

DIGITAL EPIC-2® HART DD® USER GUIDE
INSTALLATION AND OPERATING INSTRUCTIONS

TABLE OF CONTENTS

1. Introduction 1

2. DD files..... 2

3. Initial setup 2

4. HART process variables..... 3

5. Main menu 4

 5.1 Login/logout 4

 5.2 Configuration..... 5

 5.2.1 HART identification 5

 5.2.2 Loop current..... 6

 5.2.3 View/modify factory options..... 6

 5.2.4 Factory defaults..... 7

 5.2.5 Date/time setup..... 7

 5.2.6 Basic configuration 8

 5.2.7 PST configuration..... 10

 5.2.8 Signature configuration 11

 5.2.9 SOVT configuration..... 12

 5.2.10 Alert hysteresis configuration 12

 5.2.11 Service/maintenance configuration 13

 5.2.12 Alarm configuration 13

 5.3 Calibration 15

 5.3.1 Last full calibration 15

 5.3.2 Full device controlled calibration.... 15

 5.3.3 Full user controlled calibration 15

 5.3.4 Low position calibration..... 15

 5.3.5 High position calibration..... 16

 5.3.6 mA output calibration 16

 5.3.7 PV re-range 16

 5.4 Diagnostics 16

 5.4.1 Fixed mA loop test 17

 5.4.2 Squawk 17

 5.4.3 Device reboot..... 17

 5.4.4 FST 18

 5.4.5 PST 23

 5.4.6 SOVT 27

 5.5 Device info 28

 5.5.1 Show manufacturer 28

 5.6 Device specific status 28

 5.6.1 Field device status 28

 5.6.2 General alarm status 29

 5.6.3 Calibration error alarms..... 29

 5.6.4 PST/SOVT fail alarm status 31

 5.6.5 Alert file 31

 5.6.6 Miscellaneous device status 31

6. Abbreviation 33

7. References..... 33

8. Copyrights and trademarks..... 33

1 INTRODUCTION

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.

DIGITAL EPIC-2® HART DD® USER GUIDE

INSTALLATION AND OPERATING INSTRUCTIONS

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.

The DEPIC-2 offers variety of different user interfaces to operate the device like Keypad/LCD, HART DD and DTM. Device Description (DD) is a tokenized binary file that can be loaded on the host system to communicate with the field device. DD provides a communication and user interface for accessing the devices' most sophisticated features. DEPIC-2 provides a DD file that can be used on majority of host systems to configure, calibrate and perform diagnostics functions on the device. There are 3 different essential component of the DD technology as mentioned below.

- Host System like Emerson 475®, Delta-V, Honeywell FDM®
- Communication interface like HART Modem
- Manufacturer specific DD file

The DEPIC-2 DD provides an interface to access the specific features available on the device like calibration, diagnostics etc. through any HART DD based host system.

This document is designed as a supplemental guide to help user configure, calibrate and operate DEPIC-2 using the Emerson 475® field communicator and any HART DD based host systems.

NOTES

The DEPIC-2 is available in variety of different models with different features and functionality. This document is designed to cover all available features and functionality. It is possible that your model MIGHT NOT have some features and functions discussed in this document. In this case, the Westlock Controls sales team should be contacted in order to add/enable certain features/function not available on your model. Furthermore, all menus on the DEPIC-2 DD are dynamic so depending on a particular setting enabled or disabled it will show or hide other related menus.

2 DD FILES

The DEPIC-2 DD is a required component to communicate and operate with the DEPIC-2. It might have been supplied with DEPIC-2 or it can be downloaded from the download center below.

<http://downloadcenter.westlockcontrols.com/>

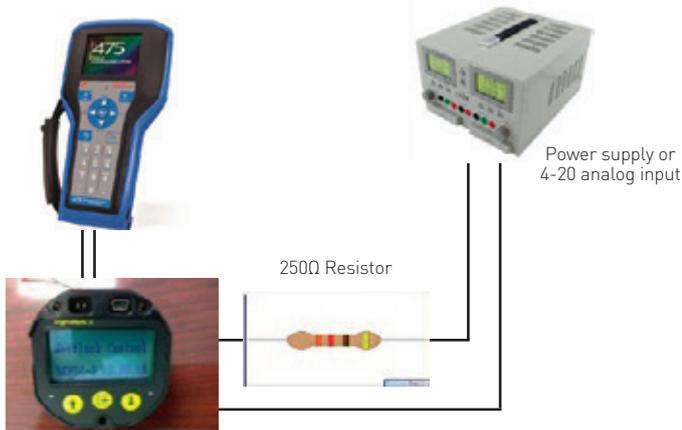
Once downloaded, follow the step by step installation guide for the specific host system you are using. In most cases, it might be as simple as copying and pasting files to a specific folder on the host system.

3 INITIAL SETUP

In order to communicate with the DEPIC-2, the DD files should be installed on the host system using the tools and procedure provided by a specific host system manufacturer. Following figure shows the basic setup to communicate using the Emerson 475 field communicator:

- Connect the 475 field communicator to the HART terminals on the DEPIC-2.
- Power up the DEPIC-2 electronics through the power supply OR 4-20 mA Analog Input block from the DCS. Follow the DEPIC-2 product manual for wiring diagrams and details.

DEPIC-2



DIGITAL EPIC-2® HART DD® USER GUIDE

INSTALLATION AND OPERATING INSTRUCTIONS

4 HART PROCESS VARIABLES

This section describes different HART process variables (PV, SV, QV and TV) that DEPIC-2 uses to measure and display different sensor values on the device. When the 475 field communicator successfully establishes the communication with DEPIC-2 using the DD, it will display following online screen with all four process variables, its values and the units of measurement. The following table describes the process variables displayed on the main screen and how they are mapped to the sensor values on the DEPIC-2.

