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<td>71 4-20mA with HART Diagnostics</td>
<td>1D 24VDC/0.5 watt coil 1E 12VDC Intrinsically Safe</td>
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<td>DRA Red Closed DGA Green Closed D1A T1 Three Way D2A T2 Three Way DXA Special</td>
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<td>Single Solenoid Spring Return (Momentary Ext. Manual Override)</td>
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<td>Single Solenoid Spring Return (Latching Ext. Manual Override)</td>
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<td></td>
<td>5D 24VDC/0.5 watt coil 5E 12VDC Intrinsically Safe</td>
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</table>
Pneumatic Valve Specifications

General Pneumatic Specifications

Valve Design: Pilot Operated Spool Valve
Pilot Operator Options: Solenoid Coil
Configuration: Dual Pilot, 5-Way, 3-Position, Open Center
Flow Rating: 0.70 Cv (Kv = 0.60 based on flow m3/h)
Porting: 1/4” NPT
Operating Pressure: 40 psi to 120 psi (2.7 to 7.5 bar)
Filtration Requirements: 40 Microns
Operating Temperature: See pilot specifications
Operating Life: One million cycles (Use solenoid spool service kit to extend operating life)
Manual Override: Internal Momentary
Material of Construction:
- Spool: Teflon Coated, Nickel Plated Aluminum
- Body: Epoxy Coated Anodized Aluminum
- O-ring Spacers: Polysulphone
- End Caps & Fasteners: Stainless Steel
- O-rings: A Nitrile Compound

24 VDC (1D, 3D, 5D)

Operating Voltage: 24 VDC
Power Consumption: 0.5 Watts
Operating Temperature: -18° C to 50° C (0° F to 122° F)
Extended Temp (-T option) -20° C to 70° C (-4° F to 158° F) (IEC)
Filtration Requirements: 40 Microns

12 VDC (1E, 3E, 5E) (Intrinsically Safe)

Operating Voltage: 12 VDC (output of barrier)
Power Consumption: 0.5 Watts
Operating Temperature: -18° C to 50° C (0° F to 122° F)
Extended Temp (-T option) -20° C to 70° C (-4° F to 158° F) (IEC)
Filtration Requirements: 40 Microns
Entity Parameters: Ui=28VDC; Ii=120mA; Ci=0; Li=0; Pi=1.0W
In order to maintain CE conformity, the Axiom housing shall be grounded to earth potential by one of the housing ground screws.

Mounting of the Axiom requires a StoneL mounting kit specific to the actuator the Axiom is to be mounted to.

It is recommended that thread lubricant or anti-seize be used on the Axiom Cover Screws (Item# 1) and Axiom Body Screws (Item# 3) prior to assembly.

In high cycle or high vibration applications, blue Loctite® may be used on the Air Manifold Mounting Screws (Item# 11) and the Visual Indicator Drum Retaining Screw (Item# 9).

It is highly recommended that exhaust ports E2 and E3 be fitted with low restriction mufflers or breather vent caps to prevent ingestion of water and debris into the pneumatic valve.

