MODEL CM-400

Mass Flow Instrument Control Module

FM-1179 Rev. C

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1.0 GENERAL INFORMATION

1.1 Introduction

The Porter CM-400 is a versatile measurement and control device designed specifically to interface with Porter Mass Flow Meters (MFM) and Mass Flow Controllers (MFC). It has the capability to provide the required power and user selected set point for up to four (4) Mass Flow Controllers, while displaying the feedback flow signal from each MFC. The set point and flow signal can be programmed to several standard values, and the signals can be scaled to read in multiple engineering units. Additionally, a gas correction factor can be programmed to facilitate the use of gases other than the MFC nameplate gas.

The CM-400 provides ease of use and maximum versatility. Batch and blend control functions can be easily programmed on all channels and an RS-232 communication port is available for direct digital interface. When coupled with Porter 100 and 200 Series Mass Flow Controllers, the CM-400 provides a flexible, cost-effective solution for many critical gas control applications.

1.2 Instrument Overview

The Model CM-400 functions as a power supply, indicator, and set-point controller for Porter 100 and 200 Series thermal MFM's and MFC's. The instrument provides indication of flow rate, total and set-point.

Up to four MFC's can be connected directly to the back of the CM-400 using 15 pin D-connectors. The CM-400 will function with and power both current and voltage signal analog MFC's with a +15 Vdc power requirement.

Setup and operation is performed via the keypad on the front panel or serially. Intuitive menu navigation allows the user to quickly configure flow ranges in selected units that directly correspond to analog signal levels. A gas correction factor can be programmed by the operator during setup allowing the user to adapt the CM-400 to any non-calibrated gas.

1.3 Indicators & Operator Controls

The CM-400 features a large, high-contrast, backlit graphic display allowing for a user to view the real-time process rate and the programmed set-point for each mass flow device. This ability enables the user to rapidly identify and make in-process adjustments in seconds if needed. The display and audio indicators provide the user immediate status for quantities, rates, and diagnostic operating status.

1.4 Communication

As a standard component, the CM-400 includes an RS-232 port providing serial communication capability. Communications provide for command, control functions, and data acquisition.

1.5 Diagnostics

Automatic built-in diagnostic tests support easy installation and assist in ensuring a long, trouble-free operating life. These tests include overall system operating status, memory conditions, communication adapter status, and proper operation of the display and audio functions.

1.6 Installation

The CM-400 includes a standard desk mounting kit. The assembly diagram is shown below in Figure 1. An optional panel mounting kit is available. The panel mount cutout dimensions are shown in Figure 2 below.

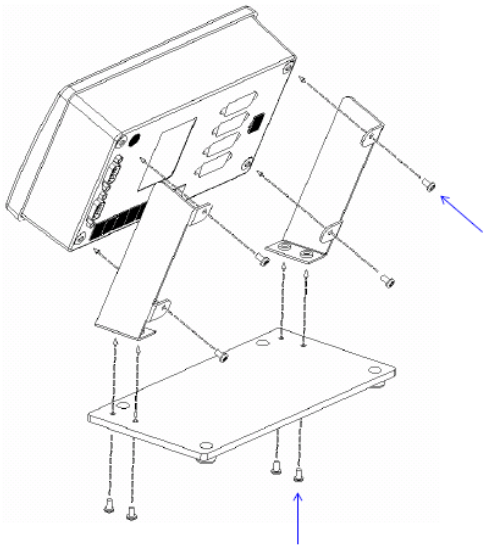

Figure 1: Drawing depicting the assembly of CM-400 with standard desk mounting kit.

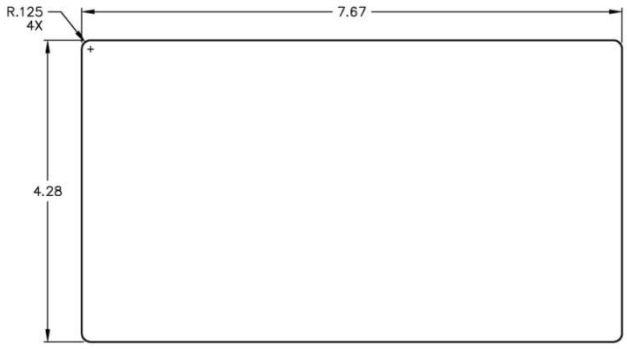

Figure 2: Cutout dimensions of the optional panel mounting kit.

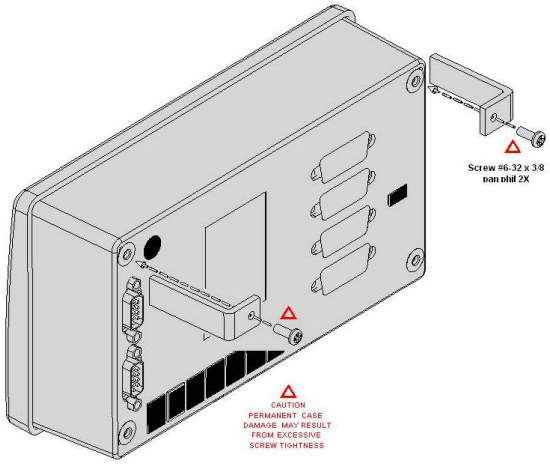

Figure 3: Panel Mount Components

1.7 Hookup and Wiring

A 15 volt, 1.2 Amp DC power supply is provided with the CM-400 module. This supply has adequate capacity to power up to four (4) Porter Thermal Mass Flow devices. When using the CM-400 with products other than Porter MFC's it is the responsibility of the user to determine compatibility with the power supply. Interconnect cables (Part Number: C-1666-010) are available for connecting Porter Mass Flow Controllers to the CM-400. Pin out details of the CM-400 MFC connections and power supply connection are shown in Figure 4.

> *NOTE: C-1666-010 interconnect cable is specifically configured for use with Porter 100 and 200 Series Mass Flow Meters/Controllers and the CM-400. Other Porter 9 to15 pin D connector cables are NOT compatible and their use can damage both the MFC and the CM-400. The C-1666-010 has a yellow band on the cable near the 15 pin connector. Consult the factory for use of Porter 600 and 700 Series Digital MFC's with the CM-400.*

