

DIGITAL EPIC-2 TECHNICAL MANUAL

INSTALLATION AND OPERATING INSTRUCTIONS

To be used in conjunction with the relevant VCIOM-04592 for the D510/520 or VCIOM-04979 for the D530/540/550 short form installation and operating manuals

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1 INTRODUCTION

1.1 PRODUCT OVERVIEW

Westlock Controls Digital EPIC-2® is a second generation ARM® Cortex-M3 microcontroller based intelligent valve position transmitter with an advanced diagnostics functions designed especially for safety valves. The key application of the DEPIC-2 is on emergency shut-down valves to monitor the valve position in real-time and perform diagnostics functions like Partial-Stroke (PST), Full-Stroke Test (FST) and Solenoid Operated Valve Test (SOVT) to ensure valve will move to its fail-safe position in emergency situation.

The DEPIC-2 is powered through the 9-24 V analog signal from the control system and provides 4-20 mA position feedback and digital HART communication on the same signal to the control system. The safety function is provided from the 0-24 V digital signal from the safety system to DEPIC-2 to de-energize the valve during an emergency shutdown event.

A step by step guided setup wizard on 64x128 graphic LCD and 3 buttons provides an easy way to configure, calibrate and operate the device locally. In addition, the remote HART® DD or FDT® DTM can be used to configure, calibrate and perform advanced diagnostics functions on the device.

Under the hood is a powerful industry leading low power 32 bit ARM® Cortex-M3 microcontroller with one non-contact Hall Effect position sensor, two pressure sensors and one temperature sensor. The low power operation of the microcontroller keeps the device operating even at 3.8 mA with HART® communication during an ESD event.

The DEPIC-2 can be easily mounted using NAMUR compatible mounting kits on linear or rotary actuator. The completely sealed and potted electronics are resistant to dirt and moisture and expanded temperature range of -40°C to +85°C enhances the reliability of the device to work in harsh environments.

The state of the art diagnostic functions like Emergency Shutdown (ESD), Partial Stroke Testing (PST), Solenoid Operated Valve Testing (SOVT) and Full Stroke Testing (FST) lowers the total cost of ownership by suggesting predictive maintenance of the device under operation before it fails and interrupt the process. The artificial intelligence of the underlying alarm system points to the root cause of the problem instead of reporting nuisance alarm.

All packaged and integrated in a single housing, DEPIC-2 offers a unique solution to tackle the problems faced by plant operation team.

1.2 PRINCIPLES OF OPERATION

As explained in the product overview section, the DEPIC-2 is a 4-20 mA position transmitter. The primary function of the device is to measure the valve position using the Hall Effect sensor and provide 4-20 mA current output as a feedback to the control system. In addition, it has one temperature sensor to monitor the temperature of the device and two pressure sensors to monitor the pressure. It also monitors the safety demand signal from the safety system as an input voltage to solenoid and generates an ESD alarm when the device is in emergency shut-down mode. As a secondary function, it offers variety of different diagnostics tests that can be performed on the valve/actuator package to detect any potential failures. These tests include Partial Stroke Test (PST), Full Stroke Test (FST) and Solenoid Operated Valve Test (SOVT). The DEPIC-2 uses the data collected from its position, pressure and temperature sensors during these tests to generate an alert for less severe condition and alarm for any potential dangerous condition. This is particularly important in safety applications to detect abnormal operation and notify the user before it becomes a critical problem, possibly preventing a valve from going to its safety position when required. More details about each diagnostic test can be found in later sections of the document.

2 DEFINITIONS

2.1 ACRONYMS

The following acronyms are related to the DEPIC-2 and safety functions used throughout this document.

- **DEPIC2** - Digital EPIC second generation
- **DD** - Device Description
- **DTM** - Device Type Manager
- **ESD** - Emergency Shut-Down
- **FDM** - Field Device Manager
- **FMEDA** - Failure Modes, Effects and Diagnostic Analysis
- **FST** - Full-Stroke Test. While FST is not used extensively in SIF applications due to its interference with the normal process, it should be used on occasion to verify that the valve can fully move to its de-energized position.
- **HFT** - Hardware Fault Tolerance
- **IS** - Intrinsically Safe
- **PFD** - Probability of Failure on Demand
- **PFD_{avg}** - Average Probability of Failure on Demand. Each component of an SIF system has its own PFD. The average is the average of all components combined. The average is heavily influenced by the weakest link.
- **PST** - Partial Stroke Test, a test used to detect failure modes in the positioner, actuator, and valve assembly with minimal disruption to the process.
- **SFF** - Safe Failure Fraction, the fraction of the overall failure rate of a device that results in either a safe fault or a diagnosed unsafe fault.
- **SIF** - Safety Instrumented Function, a set of equipment intended to reduce the risk due to a specific hazard (a safety loop).
- **SIL** - Safety Integrity Level, discrete level (one out of a possible four) for specifying the safety integrity requirements of the safety functions to be allocated to the E/E/PE safety-related systems where Safety Integrity Level 4 has the highest level of safety integrity and Safety Integrity Level 1 has the lowest.
- **SIS** - Safety Instrumented System - Implementation of one or more Safety Instrumented Functions. A SIS is composed of any combination of sensor (s), logic solver (s), and final element (s).
- **SOV** - Solenoid Operated Valve
- **SOVT** - Solenoid Operated Valve Test. This can be an important test in SIF applications because a solenoid can fail at any time and it is better to find it before the next PST is done and fails. This also tests pressure sensor 1 in safety applications. This should be done more frequently than a PST.
- **TUV** - Technischer Überwachungs-Verein (English - a Technical Inspection Association)
- **XP** - Explosion Proof

2.2 TERMS

The following terms and abbreviations are related to the DEPIC-2 device and safety functions used throughout this document.

2.2.1 Safety

This is defined as the freedom from unacceptable risk of harm.

2.2.2 Functional safety

This is the ability of a system to carry out the actions necessary to achieve or to maintain a defined level of safety for the valve/actuator assembly under control of the system.

2.2.3 Basic safety

The equipment must be designed and manufactured such that it protects against risk of damage to persons by electrical shock and other hazards and against resulting fire or explosion. The protection must be effective under all conditions of the nominal operation and under single fault condition.

2.2.4 Safety assessment

The investigation to arrive at a judgment, based on evidence, of the safety achieved by safety-related systems.

2.2.5 Fail-safe state

State where the DEPIC-2 solenoid is de-energized and has exhausted Pressure 1 in a spring-return actuator.

2.2.6 Full-stroke test

Full-Stroke Test (FST) here means a test of full valve movement from fully closed to fully open (open movement) or from fully open to fully closed (close movement). Since it is disruptive to the process, there is no mechanism to automatically perform this. It must be scheduled and performed by field personnel. In general it should be done at least once per year if not sooner. Note this feature is only available on devices that have the Signature option enabled from Factory and by the user.

2.2.7 Partial-stroke test

Partial-Stroke Test (PST) refers to a special test of valve movement used mainly in safety systems where a valve remains mostly in one position (open or closed) for long periods of time. So in order to determine if the valve/ actuator assembly is functioning properly without disrupting the process, a Partial-Stroke Test (PST) is performed moving the valve from the energized position to a configured position which may be 1-50% of full-stroke and back again. In general it should be done at least monthly or weekly depending upon environment and corrosive process and/or time-frame needed to achieve SIL3.

2.2.8 Solenoid operated valve test (SOVT)

This is a special function which can test the operation of the solenoid and pressure sensor 1 with virtually no disruption in process. Since a solenoid or pressure sensor can fail without warning at any time, this test is recommended daily or weekly, generally more often than a PST (unless PST Duplex is enabled which does an SOVT as part of PST with redundant solenoids).

2.2.9 Signatures

A Signature is a plot or graph of data captured either during a full-stroke or partial-stroke movement of the valve. All sensors on the device (position and pressure) are monitored at a specific interval (based upon valve speed) to produce a plot showing the characteristic operation of the valve/actuator in the process. Note this feature is only available on devices that have the Signature option enabled from Factory and by the user.

2.2.10 On-line proof test

The objective of on-line proof testing is to detect potentially dangerous failures and proves the PFD_{avg} for the SIL rating. Increasing the proof test frequency is directly proportional to an improvement in lowering the average PFD, consequently increasing SIL. FST, PST and SOVT are available proof tests on DEPIC-2.

3 INSTALLATION

3.1 ROTARY DIRECT MOUNT

Step 1. Mount bracket and inner beacon coupler to actuator. If actuator shaft has a tapped hole, fasten using proper flat head screw. If actuator does not have a tapped hole, fasten using set screws on side of coupler. (See Figure 1)

Step 2. Press fit the inner beacon to the inner beacon coupler. The inner beacon needs to be properly oriented. Use the symbols on the top of the inner beacon to mount as shown in Condition 1 or Condition 2. (See Figure 2)

Condition 1 and Condition 2 show the placement of the inner beacon with respect to the Transmitter housing while the actuator is in the fail position.

Step 3. Mount the Transmitter to the bracket. As stated in Step 2 make sure that the Transmitter is mounted in a fashion that properly orients it with respect to the inner beacon.

FIGURE 1
Bracket / coupler mounting

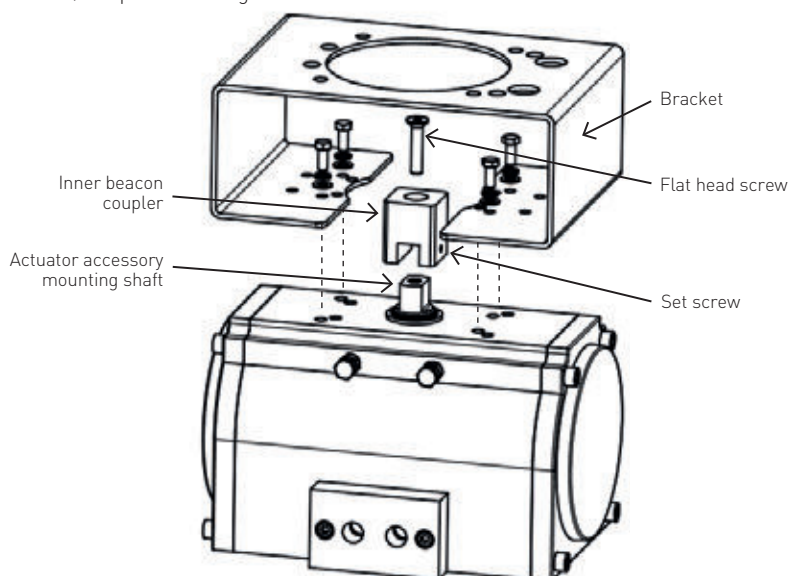
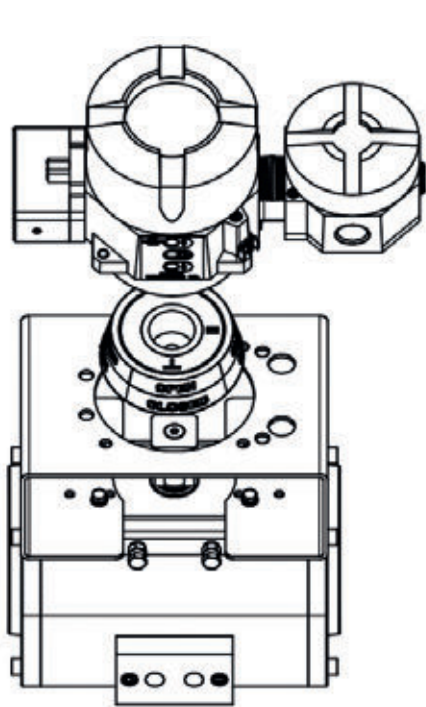


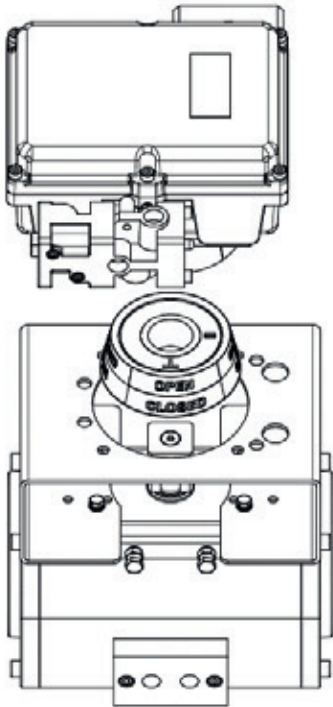
FIGURE 2
Direct mount beacon orientation

Condition 1: Actuator fails in a clockwise direction.

T placed at 6:00
II placed at 3:00



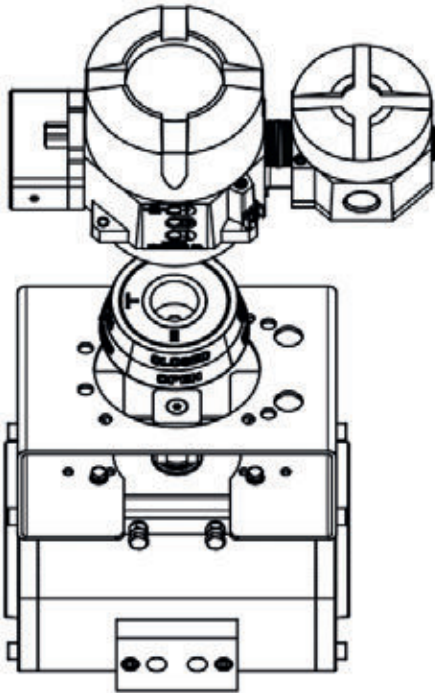
D510/20 MODELS



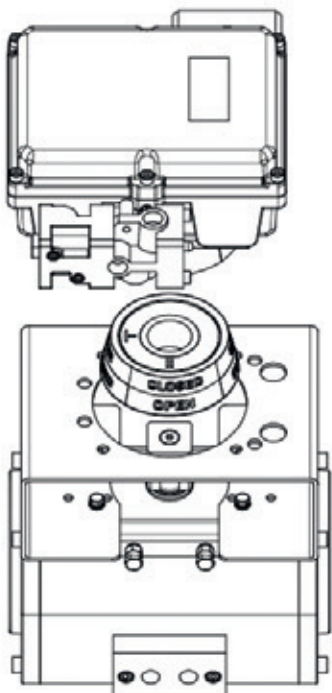
D530/40/50 MODELS

Condition 2: Actuator fails in a counter clockwise direction.

T placed at 9:00
II placed at 6:00



D510/20 MODELS



D530/40/50 MODELS

3.2 ROTARY REMOTE MOUNT

Step 1. Mount bracket and inner beacon coupler to actuator as described in Section 3.1 Step 1.

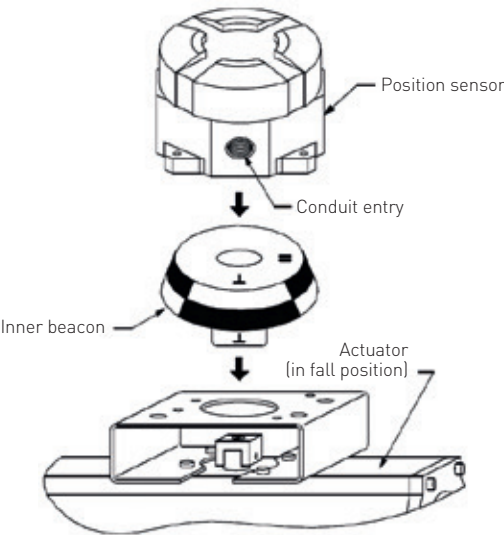
Step 2. Press fit the inner beacon to the inner beacon coupler. The inner beacon needs to be properly oriented. Use the symbols on the top of the inner beacon to mount as shown in Condition 1 or Condition 2. (See Figure 3). Condition 1 and Condition 2 show the placement of the inner beacon with respect to the position sensor housing while the actuator is in the fail position.

Step 3. Mount the position sensor to the bracket. As stated in Step 2 make sure that the position sensor is mounted in a fashion that properly orients it with respect to the inner beacon.

FIGURE 3
Remote mount beacon orientation

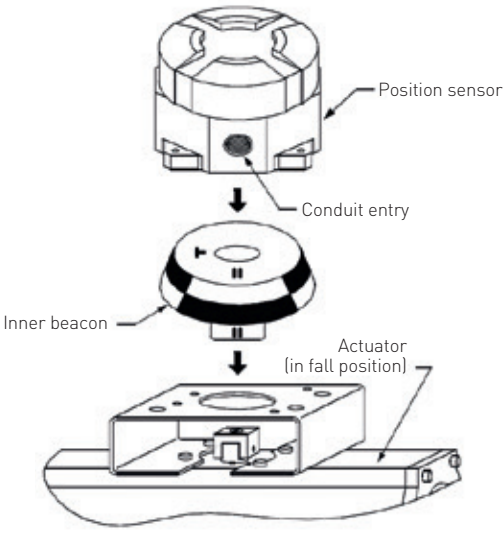
Condition 1: Actuator fails in a clockwise direction.

- T placed at 6:00
- II placed at 3:00



Condition 2: Actuator fails in a counter clockwise direction.

- T placed at 9:00
- II placed at 6:00



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3.3 LINEAR DIRECT MOUNT

Step 1. Mount the magnet assembly to the stem of the actuator. A coupler block normally is needed to extend the magnet assembly outside the yoke area and into the sensing range of the magnetic pick-up unit.

Step 2. Fasten the mounting bracket to the actuator.

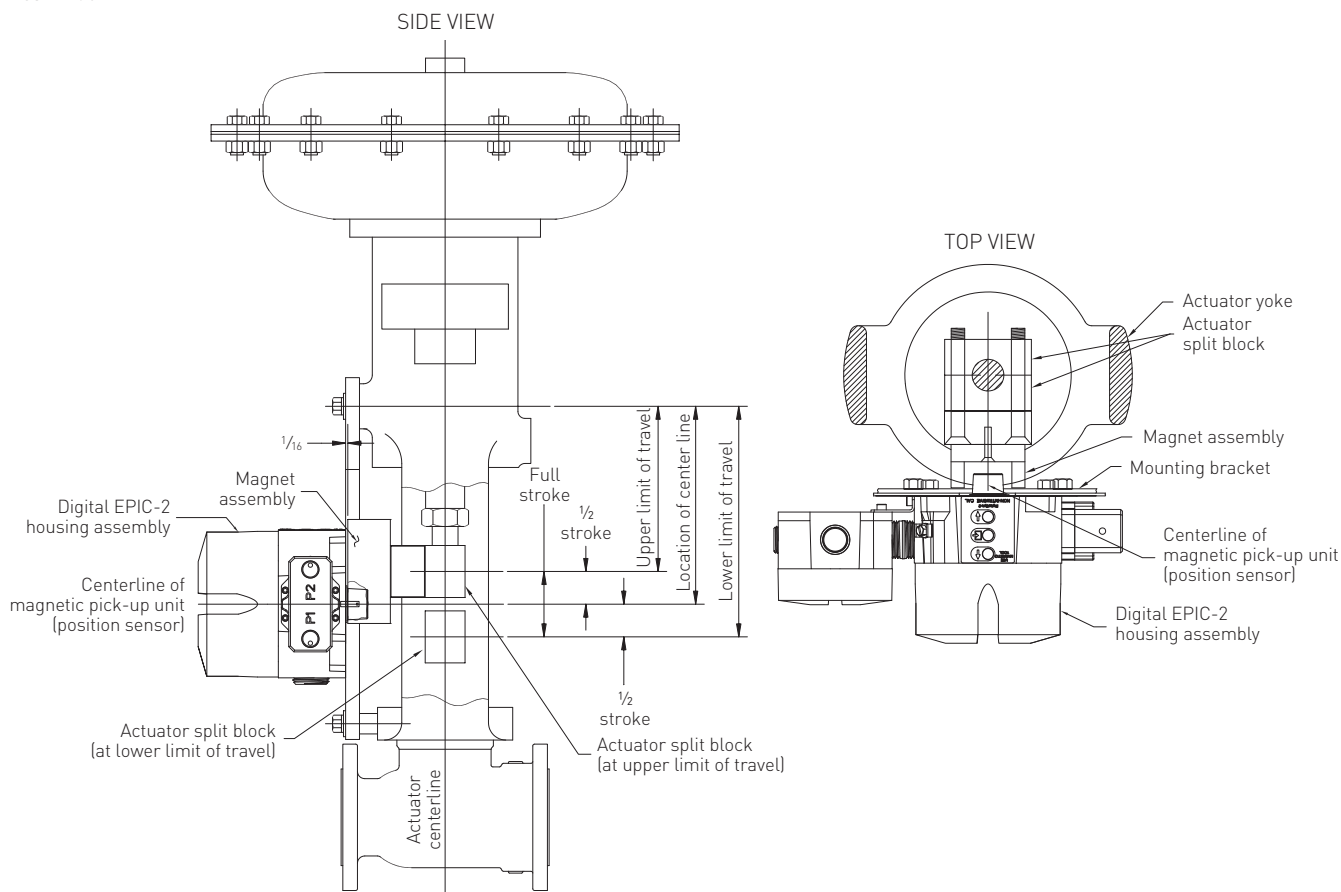
Step 3. Mount the transmitter to the mounting bracket. The transmitter should be mounted so the magnetic pick-up unit of the transmitter is centered between the limits of the magnetic assembly's stroke. After mounting the transmitter, the magnet assembly should be within $\frac{1}{8}$ " from the back of the transmitter ($\frac{1}{16}$ " is ideal). (See Figure 4).



NOTE

For fisher actuators model 657 and 667 sizes 34 thru 70, Westlock Controls can supply a slotted mounting kit design. This will allow the user to easily center the transmitter sensor between the limits of the magnet assembly's stroke. Other mounting kits are available upon request.

FIGURE 4
Linear mount



To center the transmitter

1. Stroke the actuator to its upper limit and place a mark on the actuator's yoke that lines up with the red arrow on the magnet assembly.
2. Stroke the actuator to its lower limit and place a mark on the actuator's yoke that lines up with the red arrow on the magnet assembly.
3. Place a third mark on the yoke centered between the upper and lower limit marks.
4. Lastly, mount the transmitter to the bracket so that the transmitter sensor (nose) of the Epic Transmitter lines up with the midpoint mark. (See Figure 5).

3.4 LINEAR REMOTE MOUNT

Step 1. Mount the magnet and bracket to the actuator as described in Section 3.3 Step 1.

Step 2. Mount the position sensor housing so that the conduit entry faces away from the diaphragm or cylinder. (See Figure 6).



NOTE

For Fisher actuators model 657 and 667 sizes 34 thru 70, Westlock Controls supplies a slotted mounting kit design, to ease the mounting process. This will allow the user to easily center the transmitter sensor between the limits of the magnet assembly's stroke. Other mounting kits are available upon request.

Step 3. Mount transmitter at a remote location. For wiring instructions on remote transmitter see Section 5.

FIGURE 5
Linear mount

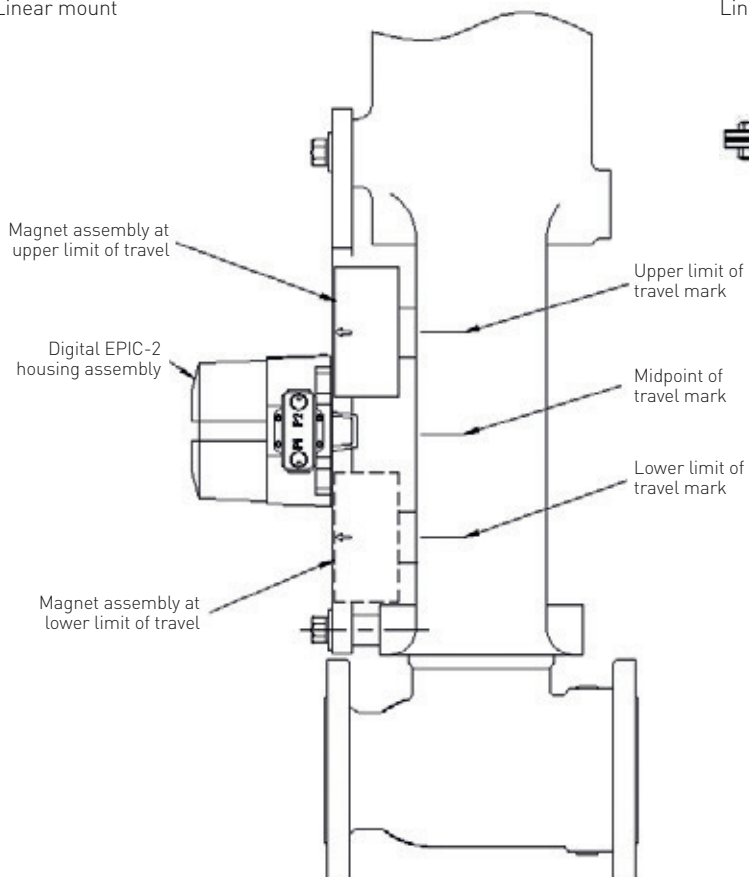
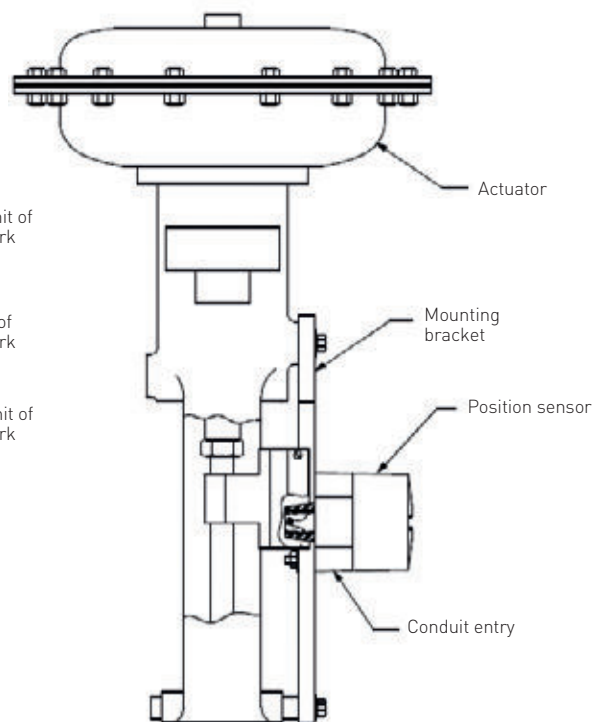


FIGURE 6
Linear remote mount



3.5 PNEUMATIC CONNECTIONS FOR UNITS SUPPLIED WITH ESD AND PRESSURE PROFILING
ENABLED

Install a "T" air fitting in the air line from solenoid valve outlet port and pipe to the pressure sensor port "P1" and to the actuator energize port. Plug port "P2". See Figure 7.