Variable	Mapping	Range	Unit of measurement
PV	Valve position	0% to 100%	Percentage
SV	Set-point (Solenoid energized/de-energized)	0% to 100%	Percentage
TV	Pressure sensor-1 (Actuator chamber-1 pressure)	0 PSI to 150 PSI	PSI
QV	Pressure sensor-2 (Supply pressure or actuator chamber-2 pressure)	0 PSI to 150 PSI	PSI
AO	Analog output current (valve position feedback / loop current)	4 mA to 20 mA	mA



5 MAIN MENU

From the 475 main screen, select the first entry "Main Menu" and press the "Enter" button to get into main menu. Following screen shows all items within the main menu.



Once the main menu is entered, it will display all menu entries within the main menu as shown below.



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 only 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 or time consuming 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.

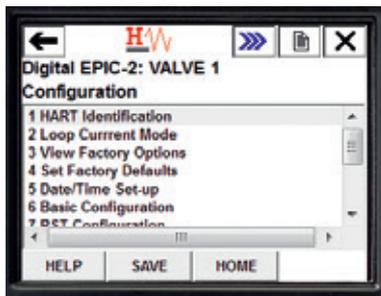
5.1 Login/logout

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 DD 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 DD. The default password for the user login is "123456".

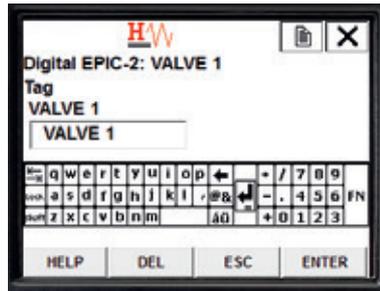
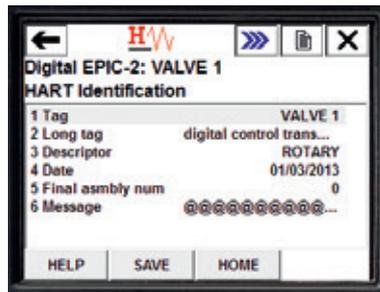
5.2 Configuration

This menu provides the different settings that can be configured for the proper operation of the device. The settings are categorized and grouped based on the functions as explained below. To enter the configuration menu, scroll down to item 2 Configuration, then press ENTER to go into the Configuration Menu shown below.



5.2.1 HART identification

This section under the configuration menu has all settings required and related by the HART specifications as shown below. The device will have factory defaults values that can be changed as needed for asset management and tracking.



This menu does not exist from Keypad/LCD due to constraints in implementation. By scrolling to each item here and pressing Enter, a screen similar to above will appear. This allows setting the text values for each HART identification parameter. Above shows the HART Tag field if selected. Simply use number keypad or select appropriate letters on screen to add letters to text field. Then press ENTER to save data and then press SEND to send changes to the device to save. All other parameters will bring up a similar screen to modify the text strings. Fields such as "Final assembly num" and "Date" only allow relevant numbers.

NOTES

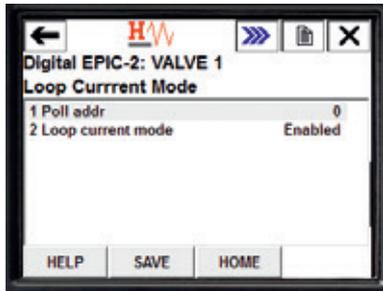
If any of this setting is changed, the new value MUST be sent to the device by pressing the "Send" button on the menu.

DIGITAL EPIC-2® HART DD® USER GUIDE

INSTALLATION AND OPERATING INSTRUCTIONS

5.2.2 Loop current

This section under the configuration menu has all settings required and related for the HART communication as shown below.



- **Polling address:** the polling address is used by the field communicator 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.

NOTES

If either "Poll addr" or "Loop current mode" was changed, when you come back out to Loop Current Mode sub-menu there will be a SEND button available, click SEND to send and save changes to the device.

- **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.

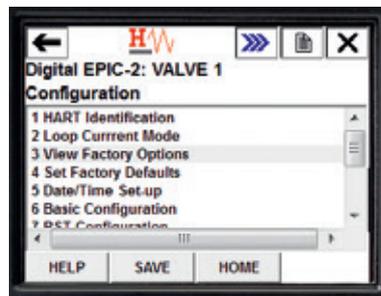
5.2.3 View/modify factory options

This menu shows the device options that are currently enabled or disabled on the device from factory. 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.

If logged in as Factory, the Options will display as binary bits as shown above. Click on Factory Options will bring you to the next screen. From here if an option is ON simply select the option such as PST/SOVT Enable as shown and click on OFF to change it. The same can be done with any other option. When done, click ENTER button. If option was changed, when you come back out to Modify Factory Options sub-menu there will be a SEND button available, click SEND to send and save changes to the device.

NOTES

The Factory Options will show as "View Factory Options" or if logged in using Factory password, it will appear as "Modify Factory Options", where you can view and modify these options.



DIGITAL EPIC-2® HART DD® USER GUIDE

INSTALLATION AND OPERATING INSTRUCTIONS

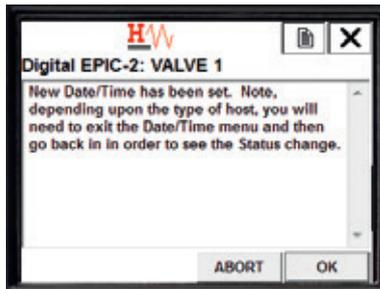
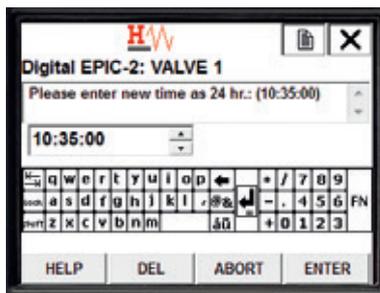
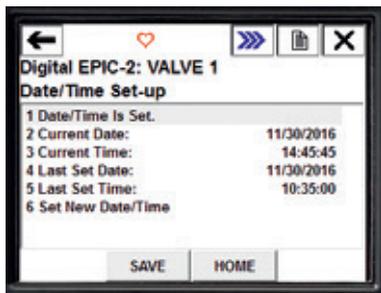
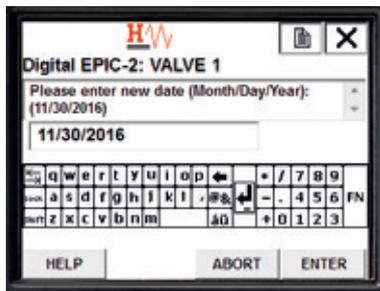
5.2.4 Factory defaults

This menu 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.

