Product Bulletin
62.1:DVC6000 SIS
September 2006

FIELDVUE® DVC6000 Series Digital Valve Controllers for Safety Instrumented System (SIS) Solutions

The operation of many industrial processes, especially in the chemical and oil & gas industries, involves inherent risk due to the leaking of lethal or flammable chemicals or gases. Safety Instrumented Systems are specifically designed to reduce the likelihood or the severity of the impact of an identified event, thus helping to protect personnel, equipment, and the environment. These systems involve final control elements, which are mostly in one position and are requested to move only when an emergency situation arises. Typical applications with Safety Instrumented Systems involve Emergency Shutdown Valves, Emergency Blow Down Valves, Emergency Venting Valves, Emergency Isolation Valves, Critical On-Off Valves, etc. Because the final control element remains in one position without mechanical movement, the dependability of the valve is reduced; that is, it may not operate successfully upon demand. This could cause a potentially dangerous condition leading to an explosion or fire and the leaking of lethal chemicals and gases to the environment.

Emerson Process Management™ offers a solution for Safety Instrumented System (SIS) valves that use Fisher® DVC6000 Series FIELDVUE® digital valve controllers (see figure 1). Using DVC6000 Series instruments for SIS solutions permits partial stroking of the valve to reduce the Probability of Failure on Demand (PFD) and, consequently, the possibility of catastrophic situations. Partial stroking tests valve movement with a small ramp. This ramp is small enough not to disrupt production, but large enough to confirm that the valve is working. DVC6000 Series instruments in SIS solutions also provide state-of-the-art testing methods, which reduce testing and maintenance time, reduce initial investment cost, improve system performance, and provide diagnostic capabilities.

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Figure 1. FIELDVUE® DVC6030 Digital Valve Controller in SIS Solution Mounted on a Quarter-Turn Actuator

Note

Neither Emerson®, Emerson Process Management, Fisher, nor any of their affiliated entities assumes responsibility for the selection, use, and maintenance of any product. Responsibility for the selection, use, and maintenance of any product remains with the purchaser and end-user.

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Features

- **Increased System Availability**—The simple and secure method of partial stroke testing allows end-users to perform more frequent valve mechanical movement tests. This reduces the PFD factor. Because the test procedures are flexible, they can be conducted at any time, providing more assurance the system will be available upon demand. In addition, continuous valve monitoring through AMS™ ValveLink® Software provides awareness of the valve's status.

- **Reduced Cost of Ownership**—Lower base equipment cost with considerable reduction in testing time and a reduced manpower requirement makes this solution economically feasible. DVC6000 Series digital valve controllers in SIS solutions offer an economic alternative to expensive pneumatic test panels and skilled personnel presently required for testing Safety Instrumented System valves.

- **Valuable Time Savings**—Remote testing capability requires fewer maintenance inspection trips to the field thus saving considerable time. Using AMS ValveLink Software's Batch Runner to establish an automatic test routine can also provide increased time savings.

- **Predictive Maintenance**—DVC6000 Series instruments in SIS solutions permit using AMS ValveLink Software to provide Valve Degradation Analysis, which is important for critical valves in shut down systems. This may also reduce the amount of scheduled maintenance.

- **Valve Stuck Alert**—While performing the partial stroke test, if for any reason the valve is stuck, the digital valve controller will not completely exhaust the actuator pressure. This reduces the likelihood that the valve will slam shut should it become unstuck. The digital valve controller will abort the test and set an alert indicating that the valve is stuck. The alert is accessible through either the 375 Field Communicator or AMS ValveLink Software.

- **System Audit Documentation**—Using AMS ValveLink Software provides a time and date stamp on all tests and reports, which is important for documenting compliance with the requirements of statutory authorities.

- **Verification**—AMS ValveLink Software provides the capability for comparing and interpreting diagnostic data.

- **Device Initiated Partial Stroke Test Available**—DVC6000 Series digital valve controllers allow a partial stroke test, which ramps valve travel a small amount, while the valve is in-service and operating. Should a demand arise during the test, the test is overridden immediately and the valve moves to the safe state. The partial stroke test can be automatically scheduled and initiated by the device itself or can be performed manually by the user. Configuring the time interval between tests for a device initiated partial stroke test automates the process.

- **Built-In Redundancy**—When used in conjunction with a solenoid valve, as shown in figures 9 and 11, DVC6000 Series digital valve controllers in SIS solutions provide an inherent redundant pneumatic path. Should an emergency situation arise, the actuator pressure exhausts through either the solenoid valve or through the digital valve controller, allowing the valve to move to the safe position.

- **Reduced Wiring Cost**—DVC6000 Series instruments in SIS solutions eliminate the need for position transmitters and separate wiring from the transmitter. Through HART® protocol, the valve position is communicated over the same 4 to 20 mA analog loop that provides the valve control signal. A HART-to-analog signal converter in the control room can provide a 4 to 20 mA signal that is proportional to valve position. The HART-to-analog signal converter can also provide discrete contact outputs to the logic solver, which may replace hard-wired limit switches.

- **Device Integrity Continuously Checked**—When “End Point Pressure Control Mode” is enabled, the digital valve controller remains constantly in control while the valve is at its normal position (either fully open or fully closed); it is not allowed to reach a saturated state. The digital valve controller constantly tests its internal components, and if any component fault is detected, it sets an alert which may be accessed through either the 375 Field Communicator or AMS ValveLink Software.

- **Manual Reset**—The DVC6000 Series digital valve controller in SIS applications can be configured to hold the trip state until a local reset button is pressed. Manual reset can be initiated by pressing the built-in button on the optional LCP100 local control panel. Alternatively, if the LCP100 is not used, a user-supplied push button can be used to short the AUX terminals.

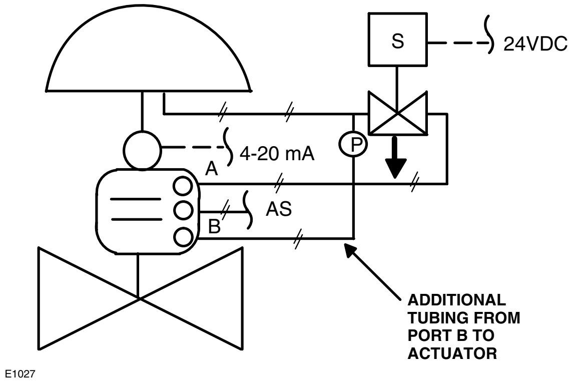

Figure 2. Pneumatic Hookup for Solenoid Testing

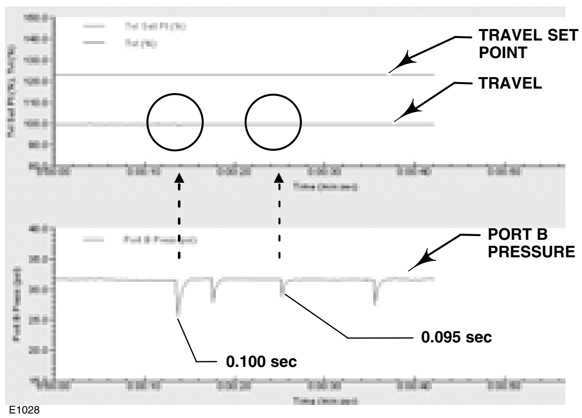

Figure 3. AMS™ ValveLink® Software Screen Image Showing Pressure Drop Across the Solenoid Valve

● **Trigger Functionality**—Data can be collected and stored in the microprocessor memory of the DVC6000 digital valve controller. Trip event data can be accessed for an audit and presented to a regulatory or insurance authority when the DVC6000 SIS operates with 4−20 mA. The trigger will initiate on-board data collection based on a change in actuator pressure, valve travel, input current, pressure differential, travel deviation, travel cutoff, or auxiliary input/external trigger. The data is stored on board the device for later retrieval, and is retained in the event of a power loss.

● **Solenoid Testing**—When a solenoid valve is installed between the DVC6000 pressure output and the actuator, the control valve assembly can be configured to verify the operation of the solenoid valve. In single acting actuator applications, the "unused" output port of the DVC6000 can be piped such that the pressure downstream of the solenoid valve is measured (see figure 2). When the solenoid valve is pulsed, the DVC6000 can sense the momentary pressure drop across the solenoid valve,

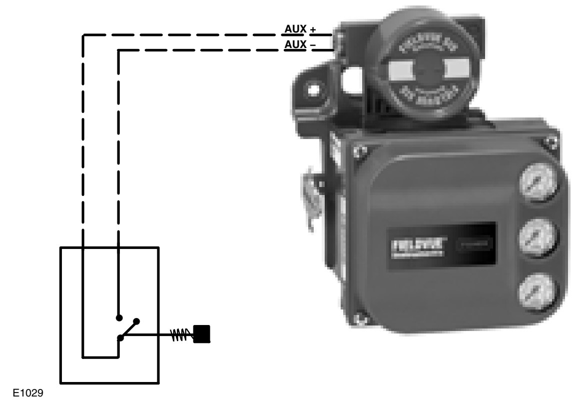

Figure 4. Initiate the Partial Stroke Test from a Push Button Remotely Located from the Valve

as shown in figure 3. If the pulse is short enough, the emergency shutdown valve will not move or disrupt the process. This not only increases the availability of the solenoid valve during a safety demand, but also enhances the reliability of the SIF (Safety Instrumented Function) loop.

● **Spurious Trip Protection**—The DVC6000 Series digital valve controller can be supplied with a reverse acting relay to provide maximum output pressure at minimum input signal. This solution provides trip protection because loss of control signal will not cause the valve to trip (i.e. the relay stays at maximum output pressure).

In point-to-point mode, (where the DVC6000 SIS is powered with 4mA), the valve can be taken to its fail safe position by applying 20mA.

In multidrop mode, (where the DVC6000 SIS is powered with 24VDC), a solenoid valve will be required to take the final control element to its fail safe position.

The DVC6000 digital valve controller also offers a diagnostic to test the operation of the solenoid valve when used with a single-acting actuator.

