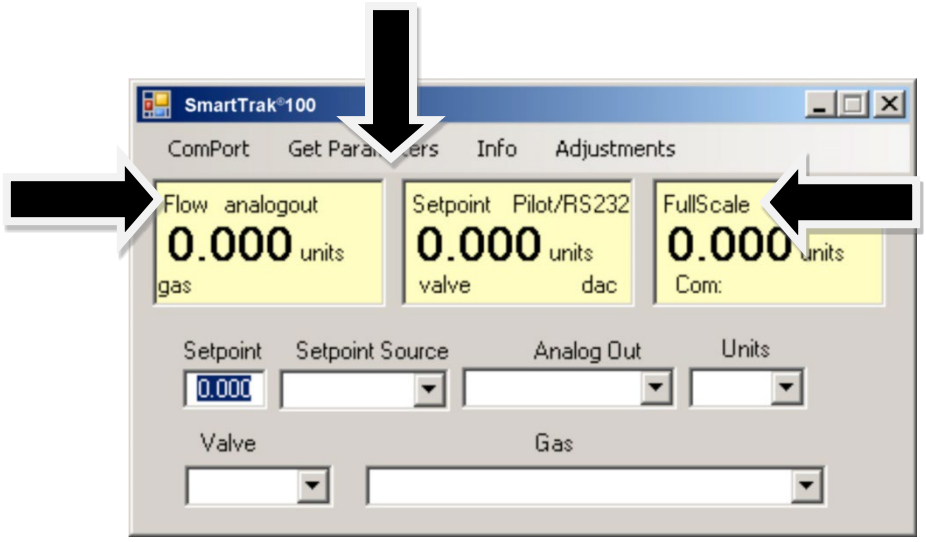
Your SmartTrak instrument is now ready for use!

4.6 Using the SmartTrak Software

4.6.1 Upper Section Software Window

Across the upper half of the SmartTrak Software window you will see 3 yellow boxes. These are titled:

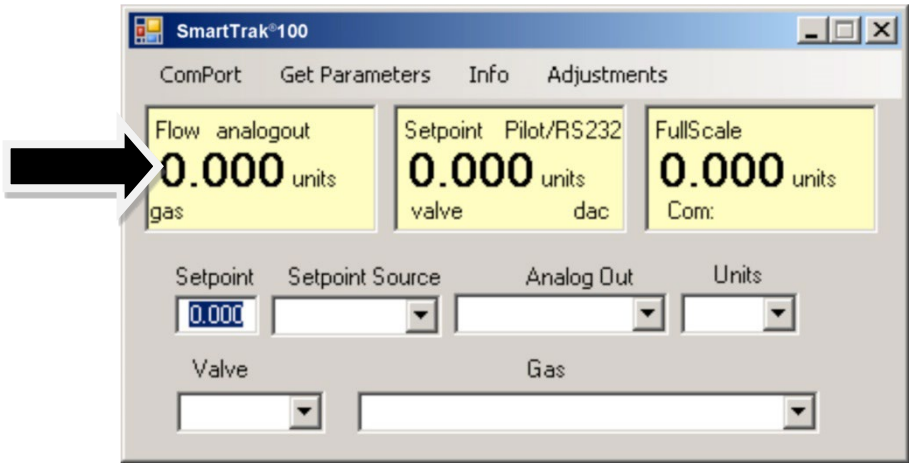
- Flow
- Setpoint (flow controllers only. Will show zero for meters)
- Full Scale



These boxes display the current operating conditions of your SmartTrak instrument. If you have the Pilot Module, these boxes on the upper half of the software screen are identical to the Upper Level Screens on the Pilot Module discussed in Chapter 4. The features of these boxes are described below.

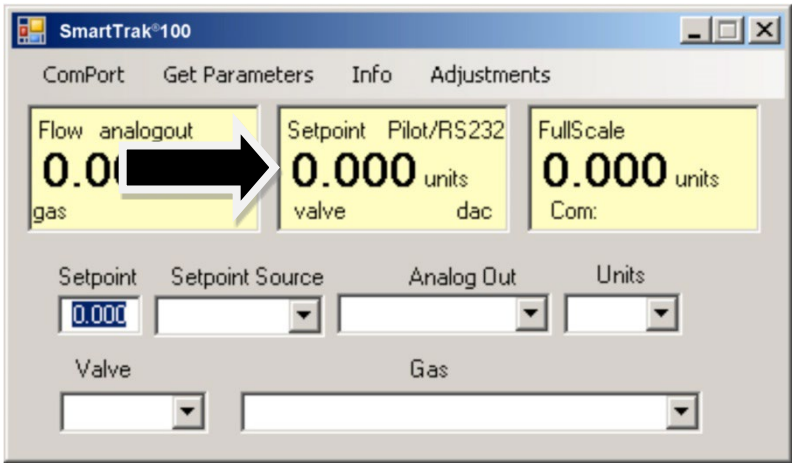
Flow

The box displays the mass flow rate, the engineering units, the gas choice and the analog output choice.



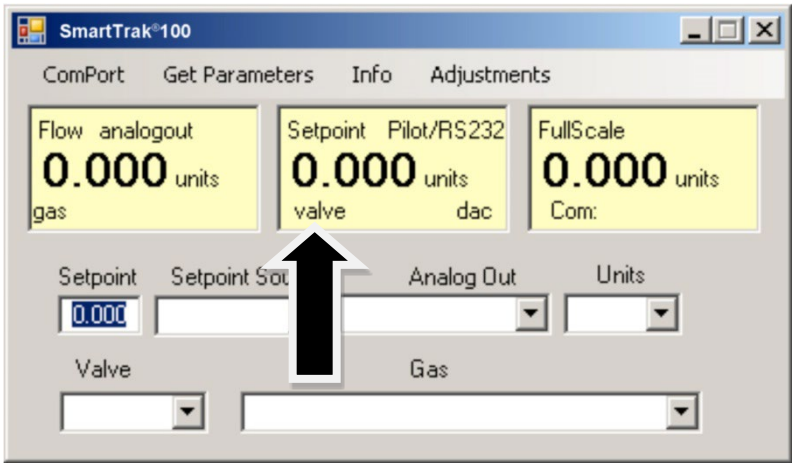
Setpoint

If you have a Mass Flow Meter, this box is zero (as shown above). The Setpoint box displays the current setpoint given to the flow controller, the engineering units, the source of the setpoint signal, the current valve state (open, closed or purge) and the dac values for the valve (for Sierra troubleshooting only).



	CAUTION: If this box does not show Pilot Module/RS-232 on the first line, you will not be able to give the controller a setpoint command from your computer. This is because your SmartTrak is expecting an analog setpoint at the 15-pin mini- D-connector. To supply a setpoint from your computer, see "Change Setpoint Source" on page 5-13.

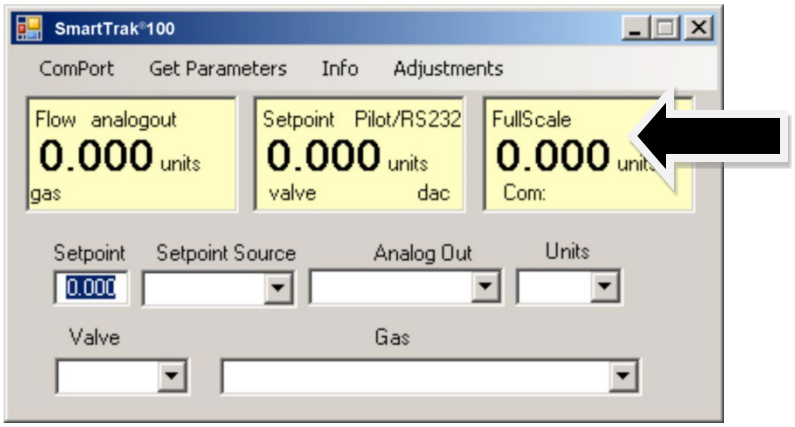
NOTE: If you have a Mass Flow Meter, this information can be bypassed. For normal operation of the flow controller, this line should display automatic. If this is visible, the instrument will automatically control flow as soon as a setpoint is given to it.



If this box does not display "Automatic," it will not be possible to control gas flow. Your valve is locked open (Purge) or closed (Closed). See the section titled "Change Valve Operation" below for further instructions

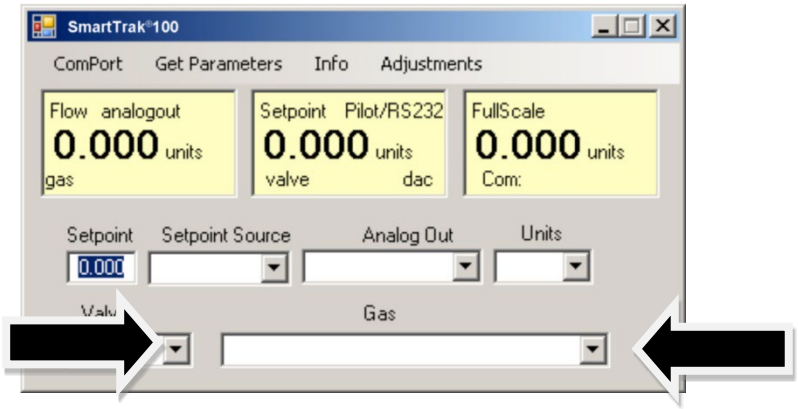
Full Scale

This screen displays the current full-scale value of the instrument with engineering units. It also displays the com port selected and a counter for the com port (for Sierra Troubleshooting only).