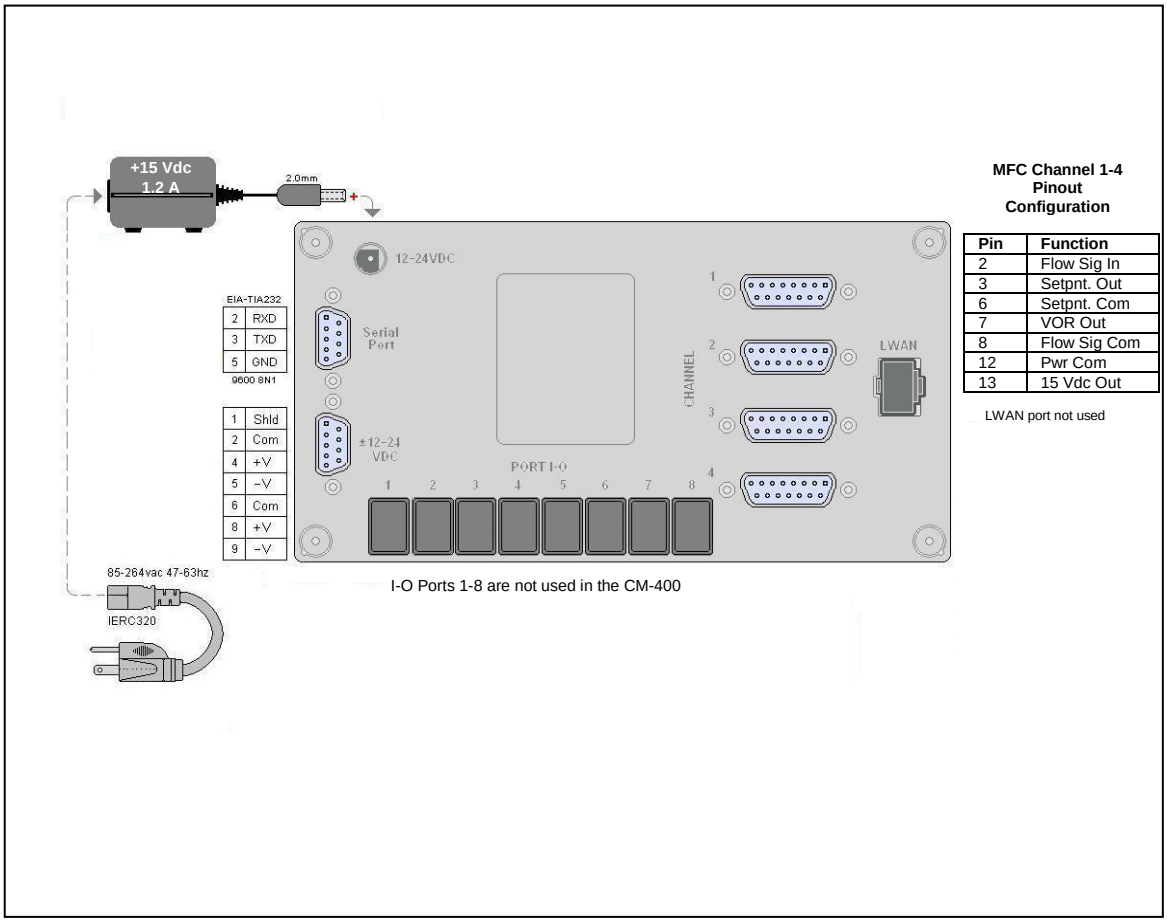

Figure 4: Image of pin out details and connections of the Porter CM-400

2.0 "QUICK START" GUIDE

2.1 Introduction

The purpose of this document is to facilitate setup and operation of the CM-400 for those who simply wish to connect, operate and control set-points for 1-4 MFC's without utilizing features that require a more extensive review of the operations manual.

NOTE: It is recommended that the Owner's Manual be studied completely to achieve the maximum benefit of the CM-400's full features.

2.2 Procedure

Assembly

1. Unpack and inspect the unit and any accessories. The contents of the shipping carton are packed in two layers. It is necessary to remove the CM-400, the power supply (110/240 Vac to 15 Vdc), and a layer of protective foam to access the table top bracket. In addition to these items, an interconnect cable (Part Number: C1666-010) is necessary and is available for order separately.

   NOTE: This cable is specifically designed for use with the CM-400 Module and Porter 200 Series Analog MFC's with 9 pin "D" connectors. Please consult factory before using any other cables or flow controllers.

2. Assemble and attach the Table Top Bracket (See Figure 1).
3. Plug the power supply into an appropriate power source and also into the round input connection on the CM-400's rear panel marked 12-24 VDC.

4. The unit will go through a power up routine after which the below display will show:

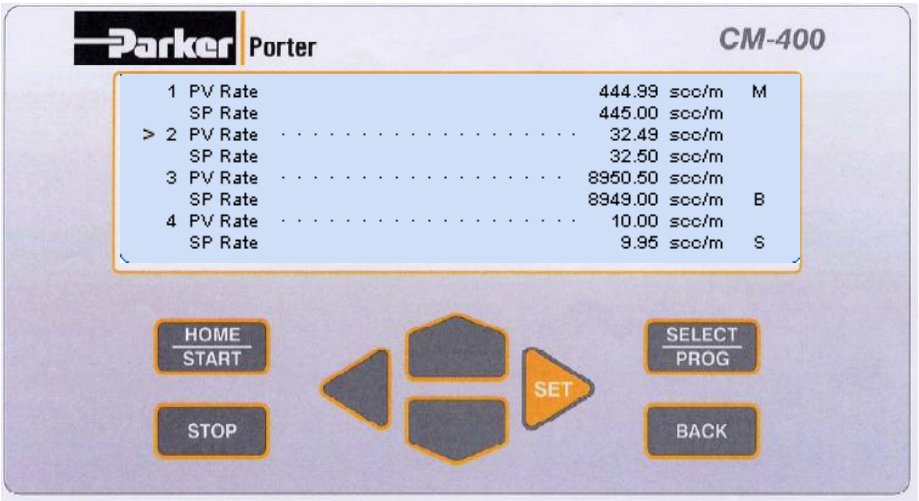

Figure 5: Image of CM-400 showing the Home Screen

NOTE: If the unit does not automatically power up upon connection to a power source, then push the HOME START *button to start up the unit.*

Program Setup

5. At the Home Screen, use the  and  buttons to move the cursor (>) so that it is next to Channel 1.
6. Push the 

button once to edit the channel.
7. Move the cursor so it is next to “Display Configuration”.
8. Push the 

button to edit “Display Configuration”.
9. Determine that the asterisks (*) are next to “PV Rate” and “SP Rate”. If not, use the  and  keys to move the cursor up and down. Then press 

to set asterisk in correct place.

   NOTE: The asterisk will not move until its final location is selected.

10. Press 

to return to the previous screen.
11. Move cursor so it is next to “Program Configuration”.
12. Push 

to edit “Program Configuration”.
13. Move the cursor, if necessary, so it is next to “Measure Units”.
14. Push 

to edit “Measure Units”.
15. Use the  and  keys to scroll through the available units.

   NOTE: See Section 7.3 for the list of engineering units available.