● **Partial Stroke Testing**—This test checks for valve movement. The partial stroke test can be initiated by an authorized technician with the 375 Field Communicator or AMS ValveLink Software. The technician may also initiate the test by shorting the AUX Terminal in the field with a push button located at the device, or remotely from the valve (figure 4) or by using an LCP100 local control panel (shown in figure 19). Initiating the test does not require removing any instrument covers or being near the valve during the test. Once initiated, the

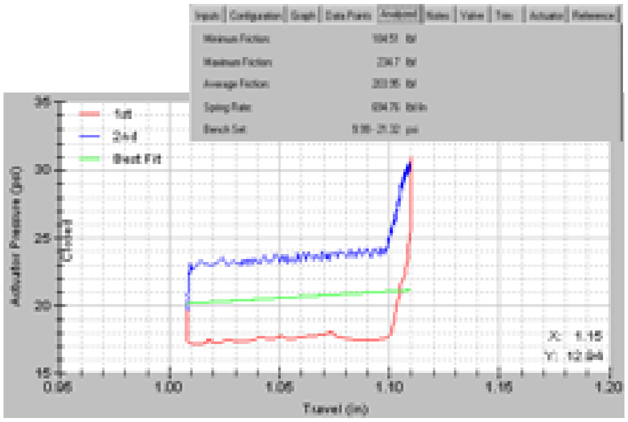

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Figure 5. Valve Signature and Analysis Obtained from Partial Stroke Test on an SIS Valve

automated test moves the valve to a predetermined value then returns the valve to its original position. The default value for valve movement is 10% from its original position, but can be custom set to any value up to 30% to meet plant safety guidelines.

The partial stroke test can reduce costly, labor intensive testing techniques. The simplicity of this automated test allows for more frequent online testing. More frequent testing enhances loop availability and increases the reliability of the system.

A partial stroke test can be initiated when the valve is operating at either 4 or 20 mA (point-to-point mode). In applications where a spurious trip is to be minimized, 4 mA is the normal operating position.

- **Valve Signature**—A valve signature obtained with AMS ValveLink Software can be used to easily determine valve packing problems (through friction data), leakage in the pneumatic pressurized path to the actuator (through the Pressure vs Travel graph), valve sticking, actuator spring rate, and bench set.

Any time a partial stroke test is run on the valve, a partial stroke valve signature and analysis, shown in figure 5, is available. Comparing valve signature results can be used to determine if valve response has degraded over time.

In addition, when the valve is not online, several full stroke valve diagnostic tests can be run, including valve signature, dynamic error band, and step response. AMS ValveLink Software enables simultaneous multiple overlay of up to ten tests (partial stroke test or dynamic scan or a combination of both tests) and allows end-user capability to trend valve history. Pressure and travel vs. time plot provides the exact status of the valve movement, helping to critically analyze events like a “Safety Demand”. These tests can also be used to evaluate valve performance, such as stroking time and shutoff capability. Running these tests when the valve is first installed in the safety system allows establishing a bench mark for valve performance. The results of these tests can be compared to results from later tests to determine if valve performance has degraded.

- **Automatic Testing**—The AMS ValveLink Software Batch Runner tool can be used to automate diagnostic testing. It provides the capability of running multiple tasks back to back on multiple valves with no intervention. This permits the user to do other things while Batch Runner does the work.

- **Travel Record**—The cycle counter and travel accumulator provide a record of the number of cycles and percentage of travel accumulated over time.

- **Alerts**—All device alerts are available through either the 375 Field Communicator or AMS ValveLink Software. Alerts are immediately available, and logged if AMS ValveLink Software is set up for alert scanning. Alerts are also stored in an alert record in the instrument. Alerts in the alert record can be retrieved by connecting a Field Communicator or AMS ValveLink Software to the device. Each alert is recorded with a time and date stamp to allow the operator to determine the nature of the alert and when it occurred.

- **Alert Notification**—AMS ValveLink Software Event Messenger allows notifying key people of critical alerts via e-mail. AMS ValveLink Software can be set up to automatically send an e-mail when a specified alert occurs on a final control element in a Safety Instrumented System (figure 6). This e-mail could also be setup to send a text message. The capability can be setup to notify a designated technician if a specific alert, or sets of alerts, occurred on a predefined set of safety shutdown valves. This means key plant operation personnel can be continuously informed of alert status, no matter where they are, enabling them to provide more timely and precise corrective action.

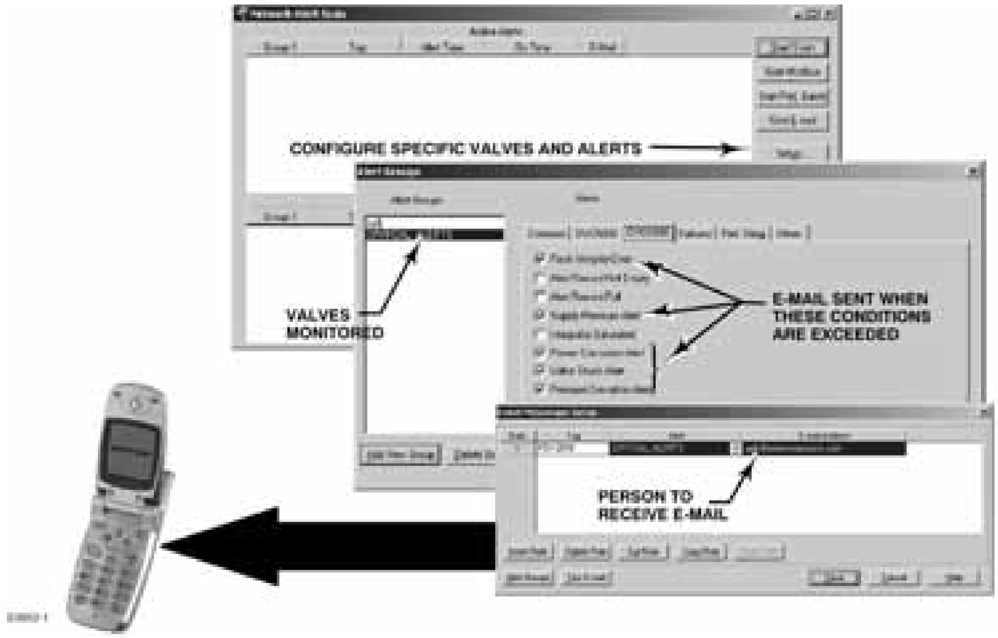

Figure 6. Notify Key People via E-Mail whenever a Specified Alert Occurs on a Safety Shutdown Valve

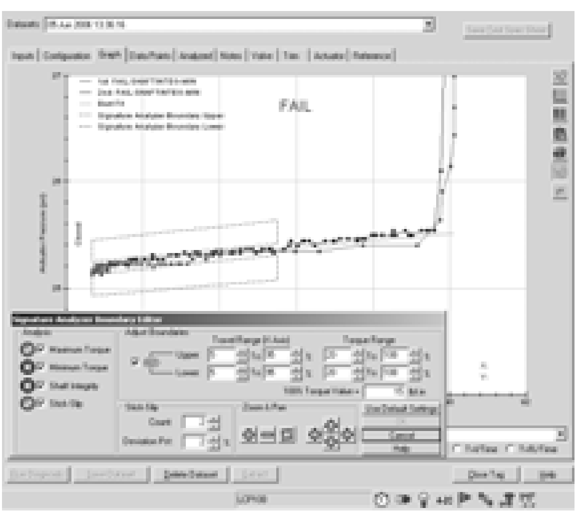

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Figure 7. Broken Shaft or Stem Diagnostic, available through AMS™ ValveLink® Software

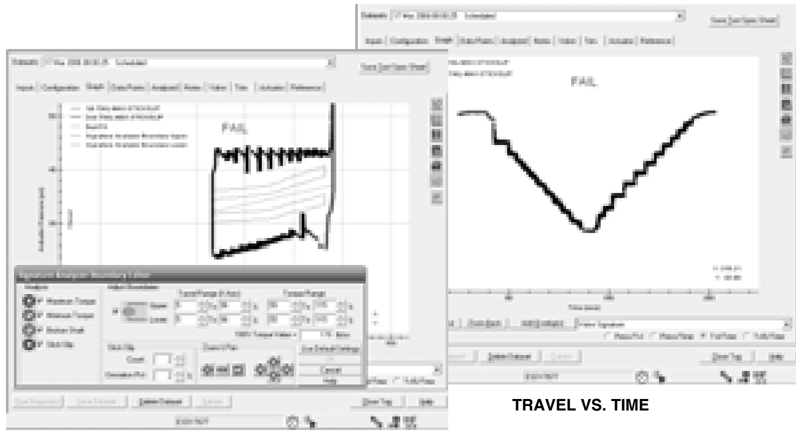
- **Adjustable Travel Cutoff**—Travel Cutoffs are adjustable when the DVC6000 SIS is operating with a 4–20 mA current. The Setup Wizard automatically sets travel cutoffs at 50%, making the DVC6000 SIS work like an on-off device. At current levels from 4.0 to 11.99 mA, the DVC6000 SIS will provide minimum output pressure, and at 12 to 20 mA, the DVC6000 SIS will provide full output pressure.

A user can customize valve response to the control signal by changing the travel cutoffs. For example, it is possible to have the valve throttle between 10 and 90% open, but work as an on-off valve between 0% to 10% and 90% to 100% opening. The user now has a standard throttling control valve between 10% and 90% opening, but has an SIS outside of this range. While in SIS mode, in this example, partial stroke and pressure control mode can be enabled during travel greater than 90%.

- **Travel Characterization**—The DVC6000 SIS provides flexibility to configure quick open, linear, equal percentage, or custom characterization.

- **Signature Analyzer**—An additional diagnostic is available through AMS ValveLink Software for the possible indication of a broken shaft or stem, as shown in figure 7. Stick-Slip, a new diagnostic also available through AMS ValveLink Software (see figure 8), is used to indicate inherent dead motion and degraded performance.

- **Enhanced Tuning Capabilities**—Large size valves and actuators are often equipped with air accessories to improve stroking speed requirements. DVC6000 SIS firmware has simple parameter choices to allow the operator to more easily tune valves with accessories.



TRAVEL VS. TIME

E1038/E1039 PRESSURE / TRAVEL

Figure 8. Stick-Slip Diagnostic, available through AMS™ ValveLink® Software

Installing DVC6000 Series Instruments in SIS Systems

DVC6000 Series instruments in SIS solutions can be extended to any valve style configuration including sliding-stem, rotary, quarter-turn, etc. with spring and diaphragm actuators or spring-return piston actuators so long as the actuator system was designed so that it will move the valve to the safe state. A spring return actuator is normally used. An extensive number of mounting kits have been designed to work with actuators produced by various manufacturers.

Two types of installation are possible:

- **2-wire system**
- **4-wire system**

Installations with the digital valve controller in 2-wire systems (multidrop mode) are shown in figures 9 and 10. In installations that include a solenoid valve with the digital valve controller, the logic solver provides a single 24 volt dc source to provide power for both the solenoid valve and the digital valve controller. Installations with the digital valve controller in a 4-wire system (point-to-point mode) are shown in figure 11. These installations require two separate sources: a 24 volt dc source (from the Logic Solver) for the solenoid valve and a 4 to 20 milliamp dc current source (either from the Logic Solver or the DCS control system) for the digital valve controller.