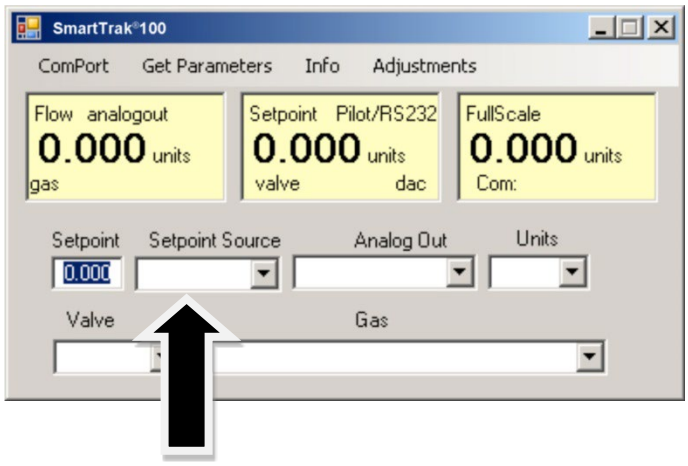
4.7 Lower Section of Software Window-Changing Parameters

Across the bottom half of the screen you will find a number of white boxes. Each box allows you to adjust one or more meter functions. The various functions are reviewed in the following section.



Change Setpoint Value (flow controllers only)

This is the box that allows you to change the setpoint of the mass flow controller. To make a change to the setpoint value, move your pointer to this box and left click. You may change a digit or delete the current setpoint and key in a new one. When you have made your selection, press the enter key to implement it.

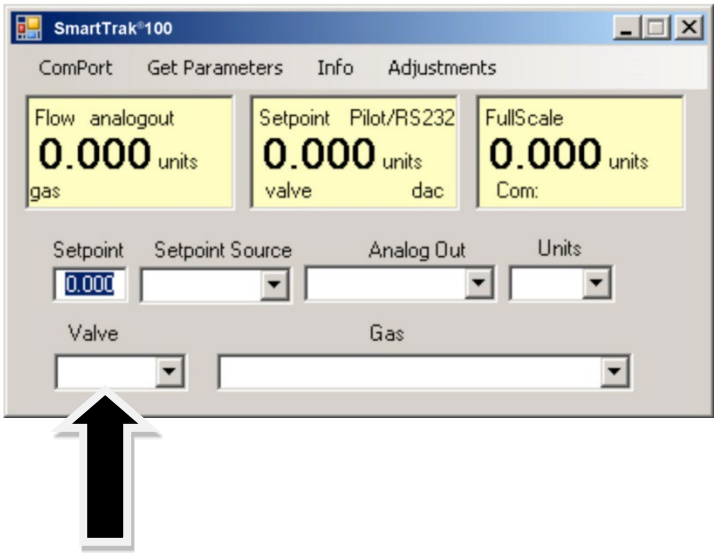


If, instead of using the RS-232 link, you prefer to supply analog set point signal to the SmartTrak, activate the pull-down menu. Make your selection carefully and click. Your selection will appear in the box and, after a few seconds, it will also appear in the yellow setpoint box.

	**WARNING:** If you change the source of the setpoint to one of the analog values, you will not be able to control your SmartTrak with your computer.

4.7.1 Change Valve Operation-Automatic, Close, Purge

This function enables or overrides any setpoint command given to the SmartTrak. At start-up, the box will show Automatic:

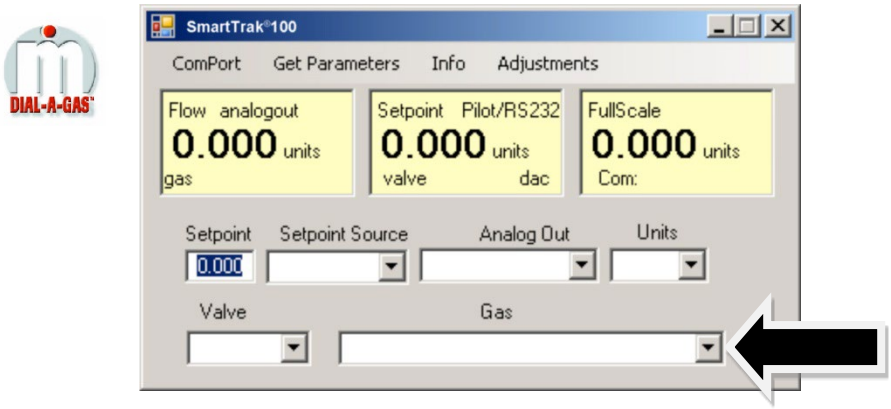


In this normal operating position, the valve is ready to control flow when it receives a setpoint from some source. Using this box, you may set the valve to open well beyond its normal maximum position ("Purge") or force the valve to remain shut regardless of setpoint ("Closed"). Use the pull down menu to make this change. Choose "purge" to fully open the valve regardless of the given setpoint or choose "closed" to override any setpoint command and close the valve.

	WARNING: Do not activate the valve state pull-down menus unless you are ready to make this change. Once in the pull-down menu, if you click on one of the selections, the valve operation will change immediately. Remember that the SmartTrak is not a positive shut-off device.

4.7.2 Change Gas (Dial-A-Gas®)

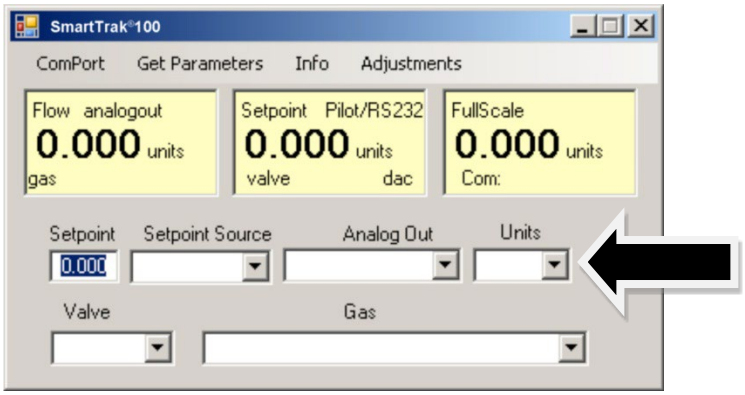
This box will display the current gas selection. If you wish to change the gas used in the instrument, activate the pull-down menu. The 10 gases programmed into the memory of your SmartTrak will be displayed.



Choose the correct gas for your current application and click. The new gas selection will appear in the box. Within a few seconds, the new gas selection will also appear in the yellow Flow box and the values of the mass flow, setpoint and the full scale will be adjusted for this new gas. This is normal. In some cases, where the thermal properties of one gas are very similar to another, these values may not change very much.

4.7.3 Change Units

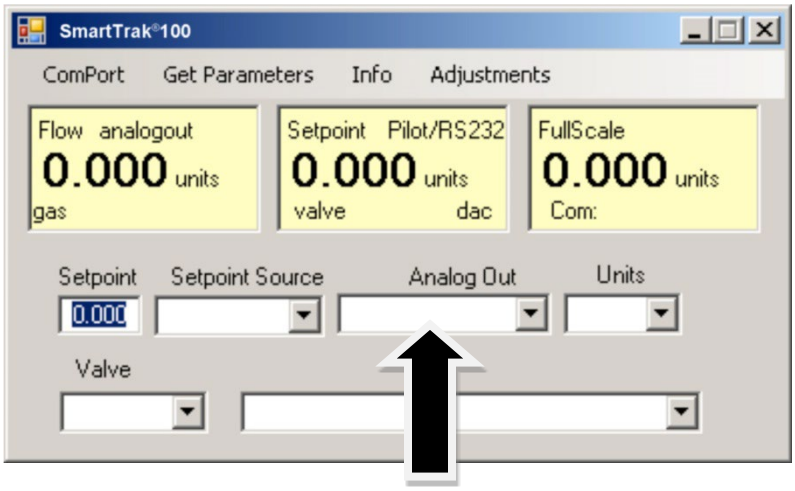
This box will show the current engineering units. Should you wish to change the engineering units, use the pull-down menu.



Make your selection, noting that each engineering unit is available with 3 different time constants: seconds, minutes and hours. Choose the combination of units and time constants you desire, then click. The box will display your new selection. Within a few seconds, the units will change in the Flow, Setpoint, and Full Scale boxes and the numerical values will be adjusted into the new units.

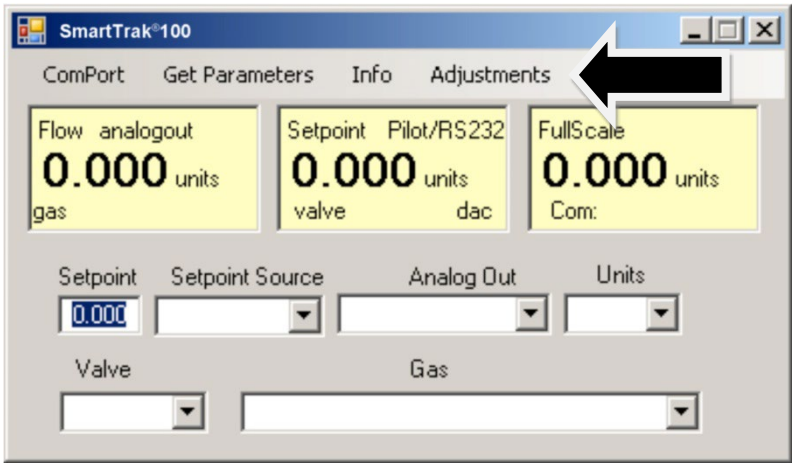
4.7.4 Change Analog Out

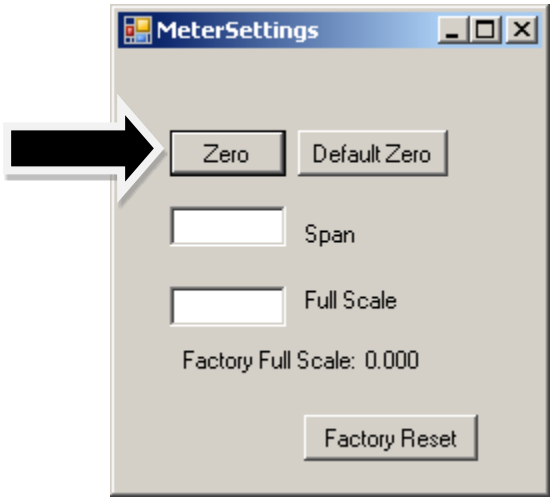
This box will show the two analog output signals currently selected for your instrument. To re-configure the analog output signals, use the pull-down and make your selection. The SmartTrak will adjust the analog output voltage signal per your instruction.