NOTE
Air supply to the DEPIC-2 must be clean, dry, oil free instrument air per ANSI/ISA-7.0.01-xxx and ISO 8573-1:xxx.

MAXIMUM PARTICLE SIZE AND CONCENTRATION OF SOLID CONTAMINANTS

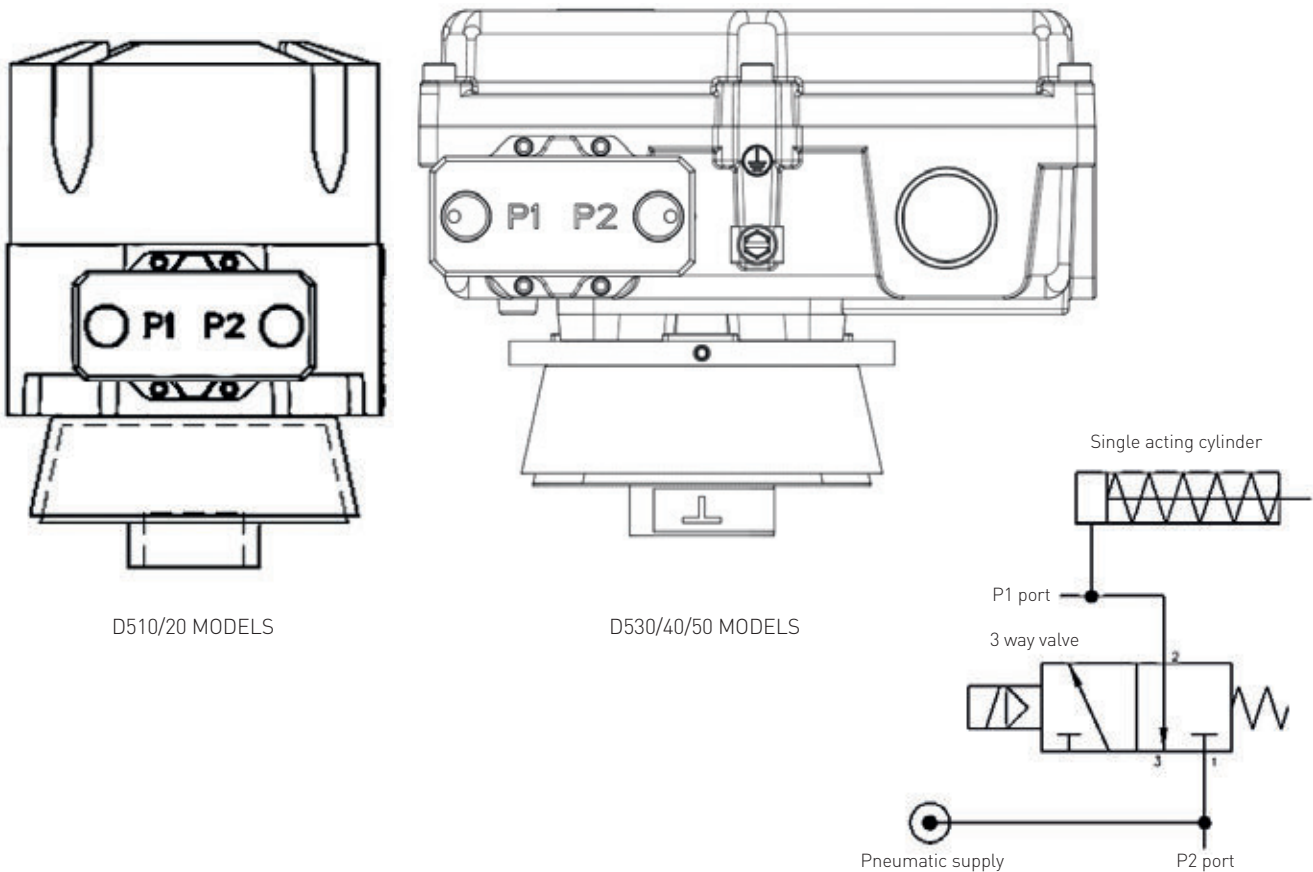
Class	Maximum particle size (microns)	Maximum concentration (mg/m³)
3	5	5

MAXIMUM OIL CONTENT

Class	Maximum concentration (mg/m³)
3	1

All pneumatic connections are 1/4" NPT or BSP.

FIGURE 7
Figure pneumatic connections



4 FIELD WIRING

- The DEPIC-2 has been certified for use in hazardous locations to international standards. Although wiring practices may vary from region to region it is up to the end user to ensure that the electrical codes for installation have been satisfied.
- All unused cable entries must be plugged with suitably certified plugs that can maintain an ingress protection level of IP66.
- For ambient temperatures below -10°C and above +60°C, use field wiring suitable for both minimum and maximum ambient temperatures.
- Electromagnetic compatibility (emissions and susceptibility) is guaranteed only if, the unit and all cables are shielded and grounded as illustrated in Appendix.

4.1 D510/520 MODELS

4.1.1 Direct mount

1. Remove cover from enclosure.
2. Locate terminal strip (for EXD option terminal strip is removable, See illustration on right).
3. Connect the 4 to 20 mA loop signal to terminal points marked 1 and 2. The 4-20 mA analog output is of the current sink type. Typically the 24 VDC supply required comes from the HOST system [24 VDC nominal]. See Figure 8 for a wiring schematic.

4. Connect the solenoid coil to terminal points 3 and 4.
See Figure 8 for wiring. Solenoid coil is 24 V with current not to exceed 500 mA. Power to activate the solenoid comes from a Safety Instrumented System logic solver 24 V output and is connected to terminals 5 and 6. See Figure 8 for wiring schematic. The SIS logic solver output must be able to provide sufficient current to operate the solenoid.
5. Connect electrical ground wire to green screw on housing (ground). Do not connect cable shield to ground. Cable shield at this end should be isolated using a shrink tubing or isolation tape.
6. External grounding is required for all zone installations. All wiring must be done in accordance with local and national electric code. See Figure 8 for external ground connection.
7. After all connections have been made (for EXD option reconnect the terminal strip) replace cover.



ATTENTION
*Do not over tighten terminal screws.
Max torque 3.5 in-lbs /0.4 Nm.*

All unused cable entries must be plugged with suitably certified plugs that can maintain an ingress protection level of IP66.

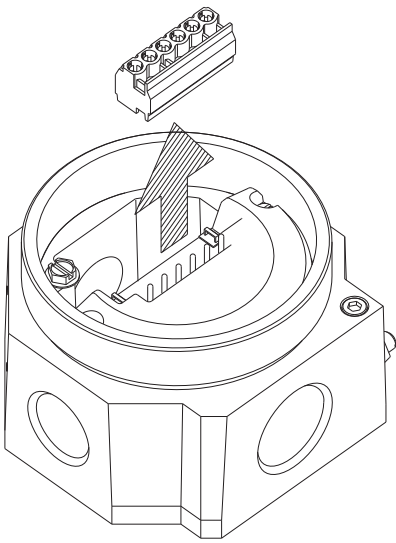
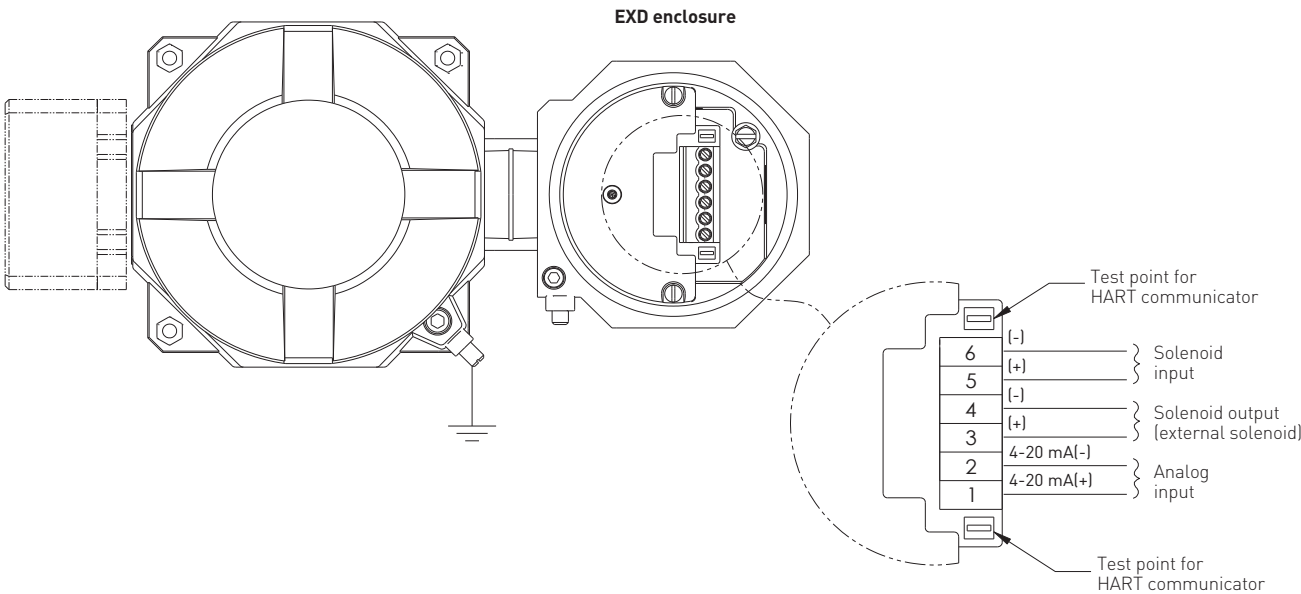


FIGURE 8
Field wiring direct mount



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4.1.2 Remote mount

1. Remove cover from junction enclosure by screwing 'clockwise' the cover retaining screw using a 9/64 A/F allen key.
2. Locate terminal board mounting screws (See Figure 9), remove the two screws and lift up terminal board. (See Figure 9).
3. Locate J3 and J4 connectors on the bottom of terminal board and connect the two part remote cable plugs as shown. See Figure 10.
4. Replace the terminal strip board, replace the screws and replace the cover.



NOTE

To maintain the approval compliance, ensure that the junction enclosure cover locking screw is used. Screw the cover down to create a water tight seal, then rotate the locking screw anti-clockwise until the head of the screw mates with the underside of the cover. See Appendix B.

5. If necessary, cut the remote cable to required length.



NOTE

When shortening the cable, ensure to cut the end opposite female connector.

6. Locate remote transmitter enclosure and remove cover.
7. Wire the cable from junction enclosure to remote transmitter. See Figure. After all connections have been made replace remote transmitter cover.

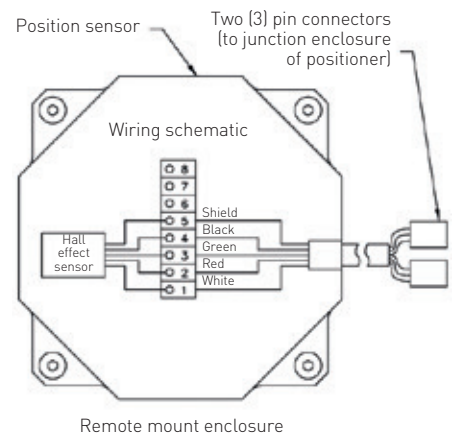


FIGURE 9
Field wiring remote Mount-1

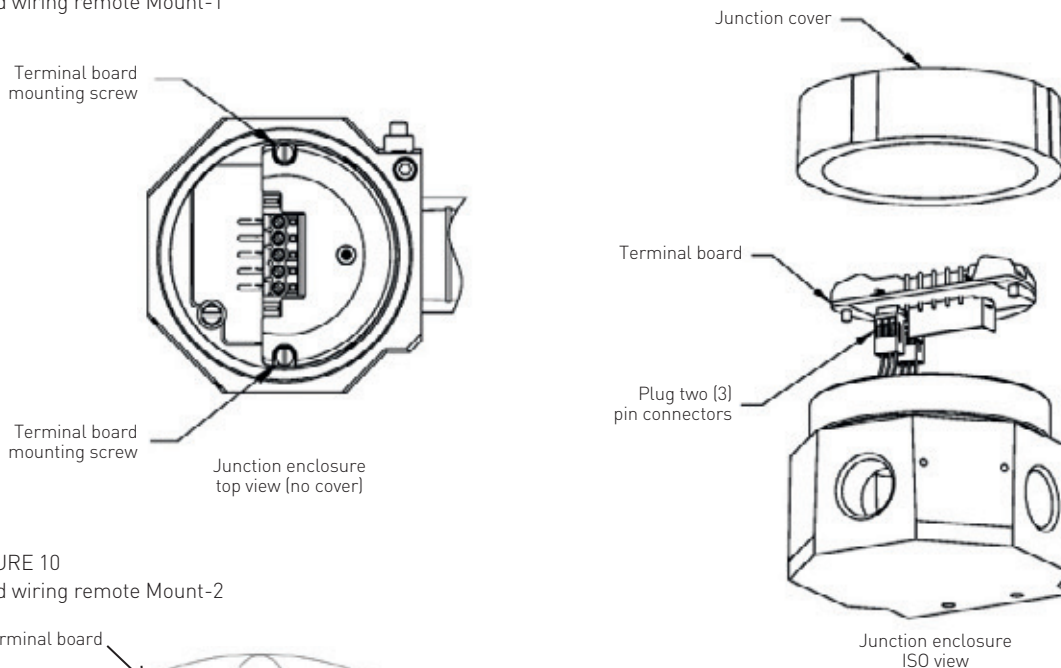
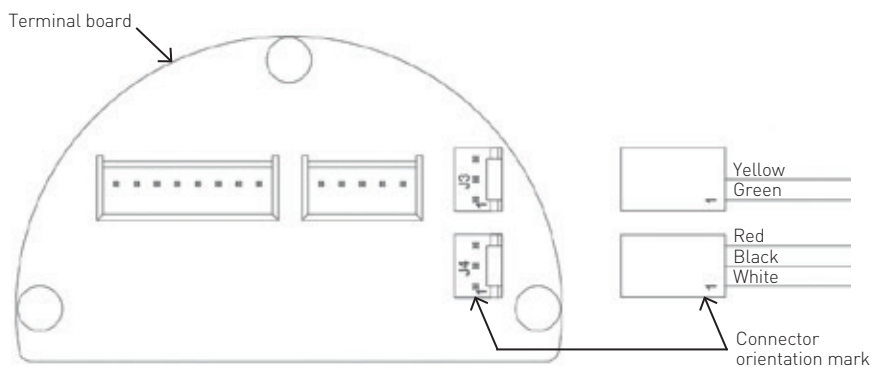


FIGURE 10
Field wiring remote Mount-2



4.2 D530/540/550 MODELS

4.2.1 Direct mount

- Remove cover from enclosure.
- Connect the 4 to 20 mA loop signal to terminal points marked 1 and 2. The 4-20 mA analog output is of the current sink type. Typically the 24 VDC supply required comes from the HOST system (24 VDC nominal). See Figure 11 for a wiring schematic.
- Connect the solenoid coil to terminal points 3 and 4. See Figure 11 for wiring. Solenoid coil is 24 V with current not to exceed 500 mA. Power to activate the solenoid comes from a safety instrumented system logic solver 24 V output and is connected to terminals 5 and 6. See Figure 11 for wiring schematic.
- The SIS logic solver output must be able to provide sufficient current to operate the solenoid.



ATTENTION

Do not over tighten terminal screws.
Max torque 3.5 in-lbs / 0.4 Nm.

- Connect electrical ground wire to Earth screw inside the housing.

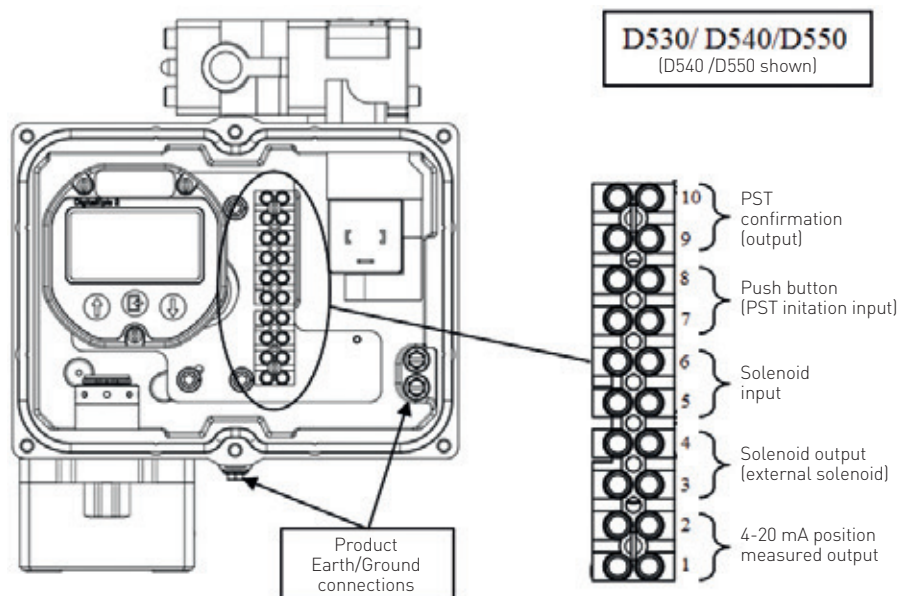


NOTE

Do not connect cable shield to ground. Cable shield at this end should be isolated using a shrink tubing or isolation tape.

- External grounding is required for all zone installations. All wiring must be done in accordance with local and national electric code. See Figure 11 for external ground connection.
- All unused cable entries must be plugged with suitably certified plugs that can maintain an ingress protection level of IP66.

FIGURE 11
Direct mount wiring



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4.2.2 Remote mount

- Remove the enclosure cover. The remote cable connections are located under the terminal strip. See Figure 12 for the standard configuration and Figure 13 for the flying lead version.
- The standard length of the remote cable is 50 feet (approx. 15 m). If necessary, cut the remote cable to the required length.



NOTE

- When shortening the cable, ensure to cut the end opposite female connector.
- For the flying lead version, either end can be shortened.



ATTENTION

When shortening the cable please ensure that the following steps are followed:

- Remove shrink tubing.
- Cut cable to length (see note above).
- Remove outer insulation approx. 2.25 to 2.50" (57 - 63 mm).



NOTE

Do not remove braid.

- Strip conductors by .160" (4 mm) and tin.
- Separate and twist braid.

- Terminate the cable to remote transmitter. See Figure 14.
- After all connections have been made replace remote transmitter cover.

FIGURE 12
Customer remote connection

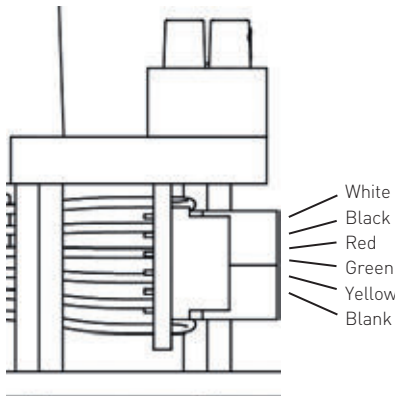
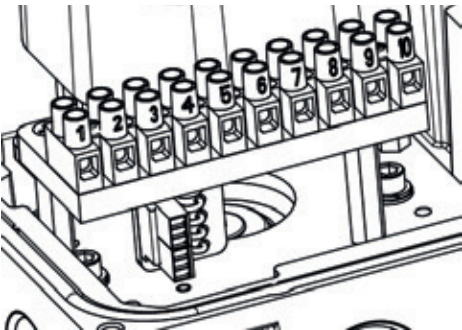


FIGURE 13
Customer remote connection - flying lead version

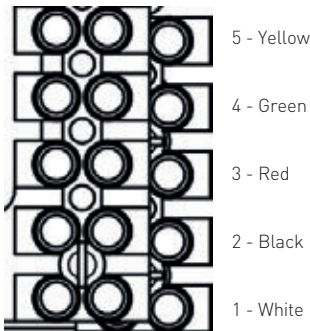
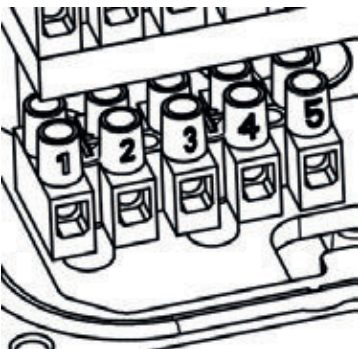
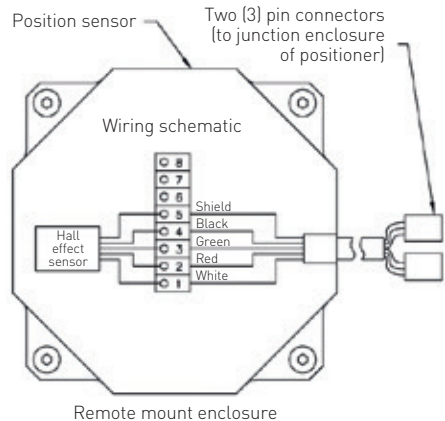


FIGURE 14
Remote mount enclosure



5 SAFETY INSTRUMENTED FUNCTIONS

This section provides the required information needed to design, install, verify and maintain a Safety Instrumented Function (SIF) utilizing the Digital EPIC-2 (DEPIC-2) in ESD applications. This manual provides requirements for conforming to the IEC 61508 or IEC 61511 functional safety standards.

5.1 REFERENCES AND STANDARDS

Listed below are functional safety standards and references related to the DEPIC-2:

- IEC 61508: 2000 - Functional safety of electrical/electronic/programmable electronic safety-related systems.
- IEC 61511 (ANSI/ISA 84.00.01-2004) Functional safety - safety instrumented systems for the process industry sector.
- NAMUR NE-43 Standardization of the signal level for the failure information of digital transmitters.

5.2 DEPIC-2 ESD DESCRIPTION

An ESD valve is a valve that reacts to ensure that the process is brought to a safe state. During normal operating conditions, these ESD valves are typically energized to remain open/closed depending upon Fail-Closed or Fail-Open configuration. In case of an unsafe situation, the ESD valve is de-energized by the Safety Instrumented System. The DEPIC-2 ESD device (DEPIC-2 configured for ESD support) performs this shutdown function for Safety Instrumented Functions (SIF) which requires field devices to be certified for safety related applications in accordance with IEC-61508 as certified by EXIDA for use up to SIL3 with an HFT of 0 in low demand applications. The DEPIC-2 ESD is a valve controller which mounts on a pneumatically actuated valve assembly. Its role is to position an emergency shutdown valve to 0% or 100% with a PFD_{avg} in accordance with IEC-61508 for SIL3 application. Because of its capability of monitoring data from its embedded sensors, the DEPIC-2 ESD is capable of validating the health of its integral components. In addition, due to the ability to perform PST and SOVT of the ESD valve while in normal operations (from energized position), it becomes possible to validate the health of the valve and actuator assembly. Configurable time based testing of the ESD valve (Auto PST and Auto SOVT) reduces the PFD_{avg} by detecting dangerous failures or potential dangerous failures before they become failures thereby preventing the device from performing its safety functions on demand.

5.3 DESIGNING A SIF USING A DEPIC-2 ESD

The following points must be taken into consideration when designing a SIF (Safety Instrumented Function) using the DEPIC-2 ESD:

- Safety function
- Environmental limits
- Design verification
- SIL Capability
- Connecting the DEPIC-2 ESD to the SIS logic-solver
- General requirements

5.3.1 Safety function

When de-energized, the DEPIC-2 ESD moves to its fail-safe position. For a single-acting PST controller the safe state is when the port Actuator 1 is exhausted to a pressure less than 1 psig (0.069 bar, 6.9 kPa) allowing the actuator spring to move the valve to its fail-safe position. For a double-acting PST controller the safe state is when Actuator pressure 1 is equal or below the Actuator pressure 2. The valve actuation must automatically move the valve to the safe state when the digital valve controller falls in safe state.

The DEPIC-2 ESD is intended to be part of the final element subsystem, as per IEC-61508, and the achieved SIL level of the function must be verified by the function designer.

5.3.2 Environmental limits

The designer of a SIF must check that the product is rated for use within the environmental limits it is being used.

5.3.3 Application limits

Listed below are the application limits for the DEPIC-2 ESD installed in a SIF:

- The application of the DEPIC-2 ESD is limited for SIF where the safe state is the de-energized state (shutdown) of the valve. The device is operated as a position transmitter with an output loop signal: 4-20 mA or any user selected range of 3.8-21.0 mA. Furthermore, the 4-20 mA output shouldn't be used as a decision point for safety demand.
- The DEPIC-2 is a non-interfering device during safety demand. The safety signal (solenoid voltage) should come from the safety system. If the device detects SIS voltage to the solenoid, it is in energized position. In the absence of SIS voltage, it is in de-energized or fail-safe position (ESD).