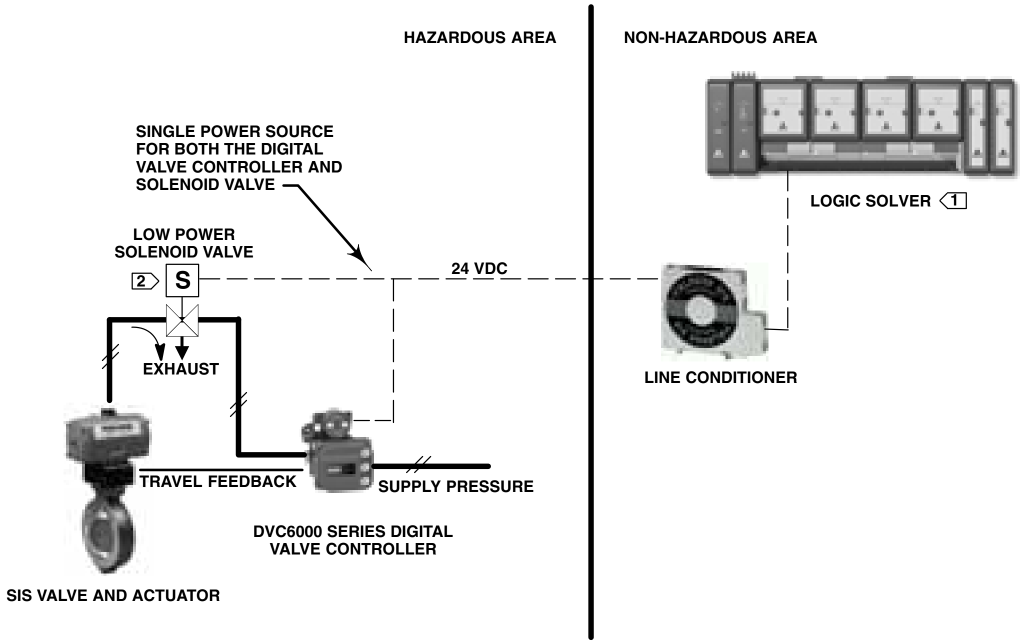
In installations that include a solenoid valve, a redundant pneumatic path exists, i.e., the actuator pressure will always be able to exhaust to allow the valve to move to the safe position. If the solenoid valve fails, the actuator pressure will exhaust through the digital valve controller. If the digital valve controller fails, the actuator pressure will exhaust through the solenoid valve. If necessary, the solenoid valve can have larger ports to allow the safety shutdown valve to meet any response time criteria.

2-wire system installations:

- Reduce wiring cost for new installations or no additional wiring cost for existing installations
- Save an I/O card in the control room
- Require a line conditioner that adds an approximate 2 volt dc line drop (in installations that include a solenoid valve) or can use a HART-pass through multiplexer, which has the built in capability to allow HART communication without a line conditioner.
- Require a low power solenoid valve (if the installation includes a solenoid valve)

4-wire system installations:

- Permit the digital valve controller to continue to communicate even during emergency conditions (on demand). This allows the digital valve controller to provide valuable trending information through AMS ValveLink Software. Being able to record the valve action can provide important evidence that the valve did stroke upon demand.
- Require an additional pair of wires
- Permit the use of existing solenoid valves which may be powered with 48 volts dc, 120 volts ac, etc.



NOTE:
1 A LOGIC SOLVER, IF REQUIRED, CAN BE PROVIDED BY EMERSON PROCESS MANAGEMENT. CONTACT YOUR LOCAL SALES OFFICE.
2 IF SHARING 24 VOLT DC SIGNAL IS NOT PERMISSIBLE, THE SOLENOID VALVE MAY BE ELIMINATED, AS SHOWN IN FIGURE 10.
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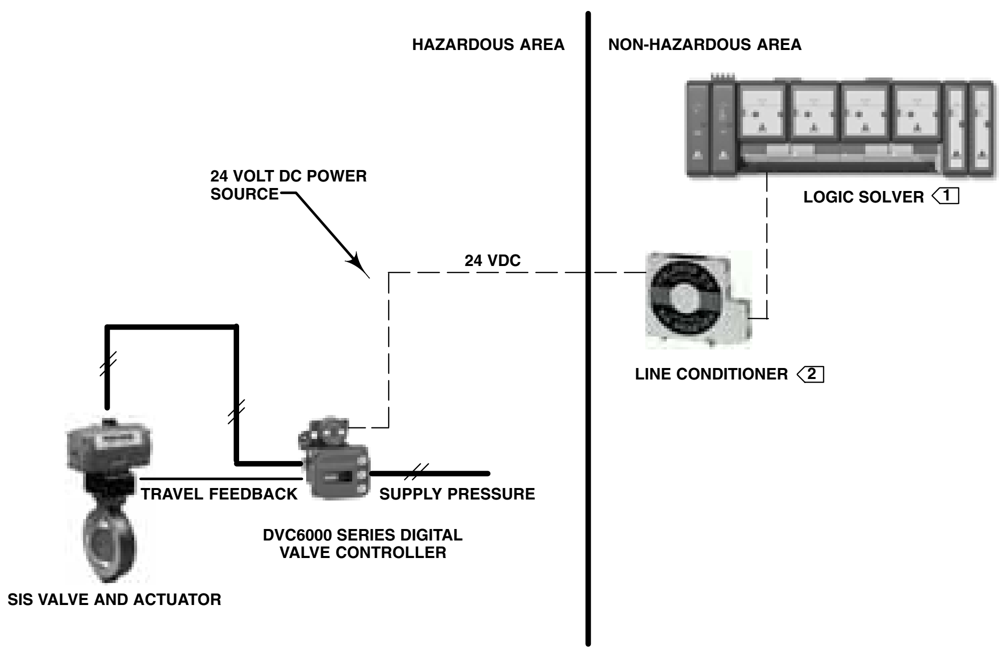
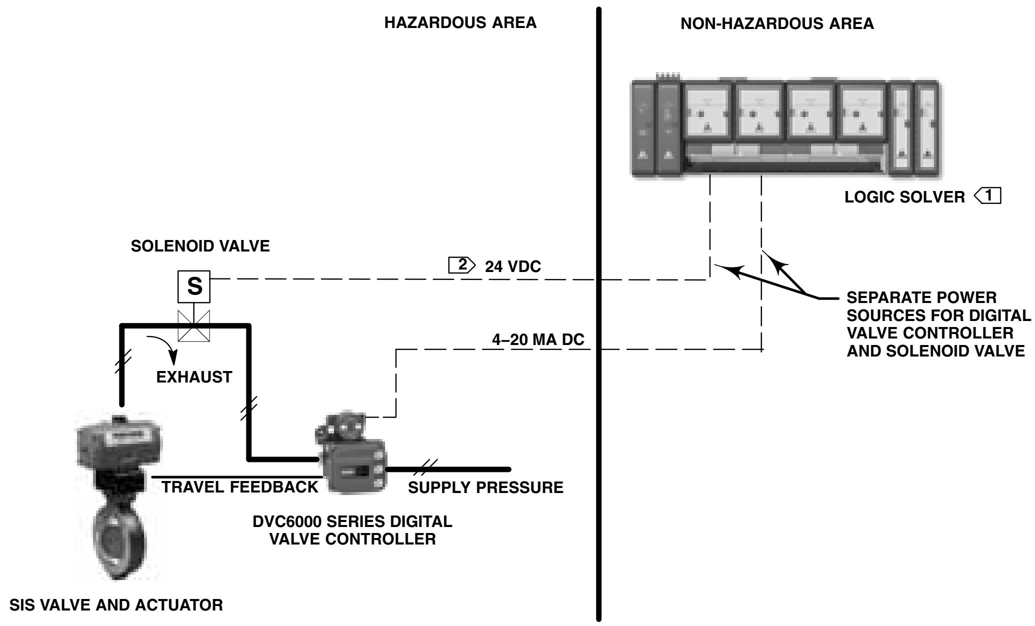
Figure 9. Safety Instrumented System Schematic with DVC6000 Series Digital Valve Controller in 2-Wire System



NOTE:
1 A LOGIC SOLVER, IF REQUIRED, CAN BE PROVIDED BY EMERSON PROCESS MANAGEMENT. CONTACT YOUR LOCAL SALES OFFICE.
2 LINE CONDITIONER OR 250 OHM IMPEDANCE TO PERMIT HART COMMUNICATION
E0845-1

Figure 10. Safety Instrumented System Schematic with DVC6000 Series Digital Valve Controller in 2-Wire System (See figure 9 for alternate installation with solenoid valve)



NOTE:
1 A LOGIC SOLVER, IF REQUIRED, CAN BE PROVIDED BY EMERSON PROCESS MANAGEMENT. CONTACT YOUR LOCAL SALES OFFICE.
2 EXISTING SOLENOID VALVE MAY BE USED. DEPENDING UPON SOLENOID VALVE, LOGIC SOLVER WOULD NEED TO SUPPLY OPERATING POWER FOR SOLENOID VALVE (120 VAC, 48 VDC, ETC.).
E0513-2

Figure 11. Safety Instrumented System Schematic with DVC6000 Series Digital Valve Controller in 4-Wire System

Valve and Actuator Selection

To be compliant in a Safety Instrumented System, the valve assembly should be of fire-safe design and should meet the design criteria of API 607 and API 6D. Butterfly valves, such as the Fisher A11, A31D, or 8560, are designed to meet the above standards. If the requirement is for a full-bore ball valve with fire-safe design criterion, select an appropriate vendor. These are only guidelines for selecting valves and actuators for an SIS application. For more specific details, contact your Emerson Process Management sales office.

