FIELDVUE® DVC5000 Series Digital Valve Controller

DVC5000 Series digital valve controllers (figures 1 and 2) are communicating, microprocessor-based current to pneumatic instruments. In addition to the traditional function of converting a current signal to a pressure signal, these instruments, using HART communications protocol, provide easy access to information critical to process operation. Tables 1 and 2 list the information that is accessible through FIELDVUE ValveLink software or the Rosmount Model 275 HART Communicator, shown in figure 6. Much of the information is also available on a HART compatible distributed control system.

Because the digital valve controller receives feedback of the valve travel position, the instrument can not only diagnose itself but also the valve and actuator on which it is mounted. This provides you with very cost effective maintenance information, so that required maintenance can be performed on the instrument and valve when there really is a need.

Wiring is economical because DVC5000 Series digital valve controllers use two-wire 4 to 20 mA loop power. This provides for low cost replacement of existing analog instrumentation and avoids the high cost of running separate power and signal wiring.

Features

● **Improved Process Control**—Two-way digital communication provides current valve conditions. You can rely on this real-time information to make sound process management decisions. By analyzing valve dynamics with AMS ValveLink software, you can identify those control areas that need improvement and maintain a high level of system performance.

W6164–B/IL

**DVC5000 SERIES DIGITAL
VALVE CONTROLLER**

W6164/IL

**TYPE DVC5020 DIGITAL VALVE
CONTROLLER MOUNTED ON
ROTARY ACTUATOR**

W6341/IL

**TYPE DVC5010 DIGITAL VALVE
CONTROLLER MOUNTED ON
SLIDING-STEM ACTUATOR**

Figure 1. *FIELDVUE DVC5000 Series Digital Valve Controllers*

FISHER®

FISHER-ROSEMOUNT™

D200440X012

Specifications

Available Configurations

Type DVC5010: Sliding-stem applications
Type DVC5020: Rotary and long-stroke sliding-stem applications
Type DVC5030: Quarter-turn rotary applications
Type DVC5040: Sliding-stem application—Fisher Controls System 9000 actuator

DVC5000 Series digital valve controllers mount on Fisher Controls and other manufacturers' rotary and sliding-stem actuators.

Input Signal

Point-to-Point:
Analog Input Signal: 4 to 20 mA dc, nominal
Minimum Voltage Available at instrument terminals must be 11.5 volts dc for analog control, 12 volts dc for HART communication (see instrument instruction manual for details)
Minimum Control Current: 4.0 mA
Minimum Current w/o Microprocessor Restart: 3.5 mA
Maximum Voltage: 30 volts dc
Overcurrent Protection: Input circuitry limits current to prevent internal damage
Reverse Polarity Protection: No damage occurs from reversal of loop current

Multi-drop:
Instrument Power: 12 to 30 volts dc at approximately 8 mA
Reverse Polarity Protection: No damage occurs from reversal of loop current

Output Signal[1]

Pneumatic pressure as required by the actuator, up to 95% of supply pressure.
Minimum Span: 0.4 bar (6 psig)
Maximum Span: 6 bar (90 psig)
Action: Direct only

Supply Pressure[1]

Minimum and Recommended: 0.3 bar (5 psig) higher than maximum actuator requirements
Maximum: 6.9 bar (100 psig) or maximum pressure rating of the actuator, whichever is lower.

Steady-State Air Consumption[1],[2]

At 1.4 bar (20 psig) supply pressure: Less than 0.3 normal m^3/hr (10 scfh)
At 2.4 bar (35 psig) supply pressure: Less than 0.4 normal m^3/hr (15 scfh)
At 4.1 bar (60 psig) supply pressure: Less than 0.6 normal m^3/hr (22 scfh)

At 6.9 bar (100 psig) supply pressure: Less than 0.9 normal m^3/hr (34 scfh)

Maximum Output Capacity[2]

At 1.4 bar (20 psig) supply pressure: 7.6 normal m^3/hr (285 scfh)
At 4.1 bar (60 psig) supply pressure: 17.6 normal m^3/hr (658 scfh)

Independent Linearity[1]

±0.5% of output span, typical

Electromagnetic Interference (EMI)

These instruments have the CE mark in accordance with the Electromagnetic Compatibility (EMC) Directive. They meet the requirements of EN50081-1 (emissions for light industry) and EN50082-2 (immunity for industrial environment).

