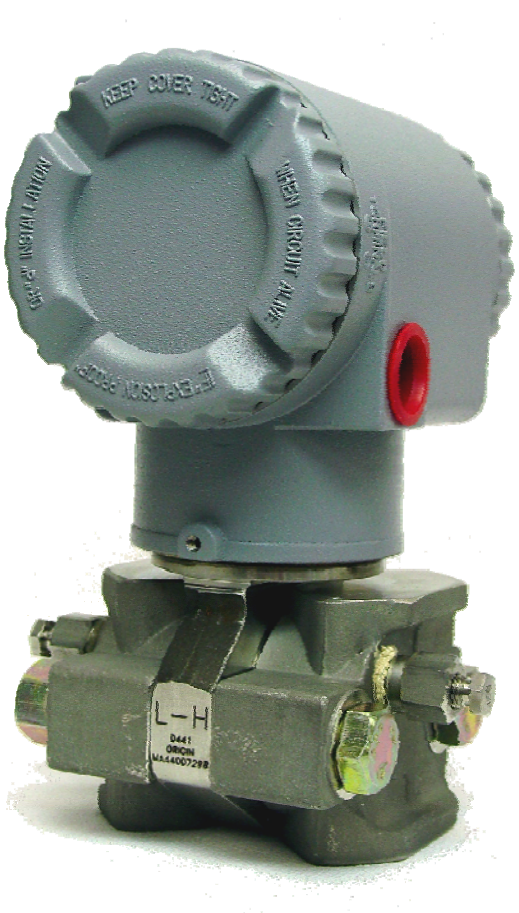
NUFLO™

MVX®-II Transmitter

User Manual



Manual No. 30165003, Rev. 01

Important Safety Information

Symbols used in this manual:

WARNING

This symbol identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.

Terms used in this manual:

Caution – Indicates actions or procedures which if not performed correctly may lead to personal injury or incorrect function of the instrument or connected equipment.

Note – Indicates actions or procedures which may affect instrument operation or may lead to an instrument response which is not planned.

Symbols Marked on Equipment:

Attention – Refer to manual

Protective (earth) ground

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February 2007

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Section 1

Features of the NuFlo MVX®-II Transmitter

Introduction

The NuFlo MVX-II transmitter provides linearized digital measurements for static pressure, differential pressure, and process temperature (via an external 100-ohm RTD). Paired with any of the NuFlo flow computers, the MVX-II provides a highly accurate gas measurement solution.

The MVX-II communicates with the industry-standard Modbus® protocol via an RS-485 port, allowing easy connection to flow computers, PLCs, and computers that communicate via Modbus®.

The transmitter is housed in an explosion-proof, weatherproof enclosure sealed on both ends with a removable threaded cover, providing easy access for field wiring connections and the integrated electronics (see Figures 1-1 and 1-2, page 1-2).

An integral multivariable sensor collects input data via the process connections, and sends the data to the various electronics for processing. The instrument is available with either of two sensor types to accommodate both direct-mount and remote-mount installations:

- a low-profile sensor with process connections on the bottom for mounting directly to a pipe or surface
- a standard sensor with process connections on the side to accommodate remote-mount installations

The sensor is available in a wide range of pressure ranges to support a variety of flow conditions (100 to 1500 psia for standard pressure conditions and 3000 and 5300 psia for high-pressure applications); NACE models are also available for H2S gas applications. See *Appendix B* for a complete list of sensor ranges.

The MVX-II interface software is used for setup and calibration. The unit is calibrated at the factory, and can be easily recalibrated in the field using one to five calibration points. Three sets of calibration data are stored in nonvolatile memory and are always accessible:

- current calibration data
- calibration data set written to memory just previous to the current calibration data
- original factory-default calibration settings

Safety Information

WARNING **To prevent possible explosion and to maintain explosion-proof/flameproof and dust ignition-proof protection, plug unused openings with the provided conduit plug. This plug must be engaged a minimum of five full threads. The threaded housing covers must be installed. Turn covers to seat O-ring into the housing, and then continue to hand-tighten until the cover contacts the housing metal-to-metal.**

If the electronics housing is removed for any reason, it must be hand-tightened fully. Then, engage the set screw until it bottoms out and back it off 1/8th of a turn. Fill the set screw recess with Torque Seal (Organic Products Company) or comparable product. The housing then may be rotated up to one full turn counterclockwise.

Nomenclature

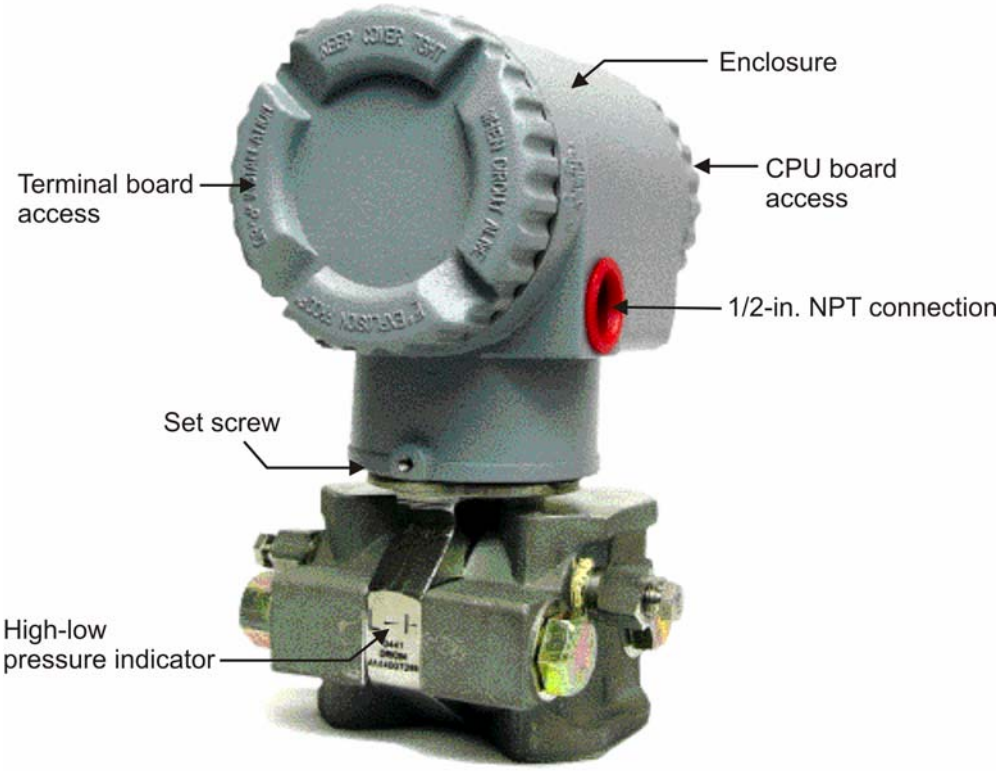


Figure 1-1—MVX-II, nomenclature, shown with low-profile sensor (bottom process connections)

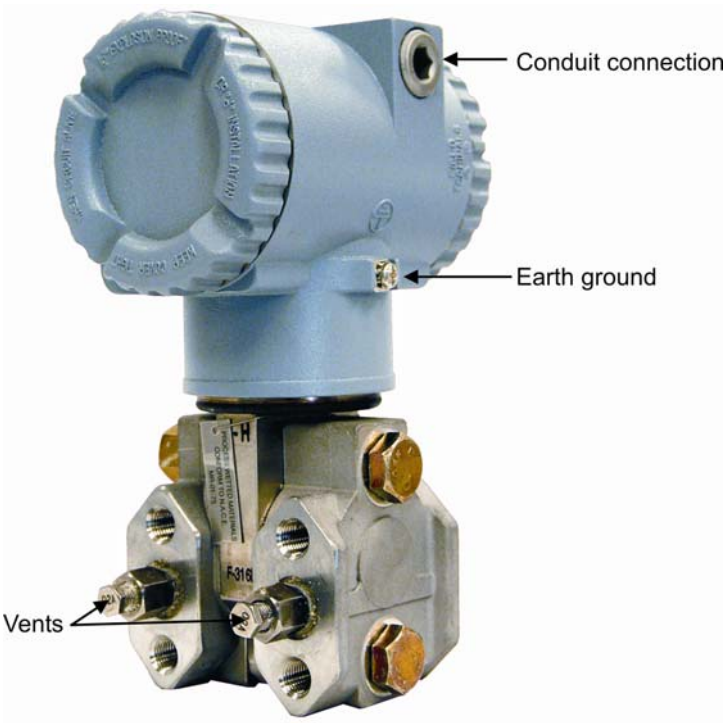


Figure 1-2—MVX-II, nomenclature, vent side view, shown with standard sensor (side process connections)

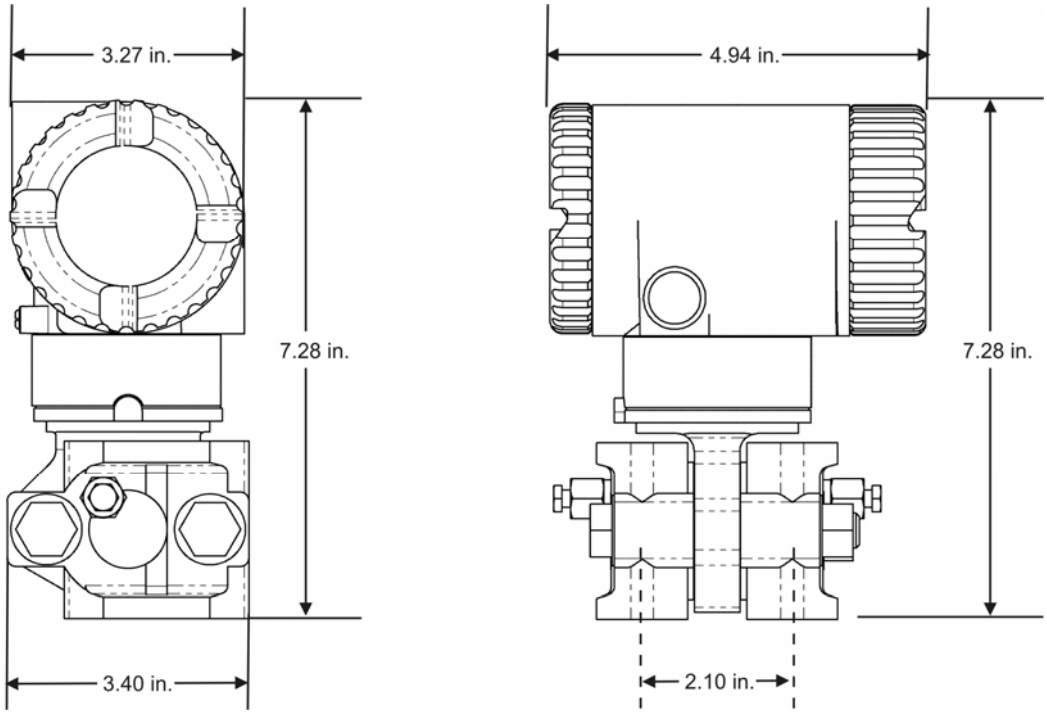


Figure 1-3—MVX-II dimensions with low-profile sensor (bottom process connections)

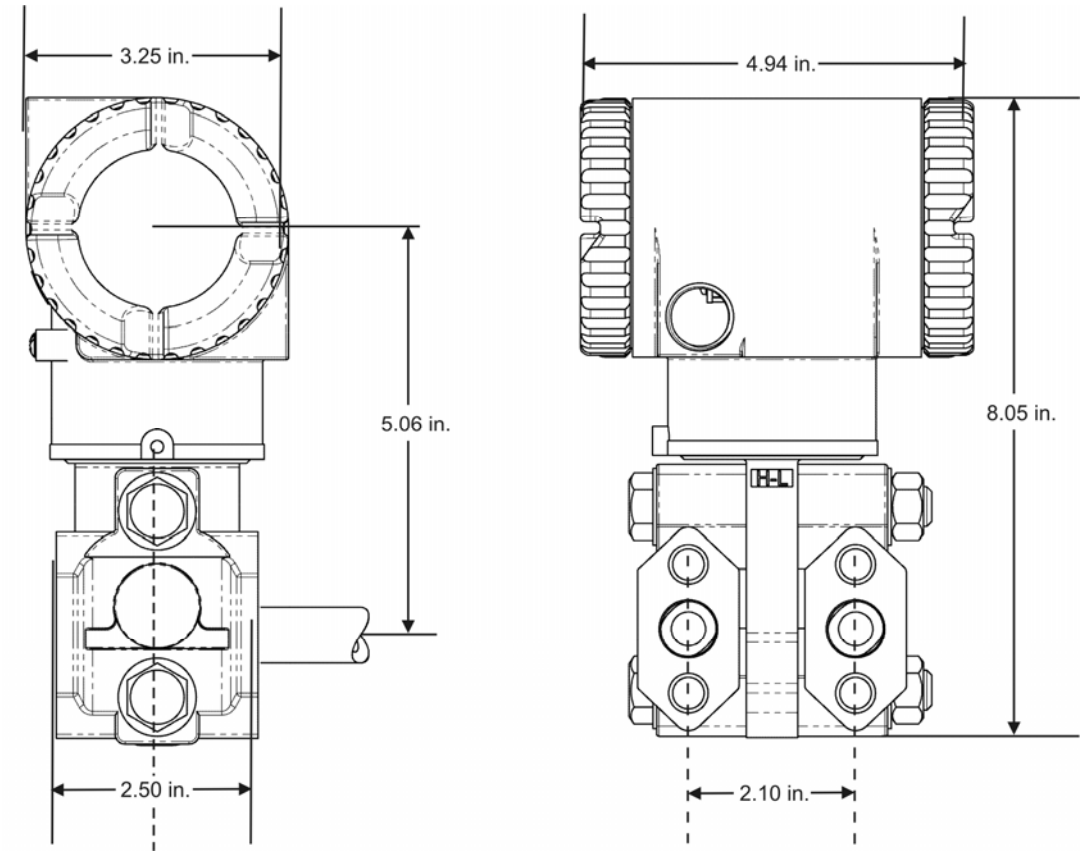


Figure 1-4—MVX-II dimensions with standard sensor (side process connections)

Specifications

Housing	Epoxy-coated aluminum Type 4X
Approvals	CSA-approved for US and Canada – Class I, Division 1, Groups B, C and D (explosion-proof) – Class I, Division 2, Groups B, C and D (non-incendive)
Environmental	Operating Temperature Range: -40°F to + 158°F (-40°C to +70°C)
System Power	MVX-II power requirements: 8-28 VDC at 30 mA max (15 mA typical) Reverse polarity and transient protection Supply must be limited to 3 A by fusing or equivalent overcurrent protection.
Communications	RS-485 port • Modbus® slave • Selectable 4800, 9600, 19200, 38400 baud rate • Selectable word ordering for multi-word data types (high word first, low word first)
Protocol	RTU Mode Modbus® Functions Supported: • Read Holding Register • Read Input Register • Preset Single Register • Preset Multiple Registers Maximum Registers per Message: 32
Multivariable Sensor Accuracy	Differential Pressure - +/- 0.05% of span Absolute Pressure - +/- 0.05% of span (does not include variation from user entered barometric pressure) Process Temperature - +/- 0.5°F (does not include RTD uncertainties)
Adapter Options	Adapts to Rosemount manifold with optional coplanar flange kit (see *Spare Parts, page B-1*) Converts to ½-in. process connections with ½-in.-14 NPT flange adapters (see *Spare Parts, page B-1*)

Temperature Sensor Input

100-ohm platinum RTD, with temperature coefficient 0.00385 Ω/Ω/ºC
For use in Division 1 applications, must be a Model 21 explosion-proof RTD assembly or equivalent

Interface Software

Included with instrument

- Configures the instrument
- Calibrates the instrument (up to 5 points)
- Reporting capabilities
  - Calibration report
  - Configuration report
- System requirements
  - Requires PC with Windows® 98 or later operating system (Windows XP recommended)
  - Memory: 256 MB of RAM (system is operable with 128 MB, but not recommended)
  - Hard disk space: 160 MB minimum
  - Computer/processor - 1 GHz or faster
  - CD-ROM drive
  - Display 600 x 800
  - Keyboard and mouse
  - RS-232 serial port

Section 2

Installing the MVX®-II Transmitter

Mounting the MVX-II

The MVX-II transmitter with the low-profile sensor (bottom process connections) can be mounted directly to the orifice plate or to a multi-valve manifold. The MVX-II transmitter with the standard sensor (side bottom process connections) can be used with direct-mount or remote-mount installations. A pole-mounting hardware kit is available as an option for mounting the MVX-II remotely.

Direct Mount

To mount the MVX-II transmitter to a pipe or surface, perform the following steps:

1. Identify the low and high pressure sides of the transmitter, as shown by the H-L indicator (Figure 2-1).
2. Install and connect process piping between the MVX-II and the orifice plate or manifold with appropriate fittings. Process piping installation procedures vary with each application, and are outside the scope of this manual.

   The MVX-II can be mounted to a horizontal or vertical process piping, and can be mounted facing several different directions to suit various piping arrangements.

   - If the MVX-II is mounted to a horizontal pipeline, process connections should be at the top of the line, and the MVX-II should be mounted above the pressure connections at the pipe.
   - If the MVX-II is to be mounted to a vertical pipeline, flow in the pipeline should be upward.

The MVX-II housing can be rotated 180 degrees, if desired, for added flexibility in tight locations. To rotate the housing, loosen the set screw, rotate the housing, retighten the set screw, and fill the set screw recess with Torque Seal (Organic Products Company) or comparable product.

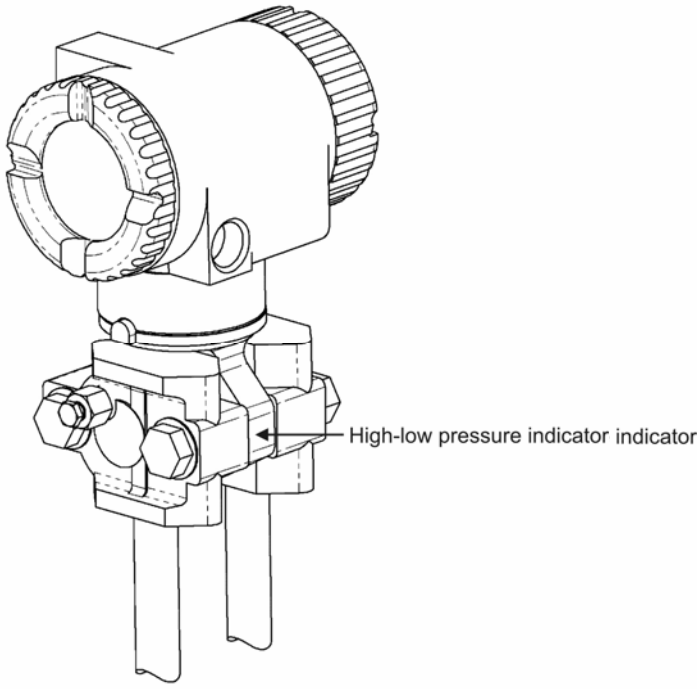


Figure 2-1—Direct-mount installation; low-profile sensor with bottom process connections

Caution	**Do not rotate the housing more than 180 degrees. Doing so could damage the ribbon cable that connects the sensor to the electronics in the housing.**

Remote (Pole) Mount

To mount the MVX-II using the optional pole-mount kit, perform the following steps:

1. Identify the low and high pressure sides of the transmitter, as shown by the H-L indicator (Figure 1-1).
2. Determine the orientation that will best accommodate process connections and field wiring connections. The mounting bracket design allows the MVX-II to be mounted in a horizontal or vertical position, and on either side of the bracket. See also *Vertical Installation, page 2-3*.
3. Connect the mounting bracket to the MVX-II using the four bolts provided (Figure 2-2).
4. Position the U-bolt around the pipe and through the support bracket provided with the U-bolt.
5. Align the mounting bracket against the pole so that the U-bolt passes through the mounting holes in the bracket. Place the mounting plate over the threaded ends of the U-bolt and against the bracket, and secure the U-bolt with the two screws provided.