SIL-PAC™ Final Control Solution for Safety Systems

The Emerson Process Management SIL-PAC™ is a complete integrated, Final Control Solution for Safety Systems. SIL-PAC includes Emerson Valve Automation’s range of actuators, including the Bettis® Scotch Yoke Series (G & CBA) and the rack and pinion family (Hytork, El-O-Matic®, FieldQ™, and Bettis). SIL-PAC integrates these actuators with the applicable controls and mounts them to the customer specified valve body for a complete Final Control Solution. Incorporating the reliability of the industry leading actuators with the diagnostics and functionality of a Fisher digital valve controller, the DVC6000 SIS makes the package a smart SIL-PAC and an integral part of the Emerson Smart SIS. The smart SIL-PAC provides diagnostics for the entire package, partial stroke testing, and all of the familiar features available through the FIELDVUE DVC6000 Series digital valve controller. SIL-PAC includes documentation, testing, technical support, and a certification per industry standards authenticated by a third party, providing functional safety assessment and application criteria (see figure 13). The SIL-PAC Solution, complete with desired functionalities and added value required for use in safety instrumented function (SIF) loops of Safety Instrumented Systems (SIS), allows flexibility, reduced cost, improved reliability, and a familiar signal point of contact.

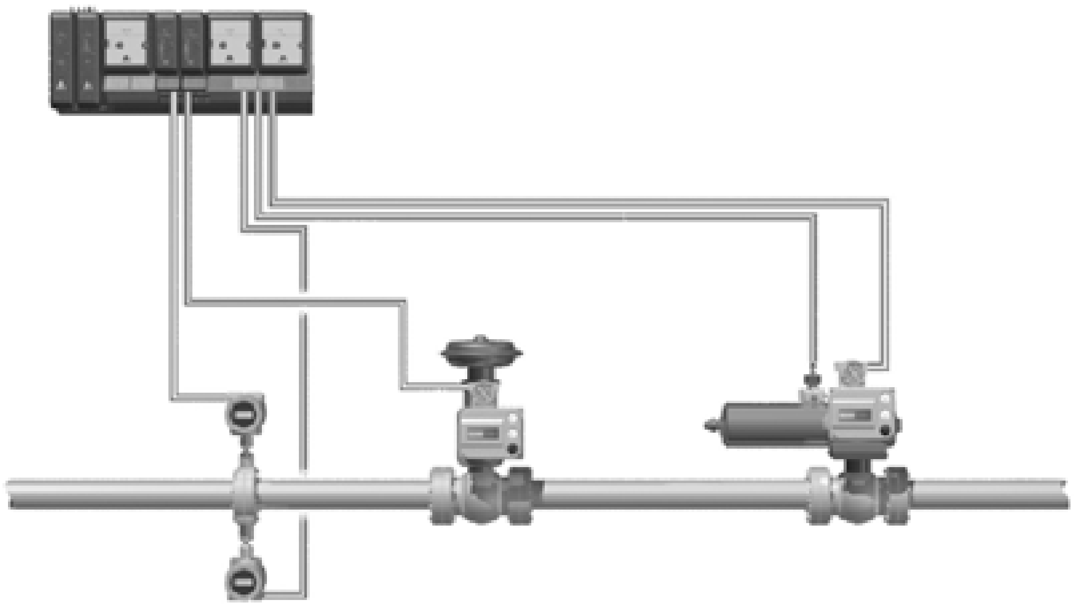


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Figure 12. DeltaV™ SIS Solution

E1041

Figure 13. SIL-PAC™ Certificate of Safety Evaluation

Integrated Solution—Smart SIS from Emerson Process Management™

With the introduction of DeltaV™ SIS (Logic Solver) and transmitters (sensor) from Emerson Process Management (see figure 12), a complete integrated solution can be provided for SIS applications, enabling the SIF (Safety Instrumented Function) loop to increase safety while decreasing spurious trips, thereby increasing the reliability from the sensor to the final control element. This integrated approach helps to provide easy regulatory compliance, reduced project capital and maintenance cost, increased system availability by better management of SIF components and easy documentation audit. For more details, contact your Emerson Process Management sales office.

TÜV Certification

TÜV has certified that DVC6000 Series digital valve controller hardware, when operating in a Safety Instrumented System with a 0 to 24 volt dc or 0 to 20 mA dc control signal, meets the requirements of IEC 61508, and can be incorporated into Safety Instrumented Function (SIF) loops that are rated to Safety Integrity Level 3 (SIL3).

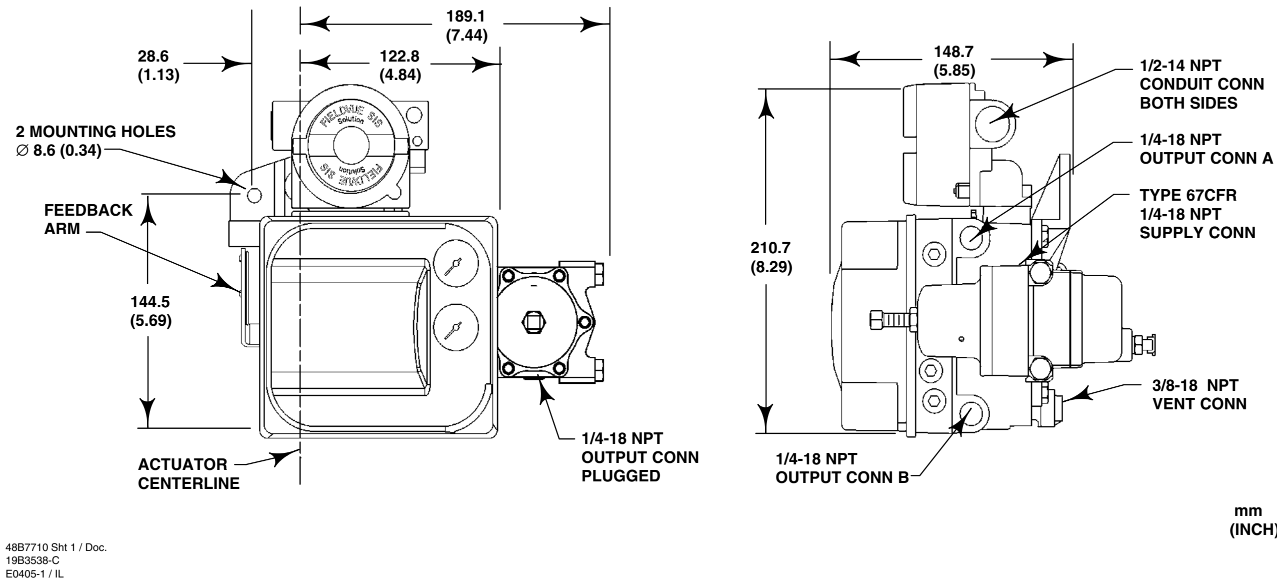

Figure 14. Dimensions for Type DVC6010 Digital Valve Controller with Integrally Mounted Filter Regulator

DVC6000 Installation

The Type DVC6010 digital valve controller is designed for yoke mounting to sliding stem actuators. Type DVC6020 digital valve controllers are designed for mounting to rotary actuators or long stroke sliding stem actuators (over 4-inches travel). Type DVC6030 digital valve controllers are designed for mounting on virtually any quarter-turn actuator. Dimensions for valve-mounted instruments are shown in figures 14, 15, and 16. Dimensions for remote-mounted instruments are shown in figures 17 and 18.

The Type DVC6005 digital valve controller base unit may be remote mounted on 2-inch pipestand or wall.

The remote-mounted DVC6005 base unit connects to the DVC6015, DVC6025, or DVC6035 feedback unit mounted on the actuator. Feedback wiring and pneumatic tubing to the control valve assembly must be connected in the field.

The digital valve controllers are loop powered and do not require additional power. Electrical connections are made in the terminal box.

All pressure connections on the digital valve controllers are 1/4-inch NPT female connections. The digital valve controller outputs are typically connected to the actuator inputs using 3/8-inch diameter tubing. Remote venting is available.

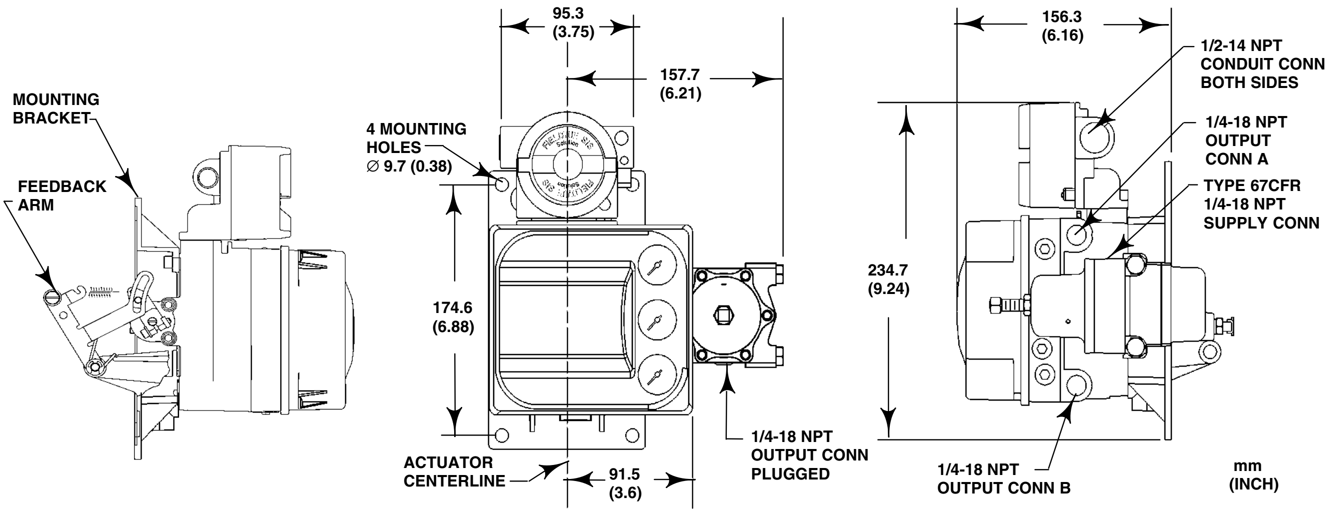

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Figure 15. Dimensions for Type DVC6020 Digital Valve Controller with Integrally Mounted Filter Regulator