Electrical Classification

Hazardous Area: Explosion-proof, intrinsically safe, Division 2, and flameproof constructions are available to CSA, FM, CENELEC, and SAA standards. Refer to the hazardous-area classification bulletins.
Electrical Housing: Meets NEMA 4X, IEC 529 IP65

Connections

Supply Pressure: 1/4-inch NPT female and integral pad for mounting Type 67CFR regulator
Output Pressure: 1/4-inch NPT female
Tubing: 3/8-inch metal, recommended
Vent (pipe-away): 1/4-inch NPT female
Electrical: 1/2-inch NPT female conduit connection, M20 adaptor optional

Operating Ambient Temperature Limits

–40 to 80°C (–40 to 175°F)

Construction Materials

Housing, module base, and terminal box: ANSI B360.0 low copper aluminum alloy
Cover: Valox
Elastomers: Nitrile

Stem Travel

DVC5010: 0 to 102 mm (4 inches) maximum
0 to 9.5 mm (3/8 inches) minimum
DVC5020: 0 to 606 mm (23-7/8 inches) maximum

Shaft Rotation (DVC5020 and DVC5030)

0 to 50 degrees minimum
0 to 90 degrees maximum

Mounting

Designed for direct actuator mounting. For weatherproof housing capability, mount the instrument upright to allow the vent to drain.

(continued)

Specifications (continued)

Dimensions	Weight
See figures 9 and 10. For dimensions of a Type DVC5040 digital valve controller, see Bulletin 41.1:FloVue.	Less than 2.7 kg (6 lbs)
	Options
	■ Standard Diagnostics or ■ HART communicating; ■ Supply and output pressure gauges or ■ tire valves; ■ Integrally mounted filter regulator

1. These terms are defined in ISA Standard S51.1.
2. Normal m^3/hr—Normal cubic meters per hour (0°C, 1.01325 bar, absolute); Scfh—Standard cubic feet per hour (60°F, 14.7 psia).

W6564/IL

Figure 2. *DVC5000 Series Digital Valve Controller Mounted on FloVue™ System 9000 Actuator*

● **Enhanced Safety**—Check instrument and valve operation from a remote location. Access is possible at a field junction box, marshalling panel, or within the safety of the control room using either a HART Communicator, a notebook PC, or a system workstation. Minimize exposure to hazardous environments and avoid having to access hard-to-reach locations.

● **Environmental Protection**—Avoid additional field wiring by connecting a leak detector or limit switch to the digital valve controller auxiliary terminals. If limits are exceeded, the instrument will issue an alert.

● **Hardware Savings**—When placed in an integrated system, DVC5000 Series digital valve controllers allow you to realize significant hardware

and installation cost savings by replacing other devices in the process loop, such as positioners and limit switches. Because the digital valve controller is loop powered, it can replace analog instrumentation in new or existing installations, no additional wiring is required.

● **Built to Survive**—Field-tough DVC5000 Series digital valve controllers have fully encapsulated printed wiring boards that resist the effects of vibration, temperature, and corrosive atmospheres. As shown in figure 7, a separate weather-tight field wiring terminal box isolates field wiring connections from other areas of the instrument.

● **Increased Uptime**—With the self-diagnostic capability of DVC5000 Series digital valve controllers, you can answer questions about a valve's performance, without pulling the valve from the line. You can compare the present valve/actuator signature (bench set, seat load, friction, etc.) against previously stored signatures to discover performance changes, before they cause process control problems.

● **Faster Commissioning**—Quickly commission loops by using the HART communications protocol to remotely identify each instrument, verify its calibration, review stored maintenance notes, and more.

● **Easy Maintenance**—With its patented design, digital valve controller field repair consists of quick and easy replacement of a single master module, without disconnecting field wiring, pneumatic tubing, or valve stem linkages. The master module may be then taken to the instrument shop for fast and easy troubleshooting of critical components.

Diagnostics

● **Valve Assembly Diagnostics**—When integrated with a HART communication-based system, the DVC5000 Series digital valve controller user-configurable alerts provide real-time notification of current and potential valve and instrument problems. With AMS ValveLink software, tests can be

Bulletin 62.1:DVC5000
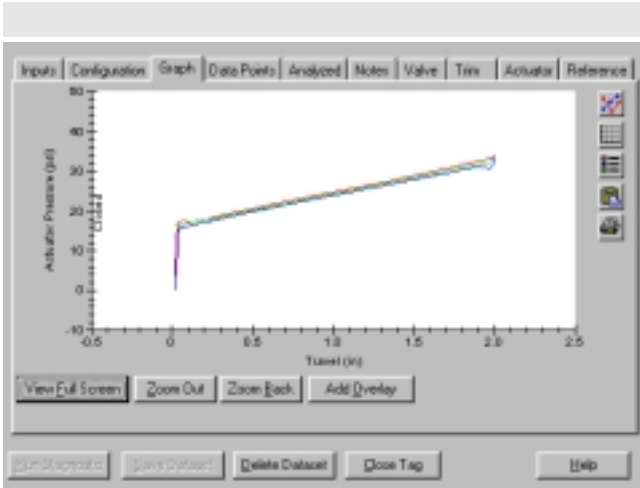
Figure 3. *The Valve Signature Diagnostic Test Can Reveal Areas of Degradation*

performed to identify problems with the entire control valve assembly. Figure 3 shows an example of a ValveLink display. Valve stem travel feedback and actuator pressure sensors, permit evaluating the health of the control valve. When compared with a benchmark Valve Signature, a later signature will reveal areas of valve degradation. This helps to pinpoint problems before the equipment fails.