5.3.4 Design verification

The following describes the design verification criteria for the SIF and the DEPIC-2 ESD:

- A detailed Failure Mode, Effects, and Diagnostics Analysis (FMEDA) report is available online at www.westlockcontrols.com. This report details all failure rates and failure modes as well as the expected lifetime.
- The achieved Safety Integrity Level (SIL) of an entire Safety Instrumented Function (SIF) design must be verified by the designer by means of PFD_{avg} calculation, considering redundant architectures, proof test interval, proof test effectiveness, any automatic diagnostics, average repair time and specific failure rates of all products included in the SIF. Each subsystem must be checked to assure compliance with minimum hardware fault tolerance (HFT) requirements. When using DEPIC-2 ESD in a redundant configuration, include a common cause factor of 5% in safety integrity calculations.
- The failure rate data listed in the FMEDA report is valid only for the useful life time of a DEPIC-2 ESD. The failure rates sometimes increase after this time period. Reliability calculations based upon the data listed in the FMEDA report for mission times beyond the lifetime can yield results too optimistic, i.e. the calculated Safety Integrity Level will not be achieved.

5.3.5 SIL capability

The DEPIC-2 ESD will meet SIL 3 requirements as outlined below.

5.3.5.1 Systematic integrity

The product has met manufacturer design process requirements of Safety Integrity Level (SIL) 3. These are intended to achieve sufficient integrity against systematic errors of design by the manufacturer. A Safety Instrumented Function (SIF) designed with this product must not be used at a SIL level higher than stated without prior use justification by end user or diverse redundant technology in the design.

5.3.5.2 Random integrity

The DEPIC-2's ESD safety critical function is maintained as a Type A Device. Therefore based upon the $SFF > 90\%$, when the DEPIC-2 ESD is used as the sole component in a final element subassembly, a design can meet SIL 3 at $HFT=0$.

When the final element assembly consists of many components (DEPIC-2 ESD, quick exhaust valve, actuator, isolation valve, etc.) the SIL must be verified for the entire assembly taking into consideration failure rate of each component. This analysis must account for any hardware fault tolerance and architecture constraints.

5.3.5.3 Safety parameters

For detailed failure rate information refer to the Failure Modes, Effects and Diagnostic Analysis (FMEDA) Report for the DEPIC-2 ESD available from the Westlock Controls Website at www.westlockcontrols.com

5.3.5.4 SIL certification

This product is designed to respond to a commanded trip signal (ESD) with a PFD in accordance to IEC61508 SIL3, capable of partially stroking the valve using one of the following initiation methods, that will be IEC61508 SIL3 certified:

- Allows built-In scheduling (periodic Auto-PST and Auto SOVT) within the DEPIC-2 ESD.
- PST Locally with an external pushbutton.
- FST, PST, and SOVT locally with built-in keypad menu.
- FST, PST, and SOVT from HART commands.

Note, it is the responsibility of the user to interrogate the results of any Auto-PST or Auto-SOVT periodically to ensure that they were performed and no potential failures were detected. Even though there may not have been any failures, the Alarm database should be checked for any Alarms that may suggest trending toward a possible future failure.

5.3.6 Connecting the DEPIC-2 ESD to the SIS logic solver

When connecting the DEPIC-2 ESD to the SIS logic solver follow the guidelines below.

- The DEPIC-2 ESD is connected to the safety rated logic solver which is actively performing the safety function. Connections must be made as per the instructions supplied by the safety rated logic solver.
- The output rating of the I/O module has to meet or exceed the electrical specifications of the DEPIC-2 ESD as referenced in the DEPIC-2 ESD Quick Start Guide.

5.3.7 General requirements

The following general requirements for the DEPIC-2 ESD must comply with the following:

- The system response time shall be less than the process safety time. The DEPIC-2 ESD switches to its fail safe state in less than 100ms. Response time is actuator dependent.
- The end user must add the DEPIC-2 ESD response time to actuator/valve response to obtain overall response time.
- All SIS components, including the DEPIC-2 ESD, must be operational before process start-up.
- In order to use the PST as an automatic diagnostic tool the PST shall be scheduled (using Auto-PST) to run at least once per month or ten times within the expected hazard demand interval, whichever comes first. Detailed failure rate data is specified in the FMEDA report available from the factory.
- In order to use the SOVT as an automatic diagnostic tool the SOVT shall be scheduled (using Auto-SOVT) to run at least once per week or twenty times within the expected hazard demand interval, whichever comes first. Detailed failure rate data is specified in the FMEDA report available from the factory.
- Personnel performing maintenance and testing on the DEPIC-2 ESD has to be qualified to do so.
- Results from the FST, PST, and SOVT proof tests shall be recorded and periodically reviewed.
- The useful life of the DEPIC-2 ESD is discussed in the Failure Modes, Effects and Diagnostic Analysis (FMEDA) Report for the DEPIC-2 ESD.

5.4 DIAGNOSTICS

The DEPIC-2 provides several types of diagnostic information from proof testing:

- Full-Stroke Testing (FST) diagnostics.
- Partial-Stroke Testing (PST) diagnostics.
- Solenoid Operated Valve Test (SOVT) diagnostics.
- Signatures on FST and PST if enabled.

5.4.1 FST

You can configure and run FST manually at any. For more information on FST refer to "Full-Stroke Testing" section in this document.

5.4.2 PST

You can configure and run PST manually at any time or set it up to be automated and run periodically. For more information on PST refer to "Partial-Stroke Testing" section in this document.

5.4.3 SOVT

You can configure and run SOVT manually at any time or set it up to be automated and run periodically. For more information on SOVT refer to "Solenoid Operated Valve Testing" section in this document.

5.4.4 Signatures

If enabled, signatures of FST and PST may be collected for analysis. The signatures are graphical representations of the FST and PST and can be used for trending information.

5.4.5 Proof test

You can automatically or manually run a proof test (any of above tests). The objective of proof testing is to detect failures within a DEPIC-2 and ESD valve that are not detected normal operation of the system. Of main concern are undetected failures that prevent the safety instrumented function from performing its intended function.

Proof testing frequency or proof test interval, has to be determined in reliability calculations for the safety instrumented functions to which DEPIC-2 ESD is applied. The proof tests must be performed either more frequent or as frequently as specified in the PFD_{avg} calculation in order to maintain the required safety integrity of the safety instrumented function.

The following proof test is recommended as a guideline to increase the safety and reliability of the operation. Report any detected failures that compromise functional safety to the factory.

TABLE 1 - PROOF TEST STEPS

Step	Action
1	Read the DEPIC-2 ESD data record using either a HART handheld device or DTM software. Solve any active faults before proceeding (Failure Alerts and Alarms).
2	Bypass the valve, or isolate or take other appropriate action to avoid a false trip, following appropriate procedures.
3	Inspect the DEPIC-2 valve/actuator/solenoid for dirty or clogged ports and other physical damage.
4	De-energize the DEPIC-2 and observe that the actuator and valve move. Energize the DEPIC-2 after the valve has moved to its full stroke length. This will automatically collect a Full-Stroke Signature if enabled which can be evaluated against a Baseline Signature.
5	Inspect the DEPIC-2/valve/actuator/solenoid for dirt, corrosion or excessive moisture. Clean if necessary and take corrective action to properly clean the air supply. It has to be done in order to avoid incipient failures due to dirty air.
6	Record any failures in your company's SIF inspection database. Restore the loop to full operation.
7	Remove bypass or otherwise restore normal operation.

This test should detect approximately 99% of possible dangerous undetected failures in the DEPIC-2 (Proof Test Coverage).

The person(s) performing the proof test of a DEPIC-2 must be trained in SIS operations, including bypass procedures, maintenance and appropriate procedures.

5.5 DEPIC-2 ESD PRODUCT SAFETY

The DEPIC-2 ESD is intended for use with industrial compressed air systems only. Ensure that an adequate pressure relief provision is installed where the application of system supply pressure may cause peripheral equipment malfunctioning. Installation must be in accordance with local and national compressed air and instrumentation codes.

5.5.1 General installation, maintenance or replacement

- Products must be installed in compliance with all local and national codes and standards by qualified personnel using safe site work practices. Personal Protective Equipment (PPE) must be used per safe site work practices.
- Ensure proper use of fall protection when working at heights, per safe site work practices. Use appropriate safety equipment and practices to prevent the dropping of tools or equipment during installation.
- Under normal operation, compressed air is vented to the surrounding area, and may require additional precautions or specialized installations if used in areas with potentially explosive atmospheres.



ATTENTION

Before using these products with fluids/ compressed gases other than air or for non-industrial applications, consult the factory. This product is not intended for use in life support systems.



ATTENTION

Do not use damaged instruments.



ATTENTION

Installation in poorly ventilated confined areas, with any potential of gases other than oxygen being present, can lead to a risk of personnel asphyxiation.

Use only genuine replacement parts which are provided by the manufacturer, to guarantee that the products comply with the essential safety requirements of the European Directives mentioned on the front cover. Changes to specifications, structure, and components used may not lead to the revision of this manual unless such changes affect the function and performance of the product.

6 OPERATION

The DEPIC-2 can operate in three basic functional characteristics. Even if the DEPIC-2 uses three different modes of operations, it uses the same hardware and software so the external look and user interfaces will remain the same during these different modes of operation. Please refer to the ordering guide to select different configurations and features of the device while ordering. Furthermore, many features are controlled through software also so it might be possible to enable those features later on after the purchase. Please contact Westlock Controls sales team for more details.

- Valve position transmitter with 4-20 mA position feedback.
- ESD monitor and basic diagnostics.
- Advanced diagnostics with pressure profiling.

Each mode is described in more details in the following sections.

6.1 VALVE POSITION TRANSMITTER

In this mode, the DEPIC-2 is used only for valve position. The field wiring remains the same as mentioned in the earlier sections. However the device doesn't have pressure sensor manifold in this mode so the air is not tubed to monitor the pressure and perform other diagnostics functions. After calibration, the device basically measures the signal from hall sensor and converts the reading into 0% to 100% position signal after compensation for rotary/linear conversion. The position reading is then represented by the 4-20 mA on the loop. The DEPIC-2 is basically a current sinking device so the transmitter output is represented on the same 4-20 mA loop being used to power up the device. The HART communication is available in this configuration so the device can be operated using other user interfaces discussed in later sections of the document. In this mode, the device has some basic information for diagnostics like valve cycle count, valve opening/closing time etc. The device doesn't monitor the ESD signal in this mode and doesn't generate an ESD alarm if there is a safety demand and the valve moves to fail safe position.

6.2 ESD MONITOR AND BASIC DIAGNOSTICS

For applications in SIS, the DEPIC-2 with ESD enabled (DEPIC-2 ESD) is a solution to improve safety in a processing plant; specifically designed to prevent and mitigate possibly uncontrollable situations. DEPIC-2 ESD is a SIL 3 compliant valve smart monitor interface that continuously monitors the ESD valve operation of the plant and reports any operational failures. The installation and wiring is still the same as mentioned in earlier sections.

An emergency shutdown (ESD) valve is a valve that operates to insure a safe state of a plant when process conditions become or could become uncontrollable. Hundreds of ESD valves are part of every petro-chemical and offshore production plant, as well as part of pipeline installations. During normal operation, these valves are energized to stay open or closed, with the means of a solenoid valve. If an unsafe situation occurs, the ESD valve is de-energized to go to its fail-safe position (fail-closed or fail-open). The solenoid valve vents the pressure from the spring-return actuator chamber, to atmosphere. The accumulated static energy in the actuator spring provides the necessary force to bring the valve to its closed position.

Because of its data monitoring capability, the DEPIC-2 ESD is capable of validating the health of its integral components. The limited partial stroke test enables validation of valve, actuator, and solenoid assembly health without interfering with the plant process. Periodic ESD valve testing reduces PFD (Probability of Failure on Demand) since exercising the valve reduces the risk of improper operations due to sticking, and confirms if an impending problem would prevent the ESD valve to properly operate.

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- The ESD device performs as a smart solenoid to pneumatically activate an ON/OFF valve.
- It is primarily used for Safety Instrumented Systems (SIS) that require field devices to be certified for safety related applications according to IEC-61508.
- It is certified by EXIDA for usage to a SIL3 safety integrity level.
- Interacts with a SIS Logic solver.
- Works with existing 24 VDC as a 4-20 mA output signal (position transmitter), 2 wire installations with superimposed HART communications.
- Monitors SIS voltage to solenoid as a control signal to determine a set-point for 0% or 100% in conjunction with a discrete 0-24 VDC signal as the safety trip trigger.
- Communicates HART over existing wires (4-20 mA).
- Generates an alarm during ESD condition to notify the user.

In addition, DEPIC-2 ESD is a PST controller that mounts on a pneumatically actuated valve assembly. Its role is to position an emergency shutdown valve to 0% or 100% with a Probability of Failure on Demand (PFD) in accordance with IEC-61508 for SIL3 application (SIL = Safety Integrity Level). It replaces solenoid valves, typically utilized to actuate a spring-return or double-acting actuator, while providing extensive online valve diagnostics. The PST function offered in this mode has limited functionality as it doesn't use the pressure sensor data during the PST. In this mode, the PST is basically a time based test, where it monitors the valve moves to the pre-configured travel limit and returns to its fully energized position. It can still generate an alarm if the PST fails. However more advanced PST and other tests like SOVT and FST are not available in this mode of operation.

6.3 ADVANCED DIAGNOSTICS WITH PRESSURE PROFILING

In this mode, the DEPIC-2 has the pressure sensor manifold and the air is tubed to the manifold to monitor the actuator and/or supply pressure. The DEPIC-2 can collect signature information on any Full-Stroke or Partial-Stroke movement of a valve if configured to do so (Signatures Enabled and Pressure Sensors used). It also offers a pressure based diagnostic test SOVT (Solenoid Operated Valve Test), where it monitors the change in the actuator pressure to make sure the spool valve of the solenoid is working. A Signature is a collection of sensor readings (position and pressure) read periodically during valve movement. The Full-Stroke and PST Signatures consist of both a Baseline and Maintenance Signatures. The Baseline is obtained shortly after commissioning of a valve in process and is used as a reference of normal operating performance. The Maintenance Signature is collected anytime the valve moves after the Baseline is collected and is used to compare with the Baseline to aid in detecting degradation in valve/actuator performance over time which can be used to predict possible failures before they occur. This feature can be very important in safety applications.

The following 2 figures show examples of Full-Stroke Signatures as they might appear displayed on a HART host using the HART DD.

FIGURE 15
Closing full stroke signature

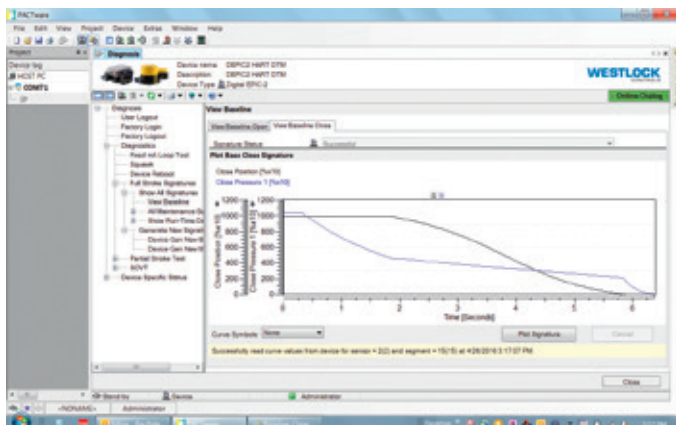
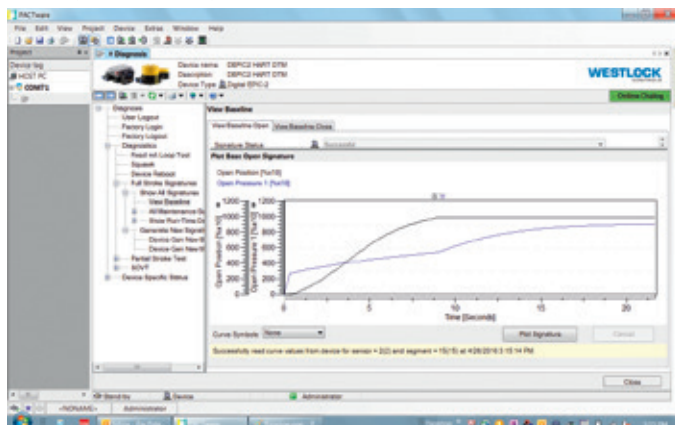


FIGURE 16
Opening full-stroke signature



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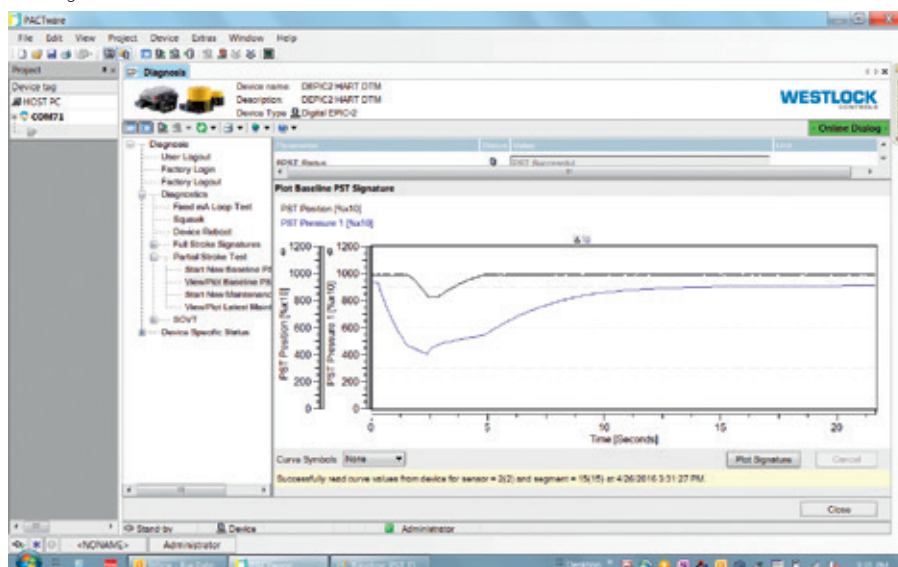
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Note with Full-Stroke Signatures they are actually broken into two signatures, one for opening direction and one for closing direction which makes up one full-stroke cycle. In addition, there are certain critical points within these signature plots which are very meaningful in determining if a valve/actuator is performing properly. These critical points or data are found by the device during the capture of the signatures and save in a database called Run-Time Data. There is Run-Time Data for the Baseline Signature and for the latest Maintenance Signature only. The device in analyzing the Maintenance Signature against the Baseline actually uses this data derived from the signatures to determine if there is degradation in performance. This way the user does not need to actually analyze the signature plots especially if unfamiliar. The device looks at the Run-Time Data and makes decisions and sets or clears Alerts in an Alert File as notification to the user of any potential problems. It is only up to the user to set hysteresis settings in configuration as a guide for the device to know what is out of tolerance.

Again, there are certain critical points within these PST signature plots which are very meaningful in determining if a valve/actuator is performing properly. These critical points or data are found by the device during the capture of the signatures and saved in a PST database. There is data for the Baseline PST Signature and for the latest Maintenance PST Signature. The device in analyzing the Maintenance PST Signature against the Baseline actually uses this data derived from the signatures to determine if there is degradation in performance. This way the user does not need to actually analyze the signature plots especially if unfamiliar. The device looks at the data and makes decisions and sets or clears Alerts in an Alert File as notification to the user of any potential problems and also sets Alarms in the Alarm File if there is a hard failure. It is only up to the user to set hysteresis settings in configuration as a guide for the device to know what is out of tolerance.

Figure 17 shows an example of a PST signature plot as they might appear displayed on a HART host using the HART DD:

FIGURE 17
PST signature



7 USER INTERFACES

There are basically two user interfaces, the Keypad/LCD menu system and the HART menu system. Both user interfaces have been designed to be very similar in look and feel. This way if a user gets familiar with one interface, they should be able to navigate the other as well.

- Local Push Buttons (Keypad) with graphic LCD display.
- HART Communications.

The menu system can be entered by pressing the  (Select/Enter) key from the keypad.

Once the menu screen shows up, the  (Previous/Up) key can be used to go back to the previous menu or exit the menu if already at the main menu. The  (Next/Down) key can be used to navigate to the next menu entry in the current menu. The "Select/Enter" key can be used to enter into the next menu OR perform an action associated with the menu entry.

7.1 LOCAL KEYPAD/LCD

The DEPIC-2 has three local Push Buttons or an optional non-intrusive magnetic buttons for IS applications along with an LCD. The LCD area will be used to display very useful information (for example, position, transmitter output current, date/time, temperature, other diagnostic information etc.), to configure the device, to perform the calibration and other diagnostic tests.

The 3 membrane buttons/keys on the DEPIC-2 board are as shown in Figure 18.

FIGURE 18
Local user interface



7.1.1 Boot-up LCD screen

When the device is powered up, it will display the message on the LCD screen as shown in Figure 19.

During the boot-up screen, it will display the actual firmware version on the screen (such as V1.00.0) instead of the VX.YY.Z displayed in the screen. The only functionality available during the boot-up screen will be to perform the factory defaults, which can be done by pressing and holding the "Select" key during the boot-up. If the device is resetting all settings to factory defaults, the screen will show following messages instead of displaying the manufacturer and device name during the boot-up screen. After performing the factory defaults, the device will return to the idle/main screen.

However if the user has enabled the user password, the feature of performing factory defaults during power-up sequence will be disabled.

7.1.2 Idle/main LCD screen

The LCD will use its entire display area of 64x128 to display various information on the main screen. The area is divided into different segments to display different kind of information as described below (Figure 20).

FIGURE 19
LCD screen during power-up

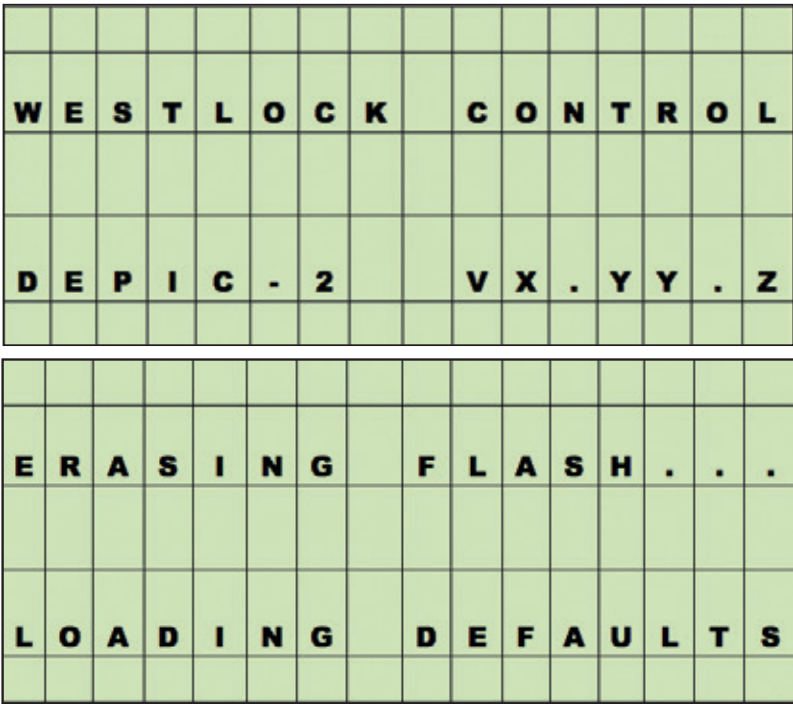
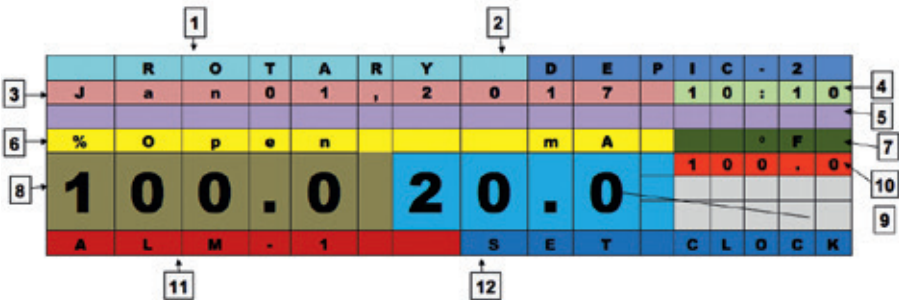


FIGURE 20
LCD main screen layout



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Segment	Description
1	Valve type (rotary or linear)
2	Product name (DEPIC-2)
3	Current date (Month/Day,Year) This is the only format supported
4	Current time (HH:MM) The time is always displayed in 24 hours
5	This area will usually be blank but will have the text "Fix" above the mA to indicate the device is currently in fixed current mode. If the text "Fix" doesn't appear, it means the transmitter output current reflects the current position of the valve.
6	Position/mA text (%Open or %Close)
7	Temperature unit (°F or °C)
8	Valve position usually 0% to 100%
9	Transmitter output current usually 4 mA-20 mA
10	Temperature value
11	Number of active alarms
12	Current active process or current device status
	This area is used to display the current running process if there is any otherwise it display the status of last maintenance PST. Each message has a priority and gets displayed based on its priority if there are multiple status messages active at a time. The priority 0 is the highest and 3 is the lowest.

7.1.3 Quick Setup Screen

- The DEPIC-2 can be configured for the basic operation and calibrated through the local user interface of LCD and Keypad. When the DEPIC-2 is shipped from the factory, it has all factory defaults settings. However the user has to configure a few basic settings and calibrate the device depending on the user configuration of the DEPIC-2. The Quick Setup provides an easy and intuitive way to configure the basic settings, calibrate and get the DEPIC-2 up and running within few minutes.
- When the user presses the  key to enter the menu the first time after receiving from the factory, the DEPIC-2 will ask the user if he wants to run the Quick Setup as shown below. The user can select "Yes" or "No" to run or exit the Quick Setup. If the user selects to run the Quick Setup, the DEPIC-2 will guide the user step by step to enter all required settings and calibrate the device. The DEPIC-2 must be mounted on an actuator with proper electrical and pneumatic connections before running the Quick Setup. The following section explains each step in the Quick Setup.
- Using the up/down arrow keys, toggle until 'YES' is displayed. Then press the  key to run the Quick Setup when the DEPIC-2 displays screen shown in Figure 21 on the LCD.
- The LCD will display the screen in Figure 22 to configure the DEPIC-2 for the Rotary or Linear application. Use the up/down arrow key to change the selection between "Rotary" and "Linear". Press the Select key to accept the current selection.
- Rotary:** For rotary actuators, it should be selected as rotary as the DEPIC-2 will convert the linear position reading to angular rotary position.
- Linear:** For linear actuators, it should be selected as linear as the DEPIC-2 will compensate non-linearity for linear magnets

- The LCD will display screen in Figure 23 to configure the DEPIC-2 for the fail mode. Use the up/down arrow key to change the selection between "Fail Closed" and "Fail Open". Press the Select key to accept the current selection.