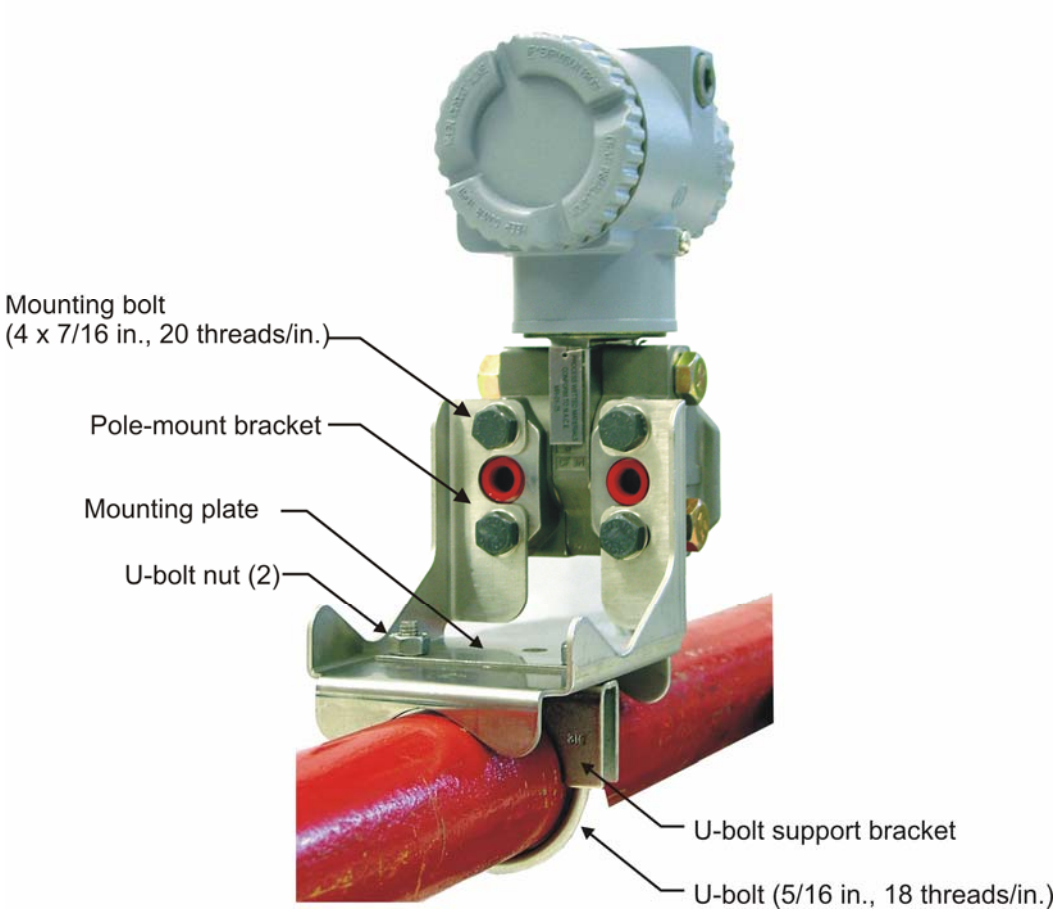


Figure 2-2—Remote-mount installation to horizontal pipe; shown with standard sensor with side process connections and optional mounting kit

Vertical Installation. When installing the MVX-II to vertical pipe, make sure the process connections are facing downward (Figure 2-3). This may cause the field connections end of the housing to also face downward or to the side (never upward).

To make the terminal board more accessible for wiring connections, loosen the set screw and turn the housing 180 degrees so that the field connection end of the housing is facing upwards, retighten the set screw, and fill the set screw recess with Torque Seal (Organic Products Company) or comparable product.

Caution	**Do not rotate the housing more than 180 degrees. Doing so could damage the ribbon cable that connects the sensor to the electronics in the housing.**

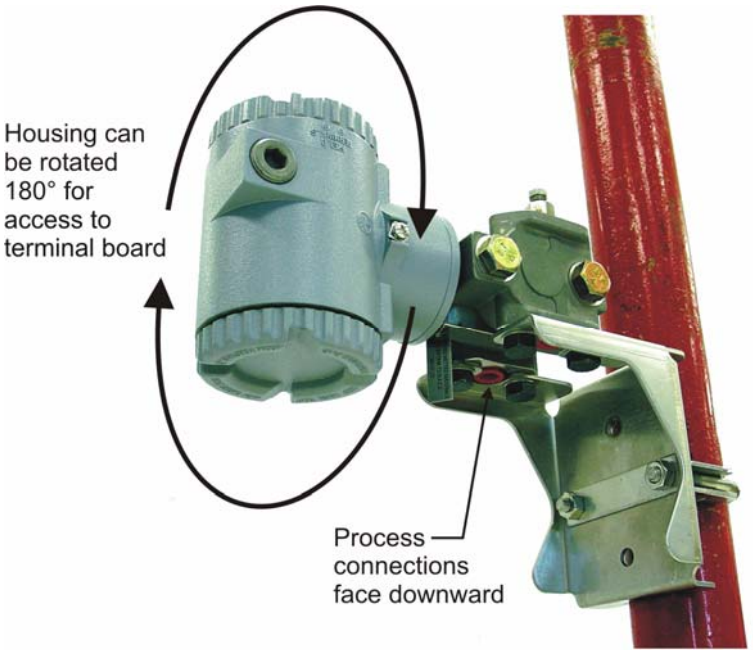


Figure 2-3— Remote-mount installation to vertical pipe; shown with standard sensor with side process connections and optional mounting kit

Hardware Requirements

The MVX-II supports digital serial communications using EIA-RS-485 hardware with AEG Modicon Modbus® protocol. A single Modbus® slave port facilitates both communications with a laptop or PC for operating the MVX-II interface software and communications with a flow computer. The port is protected from high-voltage transients.

The following user-supplied hardware is required or recommended for proper MVX-II installation:

- An RS-485 converter is required for connecting the transmitter to a laptop or PC so that the MVX-II can be configured and calibrated with the MVX-II interface software. The MVX-II is known to be compatible with two such converters that require no handshaking or external power to operate; their connections are shown in Figure 2-7.
- A DB-9 male-to-female extension cable is optional, but recommended, for connecting the RS-485 converter to the laptop or PC.

Sensor Requirements

Before connecting the MVX-II transmitter to the flow line, consider the pressure rating of the sensor, and the presence of harmful gases. The tubing and fixtures used to connect the sensor

to the manifold in the flow line must be manufactured from materials that are appropriate for the pressure ratings of the sensor used.

If H2S is present, use a NACE sensor model and take appropriate precautions to avoid exposure to this hazardous gas.

NACE-compliant sensors for standard pressure ranges (100 to 1500 psia) include NACE bolts; however, NACE-compliant sensors for high-pressure ranges (3000 and 5300 psia) include non-NACE bolts. Note that the bolt classification (NACE/non-NACE) does not affect the NACE classification of the sensor.

Table 1—Bolt Specifications for NACE-Compliant Sensors

Static Pressure	Differential Pressure	NACE Bolts	Non-NACE Bolts
100 PSIA	30 In H2O	B7M	B7
300 PSIA	200 In H2O	B7M	B7
300 PSIA	840 In H2O	B7M	B7
500 PSIA	200 In H2O	B7M	B7
1500 PSIA	200 In H2O	B7M	B7
1500 PSIA	300 In H2O	B7M	B7
1500 PSIA	400 In H2O	B7M	B7
1500 PSIA	840 In H2O	B7M	B7
3000 PSIA	200 In H2O	718 Inconel	B7
3000 PSIA	300 In H2O	718 Inconel	B7
3000 PSIA	400 In H2O	718 Inconel	B7
3000 PSIA	840 In H2O	718 Inconel	B7
5300 PSIA	200 In H2O	718 Inconel	B7
5300 PSIA	300 In H2O	718 Inconel	B7
5300 PSIA	400 In H2O	718 Inconel	B7
5300 PSIA	840 In H2O	718 Inconel	B7

Field Wiring for Single MVX-II

The MVX-II requires power, RTD (optional) and communications connections for proper operation. All field wiring enters into the MVX-II through either of two 1/2" NPT conduit openings in the sides of the enclosure and connects to two terminal blocks on the terminal board circuit assembly (Figure 2-5).

- Field wiring to Terminal Block 1 (TB1) supplies power to the transmitter, and connects the transmitter to the RS-485 converter (for use with a laptop computer or PC) or to a flow computer.
- Field wiring to Terminal Block 2 (TB2) allows the transmitter to sense the temperature of an RTD.

Because the MVX-II has only one communications port, the laptop/PC connections to the terminal board must be disconnected before the flow computer can be connected to the MVX-II. See *Terminal Board Connections for Flow Computer Communications, page 2-8* for instructions on making field connections to the flow computer.

Caution – All field wiring must conform to the National Electrical Code, NFPA 70, Article 501-4(b) for installations within the United States or the Canadian Electric Code for installations within Canada. Local wiring ordinances may also apply. All field wiring must have a wire range of 22 to 14 AWG and terminal block screws must be tightened to a minimum torque of 5 to 7 in-lbs. to secure the wiring within the terminal block. Only personnel who are experienced with field wiring should perform these procedures.

Terminal Board Connections for PC/Laptop Communications

To wire the MVX-II for communication with a laptop or personal computer, perform the following steps. A user-supplied RS-485 to RS-232 converter is required.

1. Remove the cover on the port side of the MVX-II enclosure to access the terminal board (Part No. 30160005, Figure 2-4).
2. Make TB1 connections as follows (see Figures 2-5 through 2-7):
   a. Connect the positive lead from the power supply to Terminal 1.
   b. Connect the negative lead from the power supply to Terminal 2.
   c. Connect the B lead from the RS-485 converter to Terminal 3 (marked A).
   d. Connect the A lead from the RS-485 converter to Terminal 4 (marked B).
   e. Connect the GND lead from the converter to Terminal 5.
3. Make TB2 connections as shown in Figure 2-8, depending on the type of RTD used. Terminal 1 on TB2 is typically not used.

The MVX-II power requirements are 8 to 28 VDC at 30 mA max. The power supply must be limited to 3A by fusing or equivalent overcurrent protection.

Figure 2-4—Location of the terminal board

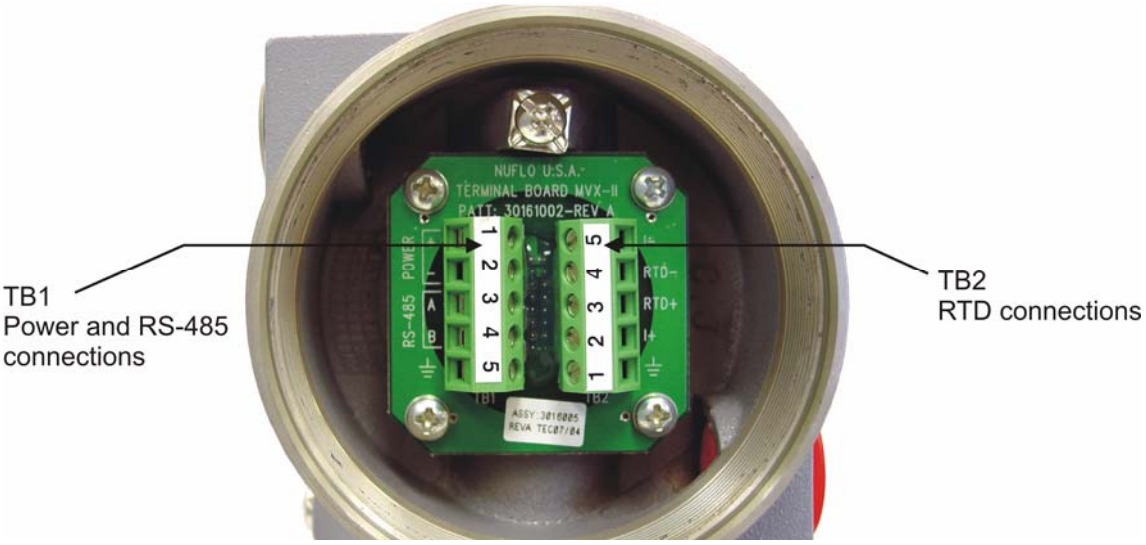


Figure 2-5—Terminal block locations

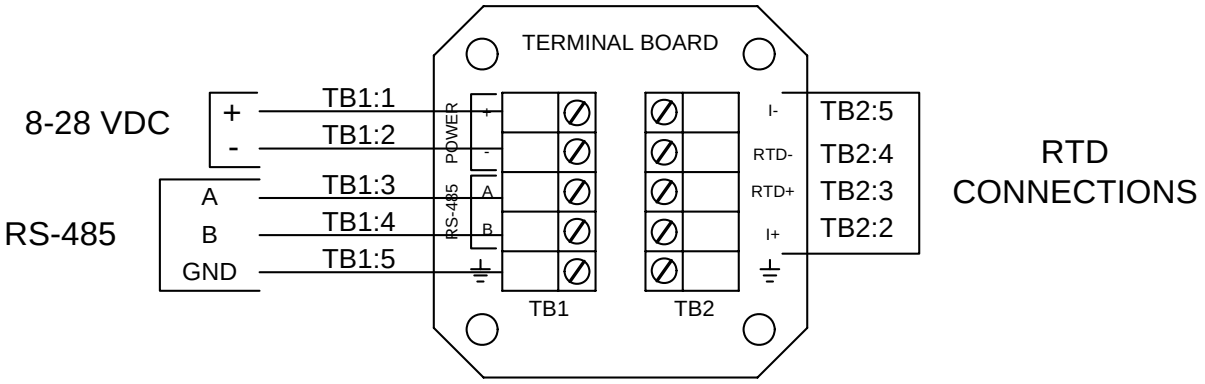


Figure 2-6— Terminal board wiring diagram

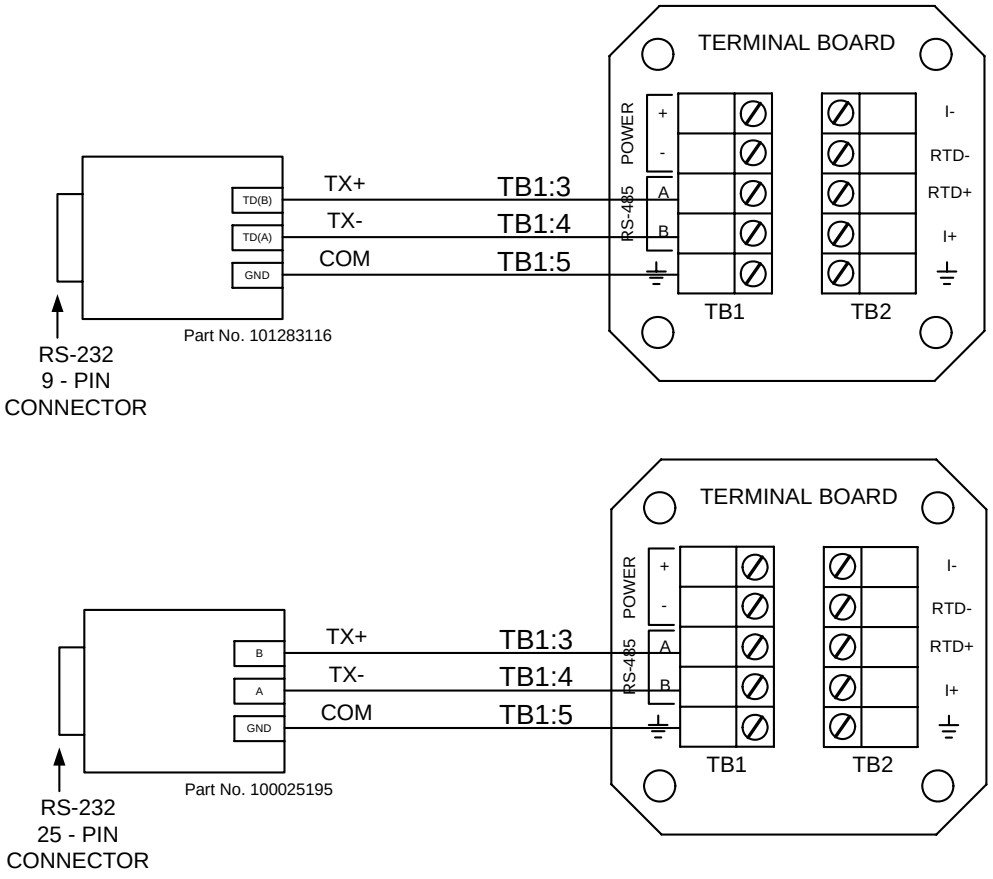


Figure 2-7—Wiring diagrams for 9-pin and 25-pin RS-485 to RS-232 converters

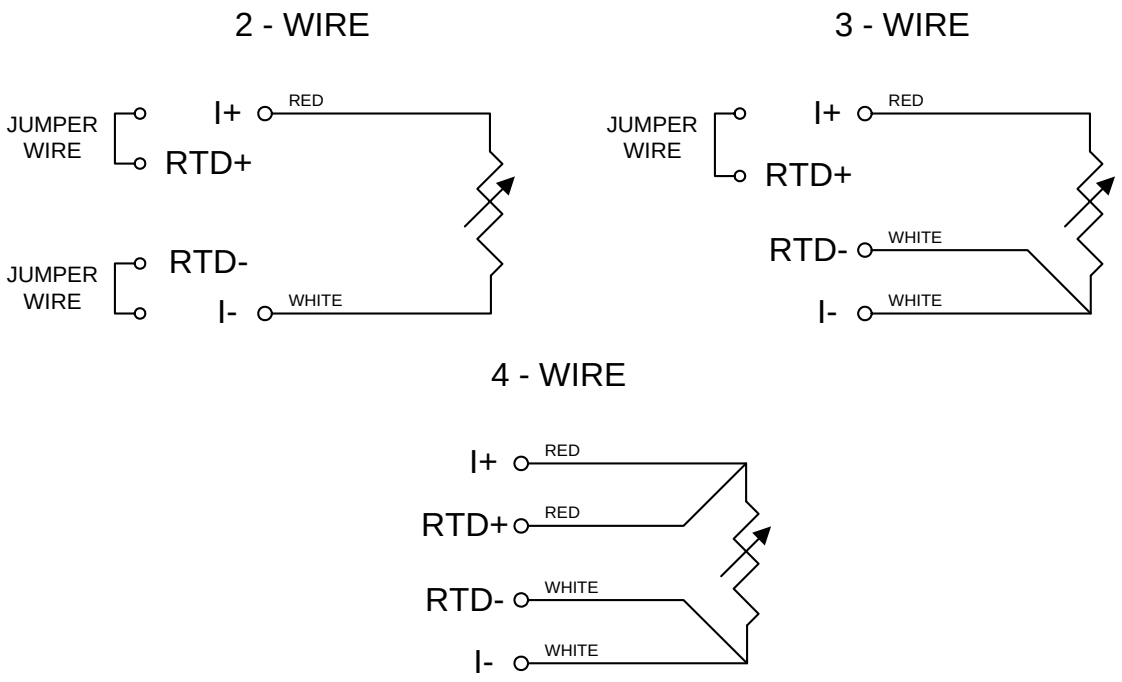


Figure 2-8—Wiring diagrams for 2-wire, 3-wire, and 4-wire RTDs

Terminal Board Connections for Flow Computer Communications

When the MVX-II has been fully configured and calibrated, the transmitter may be disconnected from the laptop or PC and reconnected to a flow computer.

To wire the MVX-II for communication with a flow computer, perform the following steps.

1. Disconnect the RS-485 converter wiring from Terminals 3, 4 and 5 on TB1.
2. Pull the wiring through the conduit opening to remove it from the housing.
3. Route the A and B leads from the flow computer through the conduit opening and connect to Terminals 3 and 4 on TB1. If shielded cable is used for these connections, the shield shall be open at the MVX-II and grounded at the flow computer. The arrangement of these connections may vary, depending on the flow computer manufacturer.
4. Replace the cover on the enclosure and hand-tighten until the cover contacts the housing metal-to-metal.

Caution: **Before connecting the MVX-II transmitter to the flow line, consider the pressure rating of the sensor, and the presence of harmful gases. If H2S is present, use a NACE-compliant sensor. See *Sensor Requirements, page 2-3*.**

Field Wiring for Networked MVX-IIs

Before connecting multiple MVX-IIs together in a network, review the installation and field wiring instructions for a single MVX-II unit. These instructions will apply to your installation, with the following exceptions:

- Multiple Modbus® slave devices must be daisy-chained together.
- Each Modbus® device must have a unique address. See *MVX-II (Unit ID and Serial Number), page 4-2*.
- The devices at each end of the bus must be terminated. Termination for the MVX-II is configured with a jumper.

Termination Settings for Networked MVX-IIs

RS-485 communications loops require termination at the beginning and at the end of the loop. However, any units within the loop should not be terminated, for optimum performance.

When an MVX-II leaves the factory, the RS-485 jumper on the CPU circuit board is terminated. For single unit installations, this setting is appropriate and requires no change to the CPU circuit board. However, if multiple MVX-II units are connected together in a network, the CPU circuit boards of MVX-II units within the loop (between the beginning and ending units) should be set to the non-terminated position.

Jumper W1 on the CPU board determines the termination for the RS-485 communications loop (Figure 2-11).

Changing a Termination Setting

To change an MVX-II communications loop from a terminated position to a non-terminated position, perform the following steps:

1. Remove the cover from the side that is away from the conduit openings of the MVX-II enclosure. The black SI/CPU circuit board mount will be in view (Figure 2-9).
2. Remove the two screws holding this mount in place.
3. Gently pull the SI/CPU circuit board assembly forward, taking care not to disconnect the ribbon cable attached to it. The CPU board is attached to the back of the assembly (Figure 2-9).