5.2.5 Date/time setup

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 below.

- **RTC status:** shows the current status of the real-time clock. Note that this status may not update if a new Date/Time is set unless you exit this sub-menu and then go back in again.
 - **Current date:** shows the current date on the device.
 - **Current time:** shows the current time on the device.
 - **Last set date:** shows the last date when the clock was setup on the device.
 - **Last set time:** shows the last time when the clock was setup on the device.
- To setup the new date and time on the clock, follow the steps below.
- In the New Set Date section, enter the new date to be setup.
 - In the New Set Time section, enter the new time to be setup. 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.
 - Press the Enter button. The DD will send the new date and time to the device.
 - Note from either the Date or Time screen there is an ABORT button to abort the process.
 - Once finished, the screen above will appear to acknowledge the change. Click OK to complete.



DIGITAL EPIC-2® HART DD® USER GUIDE

INSTALLATION AND OPERATING INSTRUCTIONS

5.2.6 Basic configuration

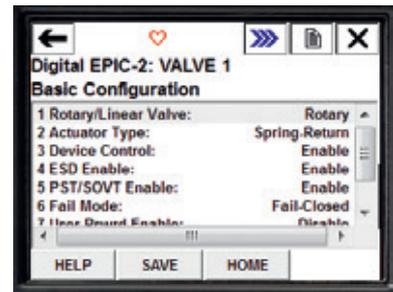
This section has all parameters that need to be configured for the basic operation of the device and to calibrate the device as explained below. From Configuration Menu scroll down to Item 6 Basic Configuration Sub-menu and double click on it or press ENTER. Following screen will appear with all basic configuration parameters. To change any parameter on this screen, select a parameter and then press the Enter key. Use Up/Down arrow keys to change the value and then click ENTER. If no other change will be made in Basic Configuration, click "SEND" button to send new value and save on device.

- **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.

NOTES

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.
- **PST/SOVT:** 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.



DIGITAL EPIC-2® HART DD® USER GUIDE

INSTALLATION AND OPERATING INSTRUCTIONS

- **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 (||) is visible on the beacon.
- **User password:** 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, device 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.

There are certain settings available under a separate menu "User Interface (UI) Configuration" under basic configuration as shown below. To change any parameter on this screen, select a parameter and then press the Enter key. Use Up/Down arrow keys to change the value and then click ENTER. If no other change will be made in this menu, click "SEND" button to send new value and save on device.

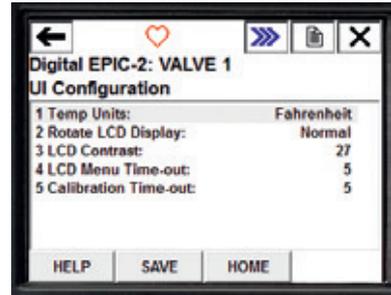
- **Temperature units:** this setting defines how the temperature is displayed on all diagnostics data.
 - **Fahrenheit:** the temperature is displayed in Fahrenheit everywhere including LCD and DD.
 - **Celsius:** the temperature is displayed in Celsius everywhere including LCD and DD.

- **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.
- **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. This is particularly important if a user login is required, since after time-out, the user would have to login again to prevent unauthorized usage. Also note, this time-out does not apply in cases where the user has entered a menu that runs a process such as Calibration, since the process must complete first.

NOTES

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.

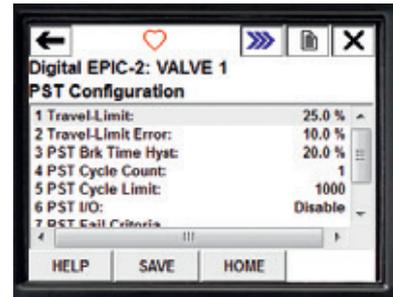


5.2.7 PST configuration

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. Also the user PST setting in the basic configuration MUST be enabled to gain access to this menu. 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. To change any parameter on this screen, select a parameter and then press the Enter key. Use Up/Down arrow keys to change the value and then click ENTER. If no other change will be made in this menu, click "SEND" button to send new value and save on device.

- **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. The Auto PST can be set to an interval of 0-365 days. The Auto PST can be set to specified hour of the day 0-23 hours.
- **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.

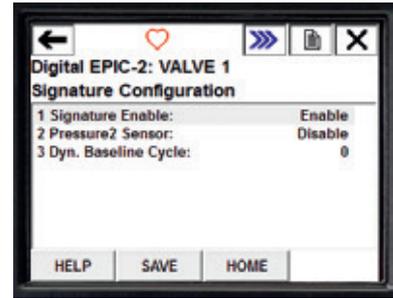


5.2.8 Signature configuration

A signature is a collection of sensor data collected periodically during a Full-Stroke movement or a PST. 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 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. To change any parameter on this screen, select a parameter and then press the Enter key. Use Up/Down arrow keys to change the value and then click ENTER. If no other change will be made in this menu, click "SEND" button to send new value and save on device.

- **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.