● **Emerson Performance Solutions**—Emerson Performance Solutions can use instruments with on-line diagnostic capability to evaluate the valve and the process while the loop is running. Performance Diagnostics permit identifying and isolating the process element that is currently causing quality problems.

Integration

● **Non-HART Systems**—Because they operate with a traditional 4 to 20 milliamp dc control signal, DVC5000 Series digital valve controllers can replace older analog instruments. Microprocessor-based electronics provide improved performance along with repeatable and reliable configuration and calibration.

● **HART Multiplexers and AMS ValveLink Software with Modbus Interface**—Integrating DVC5000 Series instruments into a multiplexer network and using AMS ValveLink software allows monitoring multiple instruments for alarms. Additionally, tasks such as configuration, calibration and diagnostic testing do not require special trips to the field. AMS ValveLink software can also

communicate with non-HART distributed control systems through the Modbus interface, as shown in figure 4. This allows integrating critical information such as valve travel and alerts into the process operation.

● **HART-Based Control Systems**—A control system with HART communication capabilities has the ability to directly gather information from DVC5000 Series digital valve controllers. Information such as valve travel and alerts can be seamlessly integrated into operational displays.

Communication

HART Protocol

The HART (Highway Addressable Remote Transducer) protocol gives field devices the capability of digitally communicating instrument and process data. This digital communication occurs over the same two-wire loop that provides the 4 to 20 mA process control signal, without disrupting the process signal. The analog process signal, with its faster response, is used for control. At the same time, the HART digital communication provides access to calibration, configuration, diagnostic, maintenance, and additional data.

The HART protocol uses frequency shift keying (FSK). Two individual frequencies of 1200 and 2200 Hz are superimposed over the 4 to 20 mA current signal. These frequencies represent the digits 1 and 0, as shown in figure 5. The average value of the HART signal is zero, therefore no dc value is added to the 4 to 20 mA signal. Thus, true simultaneous communication is achieved without interrupting the process signal.

The HART protocol also provides the capability of multidropping several devices to a single communications line. This type of connection is well suited for remote applications such as pipelines, custody transfer sites, and tank farms.

Model 275 HART Communicator

You can perform configuration and calibration at the valve or anywhere on the two-wire loop via a Model 275 HART Communicator (figure 6). Powerful tools such as the Setup Wizard and Auto Travel Calibration automate the tasks of commissioning DVC5000 Series digital valve controllers. These automation tools not only save time, but also provide accurate and repeatable results.
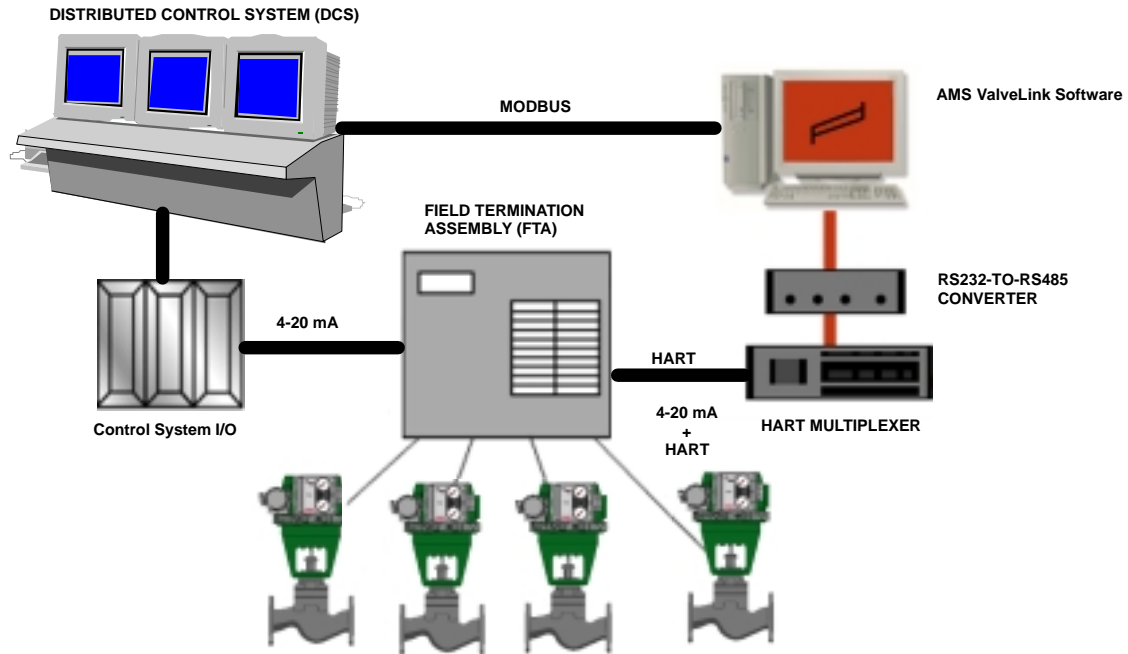
W8082-1 / IL