Important	**Because of the ribbon cable attachments, the circuit board assembly will not come completely out of the enclosure. Do not attempt to disconnect the ribbon cable, or otherwise disassemble the circuit board assembly. The ribbon cable should be long enough to allow access to the CPU board without disturbing these connections.**

4. Remove the circuit assembly from the housing to access the CPU circuit board (Part No. 30160004).

Important	**Do not attempt to disassemble the circuit assembly. The CPU circuit board is easily accessed when the assembly is intact.**

5. Locate Jumper W1 on the CPU circuit board (Figure 2-10).

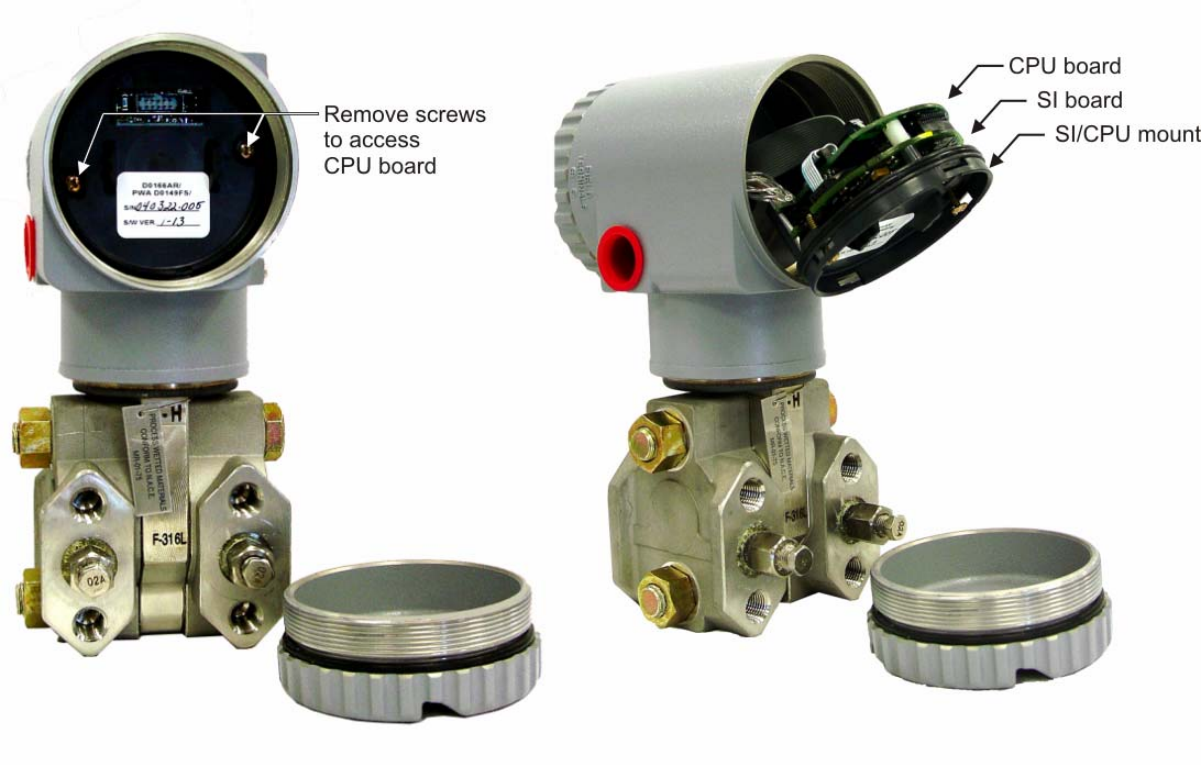


Figure 2-9—Location of the CPU circuit board

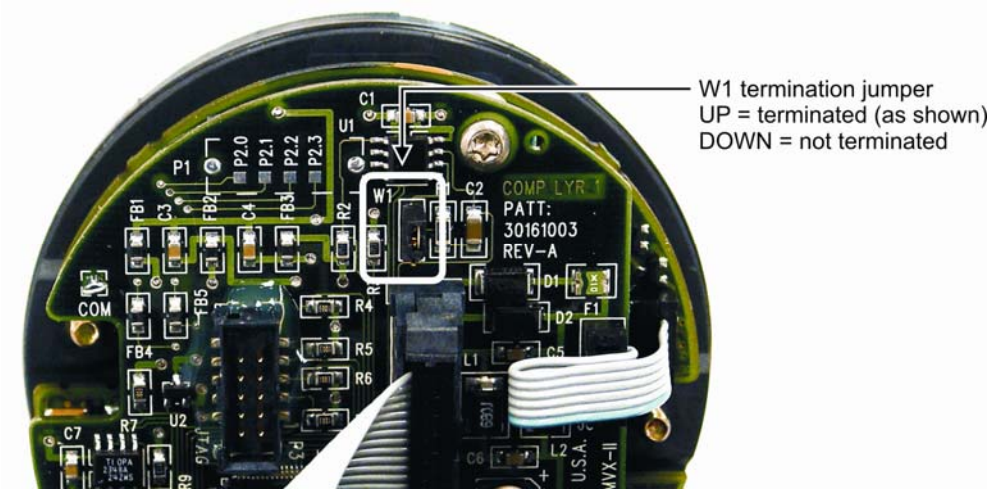


Figure 2-10—Location of W1 termination jumper on CPU board

6. Remove Jumper W1 from the upper position (terminated) and place it in the lower position (non-terminated) (Figure 2-11).

Figure 2-11—Placement of Jumper W1 – RS-485 Termination

Important	**Do not change the termination status of an MVX-II that is located at the beginning or end of the loop. These jumpers should remain in the terminated (upper) position.**

7. Return the SI/CPU board assembly to the MVX-II enclosure and secure it with the two screws.
8. Screw the cover back on the housing and hand-tighten until the cover contacts the housing metal-to-metal.

Section 3

Startup Instructions

Introduction

The MVX-II® software is easily installed on a PC. This section provides step-by-step instructions for installing the software, accessing the software following installation, and navigating the interface screens.

For instructions on configuring and calibrating the MVX-II, see *Section 4* and *Section 5*.

Installing the Interface Software

To install the interface software on your computer, perform the following steps:

1. Select Add/Remove programs in the Control Panel.
2. Click on Add New Programs.
3. Click on CD.
4. Select the location of the setup files on the installation CD or on the computer hard drive.
5. Follow the on-screen instructions to complete the installation.

Upgrading the Interface Software

To upgrade the interface software on your computer to a newer version, perform the following steps:

1. Remove the old version of the software from the computer by selecting Add/Remove programs in the Control Panel; select the Remove option.
2. Open the file folder "C:\Program Files\NuFlo\MVX-II." If there are any files remaining there, delete them.
3. Follow the *Installing the Interface Software* instructions above to install the new version.

Note	**There may be report files on the computer in the folder "C:\NuFlo_MVX." These files will not be deleted when the application is uninstalled. These files may need to be archived or deleted periodically.**

Accessing the MVX-II Software

When the interface software is properly installed, a shortcut icon (left) will appear on the desktop of your PC or laptop computer.

To open the interface software,

- double-click the shortcut icon, or
- go to the Start menu on your PC and follow the path: Programs➔NuFlo➔MVX-II➔MVX-II

The MVX-II Interface Software screen (Figure 3-1) will appear momentarily, and then disappear as the Host Connection screen (Figure 3-2) appears in its place.

Figure 3-1—Interface Software Screen

Figure 3-2—Host Connection Screen

PC Communications Port

The PC Communications Port Number at the top of the Host Connection screen is the number of the serial port on the computer that is connected to the MVX-II. Some applications (such as serial PDAs) may reserve the COM port even though there is no present connection. Ensure that such applications are stopped prior to starting the interface software.

To select a port, click the PC Communications Port Number box. A selection of port numbers will appear. Click on the correct port number (typically 1 or 2).

Connection Type

To connect your PC to the MVX-II software, you must choose one of two connection types:

- Direct Connect – Select this option when connecting directly to a single MVX-II via a cable to COM 1. Communications are performed on COM 1 via an RS-485 port. (See *Section 2* for wiring instructions.)
- Select Unit ID – Select this option when connecting to an MVX-II in applications where multiple MVX-II units are daisy-chained together. The user must know the Unit ID and baud rate of the desired MVX-II . All of the MVX-IIs must be configured to have a unique Unit ID. If the sensors are connected to a master device, such as a flow computer, the master should be removed from service while trying to connect to an MVX-II with the interface software. If you are not sure if the devices have a unique Unit ID, then the instruments should be removed from service except for the desired unit.

Press ***Connect*** to proceed with the connection. The MVX-II Main screen appears (see *Section 4* for help in navigating the Main screen).

Press ***Exit*** to close the MVX-II program.

Section 4

Navigating the MVX®-II Software

Main Screen

The Main screen is the primary user interface that provides access to all other configuration and calibration information. To access the Main screen following installation, click on the MVX-II icon on your computer desktop. The Main screen automatically appears after you have connected to the MVX-II as described in Section 3.

The MVX-II Main screen is separated into five different sections, each defined by faint outlines; the section title appears in the upper left corner of each section (see arrows in Figure 4-1). Each section is described in detail on the following pages of this section.

The parameters that appear on the Main screen on initial startup are default parameters programmed into the MVX-II at the factory. These parameters may be changed to suit specific applications. For example, the static pressure measurement is in terms of PSIG by default, but can be changed to other commonly specified engineering units. For more information see *Changing Engineering Units, page 5-2*.

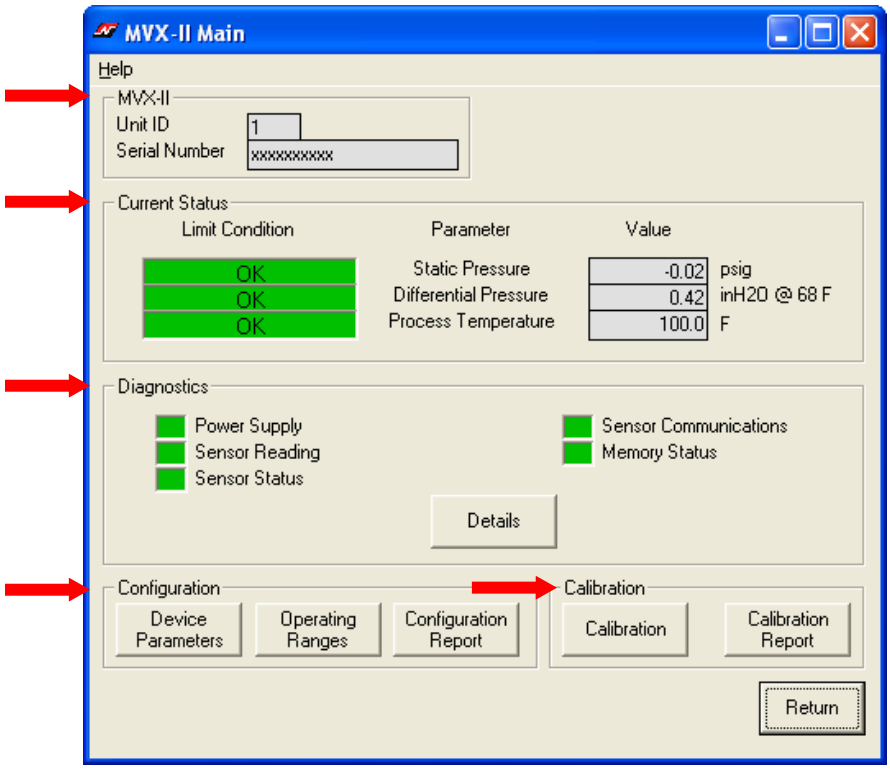
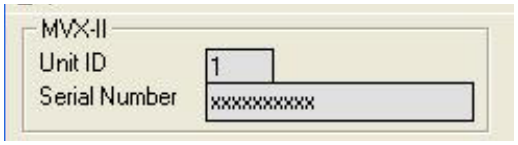


Figure 4-1— MVX-II Main screen

MVX-II (Unit ID and Serial Number)



The Unit ID is a unique identifier for each MVX-II. This identifier may be assigned a number between 1 and 247 (number 248 is reserved). Any information downloaded and displayed using the interface software is linked to this number. This number is the Modbus® address of the MVX-II.

Important The default unit ID for the MVX-II is 1.

The serial number is a unique identifier for the unit. The default serial number matches the serial number printed on the metal tag that is affixed to the MVX-II. To change the serial number to a user-defined number, see *Changing Unit ID / Serial Number, page 5-1*.

Current Status

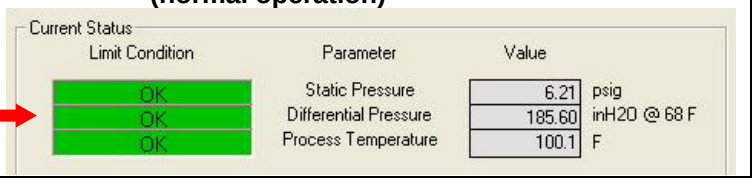
The Current Status section displays values for the following parameters.

- current static pressure (default is psig)
- current differential pressure (default is in. H_2O @ 68°F)
- current process temperature (default is degrees Fahrenheit)

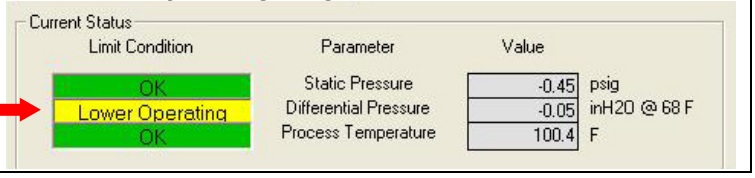
Also in the Current Status section are status indicators for static pressure, differential pressure, and process temperature. Four different indications are possible for each parameter; each indication is defined by a different color in the Limit Condition field (see the example at right showing Differential Pressure status).

For information about changing operating ranges, see *Changing Operating Ranges, page 5-4*.

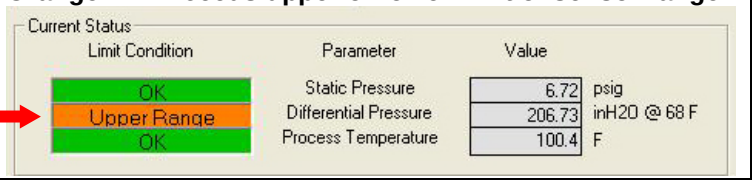
Green: Within the user-defined operating range (normal operation)



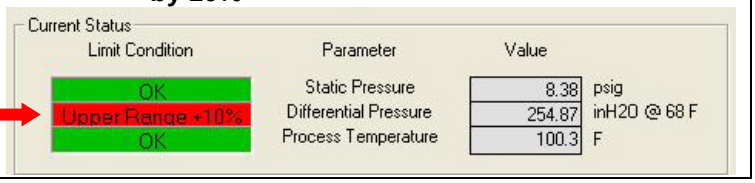
Yellow: Exceeds upper or lower limit of user-defined operating range



Orange: Exceeds upper or lower limit of sensor range



Red: Exceeds upper or lower sensor range limits by 10%



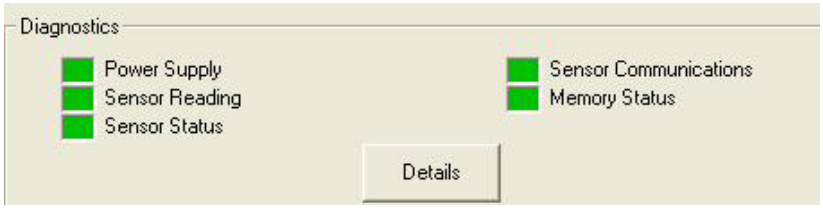
Diagnostics

The Diagnostics section alerts the user to a variety of events that may prevent the MVX-II from operating properly, and/or affect the accuracy of the measurements indicated by the MVX-II. This section is comprised of five indicators: Power Supply, Sensor Reading, Sensor Status, Sensor Communications, and Memory Status.

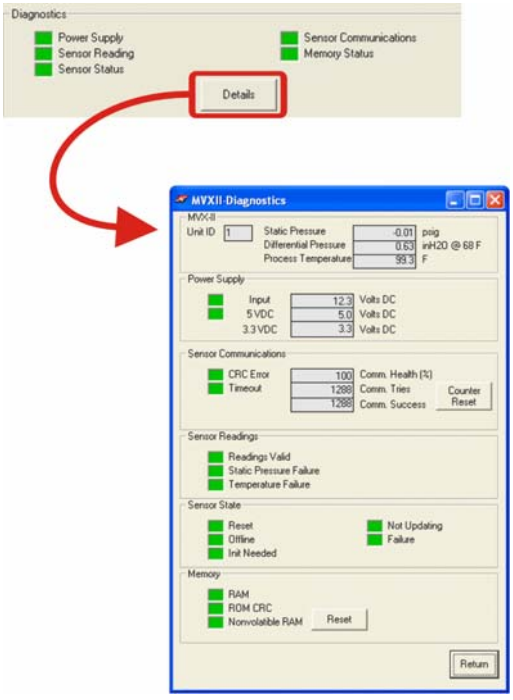
A change in the color of the indicator from green to red alerts the user to a possible problem in the system. Each of these indicators is a summary of grouped status indicators that can be viewed by clicking on the ***Details*** button.

GREEN:
System/component is operating properly.

RED:
System/component is not operating properly and should be checked.



Press the ***Details*** button for a more detailed breakdown of possible causes for the red alert status. Press ***Return*** in the lower right corner of the MVX-II Diagnostics screen to return to the Main screen.



The Details screen is a read-only screen that comprises six different sections. Often, the events triggering an indicator are resolved automatically by the instrument and require no intervention from the user.

Details—MVX-II

The MVX-II section displays the unit ID and Current Status information from the Main screen.

Details—Power Supply

If the power supply indicator from the Main screen is red, this section will provide voltage information.

- If the input voltage is less than 8V (see *Specifications, page 1-5*), it is too low.
- If the input voltage is within the range specified for the MVX-II, but the 5VDC indicator is on (and the voltage is less than 5.0), the source of the problem is the CPU circuit board.

Details—Sensor Communications

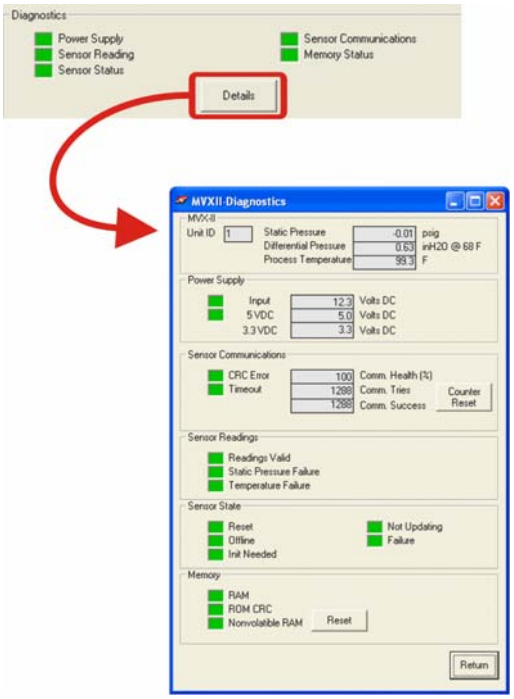
This section identifies sensor communications status and health. Comm Health indicates the number of successful communications between the MVX-II CPU board and the integral sensor in the previous 100 seconds. Comm Tries is incremented with each message attempted by the CPU board. Comm Success is incremented with each successful communication

attempted by the CPU board. (By monitoring these counters, the user can determine long and short-term communication success rate.) To reset the counter, press Counter Reset.

If Timeout is red, the CPU board requested communication from the sensor, but the sensor did not reply in the time allotted. If the CRC Error is red, the CPU board received data from the sensor that did not match the data check at the end of the message.

Details—Sensor Readings

This section helps the user to determine if a problem with the sensor readings involves a temperature or pressure transducer.



Details—Sensor State

This section identifies possible problems with the MVT. If Reset is red, the sensor is in the process of resetting. If too many timeouts or CRC errors are encountered, the Offline indicator turns red.

If Init Needed is red, an internal error has occurred and the sensor requires initialization. The MVX-II will attempt to reset the sensor electronics.

If Not Updating is red, the sensor microcontroller has reported a general sensor failure that could indicate a problem with the analog to digital converter, failure to calculate sensor readings, or failure of the inter-processor communication system.

If Failure is red, the sensor microcontroller has detected any of several failure conditions that can prevent sensor communication, such as input power failure, or CPU board communication failure. Any of the conditions described in *Diagnostics – Register 7* will generate a Failure indication on the Details screen.

Details—Memory

This section identifies problems with RAM, ROM CRC, or nonvolatile RAM (resettable). If Nonvolatile RAM is red, the CPU has detected an error in its memory and has replaced the nonvolatile RAM with factory default data. The indicator will remain red until Reset is pressed.

Important **After the Reset button is pressed, the user must reconfigure and recalibrate the MVX-II to restore the last settings used or establish new settings.**

Configuration

The Configuration section of the Main screen allows the user to establish operating parameters, determine the units that will be used to measure static pressure, differential pressure, and process temperature, and save the new configuration settings for future reference.

Configuration tools are provided in three different Configuration screens; all three screens are accessed from the Configuration section at the bottom of the Main screen (Figure 4-2) by clicking on the appropriate button.

Configuration screens and their functions include:

- ***Device Parameters***
  - view and/or change MVX unit ID and serial number
  - view MVX-II firmware/ register table versions, and model ID
  - change atmospheric pressure
  - change engineering units
  - change baud rate/word order and delay timing for MVX-II communications
- ***Operating Ranges***
  - enter operating ranges for static pressure, differential pressure, and process temperature
  - enter override parameters for static pressure, differential pressure, and process temperature
- ***Configuration Report***
  - take a snapshot of current parameters, diagnostics, power and sensor status, and operating range information
  - save the information in an rtf file
  - print the information in a one-page report

See *Section 5* for instructions on configuring the MVX-II.