4.8 Adjustments

Clicking on “adjustments” brings up the meter settings screen.



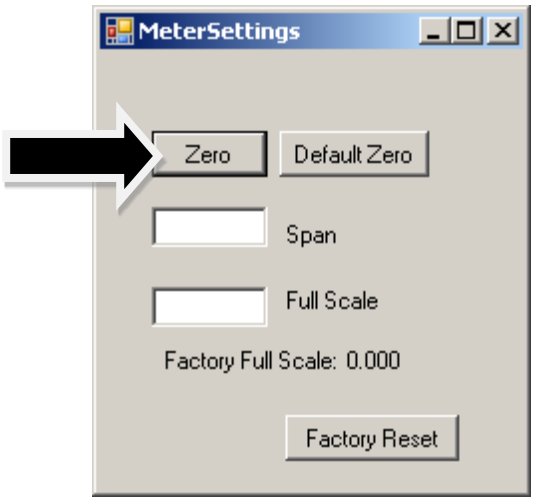


This screen allows for zeroing, spanning and adjusting the full scale for each of the 10 gases in the gas table individually. The screen will be displayed for the gas selected in the gas table on the main screen.

	CAUTION: The values in this screen can be set individually for each of the 10 gases. MODIFICATIONS of this screen will only be applicable to the gas displayed. To modify other gases, change the gas in the pull down menu and repeat.

4.8.1 Change Zero

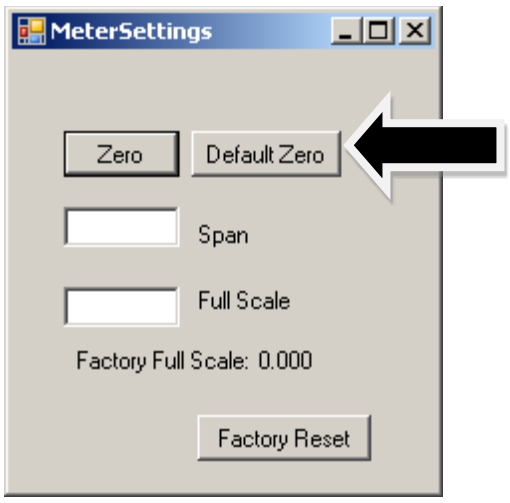
This button automatically zeros the meter.



To perform this zero procedure, you must make sure that the actual flow is zero. Attempting to zero the meter or controller while there is a flow condition will cause an offset. Also, the best zero is obtained by using the actual gas at the listed operating pressure.

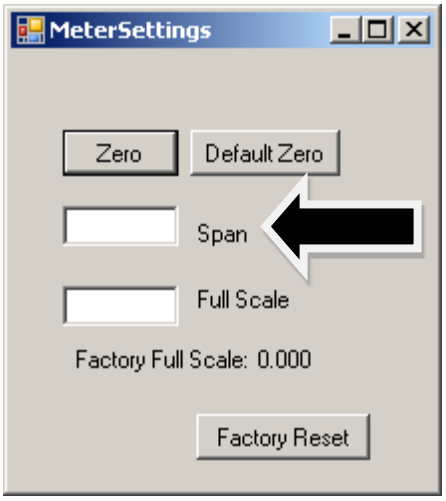
4.8.2 Default Zero

This will set the zero value back to factory conditions. Use this in order to recover from a mistaken entry.



4.8.3 Span

This allows the user to enter an offset to the span to adjust the meter outputs to match another device or field conditions. The span is a MULITPLIER and will multiply all outputs by the entered amount.

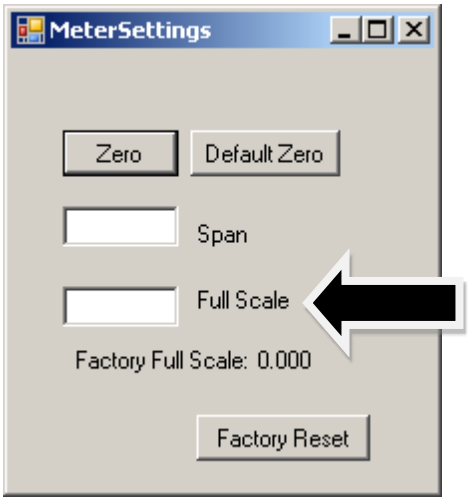


For example, the meter reads 98. The desired reading is 100. A span value of 1.02 will adjust the meter output to read 100.

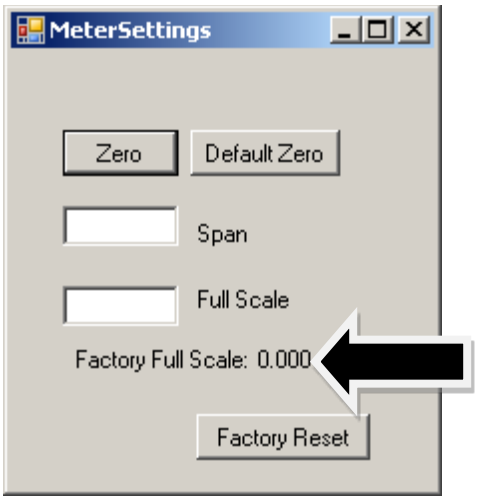
	CAUTION: This number should not be adjusted beyond 0.8 to 1.2.

This setting allows you to change the full scale of your instrument

4.8.4 Change Full Scale



The instrument will display its current full-scale value. If your instrument is new or this value has never been modified, the value displayed will be 100% of the maximum flow rate your SmartTrak can measure or control without factory re-calibration. This is the number listed here:

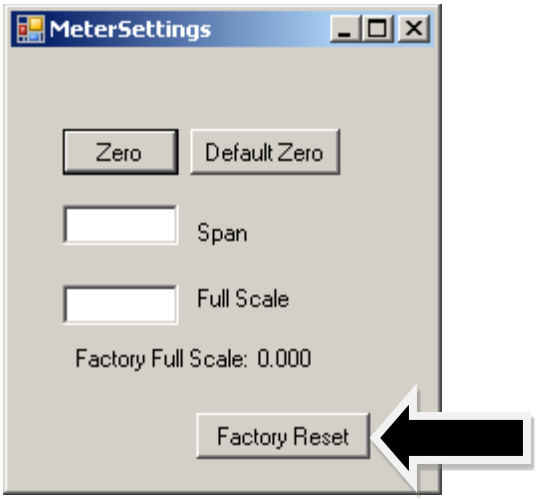


The instrument's maximum flow rate is also recorded on the data label (at the back of the instrument) and on the calibration certificate.

You may select any full-scale value between 100% and 50% of the maximum full-scale value. If you select a new full-scale value, it will re-define the analog outputs of the instrument. The 20 mA signal and the corresponding voltage signal (5 or 10 VDC) will now represent this new full-scale value.

To change the full-scale value of your device, modify one digit or erase the current value displayed and type in your desired full-scale value. When you are satisfied with your selection, press the enter key. The new full-scale value will appear in the white box. A few seconds later, the same value will appear in the yellow box in the upper half of the screen titled "Full Scale."

	WARNING: The Change Full Scale function allows you to re-range your instrument, but it is important to be aware of the limitations of this function. Changing beyond recommended values may require a new LFE or even flow body be installed. If in doubt, select factory reset and both zero and span values are reset to factory values.



Here are some guidelines to remember if you choose to modify the Full Scale Value: Changing the full-scale value of the instrument does not affect the accuracy of the measurement. Instrument accuracy is a percentage of the original factory full-scale value

If you enter a full-scale value beyond the instrument's calibrated maximum range, the SmartTrak will automatically modify the full-scale to equal the factory full-scale value. Below 1% of the original factory full-scale value for a meter and 2% for a controller, your SmartTrak is programmed to read zero because the error in the measurement may exceed the measurement itself.

4.9 Other Useful Features

There are several additional features that you may utilize via the SmartTrak Software. Across the top of the SmartTrak Master Screen, you can see these options:

Com Port
Read Parameters
Info

To use any of these functions, simply place the mouse pointer onto the name of the feature you wish and left click.

4.9.1 Com Port

To change the communication port for the SmartTrak, click on this feature. Use the pull down menu to choose the Comm Port that your SmartTrak's serial connector is plugged into. Remember that the software asks you to confirm your Comm Port every time you re-start. This feature is designed for situations when you have multiple Comm Ports available and you wish to move the SmartTrak from one to another or you are controlling more than one SmartTrak at one time.

4.9.2 Read Controller Parameters

Use this function if you believe your computer and your SmartTrak instrument may have stopped communicating. It is essentially a re-boot command for the SmartTrak microprocessor. When you switch Comm Ports, it is recommended that you use this function. If your computer requires a re-boot and you do not unplug your SmartTrak, the communication link will be broken. Use this function to re-establish communication. If at any time, the instrument does not appear to be sending correct information to the SmartTrak software, try this command to ensure communication.

4.9.3 Info

This gives information about the meter serial and software revisions.

5 Technical Support & Service

If you encounter any problem with your instrument, review the configuration information for each step of the installation, operation, and set up procedures as explained in this manual. Verify that your settings and adjustments are consistent with factory recommendations.

If the problem persists, Sierra is eager to help you. You may contact us at any of the following Technical Support Centers. It may also help to call your Sierra Sales Agent, who is also well trained in the operation and installation of the product.