Figure 4. *Integrate Information from the Digital Valve Controller into a Non-HART Compatible Control System With AMS ValveLink Software's Modbus Interface*
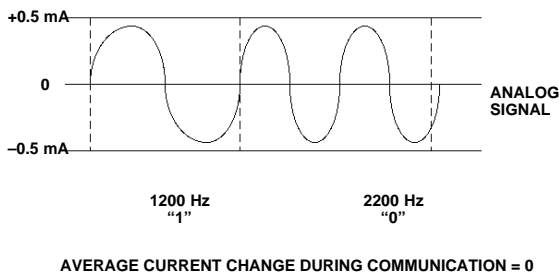
A6174/IL

Figure 5. *HART® Frequency Shift Keying Technique*

W7125 / IL

Figure 6. *Model 275 HART Communicator*

AMS ValveLink Software

AMS ValveLink software is a Windows-based software package that allows easy access to the information available from DVC5000 Series digital valve controllers. Use AMS ValveLink software to monitor the performance characteristics of the valve and obtain vital information without having to pull the valve from the line. Results from diagnostic tests such as

Valve Signature, Dynamic Error Band, and Step Response are displayed in an intuitive user-friendly environment that allows easy interpretation of the data. Diagnostic graphs can be superimposed over

TERMINAL BOX ASSEMBLY

TERMINAL BOX COVER

PRINTED WIRING BOARD ASSEMBLY

MODULE BASE ASSEMBLY

I/P CONVERTER

SHROUD

TRAVEL SENSOR ASSEMBLY

GASKET

HOUSING

PRESSURE GAUGES (OPTIONAL)