Fail closed: Select this setting if the valve moves towards fully closed position when the solenoid is de-energized.

Fail open: Select this setting if the valve moves towards fully open position when the solenoid is de-energized.

- The LCD will display screen as shown in Figure 24 to configure the DEPIC-2 for the device control mode. Use the up/down arrow key to change the selection between "Enable" and "Disable". Press the Select key to accept the current selection.

Enable: If device control is enabled, the DEPIC will move the valve automatically to perform certain actions like auto calibration and auto full stroke signatures.

Disable: If device control is disabled, the DEPIC will not move the valve automatically to perform certain actions like auto calibration and auto full stroke signature. In this case the user can use the manual calibration and dynamic baseline features to configure the device, however the valve is required to be moved manually to the correct position during manual calibration.

FIGURE 21
Quick setup screen

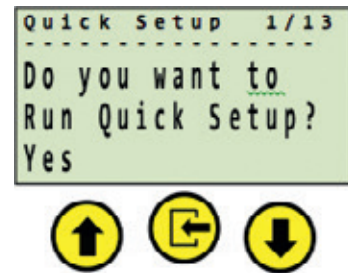


FIGURE 22
Rotary/linear configuration

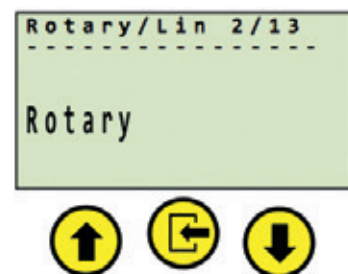


FIGURE 23
Fail closed/fail open configuration

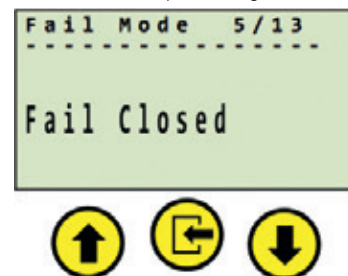
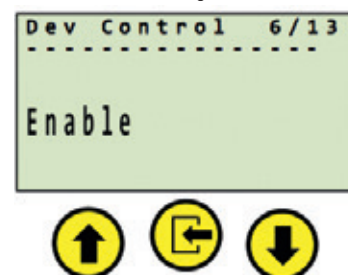


FIGURE 24
Device control configuration



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- The LCD will display the screen in Figure 25 to configure the DEPIC-2 for the ESD monitoring. Use the up/down arrow key to change the selection between "Enable" and "Disable". Press the Select key to accept the current selection.

Enable: Emergency Shut Down monitoring is enabled. The DEPIC-2 will generate an alarm when the solenoid is de-energized. The ESD alarm should be enabled separately in the basic configuration for the DEPIC-2 to generate an alarm.

Disable: Emergency Shut Down monitoring is disabled. The DEPIC-2 will not generate an alarm when the solenoid is de-energized.

Notes: The factory option "ESD" must be enabled to have this setting available for the user. The user must have purchased a DEPIC-2 model that has the ESD monitoring feature.

- The LCD will display the screen as shown in Figure 26 to configure the DEPIC-2 for the pressure sensor-1 operation. Use the up/down arrow key to change the selection between "Enable" and "Disable". Press the Select key to accept the current selection.

Enable: Pressure sensor-1 is enabled. The DEPIC-2 will assume the current model is equipped with the pressure sensor-1 and is pneumatically connected to the actuator chamber. It will show all pressure-1 related hysteresis and alarm settings in the full menu later on. The user must have purchased a DEPIC-2 model that has the pressure sensor-1.

Disable: Pressure sensor-1 is disabled. The DEPIC-2 will assume the current model is NOT equipped with the pressure sensor-1 or it is not pneumatically connected to the actuator chamber. It will hide all pressure-1 related hysteresis and alarm settings in the full menu later on.

- The following setting is dependent on the pressure sensor-1 configuration. If the user has disabled the pressure sensor-1 in the previous step, the DEPIC-2 will skip this step otherwise the LCD will display the screen in Figure 27 to configure the DEPIC-2 for the pressure sensor-2 operation. Use the up/down arrow key to change the selection between "Enable" and "Disable". Press the Select key to accept the current selection.

Enable: Pressure sensor-2 is enabled. The DEPIC-2 will assume the current model is equipped with the pressure sensor-2 and is pneumatically connected. It will show all pressure-2 related hysteresis and alarm settings in the full menu later on. The user must have purchased a DEPIC-2 model that has the pressure sensor-2.

Disable: Pressure sensor-2 is disabled. The DEPIC-2 will assume the current model is NOT equipped with the pressure sensor-2 or it is not pneumatically connected. It will hide all pressure-2 related hysteresis and alarm settings in the full menu later on.

FIGURE 25
ESD configuration

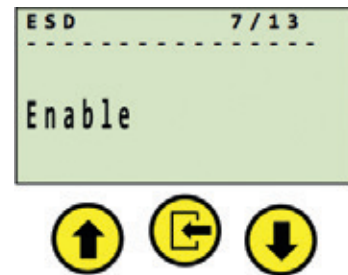


FIGURE 26
Pressure sensor-1 configuration

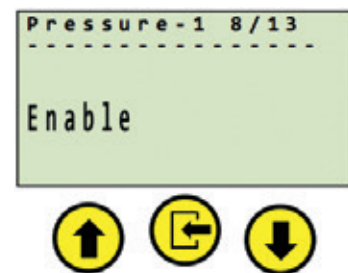
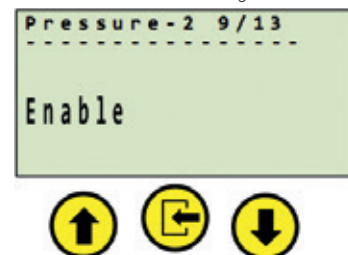


FIGURE 27
Pressure sensor-2 configuration



- The following setting is dependent on the pressure sensor-2 configuration. If the user has disabled the pressure sensor-2 in the previous step, the DEPIC-2 will skip this step otherwise the LCD will display the screen Figure 28 to configure the DEPIC-2 for the pressure sensor-2 usage. Use the up/down arrow key to change the selection between "Supply Pressure" and "Actuator Chamber Pressure". Press the Select key to accept the current selection.

Supply pressure: The DEPIC-2 will assume the pressure sensor-2 is pneumatically connected to monitor the supply pressure. It will show all pressure-2 related hysteresis and alarm settings in the full menu later on to monitor the supply pressure. The user must have purchased a DEPIC-2 model that has the pressure sensor-2.

Actuator pressure: The DEPIC-2 will assume the pressure sensor-2 is pneumatically connected to monitor the second chamber of the actuator. It will show all pressure-2 related hysteresis and alarm settings in the full menu later on to monitor the pressure in the second actuator chamber. The user must have purchased a DEPIC-2 model that has the pressure sensor-2.

- This step is dependent on the current clock configuration. If the DEPIC-2 has the valid time pre-configured from the factory, it might skip this step to configure the clock otherwise it will display the screen Figure 29 to configure the clock on the device. Use the up/down arrow key and the select key to configure the date and time. The date must be configured in Month/Day/Year format and the time must be configured in Hours: Minutes in 24 hours format.
- This step is dependent on the setting "Device Control" configured in the previous step. If the user has disabled the "Device Control" in the previous step, the DEPIC-2 will display the screen to run the manual calibration Figure 30. If the user has enabled the "Device Control" setting in the previous step, the DEPIC-2 will display screen to run the auto calibration. Use the up/down arrow key to change the selection between "Yes" and "No". Press the Select key to accept the current selection.



NOTES

If 'AUTO CALIBRATION' has been selected, please ensure that the correct pneumatic (see Section 3.1 and 3.2)/ electrical connections (see Section 4) have been made and are turned on and the solenoid voltage connections have been made.

FIGURE 28
Pressure sensor-2 usage configuration

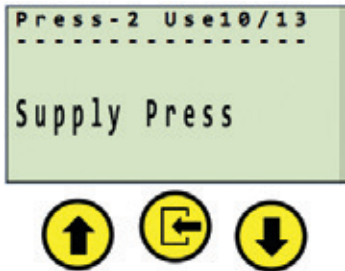


FIGURE 29
Clock configuration

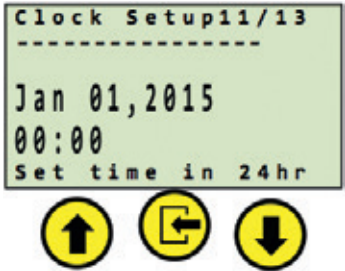
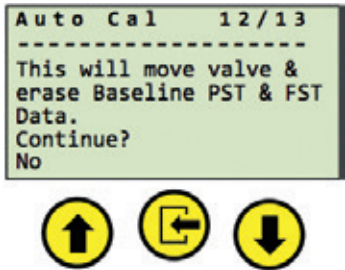


FIGURE 30
Auto calibration



7.2 HART COMMUNICATIONS

All the functionality available from the LCD/Keypad will be available in the HART DD. In addition, the HART DD will have some additional menus and menu entries due to expanded capabilities over the LCD. As mentioned in the menu structure section, the menus will be nearly identical on LCD and HART DD with a few exceptions mentioned.

The DD is a HART 7.2 compliant Device Description (DD) which can be loaded from HART Communication Foundation (HCF) website and used to run on the hosts below.

7.2.1 Field Device Manager (FDM)

The DEPIC-2 can communicate via HART protocol with an FDM such as the Emerson DeltaV/AMS or Honeywell FDM. The HART DD is written to make extensive use of EDDL formatting, as such the display on a DeltaV will look much different than the other hosts described below but more intuitive. The description of the FDM is beyond the scope of this document. Please refer to the Additional Documentation section to find the document for DD User Interface.

7.2.2 Device Type Manager (DTM)

The DEPIC-2 can communicate via HART protocol with a Device Type Manager (DTM) developed specifically for the DEPIC-2 based on the HART DD. Please refer to the Additional Documentation section to find the document for DTM User Interface.

7.2.3 Emerson 475 Handheld Communicator

This host is widely used in plants for mobile access to devices. This will be covered in more detail in the document DD User Guide. Please refer to the Additional Documentation section to find the document for DD User Interface.

The following information will be available on the Emerson 475 Online screen upon first connecting to a device (other DD hosts will be different).

Item	Description
Main menu	To enter into main menu selection, from here will be similar to LCD menus (see next section).
PV position	Primary variable - displays current position of valve as % open (read only).
PV AO current	Primary variable analog output. Transmitter output current based on the current position of the valve (read only).
SV set-point	Secondary variable - displays current set-point 0% or 100% based on the solenoid voltage signal (read only).
TV pressure1	Tertiary variable - displays pressure sensor 1 reading, which is the pressure in the actuator chamber as a percent of Supply Pressure during calibration. It is only visible if the device has signature enabled
QV pressure2	Quaternary variable - displays the pressure sensor 2 reading (if enabled and device has signature option enabled) as a percent of Supply Pressure during calibration, which can be the other actuator chamber (double-acting) or potentially a supply pressure (spring-return).

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It should be noted again that certain functionality that can be done from multiple user interfaces (HART, Keypad, External Signals etc.) will be mutually exclusive. For example if the calibration is in progress from Keypad, it can't be initiated from HART until the keypad calibration is finished. Similarly, if the PST is in progress from the external signal, it can't be initiated from the keypad or HART until it is finished.

7.3 USER INTERFACE MENU SYSTEM

The basis of the menu systems of the DEPIC-2 were developed on a HART DD and are emulated by the Push Button/LCD menu system so once someone gets familiar with one interface, it becomes easier to navigate the other interface. However there are some limitations on the LCD menu structure as it has limited area to display menus.

The basis of the menu system is broken down into the following 6 categories:

1. Login/logout menus
2. Configuration
3. Calibration
4. Diagnostics
5. Device information
6. Device status

In the following sections there will be some flow chart layouts of these basic menus as well as information on how to use them from the Keypad/LCD. To operate the device using other HART based interfaces like DD and DTM; please refer to the Additional Documentation section of the document.



NOTES

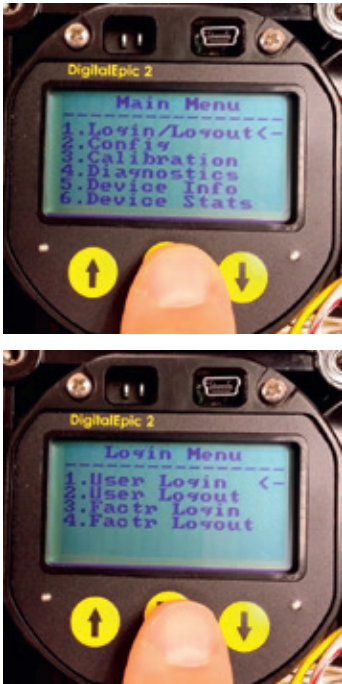
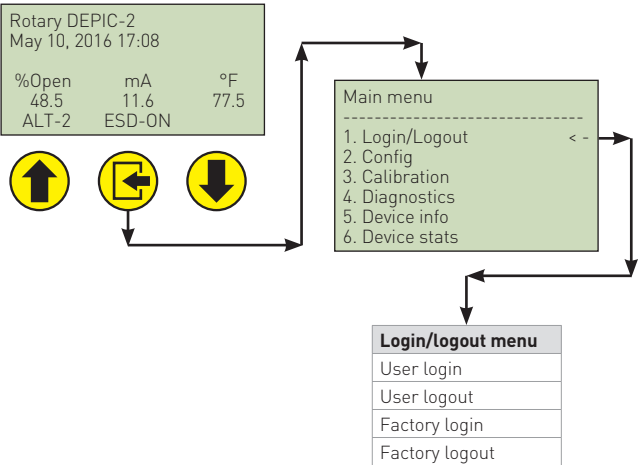
- Some menus or menu items will only be available or configurable if logged in as factory mode. For example, the menu item to view the current device factory options will be available in read only mode to the user but can be changed while logged-in as factory mode.
- Some menus or menu items will only be available on the HART DD but not on the LCD. This is because either it is too complex due to limited area to implement on the LCD or it is unnecessary.
- Some menus or menu items will not be displayed (hidden) depending on the other settings. For example, if the device doesn't have the PST option, it will not show any menu or menu item related to the PST.
- Momentarily press and hold the Select key during power-up will load factory default parameters for configuration and calibration. The Alert configuration will not be affected. If a unit is powering up for the first time in which case it does not have a valid database, factory defaults will automatically be loaded (without pressing Select key), including Alert configuration.
- If the user enters any of the keypad menus and does not exit and there is no keypad activity for certain time, it will timeout and automatically exit the menus, to allow HART access to configuration and calibration. Any modified parameters will not be saved in this case.

7.3.1 Login/logout menu

The login/logout menus provide for two basic types of login.

- 1. Factory login
- 2. User login

FIGURE 31
Login/logout menu



If the user password is enabled, anybody can view the read only parameters of the device but requires the user to login to change any configuration setting or perform any diagnostic function. The following sections show how to use this menu system.

7.3.1.1 LCD login/logout menu

This menu has following different kinds of login functions.

- Factory login-logout: this can only be used by the Westlock service engineers to enable/disable certain functions on the device and for troubleshooting.
- User login-logout: this can be used by the end user to protect the device from any unauthorized access. The user can enable the user password setting as explained in the basic configuration section. When the user password is enabled, the LCD will not show any configuration parameters or calibration and diagnostics menu until the user logs in using the password. Once logged in, it is user's responsibility to log-out to prevent unauthorized access using the Keypad/LCD.

The default password is 123456 until the user configures and chooses their own password. Numbers may be entered with the display or keypad. With display use the arrows and click ENTER for each character. Press SELECT after each character is entered.

7.3.2 Configuration menus

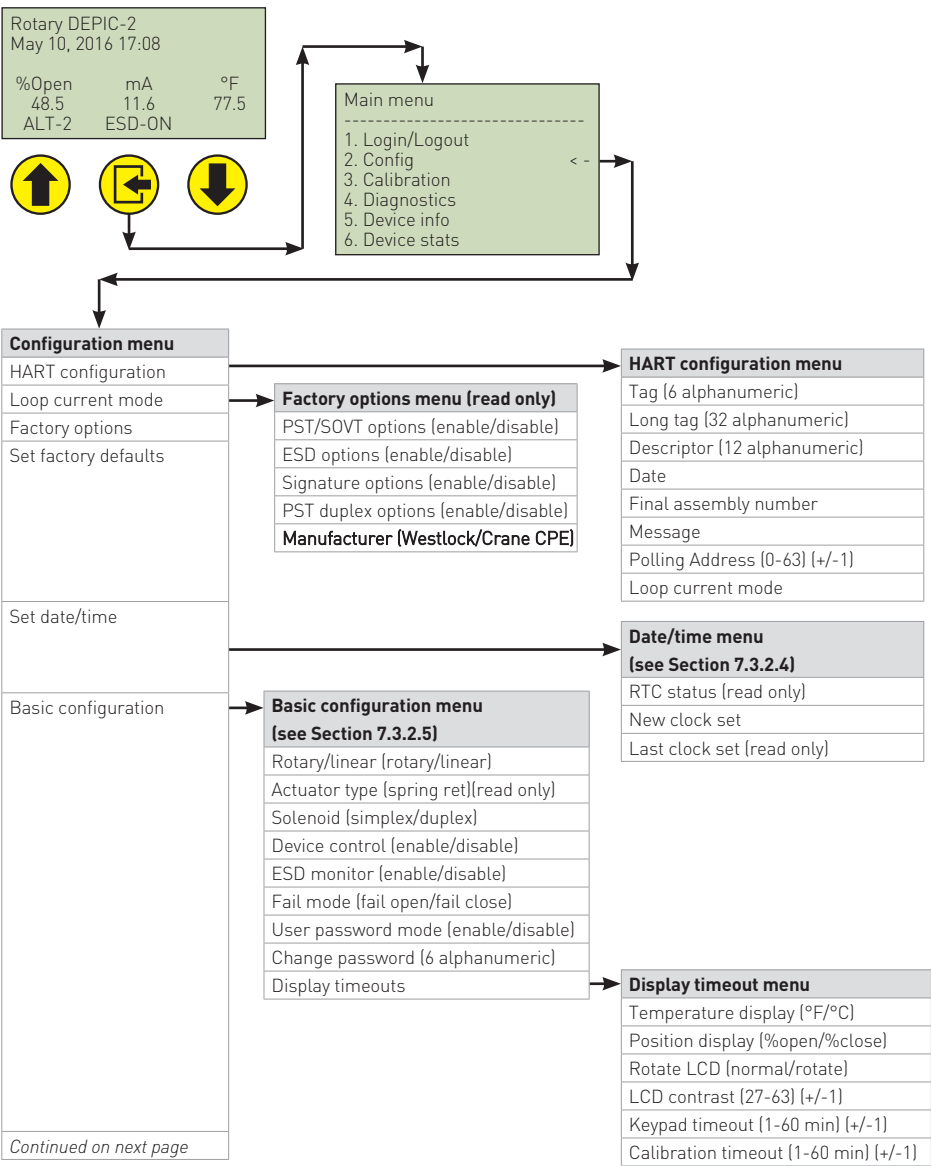
The Configuration menu has many sub-menus based on the functionality of the device. It allows configuring various settings for the device operation based on the application requirement. If the configuration menu is not visible, it is possible that the user has enabled the password mode and the user might have to login using the password to access this menu. Figure 32 shows the full configuration menu chart.

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FIGURE 32

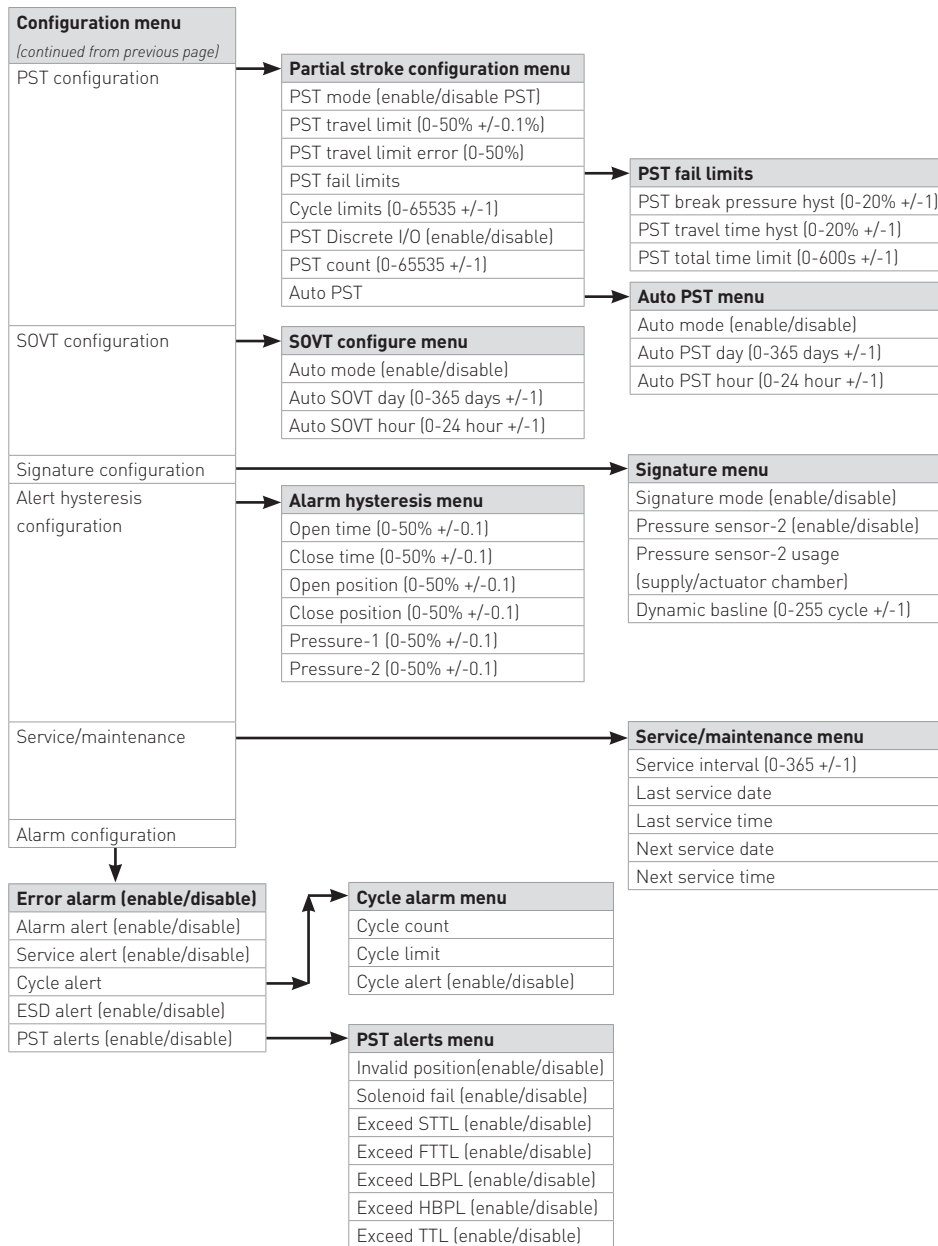
Configuration menu



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FIGURE 33
Configuration menu - continued



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Refer to Figure 34

On the LCD from the Main Menu, use "Down" button to scroll to "Config", then press ENTER to go into the Configuration Menu shown below.

7.3.2.1 Loop current mode sub-menu

This section under the configuration menu has all settings required and related by the HART specifications as shown in Figure 35. The device will have factory defaults values that can be changed as needed for HART communication.

- Polling address: the polling address is used by the DTM to initially communicate with the device and determine the full address. The polling address can be changed from its factory default value of 0 if the device is configured for the HART multi-drop mode. In this mode, the loop current mode should be disabled. Use the Up/Down arrows to change address, then press ENTER to save it.

- Loop current: the loop current mode can be enabled or disabled and will function as below.
Enabled: the loop current WILL reflect the current position of the valve
Disabled: the loop current will be fixed at 4 mA and WILL NOT reflect the current position of the valve.
- ARM mode: this setting is for factory use only and should not be changed by the user.

Press the up arrow to go back to Config menu.

FIGURE 34
Navigating to configuration menu



FIGURE 35
Navigating to loop current mode menu



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7.3.2.2 View factory options sub-menu

This menu shows the device options that are currently enabled or disabled on the device - Figure 36. These are read only options and cannot be modified by the user. However the user can contact Westlock Controls to enable additional options on the device. For example, if the user purchased the DEPIC-2 without the partial-stroke function and later on decided to add the partial-stroke option, it can be added by contacting the factory.

Scroll down to "Factory Opts" then SELECT the Factory Options menu. Selecting each of these options will show the current state of each option.

For example: if the ESD Option is selected, the status of the ESD Option is shown as Enabled or Disabled - Figure 37. All options can be viewed the same way. Press the up arrow twice to return to the Configuration menu.

Note, these options can only be modified by Westlock/Crane CPE personnel. In order to modify, you need to login to the device as Factory level, then using the Up/Down arrow the current state of Enable/Disable can be modified.

7.3.2.3 Factory defaults sub-menu

This menu - Figure 38 allows the user to perform the factory defaults on the device, which will restore all parameters to the factory default values. The user MUST re-configure and re-calibrate after performing the factory defaults. Certain parameters like Date/Time, LCD rotation, user password will not be restored to factory defaults.