When contacting Technical Support, make sure you have included the following information:

- The model number, flow range, serial number and Sierra order number (all marked on the instrument data label).
- The problem you are encountering and any corrective action taken.
- Application information (gas, pressure, temperature, pipe and fitting con-figuration

5.1 Sierra Customer Service Locations

USA World Headquarters

Monterey, California
TOLL FREE: 800-866-0200
PHONE: 831-373-0200
EMAIL: service@sierrainstruments.com

www.sierrainstruments.com

European Sales and Service Center

Egmond a/d Hoef, the Netherlands
PHONE: +31 72 5071400
EMAIL: service@sierra-instruments.nl

www.sierrainstruments.nl

Asia Sales and Service Center

Shanghai, Peoples Republic of China
PHONE: + 8221 5879 8521
www.sierra-asia.com

5.2 Returning Equipment to the Factory

5.2.1 Factory Calibration-All Models

Sierra Instruments maintains a fully-equipped calibration laboratory. All measuring and test equipment used in the calibration of Sierra transducers are traceable to NIST Standards. Sierra is ISO-9001 registered and conforms (but is not certified) to the requirements of ISO 17025.

5.2.2 Instructions for Returning Your Instruments for Service

The following information will help you return your instrument to Sierra Instruments' Factory Service Center and will ensure that your order is processed promptly. Prices may vary depending on the flow range, type of gas and operating pressure of your unit. To request a rough estimate of the pricing, contact your local Sierra Instruments distributor or contact one of our offices directly. A detailed quote will be provided following a full evaluation of your instrument.

5.2.3 Please follow these easy steps to return your instrument for factory service:

Obtain a Return Materials Authorization (RMA) number from the Sierra Instruments website at http://www.sierrainstruments.com/rma/login.php

If you require service beyond calibration, but do not know which service(s) will be required, describe the symptoms as accurately as possible on the RMA form.

Pack your instrument carefully. Use the original packaging and foam or bubble wrap (packing peanuts NOT recommended) and include a copy of the RMA form (complete with Sierra supplied RMA number) with the unit(s).

Ship the unit(s) to the following address:

Sierra Instruments, Inc.
Attention: Factory Service Center

5 Harris Court, Building L
Monterey, CA 93940 USA
RE: RMA# (your number)

Important Safety Note About Purging

	**WARNING:** When toxic or corrosive gases are used, purge unit thoroughly with inert dry gas before disconnecting from the gas line to prevent personnel from being injured when coming in contact with the instrument. Chapter 3 discusses how to purge your instrument.
	**WARNING:** If an instrument used with a toxic or corrosive gas is returned to the factory, a Material Safety Data Sheet (MSDS) must be enclosed & attached to the outside of the box to alert Sierra personnel of the potential hazard. Also, make sure the inlet & outlet are securely sealed.

6 Appendix A Gas Tables

6.1 MaxTrak Pre-Programmed Gases: Dial-A-Gas

The following gases have been programmed into the MaxTrak instrument in this order. If you are using one of these gases, you may use the Dial-A-Gas feature in the Software Package and the instrument will adjust the outputs automatically.

1. Air
2. Argon
3. CO2
4. CO
5. Helium
6. Hydrogen
7. Methane
8. Nitrogen
9. Nitrous Oxide
10. Oxygen

6.2 K-Factor Calculations-Using MaxTrak with Other Gases

If you will be using MaxTrak with a gas not on this list, you may use the tables below. They provide K-factors and thermodynamic properties of gases commonly used with mass flow meters and controllers. This is particularly useful if the actual gas is not a common gas or if it is toxic, flammable, corrosive, etc. The tables can also be used to interpret the reading of a flow meter or flow controller that has been calibrated with a gas other than the actual gas.

Before applying the tables, set the instrument for Air. Then, the following fundamental relationship may be used:

$$Q_1/Q_N = K_1/K_N$$

Where:

Q = The volumetric flow rate of the gas referenced to normal conditions of 0°C and 760 mm Hg (sccm or slm),

K = The K-factor from the following tables, referenced to Air

$( )_1$ = Refers to the “actual” gas, and

$( )_N$ = Refers to the “reference” gas, Air in this case.

6.3 Gas Tables and K-Factors

NOTE: If no O-ring material is specified then O-ring to be used is Viton. NEO is neoprene or equivalent. KR is DuPont Kalrez or equivalent. Valve Seat applies only to controllers.

Actual Gas	Chemical Symbol	K-factor Relative to Air	Cp (Cal/g)	Density (g/l) @ 70°F	Density (g/l) @ 0°C	Elastomers*	
						O-ring	Valve Seat
Acetylene	C_2H_2	0.581	0.4036	1.079	1.162	Viton®	Viton®
Air		1	0.24	1.2	1.293	Viton®	Viton®
Allene (Propadiene)	C_3H_4	0.431	0.352	1.659	1.787	Viton®	KR
Ammonia	NH_3	0.732	0.492	0.706	0.76	NEO	KR
Argon	Ar	1.398	0.1244	1.655	1.782	Viton®	Viton®
Arsine	AsH_3	0.671	0.1167	3.229	3.478	Viton®	KR
Boron Trichloride	BCl_3	0.411	0.1279	4.852	5.227	**Use 800 Series**	
Boron Trifluoride	BF_3	0.511	0.1778	2.808	3.025	Viton®	KR
Boron Tribromide	Br_3	0.381	0.0647	10.378	11.18	Viton®	KR
Bromine	Br_2	0.812	0.0539	6.619	7.13	Viton®	Viton®
Bromine Pentafluoride	BrF_5	0.261	0.1369	7.244	7.803	Viton®	KR
Bromine Trifluoride	BrF_3	0.381	0.1161	5.67	6.108	Viton®	KR
Bromotrifloromethane	$CBrF_3$	0.371	0.1113	6.168	6.644	Viton®	Viton®
(Freon-13 B1)						Viton®	Viton®
1,3-Butadiene	C_4H_6	0.321	0.3514	2.24	2.413	Viton®	Viton®
Butane	C_4H_{10}	0.261	0.4007	2.407	2.593	Viton®	Viton®
1-Butane	C_4H_8	0.301	0.3648	2.324	2.503	Viton®	Viton®
2-Butane	C_4H_8 CIS	0.325	0.336	2.324	2.503	Viton®	Viton®
2-Butane	C_4H_8 TRANS	0.292	0.374	2.324	2.503	Viton®	Viton®
Carbon Dioxide	CO_2	0.737	0.2016	1.835	1.964	90 D Viton®	ValFlex
Carbon Disulfide	CS_2	0.601	0.1428	3.153	3.397	Viton®	Viton®
Carbon Monoxide	CO	1.002	0.2488	1.16	1.25	Viton®	Viton®
Carbon Tetrachloride	CCl_4	0.311	0.1655	6.368	6.86	Viton®	KR
Carbon Tetrafluoride	CF_4	0.421	0.1654	3.645	3.926	Viton®	Viton®
(Freon-14)						Viton®	Viton®
Carbonyl Fluoride	COF_2	0.541	0.171	2.734	2.945	Viton®	Viton®
Carbonyl Sulfide	COS	0.661	0.1651	2.488	2.68	Viton®	Viton®
Chlorine	CL_2	0.862	0.114	2.936	3.163	**Use 800 Series**	
Chlorine Trifluoride	ClF_3	0.401	0.165	3.829	4.125	Viton®	KR
Chlorodifluoromethane (Freon-22)	$CHClF_2$	0.461	0.1544	3.581	3.858	Viton®	KR
Chloroform	$CHCl_3$	0.391	0.1309	4.944	5.326	Viton®	KR
Chloropentafluoroethane (Freon-115)	C_2ClF_5	0.241	0.164	6.398	6.892	Viton®	KR
Chlorotrifluromethane (Freon-13)	$CClF_3$	0.381	0.153	4.326	4.66	Viton®	KR

Actual Gas	Chemical Symbol	K-factor Relative to Air	Cp (Cal/g)	Density (g/l) @ 70°F	Density (g/l) @ 0°C	Elastomers*	
						O-ring	Valve Seat
Cyanogen	C_2N_2	0.611	0.2613	2.156	2.322	Viton®	KR
Cyanogen Chloride	CICN	0.611	0.1739	2.545	2.742	KR	KR
Cyclopropane	C_3H_5	0.461	0.3177	1.742	1.877	Viton®	KR
Deuterium	D_2	1.002	0.1722	1.67	1.799	Viton®	Viton®
Diborane	B_2H_6	0.441	0.508	1.147	1.235	Viton®	KR
Dibromodifluoromethane	CBr_2F_2	0.19	0.15	8.691	9.362	Viton®	KR
Dibromethane		0.471	0.075	7.204	7.76	Viton®	KR
Dichlorodifluoromethane (Freon-12)	CCl_2F_2	0.351	0.1432	5.008	5.395	Viton®	KR
Dichlorofluoromethane (Freon-21)	$CHCl_2F$	0.421	0.14	4.597	4.952	Viton®	KR
Dichloromethylsilane	$(CH_3)_2SiCl_2$	0.251	0.1882	5.345	5.758	Viton®	KR
Dichlorosilane	SiH_2Cl_2	0.401	0.15	4.183	4.506	Viton®	KR
Dichlorotetrafluoroethane (Freon-114)	$C_2Cl_2F_4$	0.22	0.1604	7.079	7.626	Viton®	KR
1,1-Difluoroethylene (Freon-1132A)	$C_2H_2F_2$	0.185	0.224	2.652	2.857	Viton®	KR
Dimethylamine	$(CH_3)_2NH$	0.371	0.366	1.867	2.011	Viton®	KR
Dimethyl Ether	$(CH_3)_2O$	0.391	0.3414	1.908	2.055	Viton®	KR
2,2-Dimethylpropane	C_3H_{12}	0.22	0.3914	2.988	3.219	Viton®	KR
Ethane	C_2H_6	0.501	0.4097	1.246	1.342	Viton®	Viton®
Ethanol	C_2H_6O	0.391	0.3395	1.908	2.055	Viton®	KR
EthylAcetylene	C_4H_6	0.321	0.3513	2.24	2.413	Viton®	KR
Ethyl Chloride	C_2H_5Cl	0.391	0.244	2.673	2.879	Viton®	KR
Ethylene	C_2H_4	0.601	~.358	1.161	1.251	Viton®	Viton®
Ethylene Oxide	C_2H_4O	0.521	0.268	1.824	1.965	**Use 800 Series**	
Fluorine	F_2	0.982	0.1873	1.574	1.695	**Viton**	
Fluoroform (Freon-23)	CHF_3	0.501	0.176	2.903	3.127	Viton®	KR
Freon-11	CCl_3F	0.331	0.1357	5.69	6.129	Viton®	KR
Freon-12	CCl_2F_2	0.351	0.1432	5.008	5.395	Viton®	KR
Freon-13	$CClF_3$	0.381	0.153	4.326	4.66	Viton®	KR
Freon-13	B1 $CFrF_3$	0.371	0.1113	6.168	6.644	Viton®	KR
Freon-14	CF_4	0.421	0.1654	3.645	3.926	Viton®	Viton®
Freon-21	$CHCl_2F$	0.421	0.14	4.597	4.952	Viton®	KR
Freon-22	$CHClF_2$	0.461	0.1544	3.581	3.858	Viton®	KR
Freon-113	CCl_2FCClF_2	0.2	0.161	7.761	8.36	Viton®	KR
Freon-114	$C_2Cl_2F_4$	0.22	0.16	7.079	7.626	Viton®	KR
Freon-115	C_2ClF_5	0.241	0.164	6398	6.892	Viton®	KR
Freon-C318	C_4F_8	0.17	0.185	7.795	8.397	NEO	NEO
Germane	GeH_4	0.571	0.1404	3.173	3.418	Viton®	Viton®
Germanium Tetrachloride	$GeCL_4$	0.271	0.1071	8.879	9.565	Viton®	KR
Helium	He	1.399	1.241	0.164	0.1786	Viton®	Viton®