PNEUMATIC RELAY

RELAY CAP
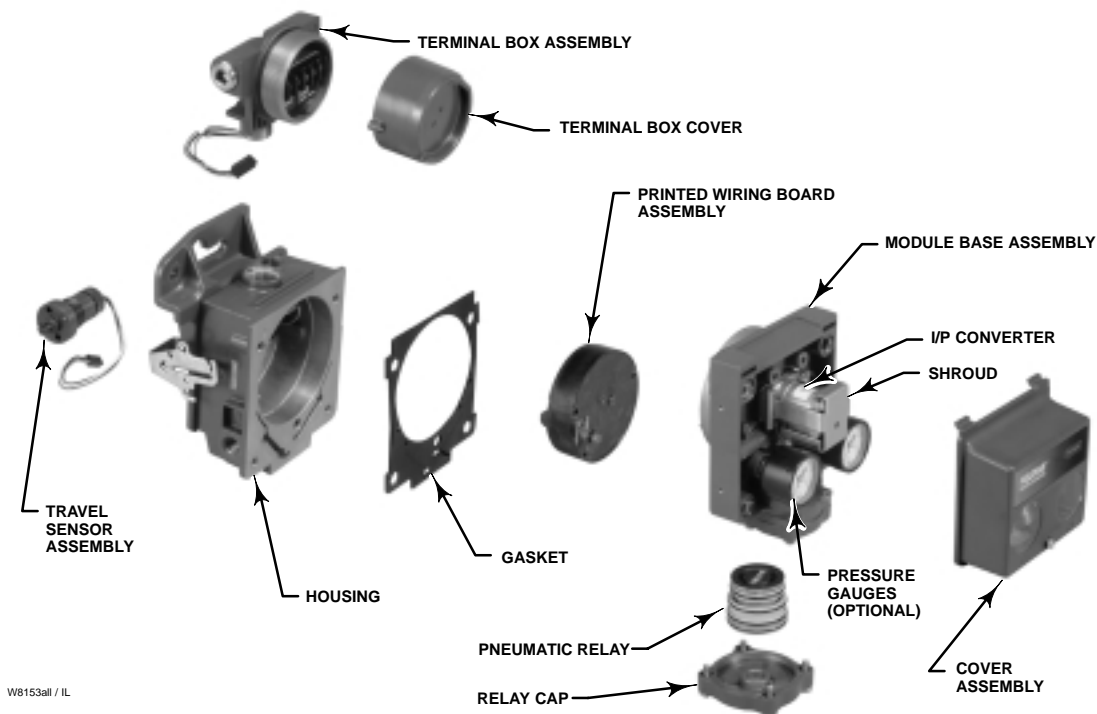
COVER ASSEMBLY

W8153all / IL

Figure 7. *DVC5000 Series Digital Valve Controller Assembly*

those previously stored to view areas of valve degradation. This allows plant personnel to concentrate efforts on equipment that needs repair, avoiding unnecessary maintenance. This diagnostic capability is readily accessible and available to you either in the control room or on the plant floor. In addition to the diagnostic features, AMS ValveLink software contains an Audit Trail, Batch Runner for automating repetitive tasks, and Trending to view valve performance.
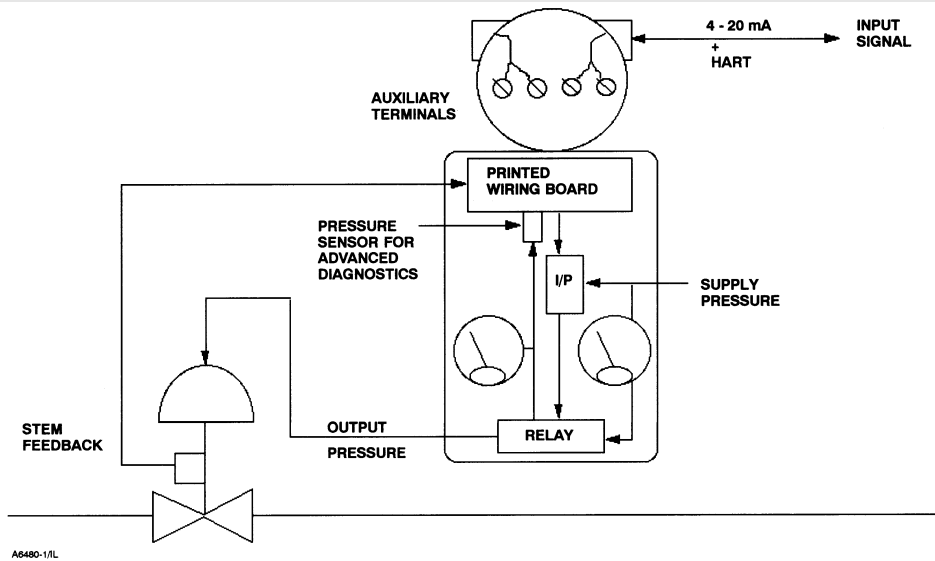
Principle of Operation

As shown in figure 7, DVC5000 Series digital valve controllers have a single master module that contains the I/P converter, printed wiring board assembly, pneumatic relay submodules, and gauges. The master module can be rebuilt by replacing the submodules.

The digital valve controller receives the 4 to 20 mA input signal and power through a single twisted pair of wires brought into the terminal box, as shown in figure 8. The input signal is routed to the printed wiring board assembly submodule, where any characterization, limits, and other signal preconditioning may be applied. The printed wiring board assembly submodule

sends a signal to the I/P converter submodule. The I/P converter transforms the input signal to a pressure signal. This signal is sent to a pneumatic relay, where it is amplified and delivered as the output signal to an actuator. The output signal is also sensed by a pressure sensor located on the printed wiring board assembly submodule and used for valve/actuator diagnostics. Stem position of the valve and actuator is brought as an input to the printed wiring board assembly submodule and used as feedback for the digital valve controller. Gauges are available in the digital valve controller to give visual indication of supply pressure and output pressure.

Installation

The Type DVC5010 digital valve controller yoke-mounts on sliding stem actuators, as shown in figure 9. The Type DVC5020 digital valve controller typically mounts on rotary actuators, as shown in figure 10. The Type DVC5030 mounts on most quarter-turn rotary actuators, including both Fisher and other manufacturers actuators (figure 11). The Type DVC5040 digital valve controller is designed for integral mounting on the FloVue System 9000 actuator (figure 12).