1. Refer to Axiom Assembly Drawing located on Page 6 when performing mounting and assembly procedures.
2. Remove Axiom unit from shipping container. Ensure all listed items are present.
3. With an M4 allen wrench, loosen the four captive Axiom Cover Screws (Item# 1), remove cover.
4. If the actuator the Axiom is to be mounted on is double acting (DA) or spring return (SR), flip the Axiom body (Item# 4) over and ensure the DA/SR Plug (Item# 5) is in the correct position. (See Detail - A on Page 6). If the DA/SR Plug is in the incorrect position, gently remove plug with a pair of pliers and insert into the proper hole.
5. From the mounting kit package, locate the Air Manifold Plate (Item# 14). Place the Air Manifold Plate on the actuator. Using an M4 allen wrench, fasten down with the four Air Manifold Mounting Screws (Item# 11). Torque screws to 25 - 30 in.lbs (2.8 - 3.4Nm).
6. Place Visual Indicator Drive Block (Item# 10) into slot on the actuator shaft. Place Visual Indicator Drum Coupler (Item# 8) onto the Visual Indicator Drive Block. Next, place the Visual Indicator Drum (Item# 7) onto the Visual Indicator Drum Coupler. Align the holes in all three items with the threaded hole in the actuator shaft and fasten down with the Visual Indicator Drum Retaining Screw (Item# 9). Leave screw loose in order to facilitate indexing of the visual indicator.
7. With the actuator in the closed position, center the Visual Indicator Drum until the “OPEN” quadrant is centered between the “V.I INDEX” markings on the Air Manifold Plate. (See Detail - B on Page 6). Tighten down with the Visual Indicator Drum Retaining Screw 15 - 20 in.lbs (1.7 - 2.3Nm).
8. Verify Air Manifold Plate Orifice O-rings (Item# 12) and Visual Indicator Cover O-ring (Item# 13) are in place.
9. Place the Visual Indicator Cover (Item# 6) over the Visual Indicator Drum assembly then set the Axiom Body (Item# 4) in place. With an M4 allen wrench, torque the Axiom Body Screws (Item# 3) to 25 - 30 in.lbs (2.8 - 3.4Nm).
10. After all wiring and sensor setting procedures have been completed, install Axiom Cover and torque Axiom Cover Screws to 15 - 20 in.lbs (1.7 - 2.3Nm).
### Axiom Assembly Drawing

**ITEM** | **DESCRIPTION** | **QTY**
--- | --- | ---
1 | Axiom Cover Screws | 4
2 | Axiom Cover | 1
3 | Axiom Body Screws | 4
4 | Axiom Body | 1
5 | DA/SR Plug | 1
6 | Visual Indicator Cover | 1
7 | Visual Indicator Drum | 1
8 | Visual Indicator Drum Coupler | 1

Item# 9 thru 14 are provided with the mounting kit. Mounting kits are sold separately.

9 | Visual Indicator Drum Retaining Screw | 1
10 | Visual Indicator Drive Block | 1
11 | Air Manifold Plate Mounting Screws | 4
12 | Air Manifold Plate Orifice O-rings | 3
13 | Visual Indicator Cover O-ring | 1
14 | Air Manifold Plate | 1

**DA/SR Plug Placement**

Bottom side of Axiom Body

**Visual Indicator Indexing**

Detail - A

**Detail - B**
Axiom HART Module Specifications:
- Communication: HART version 7.0
- Position Feedback:
  - Current Output: 4-20mA
  - Voltage: 14-35VDC (24VDC nominal)
  - Loop Resistance: 250 ohms (min) to 500 ohms (max) at 24VDC
- Pressure Accuracy: ± 1% of full scale

<table>
<thead>
<tr>
<th>Solenoid Power</th>
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<tbody>
<tr>
<td>Conventional models (D): 0.5 watt (0.02A @ 24VDC)</td>
</tr>
<tr>
<td>Intrinsic Safety models (E): 0.5 watt (0.04A @ 12VDC)</td>
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</tbody>
</table>

To Bench Test the HART Sensing & Communications Module Sensors:

**WARNING:**
DO NOT APPLY EXTERNAL POWER TO THE OUTPUT TERMINALS. THIS WILL CAUSE PERMANENT DAMAGE TO THE UNIT

To test sensors, use a 24 Vdc power supply. No series load resistor is required. Operate actuator to the closed position. Apply power across the “HART+” and “HART-” terminal points. Press and hold “Closed Set” button until “Closed LED is lit (2 seconds). Release button. Operate actuator to the open position. Press and hold “Open Set” button until “Open LED is lit (2 seconds). Release button. Set points are retained even after power is removed. A functioning HART network is required to do basic setup and all other functionalities provided by the HART Sensing & Communications Module.