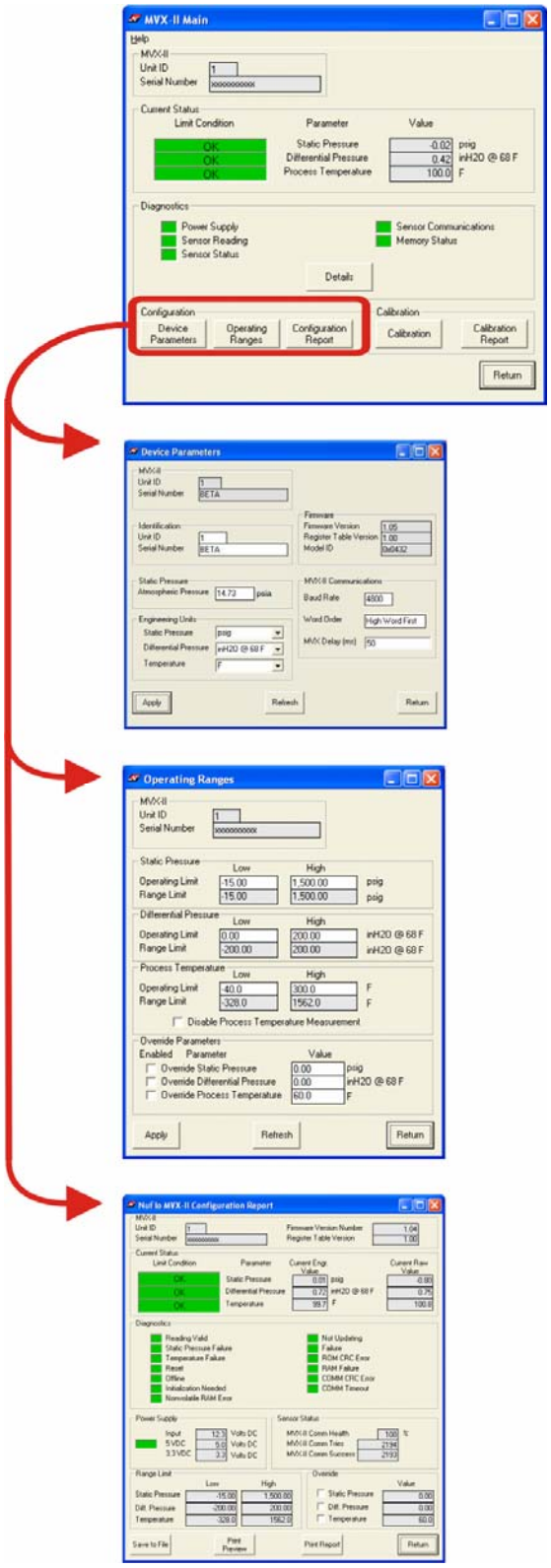


Figure 4-2—Configuration Screens

Calibration

The Calibration section allows the user to calibrate static pressure, differential pressure, and process temperature using up to five calibration points, and to create a calibration report for future reference.

From the Main screen, the user can select either of the two Calibration screens by clicking on the appropriate button (Figure 4-3):

- ***Calibration***– calibrate static pressure, differential pressure, and process temperature measurements
- ***Calibration Report*** – create a report of current and previous calibration settings for static pressure, differential pressure, and process temperature

See *Section 6* for detailed instructions on calibrating the MVX-II.

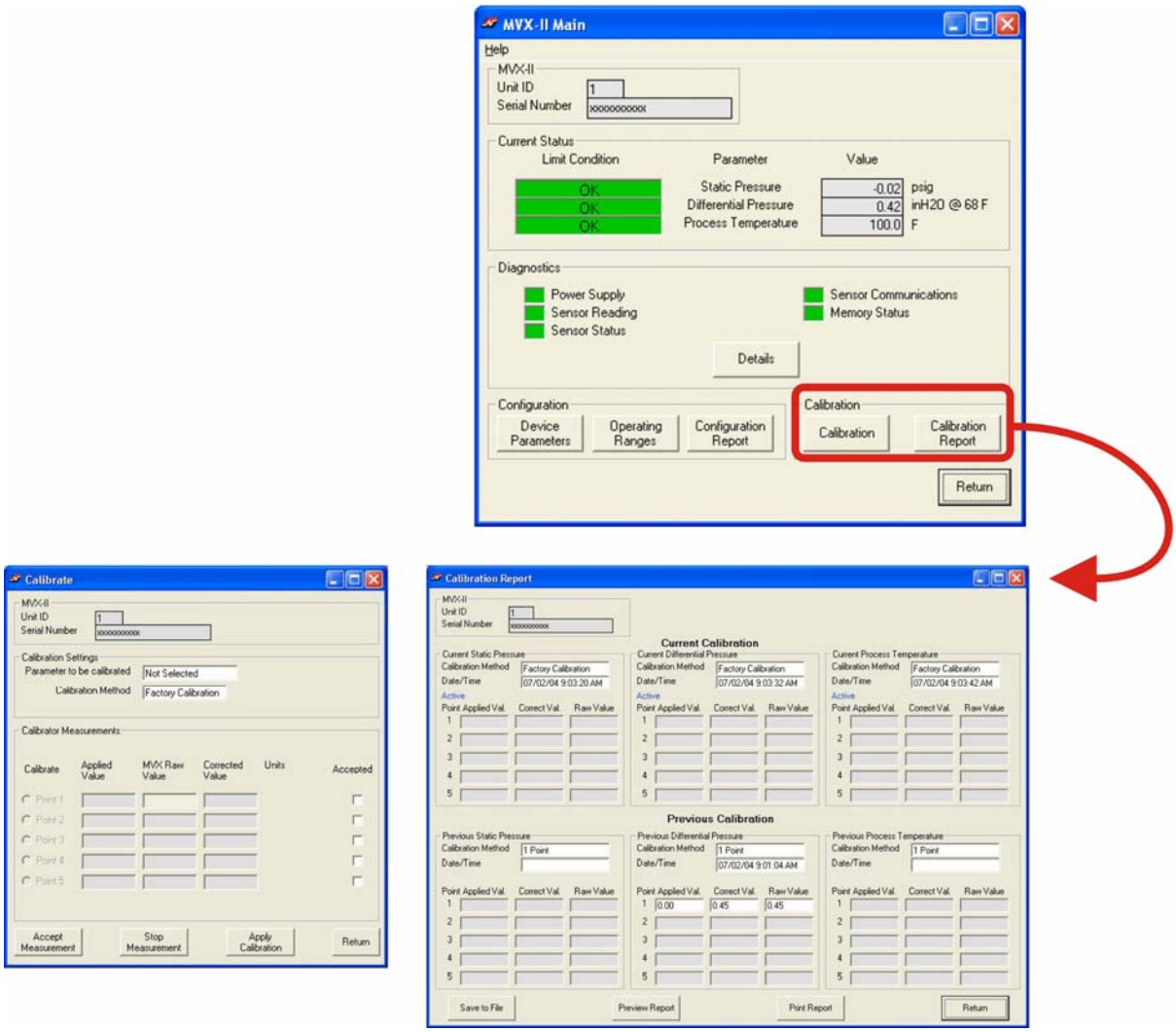
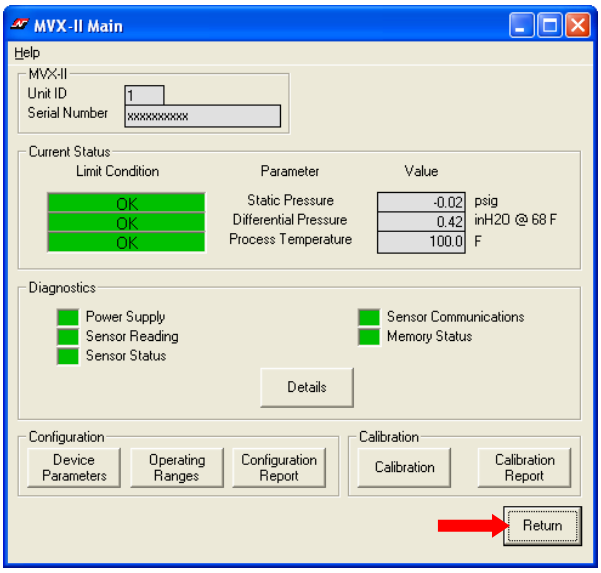


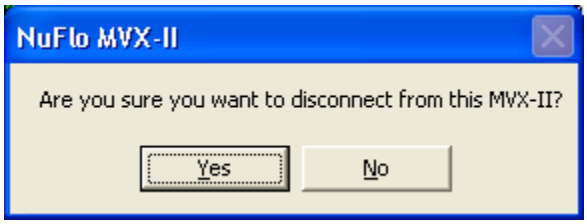
Figure 4-3—Calibration Screens

Disconnecting From the MVX-II

Press ***Return*** in the lower right corner of the Main screen to disconnect from the MVX-II software.



A prompt will appear, asking "Are you sure you want to disconnect from this MVX-II?"



Press ***No*** to return to the MVX-II Main screen.

Press ***Yes*** to disconnect your PC from the MVX-II and return to the Host Connection screen.

Press ***Exit*** to clear the Host Connection screen and return to the PC operating system.

Press ***Connect*** to reconnect to the MVX-II.

Section 5

Configuring the MVX®-II Transmitter

Introduction

The MVX-II is fully operational upon installation. However, a user typically configures the MVX-II to meet the requirements of a specific application. Configuration tools are accessed through the Configuration section of the Main screen (see Figure 4-2).

This section contains instructions for the following tasks:

- changing the unit ID and serial number of the MVX-II
- specifying atmospheric pressure
- changing engineering units for static pressure, differential pressure and process temperature
- changing communication parameters
- changing operating ranges for static pressure, differential pressure, and process temperature
- enabling and changing the override values for static pressure, differential pressure and process temperature
- generating a configuration report

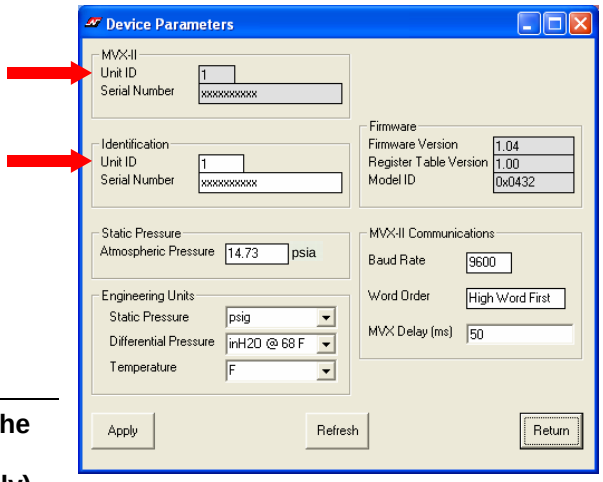
Important **When making changes to data fields, the background of the field will change to yellow. This is a reminder to the user that this data has been changed, but not written to the MVX-II. To make the changes effective, the user must press** Apply**. When a new entry is written to the MVX-II, the data field reverts to its original appearance.**

Changing Unit ID / Serial Number

Go To: Main Screen>Device Parameters

The unit ID and serial number of the MVX-II is shown in two places on this screen: in the MVX-II section (read-only) and in the Identification section.

To change this data, new numbers must be entered in the Identification section. Click in the appropriate data field, delete the characters that are invalid, and retype the new digits.



Important **Press *Apply* to write the changes to the MVX-II.**
Press *Refresh* (before you press Apply) to erase unsaved changes and restore previous settings.
Press *Return* to return to the Main screen.

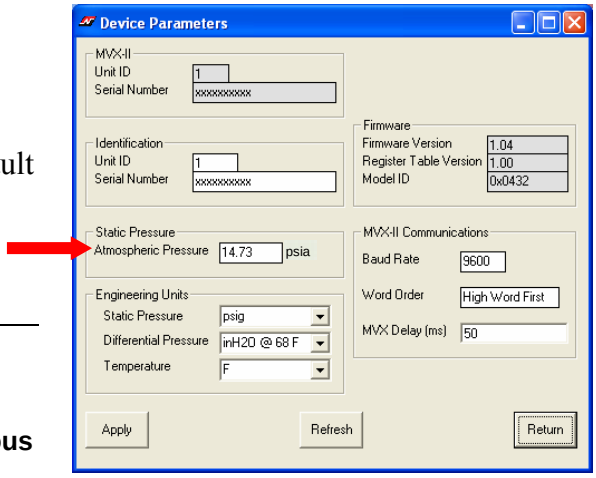
When the new entry is applied to the MVX-II, the new value will appear in both the Identification and MVX-II sections of the screen.

Changing Atmospheric Pressure

Go To: Main Screen>Device Parameters

The Static Pressure section of the Device Parameters screen displays atmospheric pressure (psia is the default unit).

To change this value, click in the box, delete the value displayed, and retype a new value in the box.



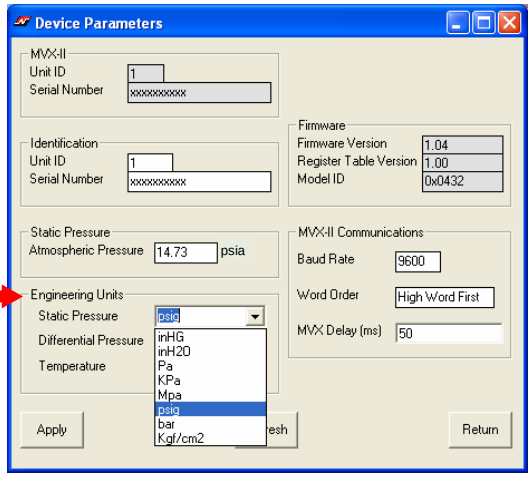
Important **Press *Apply* to write the changes to the MVX-II.**
Press *Refresh* (before you press Apply) to erase unsaved changes and restore previous settings.
Press *Return* to return to the Main screen.

Changing Engineering Units

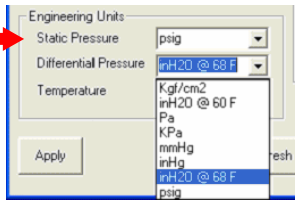
Go To: Main Screen>Device Parameters

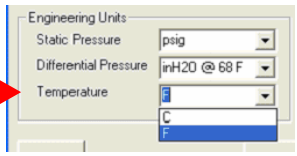
The Engineering Units section of the Device Parameters screen defines the units in which static pressure, differential pressure, and process temperature will be measured. Defaults are psig for static pressure; in. H_2O @ 68°F for differential pressure, and degrees Fahrenheit for temperature.

To change the engineering units, click on the drop-down arrow in the data field to view all available units, then click on the desired unit. Repeat as required.



Important **Press *Apply* to write the changes to the MVX-II.**
Press *Refresh* (before you press Apply) to erase unsaved changes and restore previous settings.
Press *Return* to return to the Main screen.

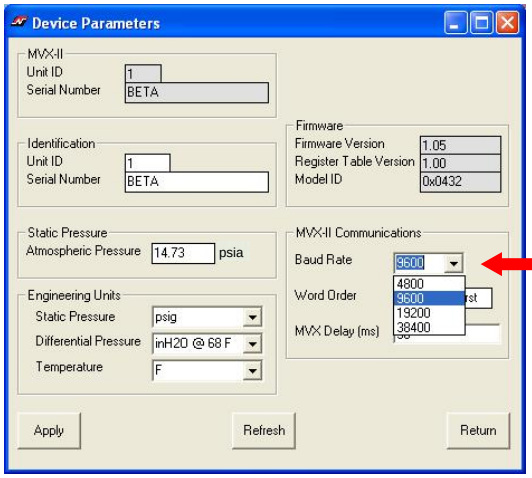


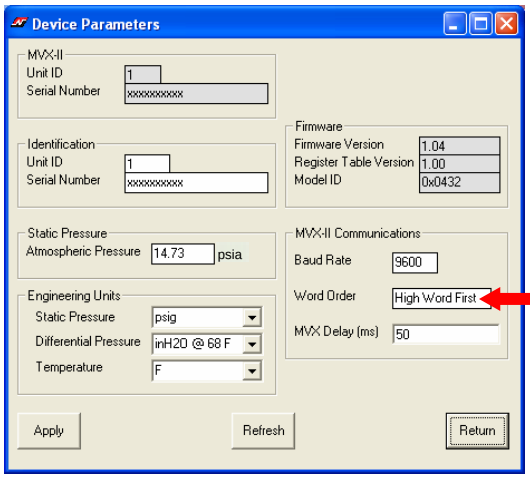


Changing Communication Parameters

Go To: Main Screen>Device Parameters

The MVX-II Communications section of the Device Parameters screen defines the baud rate and word order for communicating with the flow computer.





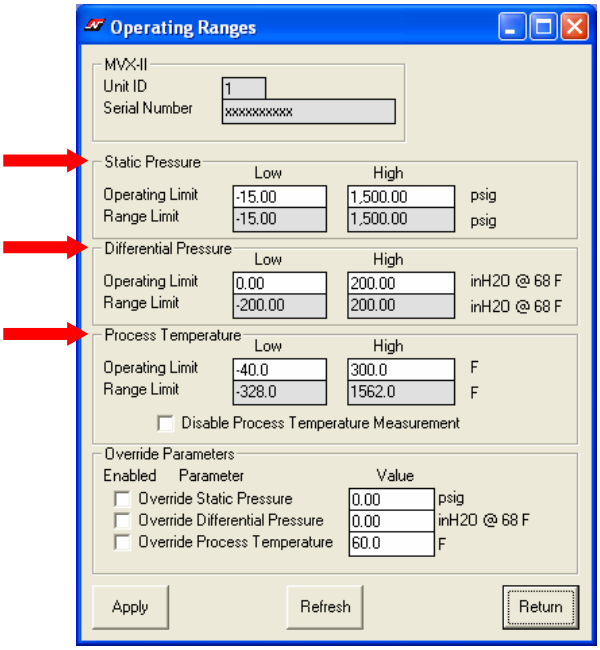
- **Baud Rate** – The selections are 4800, 9600, 19200 and 38400 baud. The default setting of 9600 baud should be retained for use with the NuFlo Scanner 1150 flow computer.
- **Word Order** – The selections are High Word First or Low Word First. This setting impacts the floating point of long integers, and is determined by the requirements of the flow computer used with the MVX-II. The default setting—High Word First—should be used with any NuFlo flow computer.
- **MVX Delay (ms)** - This is the amount of time (in milliseconds) that passes before the MVX-II attempts to take control of the RS-485 bus and transmit a message back to the requesting device. The MVX-II responds very quickly to incoming Modbus® requests—in some cases, too quickly. A configurable delay allows the user to control this response. A setting of 10 ms is normally sufficient, but may require adjustment when the MVX-II is communicating with an end device that responds more slowly.

To change the settings in either field, click inside the data field to view a dropdown arrow; click on the arrow to view the selections available, and click on the desired selection.

Important **Press *Apply* to write the changes to the MVX-II.**
Press *Refresh* (before you press Apply) to erase unsaved changes and restore previous settings.
Press *Return* to return to the Main screen.

Changing Operating Ranges

Go To: Main Screen>Operating Ranges



The Static Pressure, Differential Pressure, and Process Temperature sections of the Operating Ranges screen define the upper and lower pressure and temperature limits for an operating range that the user deems acceptable.

- The Range Limit values shown (gray fields) are set by the sensor and cannot be changed.
- The Operating Limit values (white fields) are determined by the user. The Operating Limit values are frequently set to match the calibrated range or Range Limit values.

The Range Limit and Operating Limit values provide the setpoints for the Limit Condition indicators on the Main screen. A limit condition is triggered by a measurement that exceeds the Range or Operating limits.

See *Current Status, page 4-2*, for an illustration of the Limit Condition indicators.

To change an operating limit for an input parameter, click inside the white data field, delete the existing value, and retype a new value. Allowable ranges and default values are shown below.

- **Static Pressure Low** – allowable range: -15.0 to 5300.0 PSIG
- **Static Pressure High** –allowable range: -15.0 to 5300.0 PSIG
- **Differential Pressure Low** –allowable range: -840.0 to 840.0 in. H_2O at 68°F
- **Differential Pressure High** –allowable range: -840.0 to 840.0 in. H_2O at 68°F
- **Process Temperature Low** –allowable range: -40.0°F to 300.0°F
- **Process Temperature High** –allowable range: -40.0°F to 300.0°F

Important **If no RTD is being used with the MVX-II, check the "Disable Process Temperature Measurement" checkbox. Then check the Override Process Temperature checkbox and enter an override value that is within the Process Temperature operating limits. See also *Changing Override Parameters, page 5-5*.**

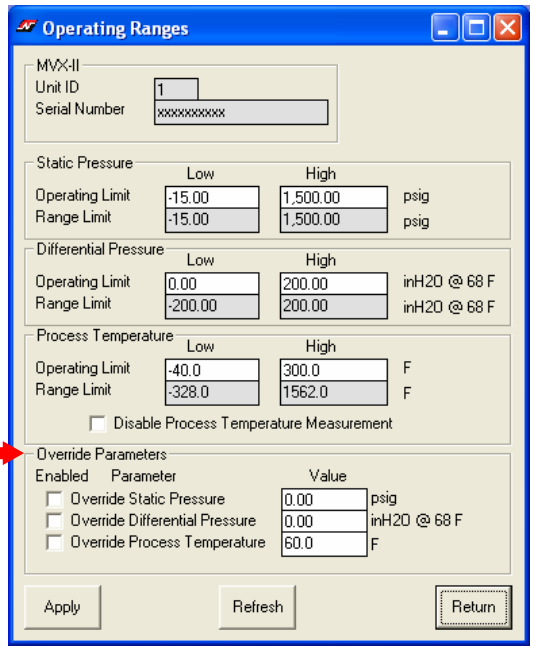
Important **Press *Apply* to write the changes to the MVX-II.**
Press *Refresh* (before you press Apply) to erase unsaved changes and restore previous settings.
Press *Return* to return to the Main screen.

Changing Override Parameters

Go To: Main Screen>Operating Ranges

The Override Parameters section of the Operating Ranges screen also allows a user to override transmitter inputs and use a constant value instead.