**Figure 8.** *Digital Valve Controller Principle of Operation*
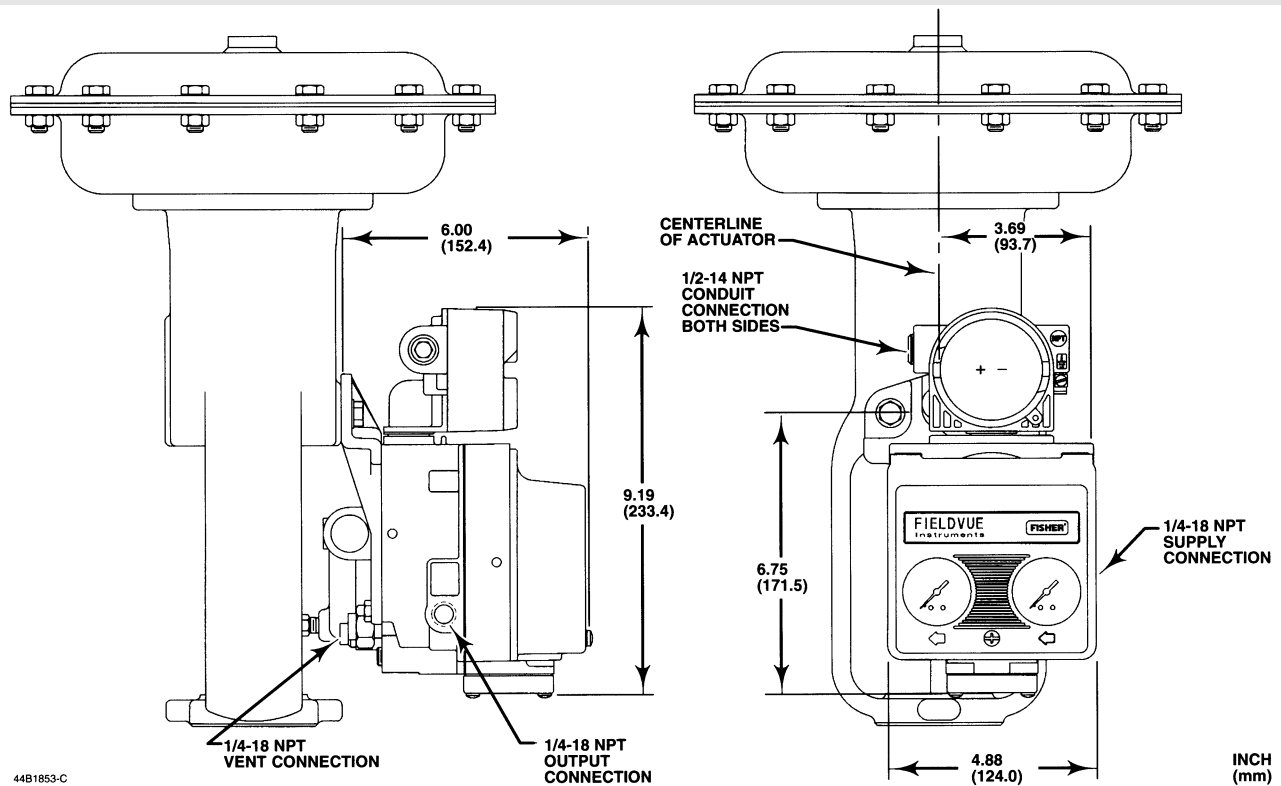
Figure 9. *Type DVC5010 Digital Valve Controller Mounted on Type 657 Actuator*