DIGITAL EPIC-2® HART DD® USER GUIDE

INSTALLATION AND OPERATING INSTRUCTIONS

5.2.9 SOVT configuration

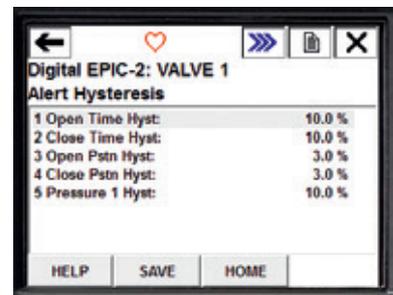
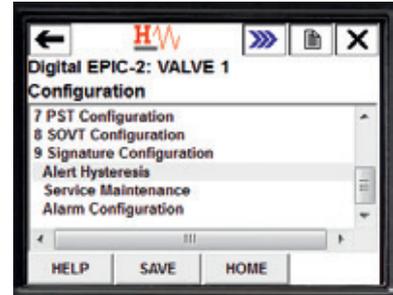
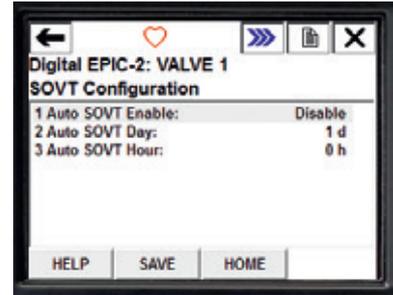
This menu will ONLY be available if the DEPIC-2 model has the Signature option enabled; the user has enabled the signature parameter as mentioned in the above section and the user has logged in using the user password. To change any parameter on this screen, select a parameter and then press the Enter key. Use Up/Down arrow keys to change the value and then click ENTER. If no other change will be made in this menu, click "SEND" button to send new value and save on device.

- **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 and at a specific time of the day. Once configured, the DEPIC-2 will perform a SOVT automatically at the specified time of the day and interval.

5.2.10 Alert hysteresis configuration

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 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. To change any parameter on this screen, select a parameter and then press the Enter key. Use Up/Down arrow keys to change the value and then click ENTER. If no other change will be made in this menu, click "SEND" button to send new value and save on device.

- **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. This will allow changing the hysteresis value for the Open Time of the valve. The default is 10.0% but can be set from 0-25.0%.
- **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. The default is 10.0% but can be set from 0-25.0%.
- **Open position:** this value represents the allowable deviation value ($\pm\%$) from its baseline open position before generating an alarm. It is used to determine the valve movement during PST and FST. The default is 2.5% but can be set from 0-20.0%.
- **Close position:** this value represents the allowable deviation value ($\pm\%$) from its baseline close position before generating an alarm. It is used to determine the valve movement during PST and FST. The default is 2.5% but can be set from 0-20.0%.
- **Pressure-1:** this value represents the allowable deviation value ($\pm\%$) from its baseline break or supply pressure-1 reading before generating an alarm. It is only available for the devices with signature option. The default is 10.0% but can be set from 0-20.0%.
- **Pressure-2:** this value represents the allowable deviation value ($\pm\%$) from its baseline break or supply pressure-2 reading before generating an alarm. This parameter is only available if the user enabled the pressure sensor-2 and signature. The default is 10.0% but can be set from 0-20.0%.



DIGITAL EPIC-2® HART DD® USER GUIDE

INSTALLATION AND OPERATING INSTRUCTIONS

5.2.11 Service/maintenance configuration

This menu provides the parameters to set a reminder to service the valve or actuator by specified date. It also shows the information about the last service performed as shown below. To change any parameter on this screen, select a parameter and then press the Enter key. Use Up/Down arrow keys to change the value and then click ENTER. If no other change will be made in this menu, click "SEND" button to send new value and save on device.

- **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. The default is 0 (Disabled) but can be set from 0-1095 days (3 years). The interval starts from the current Date/Time when set. So if an interval of 1 day is selected, the notification will occur the next day at the same time of day.
 - **0 (Disabled):** when this parameter has value 0, it is disabled.
 - **1-1095:** the interval in number of days to generate a service alarm.
 - **Last service date:** the date when the last service was performed. This is basically a date when the service interval was re-configured.
 - **Last service time:** the time when the last service was performed. This is basically a time when the service interval was re-configured.
 - **Next service date:** the date when the next service should be performed or an alarm will be generated.

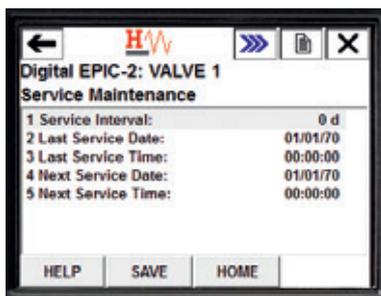
- **Next service time:** the time when the next service should be performed or an alarm will be generated. The time is based on the last time the service interval was re-configured.

5.2.12 Alarm configuration

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.

To change any parameter on this screen, select a parameter and then press the Enter key. Use Up/Down arrow keys to change the value and then click ENTER. If no other change will be made in this menu, click "SEND" button to send new value and save on device.

- **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.



DIGITAL EPIC-2® HART DD® USER GUIDE

INSTALLATION AND OPERATING INSTRUCTIONS

- **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. This allows the user to modify or reset the cycle count of the device (a cycle is defined as a full-stroke movement from open to close to open again).
 - **Cycle limit:** indicates the limit to generate a cycle alarm (if enabled) when the Cycle Count reaches this value. This allows the user to modify the cycle limit of the device (the cycle limit is defined as a point where after this many cycles and Alarm may be).
 - **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 disable, 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.
 - **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.
 - **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.
 - **Solenoid2 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.

DIGITAL EPIC-2® HART DD® USER GUIDE

INSTALLATION AND OPERATING INSTRUCTIONS

5.3 Calibration

This section provides methods to perform different types of calibration as discussed below. Follow the steps below to access the calibration menu.

- In the left side project windows, Right click on the DEPIC-2 long tag.
- Browse to "Additional Functions".
- Select "Calibrate Device".
- The calibration menu screen will pop up as shown below.

NOTES

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.

5.3.1 Last full calibration

This is a read only parameter and provides the information about the last successful full auto or manual calibration. This parameter is not updated if the user perform other types of calibration like low, high, mA etc.