16. Push 

to select the proper engineering units.
17. Use the  button to move the cursor to the next setup parameter.
18. Repeat steps 21-25 for Time Base, Decimal Point, Gas Factor, Log Type, PV Signal Type, PV Full Scale, SP Signal Type, SP Full Scale, SP Function, and SP VOR.

    a. *NOTE: SP Rate should read zero (0) at this stage. A value will be entered immediately prior to operation. Log Type should read “Off”, SP Function should be set to “Rate”, and SP VOR should read “Normal”. SP Batch, SP Blend, and SP Source will be addressed in Section 9.0.*

19. Press 

to return to the Home Screen.

20. Repeat steps 13-27 to edit Display and Program Configuration for Channels 2-4, if necessary.

21. Once each channel is programmed correctly, push 

to begin MFC control operation. Plug MFC's into the appropriate channel's 15 pin "D" connector on the rear panel of the CM-400.

Set Point Setup:

22. To input set point, move the cursor so it is adjacent to Channel 1.

23. Push 

to be taken directly to SP Rate edit mode.

NOTE: The least significant digit will be flashing.

24. Use the  ,  , 

, and  keys to enter the desired set point value.

25. Push 

to program the value as the set point.

NOTE: The MFC will begin operation upon the completion of this step.

Push the 

button to shut down the MFC, if the set point is not desired. The stop button can be used at any time to force the setpoint to zero and stop flow in all channels.

26. Press 

to return to the main screen.

NOTE: The set point and flow signal of the channels can now be observed.

27. Repeat steps 30-34 to program and observe the set point of additional channels and MFC's, if necessary.

NOTE: It is recommended that the Owner's Manual be studied completely to achieve the maximum benefit of the CM-400's full features.

3.0 Home Screen

3.1 Introduction

The home screen (Figure 6) is the instrument's central information and navigation indicator. The home screen is presented following initial power application and the make-model screen banner. It provides an overall view of the instrument's operation.

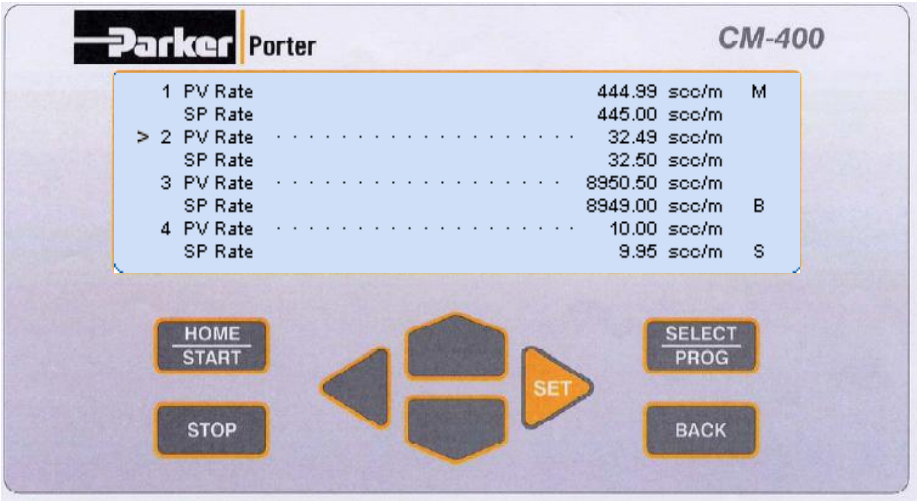

Figure 6: Image of the CM-400 displaying the Home Screen.

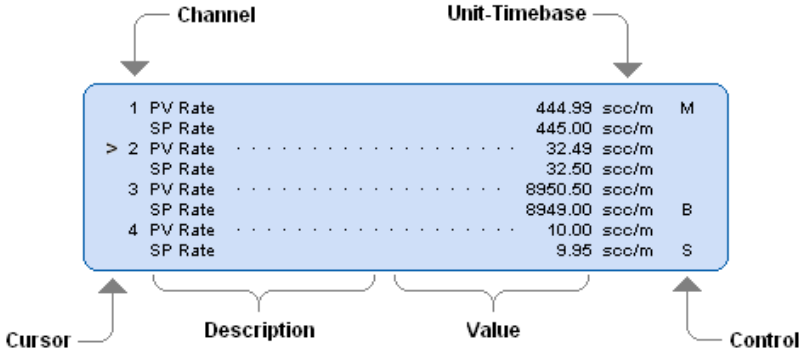

Figure 7: Labeled image of CM-400's Home Screen display.

3.2 Home Screen Display

3.2.1 Cursor - points to channel even when channel is off
3.2.2 Channel - numbers 1-4
3.2.3 Description - process value text
3.2.4 Value - numeric process value
3.2.5 Unit-Time base - combined measure units and rate time-base
3.2.6 Control - process control state indicators
3.2.7 Process Value (PV) Rate - the actual flow rate as indicated from the flow signal output of the MFC
3.2.8 Set Point (SP) Rate - the set point flow rate sent to the MFC

4.0 CONTROLS

4.1 Introduction

The primary instrument controls consist of eight (8) front-panel, tactile, snap-action keys. Serial communication capability is also included. Every function that can be accomplished by using the keys can also be accomplished by serial communication commands. Consult the factory for Serial Communication details.

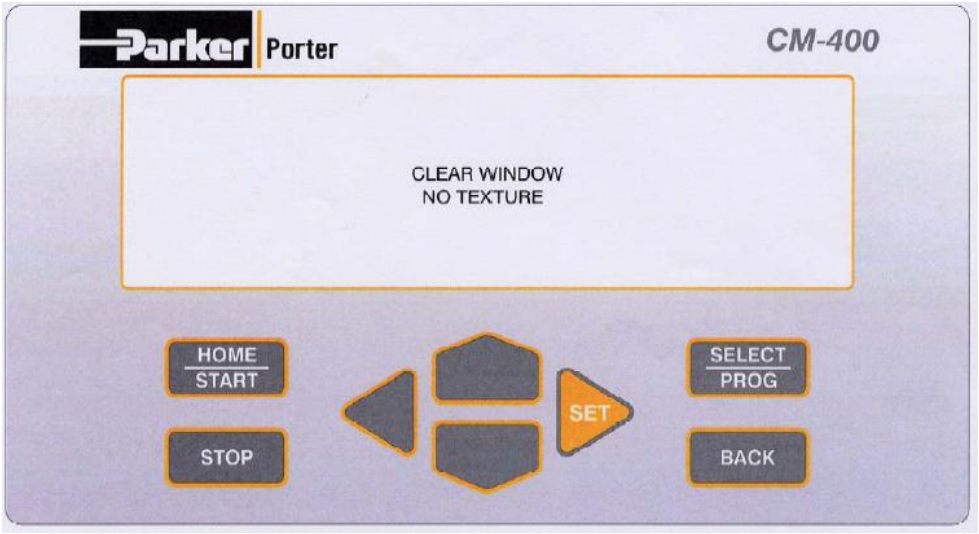

Figure 8: Image of the CM-400 with snap-action keys

4.2 Navigation Functions

4.2.1 Select a channel

4.2.2 Select a channel process value to be shown show on the home screen

4.2.3 Change the value of a channel program variable

4.2.4 Enter the Global System Settings selection menu

4.2.5 Quickly navigate to certain special values requiring frequent change

4.2.6 Start and stop control functions

4.2.7 Select a blend control main

4.3 Control Functions

Each key has a variety of functions that differ depending on which screen is in view. The following table (Table 1) details those functions as they relate to the corresponding screen.