Actual Gas	Chemical Symbol	K-factor Relative to Air	Cp (Cal/g)	Density (g/l) @ 70°F	Density (g/l) @ 0°C	Elastomers*	
						O-ring	Valve Seat
Hexafluoroethane (Freon-116)	C_2F_6	0.241	0.1834	5.716	6.157	Viton®	KR
Hexane	C_6H_{14}	0.18	0.3968	3.569	3.845	Viton®	KR
Hydrogen	H_2	1.001	3.419	0.083	0.0899	Viton®	Viton®
Hydrogen Bromide	HBr	1.002	0.0861	3.351	3.61	Viton®	KR
Hydrogen Chloride	HCl	1.002	0.1912	1.51	1.627	**Use 800 Series**	
Hydrogen Cyanide	HCN	1.072	0.3171	1.12	1.206		KR
Hydrogen Fluoride	HF	1.002	0.3479	0.829	0.893	**Use 800 Series**	
Hydrogen Iodide	HI	1.002	0.0545	5.298	5.707	Viton®	KR
Hydrogen Selenide	H_2Se	0.792	0.1025	3.354	3.613	Viton®	KR
Hydrogen Sulfide	H_2S	0.802	0.2397	1.411	1.52	NEO	KR
Iodine Pentafluoride	IF_5	0.251	0.1108	9.19	9.9	Viton®	KR
Isobutane	$CH(CH_3)_3$	0.271	0.3872	3.335	2.593	Viton®	KR
Isobutylene	C_4H_8	0.291	0.3701	2.324	2.503	Viton®	KR
Krypton	Kr	1.456	0.0593	3.471	3.739	Viton®	Viton®
Methane	CH_4	0.754	0.5328	0.665	0.715	Viton®	Viton®
Methanol	CH_3OH	0.581	0.3274	1.327	1.429	Viton®	Viton®
Methyl Acetylene	C_3H_4	0.431	0.3547	1.659	1.787	Viton®	KR
Methyl Bromide	CH_3Br	0.581	0.1106	3.932	4.236	Viton®	Viton®
Methyl Chloride	CH_3Cl	0.193	2.253	2.092		Viton®	KR
Methyl Fluoride	CH_3F	0.681	0.3221	1.409	1.518	Viton®	KR
Methyl Mercaptan	CH_3SH	0.521	0.2459	1.992	2.146	Viton®	KR
Methyl Trichlorosilane	$(CH_3)SiCl_3$	0.251	0.164	6.191	6.669	Viton®	KR
Molybdenum Hexafluoride	MoF_6	0.21	0.1373	8.695	9.366	Viton®	KR
Monoethylamine	$C_2H_5NH_2$	0.351	0.387	1.867	2.011	Viton®	KR
Monomethylamine	CH_3NH_2	0.511	0.4343	1.287	1.386	Viton®	KR
Neon	NE	1.463	0.245	0.836	0.9	Viton®	Viton®
Nitric Oxide	NO	0.992	0.2328	1.243	1.339	Viton®	Viton®
Nitrogen	N_2	1.002	0.2485	1.161	1.25	Viton®	Viton®
Nitrogen Dioxide	NO_2	0.742	0.1933	1.905	2.052	**Use 800 Series**	
Nitrogen Trifluoride	NF_3	0.481	0.1797	2.941	3.168	Viton®	KR
Nitrosyl Chloride	NOCl	0.611	0.1632	2.711	2.92	Viton®	KR
Nitrous Oxide	N_2O	0.716	0.2088	1.836	1.964	Viton®	
Octafluorocyclobutane (Freon-C318)	C_4F_8	0.17	0.185	7.795	8.397	Viton®	KR
Oxygen Difluoride	OF_2	0.631	0.1917	2.234	2.406	Viton®	Viton®
Oxygen	O_2	0.998	0.2193	1.326	1.427	Viton®	Viton®
Ozone	O_3	0.447	0.3	1.99	2.144	Viton®	Viton®
Pentaborane	B_5H_9	0.261	0.38	2.614	2.816	Viton®	KR
Pentane	C_5HI_2	0.21	0.398	2.988	3.219	Viton®	KR
Perchloryl Fluoride	ClO_3F	0.391	0.1514	4.243	4.571	Viton®	KR
Perfluoropropane	C_3F_8	0.174	0.197	7.787	8.388	Viton®	KR

Actual Gas	Chemical Symbol	K-factor Relative to Air	Cp (Cal/g)	Density (g/l) @ 70°F	Density (g/l) @ 0°C	Elastomers*	
						O-ring	Valve Seat
Phosgene	$COCl_2$	0.441	0.1394	4.101	4.418	Viton®	KR
Phosphine	PH_3	0.762	0.2374	1.408	1.517	Viton®	KR
Phosphorous Oxychloride	$POCl_3$	0.361	0.1324	6.352	6.843	Viton®	KR
Phosphorous Pentafluoride	PH_5	0.301	0.161	5.217	5.62	Viton®	KR
Phosphorous Trichloride	PCl_5	0.301	0.125	5.688	6.127	Viton®	KR
Propane	C_3H_8	0.335	0.3885	1.826	1.967	Viton®	Viton®
Propylene	C_3H_6	0.411	0.3541	1.742	1.877	Viton®	Viton®
Silane	SiH_4	0.601	0.3189	1.33	1.433	Viton®	KR
Silicon Tetrachloride	$SiCl_4$	0.281	0.127	7.037	7.58	Viton®	KR
Silicon Tetrafluoride	SiF_4	0.351	0.1691	4.31	4.643	Viton®	KR
Sulfur Dioxide**	SO_2	0.691	0.1488	2.653	2.858	Viton®	KR NOTE: Limited Warranty on SO_2
Sulfur Hexafluoride	SF_6	0.261	0.1592	6.049	6.516	Viton®	
Sulfuryl Fluoride	SO_2F_2	0.391	0.1543	4.235	4.562	Viton®	KR
Teos		0.09				**Use 800 Series**	
Tetrafluorahydrazine	N_2F_4	0.321	0.182	4.307	4.64	Viton®	KR
Trichlorofluormethane (Freon-11)	CCl_3F	0.331	0.1357	5.69	6.129	Viton®	KR
Trichlorisilane	$SiHCl_3$	0.331	0.138	5.61	6.043	Viton®	KR
1,1,2-Trichloro-1,2,2 Trifluorethane (Freon-113)	CCl_2FCClF_2	0.2	0.161	7.761	8.36	Viton®	KR
Trisobutyl Aluminum	$(C_4H_9)Al$	0.061	0.508	8.214	8.848	Viton®	KR
Titanium Tetrachloride	$TiCl_4$	0.271	0.12	7.858	8.465	Viton®	KR
Trichloro Ethylene	C_2HCl_3	0.321	0.163	5.523	5.95	Viton®	KR
Trimethylamine	$(CH_3)_3N$	0.281	0.371	2.45	2.639	Viton®	KR
Tungsten Hexasfuoride	WF_6	0.251	0.081	12.328	13.28	**Use 800 Series**	
Uranium Hexafluoride	UF_6	0.2	0.0888	14.574	15.7	Viton®	KR
Vinyl Bromide	CH_2CHBr	0.461	0.1241	4.43	4.772	Viton®	KR
Vinyl Chloride	CH_2CHCl	0.481	0.1205	2.588	2.788	Viton®	KR
Xenon	Xe	1.443	0.0378	5.438	5.858	Viton®	Viton®

7 Appendix B: 180 Product Specifications, Dimensions, and Mounting

2

PERFORMANCE SPECIFICATIONS

Accuracy
Standard: +/- 1.0% of full scale including linearity under calibration conditions
(+/- 2.0% of full scale for 180M from 201 to 300 slpm)

Dial-A-Gas
+/- 1.0% of full scale in all 10 standard gases

Repeatability
+/- 0.2% of full scale

Temperature Coefficient
+/- 0.025% of full scale per °F (0.05% of full scale per °C), or better

Pressure Coefficient
+/- 0.01% of full scale per psi (0.15% of full scale per bar), or better

Response Time
300 millisecond time constant; 2 seconds typical to within +/-2% of final value (includes settling time). Faster or slower available upon request.

OPERATION SPECIFICATIONS

Gases
Measures and controls all clean gases including corrosives and toxics; specify when ordering.
The following ten gases make up the Dial-A-Gas® feature of every SmartTrak instrument; up to nine alternate gases may be substituted.