All pressure connections on the digital valve controllers are 1/4-inch NPT female connections. Typically, 3/8-inch (9.5 mm) outside diameter tubing is used between the digital valve controller output connection and the actuator. Electrical connections to the terminal box are through a 1/2-inch NPT conduit connection. If necessary, a remote vent may be connected to the digital valve controller.
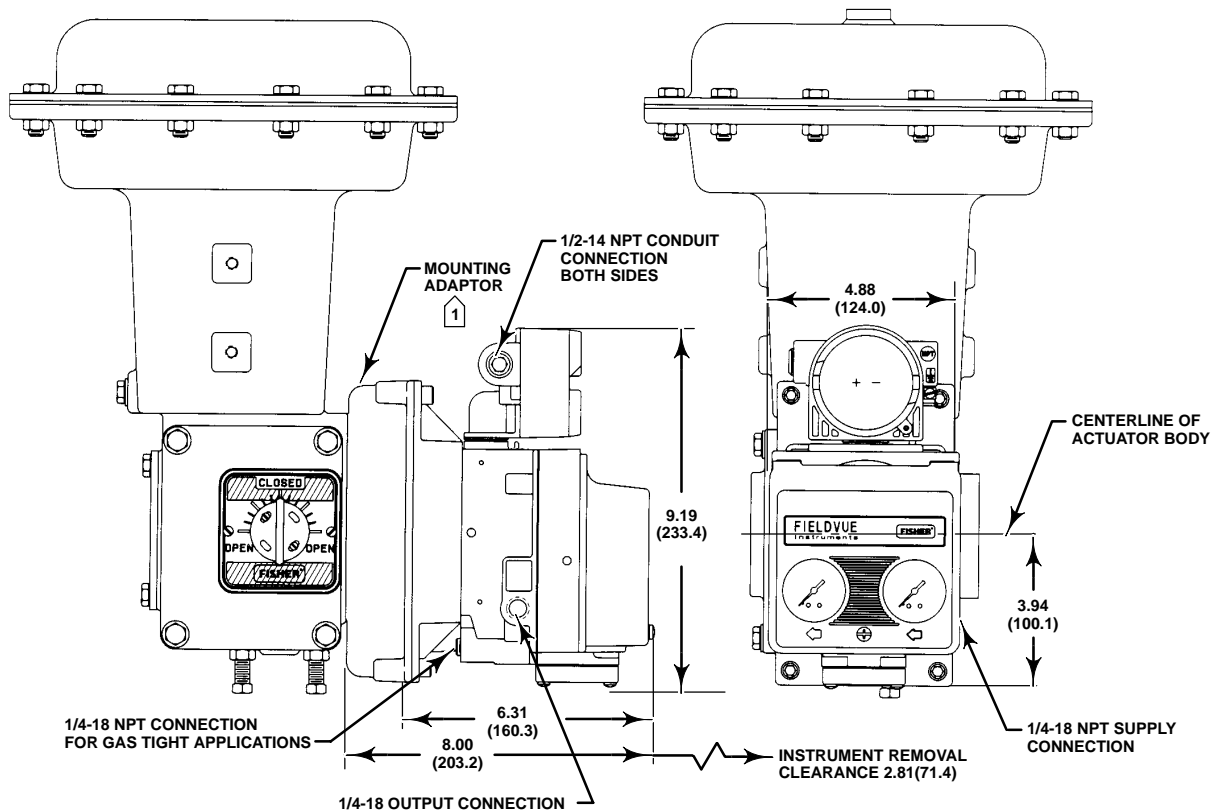
NOTE:
1 MOUNTING ADAPTOR REQUIRED FOR TYPE 1051 SIZE 33 AND TYPE 1052 SIZE 20 OR SIZE 33 ONLY.
E0525 / IL

INCH
(mm)

Figure 10. *Type DVC5020 Digital Valve Controller Mounted on Type 1052 Actuator*

Ordering Information

Refer to the specifications on page 2. Carefully review each specification and indicate your choice whenever a selection is to be made.
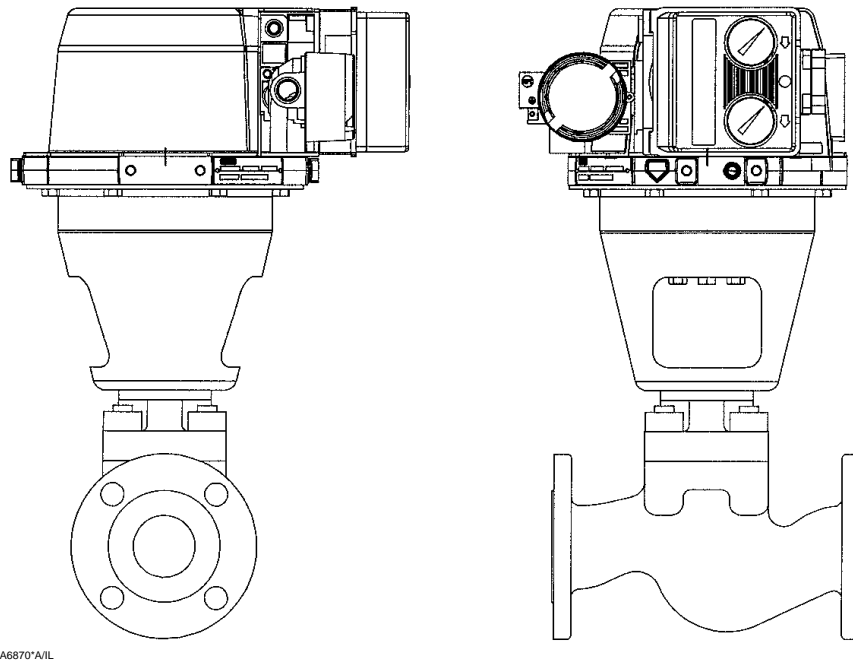
When ordering, specify:

1. Type number

2. Actuator type and size

3. Maximum actuator travel or rotation

4. Options

   a. HART Communicating or Standard Diagnostics

   b. Integrally-mounted supply pressure regulator

   c. Supply and output gauges or tire valves
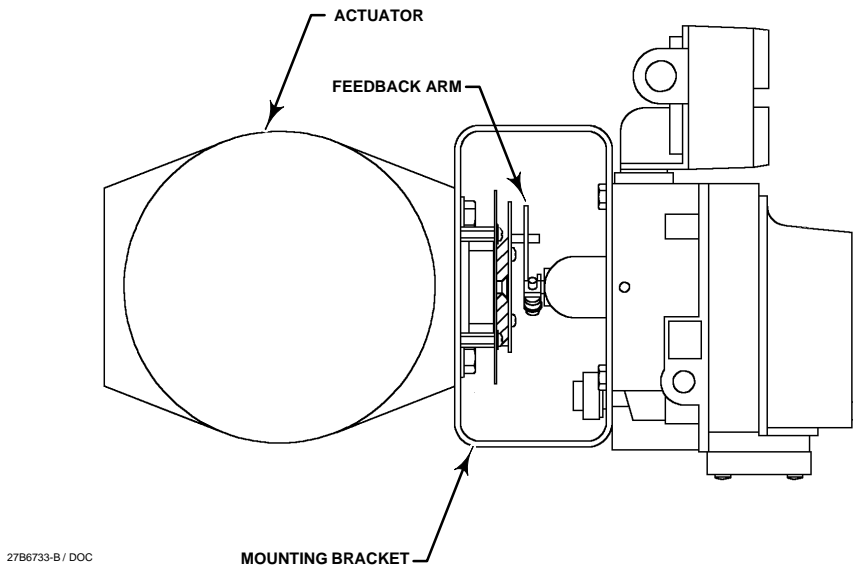
Figure 11. *Type DVC5030 Digital Valve Controller Mounted on Typical Quarter-Turn Actuator*

Figure 12. *Type DVC5040 Digital Valve Controller Mounted on FloVue System 9000 Actuator*

Bulletin 62.1:DVC5000

Table 1 *Information Accessible through AMS ValveLink Software or a Model 275 HART Communicator*

INFORMATION CATEGORY	TYPE OF INFORMATION	DESCRIPTION
Measure Variables	Analog Input Actuator Pressure Travel Temperature Auxiliary Input	The input current value on the primary terminals, in milliamps or percent The actuator presssure in psig, kPa, or bar The actual stem or shaft position in percent The internal instrument temperature in °F or °C The contacts connected to the auxiliary terminals are open or closed
Identification	Tag Instrument Serial Number Valve Serial Number Descriptor Date Calibration Location Revision Level Message Engineering Units	The instrument or loop tag The serial number assigned to the digital valve controller The serial number of the valve on which the digital valve controller is mounted A description of the application The last date the instrument was calibrated or the next date assigned for instrument calibration The instrument was calibrated in the field or at the factory The instrument and firmware revision level A user entered message of up to 32 characters. May be used for maintenance history information. Psig, kPa, bar, or %
Input/Output Characteristics	Travel Cutoffs Feedback Connection Minimum Opening and Closing Time Travel Limits Dynamic Bypass Manual Output Protection	Low cutoff drives valve to seat when travel is less than a user configurable point. High cutoff drives valve open when travel is greater than a user configurable point. The specific valve mounting choice of sliding stem or rotary The minimum time for full travel or rotation of the valve stem or shaft The user configurable software upper and lower travel limit The dynamic response of the digital valve controller to emulate a transducer The command for the digital valve controller to move to a determined position Prohibits unauthorized changes to configuration and calibration
Failure	Restart Control Mode Selftest Shutdown	Selects the control mode in the event of a restart Selects type of failure that causes an instrument shutdown
Calibration	Input Range	Sets the input current range (4 to 20 mA, typical)
Diagnostics	Deviation Alert Travel Alert Drive signal Alert Cycle Counter Cycle Alert Travel Accumulation Travel Accumulation Alert Auxiliary Terminal Alert Instrument Status Configuration Changed Flag	Alerts when the valve travel deviates from the correct value Establishs alert points based on stem or shaft position Alerts when the internal drive signal is out of bounds Records the number of changes in stem direction Alerts when a user configurable number of cycles are exceeded Records total accumulated stem or shaft travel Alerts when a user configurable travel accumulation is exceeded Alerts when the contacts connected to the auxiliary terminals are open or closed (alert can be configured to occur with either open or closed contacts) The status of internal instrument checks The instrument configuration has been changed

Table 2. *Additional information Accessible with AMS ValveLink Software*

INFORMATION CATEGORY	TYPE OF INFORMATION	DESCRIPTION
Diagnostics	Dynamic Error Band Valve Signature Step Response	Runs an input versus travel test of the instrument and valve Runs an actuator pressure versus travel test to determine valve/actuator friction, bench set, spring rate, and seating load Runs a multipoint travel versus time test for various step inputs