Table 1: Control Functions categorized by screen function.

Button	Screen	Function
	Power Off	Restores power to CM-400
	All Screens	Navigates Directly to the Home Screen
	Home Screen	Selects channel to edit
	Display Configuration Screen	Selects Home screen viewing parameters
	Program Configuration Screen	Selects value to edit and save
	Global System Settings Screen	Selects setting to edit and save
	Home Screen	Directly navigates to Global System Settings when pressed three (3) times
	All Screens	Navigates to the previous screen
	Home Screen	Shuts down MFC and clears set point when pressed one (1) time
	All Screens	Powers down when held for four (4) seconds
	All Screens	Powers down when held for four (4) seconds
	All Screens	Move cursor/selection up or down
	Home Screen	Selects/deselects blend main channel
	Program Configuration Screen (PV Total Blinking)	Clears PV Total to zero (0)
	Program Configuration Screen	Moves blinking program selection to the next left choice
	All Screens	Moves cursor left
	Home Screen	Navigates directly to channel set-point edit mode
	All Screens	Moves cursor right

5.0 CHANNEL NAVIGATION

5.1 Background/Overview

The selection screen provides a secondary navigation layer for the operator to specify whether PV-SP Viewing (Display Configuration) or PV-SP Programming (Instrument/Program Configuration) is desired for a channel. The screen shown below is displayed as a result of having pressed the [SELECT] key while viewing the home screen.

> *NOTE: The screen may read Program Configuration or Instrument Configuration.*

The screen shown below (Figure 9) is for Channel 2. Use the cursor keys to point to either “Display Configuration” to show the PV and SP values currently selected for display on the Home Screen or “Instrument/Program Configuration” to program PV and SP values. Press [SELECT] to proceed to the desired selection.

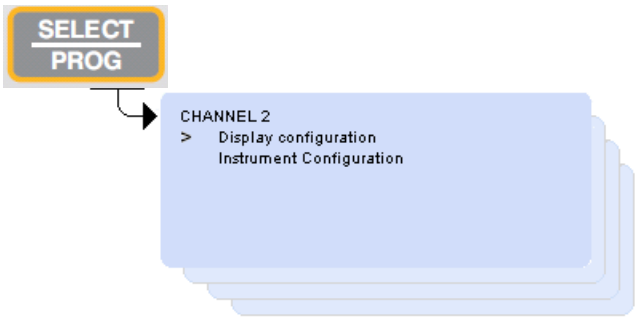

Figure 9: Image of CM-400’s channel screen

6.0 DISPLAY CONFIGURATION

6.1 Process Values (PV) and Set Point (SP) Values

The PV and SP values sections provide a detailed description of the various system map values that are used to setup the instrument's operating characteristics. These characteristics establish how the instrument is desired to perform and discuss the various process values that are the outcome of the setup.

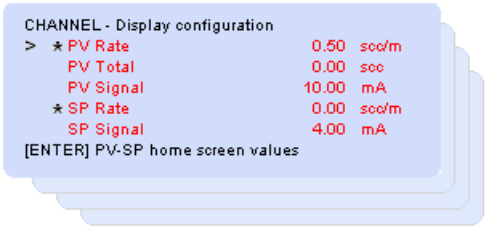

Figure 10: Image of the display configuration screen

6.2 Home Screen Display Value

The present PV and SP values shown on the home screen (Figure 10) are indicated by an asterisk (*). To change the PV displayed on the home screen point the cursor to the desired PV value and press the [SELECT] key. To change the SP displayed on the home screen point the cursor to the desired SP value and press the [SELECT] key. In both cases for PV and SP, note that the asterisk indicator is now prefixed to a new PV or SP value.

6.3 Process Value (PV) Descriptions

6.3.1 PV Rate

This value is a rate defined as quantity per unit time, or a scalar value (indicated as "none") not having a time associated. Scalar measurements are not totalized. The value displayed is updated live as the value changes.

6.3.2 PV Total

This is a quantity accumulator for a rate value. The quantity values are displayed when the channel time base is programmed for "none". PV Total quantity is not accumulated for "none" values and will not show a PV Total value on the screen. The value displayed is updated live as the value changes.

To clear an accumulated quantity to zero, point the cursor to PV Total and press the [◄] key. The value should become zero.

6.3.3 PV Signal

This value is the measured electrical value being input into the instrument/program channel. It may be used to provide assistance in system installations, and is used to support instrument calibration. The value displayed is updated live as the value changes.

6.4 Set Point (SP) Value Descriptions

6.4.1 SP Variables

Separate set-points are provided for rate control (SP Rate), batch quantity (SP Batch), and blend proportion (SP Blend). The specific set-point shown on the screen is dependent on the SP Function control type that has been selected. The value displayed is updated in real time as the value changes.

6.4.2 SP Signal

This value is the output signal being sent from the instrument/program channel and is expressed in the appropriate analog signal type units of volts or milliamps (mA).

7.0 INSTRUMENT/PROGRAM CONFIGURATION

7.1 Introduction

This section describes the combined PV and SP programmable channel values. The programmed values determine how signal inputs and signal outputs from the instrument are serviced.

The PV and SP program values are used to determine channel fundamental attributes, gas type service, logging type, channel override signal, PV signal type and full scale range, SP signal type and full scale range, channel service function, channel override signal, SP set-point values, and SP programming source. The PV and SP values are static and updated only after a value has been changed and saved.

7.2 Value Programming

Program a value by pointing the cursor to its line and pressing the [SELECT] key. The character or string (character-string) will be blinking when ready to be edited. Edit the character-string by changing the character-string to next value or previous value by using the [▲] and [▼] keys. Move the blinking character-string edit field left or right by using the [◄] and [►] keys. When finished editing, press [SELECT] to save the changed value.

> *NOTE: When editing a character-field that is blinking, the program state will be terminated if a key is not pressed within 30 seconds. This will result in any changes to the field being restored to the original value.*

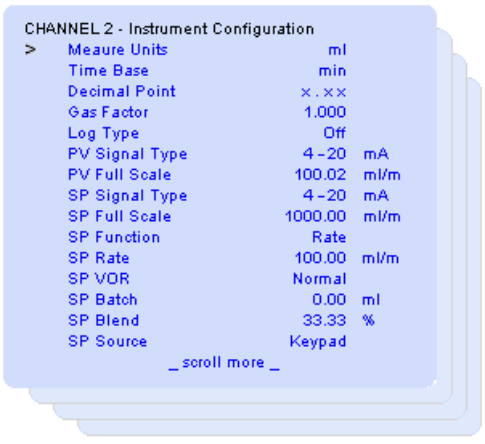

Figure 11: Image of Instrument/Program Configuration screen

7.3 Engineering Measure Units

Measure units are a combination of symbols used to identify a physical engineering measurement. The measure units may be selected from a fixed set of customary strings. Measure units have no arithmetic affect. See Table 2 below for a list of the engineering measure units available on the CM-400.