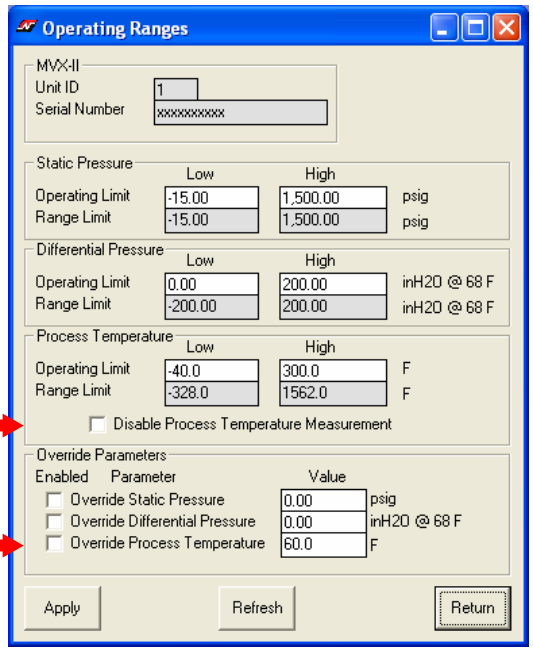
To override a measurement, check the appropriate checkbox in the Override Parameters section and enter a constant value in the data field to the right of the checkbox. Press ***Apply***.



Note	**The override values are not in effect unless the checkbox is checked.**

Allowable ranges and default values are shown below.

- **Override Static Pressure**
  allowable range: -15.0 to 5300.0 PSIG
  default: 0 psig
- **Override Differential Pressure**
  allowable range: -840.0 to 840 in. H_2O
  default: 0 in. H_2O
- **Override Process Temperature**
  allowable range: -40.0°F to 300.00°F
  default: 60°F



Important	**If no RTD is being used with the MVX-II, check the "Disable Process Temperature Measurement" checkbox. Then check the Override Process Temperature checkbox and enter an override value that is within the process temperature operating limits. The Disable Process Temperature Measurement setting prevents a disconnected RTD from activating the Readings Valid and Temperature Failure diagnostic alarm indicators. Setting a process temperature override that is within the operating limits will prevent a change in the "green" (normal operation) status shown by the Limit Condition indicator for temperature in the Current Status section of the Main screen.**

Important	**Press *Apply* to write the changes to the MVX-II. Press *Refresh* (before you press Apply) to erase unsaved changes and restore previous settings. Press *Return* to return to the Main screen.**

To disable an override parameter, clear the Enabled checkbox for the appropriate enabled override. The checkmark will disappear and the MVX-II will resume reading the parameters from the sensor.

Generating a Configuration Report

Go To: Main Screen>Configuration Report

The Configuration Report screen allows a user to take a snapshot of configuration data and save it in an electronic configuration report for future reference.

A report showing current transmitter inputs, diagnostic status indications, and operating range limits/override settings appears immediately on screen when you click on the Configuration Report button on the Main screen.

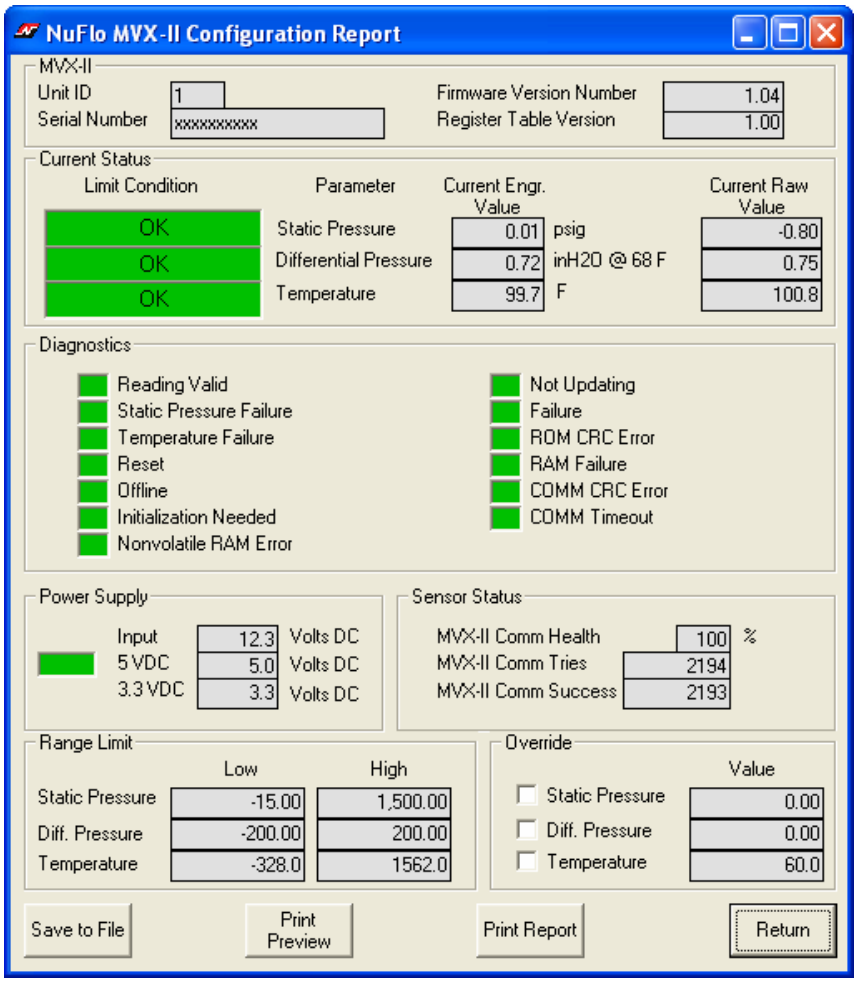
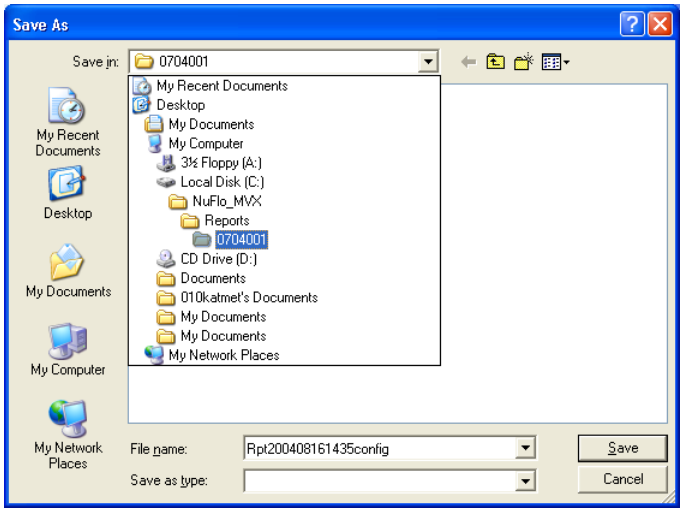


Figure 5-1—MVX-II Calibration Report screen

From the Configuration Report screen, you can save the information to a rich text file (rtf) or print the file directly from your PC.

Saving an RTF File

To save an rtf file, perform the following steps:



1. Click ***Save to File***. A new Save As window on your PC will open.
2. Rename the file, if desired. The default filename uses the following name structure: Rpt(YYYYMMDDHHMM> config.rtf
3. Using the *Save in* drop-down menu, choose the location where you want the file to be saved. The default location is C:\NuFlo_MVX\Reports\<serial number>.
4. Press ***Save*** in the Save As window to save the file.

Printing the Report

To print the file, press ***Print Report***. A new Print window will open on your PC, allowing you to select a printer.

To preview the file before printing, press ***Print Preview*** at the bottom of the Configuration Report screen.

A sample printout is shown on the following page.

NuFlo MVX-II
Configuration Report
12/7/2004 2:18:02 PM

Configuration Program Version: 1.10
Serial Number: MVX_BETA
Device ID: 0x0432
Firmware Version: 1.04
Register Table Version: 1.00

Current Status

	Engr. Value	Raw. Value	Unit	Condition
Static Press.	5.15	4.36	psig	OK
Diff. Press.	145.82	145.87	inH2O @ 68	OK
Process Temp.	200.3	201.4	F	OK

Diagnostics

Reading Valid	Normal
Static Press. Failure	Normal
Temperature Failure	Normal
Reset	Normal
Offline	Normal
Initialization Needed	Normal
Nonvolatile RAM Error	Normal
Not Updating	Normal
Failure	Normal
ROM CRC Error	Normal
RAM Failure	Normal
COMM CRC Error	Normal
COMM Timeout	Normal

Power Supply

Input	12.3 Volts DC
5 VDC	5.0 Volts DC
3.3 VDC	3.3 Volts DC
5V	Normal

Sensor Status

MVX Comm Health	100 %
MVX Comm Retries	2187
MVX Comm Success	2187

Range Limit	LOW	HIGH	UNIT
Static Pressure	-15.00	5,300.00	psig
Diff. Pressure	-200.00	200.00	inH2O @ 68
Temperature	-328.0	1562.0	F

Override	VALUE	Enable	UNIT
Static Pressure	0.00	No	psig
Diff. Pressure	0.00	No	inH2O @ 68
Temperature	60.0	No	F

Section 6

Calibrating the MVX®-II Transmitter

Introduction

The MVX-II is calibrated at the factory. However, a user should recalibrate as required to ensure accurate measurement parameters. All calibration settings are controlled from the Calibrate screen. To access this screen from the Main screen, press Calibration (see Figure 4-2).

Important **When the MVX-II transmitter is installed with a flow computer, it may be necessary to calibrate the MVX-II using the flow computer software. For example, the NuFlo Scanner 1150 flow computer requires MVX-II calibration to be performed using the Scanner software. The calibration procedures described in this section will not apply in such cases. Users who are unsure of which calibration procedures to use should contact the flow computer manufacturer.**

This section of the manual contains instructions for the following tasks:

- calibrating the MVX-II
- generating a calibration report

Important **When making changes to data fields, the background of the field will change to yellow. This is a reminder to the user that this data is not written to the MVX-II. To make the changes effective, the user must press *Apply Calibration*. When a new entry is written to the MVX-II, the data field reverts to its original appearance.**

Calibration Options

To calibrate the MVX-II, you must select the parameter to be calibrated (static pressure, differential pressure, or process temperature) and the method to be used to calibrate the unit. The MVX-II Calibrate screen provides eight different calibration options to choose from:

- Factory Calibration: loads default calibration values set at the factory
- 1-Point: applies an offset correction
- 2-Point: applies a slope and offset correction
- 3-Point: applies a point-to-point linearization using three calibration points
- 4-Point: applies a point-to-point linearization using four calibration points
- 5-Point: applies a point-to-point linearization using five calibration points
- Previous Calibration: applies the last set of calibration settings saved previous to the current settings (actual values are not displayed)
- Current Calibration: applies the most recent set of calibration settings saved in a full calibration

If Factory Calibration, Previous Calibration, or Current Calibration is selected, no further data entry is required, and the calibration settings are enabled simply by pressing ***Apply Calibration***.

To calibrate the unit with user-supplied calibration point values, the user will select a 1-, 2-, 3-, 4-, or 5-point calibration in the Calibration Settings section, and enter the required calibration point values in the "Applied Values" column of the Calibrator Measurements section.

The Calibrator Measurements section displays three values for each calibration point:

- **Applied Value** – The user enters the value of the parameter being calibrated in this box. (For example, if 25°F is the RTD temperature, the user enters 25 in this box.).
- **MVX Raw Value** – This read-only box displays the raw value reported by the sensor in the MVX-II.
- **Corrected Value** – This read-only box displays the value of the parameter based on the existing "active" calibration.

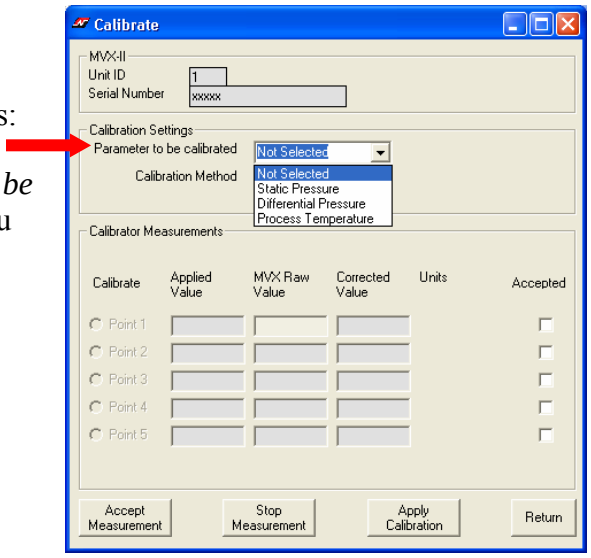
Once the calibration points are entered, the four buttons at the bottom of the screen are used for completing the calibration process, and exiting the Calibrate screen:

- ***Accept Measurement*** – This button is pressed when the calibration point has been entered and the screen indicates the input is stable.
- ***Stop Measurement*** – This button stops the calibration process and allows the user to re-enter the parameter value in the Applied Value field.
- ***Apply Calibration*** – Pressing this button causes the new calibration data set to be sent to the MVX-II. This button is pressed after all calibration points have been entered and 'Accepted'. Until this button is pressed, the previous calibration is still in effect.
- ***Return*** – Pressing this button returns the display to the MVX-II Main screen.

MVX-II Calibration Procedure

Go To: Main Screen>Calibration

To calibrate the MVX-II, perform the following steps:



1. In the Calibrate screen, click in the *Parameter to be calibrated* data field, and select the parameter you wish to calibrate.
2. Click in the *Calibration Method* data field, and select one of eight calibration methods:
   - Factory Calibration
   - 1-Point
   - 2-Point
   - 3-Point
   - 4-Point
   - 5-Point
   - Previous Calibration
   - Current Calibration

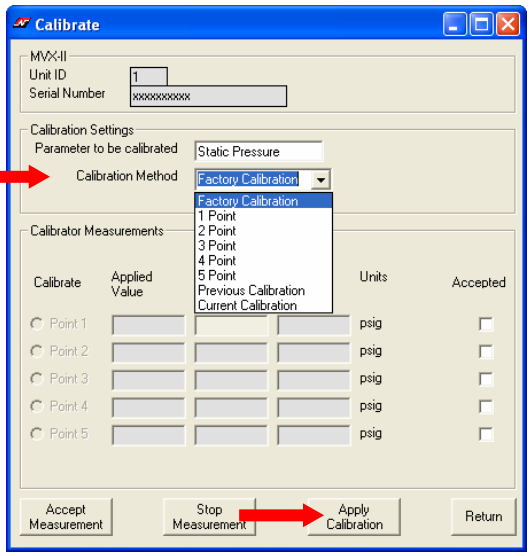
See *Calibration Options, page 6-1* for a description of each calibration method.

Factory Calibration

Selecting Factory Calibration will load the original calibration settings that were applied to the MVX-II before it left the factory. No further data entry is required.

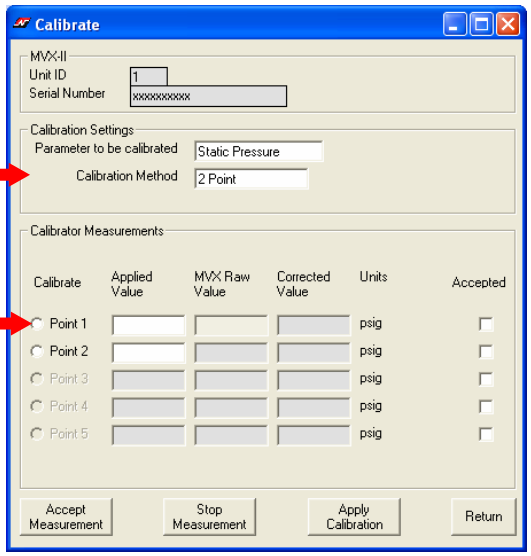
Note	**Actual calibration values are not displayed when this calibration option is active.**

Click ***Apply Calibration*** to activate the factory default settings.



Custom Calibration (1-Point through 5-Point)

If custom calibration (1-Point, 2-Point… 5-Point) is selected, the Applied Value boxes in the Calibrator Measurements section of the screen will change to white, and the cursor will flash in the Point 1 Applied Value data field, prompting you to enter a value.

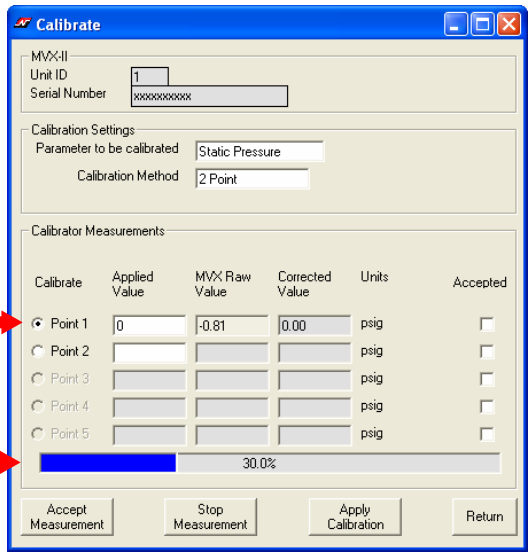


1. Enter an appropriate value in the Applied Value data field for Point 1. Calibration points can be entered in ascending or descending order.

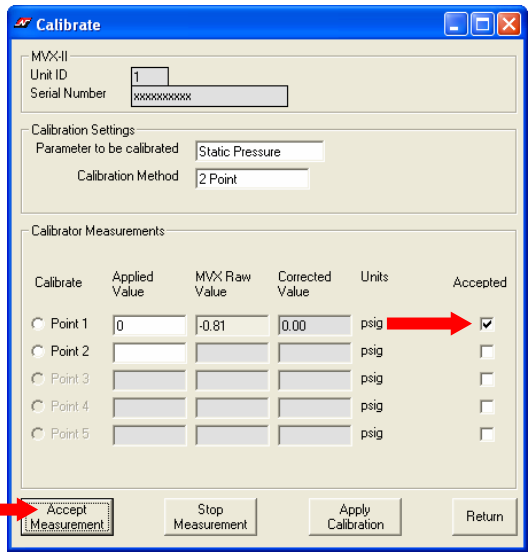
2. Click on the round checkbox to the left of the Applied Value data field to start the calibration process.

   A black dot will appear inside the round checkbox, and a blue bar will appear at the bottom of the screen as the MVX-II samples the output of the sensor. The MVX raw and corrected values will appear and update during the sampling process.

   When the samples of the output values are stable, the blue sampling progression bar will read 100% complete.



3. Click Accept Measurement to accept the values shown. A checkmark will appear in the "Accepted" column at the right of the screen.



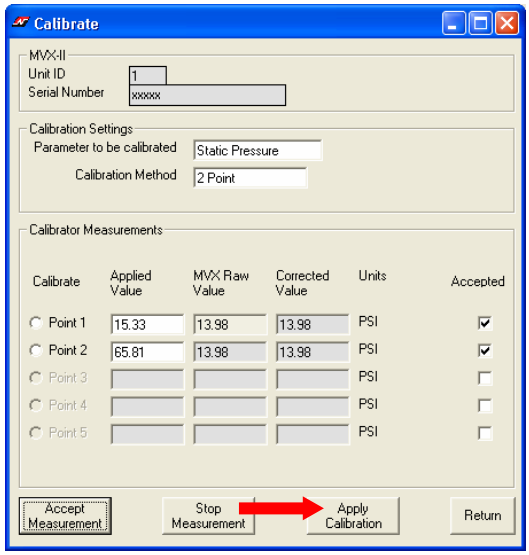
Note **Be sure to click on the appropriate round checkbox before you press *Accept Measurement*. If the round box is not selected, the *Accept Measurement* button is disabled and this error message will appear.**

4. Repeat Steps 1 through 3 for multiple-point calibrations. The calibration points do not need to be entered in any order based on the measurement value. The software will sort the calibration points prior to applying the calibration to the sensor.

Note **Verify that all values are marked as "Accepted" in the right column. Failure to accept a value will prevent calibration settings from being applied, and will cause the following error message to appear.**

5. Press ***Apply Calibration*** to write the new calibration settings to memory.

   The new settings will become the "Current" calibration data set. See also *Previous and Current Calibration, page 6-5*.

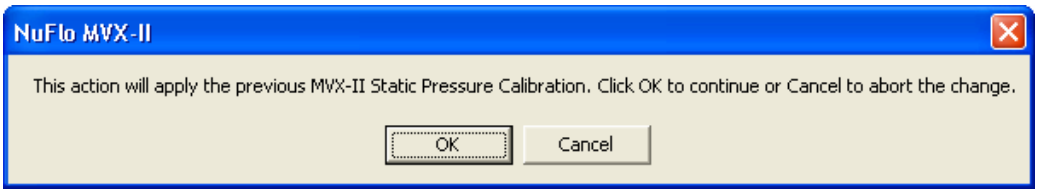


"Previous" and "Current" Calibration

Please note that the two most recent calibration data sets—Current and Previous— are always accessible to the user. The words "Current" and "Previous" refer to the order in which the data sets are written to memory.

To select the Previous Calibration data set, perform the following steps:

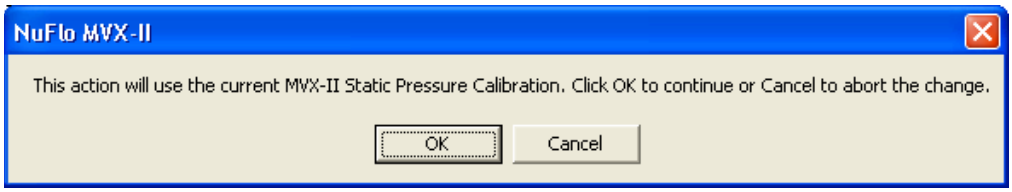
1. Select the parameter to be calibrated with the Previous Calibration values.
2. Choose ***Previous Calibration*** in the Calibration Method data field. No data will appear in the Calibrator Measurements section.
3. Press ***Apply Calibration***. The following message will appear.



4. Press OK to enable the "Previous" calibration data set.

To restore the Current calibration data set, perform the following steps:

1. Select the parameter to be calibrated with the Current Calibration values.
2. Choose ***Current Calibration*** in the Calibration Method data field. Current calibration data will appear in the Calibrator Measurements section.
3. Press ***Apply Calibration***. The following message will appear.