5.3.2 Full device controlled 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.

NOTE

The valve MUST be in its fully energized position to start this calibration.

5.3.3 full user controlled calibration

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.

5.3.4 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.



Each item available under this menu is explained in details as below.

DIGITAL EPIC-2® HART DD® USER GUIDE

INSTALLATION AND OPERATING INSTRUCTIONS

5.3.5 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.

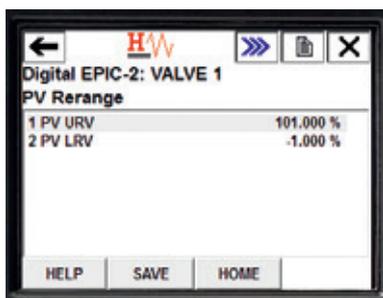
5.3.6 mA output calibration

The DEPIC-2 provides the valve position feedback through the 4-20 mA analog output current. This mA output current has factory default value as 4 mA for the valve close (0%) position and 20 mA for the valve open (100%) position. It might be useful to the user to fine tune these values or perform a custom mA calibration where the desired mA output values different than the factory default values. This calibration allows the user to adjust these values. The user is required to connect the accurate mA current meter in the loop during this calibration. Please follow the instructions displayed on the screen to perform this calibration.

5.3.7 PV re-range

This function allows the user to change the range of the primary variable, which is the valve position so that the DEPIC-2 provides the alerts for appropriate position.

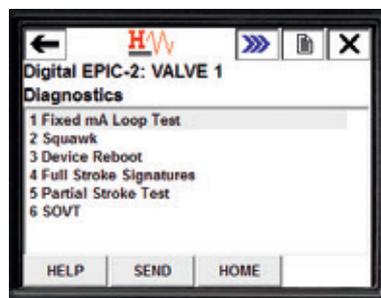
The user can change the factory default values to its custom required values so that the DEPIC-2 will generate an alert like PV out of range any time the valve position is outside the values specified in this parameter.



5.4 Diagnostics

This menu provides access to different diagnostics functions available on the DEPIC-2. Follow the steps below to access this menu. If the user has enabled the password setting in the basic configuration menu, some of the items in the Diagnostics menu might not be available until the user logs in using the password.

- From the Main menu, scroll down to Diagnostics and double click or press Enter key. Note this menu may change based upon Configuration of Signatures or PST Enable or Disable
- It will open the diagnostics menu in a new window as shown below.



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

DIGITAL EPIC-2® HART DD® USER GUIDE

INSTALLATION AND OPERATING INSTRUCTIONS

5.4.1 Fixed mA loop test

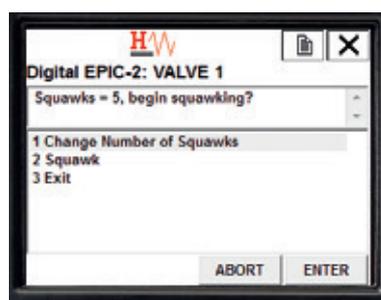
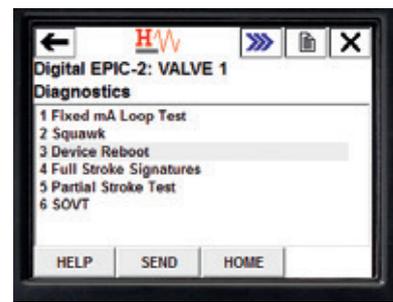
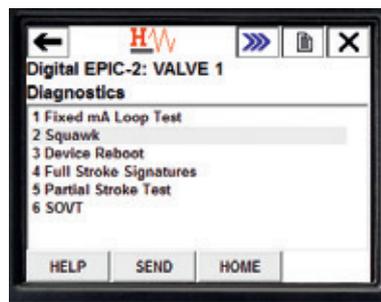
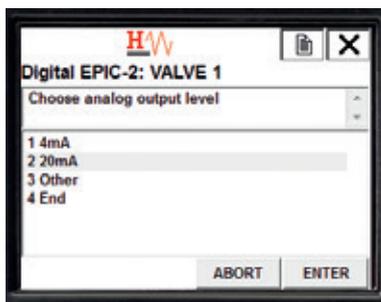
This method allows user to put the device into fixed current mode instead of representing the actual valve position. This is useful to the user in finding any issues related to the HART communication 4-20 mA loop. It is recommended to disconnect the 4-20 mA loop from the control system during this test. 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 or abort the test.

5.4.2 Squawk

This function helps user visually locate the DEPIC-2 to make sure the field communicator is communicating with the correct device in case of multi-drop mode OR if the device is located at a different location such as overhead with the HART communication access points at other location. When invoked, the DD will instruct the DEPIC-2 to blink the LED on the board as a visual indication that it is receiving the command sent from DD. Follow the instructions on the screen. If the number of Squawk is 5, the DEPIC-2 will flash the LED 5 times. This number can be changed by the user.

5.4.3 Device reboot

This method allows the user to reboot the DEPIC-2 from the DD 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. After the device is rebooted, the user might have to manually reestablish the communication with the device.



DIGITAL EPIC-2® HART DD® USER GUIDE

INSTALLATION AND OPERATING INSTRUCTIONS

5.4.4 FST

This menu 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. From main menu, select the item 5 (Diagnostics) and then select the item 4 (Full Stroke Signatures) and it will display the menu as shown below.

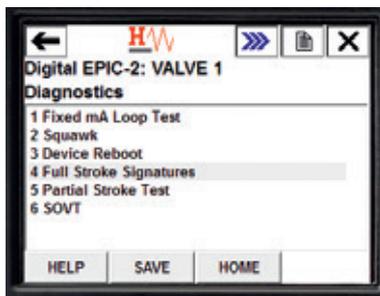
5.4.4.1 Generate new signatures

This menu allows user to capture the Baseline and Maintenance signatures on the device by de-energizing the solenoid to move the valve to its fail-safe position and then re-energizing solenoid to bring the valve back to its original position. The user can generate following two types of signatures using the DD. Follow the instructions displayed on the screen to capture the signatures.