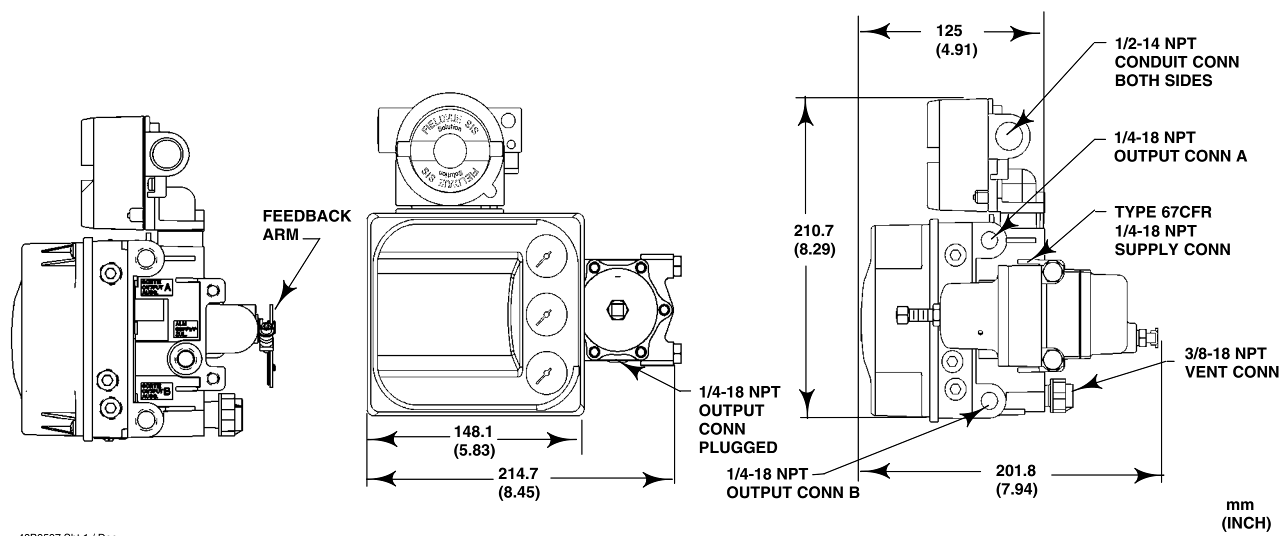

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Figure 16. Dimensions for Type DVC6030 Digital Valve Controller with Integrally Mounted Filter Regulator

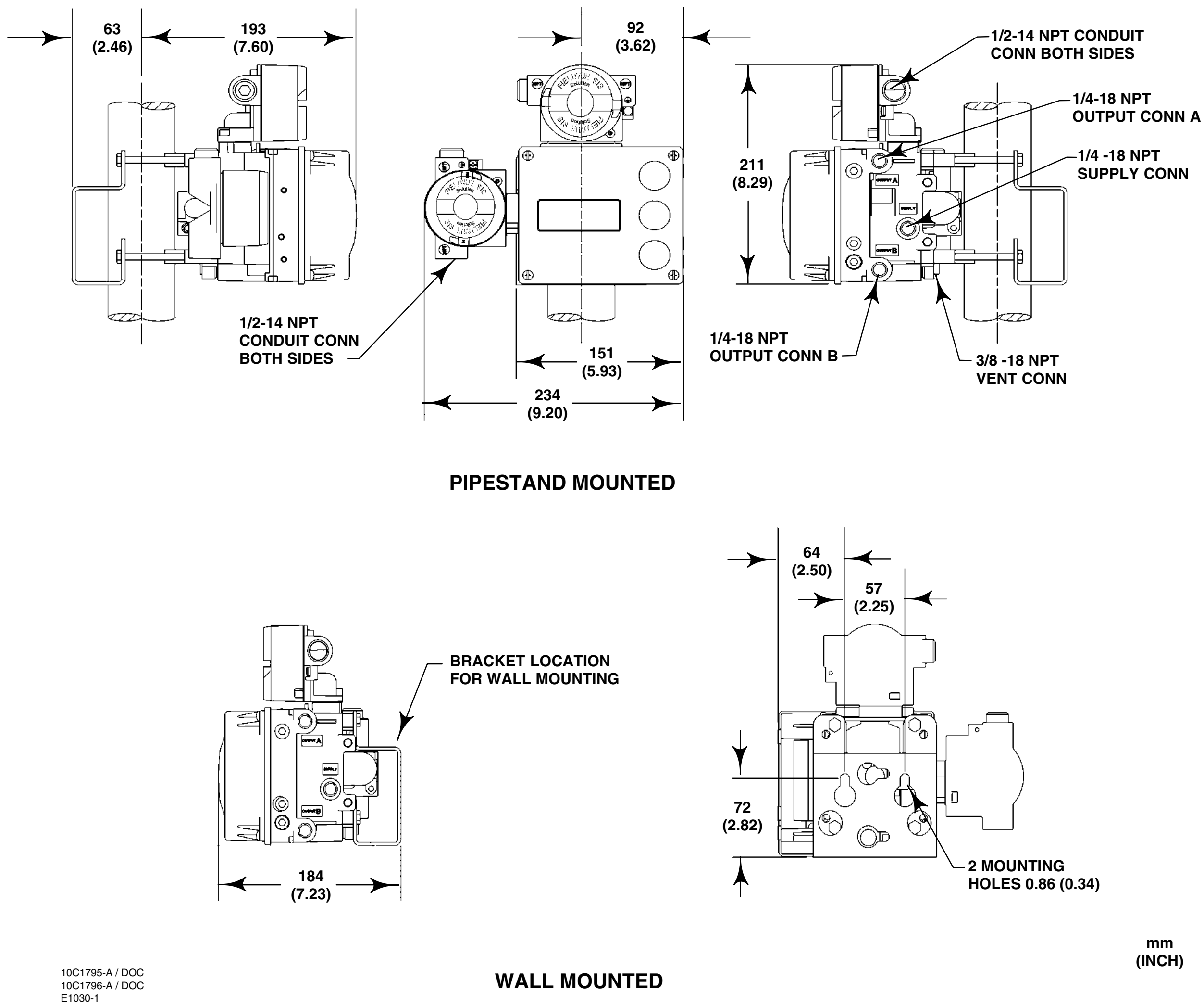
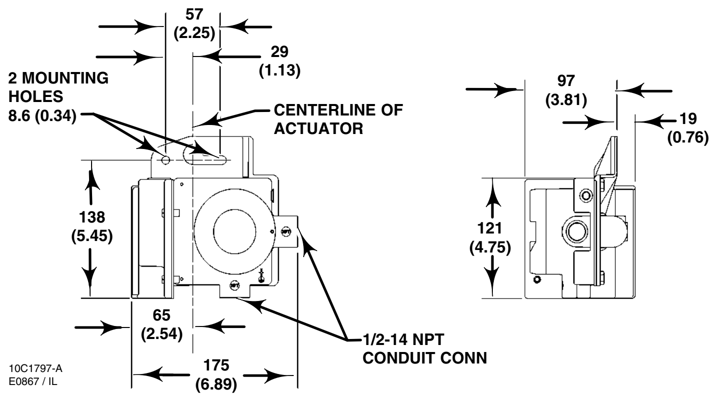
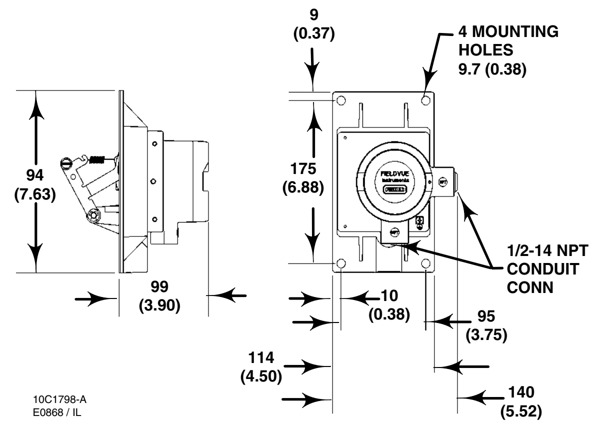


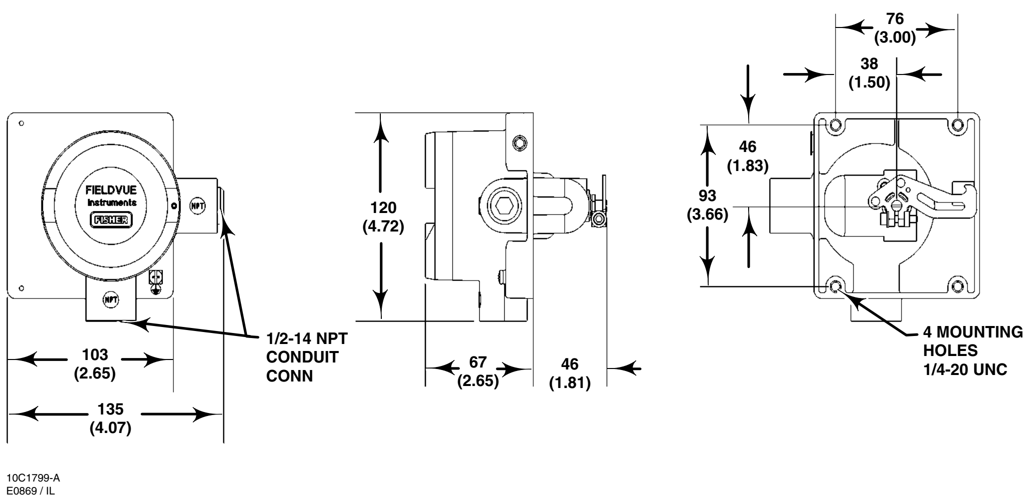
Figure 17. Dimensions for Remote-Mounted Instruments—Type DVC6005 Base Unit



TYPE DVC6015 SLIDING STEM ACTUATOR MOUNTING UP TO 102 mm (4-INCH) TRAVEL



TYPE DVC6025 ROTARY AND LONG-STROKE SLIDING STEM ACTUATOR MOUNTING



TYPE DVC6035 ROTARY ACTUATOR SHAFT MOUNTING

**mm
(INCH)**

Figure 18. Dimensions for Remote-Mounted Instruments—Feedback Units

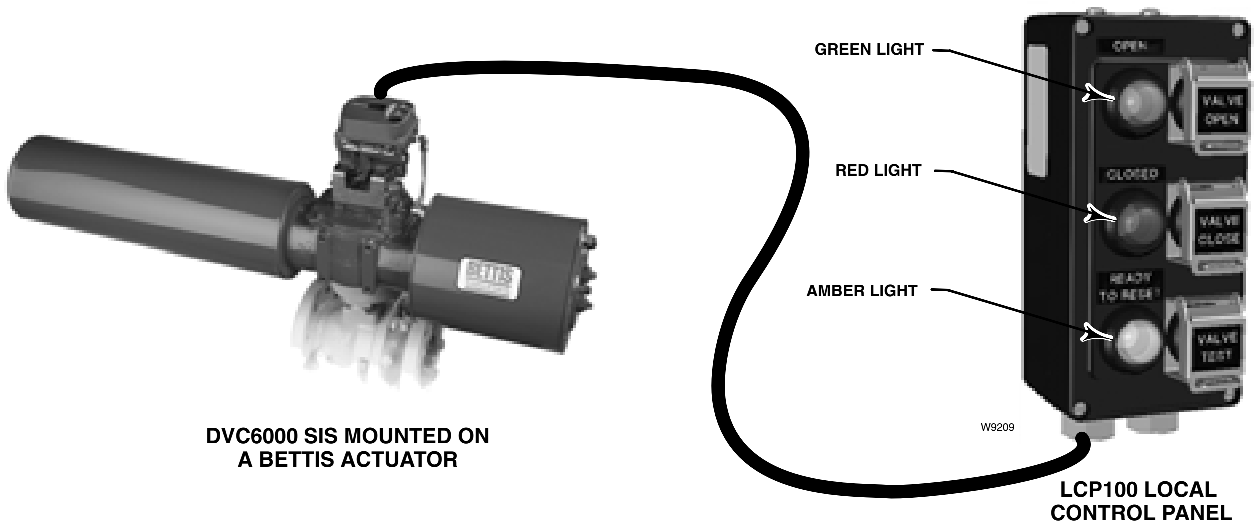


Figure 19. Type LCP100 Local Control Panel, Electrically Connects to the DVC6000 Digital Valve Controller