Factory default settings can be reloaded by pressing the down arrow to select Yes or No Figure 39. Press SELECT to select choice of Yes or No. If Yes is selected, a Factory Default Configuration will be loaded in the device, if No is selected it will go back to "Config" Menu.

7.3.2.4 Date and time sub-menu

This menu allows the user to configure the clock on the device. The user can view the current status of the clock and also configure the new date and time through the screen shown in Figure 40.

FIGURE 36
Navigating factory options menu



FIGURE 37
Viewing ESD factory option



FIGURE 38
Accessing factory defaults sub-menu



FIGURE 39
Performing factory defaults

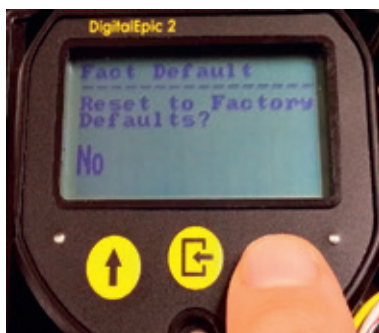
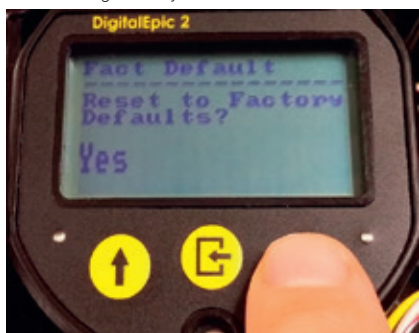


FIGURE 40
Date/time configuration



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- Last clk set: shows the last date and time when the clock was setup on the device as shown in Figure 41.
- New clk set: sets the new date and time on the device SELECT "New Clk Set". Once new date and time is set, it will remain valid for up to two weeks without power.

The current date and time is shown in Figure 42. The month will be flashing. Press the up or down arrow to change the month. Then press ENTER to set.

As shown in Figure 42, the day of the month will be flashing, use Up/Down arrows to modify the day. Then press ENTER to set.

Continue this procedure until the day and year are selected. Now use the arrows to select the hour then press SELECT. Continue this procedure until the minutes are selected. The time should be entered in the 24 hours in HH:MM:SS format. For example 1:30PM should be entered as 13:30:00 and 5:07AM should be entered as 05:07:00. Next, scroll back up to the Basic Configuration Menu. From the Keypad/LCD, the seconds default to 0 and so are not set.

FIGURE 41
Viewing last clock set

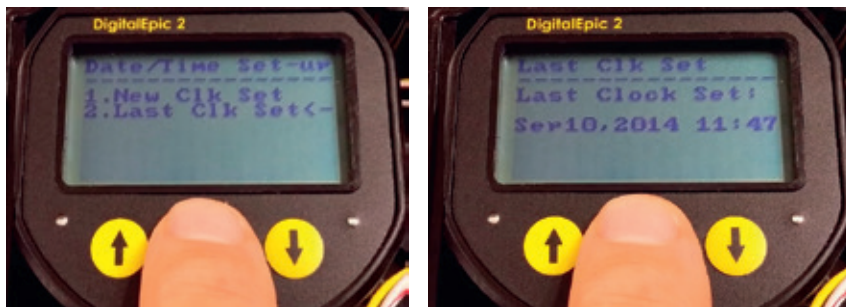


FIGURE 42
Configuring clock - month setup

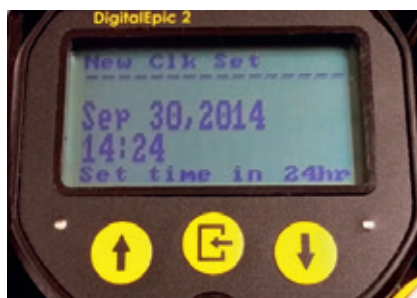
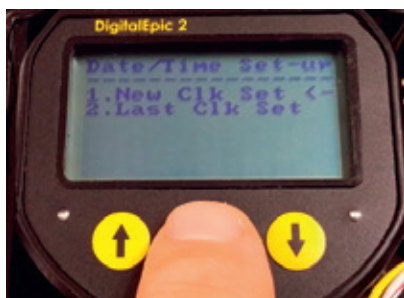


FIGURE 43
Configuring clock - date setup



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7.3.2.5 Basic configuration sub-menu

This section has all parameters that need to be configured for the basic operation of the device and to calibrate the device as explained below. (See Figure 44).

From config menu scroll down to basic config sub-menu and press ENTER.

- Rotary/linear valve: this setting defines the actuator movement on which the device is mounted as below.
 - Rotary: the DEPIC-2 assumes it is mounted on the rotary actuator and so it converts the angular rotary position to the linear position.
 - Linear: the DEPIC-2 assumes it is mounted on the linear actuator and so it allows user an optional linear calibration to compensate the non-linearity of the magnets.
- Actuator type: this setting defines the actuator action on which the device is mounted. Currently this setting cannot be changed by the user as it only supports the spring-return/single-acting actuator. However a future release of the firmware will have support for the double acting actuator.
- Device control: this setting defines whether the DEPIC-2 can control the actuator on which it is mounted in order to perform the calibration and other diagnostics functions.
 - Enabled: the DEPIC-2 controls the actuator through the on-board relay so that it can move the valve to close and open position in order to perform the auto calibration and other diagnostics functions like full-stroke signatures.
 - Disabled: the DEPIC-2 doesn't control the actuator through the on-board relay except for PST. The auto-calibration is not available in this case so the user has to perform the manual calibration where the user has to move the valve to close and open position when asked during the calibration. The Partial-Stroke (PST) function will still be available even if the device control setting is disabled.
- ESD: this setting is ONLY available if your DEPIC-2 model has the ESD feature enabled from factory options. It defines whether the DEPIC-2 should monitor the voltage signal on the solenoid and generate an alarm when the solenoid is de-energized.
 - Enabled: the DEPIC-2 monitors the voltage signal of the solenoid and considers it as normal operation when the solenoid is energized and emergency shut-down when the solenoid is de-energized. When this setting is enabled, it shows other menus related to the ESD to generate an alarm when the ESD occurs. Please see section alarm configuration for ESD related alarms.
 - Disabled: the DEPIC-2 does not monitor the voltage signal of the solenoid and doesn't provide indication on the LCD and generate an alarm when the solenoid is de-energized. When this setting is disabled, it also hides certain menus that are related to the ESD like ESD alarm.
- Fail mode: this is an important setting to configure for a successful calibration. It tells DEPIC-2 how the magnet assembly is oriented and how it rotates or moves when the solenoid is de-energized. Please read the DEPIC-2 product manual for installation of the magnet assembly or beacon on a rotary/linear fail-open/fail-close actuator
 - Fail close: the DEPIC-2 assumes when the solenoid is de-energized the valve moves in usually clockwise direction and the closed symbol (T) is visible on the beacon.
 - Fail Open: the DEPIC-2 assumes when the solenoid is de-energized the valve moves in usually counter clockwise direction and the open symbol (I) is visible on the beacon.

FIGURE 44
Accessing basic configuration menu



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- Password mode: this setting can be used to block access to certain menus like configuration, calibration and diagnostics.
 - Enabled: the DEPIC-2 shows only read-only menus like device status information, unless the user is logged-in with the user password. The user has to enter the password to gain access to other menus like configuration, calibration and diagnostics. The factory default user password is "123456" and the user may need to change and select their own secure password as mentioned in the next parameter "Change Password".
 - Disabled: the DEPIC-2 doesn't require the user to enter the password to gain access to configuration, calibration and diagnostics menu. All menus are available to all users all the time without password.
- Change pswd: when user password is enabled, an extra entry appears in the menu list so from Basic Config menu, scroll down to "Change Pswd" and press SELECT. This allows the user to select their own password for security instead of using the default password.
- LCD contrast: this setting defines the contrast of the LCD. The contrast can be set between the value 27(min) to 63(max). The higher contrast helps better visibility of the text on LCD but consumes more current.
- LCD menu time-out: this setting defines the timer for the DEPIC-2 so that when it is in the menu screen on the LCD and there is no keypad activity for a defined timeout period, the DEPIC-2 will exit the menu screen on the LCD and display main screen. It can be set in 1 minute interval from 1 to 60 minutes. If the calibration is initiated from the keypad/ LCD, this setting is ignored and the DEPIC-2 will stay in the calibration until the calibration finishes.
- Calibration time-out: this setting defines the timer for the DEPIC-2 during calibration so that if the calibration doesn't finish within the specified time, it will abort the calibration. It can be set in 1 minute interval from 1 to 60 minutes. It is recommended to set higher value for large actuators where the valve open and close time is too long.

7.3.2.6 Disp/touts sub-menu

This menu has settings related to the display and timeout as described in Figure 45.

From Basic Config menu, scroll down to "Disp/Touts" and press SELECT. This will open the Display Timeouts sub-menu.

- Temperature units: this setting defines how the temperature is displayed on all diagnostics data.
 - Fahrenheit: the temperature is displayed in Fahrenheit everywhere including LCD and DTM.
 - Celsius: the temperature is displayed in Celsius everywhere including LCD and DTM.
- Rotate LCD display: this setting defines how the text appears on the LCD.
 - Normal: the text appears in normal fashion on the LCD.
 - Rotated: the text appears 180° rotated on the LCD. This is useful when the DEPIC-2 unit is mounted in such a way where it is difficult to read the text on the LCD.

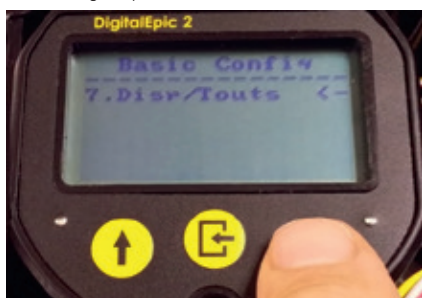
7.3.2.7 PST Configuration sub-menu

This menu might be available depending on if the DEPIC-2 model has the PST option enabled or disabled and the user has logged in using the user password. Furthermore, certain parameters might be hidden or not available depending on other setting like Signature. This section shows all configurable parameters for Partial-Stroke Testing. These parameters can be accessed under the PST configuration menu as shown in Figure 46.

From Config Menu scroll down to PST Config Sub-menu and press ENTER.

- PST mode: this setting is ONLY available if your DEPIC-2 model has the PST/SOVT feature enabled from factory options. It defines whether the DEPIC-2 should make the PST and SOVT functionality available to the user under the diagnostics menu.
 - Enabled: the DEPIC-2 shows the menus to configure the PST/SOVT related parameters and allows a way to perform these tests under the diagnostics menu.
 - Disabled: the DEPIC-2 hides the menus to configure the PST/SOVT related parameters and hides the menu item to perform these tests under the diagnostics menu.

FIGURE 45
Accessing disp/touts menu

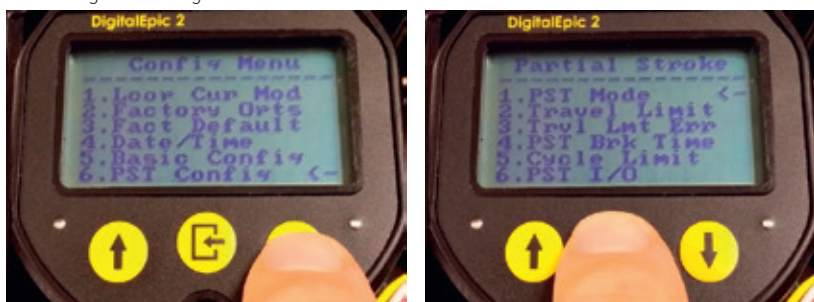


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- PST travel-limit: this parameter (previously known as PST Set-Point) defines the limit DEPIC-2 cannot cross during the PST from its fully energized position. For example, for 25% travel limit on a fail closed valve, the PST will fail if the valve travels more than 25% from its energized position OR 75% actual position.
- PST travel-limit error: this parameter defines the safe area during the valve movement. For example, for 25% travel limit and 10% travel-limit error setting, the DEPIC-2 will make the valve move 15% and then energize the solenoid to move the valve back to its fully energized position to avoid surpassing the 25% hard travel limit.
- PST break-time hysteresis: this parameter defines the hysteresis limit for the PST break time parameter. During the maintenance PST, the DEPIC-2 compares the break time to the baseline PST's break time and if it is outside the hysteresis limit set in this parameter, it generates an alert to warn the user that the dynamics of the valve/actuator package has changed.
- PST cycle limit: each time the DEPIC-2 perform a PST it keeps track of the number of PST it has performed so far. The user can set this parameter so that DEPIC-2 will generate an alert to warn the user that the DEPIC-2 has performed certain number of PSTs on the attached valve.
- PST cycle count: each time the DEPIC-2 perform a PST it keeps track of the number of PST it has performed so far. This is a parameter that provides this information to the user. In addition, the user can reset this parameter when the attached valve is serviced or replaced with a new valve.
- PST I/O: the DEPIC-2 offers digital input to activate the PST through an external dry contact signal and provides the PST status output on another digital output signal. This setting can be enabled or disabled for this functionality. Please read the DEPIC-2 IOM for wiring and signal description.
- Auto PST: the DEPIC-2 offers a feature to automatically perform a maintenance PST on a regular time interval. The parameters in this section allow the user to configure this functionality in number of days.
- PST fail limits: this section has the parameters that decides the pass/fail status of the PST as explained below.
 - Break pressure hysteresis: this parameter is used to compare the maintenance PST break pressure to the baseline PST break pressure and if it is outside this hysteresis limit, the DEPIC-2 considers the PST as a failure. PST break pressure is the pressure recorded when the DEPIC-2 observes the initial valve movement from its fully energized position during the PST.
 - Travel-time hysteresis: this parameter is used to compare the maintenance PST travel-time to the baseline PST travel-time and if it is outside this hysteresis limit, the DEPIC-2 considers the PST as a failure. The PST travel-time is the time recorded by the DEPIC-2 when the valve start movement from its fully energized position to the time it reaches the travel-limit.
 - Total-time limit: this parameter is ONLY used in the case where the DEPIC-2 model has the pressure sensors (Signature) option disabled. In this case, this parameter is used as a time limit for the PST. If the PST doesn't finish within this time, the DEPIC-2 considers the PST as a failure.

FIGURE 46
Accessing PST configuration menu



7.3.2.8 SOVT configuration sub-menu

This menu will ONLY be available if the DEPIC-2 model has the Signature option enabled; the user has enabled the signature parameter as mentioned in the above section and the user has logged in using the user password.

- Auto SOVT: the DEPIC-2 offers a feature to automatically perform maintenance SOVT on a regular time interval. The parameters in this section allow the user to configure this functionality in number of days.

Refer to Figure 47

From Config Menu scroll down to SOVT Config Sub-menu and press ENTER.

Refer to Figure 48

The Auto Mode can be set to enable or disable. Use Up/Down arrow keys to select desired operation then press ENTER/SELECT key to save. Selecting Enable allows Auto SOVT. Note that once enable is selected, this opens other selections in the SOVT Sub-menu as shown in Figure 49.

From Auto SOVT Sub-menu, if Auto SOVT is enabled, scroll to "Auto SOVT Day" and press SELECT. This allows the user to select the Auto SOVT day interval between SOVTs in the desired number of days. Using the Up/Down Arrow keys, select the interval in number of days between Auto SOVTs (from 0-365). To set the desired day interval operation press ENTER/SELECT key to save.

Refer to Figure 50

From Auto SOVT Sub-menu, if Auto SOVT is enabled, scroll to "Auto SOV Hr" and press SELECT.

Using the Up/Down Arrow keys, select the hour of the day that the Auto SOVT is desired to be performed (from 0-23), then set the desired hour of the day SOVT operation should be performed press the ENTER/SELECT key to save.

FIGURE 47
Accessing SOVT configuration menu

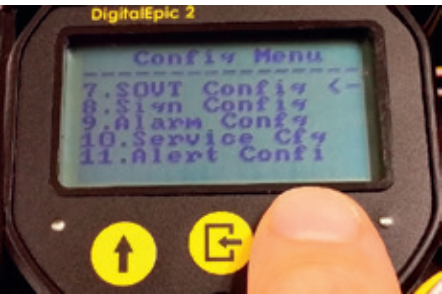


FIGURE 48
Enabling auto SOVT

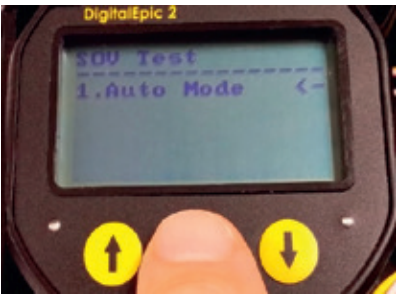


FIGURE 49
Configuring auto SOVT day interval

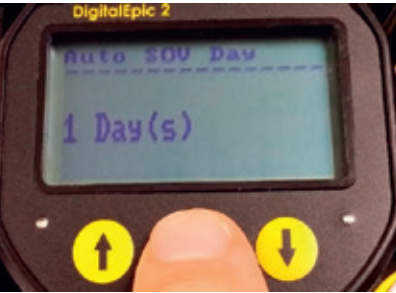
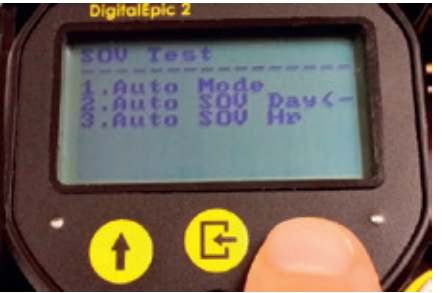
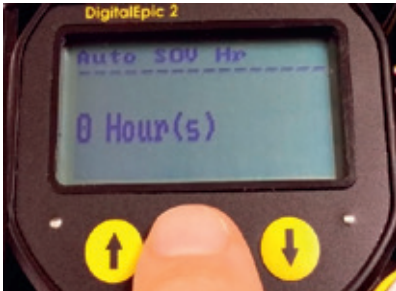
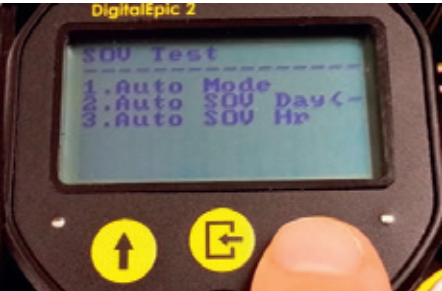


FIGURE 50
Configuring auto SOVT hours



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7.3.2.9 signature configuration sub-menu

A signature is a collection of sensor data collected periodically during a Full-Stroke movement or a Partial Stroke movement. This data consists of 255 samples of each sensor which includes position, pressure 1, and pressure 2 (if enabled). Signatures are a very important feature for users wishing to be able to monitor changes in dynamics of a valve movement and get notifications when the dynamics change outside the defined hysteresis values which may dictate possible need for maintenance before a hard failure occurs. This menu might be available depending on if the DEPIC-2 model has the Signature option enabled or disabled and user has logged in using the user password. Furthermore, certain parameters might be hidden or not available depending on other settings. This section shows all configurable parameters for Full-Stroke Testing. These parameters can be accessed using the "Signature" menu as shown in Figure 51.

Note that if Signat Mode is enabled, this opens other selections in the Sign Config Sub-menu as shown above. If the information is not shown be sure to enable signature before moving forward.

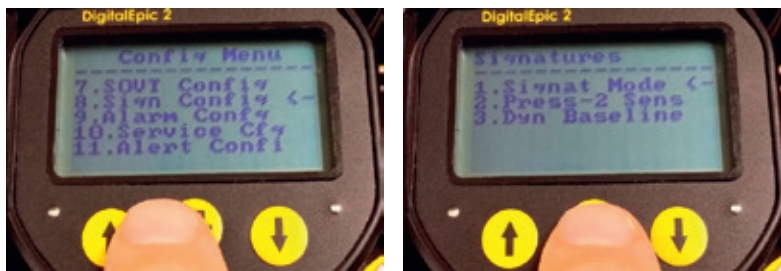
The Signat Mode can be set to enable or disable. Use Up/Down arrow keys to select desired operation then press ENTER/SELECT key to save. Selecting Enable allows collection of signature data during Full-Stroke movement and Partial Stroke movement.

All settings within this menu are explained in more details below.

- Signature: this parameter can be used to let DEPIC-2 know if it should capture the signatures (pressure and position) samples during the PST and FST. It indirectly indicates if the DEPIC-2 has the pressure sensor-1 connected/used or not.
 - Enabled: the DEPIC-2 assumes it has pressure sensor-1 connected electronically and pneumatically so it checks the pressure during calibration and other diagnostics like PST, SOVT and FST. When this parameter is enabled, it is up to the user to select the proper setting for the pressure sensor-2 depending on how it is connected or used.

- Disabled: the DEPIC-2 assumes it doesn't have pressure sensor-1 connected electronically and pneumatically so it doesn't check the pressure during calibration and other diagnostics like PST, SOVT and FST. It also doesn't generate any pressure related alerts or alarms. When this parameter is disabled, the pressure sensor-2 is disabled also.
- Pressure sensor-2: this parameter can be used to let DEPIC-2 know if it should monitor the pressure on the pressure sensor-2 during the PST, FST and generate an alert or alarm. The user can connect the pressure sensor-2 port pneumatically to monitor the supply pressure or actuator secondary chamber pressure. In order to monitor the pressure sensor-2, this setting must be enabled.
 - Enabled: the DEPIC-2 assumes pressure sensor-2 is electrically connected and it should monitor the pressure on this sensor.
 - Disabled: the DEPIC-2 doesn't monitor the pressure on this sensor.
- Pressure sensor-2 usage: this setting is ONLY available if the pressure sensor-2 is enabled. It basically tells DEPIC-2 how the pressure sensor-2 is connected pneumatically.
 - Supply pressure: the DEPIC-2 assumes pressure sensor-2 is pneumatically connected to monitor the supply pressure.
 - Actuator chamber: the DEPIC-2 assumes pressure sensor-2 is pneumatically connected to monitor the pressure within the second chamber of the actuator.
- Dynamic baseline: the DEPIC-2 offers a way to capture the FST signature automatically without direct user intervention. This setting can be used to configure automatic capture of the baseline full-stroke signature on a particular valve cycle. For example, if the setting is configured at 5, the DEPIC-2 will capture the full stroke signature when the valve cycles full-stroke 5th time. The minimum required value for this setting is 2. This can be used by a user who wants to capture a baseline signature after a break-in period on a new valve.

FIGURE 51
Accessing signature menu



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7.3.2.10 Alert hysteresis sub-menu

Alarms are considered a failure whereas Alerts are deviations that could eventually result in a failure if not addressed. This menu allows the user to tailor the hysteresis for many dynamic operating characteristics such that the user will only receive Alert notifications when these characteristic deviations fall outside of the hysteresis values. This is a critical setting to ensure nuisance alerts are kept to a minimum. This menu provides different hysteresis parameters that can be configured by user to control the generation of Alerts. DEPIC-2 considers alerts as a warning signal and not a critical failure. Thus the values in these parameters should be different than the Alarm hysteresis since an alert indicates a trend building towards a potential failure but not a failure yet. These parameters can be accessed and configured as shown in Figure 52.

Note, if Pressure 2 is enabled in Signature Configuration, there will also be Pressure-2 setting in the above display. Likewise if signatures are disabled, neither Pressure-1 nor Pressure-2 will be shown.

- Open time: this value represents the allowable deviation value ($\pm\%$) from its baseline open break and travel time before generating an alert. It is used for the FST and PST travel-time.
- Close time: this value represents the allowable deviation value ($\pm\%$) from its baseline close break and travel time before generating an alert. It is used for FST and PST travel-time.
- Open position: this value represents the allowable deviation value ($\pm\%$) from its baseline open position before generating an alert. It is used to determine the valve movement during PST and FST.
- Close position: this value represents the allowable deviation value ($\pm\%$) from its baseline close position before generating an alert. It is used to determine the valve movement during PST and FST.

- Pressure-1: this value represents the allowable deviation value ($\pm\%$) from its baseline break or supply pressure-1 reading before generating an alert. It is only available for the devices with signature option.
- Pressure-2: this value represents the allowable deviation value ($\pm\%$) from its baseline break or supply pressure-2 reading before generating an alert. This parameter is only available if the user enabled the pressure sensor-2 and signature.

7.3.2.11 Service configuration sub-menu

This menu - Figure 53 allows the user to set a Date in which to receive an Alert notification as a reminder that it is time to perform service maintenance on the Valve/Actuator assembly before a hard failure can occur. This assumes the user has some historical data of the amount of time before a valve/actuator assembly may be nearing required maintenance or failure.

All settings in this menu are explained in more details below.

- Service interval: this parameter can be used to set a reminder so that DEPIC-2 will generate an alarm to warn the user to perform the service on valve or actuator. The service alarm should be enabled to get an alarm generation as discussed in the alarm configuration section.
 - 0 [Disabled]: when this parameter has value 0, it is disabled.
 - 1-365: the interval in number of days to generate a service alarm.
 - Last service: the date/time when the last service was performed. This is basically a date when the service interval was re-configured.
 - Next service: the date/time when the next service should be performed or an alarm will be generated.

FIGURE 52
Alert hysteresis menu



FIGURE 53
Accessing service configuration menu



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7.3.2.12 Alarm configuration sub-menu

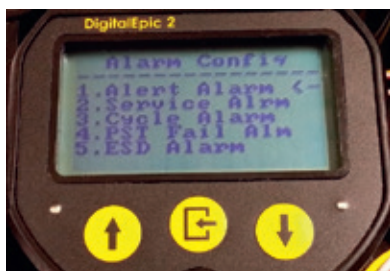
Alarms are considered a failure whereas Alerts are deviations that could eventually result in a failure if not addressed. From this sub-menu, the user can enable/disable many of these Alarms.

Refer to Figure 54

This section contains the parameters to configure different critical alarms on the DEPIC-2 to let user know about a specific failure that occurred on the device. The parameters are explained below.