- **Baseline signatures:** this signature must be captured before capturing the maintenance signature as it serves as a reference to compare the future maintenance signatures against. This signature should be generated when the valve/actuator package is installed and commissioned.
- **Maintenance signatures:** the baseline signature must be captured before capturing this signature. The maintenance signature should be captured by the user periodically to detect the degrading valve/actuator performance. The latest maintenance signature will be compared to the baseline signature data and any deviation in the parameter by the specified hysteresis limits in the configuration menu will generate an alert to warn user about potential issue. The device can store maximum of 4 maintenance signatures at a time. The user has the ability to lock and unlock the specific maintenance signature data. The user can lock maximum of 2 maintenance signatures leaving the other 2 to capture the latest data. If a maintenance signature is out of tolerance with the baseline, the device will automatically lock that maintenance signature for future reference until unlocked by the user.

NOTES

The valve **MUST** be in its fully energized position to capture full stroke signature.



DIGITAL EPIC-2® HART DD® USER GUIDE

INSTALLATION AND OPERATING INSTRUCTIONS



5.4.4.2 Show all signatures

This menu allows user to view the signature data and plot for the current signatures captured by the user on the device. This screen will show the number of total signatures and other signatures available on the device. As explained below, the DD allows the user to view/plot following signatures under this menu.

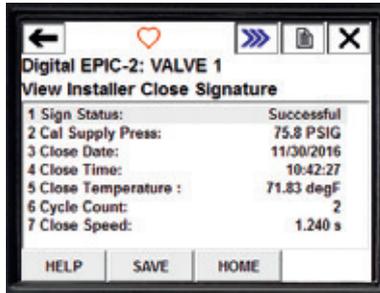
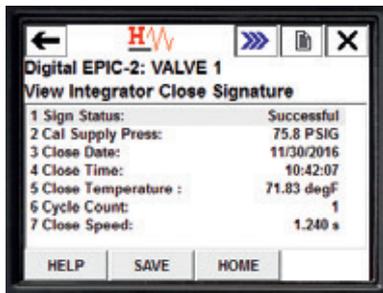
• Integrator signature

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.

However the data can be viewed from the DD. None of the data from this signature is used to compare against other data to generate any alert or alarm. As shown below, it only shows the numerical data for this signatures and there is no plot available for this signature.

• Installation 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. However the data can be viewed from the DD. None of the data from this signature is used to compare against other data to generate any alert or alarm.



As shown above, it only shows the numerical data for this signature and there is no plot available for this signature.

As shown above, it only shows the numerical data for this signature and there is no plot available for this signature.

• **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. The user can also view the signature plot by selecting the "Plot Base Opn Sign" OR "Plot Base Opn Sign" and pressing the "Enter" button. Once clicked, the DD will download all signature data and plot it as a graph of position/pressure vs. time. The signatures are divided in two parts: Opening Signature and Closing Signature. As shown above, when the "Plot Base Open Sign" is selected, the DD retrieves the signature data from the device and plots it as a graph. Once the upload is completed, a screen similar to above will appear showing the signature plotted by Position in Red, Pressure 1 in Green, and Pressure 2 (if enabled) in Blue as % times 10 of full value on y-axis vs Time on x-axis. Note, the top buttons on the screen allow the user to zoom-in or zoom-out the plot if desired. Click on Back Arrow twice to return back to the View Baseline sub-menu.



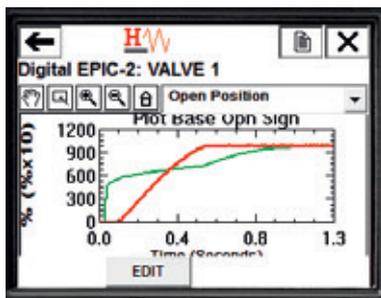
• **All maintenance signatures**

This menu allows the user to view the number of maintenance signatures available on the device and plot the signature graph and also lock/unlock a specific maintenance signature. As explained before, the DEPIC-2 allows the user to store up to four maintenance signatures. The main screen on this menu shows the currently selected maintenance signature by the user. The user can select a different maintenance signature to view by selecting it from the selection box shown on this screen.



- **List available signatures**

The user can view the available maintenance signatures on the device by selecting this option on the menu. The DD will display all available maintenance signatures and the latest and oldest maintenance signature as shown above.



- View selected signature

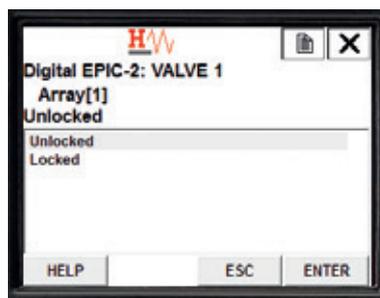
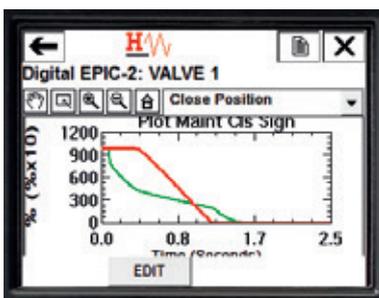
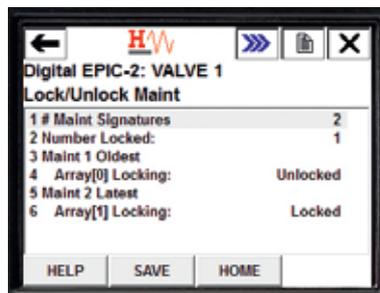
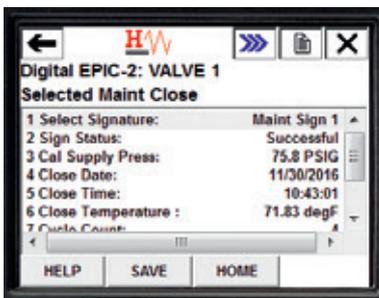
This menu allows the user to view the selected maintenance signature data and plot the graph. The signature MUST be selected under the "All Maintenance Signatures" screen discussed before. The user first should browse to the menu "List Available Signatures" to determine which signature are available on the device and then go to "All Maintenance Signatures" menu to select a particular maintenance signature he want to view and then come to this menu to view or plot the data as shown on the screen below. Each maintenance signature is divided into two parts: Open Signature and Close Signatures. As shown below, each signature can individually be selected and the graph can be plotted on the following screen.