Wiring Diagram and Standard Connector Configuration Pin-Out

<table>
<thead>
<tr>
<th>PIN</th>
<th>SIGNAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SOL PWR -</td>
</tr>
<tr>
<td>2</td>
<td>SOL PWR +</td>
</tr>
<tr>
<td>3</td>
<td>HART +</td>
</tr>
<tr>
<td>4</td>
<td>HART -</td>
</tr>
<tr>
<td>5</td>
<td>Ground</td>
</tr>
</tbody>
</table>

HART Sensing & Communications Module Setup Instructions

**NOTE:**
SOLENOID POWER MUST INITIALLY BE TURNED “OFF” IN ORDER TO PERFORM THE SETUP PROCEDURE

1. With the Sensor & Communication Module (CCM) wired to the control system, power applied to the HART+/- terminals, and solenoid power turned “off”, press and hold both SET OPEN and SET CLOSED buttons until both the Red and Green LEDs turn on. Release buttons.
2. If the valve/actuator is in the Closed position, push SET CLOSED button and release. If the valve/actuator is in the Open position, push SET OPEN button and release.
3. Energize the solenoid.
4. If the valve/actuator goes to the Closed position, push SET CLOSED button and release. If the valve/actuator goes to the Open position, push SET OPEN button and release.
General Overview

The Axiom HART is a valve-monitoring package for ¼ turn actuators. It has the added capability of providing diagnostic information on the pilot solenoid, spool valve, and actuator. The device will also store historical data on each cycle.

Description of Operation

Device Description: The Axiom HART (Highway Addressable Remote Transducer) takes advantage of the HART protocol’s ability to provide position feedback as well as device variables over 2 wires. HART communication is master/slave over a 4-20mA current loop. Communication is superimposed on the current loop.

The HART C-module is powered by 24VDC (14VDC min). A HART modem and master are required to communicate with the C-module. The C-module will feedback 4mA for closed or 20mA for open. It will also provide feedback for any intermediate position.

Solenoid power (24VDC) is required by the C-Module to power the pilot solenoid. For IS applications a special 12VDC IS coil will be provided.

Connecting the Device: The HART C-module requires a power source of 24VDC. A 250-400ohm resistor is required between the power source and the HART C-module. A HART modem may be attached across the resistor (or HART unit) to enable communication with the host. Below is the pin out for the terminal block connections.

Basic Installation Example

![Diagram of HART C-module installation](image-url)
Basic Operation

To move the actuator/valve, simply apply 24VDC to the solenoid power input and the actuator will move from closed (4mA) to open (20mA). A yellow LED will light on the C-module to indicate power was applied to the solenoid.

Inputs and Output

The Axiom HART C-module comes with an 8 pole terminal block. The terminal block numbering is as follows:

1. SOL - (Factory wired to solenoid coil)
2. SOL+ (Factory wired to solenoid coil)
3. SOL PWR - (Power for solenoid coil)
4. SOL PWR+ (Power for solenoid coil)
5. GND (Connected to unit internal ground screw)
6. GND (Internally connected to terminal #5)
7. HART - (HART return)
8. HART+ (HART input)

LED Indications

OPEN (Green) and CLOSED (Red) LEDs: Will light when the valve position gets within four degrees of either the Open or Closed set point. The valve needs to rotate six degrees away from either the Open or Close set point in order for that respective LED to turn off.

Solenoid POWER (Yellow): Lights whenever solenoid power is applied.

BAD SOLENOID COIL (Red): Flashes at 2Hz whenever there is an open or a short on the pilot coil.

BAD AIR SUPPLY PRESSURE (Red): If the input supply air pressure is below 40psi or above 110psi for 3 seconds, the LED will flash at 2Hz rate. The 40psi/110psi pressure levels are factory defaults and may be changed through a HART command.