4. Press OK to enable the "Current" calibration data set.

The oldest of the two data sets—Previous—is continually replaced in MVX-II memory as new calibration data sets are applied.

The following example illustrates how calibration data is removed with each addition of a new data set. In this example, Calibration 1 is the "Previous" data set and Calibration 2 is the "Current" data set:

- Calibration 2 (Current)
- Calibration 1 (Previous)

When a new set of calibration settings is applied, it becomes "Current." Calibration 2 becomes "Previous," and Calibration 1 is removed from memory.

- New Data Set (Current)
- Calibration 2 ~~(Current)~~ (Previous)
- Calibration 1 ~~(Previous)~~ (Removed from memory)

Generating a Calibration Report

Go To: Main Screen>Calibration Report

The Calibration Report screen allows a user to view the calibration settings and to save the calibration settings for future reference. Without this report, calibration settings (not including Factory Calibration settings) will be lost as the unit is recalibrated and the memory is overwritten.

A report showing Current and Previous calibration data appears immediately on screen when you click on the Calibration Report button on the Main screen. The word "Active" appears in blue, indicating which data set is enabled at the time the report is generated (Figure 6.1). The date and time indicates when the calibration was performed.

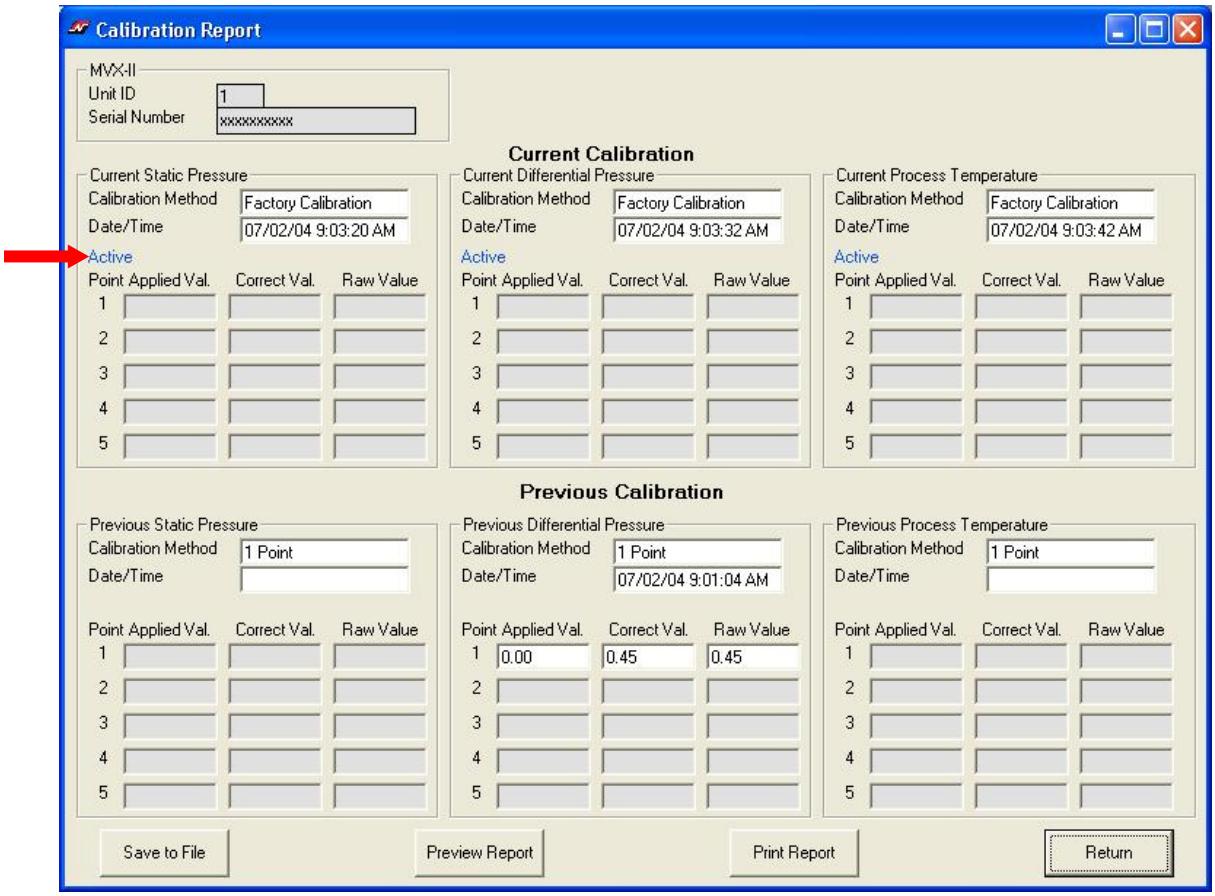
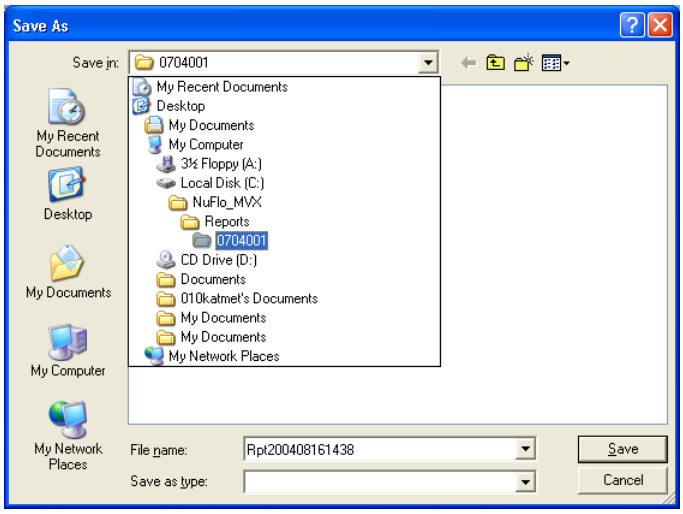


Figure 6-1— MVX-II Calibration Report screen

From the Calibration Report screen, you can save the information to a rich text file (rtf) or print the file directly from your PC.

Saving an RTF File

To save an rtf file, perform the following steps:



1. Click ***Save to File***. A new *Save As* window on your PC will open.
2. Rename the file, if desired. The default filename uses the following name structure: Rpt<YYYYMMDDHHMM>.rtf
3. Using the *Save in* drop-down menu, choose the location where you want the file to be saved. The default location is C:\NuFlo_MVX\Reports\<serial number>
4. Press ***Save*** in the *Save As* window to save the file.

Printing the Report

To print the file, press ***Print Report***. A new Print window will open on your PC, allowing you to select a printer.

To preview the file before printing, press ***Print Preview*** at the bottom of the Calibration Report screen.

A sample printout is shown on the following pages.

NuFlo MVX-II
Calibration Report
12/7/2004 2:18:28 PM

Configuration Program Version: 1.10
Serial Number: MVX_BETA
Device ID: 0x0432
Firmware Version: 1.04
Register Table Version: 1.00

Current Differential Pressure

Date Time: 12/07/04 1:38:19 PM
Method: 3 Point
Unit: inH2O @ 68 F
Status: In-Active

Point #	Applied Value	Corrected Value	Sensor Raw Value
1	0.00	0.01	0.04
2	100.00	100.02	100.04
3	200.00	200.01	200.06
4	---	---	---
5	---	---	---

Current Static Pressure

Date Time: 12/07/04 1:42:55 PM
Method: 2 Point
Atmospheric Pressure: 14.73
Unit: psia
Status: In-Active

Point #	Applied Value	Corrected Value	Sensor Raw Value
1	0.00	0.12	-0.69
2	1,500.00	1,499.77	1,497.21
3	---	---	---
4	---	---	---
5	---	---	---

Current Process Temperature

Date Time: 12/07/04 1:59:34 PM
Method: 4 Point
Unit: F
Status: In-Active

Point #	Applied Value	Corrected Value	Sensor Raw Value
1	0.0	0.1	0.1
2	100.0	99.8	100.6
3	200.0	200.0	200.9
4	300.0	300.6	301.3
5	---	---	---

Previous Differential Pressure

Date Time:	12/07/04 1:36:13 PM
Method:	5 Point
Unit:	inH2O @ 68 F
Status:	Active

Point #	Applied Value	Corrected Value	Sensor Raw Value
1	0.00	0.03	0.03
2	50.00	50.05	50.05
3	100.00	100.02	100.02
4	150.00	150.05	150.05
5	200.00	200.05	200.05

Previous Static Pressure

Date Time:	12/07/04 1:42:01 PM
Method:	5 Point
Atmospheric Pressure:	14.73
Unit:	psia
Status:	Active

Point #	Applied Value	Corrected Value	Sensor Raw Value
1	0.00	-0.81	-0.81
2	300.00	300.45	300.43
3	750.00	747.66	747.64
4	1,200.00	1,197.75	1,197.85
5	1,500.00	1,497.49	1,497.49

Previous Process Temperature

Date Time:	12/07/04 1:58:03 PM
Method:	5 Point
Unit:	F
Status:	Active

Point #	Applied Value	Corrected Value	Sensor Raw Value
1	0.0	0.0	0.0
2	50.0	50.5	50.5
3	100.0	100.8	100.8
4	150.0	151.0	151.0
5	200.0	200.9	200.9

Section 7

Maintaining the MVX®-II Transmitter

The MVX-II transmitter requires little, if any, routine maintenance. Should the terminal board or CPU circuit board fail, however, either board is easily replaced using the following instructions. Please read the disassembly instructions carefully before attempting to replace either board.

Replacing the Terminal Board

Note **The terminal board is attached to the CPU board by a ribbon cable (Figure 7.2). Because of limited space inside the enclosure, the manufacturer advises users to first detach the ribbon cable from the CPU board before removing the terminal board from the opposite end of the enclosure.**

To replace the terminal board, perform the following steps:

1. Disconnect the ribbon cable from the CPU board as follows:
   a. Remove the cover from the side that is furthest away from the conduit openings in the MVX-II enclosure. The black SI/CPU circuit board mount will be in view (Figure 2.9, page 2-10).
   b. Remove the two screws holding this mount in place.
   c. Gently pull the SI/CPU circuit board assembly forward, until the CPU circuit board and attached ribbon cables are accessible.
   d. Identify the ribbon cable that is connected to the terminal board.
   e. Remove the plastic cap that is over the top of the connector on the CPU board and keep it for reinstallation. Grasp the outer edges of the latch that is attached to the CPU board and pull gently apart to unlatch the cable.
2. Remove the cover from the side that is closest to the conduit openings in the MVX-II enclosure.
3. Remove the four screws from each corner of the terminal board, and remove the terminal board from the enclosure (Figure 7-1).

Note **A small O-ring fits in a groove behind the terminal board, and may fall out of the groove when the terminal board is removed. Replace the O-ring in the groove before installing the new terminal board.**

4. Place the new terminal board inside the enclosure, aligning the four screw holes.
5. Replace the screws and hand-tighten to secure the terminal board in the enclosure.
6. Reconnect the ribbon cable from the terminal board to the CPU board. Reinstall the plastic cap over the top of the connector on the CPU board.
7. Place the CPU/SI circuit board assembly back inside the enclosure, using the finger grips in the mount to push the assembly into position (Figure 7.3).
8. Replace the two screws in the plastic mount.
9. Replace the covers and hand-tighten until the covers contact the housing metal-to-metal.

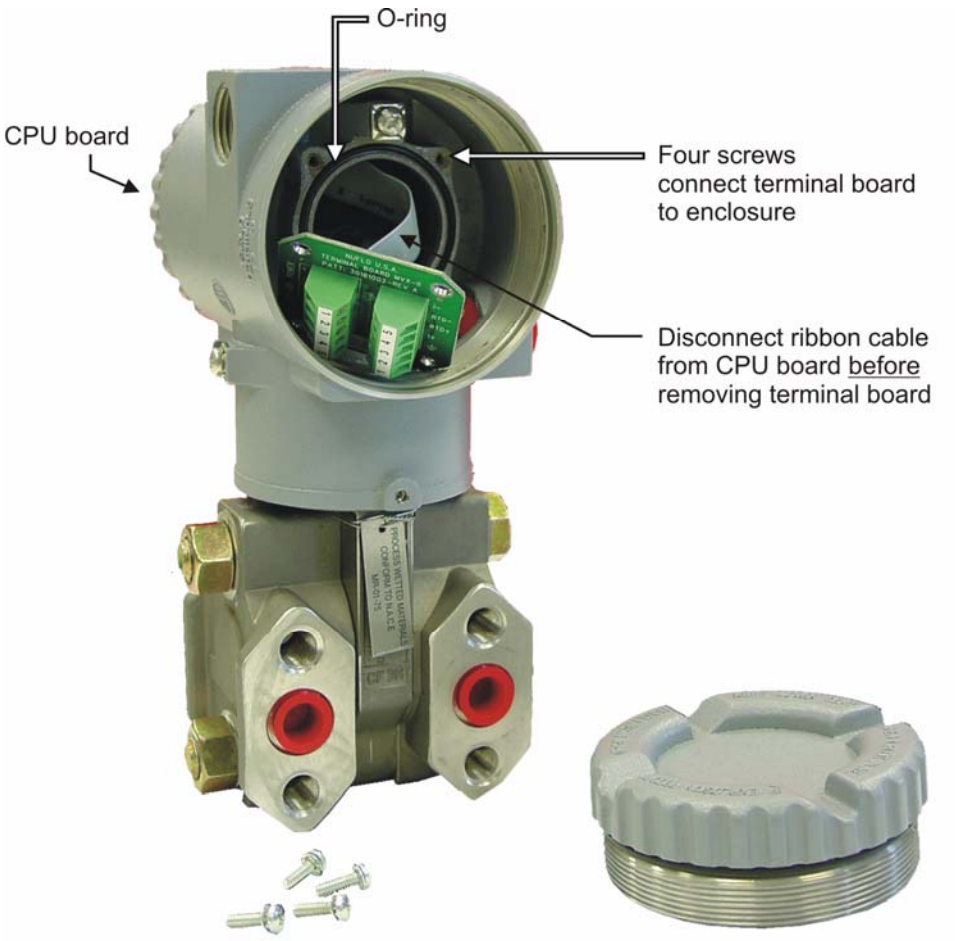


Figure 7-1— Terminal board replacement

Replacing the CPU Circuit Board

To replace the CPU circuit board, perform the following steps, using Figures 7-2 and 7-3 for reference:

1. Remove the cover from the side that is furthest away from the conduit openings in the MVX-II enclosure. The black SI/CPU circuit board mount will be in view (Figure 2-9, page 2-10).
2. Remove the two screws holding this mount in place.
3. Gently pull the SI/CPU circuit board assembly forward, until the CPU circuit board and attached ribbon cables are accessible.
4. Identify the ribbon cable that is connected to the terminal board (Figure 7-2).
5. Remove the plastic cap that is over the top of the connector on the CPU board and keep it for use with the replacement board. Grasp the outer edges of the latch that is attached to the CPU board and pull gently apart to unlatch the cable.
6. Identify the ribbon cable that is connected to the sensor.
7. Grasp the connector located near the lower edge of the CPU/SI circuit board assembly, and gently pull to disconnect.
8. Identify the ribbon connector that connects the CPU board to the SI board, and pull gently to release the connector from the SI board.

Important **The CPU-to-SI board ribbon connector is soldered to the CPU board. DO NOT PULL on this end of the ribbon cable.**

9. Remove the metal screw near the top of the CPU/SI board assembly (Figure 7-3).
10. Grasp the CPU board, and gently pull the black side latches outward, slightly pivoting the board back and forth until it is free.

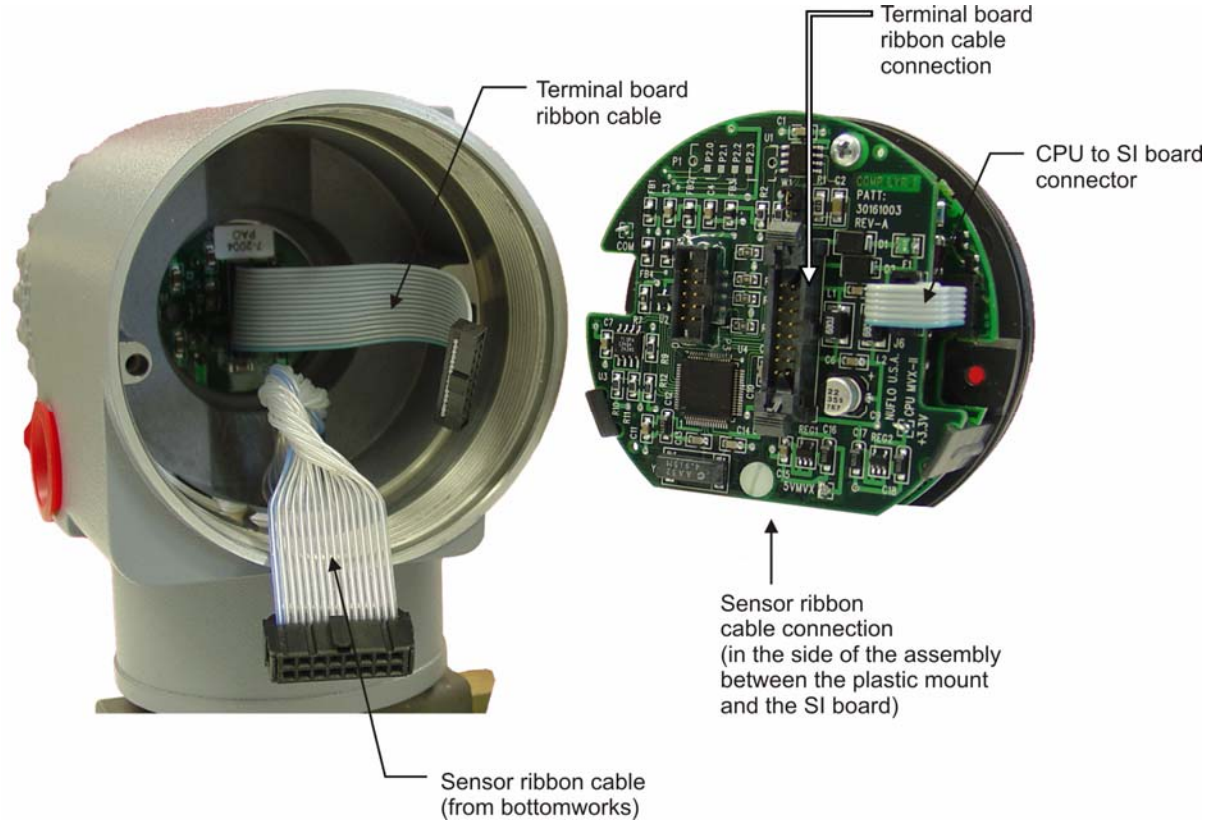


Figure 7-2— Ribbon cable connections for CPU board replacement

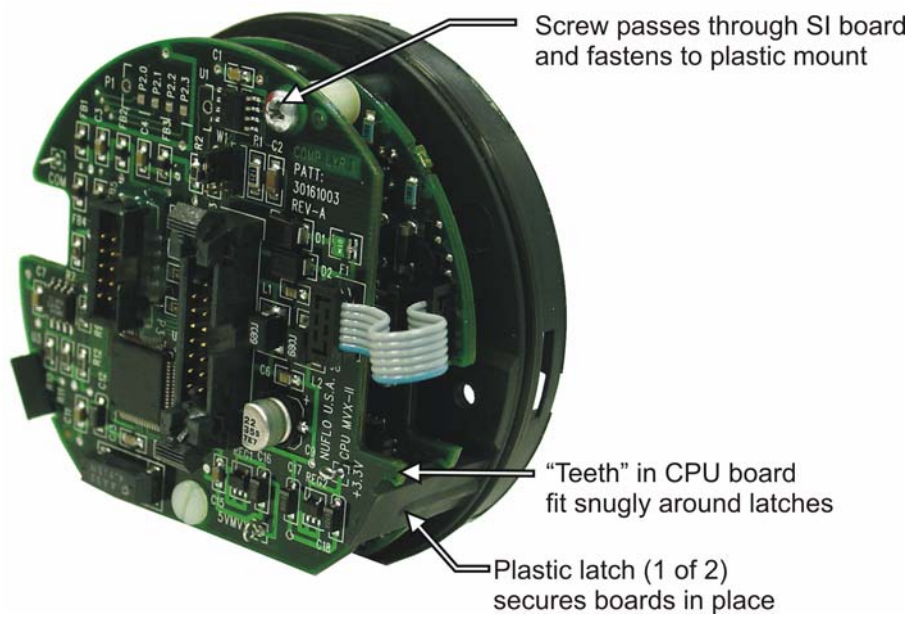


Figure 7-3— Latching mechanisms for CPU/SI board assembly

Installing a Replacement CPU Board

To install a new CPU board, perform the following steps:

1. Locate the P1 connection on the bottom of the CPU board.
2. Position the CPU circuit board on top of the SI board so that the P1 connector is aligned with a connector on the SI board. When the board is properly positioned, the screw holes in the CPU board, the SI board, and the mount should be aligned.
3. Snap the CPU board into place between the black side latches. The latches should fit snugly between the "teeth" cut out in the sides of the CPU board (Figure 7-3).