- Lock/unlock signature

This screen allows the user to view the current lock status of each maintenance signature available on the device and change the status to locked/unlocked. As explained before, the DEPIC-2 allows the user to store up to four maintenance signatures and lock up to two maintenance signatures to preserve it for future reference. This feature allows user to lock a particular signature if he find anything suspicious in the valve/actuator characteristics and wants to look at later time to compare with another maintenance signature. Once locked, the DEPIC-2 will not overwrite that signature data with any new signature it captures. Once the user is satisfied with the analysis, he can unlock the particular maintenance signature he locked previously or the device locked automatically.

• Show run-time data

This menu will only be available if the user has captured the baseline signature and at least one maintenance signature. This menu allows the user to view the run-time data captured by the DEPIC-2 during the signature. Since there is a lot of data, the run-time data are separated into groups of signature data that are critical for the valve/ actuator operation and to make comparison between the last maintenance signature run-time data and baseline signature run-time data.
 From Diagnostics->Full Stroke Signatures ->Show All Signatures sub-menu double-click on "Show Run-Time Data" sub-menu.



DIGITAL EPIC-2® HART DD® USER GUIDE

INSTALLATION AND OPERATING INSTRUCTIONS

- View run-time summary

This menu allows user to view the summary of run-time data failure alerts as shown below.



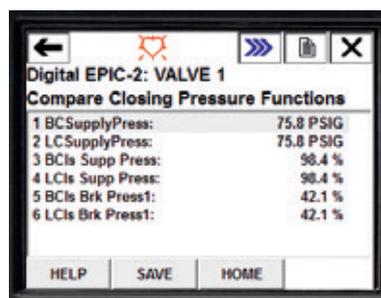
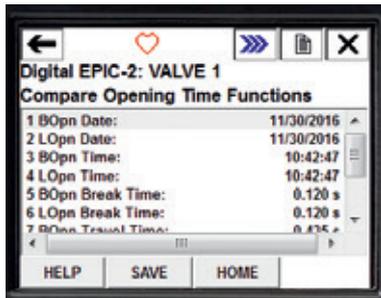
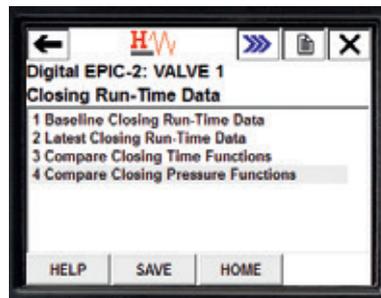
Once the user captures the baseline signature and at least one maintenance signature, the DEPIC-2 compares the maintenance signature run-time data to the baseline signature run-time data as per the hysteresis limits set by the user under the configuration menu. If any parameter goes out of the hysteresis limits, the DEPIC-2 will flag it as a failure and a checkbox will be displayed for that parameter under this screen as show below.

- Opening run-time data

This menu allows user to look at the baseline and latest maintenance signature run-time data when the valve opened. It also allow user to look at the comparison between the baseline and latest maintenance open signature run-time data grouped by time and pressure related parameters.

- Closing run-time data

This menu allows user to look at the baseline and latest maintenance signature run-time data when the valve closed. It also allow user to look at the comparison between the baseline and latest maintenance closed signature run-time data grouped by time and pressure related parameters.



DIGITAL EPIC-2® HART DD® USER GUIDE

INSTALLATION AND OPERATING INSTRUCTIONS

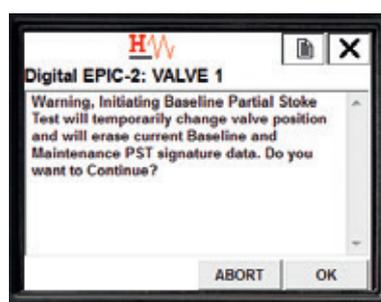
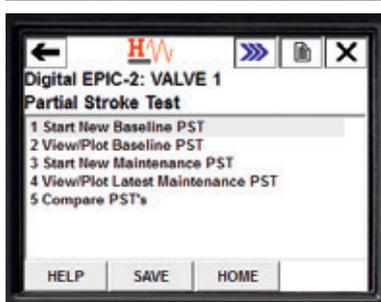
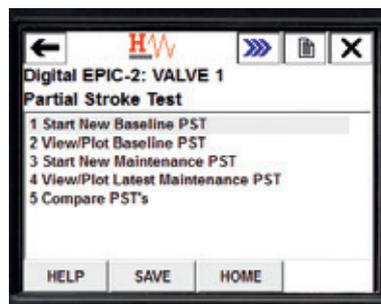
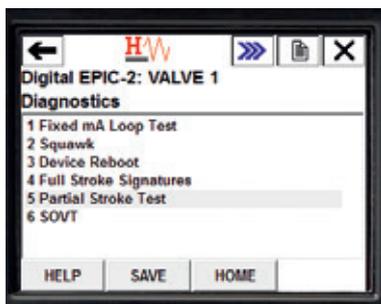
5.4.5 PST

This menu will only be available if the factory PST/SOVT option is enabled; the user has PST/SOVT setting enabled under the Basic Configuration menu and the user has logged in using the user password. If the device also has the signature option enabled, it will capture the pressure readings during PST and use it to plot along with position vs. time. If the signature option is enabled, the device needs to have the pressure sensors and the PST algorithm will use the pressure limits at different decision points to abort the PST if out of tolerance. If the device doesn't have the signature option, the PST will use the total time limit to abort the PST if it takes too long. Using this test, the user can diagnose any issue involving valve/actuator performance degradation over time without the possible disruption of the process by using partial-stroke signatures. A successful test increases the probability that the valve will move to its fail safe position during an emergency situation. During the PST, the device will de-energize the solenoid to move the valve towards the fail safe position. When the valve reaches or exceeds the specified travel limit, it will re-apply the solenoid voltage to bring the valve back to its original position. The valve must be in its energized position to perform the test. The test has a number of configurable parameters like break pressure hysteresis, travel time to the travel limit (setpoint), travel time hysteresis etc. If the test exceeds any of these specified limits, it will fail and generate an alarm.