Type LCP100 Local Control Panel

The LCP100 local control panel, shown in figure 19, is electrically connected with the DVC6000 SIS. The LCP100 can be powered by the loop current used to power the DVC6000 SIS (requires 8 mA minimum total loop current in this case) or it can have an independent 24 V DC power supply. By use of push buttons on the local control panel, commands can be sent to the DVC6000 by which Safety Shut Down valves can be opened, closed, or tested. The local control panel also has three lights, indicating normal operating position (green), tripped or fail-safe state (red), and ready-to-reset (amber) status.

The integration of the LCP100 with the DVC6000 SIS can provide considerable savings in the number of I/O's from the control room (possibly up to five) to achieve the desired functionalities. This can provide a reduction in capital and operational costs, as well as fewer maintenance issues.

The LCP100 has two power supply options:

a. *Loop Powered (8–20 mA)*—An 8–20 mA input signal from the DCS or Logic Solver to the DVC6000 SIS provides power to the LCP100. To provide power to the local control panel the minimum input signal from the DCS or Logic Solver must be 8 mA. No external power source is required.

b. *External Power*—A 24 V DC power supply is required to power the LCP100.

Ordering Information

Refer to the Specifications section. Carefully review each specification and indicate your choice whenever a selection is to be made.

When ordering, specify:

1. Digital valve controller type number

2. DVC6000 power [24 V DC (multi-drop) or 4–20 mA current loop (point-to-point)]

3. Valve style (sliding-stem or rotary)

4. Actuator (spring and diaphragm or piston with spring return)

5. Actuator manufacturer (Fisher or other)

6. Actuator type and size

7. Positioner Action (pneumatic relay) – Direct / Reverse

8. Valve failure action (fail close or fail open)

9. Mechanical position indicator, if required

10. LCP100 local control panel, if required

DVC6000 Specifications

Available Configurations

Valve-Mounted Instrument:
DVC6010: Sliding-stem applications
DVC6020: Rotary applications and long-stroke sliding-stem applications
DVC6030: Quarter-turn rotary applications

All units can be used in either 4-wire or 2-wire system installations.

DVC6000 Series digital valve controllers must have the Safety Instrumented System Application (SIS) option

Remote-Mounted Instrument[1]:
DVC6005: Base unit for 2-inch pipestand or wall mounting
DVC6015: Feedback unit for sliding-stem applications
DVC6025: Feedback unit for rotary or long-stroke sliding-stem applications
DVC6035: Feedback unit for quarter-turn rotary applications

DVC6000 Series digital valve controllers can be mounted on Fisher and other manufacturers rotary and sliding-stem actuators.

Input Signal[2]

Point-to-Point:.
Analog Input Signal: 4–20 mA dc, nominal; split ranging available
Minimum Voltage Available at Instrument Terminals must be 10.5 volts dc for analog control, 11 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: 11 to 30 volts dc at approximately 8 mA
Reverse Polarity Protection: No damage occurs from reversal of loop current

Output Signal[2]

Pneumatic signal as required by the actuator, up to 95% of supply pressure
Minimum Span: 0.4 bar (6 psig)
Maximum Span: 9.5 bar (140 psig)
Action: ■ Double, ■ Single Direct, and ■ Single Reverse

Supply Pressure[3]

Minimum Recommended: 0.3 bar (5 psig) higher than maximum actuator requirements
Maximum: 10.0 bar (145 psig) or maximum pressure rating of the actuator, whichever is lower

Steady-State Air Consumption[4,5]

Low Bleed Relay:
At 1.4 bar (20 psig) supply pressure: Average value 0.056 normal m^3/hr (2.1 scfh)
At 5.5 bar (80 psig) supply pressure: Average value 0.184 normal m^3/hr (6.9 scfh)

The low bleed relay is the standard relay for DVC6000 SIS tier, used for On/Off applications. Performance may be affected in throttling applications.

Standard Relay:
At 1.4 bar (20 psig) supply pressure: Less than 0.38 normal m^3/hr (14 scfh)
At 5.5 bar (80 psig) supply pressure: Less than 1.3 normal m^3/hr (49 scfh)

Maximum Output Capacity[4,5]

At 1.4 bar (20 psig) supply pressure: 10.0 normal m^3/hr (375 scfh)
At 5.5 bar (80 psig) supply pressure: 29.5 normal m^3/hr (1100 scfh)

Independent Linearity[2,6]

±0.50% of output span

Electromagnetic Interference (EMI)

Tested per IEC 61326-1 (Edition 1.1). Complies with European EMC Directive. Meets emission levels for Class A equipment (industrial locations) and Class B equipment (domestic locations). Meets immunity requirements for industrial locations (Table A.1 in the IEC specification document). Immunity performance is shown in table 1.

IEC 61010 Compliance Requirements (Valve-Mounted Instruments Only)

Power Source: The loop current must be derived from a separated extra-low voltage (SELV) power source
Environmental Conditions: Installation Category I

(continued)

DVC6000 Specifications (continued)

Electrical Classification

Hazardous Area:

CSA — Explosion proof, Division 2, Dust-Ignition proof, Intrinsic Safe

FM APPROVED — Explosion proof, Non-incendive, Dust-Ignition proof, Intrinsic Safety

ATEX — Flameproof, Type n, Intrinsic Safety

IECEx — Flameproof, Type n, Intrinsic Safety

Refer to tables 2, 3, 4, and 5 for specific approval information

Electrical Housing: Meets NEMA 4X, CSA Type 4X, IEC 60529 IP66

Auxiliary Terminal Contact: Nominal Electrical Rating 3V, <1 mA; It is recommended that the switch be sealed or have gold plated contacts to avoid corrosion.

Connections

Supply Pressure: 1/4-inch NPT female and integral pad for mounting 67CFR regulator
Output Pressure: 1/4-inch NPT female
Tubing: 3/8-inch metal, recommended
Vent (pipe-away): 3/8-inch NPT female
Electrical: 1/2-inch NPT female conduit connection. **optional**—M20 female conduit connection, spring clamp terminal connection(7)

Operating Ambient Temperature Limits(3)

–40 to 80°C (–40 to 176°F) for most approved valve-mounted instruments
–40 to 125°C (–40 to 257°F) for remote-mounted feedback unit.
–52 to 80°C (–62 to 176°F) for valve-mounted instruments utilizing the Extreme Temperature option (fluorosilicone elastomers).

Construction Materials

Housing, module base and terminal box:
ASTM B85 A03600 low copper aluminum alloy (standard)
CF8M (cast 316 stainless steel) (optional for valve-mounted instruments only)
Cover: Thermoplastic polyester
Elastomers
Standard: Nitrile
Optional: Fluorosilicone

Stem Travel

DVC6010, DVC6015:
0 to 102 mm (4 inches) maximum travel span
0 to 9.5 mm (3/8 inches) minimum travel span

DVC6020, DVC6025: 0 to 606 mm (23-7/8 inches) maximum travel span

Shaft Rotation (DVC6020, DVC6025, DVC6030 and DVC6035)

0 to 50 degrees minimum
0 to 90 degrees maximum

Mounting

Designed for direct actuator mounting or remote pipestand or wall mounting. Mounting the instrument vertically, with the vent at the bottom of the assembly, or horizontally, with the vent pointing down, is recommended to allow drainage of moisture that may be introduced via the instrument air supply.

Weight

Valve-Mounted Instruments.
Aluminum: 3.5 kg (7.7 lbs)
Stainless steel: 7.7 kg (17 lbs)

Remote-Mounted Instruments.
DVC6005 Base Unit: 4.1 kg (9 lbs)
DVC6015 Feedback Unit: 1.3 kg (2.9 lbs)
DVC6025 Feedback Unit: 1.4 kg (3.1 lbs)
DVC6035 Feedback Unit: 0.9 kg (2.0 lbs)

Options

■ Supply and output pressure gauges or ■ Tire valves, ■ Integral mounted filter regulator, ■ Stainless steel housing, module base and terminal box (valve-mounted instruments only), ■ Standard Relay, ■ Extreme Temperature, ■ Beacon Indicator, ■ LCP100 local control panel

1. 3-conductor shielded cable, 22 AWG minimum wire size, is recommended for connection between base unit and feedback unit. Pneumatic tubing between base unit output connection and actuator has been tested to 15 meters (50 feet) maximum without performance degradation.
2. These terms are defined in ISA Standard S51.1.
3. The pressure/temperature limits in this document and any other applicable code or standard should not be exceeded.
4. Normal m^3/hour – Normal cubic meters per hour at 0°C and 1.01325 bar, absolute. Scfh – Standard cubic feet per hour at 60°F and 14.7 psia.
5. Values at 1.4 bar (20 psig) based on a single-acting direct relay; values at 5.5 bar (80 psig) based on double-acting relay.
6. Typical value. Not applicable for Type DVC6020 digital valve controllers in long-stroke applications or remote-mounted Type DVC6005 digital valve controllers with long pneumatic tubing lengths.
7. ATEX/IEC approvals only.

Additional System Components: Specifications, Requirements, and Functionality

Type LC340 SIS Line Conditioner, figure 21. (Required for 2-wire system installations with solenoid valve)

Input Current(1): equal to load requirements, not to exceed 100 mA
Input Voltage(1): load voltage + (30 ohms x load current); nominally 24 volts dc. See figure 20.