STUCK SPOOL/PILOT (Red): If pressure to move the actuator is not present within 5 seconds after applying or removing power to the solenoid, and if there is not a Bad Solenoid or a Bad Air Supply Pressure fault, then the LED will flash at 2Hz rate. The time out is ¼ of the stroke time (5 second with a 20 second stroke time default).

STUCK PROCESS VALVE/ACTUATOR (Red): If, after 20 seconds (factory default), the position sensor doesn’t reach it’s end of travel after the power to the coil has been applied or removed and if there are no other alerts, then the LED will flash at 2Hz rate. The 20-second stroke time is a factory default and may be changed through a HART command.
Operation Overview

The Axiom HART C-module will measure various parameters, store current status, store current and historical data, provide local display indications, and make diagnostic decisions based on the inputs from the sensors. This data will be transmitted, when requested, to the host for display with the use of the StoneL HART EDD files.

**Measured Parameters:** The following is a list of parameters measured by the Axiom HART C-Module:

- Position
- Total Stroke Time (both Opening and Closing)
- Dead Time (Time between energizing or de-energizing the solenoid and the actuator moving ≥ 6°) for both Opening and Closing
- Coil Status (good or bad)
- Temperature (Internal electronics temperature)
- Cycle Count
- Inlet Supply air pressure
- Air pressure at A
- Air pressure at B

**Status Indicators transmitted over HART:** The following is a list of status indicators that are displayed locally and transmitted to the host for display:

- Valve Open
- Valve Closed
- Solenoid Energized
- Bad Solenoid Coil
- Bad Supply Pressure
- Stuck Spool/Pilot
- Stuck Valve/Actuator

**List of parameters transmitted over HART:** This is a list of parameters the C-module measures and records. They are transmitted through HART when requested by the host:

- Breakaway Pressure (derived from the differential pressure A-B) both at opening and closing
- Total Time to open – the time from when the coil is energized to when the open sensor is energized
- Total Time to close – the time from when the coil is de-energized to when the closed sensor is energized
- Dead Time to Open – the time it takes to breakaway from the seat when the valve is closed and is directed to open
- Dead Time to Close – time it takes to breakaway from the seat when the valve is open and directed to close
- Electronics Temperature – both opening and closing
- Cycle Count
- Inlet Air Pressure
- Change in Closed position from set point
Baseline Set Up: The Baseline cycle will be stored so that the user can compare all measured variables with the “as new” condition. This way, they will be able to determine if the valve is working properly or not or if the valve is possibly about to fail. This will be done in one of two ways. The first will be a command sent via the protocol to set the last stroke as the baseline. The second way is that the baseline will be automatically set as the 50th stroke. This will be transparent to the end user so if he forgets to set the baseline (or doesn’t know to do it), it will still get set.

The baseline stroke will store the following parameters:

- Open Dead Time
- Breakaway Pressure to Open
- Open Time
- Temperature when Opening
- Close Dead Time
- Breakaway Pressure to Close
- Close Time
- Temperature when Closing

C-Module Commands: The following is a list of commands that can be sent over HART to change or manipulate parameter set points or other features:

1. **Wink Feature**: When a Wink command is received from the protocol, both the open and closed LEDs will flash at a rate of 2 Hz. This will continue until another Wink command is received.

2. **Remote set Open/Close**: Open/Close positions can be remotely set via the protocol. Determination of Fail Open, Fail Close, Clockwise or Counter Clockwise operation is made automatically during set up.

3. **Set Baseline**: Used to set the last cycle as the baseline.

4. **Clear Cycle Count**: Clears cycle count to zero. Also erases all history and baseline data.

5. **Change Pressure Alarms**: Change the low-pressure alarm from 40 PSI to a range of 40 to 95 PSI. Change high pressure alarm from 110 PSI to range of 100 to 120 PSI.

6. **Change Pressure Units**: Set pressure units to either PSI or BAR. Doing this will also cause a Clear Cycle Count.