Important **Before proceeding, check the position of the W1 jumper. If multiple MVX-II transmitters are being used, the termination position may require adjustment. (See *Changing a Termination Setting, page 2-9*, for information.)**

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4. Replace the metal screw in the top of the board assembly, making sure it passes through the SI board and into the mount, and hand-tighten.
5. Reconnect the CPU-to-SI ribbon cable to the SI board connection (Figure 7-2).
6. Reconnect the sensor ribbon cable.
7. Reconnect the terminal board ribbon cable and reinstall the plastic cap for the connector.
8. Place the circuit board assembly back inside the enclosure, using the finger grips in the mount to push the assembly into position.
9. Replace the two screws in the mount.
10. Replace the cover and hand-tighten until the cover contacts the housing metal-to-metal.

Important **When replacing a CPU board, the MVX-II must be reconfigured and recalibrated prior to continued use. See *Section 5* and *Section 6* of this manual for instructions.**

Appendix A

MVX®-II Protocol Manual

Register Table Version 1.00
Firmware Version 1.06

Introduction

The communications protocol for the MVX-II is in accordance with Modicon, Inc. RTU Mode Modbus® as described in Modicon Modbus Protocol Reference Guide, PI-MBUS-300 Rev. J, June 1996. All registers are implemented as 4X or holding registers. Reading registers is implemented via function code 03H (Read Holding Registers) or via function code 04H (Read Input Registers). Writing to registers is implemented via function code 06H (Preset Single Register) or via function code 10H (Preset Multiple Registers).

The Modbus® functions supported by the MVX-II are as follows:

Function Code (Hex)	Description
03	Read Holding Registers
04	Read Input Registers
06	Preset Single Register
10	Preset Multiple Registers

Message exception handling is implemented for masters that attempt to write to read-only registers. Additionally, exception handling is implemented for masters that attempt to write or read to only half of a multiple register format data value. For more information on exception handling, refer to the Exception Response section.

The instrument is limited to operations on 32 registers in one message.

Note

Registers listed in this document are referenced by register number—not by the address of the register number that appears in the actual Modbus® message. For example, register number 40401 has an address of 400 (0x0190 Hexadecimal) in the message.

The word ordering for multiple register data types, such as floating point numbers or long integers, is configurable via the Floating Point Format Code Register. The default configuration is for the most significant word to appear first in the message. See also *Floating Point Format Code, page A-9*.

Various data types are implemented in the MVX-II. The following table lists the formats and indicates the number of bytes and the number of registers for each type.

Data Type	Byte Count	Register Count
Floating Point (FP)	4	2
Floating Point, 32-bit (FP32)	4	1
Unsigned Word (U16)	2	1
Unsigned Long (U32)	4	2
Bitfield (BITF)	2	1
Packed ASCII (PA)	2	1
Time Stamp (Time)	6	3

The Floating Point (FP) type follows the IEEE-754 format. This data type consists of 32 bits that are contained in two 16-bit registers. It is utilized for parameters and values that are not integers. For example, Differential Pressure is a process parameter that is a floating point data type. It can be read by reading 2 registers starting at register 40401.

The Floating Point-32 bit (FP32) type consists of 32 bits that are contained in a single register. See *32-Bit Floating Point Registers, page A-21*.

The Unsigned Word (U16) type is used for 16-bit integers. This data type fits into 1 register.

The Unsigned Long (U32) type is used for 32-bit integers. This data type fits into 2 registers

The Bitfield (BITF) type contains 16 bits. For the function of each bit, the user must refer to the definition of that specific register in this document. The Bitfield type is utilized for configuration or status.

The Packed ASCII (PA) type contains 2 bytes that are 2 unsigned characters. Generally there are multiple Packed ASCII types arranged consecutively for implementing strings. For example, the device's Serial Number is a string of 10 unsigned characters implemented as 5 Packed ASCII registers. Here is an example of the Serial Number that contains the string, "MVT 041303".

Register	Hexadecimal #	ASCII Characters
40003	4D56H	MV
40004	5420H	T<SPACE>
40005	3034H	04
40006	3133H	13
40007	3033H	03

It is recommended to always fill the unused Packed ASCII registers with 20 hexadecimal (<SPACE>).

The Time Stamp (Time) is a register used for time stamping calibration data. See *Time1, Time2 and Time3 definitions, page A-17*.

Each register has an Access type. The three possible access types are:

Access Type	Description
Read Only (RO)	Designates registers that can only be read. Trying to write to this parameter results in an exception response.
Read/Write (R/W)	Designates registers that can be read and written.
Read/Write (R/W) Flash	Designates registers that can be read, written and are stored in non-volatile memory.

The registers are grouped according to function. The groupings are:

- Device compatibility registers (page A-4)
- Device parameter registers (page A-7)
- Calibration parameter registers (page A-10)
- Current data registers (page A-17)
- 32-bit floating point registers (page A-21)

Device Compatibility Registers

Register Number	Description	Data Type	Access	Notes
40001	Device Model ID/ Manufacturer Code	U16	RO	Always reads (0x0432); See Device Model ID, page A-8.
40002	Reserved	U16	RO	
40003	Firmware Version Number	U16	RO	See Firmware/ Register Table Version Number, page A-8.
40004 - 40006	Reserved	U16	RO	
40007	Transmitter Serial Number	U32	RO	
40008				
40009	Reserved	U16	RO	
40010	Register Table Version Number	U16	RO	See Firmware/ Register Table Version Number, page A-8.
40011-40015	Reserved	U16	RO	
40016	Unit ID (slave address)	U16	R/W Flash	See Unit ID, page A-8.
40017-40031	Reserved	U16	RO	
40032-40035	Tag Name – 4 registers	PA	R/W Flash	
40036-40043	Serial Number (string) – 8 registers	PA	R/W Flash	
40044-40059	Reserved	U16	RO	
40060	Differential Pressure Units (Default: 1) 0: Kgf/cm2 1: InH_2O @ 60°F 2: Pa 3: KPa 4: mmHg 5: inHg 6: InH_2O @ 68°F 7: PSI	U16	R/W Flash	See Differential Pressure Units, page A-9.
40061	Static Pressure Units (Default: 5) 0: InHg 1: InH_2O 2: Pa 3: Kpa 4: Mpa 5: PSI 6: Bar 7: Kgf/cm2	U16	R/W Flash	See Static Pressure Units, page A-9.
40062	Temperature Units (Default: 21) 20: °C 21: °F	U16	R/W Flash	See Temperature Units, page A-9.

Device Compatibility Registers

Register Number	Description	Data Type	Access	Notes
40063-40130	Reserved	U16	RO	
40131	Turn Around Delay Time	U16	R/W Flash	
40132	Floating Point Format Code 0: ABCD - High word 1st 1: CDAB - Low Word First 2: DCBA - NOT SUPPORTED 3: BADC - NOT SUPPORTED	U16	R/W Flash	See Floating Point Format Code, page A-9.
40133-40150	Reserved	U16	RO	
40151-40187	Undefined	U16	RO	
40188-40400	Reserved	U16	RO	
40401	Differential Pressure	FP	RO	
40402				
40403	Static Pressure	FP	RO	
40404				
40405	Process Temperature	FP	RO	
40406				
40407	Diagnostic – Register 1	U16	RO	See Diagnostic – Register 1, page A-19.
40408	Diagnostic – Register 2	U16	RO	See Diagnostic – Register 2, page A-20.
40409	Diagnostic – Register 3	U16	R/W	See Diagnostic – Register 3, page A-20.
40410	Diagnostic – Register 4 (always 0x0000)	U16	RO	
40411	Diagnostic – Register 5 (always 0x0000)	U16	RO	
40412	Diagnostic – Register 6 (always 0x0000)	U16	RO	
40413	DP Upper Range Limit [InH_2O default unit]	FP	RO	
40414				
40415	DP Lower Range Limit [InH_2O default unit]	FP	RO	
40416				
40417	DP Upper Operating Limit [-840 to 840 InH_2O]	FP	R/W Flash	
40418				
40419	DP Lower Operating Limit [-840 to 840 InH_2O]	FP	R/W Flash	
40420				
40421	SP Upper Range Limit [PSIG default unit]	FP	RO	
40422				

Device Compatibility Registers

Register Number	Description	Data Type	Access	Notes
40423 40424	SP Lower Range Limit [PSIG default unit]	FP	RO	
40425 40426	SP Upper Operating Limit [-15 to 5300 PSIG]	FP	R/W Flash	
40427 40428	SP Lower Operating Limit [-15 to 5300 PSIG]	FP	R/W Flash	
40429 40430	PT Upper Range Limit [°F default unit]	FP	RO	
40431 40432	PT Lower Range Limit [°F default unit]	FP	RO	
40433 40434	PT Upper Operating Limit [-40 to 300°F]	FP	R/W Flash	
40435 40436	PT Lower Operating Limit [-40 to 300°F]	FP	R/W Flash	
40437- 40440	Reserved	U16	RO	
40441 40442	DP Damping	FP	R/W Flash	
40443- 40446	Reserved	U16	RO	
40447 40448	SP Damping	FP	R/W Flash	
40449- 40452	Reserved	U16	RO	
40453 40454	Process Temperature Damping	FP	R/W Flash	
40455 40456	Process Temperature Override Value [-40 to 300°F]	FP	R/W Flash	
40457- 40480	Reserved	U16	RO	

Device Parameter Registers

Register Number	Description	Data Type	Access	Notes
41001	Device Model ID/ Manufacturer Code	U16	RO	Always reads (0x0432); See Device Model ID, page A-8.
41002	Unit ID (slave address)	U16	R/W Flash	Range: 1 to 247 Default: 1 All units respond to unit #248; See Unit ID, page A-8.
41003	Serial Number (string) – 5 registers	PA	R/W Flash	
41004				
41005				
41006				
41007				
41008	Firmware Version Number	U16	RO	See Firmware/ Register Table Version Number, page A-8.
41009	Register Table Version Number	U16	RO	
41010	Override Control	BITF	R/W Flash	See Override Control, page A-8.
41011	Static Pressure Override Value [-15 to 5300 PSIG]	FP	R/W Flash	
41012				
41013	Differential Pressure Override Value [-840 to 840 InH_2O]	FP	R/W Flash	
41014				
41015	Process Temperature Override Value [-40 to 300°F]	FP	R/W Flash	
41016				
41017	COM Control	BITF	R/W Flash	See COM Control, page A-8.
41018	Static Pressure Units	U16	R/W Flash	See Static Pressure Units, page A-9.
41019	Differential Pressure Units	U16	R/W Flash	See Differential Pressure Units, page A-9.
41020	Temperature Units	U16	R/W Flash	See Temperature Units, page A-9.
41021	MVX-II Control	BITF	R/W Flash	See MVX-II Control, page A-9.
41022	Turn Around Delay Time	U16	R/W Flash	
41023	Floating Point Format Code 0: ABCD - High word 1st 1: CDAB - Low Word First 2: DCBA - NOT SUPPORTED 3: BADC - NOT SUPPORTED	U16	R/W Flash	See Floating Point Format Code, page A-9.

Device Model ID (registers 40001 and 41001)

The Device Model ID is a read only parameter used for identification. This parameter is set at the factory. This will always read 0x0432 hexadecimal.

Unit ID (registers 40016 and 41002)

The slave address of the unit (UnitID) is an unsigned word (U16) data type that has a range of values from 1 to 247. The UnitID is configured by the laptop software and is stored in non-volatile memory. Note that all MVX-IIs will respond to address 248. When the UnitID is written, the response message will be at the current address. After the response message is transmitted, the MVX-II will change to the new UnitID. Refer to the Writing to Flash Parameters section.

Firmware/Register Table Version Number (registers 40003, 40010, 41008 and 41009)

The Firmware Version Number and Register Table Version are unsigned 16-bit integers. The version number is stored in this register as 100 times the actual version number. The general format for version numbers is A.BC. For example, the firmware register number is read as 0x07B hexadecimal. This represents 123 and a firmware version of 1.23.

Override Control, register 41010

This register enables/disables the use of the override values for the 3 process parameters. Clearing the bit to a 0 makes the system use the live input.

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved													PT	DP	SP

Bit	Parameter
15-3	Reserved
2	Override Process Temperature
1	Override Differential Pressure
0	Override Static Pressure

COM Control, register 41017

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved														Baud Rate	

When the COM Control register is written, the response message will be at the current baud rate and with the current word ordering. After the response, the baud rate and word ordering of the MVT is changed. Refer to the Writing to Flash Parameters section.

Baud Rate

Bit 1	Bit 0	Baud Rate
0	0	4800
0	1	9600 (factory default)
1	0	19200
1	1	38400

Static Pressure Units, registers 40061 and 41018

Value	Parameter
0	InHg
1	InH_2O
2	Pa
3	Kpa
4	Mpa
5	PSIG (default)
6	Bar
7	Kgf/cm^2

Differential Pressure Units, registers 40060 and 41019

Value	Parameter
0	Kgf/cm2
1	InH_2O @ 60°F
2	Pa
3	KPa
4	mmHg
5	InHg
6	InH_2O @ 68°F (default)
7	PSI

Temperature Units, registers 40062 and 41020

Value	Parameter
20	C
21	F (default)

MVX-II Control, register 41021

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved														RTD Disable	Reserved

Setting the RTD Disable bit to a 1 disables the RTD measurement. In this setting, none of the diagnostic/error bits associated with the Process Temperature will be asserted. Setting this bit to 0 enables the RTD measurement. The factory default value is 0 (RTD enabled).

Floating Point Format Code (Multi-Word Ordering), registers 40132 and 41023

A value of 1 configures the word ordering to be Least Significant Word First (CDAB). A value of 0 (factory default setting) configures the word ordering to be Most Significant Word First (ABCD). For example, the static pressure is read as 100.25 PSIA at registers 40403 and 40404. In Most Significant Word First format (Floating Point Format Code = 0), the IEEE-754 value returned is 42C88000 hexadecimal. In CDAB format (Floating Point Format Code = 1), the value is 800042C8.

Writing to Flash Parameters

Changes to configuration data are stored in volatile memory until the host writes a trigger register. The trigger register has a specific value. If the value written to the trigger register is 0x5350 hexadecimal, the contents of the volatile configuration memory is transferred to the non-volatile memory.

Note **This does not apply to the R/W Flash settings in the "Device Compatibility" area, page A-4.**

Register Number	Description	Data Type	Access	Notes
41100	Flash Memory Update Trigger	U16	R/W	Performs write to flash operation if host provides correct trigger value.

Calibration

Calibration is best performed by utilizing the configuration program. For reference, the following table describes the registers associated with calibration.

Calibration Parameter Registers

Register Number	Description	Data Type	Access	Notes
41101	Calibration Trigger	CALT RIG	R/W	See Calibration Trigger, page A-15.
41102 41103	Atmospheric Pressure [0 to 25 PSIA]	FP	R/W Flash	
41104 41105	Corrected Static Pressure	FP	RO	
41106 41107	Corrected Differential Pressure	FP	RO	
41108 41109	Corrected Process Temperature	FP	RO	
41110 41111	Sensor Static Pressure Raw Value (PSIG); gage measurement	FP	RO	
41112 41113	Sensor Differential Pressure Raw Value (InH_2O)	FP	RO	
41114 41115	Sensor Process Temperature Raw Value (°F)	FP	RO	
41116	Calibration Method	BITF	R/W Flash	See Calibration Method, page A-16.
41117 41118 41119	DP Calibration Time Stamp	Time1 Time2 Time3	R/W Flash	See Time1, Time2, and Time3, page A-17.

Calibration Parameter Registers

Register Number	Description	Data Type	Access	Notes
41120	DP Calibration Point 1: As-Found	FP	R/W Flash	
41121				
41122	DP Calibration Point 1: As-Left	FP	R/W Flash	
41123				
41124	DP Calibration Point 1: Raw Value	FP	R/W Flash	
41125				
41126	DP Calibration Point 2: As-Found	FP	R/W Flash	
41127				
41128	DP Calibration Point 2: As-Left	FP	R/W Flash	
41129				
41130	DP Calibration Point 2: Raw Value	FP	R/W Flash	
41131				
41132	DP Calibration Point 3: As-Found	FP	R/W Flash	
41133				
41134	DP Calibration Point 3: As-Left	FP	R/W Flash	
41135				
41136	DP Calibration Point 3: Raw Value	FP	R/W Flash	
41137				
41138	DP Calibration Point 4: As-Found	FP	R/W Flash	
41139				
41140	DP Calibration Point 4: As-Left	FP	R/W Flash	
41141				
41142	DP Calibration Point 4: Raw Value	FP	R/W Flash	
41143				
41144	DP Calibration Point 5: As-Found	FP	R/W Flash	
41145				
41146	DP Calibration Point 5: As-Left	FP	R/W Flash	
41147				
41148	DP Calibration Point 5: Raw Value	FP	R/W Flash	
41149				
41150	SP Calibration Time Stamp	Time1 Time2 Time3	R/W Flash	See Time1, Time2, and Time3, page A-17.
41151				
41152				
41153	SP Calibration Point 1: As-Found	FP	R/W Flash	
41154				
41155	SP Calibration Point 1: As-Left	FP	R/W Flash	
41156				
41157	SP Calibration Point 1: Raw Value	FP	R/W Flash	
41158				
41159	SP Calibration Point 2: As-Found	FP	R/W Flash	
41160				

Calibration Parameter Registers

Register Number	Description	Data Type	Access	Notes
41161	SP Calibration Point 2: As-Left	FP	R/W Flash	
41162				
41163	SP Calibration Point 2: Raw Value	FP	R/W Flash	
41164				
41165	SP Calibration Point 3: As-Found	FP	R/W Flash	
41166				
41167	SP Calibration Point 3: As-Left	FP	R/W Flash	
41168				
41169	SP Calibration Point 3: Raw Value	FP	R/W Flash	
41170				
41171	SP Calibration Point 4: As-Found	FP	R/W Flash	
41172				
41173	SP Calibration Point 4: As-Left	FP	R/W Flash	
41174				
41175	SP Calibration Point 4: Raw Value	FP	R/W Flash	
41176				
41177	SP Calibration Point 5: As-Found	FP	R/W Flash	
41178				
41179	SP Calibration Point 5: As-Left	FP	R/W Flash	
41180				
41181	SP Calibration Point 5: Raw Value	FP	R/W Flash	
41182				
41183	PT Calibration Time Stamp	Time1 Time2 Time3	R/W Flash	See Time1, Time2, and Time3, page A-17.
41184				
41185				
41186	PT Calibration Point 1: As-Found	FP	R/W Flash	
41187				
41188	PT Calibration Point 1: As-Left	FP	R/W Flash	
41189				
41190	PT Calibration Point 1: Raw Value	FP	R/W Flash	
41191				
41192	PT Calibration Point 2: As-Found	FP	R/W Flash	
41193				
41194	PT Calibration Point 2: As-Left	FP	R/W Flash	
41195				
41196	PT Calibration Point 2: Raw Value	FP	R/W Flash	
41197				
41198	PT Calibration Point 3: As-Found	FP	R/W Flash	
41199				
41200	PT Calibration Point 3: As-Left	FP	R/W Flash	
41201				

Calibration Parameter Registers

Register Number	Description	Data Type	Access	Notes
41202	PT Calibration Point 3: Raw Value	FP	R/W Flash	
41203				
41204	PT Calibration Point 4: As-Found	FP	R/W Flash	
41205				
41206	PT Calibration Point 4: As-Left	FP	R/W Flash	
41207				
41208	PT Calibration Point 4: Raw Value	FP	R/W Flash	
41209				
41210	PT Calibration Point 5: As-Found	FP	R/W Flash	
41211				
41212	PT Calibration Point 5: As-Left	FP	R/W Flash	
41213				
41214	PT Calibration Point 5: Raw Value	FP	R/W Flash	
41215				
41216	Previous Calibration Method	BITF	R/W Flash	See Calibration Method, page A-16.
41217	Previous DP Calibration Time Stamp	Time1 Time2 Time3	R/W Flash	See Time1, Time2, and Time3, page A-17.
41218				
41219				
41220	Previous DP Calibration Point 1: As-Found	FP	R/W Flash	
41221				
41222	Previous DP Calibration Point 1: As-Left	FP	R/W Flash	
41223				
41224	Previous DP Calibration Point 1: Raw Value	FP	R/W Flash	
41225				
41226	Previous DP Calibration Point 2: As-Found	FP	R/W Flash	
41227				
41228	Previous DP Calibration Point 2: As-Left	FP	R/W Flash	
41229				
41230	Previous DP Calibration Point 2: Raw Value	FP	R/W Flash	
41231				
41232	Previous DP Calibration Point 3: As-Found	FP	R/W Flash	
41233				
41234	Previous DP Calibration Point 3: As-Left	FP	R/W Flash	
41235				
41236	Previous DP Calibration Point 3: Raw Value	FP	R/W Flash	
41237				
41238	Previous DP Calibration Point 4: As-Found	FP	R/W Flash	
41239				
41240	Previous DP Calibration Point 4: As-Left	FP	R/W Flash	
41241				
41242	Previous DP Calibration Point 4: Raw Value	FP	R/W Flash	
41243				

Calibration Parameter Registers

Register Number	Description	Data Type	Access	Notes
41244 41245	Previous DP Calibration Point 5: As-Found	FP	R/W Flash	
41246 41247	Previous DP Calibration Point 5: As-Left	FP	R/W Flash	
41248 41249	Previous DP Calibration Point 5: Raw Value	FP	R/W Flash	
41250 41251 41252	Previous SP Calibration Time Stamp	Time1 Time2 Time3	R/W Flash	See Time1, Time2, and Time3, page A-17.
41253 41254	Previous SP Calibration Point 1: As-Found	FP	R/W Flash	
41255 41256	Previous SP Calibration Point 1: As-Left	FP	R/W Flash	
41257 41258	Previous SP Calibration Point 1: Raw Value	FP	R/W Flash	
41259 41260	Previous SP Calibration Point 2: As-Found	FP	R/W Flash	
41261 41262	Previous SP Calibration Point 2: As-Left	FP	R/W Flash	
41263 41264	Previous SP Calibration Point 2: Raw Value	FP	R/W Flash	
41265 41266	Previous SP Calibration Point 3: As-Found	FP	R/W Flash	
41267 41268 41270	Previous SP Calibration Point 3: As-Left	FP	R/W Flash	
41271 41272	Previous SP Calibration Point 4: As-Found	FP	R/W Flash	
41273 41274	Previous SP Calibration Point 4: As-Left	FP	R/W Flash	
41275 41276	Previous SP Calibration Point 4: Raw Value	FP	R/W Flash	
41277 41278	Previous SP Calibration Point 5: As-Found	FP	R/W Flash	
41279 41280	Previous SP Calibration Point 5: As-Left	FP	R/W Flash	
41281 41282	Previous SP Calibration Point 5: Raw Value	FP	R/W Flash	
41283 41284 41285	Previous PT Calibration Time Stamp	Time1 Time2 Time3	R/W Flash	

Calibration Parameter Registers

Register Number	Description	Data Type	Access	Notes
41286 41287	Previous PT Calibration Point 1: As-Found	FP	R/W Flash	
41288 41289	Previous PT Calibration Point 1: As-Left	FP	R/W Flash	
41290 41291	Previous PT Calibration Point 1: Raw Value	FP	R/W Flash	
41292 41293	Previous PT Calibration Point 2: As-Found	FP	R/W Flash	
41294 41295	Previous PT Calibration Point 2: As-Left	FP	R/W Flash	
41296 41297	Previous PT Calibration Point 2: Raw Value	FP	R/W Flash	
41298 41299	Previous PT Calibration Point 3: As-Found	FP	R/W Flash	
41300 41301	Previous PT Calibration Point 3: As-Left	FP	R/W Flash	
41302 41303	Previous PT Calibration Point 3: Raw Value	FP	R/W Flash	
41304 41305	Previous PT Calibration Point 4: As-Found	FP	R/W Flash	
41306 41307	Previous PT Calibration Point 4: As-Left	FP	R/W Flash	
41308 41309	Previous PT Calibration Point 4: Raw Value	FP	R/W Flash	
41310 41311	Previous PT Calibration Point 5: As-Found	FP	R/W Flash	
41312 41313	Previous PT Calibration Point 5: As-Left	FP	R/W Flash	
41314 41315	Previous PT Calibration Point 5: Raw Value	FP	R/W Flash	

Calibration Trigger, registers 41101

Used for copying current data to previous data. Set by the laptop/cleared by firmware.