- Alert alarm: the DEPIC-2 has two types mechanism to let user know about fault conditions on the device. One is the Alert, which is not critical but still informational and another is Alarm, which is a critical failure and requires an immediate attention. This alarm when enabled, warns user if there is any active alert on the device. It is up to the user to browse through the alert file and find out the specific alert that triggered this alarm. When disabled, the device will not report any active alert generation through this alarm.
- Service alarm: this alarm is tied to the service/maintenance configuration mentioned in the previous section. When the service interval is configured and this alarm is enabled, the device will generate an alarm when the service period expires to let user know. When the alarm is disabled, the user has to manually look at the service parameter and find out when the next service is due on the device. This alarm is for information only and doesn't indicate any critical failure.
- Cycle alarm: the DEPIC-2 keeps count of the number of cycle valve has performed. This count can be useful in determining when the valve or actuator is coming to an end of life or requires maintenance. The user can configure this alarm to get that information. Cycle alarm has three different parameters as shown below.
 - Cycle count: provides the current count of the valve cycles
 - Cycle limit: indicates the limit to generate a cycle alarm (if enabled) when the Cycle Count reaches this value
 - Cycle alarm: if enabled, generates an alarm when the Cycle Count reaches to the Cycle Limit. If disabled, this check is ignored. This alarm is for information only and doesn't indicate any critical failure
- ESD alarm: this alarm is tied to the ESD monitor setting in the basic configuration. If the ESD monitoring is disabled, this alarm is not accessible. If the ESD monitoring is enabled, this alarm can be enabled to generate an alarm and let user know when the ESD condition occurred. If disabled, the ESD condition will be displayed on the LCD but will not be reported as an alarm for immediate attention.
- PST fail alarms: this section provides a way to configure all PST fail alarms, which are all enabled as a factory default option but can be disabled by the user. When disabled, the device will not generate an alarm when the PST failed due to that specific failure as explained below. The PST alarms can be accessed and configured using the screen shown in Figure 54.
 - Invalid position: PST/SOVT Valve was in an Invalid Position from which to perform the requested operation. This can be caused due to not enough supply pressure or solenoid voltage to keep the valve to its fully energized position.
 - PST fast travel time: the maintenance PST travel time was more than the baseline PST travel time by the PST travel time hysteresis value configured by the user.
 - PST slow travel time: the maintenance PST travel time was less than the baseline PST travel time by the PST travel time hysteresis value configured by the user.
 - PST high break pressure: the maintenance PST break pressure was higher than the baseline PST break pressure by the PST break pressure hysteresis set by user.
 - PST low break pressure: the maintenance PST break pressure was lower than the baseline PST break pressure by the PST break pressure hysteresis set by user.

FIGURE 54
Accessing alarm configuration menu



- PST not reached travel limit: the baseline PST didn't reach to the travel limit set by the user. It indicates the valve started moving but then got stuck before it reaches to the travel limit.
- Solenoid fail: this is an indication of a solenoid failure during PST or SOVT as it didn't detect the expected change in the pressure at various stages of PST/SOVT.
- Solenoid 2 fail: this is an indication of a solenoid2 failure during PST for duplex board or SOVT on solenoid 2 as it didn't detect the expected change in the pressure at various stages of PST/SOVT.
- Pressure sensor fail: this is an indication that the pressure sensor is not working as expected and might be damaged or unplugged.
- Invalid pressure: this indicates that the pressure measured before starting the PST is outside the hysteresis limit set so the PST can't be started. This is helpful in the situation where the low supply pressure can cause too much overshoot or affect the ability of the valve to come back to fully energized position after performing PST.

7.3.3 Calibration menus

This section provides methods to perform different types of calibration as discussed below. Following chart (Figure 55) shows the full calibration menu. Each calibration is explained in more details in this section. If the user password setting under the basic configuration menu is enabled, the calibration menu WILL ONLY be available after the user logs in using the password.

Refer to Figure 56
From Main Menu, scroll down to Calibration then press ENTER. Depending upon Device Control Enable/Disable configuration under Basic Configuration, the Calibration Menu will be slightly different as shown in the figure. They are basically the same except line 2 will be either "Full AutoCal" or "Full Man Cal", for Full Auto Calibration or Full Manual Calibration.

FIGURE 55
Calibration menu

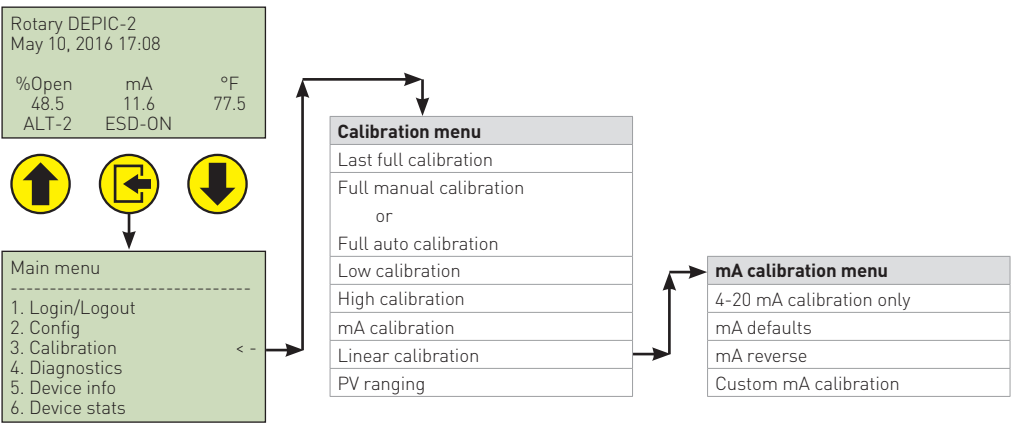


FIGURE 56
Accessing calibration menu



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7.3.3.1 Last full calibration date/time

Refer to Figure 57

This will show the Date/Time and Temperature when the device was last Calibrated.

If Signatures are enabled, an additional item will be displayed "psig" which is the supply pressure at the start of Calibration. The last calibration data is not updated if the user perform other types of calibration like low, high, mA etc.

7.3.3.2 Full manual calibration

Refer to Figure 58

From Calibration Menu, scroll down to "Full Man Cal". This calibration method is ONLY available if the device control setting under the basic configuration menu is disabled. This calibration allows user to perform the calibration manually with user moving the valve to de-energized and energized position manually. During this calibration, the DEPIC-2 reads the lower and upper end of the position and pressure and also calibrates the mA transmitter output current. If the transmitter output current is not correct after this calibration, it is recommended to perform the mA calibration. Please follow the instruction messages displayed on the screen during this calibration to finish the calibration.

Refer to Figure 59

The screen (shown below) should appear. The default is "No". Use the Up/Down arrow keys to switch between "No" or "Yes". Use "Yes" to continue with Calibration. Then press SELECT/ENTER key. Next it asks the user if the valve is fully closed. The user must manually move the valve to closed position. Once fully closed, press ENTER to continue.

Once the close calibration is done, the screen in Figure 60 will appear asking the user if the valve is fully open. The user must manually move the valve to open position. Once fully open, press ENTER to continue.

Refer to Figure 60

When it gets to 100%, the calibration is done and the above will display. If the calibration did not pass, the calibration error will be displayed. The error must be corrected for the calibration to pass.

FIGURE 57
Viewing last full calibration



FIGURE 58
Full manual calibration



FIGURE 59
Performing manual calibration - close position



FIGURE 60
Performing manual calibration - open position



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7.3.3.3 Full auto calibration

This calibration method is ONLY available if the device control setting under the basic configuration menu is enabled. This calibration allows the device to perform the full calibration automatically without user intervention to move the valve to de-energized and energized position using the relay on the board. During the calibration, the DEPIC-2 reads the lower and upper end of the position and pressure sensors and also measures the opening and closing speed of the valve. If the transmitter output current is not correct after this calibration, it is recommended to perform the mA calibration. Please follow the instruction messages displayed on the screen during this calibration to finish the calibration.

Refer to Figure 61

From Calibration Menu, scroll down to "Full AutoCal". Note, "Device Control" in Basic Configuration menu must be enabled for this sub-menu.

Once auto calibration is selected, the LCD will display the screen shown in Figure 62. This provides a warning to the user that the valve will move and erase any Baseline Signature. The user has the option of selecting "No" or "Yes" by using the Down arrow key to switch.

If "No", it will terminate the Calibration before even starting. If "Yes", the Calibration will proceed. After calibration is finished, it will display the results as PASS or FAIL with error message.

7.3.3.4 Low position calibration

This calibration method allows the user to perform only the lower end of the position (0%) without affecting any other parameters within the full calibration like the upper end position, pressure readings, speed etc. The user MUST have completed either the full device controlled or full user controlled calibration before performing this calibration. This calibration is useful in the case where after performing the full device/user controlled calibration, the user observes drift in the position for the lower end over the time due to the change in temperature, pressure, magnets degrading or weakening actuator spring or lose valve shaft coupler. The valve must be in appropriate position before starting this calibration.

FIGURE 61
Accessing full auto calibration



FIGURE 62
Performing auto calibration



FIGURE 63
Accessing low calibration



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Next the user is asked if the valve is already closed. The user has the option of aborting by simultaneously pressing the Up and Down arrow keys or continue by pressing ENTER. If continue, the Calibration will proceed to the next screen. (See Figure 64).

This is generally a very quick operation, so the above screen will appear as 100% Done-Pass. If it did not pass, an error message will be displayed. The error must be corrected for the calibration to pass.

7.3.3.5 High position calibration

This calibration method allows the user to perform only the upper end of the position (100%) without affecting any other parameters within the full calibration like the lower end position, pressure readings, speed etc. The user MUST have completed either the full device controlled or full user controlled calibration before performing this calibration. This calibration is useful in the case where after performing the full device/user controlled calibration, the user observes drift in the position for the upper end over the time due to change in temperature, pressure, magnets degrading or weakening actuator spring or lose valve shaft coupler. The valve must be in appropriate position before starting this calibration.

Refer to Figure 65

From Calibration Menu, scroll down to "High Calib" then press SELECT/ENTER. The LCD will display the screen shown in Figure 65. This asks the user if they wish to continue. The user has the option of selecting "No" or "Yes" by using the Down arrow key to switch. If "No", it will terminate the Calibration before even starting. If "Yes", the Calibration will proceed to the next screen.

Next the user is asked if the valve is already opened. The user has the option of aborting by simultaneously pressing the Up and Down arrow keys or continue by pressing ENTER. If continue, the Calibration will proceed to the next screen. (See Figure 66).

This is generally a very quick operation, so the above screen will appear as 100% Done-Pass. If it did not pass, an error message will be displayed. The error must be corrected for the calibration to pass.

FIGURE 64
Performing low calibration

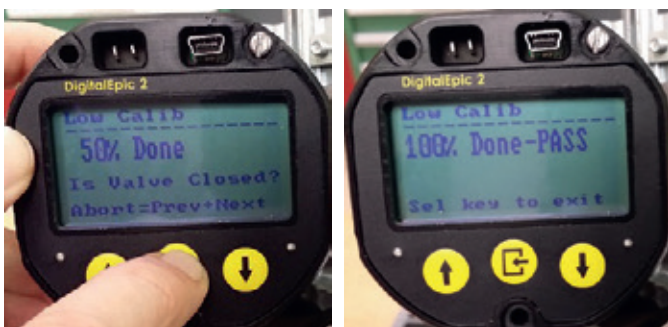


FIGURE 65
Accessing high calibration



FIGURE 66
Performing high calibration



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7.3.3.6 mA output calibration

From the Keypad/LCD menu system (Figure 67), this has two additional items that do not exist from the HART DD. The Default mA and Reverse mA are not really calibrating, they only load factory default setting for the mA output either as 4-20 mA or 20-4 mA. The Custom mA is a real calibration which allows the user to calibrate the (milliamp) mA Output from the device. The user has the option to calibrate the standard 4-20 mA (4 mA for closed and 20 mA for open) or they can reverse this or even use values other than 4 mA and 20 mA.

- Default mA
The Default mA is not really a calibration function; it is only a way to load factory default settings for the mA output as 4-20 mA without having to do a full Factory Default.

Refer to Figure 68
From mA Calib menu scroll to "Default mA" and press ENTER. Above is the first screen to appear. This asks the user if they wish to continue. The user has the option of selecting "No" or "Yes" by using the Down arrow key to switch. If "No", it will terminate the Default mA. If "Yes", the factory default settings are set to approximate a 4-20 mA current range.

This is a very quick operation, so the above screen will appear as 100% Done. Press ENTER to exit. There is no potential failure for this since it is just resetting some internal default parameters.

- Reverse mA
The Reverse mA is not really a calibration function, it is only a way to load factory default settings for the mA output as 20-4 mA without having to do a full Factory Default.

Refer to Figure 69
From mA Calib menu scroll to "Reverse mA" and press ENTER. Below is the first screen to appear. This asks the user if they wish to continue. The user has the option of selecting "No" or "Yes" by using the Down arrow key to switch. If "No", it will terminate the Reverse mA. If "Yes", the factory default settings are set to approximate a 20-4 mA current range.

This is a very quick operation, so the above screen will appear as 100% Done. Press ENTER to exit. There is no potential failure for this since it is just resetting some internal default parameters.

FIGURE 67
Accessing mA calibration

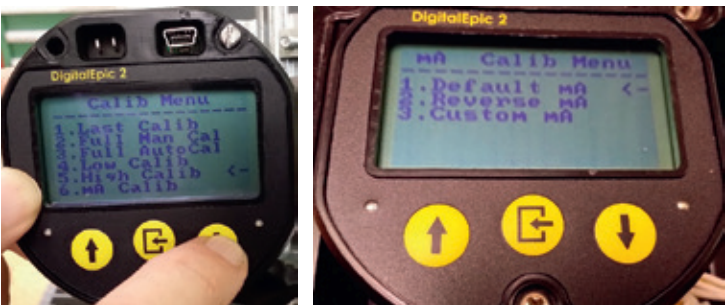


FIGURE 68
Performing default mA calibration

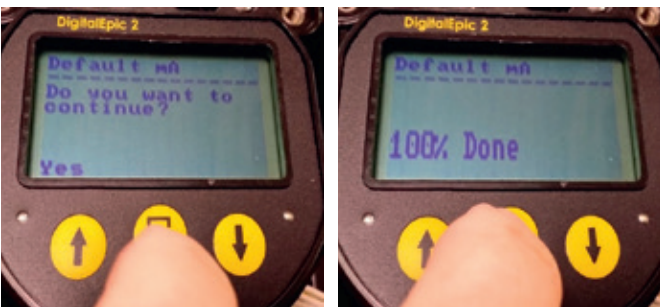
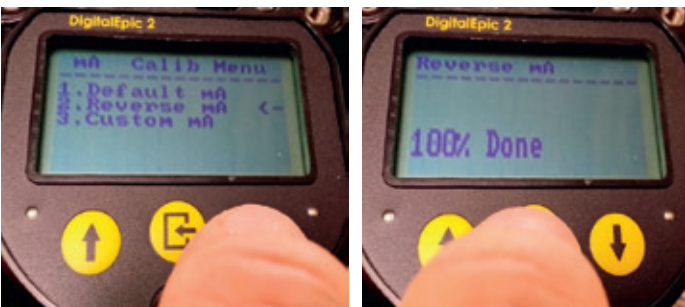


FIGURE 69
Performing reverse mA calibration



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- Custom mA Calibration

The Custom mA is a real calibration which allows the user to calibrate the (milliamp) mA Output from the device. The user has the option to calibrate the standard 4-20 mA (4 mA for closed and 20 mA for open) or they can reverse this or even use values other than 4 mA and 20 mA. Note, before proceeding, make sure a milliamp meter is connected to the current output for measurement.

Refer to Figure 70

From mA Calib menu scroll to "Custom mA" and press ENTER. Below is the first screen to appear. This asks the user if they wish to continue. The user has the option of selecting "No" or "Yes" by using the Down arrow key to switch. If "No", it will terminate the Custom mA. If "Yes", the Custom mA Calibration will start.

As shown in Figure 71, the 4.00 will be flashing. If something other than 4 mA is desired for closed position, use the Up/Down arrow keys to select the desired output, then press ENTER. Next, under Meter, the up/down arrows will be flashing. Look at the reading on the milliamp meter, then use the Up/Down arrow keys to adjust the output until the meter reading matches the desired output. Once it matches press ENTER to proceed. This calibration can be aborted by simultaneously pressing both the Up/Down (Prev+Next) keys.

On this next screen under Desired, the 20.00 will be flashing. If something other than 20 mA is desired for open position, use the Up/Down arrow keys to select the desired output, then press ENTER. Next, under Meter, the up/down arrows will be flashing. Look at the reading on the milliamp meter, then use the Up/Down arrow keys to adjust the output until the meter reading matches the desired output. Once it matches press ENTER to proceed. This calibration can be aborted by simultaneously pressing both the Up/Down (Prev+Next) keys.

Refer to Figure 72

At this point the mA Calibration is completed, and the screen below appears. Press ENTER to exit. If there is any failure (which there are not many) such as mA Span Too Small, the failure will be displayed.

FIGURE 70
Accessing custom mA calibration

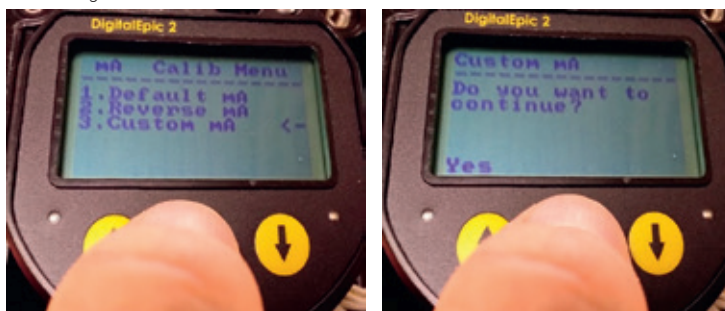


FIGURE 71
Performing custom mA calibration

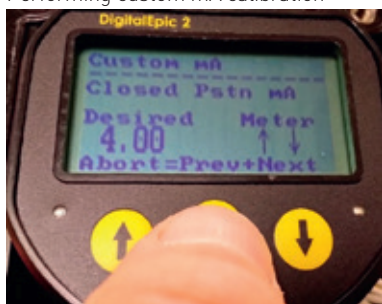
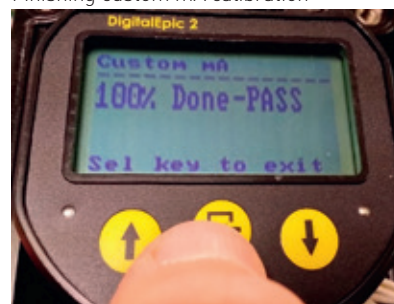


FIGURE 72
Finishing custom mA calibration

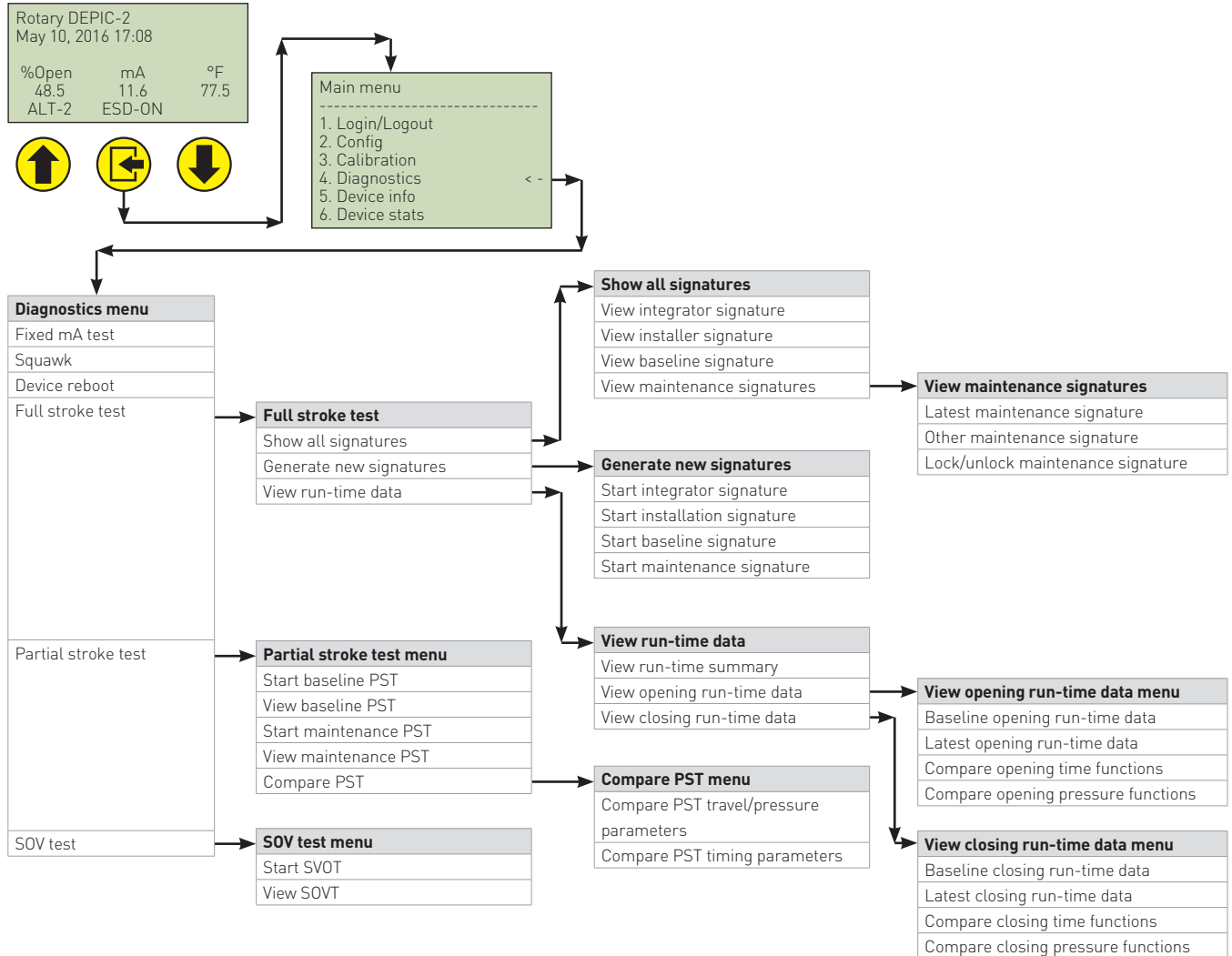


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7.3.4 Diagnostics menus

FIGURE 73
Diagnostics menu



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This menu has different diagnostics functions available on the DEPIC-2. Following sections describes the details of each diagnostic function available under this menu.

Refer to Figure 74

From Main Menu, scroll down to Diagnostic Menu then press ENTER. Depending upon Signature Enable/Disable configuration under Configuration, the Diagnostic Menu will be different as shown below.

Notice for "FST Signat" and "SOV Test" might disappear when Signatures are disabled. This is because the Pressure sensors become disabled. Signatures rely upon pressure sensors so there can be no FST Signatures or SOV Test when the pressure sensors are disabled.

7.3.4.1 Fixed mA loop test

This method allows user to put the device into fixed current mode instead of representing the actual valve position. This is useful to the user in finding any issues related to the HART communication 4-20 mA loop. The user can select the value for the fixed current mode. The device will stay in fixed current mode until the user ends this test. The user is recommended to connect an accurate mA meter in the loop during this test. Please follow the instructions displayed on the screen to finish the test.

From Diagnostic Menu, scroll to "Fix mA Test" and press ENTER. From here there is the option to fix the output current at 4 mA, 20 mA, a user selectable value, or end the test.

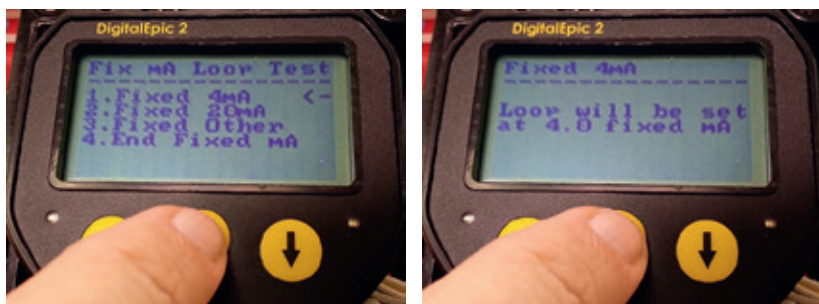
Refer to Figure 75

Scroll to "Fixed 4 mA" and press ENTER. The screen below will appear. The current can be verified by connecting a milliamp meter in series. Press ENTER again to return to the Fix mA Test sub-menu.

FIGURE 74
Accessing diagnostics menu



FIGURE 75
Fixed mA test



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7.3.4.2 Device reboot

This method allows the user to reboot the DEPIC-2 from the menu without disconnecting the power physically. This will help user if the device is being stuck in some mode and it is necessary to reboot the device. Please follow the instructions displayed on the screen to perform the reboot on the device.

Refer to Figure 76

From Diagnostic Menu, scroll to "Reboot DEPIC" and press ENTER. The screen below will appear asking do you want to continue? The default is No. Press down arrow to Yes then press ENTER to reboot.

Screen will momentarily go blank as the device resets (reboots). Configuration is always saved through reset. After reset complete, the LCD returns to the Main screen where you would need to re-enter the menu system again.

7.3.4.3 Full stroke signatures

This menu (Figure 77) will only be available if the factory Signature option is enabled and the user has enabled the signature setting under the configuration menu. Signatures is one of the diagnostic features available to the user (if he permits the movement of the valve for full-stroke) by which the user can determine degrading performance of the actuator/valve by comparing the Baseline runtime data to the last captured Maintenance runtime data. The signature data itself is used for plotting in graphical format and includes 255 samples of position and pressure readings during the valve movement from open to close and vice versa. The intelligent alarm system compares the maintenance signature runtime data to the baseline signature runtime data and generates an alarm if there is a deviation that exceeds the specified tolerance limit in the hysteresis settings. The following section describes each function available under this menu in detail.