7. **Set to Defaults**: Set unit back to factory defaults:
   - Pressure Units = PSI
   - Low Press Alarm = 40 PSI
   - Hi Press Alarm = 110 PSI
   - Stroke time = 20 seconds
   - Stuck Pilot = 5 seconds
Overview

There are 3 main screens to view the HART device status: Device Variables Screen, Device Diagnostics Screen, Historical Data, and Online Screen.

**Device Variables Screen**: This screen, shown below, will graphically and numerically display the process variables of the device. Position is displayed in ½ degree increments and in current (4-20mA). It will display pressure in psi or bar. The temperature will be displayed in degrees C. Also shown are position status either Open or Closed, Solenoid power, Cycle Count, as well as a See Device Diagnostic indication. If the See Device Diagnostic light is on there is some issue with the device that needs attention. To view the issue, go to the View menu and select the Device Diagnostics page.

![DEVICE VARIABLES SCREEN](image-url)
**Device Diagnostics Screen**: To view diagnostic information and historical data on the device select the Device Diagnostic Screen. The identity box relates to HART related info on the device. The Device Status box has status/warning flags for HART related communications. The Operation Warning box will give warning indications about the function of the device. A green indication is a good condition while a red indicates a problem or in the case of Baseline Not Set the baseline has not been set.

**DEVICE DIAGNOSTICS SCREEN**
**Historical Data:** On the Device Diagnostic Screen there is a button labeled Historical Data. Click on the button to access the historical cycle data taken by the device. The Historical Data screen below shows the Open Dead Time of a unit with 11 cycles on it as well as the base line data on the far right colored in blue. There are 9 parameters saved for each cycle. Just click on the tab of interest to view the history of that parameter. The last 16 cycles are displayed on the first row of bar graphs. The bar graphs in the second row are averaged sets of 16 cycles each. The 3rd row is averaged sets of 256 cycles each, the 4th row 4096 averaged cycles each, the 5th row 65536 averaged cycles each. Data is compressed or averaged for 1 million cycles.

**HISTORICAL DATA SCREEN**
Online Screen: The Online Screen is where functional changes to the device are made. Below is a list of those changes:

1. **Pressure Units Button**: click button to change from PSI to BAR.
2. **Low Alarm Pressure**: type in a new value of 40 to 95 psi
3. **High Alarm Pressure**: type in a new value of 100 to 120 psi.
4. **Stroke Time**: type in a value from 2 to 650 seconds.
5. **Set Open Switch**: while in the open position push this button to set to 20mA.
6. **Set Closed Switch**: while in the closed position push this button to set to 4mA.
7. **Clear Cycle Count**: click button to clear the cycle count and history.
8. **Set Baseline**: click button to set the last cycle as baseline. Otherwise the 50th cycle will be chosen.
9. **Set to Defaults**: click this button to return pressure alarms, pressure unit and stroke time to factory defaults: (Pressure Units = PSI; Low Press Alarm = 40 PSI; Hi Press Alarm = 110 PSI; Stroke time = 20 seconds; Stuck Pilot = 5 seconds)
10. **Wink**: click button to enable/disable the wink feature.

ONLINE SCREEN
The Online Screen also has tabs to perform loop current calibration and loop tests:

**Loop Test:** This method allows the user to set the loop current to a fixed value. This is often also used when setting up or maintaining a loop to verify that the loop is active or trace the loop from the transmitter to the control room. The Loop Test also allows the user to check out other devices in series with the loop such as current monitors, etc. The method provides fixed choices of 4, 12 and 20mA, as well as allowing the user to input a value between 4 and 20mA of his choosing.

**D/A trim:** This method allows the user to trim the loop current to match his plant meters. The procedure first trims the 4mA output to match his local meter and then the 20mA output again to match his local meter.

**ONLINE SCREEN**
Dimensional Information (mm)

4.8" (122.6)
6.3" (157.7)
3.9" (100.5)

Air Ports 1/4 NPT

Conduit Entries 1/2 NPT or M20

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