Table 2: List of Engineering Measure Units

SYM	DESCRIPTION	SYM	DESCRIPTION	SYM	DESCRIPTION
ml	Milliliters	mls	Standard Milliliters	mln	Normal Milliliters
l	Liters	ls	Standard Liters	ln	Normal Liters
cm^3	Cubic Centimeters	cm^3s	Standard Cubic Centimeters	cm^3n	Normal Cubic Centimeters
m^3	Cubic Meters	m^3s	Standard Cubic Meters	m^3n	Normal Cubic Meters
g	Grams	lb	Pounds	kg	Kilograms
ft^3	Cubic Feet	ft^3s	Standard Cubic Feet	ft^3n	Normal Cubic Feet
scc	Standard Cubic Centimeters	sl	Standard Liters	bar	Bar
mbar	Millibar	psi	Pound per Square Inch	kPa	Kilopascals
torr	Torr	atm	Atmospheres	volt	Volts
mA	Milliamps	oC	Degrees Centigrade	oK	Degrees Kelvin
oR	Degrees Rankin	oF	Degrees Fahrenheit	g/cc	Grams per Cubic Centimeter
sg	Standard Grams	%	Percent	lb/in^3	Pounds per Cubic Inch
lb/ft^3	Pounds per Cubic Foot	lb/gal	Pounds per Gallon	kg/m^3	Kilograms per Cubic Meter
g/ml	Grams per Milliliter	kg/l	Kilograms per Liter	g/l	Grams per Liter

NOTE: The firmware used in the CM-400 is compatible with instruments outside of those that measure flow. Therefore, the CM-400 and this table show units not consistent with flow measurement.

7.4 Time Base

This selection is used to set the quantity per unit time rate measurement (i.e. sec, min, hrs, or days). The “none” time base selection is presumed not to have a time-quantity association and does not perform quantity accumulation.

7.5 Decimal Point

The decimal point for values may be freely selected for none, one, two, or three places. The decimal sets the number of measurement value digits that are to the right of the decimal point. When the decimal point is changed, it automatically multiplies or divides an existing value so that values continue to retain their power-of-ten value. The values affected include PV and SP Full Scale, SP Rate, SP Batch.

7.6 Gas Factor

This value is a dimension-less number that makes it possible to compensate for using a gas other than the calibrated (nameplate) gas of the MFC. PV signals are internally corrected by multiplication and SP signals are corrected by division using the value entered in the “Gas Factor” location for the appropriate channel.

NOTE: See Appendix A for a list of gas factors for standard gases.

The gas factors assume a calibration gas of Nitrogen (or Air) and a factor of 1.000. For a calibration gas other than Nitrogen (or Air), divide the factor for the desired new gas by the factor for the calibration gas, both derived from Appendix A. The resulting calculated gas factor is then entered in the “Gas Factor” field for the appropriate channel.

7.7 Log Type

Log type selects PV Rate and PV Total values desired to be logged in real time. Such measured information values are periodically saved in the date-time stamped record log. Selections include PV Rate, PV Total and Off. When a channel is set to “off”, no logging is performed for that channel.

7.8 Process Value (PV) – Set Point (SP) Signal Types

Signal Selections may be set for full scale ranges which include 0-20mA, 4-20mA, 0-5V, 1-5V, 0-10V, 2-10V, or “Off”.

> *NOTE: The “Off” selection suspends service for either or both channel PV and SP signals. Inactive “Off” is indicated on the home screen as a blank line.*

When either or both the PV or SP parts of a channel are set to “Off”, the instrument remembers the active type(s) prior to having been set to “Off”. This enables the instrument to continue with the same PV and/or SP type that existed before being set to “Off” when returned to the “On” state. This insures that the factory installed hardware module configuration in the instrument continues to remain properly operable.

7.9 Process Value (PV) – Set Point (SP) Full Scale

This value sets the maximum engineering unit range over which the signal type is valid. The minimum is always presumed to be zero. Full scale values are required to be set for positive values for control functions to perform correctly.

7.10 Set Point (SP) Function

The allowable set-point functions are Rate, Batch or Blend. Set-point values are required to be positive for correct control function performance.

7.10.1 Rate

This control type ignores the channel PV Rate. The value set in the SP Rate register is translated to a corresponding analog signal which is directly sent to the channel analog signal output.

7.10.2 Batching

Batching is a non-continuous control process that delivers the quantity set in the SP Batch register. This process is started using either the keypad or a serial communication command. Batching is terminated when the desired batch quantity has been delivered or any time before delivery is complete by pressing the [STOP] key.

7.10.3 Blending

Blending is a continuous control process that delivers a rate proportion set in the SP Blend register, which is entered as a percentage of the prevailing Blend Main input rate. This process is started using either the keypad or a serial communication command. Blending is terminated at any time by pressing the [STOP] key from the home screen.

7.11 Set Point Valve Override (SP VOR)

This value is set to “normal” for standard MFC operation. VOR Normal causes the valve override signal output voltage to be disconnected. The VOR function is used in thermal mass flow applications to override the normal analog command signals and finds use for installation and system diagnostic purposes.

7.11.1 Valve Open

The VOR output signal is connected to power supply common, causing the MFC valve to be fully open.

> *Caution: This function will work on Porter Analog MFC’s only. This feature could damage other MFC’s and should be avoided.*

7.12 Set Point (SP) Source

This control enables selection of the source from which set-points may be entered as either “Keypad” or “Serial”. When set for “Serial”, changing a set-point using the keypad is prohibited.

8.0 GLOBAL SETTINGS

8.1 Introduction

This section describes the various system-wide variables used to set-up and review the overall operating characteristics, which establish how the entire instrument is desired to perform. The values include those provided only for review, those that can be selected, and those that invoke immediate action. The Global Settings screen is accessed by activating the [BACK] button three (3) times.

8.2 Information Navigation

To enter the information service screen, point the cursor to “Information” on the Global Settings screen and press the [SELECT] key.

Figure 12: Image of the global settings screen

This screen (Figure 12 above) contains system information, values, and configuration states. These values are not programmable, with the only exception being the “Factory Set” immediate action selection described below which erases present programmed values and replaces them with factory default values.