Ambient Operating Temperature(3): –40 to 85°C (–40 to 185°F)
Ambient Relative Humidity: 5–95%
Electrical Classification: Per IEC 61326–1 Complies with test requirements for I/O Signal/Control ports on equipment intended for use in industrial environments
Mounting: standard 35 mm DIN rail
Installation Environment: Marshalling cabinet, I/O cabinet, or junction box
Dimensions: 75 mm (3 inches) long by 12.5 mm (0.5 inches) wide by 60 mm (2.4 inches) deep

Solenoid Valve

ASCO® Model EF8316G303, EF8316G304, or equivalent low power solenoid valve for a 2-wire system.
ASCO Model EF8316G3, EF8316G4, or equivalent solenoid valve for a 4-wire system.
Body Size: 3/8 or 1/2-inch
Orifice Size: 5/8-inch
Operating Voltage: 24 volt dc
Body Material: brass
Body and orifice selection may vary with actuator type and size, type of media, etc. Solenoid model number will change if size and body material or electrical ratings change.

Type LCP100 Local Control Panel

Power Options (switch selectable)
■ External—Maximum Continuous Current: 24 VDC +/– 10% @ 50 mA maximum; Maximum Inrush: 100 mA or ■ Loop: 8–20 mA
Temperature Limits(3): –40 to 80°C (–40 to 176°F) for most approved valve-mounted instruments
Maximum distance between LCP100 and DVC6000 digital valve controller: Cable length is limited by maximum cable capacitance of 18000 pF. Typical 56 meters (185 feet) with 18 AWG shielded Audio, Control and Instrumentation Cable

Type LCP100 Local Control Panel (continued)

Electrical Classification

CSA: Ex em[ib] IIC T5 for Class 1 Zone 1 (pending agency approval)(2)

IECEx: Ex em[ib] IIC T5 for Class 1 Zone 1 (pending agency approval)(2)

Enclosure Rating: Designed to meet NEMA 4X, CSA Type 4X, IEC 60529 IP66 (pending agency approval)(2).

Electromagnetic Interference (EMI): Tested per IEC 61326-1 (Edition 1.1). Complies with European EMC Directive. Meets emission limits for class A equipment (industrial locations) and class B equipment (domestic locations). Meets immunity requirements for industrial locations (Table A.1 in the IEC specification document).

Connections: *Conduit*—■ 3/4-inch NPT or ■ M20
Wiring: 14 to 26 AWG
Electrical Installation: Wires are polarity sensitive
Compatibility: Requires DVC6000 SIS with Firmware revision 7 or later
Installation Orientation: Wiring entrance must be pointed down for self-draining
Push buttons: Protected with lockable covers
Dimensions: 253.1 mm (10 inches) long by 109.5 mm (4.3 inches) wide by 127.8 mm (5 inches) deep. See figure 22.
Approximate Weight: 2.2 kg (4.9 lbs)

Lights
Green: Solid when the valve is at its normal operating position, and loop current is normal. Flashing when the valve is not at its normal operating position, and loop current is normal.

Red: Solid when the valve is at its Fail Safe State and loop current is tripped. Flashing when valve is not at its Fail Safe State and loop current is tripped.

Amber (Ready-to-Reset): Solid when the valve is latched in the trip position, and loop current is normal.

(continued)

Additional System Components (continued)

Type LCP100 Local Control Panel (continued)

Buttons
Green:
•After an emergency demand— commands the valve to its normal position only after control current is restored (manual reset).
•During a test— abort test

Red: Always commands the valve to its Fail Safe State regardless of the control current.

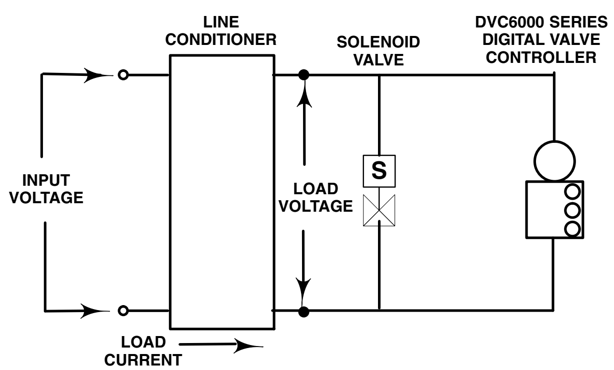
Black: Press and hold for 3 to 10 seconds. Commands the configured partial stroke test. Can be overridden by the Close button, Open button, or Emergency Demand.
•During a test— abort test

1. The line conditioner requires no power to operate; its input requirements are driven entirely by its output load requirements
2. Contact your Emerson Process Management sales office for the status of pending agency approvals.
3. The pressure/temperature limits in this document and any other applicable code or standard should not be exceeded.

Table 1. DVC6000 Series Digital Valve Controllers—Immunity Performance

Port	Phenomenon	Basic Standard	Performance Criteria(1)	
			Point-to-Point Mode	Multi-drop Mode
Enclosure	Electrostatic discharge (ESD)	IEC 61000-4-2	A(2)	A
	Radiated EM field	IEC 61000-4-3	A	A
	Rated power frequency magnetic field	IEC 61000-4-8	A	A
I/O signal/control	Burst	IEC 61000-4-4	A(2)	A
	Surge	IEC 61000-4-5	A(2)	A
	Conducted RF	IEC 61000-4-6	A	A

1. A = No degradation during testing. B = Temporary degradation during testing, but is self-recovering.
2. Excluding auxiliary switch function, which meets Performance Criteria B.



INPUT VOLTAGE = LOAD VOLTAGE + LINE CONDITIONER VOLTAGE DROP

LINE CONDITIONER VOLTAGE DROP = 30 OHMS x LOAD CURRENT

CALCULATION EXAMPLE:

CALCULATING LOAD CURRENT

FOR THE SOLENOID VALVE,
ASSUME REQUIRES MINIMUM 42 mA AT 22 VOLTS DC TO PULL–IN
(FROM SOLENOID VALVE SPECIFICATIONS)

FOR THE DIGITAL VALVE CONTROLLER,
WHEN OPERATING IN MULTI-DROP, REQUIRES 8 mA
(FROM DIGITAL VALVE CONTROLLER SPECIFICATIONS)

LOAD CURRENT=42+8=50 mA

LINE CONDITIONER VOLTAGE DROP= 30 OHMS x .050 AMPS = 1.5 VOLTS

INPUT VOLTAGE = 22 VOLTS + 1.5 VOLTS = 23.5 VOLTS DC

E0853

Figure 20. Determining Line Conditioner Input Voltage

Figure 21. Type LC340 Line Conditioner

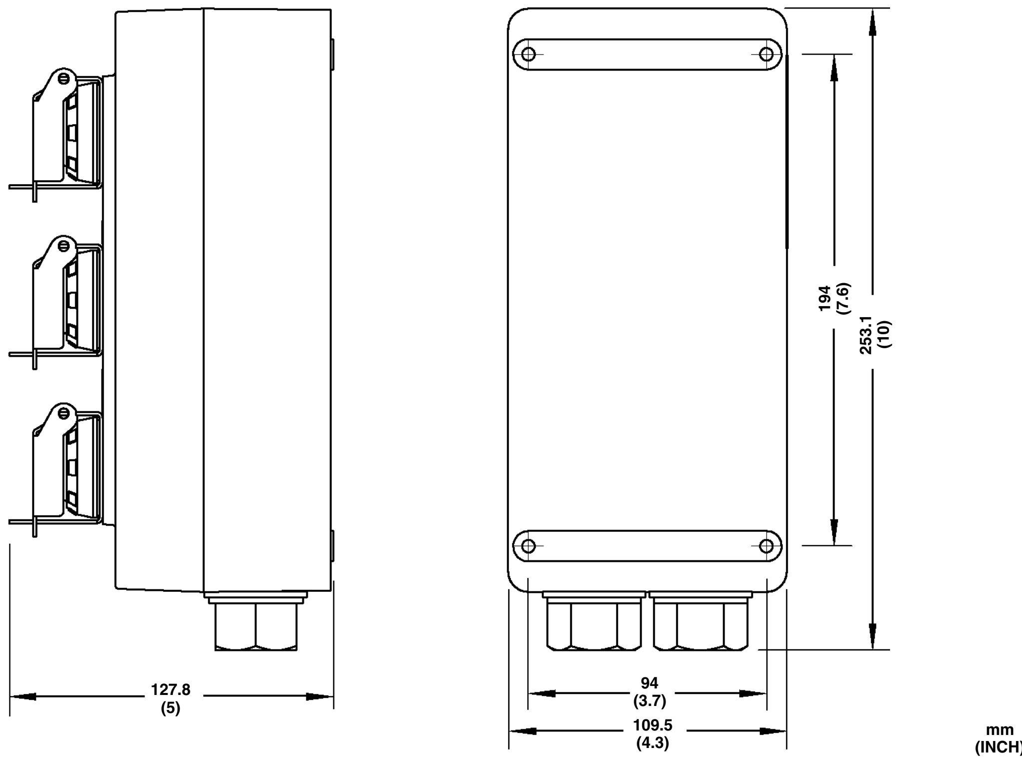


Figure 22. Type LCP100 Dimensions

Related Documents

These documents are available from your Emerson Process Management sales office. Also visit our website at www.FIELDVUE.com.

- TÜV Certificate Nr./No. 968/EZ 127.00/02
- TÜV Report for DVC6000 SIS—No. 968/EZ 127.00/02
- FMEDA Report for DVC6000 SIS– Form 5742
- FMEDA Report for LC340 Line Conditioner – Form 5749
- FIELDVUE® DVC6000 Series Digital Valve Controllers for Safety Instrumented System (SIS) Solutions – Form 5807

Note

Neither Emerson, Emerson Process Management, Fisher, nor any of their affiliated entities assumes responsibility for the selection, use, and maintenance of any product. Responsibility for the selection, use, and maintenance of any product remains with the purchaser and end-user.