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved													PTCal	DPCal	SPCal

Bit 2	Bit 1	Bit 0	
0	0	1	SP Calibration Data Ready
0	1	0	DP Calibration Data Ready
1	0	0	PT Calibration Data Ready

Calibration Method, registers 41116 and 41216

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved				PT3	PT2	PT1	PT0	SP3	SP2	SP1	SP0	DP3	DP2	DP1	DP0

The DP#, SP#, and PT# bits define the calibration method for the respective channels. The Factory Default Value for each channel is 0 (Factory Calibration).

Differential Pressure Calibration Method

Bit 3	Bit 2	Bit 1	Bit 0	
0	0	0	0	Factory Calibration
0	0	0	1	1-point: offset correction (default method)
0	0	1	0	2-point: slope and intercept correction
0	0	1	1	3-point
0	1	0	0	4-point
0	1	0	1	5-point
1	X	X	X	Previous Calibration (1 use previous, 0 use current)

Static Pressure Calibration Method

Bit 7	Bit 6	Bit 5	Bit 4	
0	0	0	0	Factory Calibration
0	0	0	1	1-point: offsset correction (default method)
0	0	1	0	2-point: slope and intercept correction
0	0	1	1	3-point
0	1	0	0	4-point
0	1	0	1	5-point
1	X	X	X	Previous Calibration (1 use previous, 0 use current)

Process Temperature Calibration Method

Bit 11	Bit 10	Bit 9	Bit 8	
0	0	0	0	Factory Calibration
0	0	0	1	1-point: offsset correction (default method)
0	0	1	0	2-point: slope and intercept correction
0	0	1	1	3-point
0	1	0	0	4-point
0	1	0	1	5-point
1	X	X	X	Previous Calibration (1 use previous, 0 use current)

Time1

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved				Month				Reserved			Day				

Time1 register contains the month and day of the time of calibration. The month is contained in bits 8 through 11 and has values ranging from 1 to 12. The day is contained in bits 0 through 4 and has values ranging from 1 to 31. For example, if the calibration time is December 15, 2002 at 8:50:07 PM, the value of 0C0F hexadecimal will be read from register Time1 for the month and day.

Time2

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved	Year							Reserved			Hour				

Time2 register contains the year and hour of the time of calibration. The year is contained in bits 8 through 14 and has values ranging from 0 to 99. The year is represented as the calendar year – 2000. The years represented by the device range from 2000 to 2099. The hour is contained in bits 0 through 4 and has values ranging from 0 to 23. For example, if the calibration time is December 15, 2002 at 8:50:07 PM, the value of 0214 hexadecimal will be read from register Time2 for the year and hour.

Time3

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved		Minutes						Reserved		Seconds					

Time3 register contains the minute and seconds of the time of calibration. The minutes are contained in bits 8 through 13 and have values ranging from 0 to 59. The seconds are contained in bits 0 through 5 and have values ranging from 0 to 59. For example, if the calibration time is December 15, 2002 at 8:50:07 PM, the value of 3207 hexadecimal will be read from register Time3 for the minutes and seconds.

Current Data Registers

Register Number	Description	Data Type	Access	Notes
41401 41402	Differential Pressure [InH_2O default unit]	FP	RO	
41403 41404	Static Pressure [PSIG default unit]	FP	RO	
41405 41406	Process Temperature [°F default unit]	FP	RO	
41407	Diagnostic – Register 1	BITF	RO	See Diagnostic – Register 1, page A-19.
41408	Diagnostic – Register 2	BITF	RO	See Diagnostic – Register 2, page A-20.
41409	Diagnostic – Register 3	BITF	R/W	See Diagnostic – Register 3, page A-20.

Current Data Registers

Register Number	Description	Data Type	Access	Notes
41410	Diagnostic – Register 4	BITF	RO	Always reads (0x0000)
41411	Diagnostic – Register 5	BITF	RO	Always reads (0x0000)
41412	Diagnostic – Register 6	BITF	RO	Always reads (0x0000)
41413	Diagnostic – Register 7	BITF	RO	See Diagnostic – Register 7, page A-21.
41414	MVX-II Comm Health (last 100 seconds)	U16	R/W	Integer from 0 to 100 representing successful communications with the sensor.
41415	MVX-II Comm Tries	U32	R/W	
41417	MVX-II Comm Successes	U32	R/W	
41419 41420	Power: Input Voltage [VDC default unit]	FP	RO	
41421 41422	Power: 3.3 VDC Supply [VDC default unit]	FP	RO	
41423 41424	Power: 5 VDC Supply [VDC default unit]	FP	RO	
41425 41426	DP Upper Range Limit [InH_2O default unit]	FP	RO	
41427 41428	DP Lower Range Limit [InH_2O default unit]	FP	RO	
41429 41430	DP Upper Operating Limit [-840 to 840 InH_2O]	FP	R/W Flash	
41431 41432	DP Lower Operating Limit [-840 to 840 InH_2O]	FP	R/W Flash	
41433 41434	SP Upper Range Limit [PSIG default unit]	FP	RO	
41435 41436	SP Lower Range Limit [PSIG default unit]	FP	RO	
41437 41438	SP Upper Operating Limit [-15 to 5300 PSIG]	FP	R/W Flash	
41439 41440	SP Lower Operating Limit [-15 to 5300 PSIG]	FP	R/W Flash	
41441 41442	PT Upper Range Limit [°F default unit]	FP	RO	
41443 41444	PT Lower Range Limit [°F default unit]	FP	RO	
41445 41446	PT Upper Operating Limit [-40 to 300°F]	FP	R/W Flash	

Current Data Registers

Register Number	Description	Data Type	Access	Notes
41447 41448	PT Lower Operating Limit [-40 to 300°F]	FP	R/W Flash	
41800 41801	Sensor Differential Pressure Raw (InH_2O)	FP	RO	
41802 41803	Sensor Static Pressure Raw (PSIA)	FP	RO	
41804 41805	Sensor Process Temperature Raw (°F)	FP	RO	
41806	Diagnostic – Register 1	BITF	RO	See Diagnostic – Register 1, page A-19.
41807	Diagnostic – Register 2	BITF	RO	See Diagnostic – Register 2, page A-20.
41808	Diagnostic – Register 3	BITF	R/W	See Diagnostic – Register 3, page A-20.
41809	Diagnostic – Register 7	BITF	RO	See Diagnostic – Register 7, page A-21.

Diagnostic – Register 1

Bit	Name	Description
15	N/A	Reserved
14	Process Variables Bad	Set if any measured parameter is questionable, cleared otherwise. RTD errors will be ignored if the RTD is disabled
13	N/A	Reserved
12	DP Upper Range Limit + 10%	Set if the corrected DP value is greater than the upper range limit +10%, cleared otherwise
11	DP Upper Range Limit	Set if the corrected DP value is greater than the upper range limit, cleared otherwise
10	DP Upper Operating Limit	Set if the corrected DP value is greater than the upper operating limit, cleared otherwise
9	DP Lower Operating Limit	Set if the corrected DP value is less than the lower operating limit, cleared otherwise
8	DP Lower Range Limit	Set if the corrected DP value is less than the lower range limit, cleared otherwise
7	DP Lower Range Limit - 10%	Set if the corrected DP value is less than lower range limit – 10%, cleared otherwise
6	SP Upper Range Limit + 10%	Set if the corrected SP value is greater than the upper range limit +10%, cleared otherwise
5	SP Upper Range Limit	Set if the corrected SP value is greater than the upper range limit, cleared otherwise
4	SP Upper Operating Limit	Set if the corrected SP value is greater than the upper operating limit, cleared otherwise

Diagnostic – Register 1

Bit	Name	Description
3	SP Lower Operating Limit	Set if the corrected SP value is less than the lower operating limit, cleared otherwise
2	SP Lower Range Limit	Set if the corrected SP value is less than the lower range limit, cleared otherwise
1	SP Lower Range Limit - 10%	Set if the corrected SP value is less than lower range limit – 10%, cleared otherwise
0	N/A	Reserved

Diagnostic – Register 2

Bit	Name	Description
15	Static Pressure Fail	Set if the static pressure value is not reliable, cleared otherwise
14	PT Upper Range Limit + 10%	Set if the corrected PT value is greater than the upper range limit +10%, cleared otherwise
13	PT Upper Range Limit	Set if the corrected PT value is greater than the upper range limit, cleared otherwise
12	PT Upper Operating Limit	Set if the corrected PT value is greater than the upper operating limit, cleared otherwise
11	PT Lower Operating Limit	Set if the corrected PT value is less than the lower operating limit, cleared otherwise
10	PT Lower Range Limit	Set if the corrected PT value is less than the lower range limit, cleared otherwise
9	PT Lower Range Limit - 10%	Set if the corrected PT value is less than lower range limit – 10%, cleared otherwise
8	Process Temp Fail	Set if the process temperature measurement is not reliable, cleared otherwise. If the RTD is disabled, this bit will always be 0.
7-0	N/A	Reserved

Diagnostic – Register 3

Bit	Name	Description
15	Sensor Not Updating	Set if the sensor microcontroller has report a general sensor failure, cleared otherwise. This could indicate a problem with the analog to digital converter, sensor readings are not being calculated or the inter-processor communication system has failed.
14	N/A	Reserved
13	Sensor Failure	Set if any of the bits in Diagnostic Register 7 are set, cleared otherwise
12-11	N/A	Reserved
10	ROM CRC	Set if the firmware has detected a ROM CRC error
9	RAM	Set if the firmware has detected a problem with the sensor's RAM
8-3	N/A	Reserved
2	Non-Volatile Memory	Set if the firmware detected an invalid CRC in parameter memory contents. This event restores the sensor to factory default settings. This bit is not cleared by the firmware. It is cleared by a host writing a 0 to Diagnostic Register 3.
1-0	N/A	Reserved

Diagnostic – Register 7

Bit	Name	Description
15-7	N/A	Reserved
6	Input Power	Set if the input power is out of tolerance (<8V)
5	Initialization Needed	Set if the sensor requires initialization
4	5V Power	Set if the 5V Power Supply is out of tolerance for valid sensor operation, cleared otherwise
3	Offline	Set if too many timeouts or CRC errors were encountered. This bit is cleared when communications resume and the sensor doesn't indicate initialization is needed.
2	Reset	The sensor is in the process of resetting.
1	CRC Error	Set if a CRC error was detected in a sensor response, cleared otherwise
0	Time Out	Set if the communications to the sensor are resulting in timeouts, cleared otherwise

32-Bit Floating Point Registers

Register Number	Description	Data Type	Access	Notes
47401	Differential Pressure	FP32	RO	
47402	Static Pressure	FP32	RO	
47403	Process Temperature	FP32	RO	
47404	Diagnostic – Registers 1 and 2	FP32	RO	See Diagnostic – Register 1 and Diagnostic – Register 2, pages A-19 and A-20.
47405	Diagnostic – Registers 3 and 4	FP32	RO	See Diagnostic – Register 3, page A-20. Diagnostic – Register 4 always reads (0x0000)
47406	Diagnostic – Registers 5 and 6	FP32	RO	Always reads (0x0000)
47407	DP Upper Range Limit	FP32	RO	
47408	DP Lower Range Limit	FP32	RO	
47409	DP Upper Operating Limit	FP32	RW Flash	
47410	DP Lower Operating Limit	FP32	RW Flash	
47411	SP Upper Range Limit	FP32	RO	
47412	SP Lower Range Limit	FP32	RO	
47413	SP Upper Operating Limit	FP32	RW Flash	
47414	SP Lower Operating Limit	FP32	RW Flash	
47415	PT Upper Range Limit	FP32	RO	

Register Number	Description	Data Type	Access	Notes
47416	PT Lower Range Limit	FP32	RO	
47417	PT Upper Operating Limit	FP32	RW Flash	
47418	PT Lower Operating Limit	FP32	RW Flash	

Exception Responses

The Modbus® protocol is based on a query and response messaging scheme. Normal responses from the MVX-II are either the requested data or an acknowledgement. Negative responses are called exception responses. There are numerous reasons that create exception responses such as: the function is not supported, a data field is out of range, or security has been violated.

In accordance with the Modbus® specification, the exception responses are identified by the most significant bit set within the function code. For example, the function code for reading holding registers is 03 hexadecimal. The exception response would indicate this as 83 hexadecimal. The function code byte is followed by a reason code. The reason code helps identify the reason for the exception response.

The table below describes the reason codes supported.

Exception Response Reason Code	Exception Response Name	Explanation
1	Illegal Function	The requested function is not supported.
2	Illegal Register Address	A single register address could be invalid or a register address implied by a block operation could be invalid. To allow for easy future expansion, the MVT contains groups of registers. Accessing any register between the groups will result in this reason code. This code will also result if either the first register accessed is offset from the first register of a 32-bit value like an unsigned long or a float, or a block operation causes the last register accessed to be offset from the last register of a 32-bit value.
3	Illegal Data	This code could be the result of any of the following: • Data for a parameter is out of range. • The byte count on a Preset Multiple Registers function is not correct. • The register count for a block function is greater than the maximum supported by the MVX-II. • A write is attempted to a read-only register.
4	Slave Device Failure	Not Supported
6	Slave Device Busy	Not Supported

Appendix B

MVX®-II Spare Parts List

WARNING

EXPLOSION HAZARD – SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2.

USE OF SPARE PARTS OTHER THAN THOSE IDENTIFIED BY CAMERON VOIDS CSA CERTIFICATION. CAMERONBEARS NO LEGAL RESPONSIBILITY FOR THE PERFORMANCE OF A PRODUCT THAT HAS BEEN SERVICED OR REPAIRED WITH PARTS THAT ARE NOT AUTHORIZED BY CAMERON.

Table B.1 – MVX-II Spare Parts

Qty.	Part No.	Description
1	101283116	RS-485 Converter, 9-Pin with 10-ft connector cable
1	100025195	RS-485 Converter, 25-Pin
1	101310194	Serial Cable – DB9, 6 ft, Male/Female
1	(see Tables B.2 and B.3)	Multi-Variable Transmitter Kit
1	(see Table B.4)	RTD, Explosion-proof, Model 21
1	30160005	Terminal Board
1	30160004	CPU Board
1	99188002	2-in. Pole Mount Kit, Bracket and Mounting Hardware, Remote Mount, Painted Steel (optional)
1	99188005	2-in. Pole Mount Kit, Bracket and Mounting Hardware, Remote Mount, 316 Stainless Steel (optional)
1	55188002	Kit, Adapter, Process Connection, ½" NPT, contains flange adapter, O-rings, and screws, for MVX-II transmitter (optional)
1	55188001	Kit, Adapter, for Rosemount Coplanar Manifold—includes stainless steel adapter plate and required bolts and gaskets (optional)

Table B.2 – Multi-Variable Transmitter, Low-Profile Sensor (Bottom Process Connections)
Select one based on specific application.

Qty.	Part No. (non-NACE)	Part No. (NACE)	Description
1	55168006	55168016	100 PSIA, 30 IN H20, LOW-PROFILE
1	55168001	55168011	300 PSIA, 200 IN H20, LOW-PROFILE
1	55168003	55168013	300 PSIA, 840 IN H20, LOW-PROFILE
1	55168007	55168017	500 PSIA, 200 IN H20, LOW-PROFILE
1	55168002	55168012	1500 PSIA, 200 IN H20, LOW-PROFILE
1	55168005	55168015	1500 PSIA, 300 IN H20, LOW-PROFILE
1	55168008	55168018	1500 PSIA, 400 IN H20, LOW-PROFILE
1	55168004	55168014	1500 PSIA, 840 IN H20, LOW-PROFILE
1	55168045	55168077	3000 PSIA, 200 IN H20, LOW-PROFILE
1	55168046	55168078	3000 PSIA, 300 IN H20, LOW-PROFILE
1	55168047	55168079	3000 PSIA, 400 IN H20, LOW-PROFILE
1	55168048	55168080	3000 PSIA, 840 IN H20, LOW-PROFILE
1	55168049	55168081	5300 PSIA, 200 IN H20, LOW-PROFILE
1	55168050	55168082	5300 PSIA, 300 IN H20, LOW-PROFILE
1	55168051	55168083	5300 PSIA, 400 IN H20, LOW-PROFILE
1	55168052	55168084	5300 PSIA, 840 IN H20, LOW-PROFILE
1	55168033	—	300 PSIA, 200 IN H2O, LOW-PROFILE, 316 STAINLESS STEEL BOLTS AND NUTS
1	55168034	—	1500 PSIA, 200 IN H2O, LOW-PROFILE, 316 STAINLESS STEEL BOLTS AND NUTS

Table B.3 – Multi-Variable Transmitter, Standard Sensor (Side Process Connections)
Select one based on specific application.

Qty.	Part No. (non-NACE)	Part No. (NACE)	Description
1	101311118	55168027	100 PSIA, 30 IN H20, STANDARD
1	101311112	55168028	300 PSIA, 200 IN H20, STANDARD
1	101311115	55168029	300 PSIA, 840 IN H20, STANDARD
1	55168009	55168019	500 PSIA, 200 IN H20, STANDARD
1	101311114	55168030	1500 PSIA, 200 IN H20, STANDARD
1	101311117	55168031	1500 PSIA, 300 IN H20, STANDARD
1	55168010	55168020	1500 PSIA, 400 IN H20, STANDARD
1	101311116	55168032	1500 PSIA, 840 IN H20, STANDARD
1	55168037	55168069	3000 PSIA, 20 0IN H20, STANDARD
1	55168038	55168070	3000 PSIA, 300 IN H20, STANDARD
1	55168039	55168071	3000 PSIA, 400 IN H20, STANDARD
1	55168040	55168072	3000 PSIA, 840 IN H20, STANDARD
1	55168041	55168073	5300 PSIA, 200 IN H20, STANDARD
1	55168042	55168074	5300 PSIA, 300 IN H20, STANDARD
1	55168043	55168075	5300 PSIA, 400 IN H20, STANDARD
1	55168044	55168076	5300 PSIA, 840 IN H20, STANDARD
1	55168035	—	300 PSIA, 200 INCHES H2O, STANDARD, 316 STAINLESS STEEL BOLTS AND NUTS
1	55168036	—	1500 PSIA, 200 INCHES H2O, STANDARD, 316 STAINLESS STEEL BOLTS AND NUTS

Table B.4 –Explosion-proof RTD and Cable Assembly
Select one based on specific application.

Qty.	Part No.	Description
1	21-05-06	MODEL 21 RTD, 5' CABLE, 6" PROBE
1	21-05-12	MODEL 21 RTD, 5' CABLE, 12" PROBE
1	21-10-06	MODEL 21 RTD, 10' CABLE, 6" PROBE
1	21-10-12	MODEL 21 RTD, 10' CABLE, 12" PROBE
1	21-30-06	MODEL 21 RTD, 30' CABLE, 6" PROBE
1	21-30-12	MODEL 21 RTD, 30' CABLE, 12" PROBE
1	21-50-06	MODEL 21 RTD, 50' CABLE, 6" PROBE
1	21-50-12	MODEL 21 RTD, 50' CABLE, 12" PROBE

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