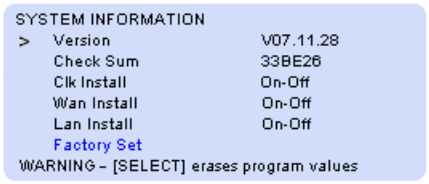

Figure 13: Image of the system information screen under global settings

8.2.1 Version

This is the date the firmware was last upgraded represented as year, month, and day. It is only for review.

8.2.2 Clk (Clock) Install

This state indicates whether the real time clock is installed and operating which is detected immediately after a power-up reset. The clock is used for scheduling data or log reports and for date-time stamping logged records.

8.2.3 Wan Install

This state indicates whether the wide area network modem adapter is installed and operating which is detected immediately after a power-up reset. This adapter supports public switched telephone network (PSTN) data communication.

8.2.4 LAN Install

This state indicates whether a local area network adapter is installed and operating which is detected immediately after a power-up reset. This adapter detects local area EIA-TIA485 or 10/100 BaseT Ethernet data communication support.

8.2.5 Factory Set

When the cursor is pointing to “Factory Set”, a pop-up warning displays "WARNING - [SELECT] erases program values" at the bottom of the display. Pressing [SELECT] will cause all user program values to be immediately erased and over-written with factory standard default values. “Factory Set” does not erase factory pre-set calibration values which continue to be retained.

8.3 System Power Navigation

To enter the System Power function - point the cursor to System Power on the Global Settings screen and press the [SELECT] key. This is an immediate action selection.

8.3.1 System Power

The System Power functions allows the user to cause power to equipment connected to the instrument to placed in an off state, allowing the user to conduct installation services and diagnostics. The power off state is also useful for placing the instrument and connected equipment in an un-powered state when the instrument is expected to remain unused for extended periods.

> *NOTE: The pop-up at the bottom of the display is shown on the screen only when the cursor is pointing to “System Power”*

8.3.2 Power Off

Press the [SELECT] key with the cursor pointing to System Power. This will cause entry into the power down state, the screen to become blank with its back-light off, and all signals and power to be removed from connected equipment.

8.3.3 Power On

Press the [START] key to restore normal system operation.

8.4 Control Service Navigation

To enter the Control Services screen point the cursor to “Control Services” on the Global Settings screen and press the [SELECT] key. These Control Service settings are programmable but are not live updated. They establish operation of the several system level operating controls.

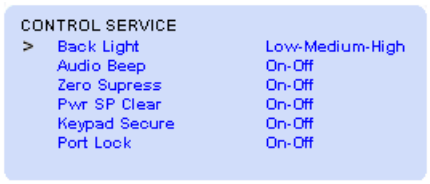

Figure 14: Image of the “Control Service” screen in Global Settings

8.4.1 Audio Beep

When this control is selected “on” it allows normal audio annunciation for alarms and key activation. Otherwise all audio indications remain disabled.

8.4.2 Zero Suppress

When this control is selected “on”, numeric measured values are displayed with leading zeros suppressed.

8.4.3 Pwr SP Clear

When this control is selected “on”, power restoration causes every channel SP value to be erased and made zero.

8.5 Communications Navigation

To enter the Communications service screen point the cursor to “Communications” on the Global Settings screen and press the [SELECT] key. The communication variables are non-programmable selections.

8.5.1 Network Address

When the date and time clock is not installed, only the Network Addr (address) is shown on the service screen.

Figure 15: Image of Communications screen in Global Settings

This address is a unique identification for the instrument operating in a network environment. It is factory pre-set and not customer programmable. The other parameters are not applicable to the CM-400 Communications firmware.

9.0 PROCESS CONTROLS

9.1 Introduction

This section provides a detailed description and operation of the CM-400's various control functions.

9.2 Rate Control

Rate control is a continuous manually oriented process performed on a channel-by-channel basis. This control type causes an SP Rate signal programmed by the operator to be output to a controller. Independently, the controller's delivery rate signal is monitored and indicated as the channel PV Rate.

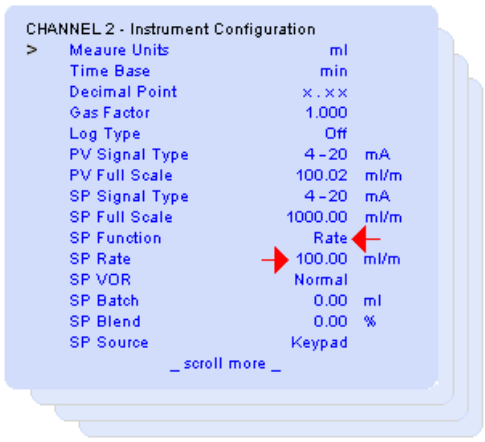

Figure 16: Image of the Instrument/ Program Configuration screen showing the SP Rate symbol

9.2.1 Set-Up

The operator programs values shown above (Figure 16) for each channel desired to perform rate control. The SP Function should show "rate" and SP Rate should be entered by the operator as desired.

9.2.2 Start Rate Control

This control type is continuous requiring no start action to be taken by the operator.

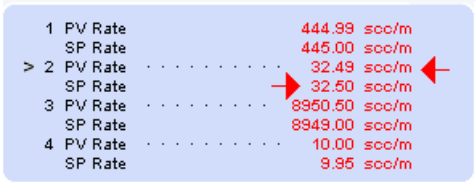

Figure 17: Image of the home screen with all channels running

The delivery process can be monitored as shown on the live update screen above (Figure 17), observing that the SP Rate is the same as the monitored PV Rate.

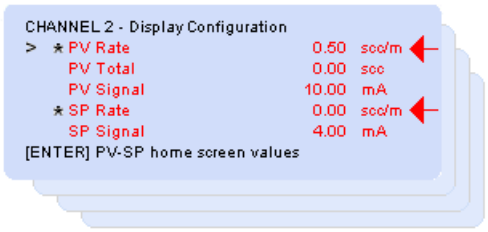

Figure 18: Image of display configuration screen showing the process is off

9.2.3 Terminate Rate Control

When the operator sets the channel SP Rate to zero the process is off (Figure 18).

9.3 Batch Control

Batch processing is a non-continuous process that is started, conducted, and terminated when a desired quantity has completed delivery. The operator may stop batch delivery at any time prior to completion.

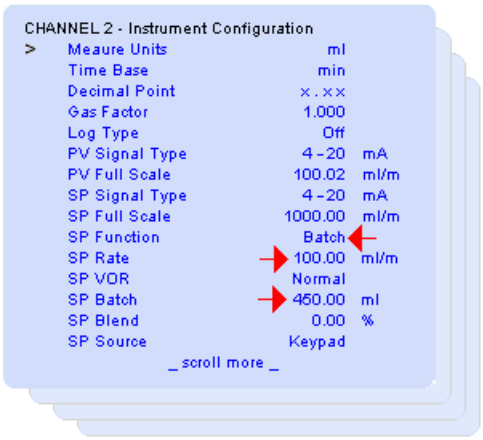

Figure 19: Image of the Instrument Configuration screen programmed in "Batch" mode

9.3.1 Set-Up

The operator programs values shown above for each channel desired to perform batch delivery. The SP Function should read "batch". The SP Rate and SP Batch should be programmed by the operator as desired.