TABLE 1: Dial-A-Gas

Flow Rate (slpm)	Maximum Flow Rate Standard Size (slpm)	Maximum Flow Rate High Flow Size (slpm)
Air	300	1000
Argon	435	1450
CO2	220	740
CO	302	1000
Methane	227	720
Helium	420	1454
Hydrogen	300	1000
Oxygen	300	1000
Nitrogen	300	1000
Nitrous Oxide (N2O)	215	710

Mass Flow Rates
180M Medium Flow Size: 0-10 to 0-300 slpm full scale
180H High Flow Size: 0-100 to 0-1000 slpm full scale
Flow range specified is for an equivalent flow of nitrogen at 760 mm Hg and 21°C (70°F); other ranges in other units are available (e.g., nlpm, scfh, NM^3/H, kg/H)

Gas Pressure
500 psig (34.5 barg) maximum, burst tested to 750 psig (52 barg)

Gas & Ambient Temperature
Gas: 32°F to 122°F (0°C to 50°C)
Ambient: -5 to 122°F (-20 to 50°C)

Leak Integrity
5 X 10-9 atm. cc/sec of helium maximum

Power Requirements (ripple should not exceed 100 mV peak-to-peak)
For All Mass Flow Meters: 15-24 VDC +/- 10%, (130 mA, regulated).
For Mass Flow Controllers:
C180M: 24 VDC +/- 10%, (700 mA, regulated)
C180H: 24 VDC +/- 10%, (1260 mA, regulated)

Control Range For Controllers
2 to 100% of full scale flow; automatic shut-off at 1.9 %

Output Signal
Analog:
Linear 4 to 20 mA, 500 ohms maximum loop resistance and one of the following (user selectable):
- Linear 0 to 5 VDC, 1000 ohms minimum load resistance
- Linear 0 to 10 VDC, 1000 ohms minimum load resistance
- Linear 1 to 5 VDC, 1000 ohms minimum load resistance

Digital:
- RS-232
- Modbus RTU

Command Signal
Analog (choice of one, user selectable):
- Linear 4–20 mA
- Linear 0–5 VDC
- Linear 0-10 VDC
- Linear 1-5 VDC

Digital:
- RS-232
- RS-485 optional

Physical Specifications
Wetted Material
316 stainless steel; 416 stainless steel; Viton® "O"-rings and valve seat standard
Other elastomers are available (consult factory).

OPERATION SPECIFICATIONS

3

Pressure Drop Across a Meter
Pressure must be above the values in the table below. Note that pressure increases with flow rate.

MINIMUM DIFFERENTIAL PRESSURE FOR AIR IN PSI (MBAR), METERS			
Flow Rate (slpm)	Standard Size (M180M) 3/8 or 1/2 inch fittings	High Flow Size Small Bore (M180H) (std up to 500 slpm) 1/2 comp fittings	High Flow Size Large Bore (M180H1, H2) (std 501 to 1000 slpm) 3/4 comp fittings
10	0.5 (34)	N/A	N/A
20	0.5 (34)	N/A	N/A
30	0.5 (34)	N/A	N/A
40	0.5 (34)	N/A	N/A
50	0.5 (34)	N/A	N/A
100	1.0 (68)	1.0 (68)	0.5 (34)
150	2.0 (136)	1.2 (81.6)	0.5 (34)
200	5.5 (374)	1.5 (102)	0.5 (34)
250	N/A	1.8 (122.4)	0.5 (34)
300	N/A	2 (136)	0.6 (408)
350	N/A	2.5 (170)	0.7 (476)
400	N/A	3 (204)	0.9 (612)
450	N/A	3.5 (238)	1.1 (748)
500	N/A	4 (272)	1.3 (884)
750	N/A	N/A	3.0 (204)
1000	N/A	N/A	5.0 (340)

Differential Pressure Requirement for Controllers (lower or higher available upon request)
Optimum: 30 to 60 psi (2 to 4 bar)
Minimum: See chart below. Note that required pressure increases with flow rate.

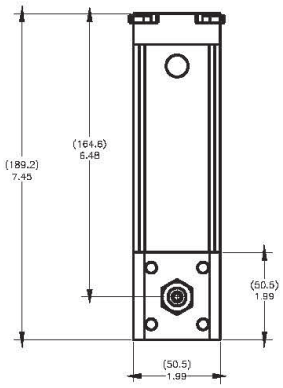
MINIMUM DIFFERENTIAL PRESSURE FOR AIR IN PSI (MBAR), CONTROLLERS			
Flow Rate (slpm)	Standard Size (C180M) 3/8 or 1/2 inch fittings	High Flow Size Small Bore (M180H) (std up to 500 slpm) 1/2 comp fittings	High Flow Size Large Bore (M180H1, H2) (std 501 to 1000 slpm) 3/4 comp fittings
10	N/A	N/A	N/A
20	1 (68)	N/A	N/A
30	1.2 (82)	N/A	N/A
40	1.6 (110)	N/A	N/A
50	2 (136)	N/A	N/A
100	5 (340)	1.5 (102)	1.0 (68)
150	10 (680)	2 (136)	1.0 (68)
200	15 (1020)	4.5 (306)	1.0 (68)
250	20 (1360)	5.5 (374)	1.5 (102)
300	25 (1700)	6.5 (442)	2.0 (136)
350	N/A	8.5 (578)	3.0 (204)
400	N/A	10.5 (714)	4.0 (272)
450	N/A	13 (884)	5.0 (340)
500	N/A	15 (1020)	6.0 (408)
750	N/A	N/A	15 (1020)
1000	N/A	N/A	20 (1360)

4 PHYSICAL DIMENSIONS

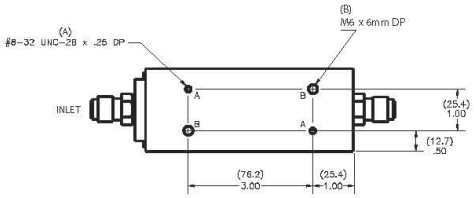
All dimensions are in inches with mm in brackets. Certified drawings are available on request.

M180M, M1 and C180M, M1 Front View

M180M, M1 and C180M, M1 Side View



M180M, M1 and C180M, M1 Bottom View

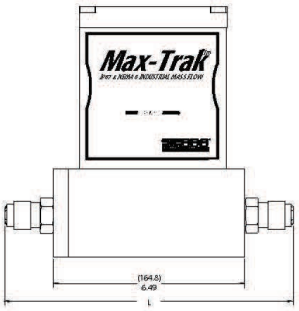


DIMENSION L					
Fittings	Length with fittings in inches (mm)				
Flow Rate (slpm)	C180/M180M	M180H	M180H1, H2	C180H	C180H1, H2
1/8 compression	N/A	N/A	N/A	N/A	N/A
1/4 compression	7.27 (186)	N/A	N/A	N/A	N/A
3/8 compression	7.39 (189)	N/A	N/A	N/A	N/A
1/2 compression	7.55 (194)	8.92 (229)	N/A	10.37 (266)	N/A
1/4 VCO	6.81 (175)	N/A	N/A	N/A	N/A
3/4 VCO	7.25 (186)	8.56 (220)	N/A	10.01 (267)	N/A
1/4 VCR	N/A	N/A	8.78 (225)	N/A	11.28 (289)
1/2 VCR	7.13 (183)	N/A	N/A	N/A	N/A
6 mm compression	7.43 (191)	9.00 (231)	N/A	10.45 (268)	N/A
10 mm compression	7.63 (196)	N/A	N/A	N/A	N/A
12 mm compression	7.10 (182)	N/A	N/A	10.35 (265)	N/A
1/4 FNPT	7.25 (186)	8.90 (228)	N/A	N/A	N/A
3/8 FNPT	N/A	N/A	N/A	N/A	N/A
1/2 FNPT	N/A	N/A	N/A	10.59 (272)	N/A
3/4 FNPT	N/A	9.14 (234)	9.30 (238)	N/A	11.30 (290)
3/4 compression	N/A	N/A	9.18 (235)	10.69 (274)	11.68 (300)
1 inch compression	N/A		9.52 (244)	N/A	12.02 (308)

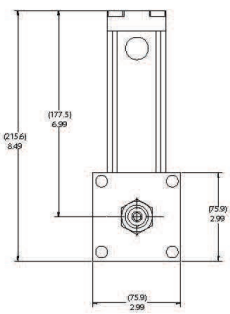
PHYSICAL DIMENSIONS (CONTINUED) 5

All dimensions are in inches with [mm] in brackets. Certified drawings are available on request.

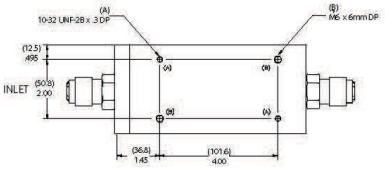
M180H, H1, H2 Front View



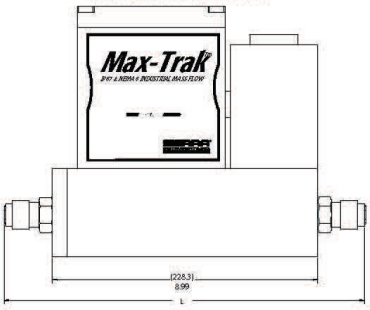
M180H, H1, H2 Side View



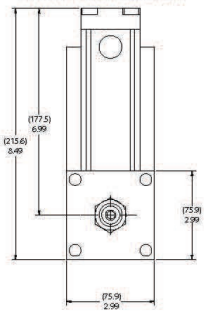
M180H, H1, H2 Bottom View



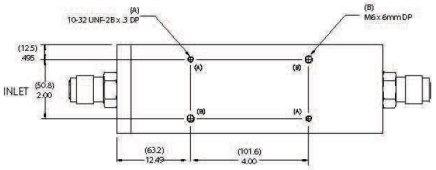
C180H, H1, H2 Front View



C180H, H1, H2 Side View



C180H, H1, H2 Bottom View



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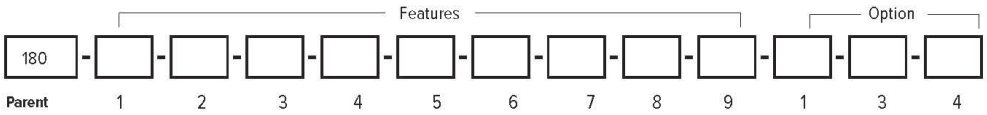
ORDERING THE MAX TRAK 180



Instructions: To order a 180 please fill in each number block by selecting the codes from the corresponding features below and following pages.