FIGURE 76
Device reboot function

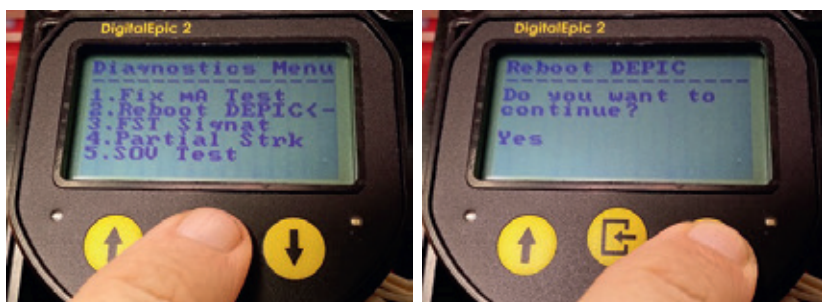
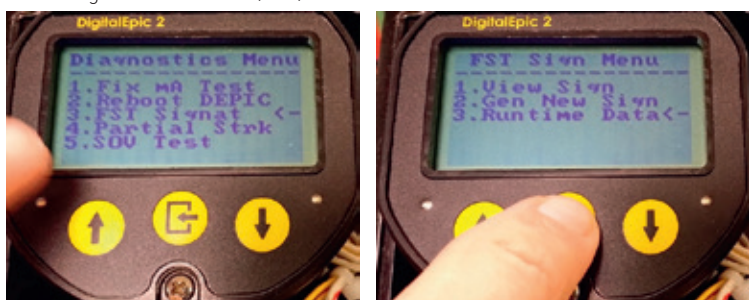


FIGURE 77
Accessing Full Stroke Test (FST) menu



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- View signatures

From this sub-menu, you can view all specific data for each signature stored on the device. Note, plotting of signatures cannot be done on the LCD, use the 475 or DD for that capability.

Refer to Figure 78

From the FST Sign Menu, scroll down to "View Sign" to view signatures stored on the device, then press SELECT.

This screen provides a list of various signatures that can be viewed. Each signature is explained in more details below.

- View integrator signature

This signature will only be available to view only (not for plotting the graph) if the user has captured the integrator signature using the keypad/LCD. The integrator signature is basically generated by the person who is integrating DEPIC-2 with valve and actuator from different manufactures. The purpose of generating this signature is to make sure the whole package was tested when it was integrated at the distributor location. This signature can only be generated using the keypad/LCD and not from the DD/DTM. However the data can be viewed from the DD/DTM. None of the data from this signature is used to compare against other data to generate any alert or alarm.

Refer to Figure 79

From the View Sign Menu, scroll down to "View Integ" to view the Integrator Signature stored on the device, then press SELECT. Note if this Signature does not exist on the device, the LCD will show "Not Available" after SELECT.

Displayed below is page 1 of the data for the Integrator Signature. Press the Down Arrow key to go on to the second page shown below.

Refer to Figure 80

Displayed below is page 2 of the data for the Integrator Signature. Press the Up Arrow key to go back to the first page or press SELECT to go back to the View Sign Menu.

FIGURE 78
View signature menu



FIGURE 79
Viewing integrator signature data



FIGURE 80
Viewing integrator signature data - page 2



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- View installer signature

This signature will only be available to view only (not for plotting the graph) if the user has captured the installation signature using the keypad/LCD. The installation signature is basically generated by the person who is installing the whole integrated valve package to the process plant. The purpose of generating this signature is to make sure the whole package was tested when it was installed at the plant but before the plant starts running the process. This signature can only be generated using the keypad/LCD and not from the DD/DTM. However the data can be viewed from the DD/DTM. None of the data from this signature is used to compare against other data to generate any alert or alarm.

Refer to Figure 81

From the View Sign Menu, scroll down to "View Instl" to view the Installer Signature stored on the device, then press SELECT. Note if this Signature does not exist on the device, the LCD will show "Not Available" after SELECT.

Displayed below is page 1 of the data for the Installer Signature. Press the Down Arrow key to go on to the second page shown below. As shown in page 2 of the data for the Installer Signature. Press the Up Arrow key to go back to the first page or press SELECT to go back to the View Sign Menu.

- View baseline signature

This menu will only be available if the user has captured the baseline signature on the device. As explained before, this signature acts as a baseline reference to compare all future maintenance signature data against and generate degradation alerts. This signature is usually captured during commissioning of the plant. Once captured, the signature data can be viewed under this menu. Due to the limited area on the LCD, only numeric data is displayed. However using the DD/DTM, the signature can be plotted for graphical representation.

Refer to Figure 82

From the View Sign Menu, scroll down to "View Base" to view the Baseline Signature stored on the device, then press SELECT.

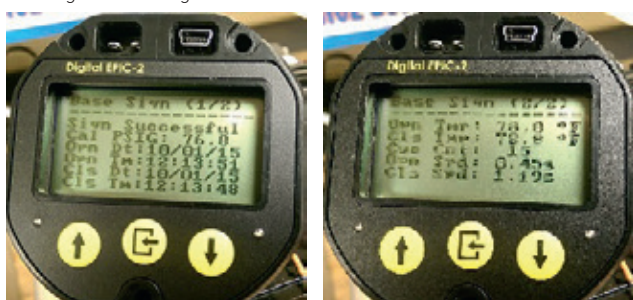
Note if this Signature does not exist on the device, the LCD will show "Not Available" after SELECT.

Displayed below is page 1 and page 2 of the data for the Baseline Signature. Press the Down Arrow key to go on to the second page shown below. Press the Up Arrow key to go back to the first page or press SELECT to go back to the View Sign Menu.

FIGURE 81
Viewing installer signature data



FIGURE 82
Viewing baseline signature data



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- View maintenance signature
This menu allows the user to view the number of maintenance signatures available on the device and also lock/unlock a specific maintenance signature.

Refer to Figure 83
From the View Sign Menu, scroll down to "View Maint" to go into the View Maintenance Signatures sub-menu shown below.

In the View Maint Sign sub-menu, it will list the available Maintenance Signatures if any. If there are none, only "Lock Maint" is shown which really doesn't do anything. If there are Maintenance Signatures, it shows the Latest first then the others are listed in order from Latest to oldest. In the screen below, all four Maintenance Signatures exist.

Refer to Figure 84
As shown below, this will bring up the first of two pages of the Latest Maintenance Signature data. Press the Down Arrow key to go on to the second page shown below. Displayed below is page 1 and 2 of the data for the Latest Maintenance Signature. Press the Up Arrow key to go back to the first page or press SELECT to go back to the View Maint Sign sub-menu.

- Lock maintenance signature
This provides the means for the user to Lock or Unlock stored Maintenance Signatures. A maximum of four Maintenance Signatures can be stored on the device at any time and when a new Maintenance Signature is generated it will overwrite the oldest unlocked signature which will make it the new Latest signature. If the user determines that they want to preserve a specific Maintenance Signature for future reference, it can be locked. Only up to two Maintenance Signatures can be locked at a time.

Refer to Figure 85
In the Lock Summary screen shown below, it shows first the total number of valid Maintenance Signatures (in this case 4) followed by the total number of Locked Maintenance Signatures (currently 0). The next four lines show each Maintenance Signature starting with the Latest and on the right side will show either a "U" for unlocked or "L" for locked. Currently there are none locked. Next in this example, scroll to "Prev MSign-1" and press SELECT.

Refer to Figure 86
In this screen it shows Maintenance Signature 1 (second Latest) is Unlocked. Use the Down Arrow key to select between Unlocked and Locked. Select Locked to lock the current signature and then press SELECT to lock it.

FIGURE 83
Accessing view maintenance signature menu



FIGURE 84
Viewing maintenance signature data



FIGURE 85
Locking/unlocking maintenance signatures menu



FIGURE 86
Lock/unlock status



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7.3.4.3.1.1 Generate new signatures



From the FST Sign Menu, scroll down to "Gen New Sign" to generate new signatures to be stored on the device, then press SELECT.

From Gen New Signature screen, you can select which Signature you would like to create; Integrator, Installer, Baseline or Maintenance. This is the only interface where the Integrator and Installer Signatures can be created and their use is limited. Also note that if a new Baseline Signature is created, any previously stored Maintenance Signatures will be deleted since Maintenance Signatures must be generated after the Baseline in case of changes in dynamics so they can be compared to the Baseline.

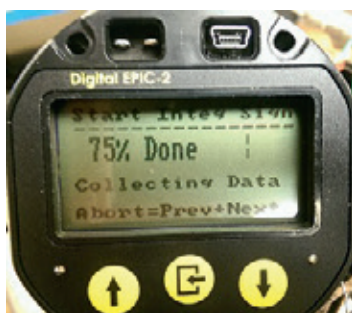
7.3.4.3.1.1.1 Generate integrator signature



To generate a new Integrator Signature, from Gen New Signature screen, scroll to "Start Integ" and press SELECT. The screen above will appear asking if you wish to continue. Use the Down Arrow key to select between "No" or "Yes" and then press SELECT. If "No" is selected, it will return to the previous screen without performing the signature. If "Yes" is selected, the signature generation will start with the next screen below.



Once the Integrator Signature completes, if successful, the screen above should appear. If not successful, it will show an error stating the problem. The problem will also be logged in the Alert File which can give more information as to the root cause and how to resolve it. Once the problem is resolved, try again.



The screen above will show the progress of the signature by showing x% complete. Once 100% is reached, it will be complete and the next screen should appear.

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7.3.4.3.1.1.2 Generate installer signature



To generate a new Installer Signature, from Gen New Signature screen, scroll to "Start Instl" and press SELECT. The screen above will appear asking if you wish to continue. Use the Down Arrow key to select between "No" or "Yes" and then press SELECT. If "No" is selected, it will return to the previous screen without performing the signature. If "Yes" is selected, the signature generation will start with the next screen below.



Once the Installer Signature completes, if successful, the screen above should appear. If not successful, it will show an error stating the problem. The problem will also be logged in the Alert File which can give more information as to the root cause and how to resolve it. Once the problem is resolved, try again. To view the Installer Signature see earlier section View Installer Signature.



The screen above will show the progress of the signature by showing x% complete. Once 100% is reached, it will be complete and the next screen should appear.

7.3.4.3.1.1.3 Generate baseline signature



The screen above will show the progress of the signature by showing x% complete. Once 100% is reached, it will be complete and the next screen should appear.



To generate a new Baseline Signature, from Gen New Signature screen, scroll to "Start Baseline" and press SELECT. The screen above will appear asking if you wish to continue. Use the Down Arrow key to select between "No" or "Yes" and then press SELECT. If "No" is selected, it will return to the previous screen without performing the signature. If "Yes" is selected, the signature generation will start with the next screen below.



Once the Baseline Signature completes, if successful, the screen above should appear. If not successful, it will show an error stating the problem. The problem will also be logged in the Alert File which can give more information as to the root cause and how to resolve it. Once the problem is resolved, try again. To view the Baseline Signature see section View Baseline Signature.

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7.3.4.3.1.1.4 Generate maintenance signature



To generate a new Maintenance Signature, from Gen New Signature screen, scroll to "Start Maint" and press SELECT. The screen above will appear asking if you wish to continue. Use the Down Arrow key to select between "No" or "Yes" and then press SELECT. If "No" is selected, it will return to the previous screen without performing the signature. If "Yes" is selected, the signature generation will start with the next screen below.



Once the Maintenance Signature completes, if successful, the screen above should appear. If not successful, it will show an error stating the problem. The problem will also be logged in the Alert File which can give more information as to the root cause and how to resolve it. Once the problem is resolved, try again. To view the Maintenance Signature see section View Maintenance Signature.

7.3.4.3.1.2 Run-time data



The screen above will show the progress of the signature by showing x% complete. Once 100% is reached, it will be complete and the next screen should appear.



This is the top level sub-menu to view Full-Stroke Run-Time Data. Since all Full-Stroke Signature contain both an Open and a Close signatures, this is further divided into sub-menus to view either Open or close data. From the FST Sign Menu, scroll down to "Runtime Data" to view critical signature data stored on the device, then press SELECT.

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7.3.4.3.1.2.1 Opening runtime data



This sub-menu is to view only Full-Stroke Opening Run-Time Data. From the Runtime Data Sub-menu, scroll down to "Opening Data" to view critical opening signature data stored on the device, then press SELECT.

From here there is a choice of Run-Time data for the Opening Baseline and Latest Opening Maintenance Signatures that can be viewed.



This is the Page 1 of the Baseline Opening Full-Stroke Signature Data. Press the down arrow to go to Page 2.



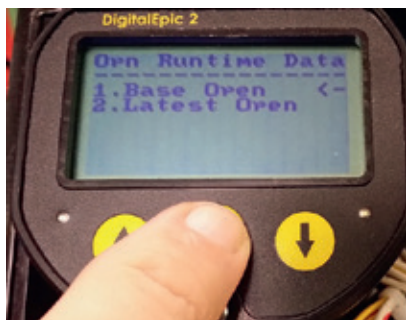
This is the Page 1 of the Latest Maintenance Opening Full-Stroke Signature Data. Press the down arrow to go to Page 2.



This is the Page 2 of the Baseline Opening Full-Stroke Signature Data. From here, press the Up arrow key to go back up to the Open Runtime Data menu.



This is Page 2 of the Latest Maintenance Opening Full-Stroke Signature Data. From here, press the Up arrow key to go back up to the Open Runtime Data menu and Up arrow again to go back to Runtime Data sub-menu.



From the Open Runtime Data Sub-menu, scroll down to "Base Open" to view critical Baseline Opening signature data stored on the device, then press SELECT.



Next from the Open Runtime Data Sub-menu, scroll down to "Latest Open" to view critical Latest Maintenance Opening signature data stored on the device, then press SELECT.

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7.3.4.3.1.2.2 Closing runtime data



From the Runtime Data Sub-menu, scroll down to "Closing Data" to view critical closing signature data stored on the device, then press SELECT.

There is a choice of Run-Time data for the Closing Baseline and Latest Closing Maintenance Signatures that can be viewed.



This is the Page 1 of the Baseline Closing Full-Stroke Signature Data. Press the down arrow to go to Page 2.



This is the Page 1 of the Latest Maintenance Closing Full-Stroke Signature Data. Press the down arrow to go to Page 2.



From the Close Runtime Data Sub-menu, scroll down to "Base Close" to view critical Baseline Closing signature data stored on the device, then press SELECT.



This is the Page 2 of the Baseline Closing Full-Stroke Signature Data. From here, press the Up arrow key to go back up to the Close Runtime Data menu.



This is Page 2 of the Latest Maintenance Closing Full-Stroke Signature Data. From here, press the Up arrow key to go back up to the Close Runtime Data menu and Up arrow again to go back to Runtime Data sub-menu.

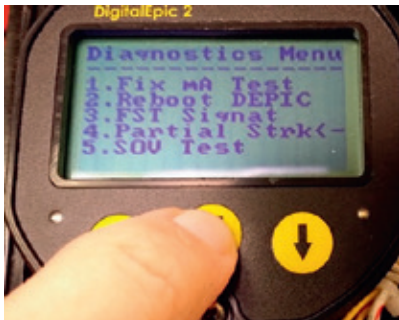


Next from the Close Runtime Data Sub-menu, scroll down to "Latest Close" to view critical Latest Maintenance Closing signature data stored on the device, then press SELECT.

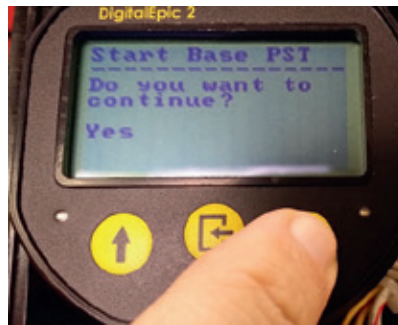
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7.3.4.3.2 Partial stroke test



From Diagnostics Sub-menu, scroll down to "Partial Strk" then press SELECT.



Next you will be asked if you want to continue, use the Down arrow key to select between "No" or "Yes" then press ENTER. If No is selected, the PST will not be done and will return to the previous sub-menu. If Yes is selected the Baseline PST will start.



Once the PST completes, if successful, the screen above will appear. If the PST failed, the screen will show the failure reason on screen. The reason for the failure must be resolved and perform the test again. Finally, press SELECT/ ENTER key to exit back to previous sub-menu.

7.3.4.3.2.1.1 Generate baseline PST



From PST Sign Sub-menu, scroll down to "Gen New PST" then press SELECT.



The Baseline PST should now proceed. The screen will update the % Done until it reaches 100%. The user has the option of aborting by simultaneously pressing the Up and Down arrow keys.

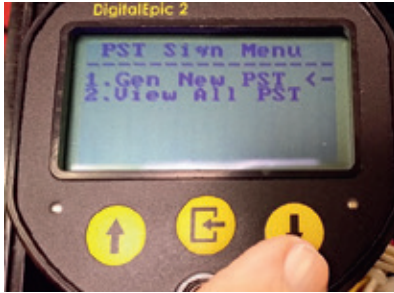


From Gen New PST sub-menu, scroll to "Start BPST" to generate a new Baseline PST, then press ENTER.

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7.3.4.3.2.1.2 Generate maintenance PST



From PST Sign Sub-menu, scroll down to "Gen New PST" then press SELECT.



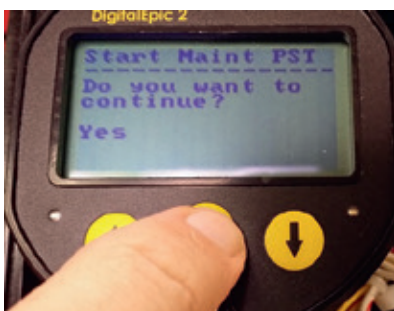
The Maintenance PST should now proceed. The screen will update the % Done until it reaches 100%. The user has the option of aborting by simultaneously pressing the Up and Down arrow keys.



From Gen New PST sub-menu, scroll to "Start MPST" to generate a new Maintenance PST, then press ENTER.



Once the PST completes, if successful, the screen above will appear. If the PST failed, the screen will show the failure reason on screen. The reason for the failure must be resolved and perform the test again. Finally, press SELECT/ENTER key to exit back to previous sub-menu.



Next you will be asked if you want to continue, use the Down arrow key to select between "No" or "Yes" then press ENTER. If No is selected, the PST will not be done and will return to the previous sub-menu. If Yes is selected the Baseline PST will start.

7.3.4.3.2.2 View PST data



From PST Sign Sub-menu, scroll down to "View All PST" then press SELECT.

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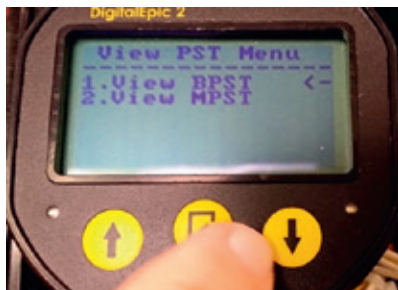
7.3.4.3.2.2.1 View baseline PST



From PST Sign Sub-menu, scroll down to "View All PST" then press SELECT.



This is the Page 2 of 3 of the Baseline PST Data. Press the down arrow to go to Page 3.



From View PST Sub-menu, scroll down to "View BPST" then press SELECT.



This is the Page 3 of 3 of the Baseline PST Data. From here, press the Up arrow key to go back up to the Open Runtime Data menu and Up arrow again to go back to View PST sub-menu.



This is the Page 1 of 3 of the Baseline PST Data. Press the down arrow to go to Page 2.

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7.3.4.3.2.2 View maintenance PST



From PST Sign Sub-menu, scroll down to "View All PST" then press SELECT.



This is the Page 3 of 3 of the Baseline PST Data. From here, press the Up arrow key to go back up to the Open Runtime Data menu and Up arrow again to go back to View PST sub-menu.



From View PST Sub-menu, scroll down to "View MPST" then press SELECT.



This is the Page 1 of 3 of the Maintenance PST Data. Press the down arrow to go to Page 2.

7.3.4.3.3 Solenoid operated valve test

The SOVT is a special test to test the solenoid without requiring any movement of the valve. Signatures must be enabled. The SOVT doesn't create a signature but does require the pressure sensor which is only available when signatures are enabled. This test will de-energize the solenoid and look for a change of pressure. When the pressure drops to about 50% of the normal break pressure, the solenoid will be energized again to avoid moving the valve.



This is the Page 2 of 3 of the Maintenance PST Data. Press the down arrow to go to Page 3.



From Diagnostics Sub-menu, scroll down to "SOV Test" then press SELECT.

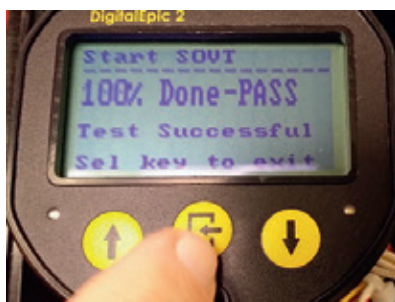
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7.3.4.3.3.1 Start SOVT



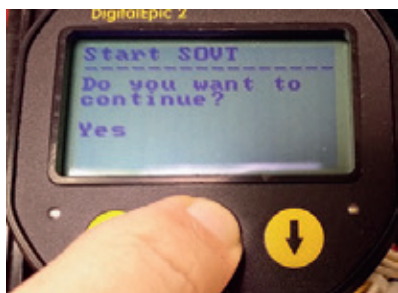
From SOVT Sub-menu, scroll down to "Start SOVT" then press SELECT.



On completion, as shown above it will be 100% Done-PASS. If a failure was to occur, it would show the failure type, usually may be due to a defective solenoid. Resolve the problem and then try again. Press SELECT to exit.

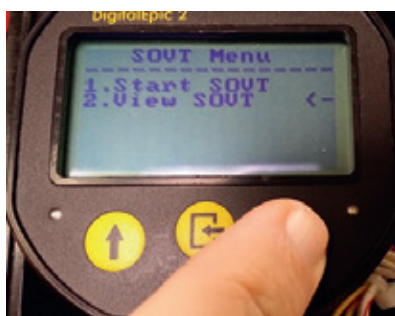


Page 2 of the SOVT is displayed. Press SELECT to exit.

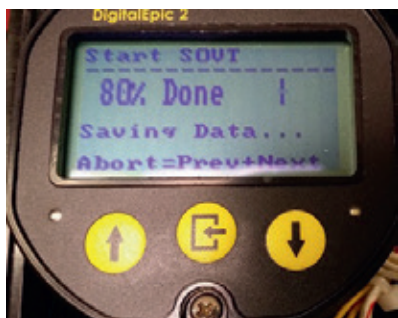


Next from this screen it will ask if you want to continue, use the Down arrow key to select between "No" or "Yes" then press ENTER. If No is selected, the SOVT will not be done and will return to the SOVT Sub-menu. If Yes is chosen, the SOVT will start the test as shown on next screen.

7.3.4.3.3.2 View SOVT



From SOVT Sub-menu, scroll down to "View SOVT" then press SELECT.



As the test progresses, the screen will show progress with x% Done. In general this will proceed quickly since it's not a long test.

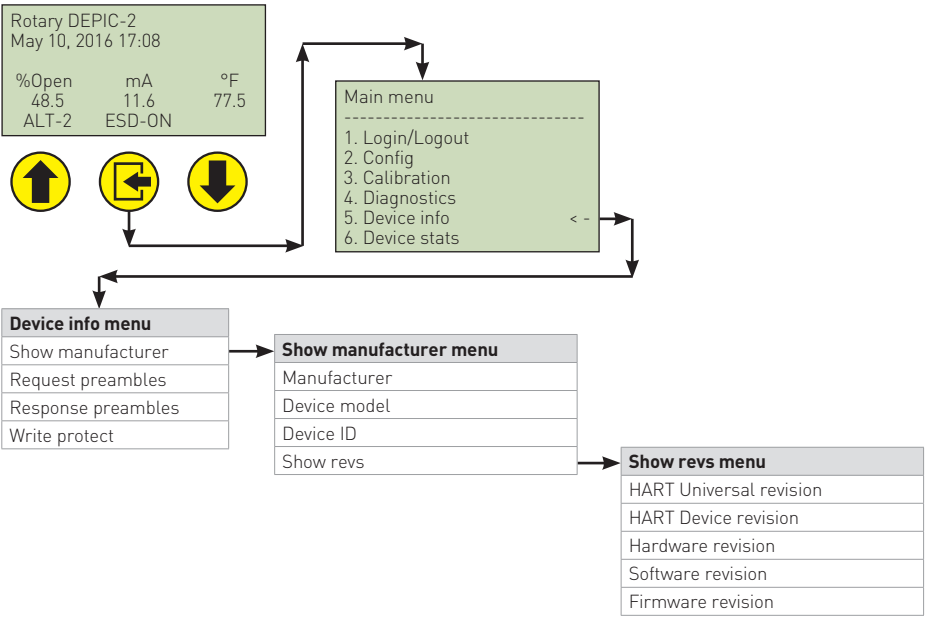


If an SOVT result does not exist on the device (never done), the LCD will show "Not Available". The SOVT data is a 2 page screen (SOVT Data (1/2)). First page 1 of the SOVT data is displayed. Press the Down arrow to go to page 2.

7.3.5 Device information menus

This menu has mostly read only information about the device manufacturer, model, hardware and software revision etc. Following chart shows how to navigate to this menu and the available options within this menu.