9.3.2 Start Batch

9.3.2.1 Return to home screen where it should indicate a 'B' control indicator for all channels selected to perform batching.

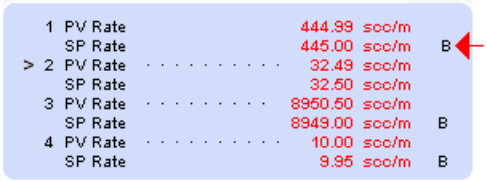

Figure 20: Image of home screen showing batch processing

9.3.2.2 Press [START] key three (3) times. The 'B' indicators are now blinking to indicate that the channel's batch is now in progress.

9.3.2.3 The delivery process can be monitored as shown on the screen below (Figure 21). Now, observe that the PV Total increases toward the SP Batch amount verify that the PV Rate properly indicates the desired delivery rate. The screen below is updated in real time. Since the SP Function was set for Batch, the SP Batch quantity appears on this screen.

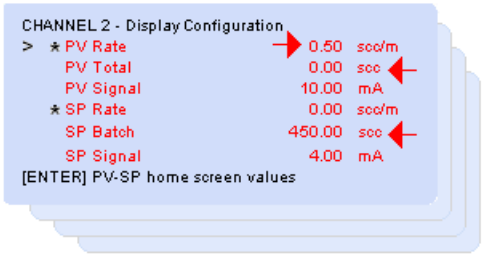

Figure 21: Image of a batch process in the display configuration screen

9.3.3 Terminate Batch

9.3.3.1 The process for each channel set for batch will automatically terminate when the PV Total has reached their programmed SP Batch set-point.

9.3.3.2 The operator may terminate any batching channels during the process by first returning to the home screen, then pressing the [STOP] key once. The 'B' control indicators on the home screen will stop blinking indicating that all batch processes are stopped.

NOTE: After using the [STOP] key, the PV Total clears to zero (0).

9.4 Blend Control

Blending is a continuous process that, when started, causes sub channel SP Rates to be a proportion of the actual rate being delivered by the main channel.

Caution: Blend parameters are saved when power is lost. This allows blending to continue after power is restored unless the operator sets "PWR SP CLEAR" to the "On" position. See Section 8.0 Global Settings.

The operator selects a main channel and sets its delivery SP Rate. One or more Sub channel is then selected, and the process is started from the home screen. Once blending is started, it may only be terminated by the operator.

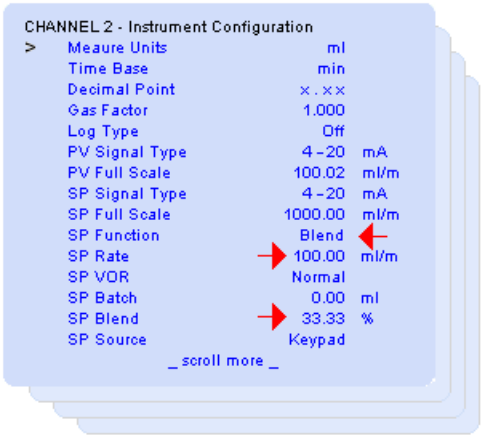

Figure 22: Image showing a blending process in the Instrument/Program Configuration Screen

9.4.1 Set-Up

The operator programs the above (Figure 22) values for main and sub channels desired to perform blending.

9.4.1.1 Select Blend Main

From the home screen, point to a channel desired to be the main and press the [◄] main blend key. This causes the home screen to show an 'M' indicating main channel. Should the operator press the main key again, the 'M' control indicator will no longer be present meaning that no main is selected and blending will not be conducted.

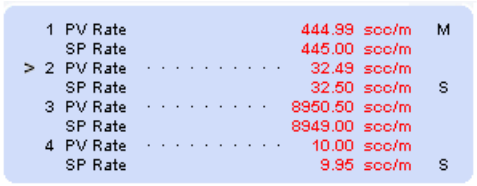

Figure 23: Image showing channel 1 as the blend main and channels 2 and 4 as sub channels

9.4.1.2 Main Channel Set-up

The operator navigates to the main programming screen in the proper channel, sets the desired main SP Function to Rate, and sets the SP Rate to a desired value.

9.4.1.3 Sub Channels Set-up

The operator navigates to each desired sub channel and sets each SP Function to “Blend”. Then the operator sets the desired SP Blend rate percentage, which is a fraction of the Main Channel’s actual delivery rate. Note that the home screen shows 'S' indicating selected blend sub channels.

Caution: The Sub Channel’s measure units (Section 7.3) must match those of the Main Channel to achieve accurate blend proportions.

Example: If the Main Channel’s MFC has a maximum flow rate of 2.0 liters per minute and the Sub Channel’s MFC has a maximum flow rate of 100 cubic centimeters per minute, then the Sub Channel’s maximum flow rate should be programmed as 0.10 liters per minute.

9.4.2 Start Blend

9.4.2.1 Return to the home screen

9.4.2.2 Press [START] key three (3) times. The 'M' and 'S' suffix are now blinking to indicate channels with blend now in process.

9.4.2.3 The blending process can be viewed on the screen below observing that the SP Rate is the programmed proportion of the main rate.

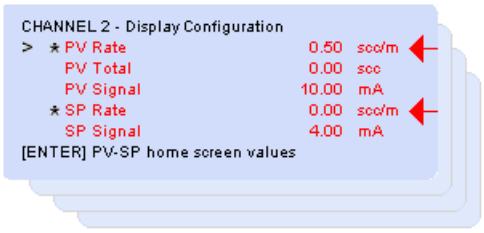

Figure 24: Image showing the display configuration of a blending process

9.4.3 Terminate blend in-process

Once the operator has started blending, it will continue unless specifically terminated by the operator. To terminate, return to the home screen and press the [STOP] key. Observe that the 'M' and 'S' process indicators no longer blink.

NOTE: Terminating a blend in progress causes the blend main channel SP Rate value to be cleared to zero (0).