Table 2. DVC6000 Series, Hazardous Area Classifications for Canada—CSA

CERTIFICATION BODY	TYPE	CERTIFICATION OBTAINED	ENTITY RATING		TEMPERATURE CODE	ENCLOSURE RATING
CSA	DVC60x0 DVC60x0S (x = 1,2,3)	(Intrinsic Safety) Class/Division Class I,II,III Division 1 GP A,B,C,D, E,F,G per drawing 29B3428	V_{max} = 30 Vdc I_{max} = 226 mA C_i = 5 nF L_i = 0.55 mH		T5($T_{amb} \leq 80°C$)	4X
		(Explosion Proof) Class/Division Class I, Division 1 GP B,C,D	– – –		T6($T_{amb} \leq 80°C$)	4X
		Class I Division 2 GP A,B,C,D Class II Division 1 GP E,F,G Class III Division 1	– – –		T6($T_{amb} \leq 80°C$)	4X
	DVC6005	(Intrinsic Safety) Class/Division Class I,II,III Division 1 GP A,B,C,D,E, F,G per drawing 29B3520	V_{max} = 30 Vdc I_{max} = 226 mA C_i = 5 nF L_i = 0.55 mH	V_{oc} = 9.6 Vdc I_{sc} = 3.5 mA C_a = 3.6 µF L_a = 100 mH	T6($T_{amb} \leq 60°C$)	4X
		(Explosion Proof) Class/Division Class I, Division 1 GP C,D	– – –		T6($T_{amb} \leq 60°C$)	4X
		Class I Division 2 GP A,B,C,D Class II Division 1 GP E,F,G Class III Division 1	– – –		T6($T_{amb} \leq 60°C$)	4X
	DVC60x5 (x = 1,2,3)	(Intrinsic Safety) Class/Division Class I,II,III Division 1 GP A,B,C,D, E,F,G per drawing 29B3520	V_{max} = 10 Vdc I_{max} = 4 mA C_i = 0 nF L_i = 0 mH		T4($T_{amb} \leq 125°C$) T5($T_{amb} \leq 95°C$) T6($T_{amb} \leq 80°C$)	4X
		(Explosion Proof) Class/Division Class I, Division 1 GP B,C,D	– – –		T4($T_{amb} \leq 125°C$) T5($T_{amb} \leq 95°C$) T6($T_{amb} \leq 80°C$)	4X
		Class I Division 2 GP A,B,C,D Class II Division 1 GP E,F,G Class III Division 1	– – –		T4($T_{amb} \leq 125°C$) T5($T_{amb} \leq 95°C$) T6($T_{amb} \leq 80°C$)	4X

Table 3. DVC6000 Series, Hazardous Area Classifications for United States—FM

CERTIFICATION BODY	TYPE	CERTIFICATION OBTAINED	ENTITY RATING	TEMPERATURE CODE	ENCLOSURE RATING
FM	DVC60x0 DVC60x0S (x = 1,2,3)	(Intrinsic Safety) Class/Division Class I,II,III Division 1 GP A,B,C,D,E, F,G per drawing 29B3427	V_{max} = 30 Vdc I_{max} = 226 mA C_i = 5 nF L_i = 0.55 mH P_i = 1.4 W	T5(T_{amb} ≤ 80°C)	4X
		(Explosion Proof) Class/Division Class I, Division 1 GP B,C,D	– – –	T6(T_{amb} ≤ 80°C)	4X
		Class I Division 2 GP A,B,C,D Class II,III Division 1 GP E,F,G Class II,III Division 2 GP F,G	– – –	T6(T_{amb} ≤ 80°C)	4X
	DVC6005	(Intrinsic Safety) Class/Division Class I,II,III Division 1 GP A,B,C,D, E,F,G per drawing 29B3521	V_{max} = 30 Vdc I_{max} = 226 mA C_i = 5 nF L_i = 0.55 mH P_i = 1.4 W V_{oc} = 9.6 Vdc I_{sc} = 3.5 mA C_a = 3.6 µF L_a = 100 mH P_o = 8.4 mW	T6(T_{amb} ≤ 60°C)	4X
		(Explosion Proof) Class/Division Class I, Division 1 GP C,D	– – –	T6(T_{amb} ≤ 60°C)	4X
		Class I Division 2 GP A,B,C,D Class II,III Division 1 GP E,F,G Class II,III Division 2 GP F,G	– – –	T6(T_{amb} ≤ 60°C)	4X
	DVC60x5 (x = 1,2,3)	(Intrinsic Safety) Class/Division Class I,II,III Division 1 GP A,B,C,D, E,F,G per drawing 29B3521	V_{max} = 10 Vdc I_{max} = 4 mA C_i = 0 nF L_i = 0 mH P_i = 10 mW	T4(T_{amb} ≤ 125°C) T5(T_{amb} ≤ 95°C) T6(T_{amb} ≤ 80°C)	4X
		(Explosion Proof) Class/Division Class I, Division 1 GP A,B,C,D	– – –	T4(T_{amb} ≤ 125°C) T5(T_{amb} ≤ 95°C) T6(Tamb ≤ 80°C)	4X
		Class I Division 2 GP A,B,C,D Class II,III Division 1 GP E,F,G Class II,III Division 2 GP F,G	– – –	T4(T_{amb} ≤ 125°C) T5(T_{amb} ≤ 95°C) T6(T_{amb} ≤ 80°C)	4X

Table 4. DVC6000 Series, Hazardous Area Classifications—ATEX

CERTIFICATE	TYPE	CERTIFICATION OBTAINED	ENTITY RATING	TEMPERATURE CODE	ENCLOSURE RATING
ATEX	DVC60x0 DVC60x0S (x = 1,2,3)	II 1 G D Gas EEx ia IIC T5/T6—Intrinsic Safety Dust T85°C (T_{amb} ≤ 80°C)	U_i = 30 Vdc I_i = 226 mA C_i = 5 nF L_i = 0.55 mH P_i = 1.4 W	T5(T_{amb} ≤ 80°C) T6 (T_{amb} ≤75°C)	IP66
		II 2 G D Gas EEx d IIB+H2 T5/T6—Flameproof Dust T90°C (T_{amb} ≤ 85°C)	– – –	T5(T_{amb} ≤ 85°C) T6 (T_{amb} ≤ 75°C)	IP66
		II 3 G D Gas EEx nCL IIC T5/T6—Type n Dust T85°C (T_{amb} ≤ 80°C)	– – –	T5(T_{amb} ≤ 80°C) T6 (T_{amb} ≤ 75°C)	IP66
	DVC6005	II 1 G D Gas EEx ia IIC T5/T6—Intrinsic Safety Dust T85°C (T_{amb} ≤ 80°C)	U_i = 30 Vdc I_i = 226 mA C_i = 5 nF L_i = 0.55 mH P_i = 1.4 mW U_o = 9.6 Vdc I_o = 3.5 mA C_o = 3.6 uF L_o = 100 mH P_o = 8.4 mW	T5(T_{amb} ≤ 80°C) T6(T_{amb} ≤ 75°C)	IP66
		II 2 G D Gas EEx d IIB T5/T6—Flameproof Dust T90°C (T_{amb} ≤ 80°C)	– – –	T5(T_{amb} ≤ 80°C) T6 (T_{amb} ≤ 70°C)	IP66
		II 3 G D Gas EEx nL IIC T5/T6—Type n Dust T85°C (T_{amb} ≤ 80°C)	– – –	T5(T_{amb} ≤ 80°C) T6 (T_{amb} ≤ 75°C)	IP66
	DVC60x5 (x = 1,2,3)	II 1 G D Gas EEx ia IIC T4/T5/T6—Intrinsic Safety Dust T130°C (T_{amb} ≤ 125°C)	U_i = 10 Vdc I_i = 4 mA C_i = 0 nF L_i = 0 mH P_i = 10 mW	T4(T_{amb} ≤ 125°C) T5(T_{amb} ≤ 95°C) T6(T_{amb} ≤ 80°C)	IP66
		II 2 G D Gas EEx d IIC T4/T5/T6—Flameproof Dust T130°C (T_{amb} ≤ 125°C)	– – –	T4(T_{amb} ≤ 125°C) T5(T_{amb} ≤ 95°C) T6(T_{amb} ≤ 80°C)	IP66
		II 3 G D Gas EEx nA IIC T4/T5/T6—Type n Dust T130°C (T_{amb} ≤ 125°C)	– – –	T4(T_{amb} ≤ 125°C) T5(T_{amb} ≤ 95°C) T6(T_{amb} ≤ 80°C)	IP66

Table 5. DVC6000 Series, Hazardous Area Classifications—IECEx

CERTIFICATE	TYPE	CERTIFICATION OBTAINED	ENTITY RATING	TEMPERATURE CODE	ENCLOSURE RATING
IECEx	DVC60x0 DVC60x0S (x = 1,2,3)	Gas Ex ia IIC T5/T6—Intrinsic Safety	U_i = 30 Vdc I_i = 226 mA C_i = 5 nF L_i = 0.55 mH P_i = 1.4 W	T5(T_{amb} $\leq$ 80°C) T6 (T_{amb} $\leq$ 75°C)	IP66
		Gas Ex d IIB+H2 T5/T6—Flameproof	– – –	T5(T_{amb} $\leq$ 80°C) T6 (T_{amb} $\leq$ 75°C)	IP66
		Gas Ex nC IIC T5/T6—Type n	– – –	T5(T_{amb} $\leq$ 80°C) T6 (T_{amb} $\leq$ 75°C)	IP66
	DVC6005	Gas Ex ia IIC T5/T6—Intrinsic Safety	U_i = 30 Vdc I_i = 226 mA C_i = 5 nF L_i = 0.55 mH P_i = 1.4 W U_o = 9.6 Vdc I_o = 3.5 mA C_o = 3.6 µF L_o = 100 mH P_o = 8.4 mW	T5(T_{amb} $\leq$ 80°C) T6 (T_{amb} $\leq$ 75°C)	IP66
		Gas Ex d IIB T5/T6—Flameproof	– – –	T5(T_{amb} $\leq$ 80°C) T6 (T_{amb} $\leq$ 75°C)	IP66
		Gas Ex nC IIC T5/T6—Type n	– – –	T5(T_{amb} $\leq$ 80°C) T6 (T_{amb} $\leq$ 75°C)	IP66
	DVC60x5 (x = 1,2,3)	Gas Ex ia IIC T4/T5/T6—Intrinsic Safety	U_i = 10 Vdc I_i = 4 mA C_i = 0 nF L_i = 0 mH P_i = 10 mW	T4(T_{amb} $\leq$ 125°C) T5(T_{amb} $\leq$ 95°C) T6(T_{amb} $\leq$ 80°C)	IP66
		Gas Ex d IIC T4/T5/T6—Flameproof	– – –	T4(T_{amb} $\leq$ 125°C) T5(T_{amb} $\leq$ 95°C) T6(T_{amb} $\leq$ 80°C)	IP66
		Gas Ex nA IIC T4/T5/T6—Type n	– – –	T4(T_{amb} $\leq$ 125°C) T5(T_{amb} $\leq$ 95°C) T6(T_{amb} $\leq$ 80°C)	IP66

CE

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