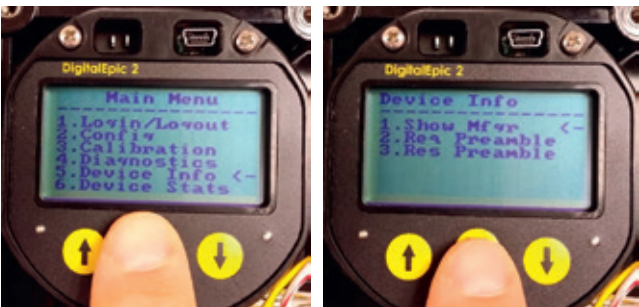
FIGURE 87
Device information menu



Refer to Figure 88

- From Main Menu, scroll down to "Device Info" and press SELECT/ENTER.
 - From the Device Information Menu, select the "Show Mfgr" sub menu. This menu has information about the manufacturer, device mode, hardware revision, software revision etc. All information in this menu is read only and cannot be changed by the user. Press the Select button to exit the menu and UP key to go back to previous menu
 - From Device Information Menu, scroll to "Req Preamble", then press SELECT/ENTER. This will display the required number of Preambles that the HART host should send with all commands to the device which is usually 5.
- This cannot be changed by the user. Press SELECT/ENTER to go back.
- Then scroll to "Res Preamble" and press SELECT/ENTER. This will display the number of Preambles that the device will send with all responses to the HART host. This value is 5 by default but can be modified by the user by pressing SELECT/ENTER again and using Up/Down arrow keys to change the number and (values of 5-20 allowed) then press SELECT/ENTER again to save the new value. Note by increasing, this increases the overhead in response HART messages.

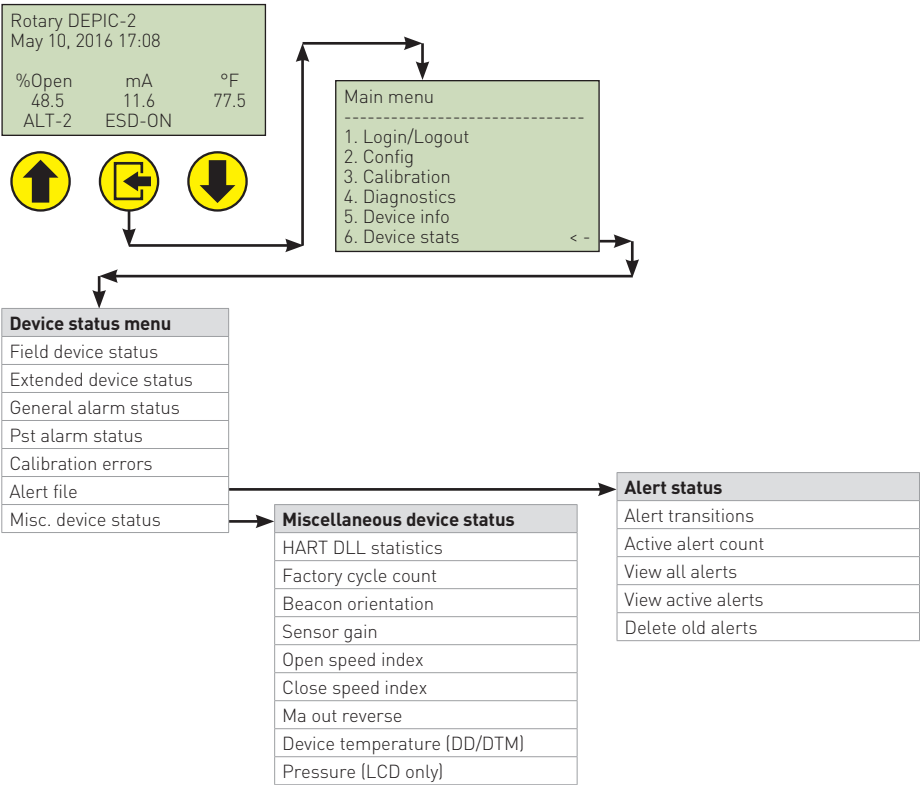
FIGURE 88
Navigating to device info menu



7.3.6 Device status menus

This menu has different device status available on the DEPIC-2. The following sections describe the details of each device status parameter available under this menu. Click on the "Device Specific Status" menu to open the screen as shown in Figure 89.

FIGURE 89
Device specific status menu



Refer to Figure 90
From the Main Menu Scroll down to "Device Stats" and press ENTER to get into the Device Specific Status Menu.

Note this menu will change if logged in as Factory in that an additional sub-menu becomes available. Line 5 will become "Error File" and Alert File will move to line 6.

FIGURE 90
Navigating to device status menu



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7.3.6.1 Field device status sub-menu

Refer to Figure 91

From "Device Specific Status Menu" scroll to "Field Dev Stats" Sub-menu and press ENTER, the display below appears. Since there is too much information to all fit in the screen so by scrolling down, the continuation screen below appears. From here you can look at each individual status bit by scrolling to each one and click ENTER as shown below. Then press ENTER again to return to the sub-menu.

Refer to Figure 91

All other status bits can also be viewed in the same manner. Following is the brief description of all status bits. For details, please refer to the HART specifications.

- Pri var out - primary variable is out of range. Use the PV re-range function on the DD or DTM to readjust the primary variable range or fix the issue that caused the primary variable to go out of range. For example, if the valve coupler is loose, position drift due to temperature or other factors can change the primary variable to go out of 0% to 100% range.
- Other var out - other variables (Secondary, Tertiary, Quaternary etc.) are out of range. Figure out which variable is out of range and try to bring the variable in its normal operating range.
- PV saturated - the analog output current is at its minimum or maximum output. This could be due to abnormal conditions on the device. Bring the device to its normal operation to reset this bit.
- PV fixed - the analog output current is in fixed mode and doesn't represent the primary variable (position). This could happen if the device is performing any diagnostics functions or due to multi-drop configuration of HART.
- More status - the device has more status available. Look at the sub menus to view more status like Alerts, Alarms, Calibration Errors etc.
- Device reset - after the device is power cycled, this bit will be set to indicate the device reset.
- Cnfg change - after any configuration change, this bit will be set to indicate the configuration was changed.
- Dev mul func - if the device malfunctioned due to any software or hardware issue, this bit will be set to indicate the device has malfunctioned and can't be used until the issue is resolved.

FIGURE 91

Accessing field device status sub-menu



FIGURE 92

Viewing status bits in field device status



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7.3.6.2 General alarm status sub-menu

This menu shows the status (active or in-active) of general alarms if enabled in the general alarms under the basic configuration menu. If the text displays "ON" next to the alarm, it means the alarm is active otherwise it is inactive.

Refer to Figure 93

From Device Specific Status Menu, scroll to "2. General Alrm" status and press SELECT. This is the General Alarm display. This shows the status of these Alarms. Note the first 3 are general in the sense that they are not indications of a hard failure, only the ESD Alarm is a hard failure. Also there is no immediate notification method from the LCD unlike the 475 where the user has the option of disabling notification of any of these alarms. Scroll back to the main menu by pressing the Up arrow the number of times required.

1. Alert Alarm, if ON indicates new Alerts have become either active or cleared in the Alert File. Once the Alert File is read by the user, the alert alarm is cleared.
2. Service Alarm, if ON indicates that the user configurable time has elapsed notifying the user it may be time for valve/actuator maintenance.
3. Cycle Alarm, if ON indicates that the user configurable cycle limit has been reached notifying the user it may be time for valve/actuator maintenance.
4. ESD Alarm, if ON indicates an Emergency Shut-Down has occurred, indicated by a loss of SIS voltage to the solenoid.

7.3.6.2.1 Calibration error alarms sub-menu

This menu shows the status of any error that occurred during the last calibration on the device. If the checkbox displays the ✓ symbol next to the calibration error, it means the calibration error is active otherwise it is inactive. Following table describes the meaning of each calibration error.

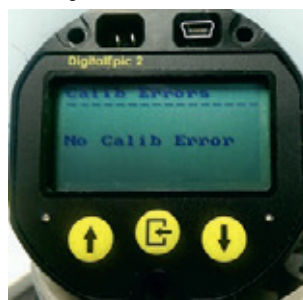
From Device Specific Status Menu, scroll to "3. Calib Errors" and press SELECT. (See Figure 94).

This will display the specific Calibration Error if one occurred during last calibration. If no error, it will show as above. All Calibration errors are mutually exclusive, meaning only one will be active at a time since calibration stops on the first error encountered. Press ENTER to return to sub-menu. Following table describes the meaning of each calibration error.

FIGURE 93
Accessing general alarm status menu



FIGURE 94
Viewing calibration errors



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Calibration error alarm	Description
Valve close error	This error can come up if the device wasn't able to fully close the valve during the auto calibration.
Valve open error	This error can come up if the device wasn't able to fully open the valve during the auto calibration.
Sensor gain span error	The device applies two hall sensor gain settings to get the better hall sensor reading for the position, which improves the linearity and provides larger span. The device will generate this error if the hall sensor position reading didn't pass the minimum span requirement even after applying both sensor gain settings.
Sensor gain linearity error	The device applies two hall sensor gain settings to get the better hall sensor reading for the position, which improves the linearity and provides larger span. The device will generate this error if the hall sensor position reading is not within the pre-defined linear range even after applying both sensor gains setting.
Beacon error	This error can come up during the calibration if the device detects the open position reading smaller than the close position reading, which is most probably caused because of the beacon is mounted 180 degree from its normal position. The device automatically sets the bit to fix this error and the user is asked to recalibrate the device.
Calibration aborted	This error message can pop up if the user aborted the calibration without letting it finish either from the keypad or from HART or an ESD prevented completion.
Calibration start error	This error message can pop up if the calibration is not started because there is another active process running. For example, if the user initiates calibration but the device is already in the ESD mode.
Calibration unstable pressure-1	During the calibration, the device captures the reading for the pressure sensor-1. It checks if the pressure is not changing and is stable for a certain time depending on the calibration timeout setting. If the pressure-1 reading isn't stable within this specified time limit, it will generate this error message.
Calibration unstable pressure-2	During the calibration, the device captures the reading for the pressure sensor-2. It checks if the pressure is not changing and is stable for a certain time depending on the calibration timeout setting. If the pressure-2 reading isn't stable within this specified time limit, it will generate this error message.
Calibration close position error	During the calibration, the device captures the reading for the close position. It checks if the position is not changing and is stable for a certain time depending on the calibration timeout setting. If the close position reading isn't stable within this specified time limit, it will generate this error message.
Calibration open position error	During the calibration, the device captures the reading for the open position. It checks if the position is not changing and is stable for a certain time depending on the calibration timeout setting. If the open position reading isn't stable within this specified time limit, it will generate this error message.
Calibration timeout	There is a setting to configure the calibration timeout. If the calibration is not finished within this time limit, which also decides the time limit to detect the stable pressure and stable position, the calibration will timeout and it will generate this error message. In this case, the user should increase the calibration timeout and perform the calibration again.
Pressure-1 span error	During the calibration, the device captures the reading for the pressure sensor-1. It checks if the pressure sensor-1 is working properly and it has at least the minimum span it needs. If not, the calibration will fail with the pressure-1 span error. The possible cause of this error might be: no air pressure, No pressure sensor, damaged pressure sensor etc.
Pressure-2 span error	During the calibration, the device captures the reading for the pressure sensor-2. It checks if the pressure sensor-1 is working properly and it has at least the minimum span it needs. If not, the calibration will fail with the pressure-2 span error. The possible cause of this error might be: no air pressure, No pressure sensor, damaged pressure sensor etc.
mA Out span error	During the mA calibration, the device captures the reading for the mA output current. It checks if the mA output configured has enough span. If not, calibration will fail with the mA Out Span Error. In this case, the span should be increased during the mA output calibration and perform the mA calibration again.

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7.3.6.3 PST/SOVT fail alarm status sub-menu

This menu shows the status (active or in-active) of PST/SOVT alarms if enabled in the PST/SOVT Fail Alarms under the basic configuration menu. If the text displays "ON" next to the alarm, it means the alarm is active otherwise it is in-active.

Refer to Figure 95

From Device Specific Status Menu, scroll to "4. PST Alm Stat" and press SELECT.

Note, this screen will change based upon configuration such as Signature Enabled or Disabled. All alarms are explained briefly below.

1. Invalid Pstn, if ON indicated PST failed due to valve bing in an invalid start position.
2. Slow Trvl Tm, if ON indicates the travel time from start of movement to reach the travel limit was too slow in the most recent Maintenance PST compared to the Baseline PST.
3. Fast Trvl Tm, if ON indicates the travel time from start of movement to reach the travel limit was too fast in the most recent Maintenance PST compared to the Baseline PST.
4. Exceed TTL, if ON indicates the last Maintenance PST exceeded the Total Time Limit compared to the Baseline PST, this is only if Signatures are disabled.
5. Exceed TrvLm, if ON indicates the last Maintenance PST exceeded the Travel Limit by the hysteresis value.

7.3.6.4 Alert file sub-menu

This menu as shown in Figure 96 shows the status of each alert (active or in-active) on the device. All alerts are enabled by default and cannot be disabled. However the hysteresis of each alert can be configured as mentioned in the Alert Hysteresis under the Basic Configuration menu.

Refer to Figure 96

From Device Specific Status Menu, scroll to "5. Alert File" and press SELECT.

From Alert File sub-menu, there are 4 selections.

By scrolling to "1. Alrt Transit" and press ENTER, it will display how many Alert Transitions (Active or Inactive) have been logged.

By scrolling to "2. Act Alert Cnt" and press ENTER, it shows the total number of Active Alerts.

By scrolling to "4. Del Old Alrt" and press ENTER, it will delete all old Alerts in the file since the last Device Reset.

Refer to Figure 97

Scroll to "3. View Act Alt" and press ENTER.

From the View Active Alerts screen shown below, notice that the top line shows Alert Stat (1/1) in this case. This means it is displaying Alert number 1 (most recent alert) out of a total of 1 Active Alert. The Alert displayed shows the name of the alert, the status (Active or Clear), and the Date/Time when it occurred. If there is more than one Alert, use the Up/Down arrow keys to scroll through the Active Alerts. From the Keypad/LCD, it is not possible right now to show all Alerts (Active or Inactive).

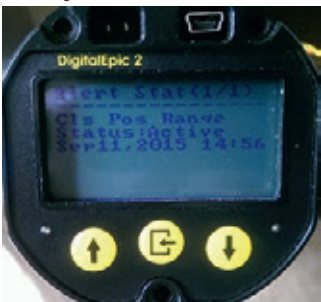
FIGURE 95
Accessing PST alarms menu



FIGURE 96
Accessing alert file menu



FIGURE 97
Viewing active alert



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7.3.6.5 Error file sub-menu

The Error File is only available if logged in as Factory. It provides a way to view any logged errors. An Error is defined as a Software detected problem and provides information about the problem to help debugging. In general with a released product, there will rarely be any detected errors but may provide valuable information to help debug a problem the user may be having.

Refer to Figure 98

From Device Specific Status Menu, scroll to "5. Error File" alarms and press SELECT. Note, the Error File Sub-menu is only available when logged in as Factory and as such is not of any value to the user.

From Error File sub-menu, there are 2 selections.

By scrolling to "1. Error Count" and press ENTER, it will display how many errors have been logged.

By scrolling to "2. View Errors" and press ENTER, it opens screen to view errors.

Refer to Figure 99

From the View Errors screen shown below, notice that the top line shows Error Stat (1/1) in this case. This means it is displaying Error number 1 (most recent error) out of a total of 1 error.

The error displayed shows the name of the Date/Time the error occurred, name of software file the error occurred in, the line number, the error type (Severe, Major, Minor), as well as an error ID (Code 1) and Code 2 which refers to the possible cause. If there is more than one Error, use the Up/Down arrow keys to scroll through the Errors.

7.3.6.6 Miscellaneous device status sub-menu

Note most of the information that can be viewed from this sub-menu is primarily for Westlock/ Crane CPE personnel and would not be meaningful to the user. Also note that some of the sub-menus from here can differ somewhat from the DD or 475 due to limitations of LCD screen and keypad.

Refer to Figure 100

From Device Specific Status Menu, scroll to "Misc Status" sub-menu and press ENTER.

Scrolling to "Fact Cyc Cnt" and press ENTER will display the Factory Cycle Count which cannot be reset but shows the number of valve movement cycles that have occurred since production from factory and can be meaningful provided the valve/actuator assembly has not changed.

Scrolling to "Beacon Mount" and press ENTER will display how the device sees the beacon is mounted. This is helpful since if the beacon is mounted 180° off, the device can still function by re-calibrating a second time.

Scrolling to "Opn Spd Index" and press ENTER shows the index chosen during calibration to measure the Open speed of the valve.

Scrolling to "Cls Spd Index" and press ENTER shows the index chosen during calibration to measure the Closing speed of the valve.

Scrolling to "mA Out Stats" and press ENTER shows if the mA output is calibrated as "Normal" (4 mA closed and 20 mA open) or Reversed.

From this data, simply press ENTER again to return to the sub-menu.

FIGURE 98

Accessing error file menu



FIGURE 99

Viewing error status



FIGURE 100

Accessing miscellaneous device status



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- HART DLL statistics

Refer to Figure 101

From "Misc Device Status" sub-menu scroll to "HART DLL Sts" and press ENTER.

This displays error statistics on the HART Data-Link Layer showing the counts of any errors that have been seen during HART communications with a host. From the DD or 475 there is an option to reset all counters to 0, but currently does not exist from LCD. Simply press ENTER again to return to the sub-menu.

- Calib Data Sub-menu

Refer to Figure 102

This sub-menu is similar to the "Hall Sensor A/D" sub-menu on the 475 only with additional information.

From "Misc Device Status" sub-menu scroll to "Calib Data" sub-menu and press ENTER. This is a 2 page menu. Initially, the first page comes up showing the calibration reading for the Hall Effect Sensor (position sensor) for two different gain settings [0] and [1], gains 10 and 30. Calibration functions will choose what is believed to be the best gain. Use the Down Arrow key to go to the next page which shows which gain was selected. Use Up Arrow key to go back to previous page. Use ENTER/SELECT key to exit sub-menu.

FIGURE 101
Viewing HART DLL statistics



FIGURE 102
Viewing calibration data sub-menu



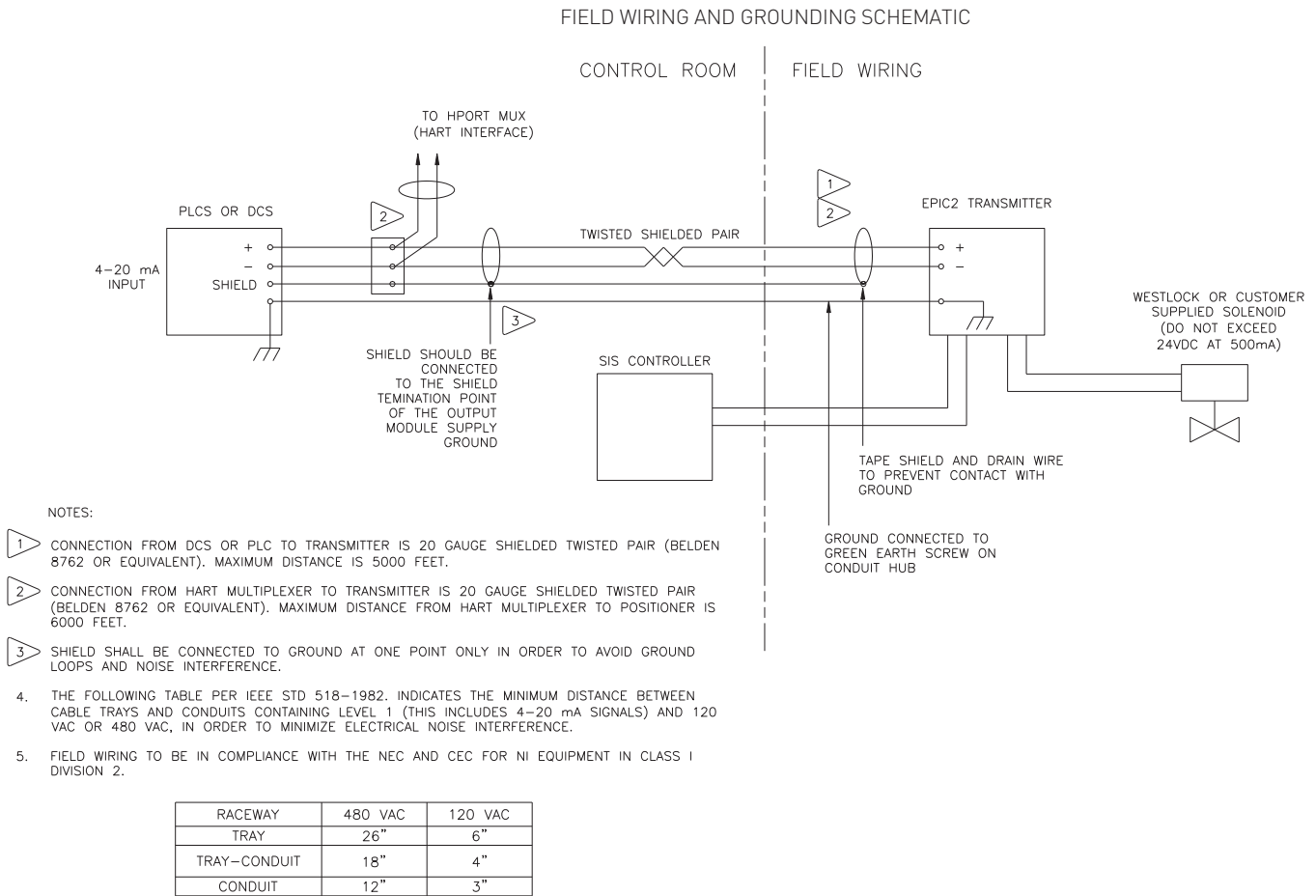
8 ADDITIONAL DOCUMENTATION

In addition to the quick start guide and this document, following is a list of documents that can be obtained by visiting the website www.westlockcontrols.com.

Doc number	DEPIC-2 models	Document title	Document content
VCIOM-04592	D510/D520	Quick start IOM	Wiring, installation, basic configuration and calibration
VCIOM-04979	D530/40/50	Quick start IOM	Wiring, installation, basic configuration and calibration
VCOSI-04978	All	Safety manual	Tips and guidelines to use product in SIL3 applications
VCIOM-05044	All	Technical manual	Advanced configuration, PST/SOVT/FST diagnostics, viewing alerts and alarms
VCIOM-05045	All	Troubleshooting guide	FAQs, error codes, alerts and alarm messages
VCIOM-05046	All	DD user guide	Operating device using 475 or other DD based hosts
VCIOM-04615	All	DTM user guide	Operating device using PACTWare or other DTM based hosts
VCTDS-03243	All	Product brochure	Product features and specifications, ordering guide

9 APPENDIX

9.1 FIELD WIRING AND GROUNDING SCHEMATIC



9.2 COVER LOCK OPERATION

The cover lock employs an Allen Head Cap Screw to secure the underside of the cover edge when turned in the CCW direction. The screw cannot be removed due to the interference with the cover. Both covers (large and small) use the same cover lock design. See Figure 103 for reference.

1. For large cover use a $\frac{5}{32}$ or .155 in. (3.95 mm) Allen wrench, for small cover use a $\frac{9}{64}$ or .141 in. (3.58 mm) Allen wrench. Turning in a CCW direction to engage the screw.
2. Tighten to 12 in.-lbs. (1.35 Nm).
3. To disengage turn screw in a CW direction to release.

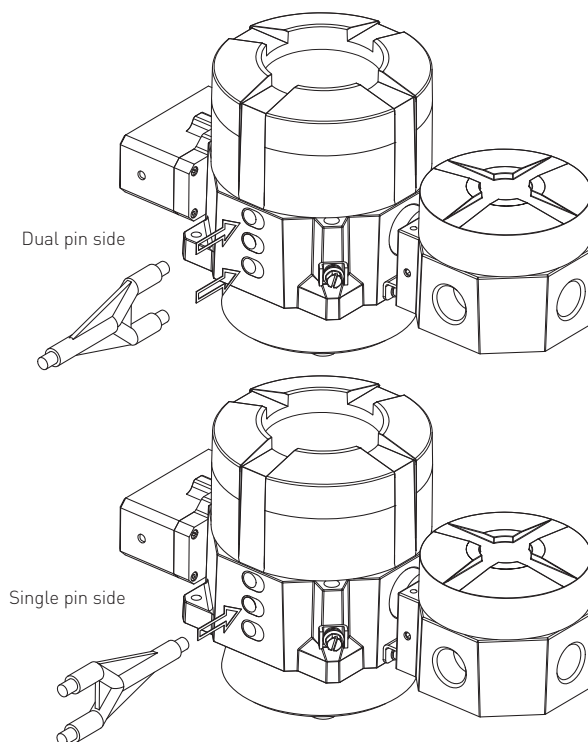
9.3 NON-INTRUSIVE FEATURE

The transmitter is equipped with three magnetic sensors that can be activated externally allowing the user to calibrate and configure Epic Transmitter without removing the cover. Any button function accessed internally can be completed externally. The transmitter comes with a magnetic tool part number TL-30003 that is used to operate the non-intrusive feature. Use single pin side or dual pin side of the magnetic tool depending on the needs of the calibration and configuration. Enter desired side of the tool into designated cavity (UP, DOWN or SELECT) to engage the sensor and remove the tool. Use non-intrusive feature to navigate any menu on the LCD and perform any function like calibration, configuration or diagnostics. See Figure 104.

FIGURE 103
Cover lock



FIGURE 104
Non-intrusive calibration



Engineering document reference

These installation and operating instructions are based on the latest engineering update, and form part of the certification for the DEPIC-2 series. To ensure you have the most recent version of this IOM, please check the document library on our website (westlockcontrols.com).

Translations

Where translated the copy is taken from the original English document VCIOM-05044-EN as checked by the relevant notified certification body and therefore the original English document will prevail. No rights or liability can be derived from any translation.

Previous documents

VCIOM-05044 is designed to supplement VCIOM-04592 D510/520 and VCIOM-04979 D530/540/550 series, which are the quick start guides for the DEPIC-2.



WARNING

This symbol warns the user of possible danger. Failure to observe this warning may lead to personal injury or death and/or severe damage to equipment.



ATTENTION

This symbol identifies information about operating the equipment in a particular manner that may damage it or result in a system failure. Failure to observe this warning can lead to total failure of the equipment or any other connected equipment.



NOTE

This symbol draws attention to information that is essential for understanding the operation and/or features of the equipment.



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