Parent Number	
M180	NEMA 6 / IP67 Compliant Industrial Mass Flow Meter, digital high performance with Dial-A-Gas®
C180	NEMA 6 / IP67 Compliant Industrial Mass Flow Controller, digital high performance with Dial-A-Gas

Feature 1:Flow Body Size*			
M180M	Standard NEMA 6 flow meter. 0-10 slpm up to 0-200 slpm	**C180M**	Standard NEMA 6 flow controller. 0-10 slpm up to 0-200 slpm
M180H	High flow NEMA 6 meter. 0-100 to 0-500 slpm full scale	**C180H**	High flow NEMA 6 controller. 0-100 to 0-500 slpm full scale
M180H1	High flow NEMA 6 meter. 0-501 to 0-800 slpm.	**C180H1**	High flow NEMA 6 controller. 0-501 to 0-800 slpm.
M180H2	High flow NEMA 6 meter. 0-801 to 0-1000 slpm.	**C180H2**	High flow NEMA 6 controller. 0-801 to 0-1000 slpm.

Note: All slpm flow ranges also available in nlpm
* Flow bodies are sized for nitrogen flow rates. Other gases must be converted to equivalent nitrogen flow. Use K-Factor and size accordingly.

Feature 2: Pilot Module Display /Interface	
NR	No display interface available
MB	RS-485 communication featuring Modbus protocol installed inside the enclosure

Feature 3: Inlet / Outlet Fittings			
3	3/8-inch compression (standard for 30 to 300 slpm). For medium bodies. (maximum 300 slpm)	**13**	1/4-FNPT adapter bushing (maximum 200 slpm). For med flow bodies
4	1/2-inch compression For all flow bodies up to 500 slpm. Above 500 slpm contact factory	**14**	3/8 FNPT. For medium flow bodies only
6	1/2-inch VCO. For medium flow bodies	**15**	1/2 -FNPT. For high flow bodies up to 500 slpm.
7	3/4-inch VCO. For H, H1, and H2 high flow bodies only	**16**	3/4-FNPT. For H1 and H2 high flow bodies only.
9	1/2-inch VCR. For all flow bodies up to 500 slpm. Above 500 slpm contact factory.	**17**	3/4-inch compression. For H, H1, and H2 flow bodies only.
11	10 mm compression. For medium bodies. (maximum 300 slpm)	**18**	1-inch compression. For H1 and H2 high flow bodies only.
12	12 mm compression. For all flow bodies up to 500 slpm. Above 500 slpm contact factory		

Feature 3A: For H, H1 and H2 only	
F2	1/2-inch ANSI class 150 flange, 316L
F3	3/4-inch ANSI class 150 flange, 316L
F4	1-inch ANSI class 150 flange, 316L
G2	1/2-inch ANSI class 300 flange, 316L
G3	3/4-inch ANSI class 300 flange, 316L
G4	1-inch ANSI class 300 flange, 316L
FD3	DN20/PN16 flange, 316L
FD4	DN25PN16 flange, 316L
GD3	DN20/PN40 flange, 316L
GD4	DN25PN40 flange, 316L

Feature 4: Flow Body Elastomers	
OV1	Viton® (Standard)
OV1-F	Viton® (Required for phosphine only)
ON1	Neoprene®
90D-M	90D Viton® for CO2 only
90D-H	90D Viton® for CO2 only

Note: Consult factory for other elastomers.

Feature 5: Valve Seat (MFC only)			
SV1	Viton®	**VX2 (MEDIUM FLOW ONLY)**	ValFlex™ required for CO2 . Use CO2 Elastomer Compatibility Concentration vs. Pressure application tool to determine required elastomers for MFC valve seat.
SN1	Neoprene® (or equivalent)	**VX3 (HIGH FLOW ONLY)**	ValFlex™ required for CO2 . Use CO2 Elastomer Compatibility Concentration vs. Pressure application tool to determine required elastomers for MFC valve seat.
SK2	Kalrez® (or equivalent for medium flow bodies)		
SK3	Kalrez® (or equivalent for high flow bodies)		

Feature 6: Input Power	
PV1M	15-24 VDC for meters (optional)
PV2	24 VDC for all instruments (standard)

Feature 7: Output Signal	
V1	0-5 VDC and 4-20 mA linear output signals
V2	1-5 VDC and 4-20 mA linear output signals
V3	0-10 VDC and 4-20 mA linear output signals

Note: Alternate among V1, V2, V3 with Smart-Trak Software

ORDERING THE SMART TRAK 180 (continued)

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Feature 8: External Setpoint Signal (MFC only)			
S0	RS-232 (standard fordigital operation)	S3	0-10 VDC, linear
S1	0-5 VDC, linear (standard for analog operation)	S4	4-20 mA, linear
S2	1-5 VDC, linear	S5	0-20 mA, linear

Note: Alternate among S0, S1, S2, S3, S4, S5 with Smart-Trak Software

Feature 9: Electrical Connection	
COND	1/2-inch FNPT port for conduit (standard) NOTE: Customer must supply own cable.
GLAND	Cable gland (wire diameter 5-9 mm required) NOTE: Customer must supply own cable.
WT	Water tight quick-connector installed in housing, pre-wired at Sierra. Allows "plug and play" installation. Must select mating cable from accessories below

Option 1: Special Cals	
GS	Gas substitution. One or more gases or mixtures may be substituted for 9 of the standard Dial-A-Gas gases. See Application Data Sheet for specifics.

Option 3: Certificates	
MC	Material Certificates--US Mill certs on all wetted flow body parts
CC	Certificate of Conformance

Option 4: O2 Cleaning	
O2C	O2 Cleaning. Includes certification. Product cleaned for O2 service. Inspected with ultra-violet light and double-bagged prior to shipment.

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7.1 Optional Parts & Accessories

The following optional accessories are available from your Authorized Sierra Instruments Representative or directly from Sierra Instruments. They are pro-vided to improve your experience with the SmartTrak Series 100 Mass Flow Meters and Controllers. Call or write for current pricing and availability.

Description	Order Code
Power Supply with fly leads (bare wires), USA plug 100	T8F
Communication cable for WT option —6 foot	C6
Communication cable for WT option—20 foot	C20
Communication cable for WT option —33 foot	C33
Communication cable for WT option —Custom length	C ( )
(specify length in brackets)	

7.2 Ordering Parts & Accessories

Email Customer Service: service@sierrainstruments.com

FACTORY USA:

PHONE: +1-831-373-0200

EMAIL: service@sierrainstruments.com

European Sales & Service Center:

PHONE: +31 72 5071400

EMAIL: service@sierrainstruments.nl

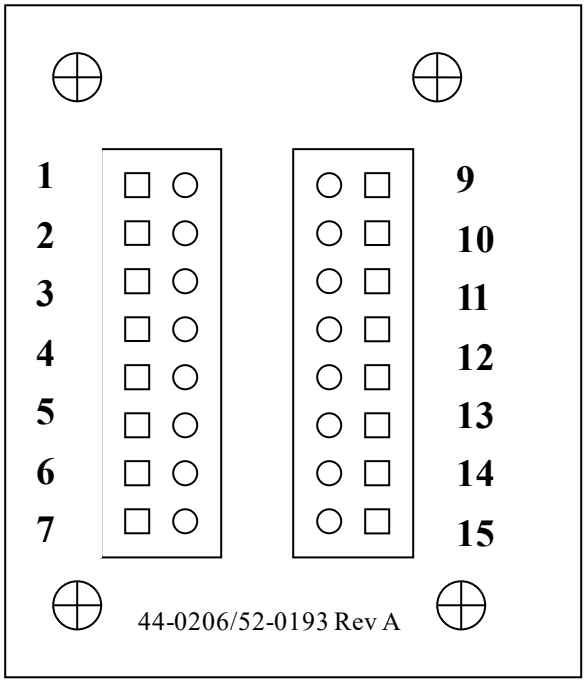
Asia Sales & Service Center:

PHONE: + 8221 5879 8521

EMAIL: www.sierra-asia.com

8 Appendix C: PIN Configuration and Wiring Diagram

Terminal Strip PCA Pin Configuration (inside the enclosure)



Wiring Functions, Location and Color Codes

Pin #	Function	Wire Color with optional WT cable
1.	Analog Ground	Brown
2.	0-5 VDC Output (or 0-10, 1-5 VDC	Red
3.	Analog Ground	Orange
4.	Valve Override (purge)	NOT CONNECTED
5.	Power Return (-)	Yellow
6.	Power Input (+)	Green
7.	RS-232 Transmit (out)	Purple
8.	Setpoint	Blue
9.	Not Used	NOT CONNECTED
10.	Analog Ground	Gray
11.	Reference Voltage (5 VDC External Setpoint & Valve Purge)	NOT CONNECTED
12.	Valve Override (close)	Black
13.	RS-232 Receive (in)	Pink
14.	4-20 mA Output	White
15.	Chassis (Earth) Ground	Tan (light Brown)
16.	Not Used	NOT CONNECTED

NOTE Sierra recommends individual wires from pins 1, 3, 5, and 10 to power supply ground.

2

PERFORMANCE SPECIFICATIONS

Accuracy
Standard: +/- 1.0% of full scale including linearity under calibration conditions
High Accuracy Calibration: Contact Sierra

Dial-A-Gas
+/- 1.0% of full scale in all 10 standard gases

Repeatability
+/- 0.2% of full scale

Temperature Coefficient
+/- 0.025% of full scale per °F (0.05% of full scale per °C), or better

Pressure Coefficient
+/- 0.01% of full scale per psi (0.15% of full scale per bar), or better

Response Time
300 millisecond time constant; 2 seconds typical to within +/-2% of final value (includes settling time). Faster or slower available upon request.