Appendix A: Table of Gas Factors for Standard Gases

Gas Type	Chemical Formula	Correction Factor vs. N_2	Gas Type	Chemical Formula	Correction Factor vs. N_2	Gas Type	Chemical Formula	Correction Factor vs. N_2
Acetylene	C_2H_2	0.602	Isobutylene	C_4H_8	0.290	Monoethylamine	$C_2H_5NH_2$	0.350
Air	--------	1.000	Krypton	Kr	1.450	Monomethylamine	CH_3NH_2	0.450
Allene (Propadiene)	C_3H_4	0.430	Methane	CH_4	0.731	Neon	Ne	1.445
Ammonia	NH_3	0.730	Methyl Acetylene	C_3H_4	0.430	Nitric Oxide	NO	0.997
Argon	Ar	1.443	Methyl Bromide	CH_3Br	0.560	Nitrogen	N_2	1.000
Arsine	AsH_3	0.662	Methyl Chloride	CH_3Cl	0.630	Nitrogen Dioxide	NO_2	0.740
Boron Trichloride	BCl_3	0.410	Dichlorosilane	SiH_2Cl_2	0.400	Nitrogen Trifluoride	NF_3	0.480
Boron Trifluoride	BF_3	0.510	1,2-Dichlorotetrafluoroethane (Freon-114)	$C_2Cl_2F_4$	0.220	Nitrosyl Chloride	NOCl	0.610
Bromine	Br_2	0.810	1,1-Difluoroethylene (Freon-1132A)	$C_2H_2F_2$	0.430	Nitrous Oxide	N_2O	0.713
Bromine Pentafluoride	BrF_5	0.260	Dimethylamine	$(CH_3)_2NH$	0.370	Octafluorocyclobutane (Freon-C318)	C_4F_8	0.170
Bromine Trifluoride	BrF_3	0.380	Dimethyl Ether	$(CH_3)_2O$	0.390	Oxygen	O_2	0.994
Bromotrifluoromethane (Freon-13B1)	$CBrF_3$	0.370	2,2-Dimethylpropane	C_5H_{12}	0.220	Oxygen Difluoride	OF_2	0.630
Butadiene	C_4H_6	0.320	Ethane	C_2H_6	0.497	Pentaborane	B_5H_9	0.260
Butane	C_4H_{10}	0.260	Ethyl Acetylene	C_4H_6	0.320	Perchloryl Fluoride	ClO_3F	0.390
1-Butene	C_4H_8	0.295	Ethyl Chloride	C_2H_5Cl	0.400	Perfluoropropane	C_3F_8	0.170
cis-2-Butene	C_4H_8	0.324	Ethylene	C_2H_4	0.622	Phosgene	$COCl_2$	0.440
trans-2-Butene	C_4H_8	0.291	Ethylene Oxide	C_2H_4O	0.520	Phosphine	PH_3	0.760
Carbon Dioxide	CO_2	0.745	Fluorine	F_2	0.978	Phosphorous Pentafluoride	PF_5	0.300
Carbon Disulfide	CS_2	0.600	Fluoroform (Freon-23)	CHF_3	0.506	Propane	C_3H_8	0.372
Carbon Monoxide	CO	1.001	Germane	GeH_4	0.596	Propylene	C_3H_6	0.405
Carbon Tetrachloride	CCl_4	0.309	Germanium Tetrachloride	$GeCl_4$	0.270	Silane	SiH_4	0.596
Carbon Tetrafluoride (Freon-14)	CF_4	0.420	Helium	He	1.444	Silicon Tetrachloride	$SiCl_4$	0.288
Carbonyl Fluoride	COF_2	0.544	Hexafluoroethane (Freon-116)	C_2F_6	0.240	Silicon Tetrafluoride	SiF_4	0.350
Carbonyl Sulfide	COS	0.640	Hydrogen	H_2	1.021	Sulfur Dioxide	SO_2	0.687
Chlorine	Cl_2	0.852	Hydrogen Bromide	HBr	0.985	Sulfur Hexafluoride	SF_6	0.270
Chlorine Trifluoride	ClF_3	0.403	Hydrogen Chloride	HCl	0.998	Sulfuryl Fluoride	SO_2F_2	0.390
Chlorodifluoromethane (Freon-22)	$CHClF_2$	0.456	Hydrogen Cyanide	HCN	0.760	Tetrafluoroethylene	C_2F_4	0.330
Chloropentafluoroethane (Freon-115)	C_2ClF_5	0.240	Hydrogen Fluoride	HF	0.997	Tetrafluorohydrazine	N_2F_4	0.320
Chlorotrifluoromethane (Freon-13)	$CClF_3$	0.380	Hydrogen Iodide	HI	0.999	Trichlorofluoromethane (Freon 11)	CCl_3F	0.330
Cyanogen	C_2N_2	0.440	Hydrogen Selenide	H_2Se	0.780	Triisobutylaluminum	$(C_4H_9)_3Al$	0.061
Cyanogen Chloride	ClCN	0.610	Hydrogen Sulfide	H_2S	0.799	Trimethylamine	$(CH_3)_3N$	0.270
Cyclopropane	C_3H_6	0.460	Iodine Pentafluoride	IF_5	0.250	Tungsten Hexafluoride	WF_6	0.250
Deuterium	D_2	1.003	Isobutane	C_4H_{10}	0.260	Uranium Hexafluoride	UF_6	0.200
Diborane	B_2H_6	0.434	Methyl Fluoride	CH_3F	0.559	Vinyl Bromide	C_2H_3Br	0.460
Dibromodifluoromethane	CBr_2F_2	0.190	Methyl Mercaptan	CH_4S	0.520	Vinyl Chloride	C_2H_3Cl	0.480
Dichlorodifluoromethane (Freon-12)	CCl_2F_2	0.354	Methyltrichlorosilane	CH_3SiCl_3	0.250	Vinyl Fluoride	C_2H_3F	0.551
Dichlorofluoromethane (Freon-21)	$CHCl_2F$	0.417	Molybdenum Hexafluoride	MoF_6	0.210	Xenon	Xe	1.410
Dichloromethylsilane	CH_4Cl_2Si	0.250						

POLICIES

PRICES

All prices are F.O.B. Hatfield, PA, and subject to change without notice. All merchandise will be invoiced at prices in effect at time of shipment. Prices do not include insurance, freight, taxes or special handling. These charges, if applicable, will be shown separately on invoice. Minimum order $100.00.

PAYMENT TERMS

Net 30 days after invoice date. All invoices past due are subject to a finance charge of 1½% per month (18% annual rate).

SHIPMENTS

Shipment of merchandise shall at times be subject to credit approval and will be contingent upon fires, accidents, emergencies, acts of God or any other causes which are beyond Porter Instrument Division's control.

CANCELLATIONS

No cancellations will be accepted on non-standard or special merchandise, except by payment of full purchase price. If buyer requests cancellation of any order or part thereof, and is agreed to by Porter Instrument Division in writing, buyer will be subject to cancellation charges to cover the cost of material and/or fabrication incurred by Porter Instrument Division to date of cancellation.

CHANGES OF ORDER

A minimum of 90 days notice is required on all changes to orders and will be subject to rescheduling as a new order at Porter Instrument Division's discretion.

RETURNS

No returns will be accepted unless authorized in writing by Porter Instrument Division and accompanied by a properly completed Returned Goods Authorization. All returns are subject to restocking and possible rework charges to be determined by Porter Instrument Division.