OPERATING SPECIFICATIONS

Gases
All clean gases including toxics and corrosives; specify when ordering

Mass Flow Rates
The following 10 gases make up the Dial-A-Gas® feature of every MaxTrak® instrument; up to 9 alternate gases may be substituted. Flow range specified is for an equivalent flow of nitrogen at 760 mm Hg and 21°C (70°F); other ranges in other units are available.

Dial-A-Gas®	
Gas	Maximum Flow (slpm)
Air	1000
Argon (Ar)	1450
Carbon Dioxide (CO_2)	740
Carbon Monoxide (CO)	1000
Methane (CH_4)	720
Helium (He)	1454
Hydrogen (O_2)	1000
Oxygen (N_2)	1000
Nitrogen)N_2O)	1000
Nitrous Oxide (N_2O)	710

Output Signals - Analog:
Linear 4 to 20 mA, 500 ohms maximum loop resistance and one of the following (user selectable):
Linear 0 to 5 VDC, 1000 ohms minimum load resistance
Linear 0 to 10 VDC, 1000 ohms minimum load resistance
Linear 1 to 5 VDC, 1000 ohms minimum load resistance

Output Signals -Digital:
RS-232 standard
RS-485 MODBUS optional

Command Signal - Analog (choice of one):
Linear 4 to 20 mA, 0 to 5, 0 to 10, 1 to 5 VDC

Command Signal - Digital
RS-232
RS-485 MODBUS optional

OPERATING SPECIFICATIONS (CONTINUED)

Gas & Ambient Temperature
Gas: 32 to 122°F (0 to 50°C)
Ambient: -5 to 122°F (-20 to 50°C)

Gas Pressure
Maximum: 500 psig (34.5 barg) maximum, burst tested to 750 psig (51.7 barg)

Pressure Drop Across a Meter
Pressure must be above the values in the table below. Note that pressure increases with flow rate.

Pressure Drop Across Meter, psi (mbar)	
Flow Rate (slpm)	Insertion Pressure Drop
100	0.5 (34)
200	0.5 (34)
300	0.6 (41)
400	0.9 (61)
500	1.3 (88)
750	3.0 (204)
1000	5.0 (340)

Differential Pressure Requirement for Controllers
Optimum: 30 to 60 psid (2 to 4 bard)
Minimum: See chart below.

Minimum Differential Pressure for Controllers, Air	
Flow Rate (slpm)	Minimum Pressure, psi (mbar)
100	1.0 (68)
200	1.0 (68)
300	2.0 (136)
400	4.0 (272)
500	6.0 (408)
750	15 (1020)
1000	20 (1360)

Note: Tested at 21°C, outlet at 14.7 psia

Leak Integrity
Flanges mounted via 1 inch Swagelok® compression fittings, for convenience.
5 X 10^{-9} atm cc/sec of helium maximum

Power Requirements (ripple should not exceed 100 mV peak-to-peak)
For Mass Flow Meters (M180): 15 to 24 VDC +/- 10%, (130 mA, regulated) 1.25 Amps output
For Mass Flow Controllers (C180):
C180H: 24 VDC +/- 10%, (1260 mA, regulated)

Control Range (Mass Flow Controllers)
2 to 100% of full scale flow; automatic shut-off at 1.9%.

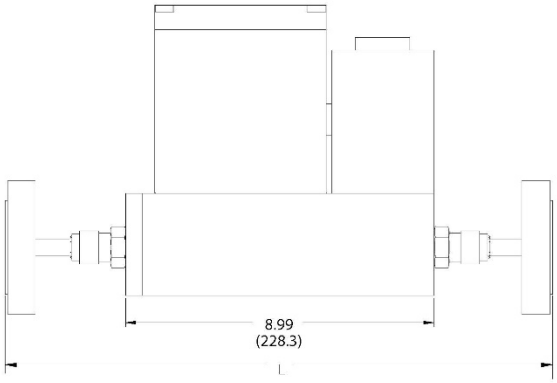
PHYSICAL SPECIFICATIONS

Wetted Material
316 stainless steel; 416 stainless steel; Viton® "O"-rings and valve seat standard
Other elastomers are available (consult factory).

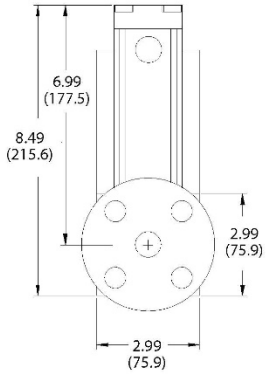
SUITABLE LOCATIONS

3

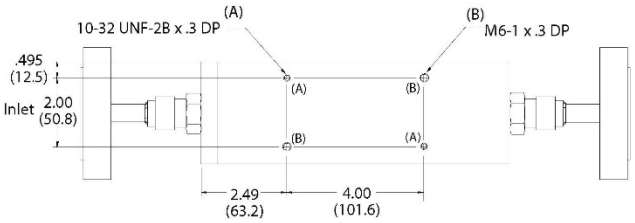
MaxTrak® Flanged - Front View



MaxTrak® Flanged - Side View



Max-Trak® Flanged - Bottom View



Dimension (L)	
Flange Option	**Inches (mm)**
1/2" 150#	14.87 (377.6)
3/4" 150#	14.75 (374.6)
1" 150	14.55 (369.5)
1/2" 300#	14.87 (377.6)
3/4" 300#	14.75 (374.6)
1" 300#	14.55 (369.5)
DN20/PN14	14.75 (374.6)
DN25/PN16	14.55 (369.5)
DN20/PN40	15.64 (397.32)
DN25/PN40	15.787 (401)

4

ORDERING THE MAXTRAK 180 + FLANGES

Features Option

Parent	1	2	3	4	5	6	7	8	9	1	2	3

Instructions: To order a MaxTrak please fill in each number block by selecting the codes from the corresponding features belows.

Parent Number	
M180	NEMA 6 / IP67 Compliant Industrial Mass Flow Meter, digital high performance with Dial-A-Gas®
C180	NEMA 6 / IP67 Compliant Industrial Mass Flow Controller, digital high performance with Dial-A-Gas

Feature 1: Flow Body Size*			
M180H1	High flow NEMA 6 meter. 0-501 to 0-800 slpm.	C180H1	High flow NEMA 6 controller. 0-501 to 0-800 slpm.
M180H2	High flow NEMA 6 meter. 0-801 to 0-1000 slpm.	C180H2	High flow NEMA 6 controller. 0-801 to 0-1000 slpm.

Note: All slpm flow ranges also available in nlpm *Flow bodies are sized for nitrogen flow rates. Other gases must be converted to equivalent nitrogen flow. Use K-Factor and size accordingly.

Feature 2: Display			
NR	No display available	MB	RS-485 communication featuring Modbus protocol installed inside the enclosure

Feature 3A: Flanges	
F2	1/2-inch ANSI class 150 flange, 316L
F3	3/4-inch ANSI class 150 flange, 316L
F4	1-inch ANSI class 150 flange, 316L
G2	1/2-inch ANSI class 300 flange, 316L
G3	3/4-inch ANSI class 300 flange, 316L
G4	1-inch ANSI class 300 flange, 316L
FD3	DN20/PN16 flange, 316L
FD4	DN25PN16 flange, 316L
GD3	DN20/PN40 flange, 316L
GD4	DN25PN40 flange, 316L

Feature 4: Body Elastomers	
OV1	Viton® (Standard). Note: Consult factory for other elastomers
ON1-F	Neoprene® (Required for phosphine only)
ON1	Neoprene®
90D-M	90D Viton® for CO_2 only
90D-H	90D Viton® for CO_2 only

Note: Consult factory for other elastomers.

Feature 5: Valve Seat (MFC Only)	
SV1	Viton®
SN1	Neoprene® (or equivalent)
SK2	Kalrez® (or equivalent for medium flow bodies)
SK3	Kalrez® (or equivalent for high flow bodies)
VX2	Medium flow only. ValFlex™ required for CO_2
VX3	High flow only. ValFlex™ required for CO_2

Note: VX2, VX3: ValFlex™ required for CO_2 . Use CO_2 Elastomer Compatibility Concentration vs. Pressure application tool to determine required elastomers for MFC valve seat

Feature 6: Input Power	
PV1M	15-24 VDC for meters (optional)
PV2	24 VDC for all instruments (standard)

Feature 7: Output Signal	
V1	0-5 VDC and 4-20 mA linear output signals
V2	1-5 VDC and 4-20 mA linear output signals
V3	0-10 VDC and 4-20 mA linear output signals

Note: Alternate among V1, V2, V3 with Smart-Trak Software

Feature 8: External Setpoint Signal (MFC Only)	
S1	0-5 VDC, linear (standard for analog operation)
S2	1-5 VDC, linear
S3	0-10 VDC, linear
S4	4-20 mA, linear
S5	0-20 mA, linear

Note: Alternate among S1, S2, S3, S4, S5 with Smart-Trak Software

Feature 9: Electrical Connection	
COND	1/2-inch FNPT port for conduit (standard) NOTE: Customer must supply own cable.
GLAND	Cable gland (wire diameter 5-9 mm required) NOTE: Customer must supply own cable.

Option 1: Special Cals	
GS	Gas substitution. One or more gases or mixtures may be substituted for 9 of the standard Dial-A-Gas gases. See Application Data Sheet for specifics.

Option 2: Certificates	
MC	Material Certificates--US Mill certs on all wetted flow body parts
CC	Certificate of Conformance
CO	Stamped Certificate of Origin

Option 3: O2 Cleaning	
O2C	O2 Cleaning. Includes certification. Product cleaned for O2 service. Inspected with ultra-violet light and double-bagged prior to shipment.

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180 Flanged E 06/22