During the test, the device will also capture 255 samples of position and pressure readings, which can be used to plot a graph. From Diagnostic Menu, scroll to or select "Partial Stroke Test" and press Enter or double-click. Following section will describe each function available under this menu.

5.4.5.1 Start new baseline PST

This menu allows the user to perform the Baseline PST test. Upon a successful test, the device will store this data as baseline PST data. A Baseline PST should generally be performed once the valve/actuator is first installed in-process. Any maintenance PST data will be compared to the baseline PST data and an alarm will be generated if any parameter exceeds the specified hysteresis limit. Follow the instructions on the screen to perform this test.



DIGITAL EPIC-2® HART DD® USER GUIDE

INSTALLATION AND OPERATING INSTRUCTIONS

As shown above, a warning will appear indicating that the valve position will momentarily change and all current PST signatures will be erased. This is because when a new Baseline PST is created, the Maintenance PST may no longer be valid, especially if something changed in dynamics. It asks if you want to continue. Click OK to continue or click ABORT if you do not want to continue.

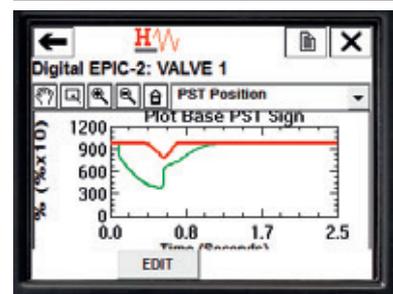
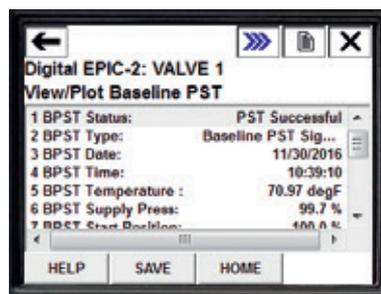
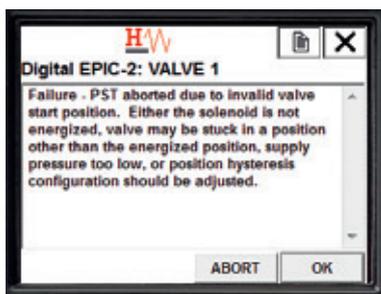
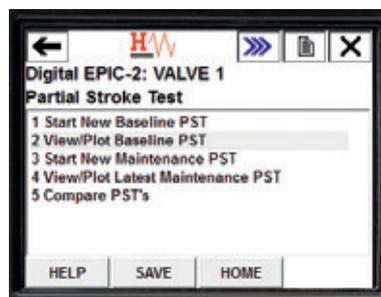
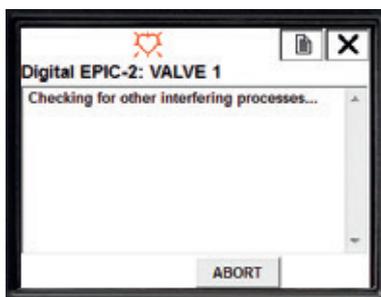
Next, the screen will show the progress of the PST by showing x% complete. Once 100% is reached, it will be complete and the next screen should appear. Once the Baseline PST completes, if failed, the screen above should appear. If not successful, it will show an error stating the problem. The problem will also be logged in the PST/SOVT Alarm Fail Status in Device Specific Status Menu 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 PST see next section View/Plot Baseline PST. Click OK when done.

5.4.5.2 View/plot baseline PST

This menu selection will only be available if the user has performed the baseline PST on the device. Once selected, it will show the Baseline PST data captured by the device as shown below. From Partial Stroke Test sub-menu, select View/Plot Baseline PST then press Enter or double-click. The screen below will appear showing many captured parameters during the PST.

If the device has the signature option enabled, the device will capture the signature data during the PST. To download the signature data from the device, press the "Read Values" button on the bottom right corner of the screen. Once all signature data is downloaded, the DD will plot a graph of signature data while downloading, which will be displayed as a pressure and position vs. time as shown on the screen below.

In the plot, all parameters are displayed in % times 10. For example, 13.5% position will be displayed as 135. The position will be displayed in the black, pressure sensor-1 in blue and pressure sensor-2 in green color. Furthermore, if the pressure sensor-2 is disabled, the graph will not show the data for the pressure sensor-2. Click on Back Arrow twice to return back to the Partial Stroke Test sub-menu.

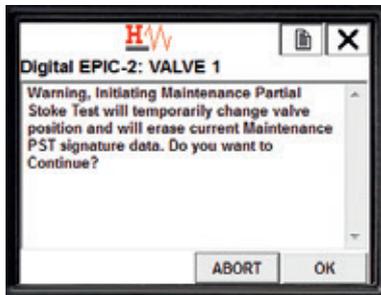
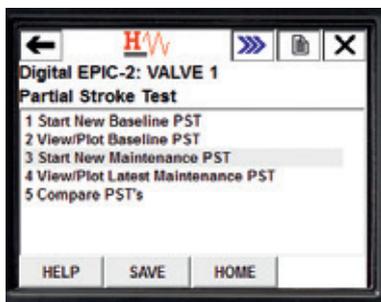


DIGITAL EPIC-2® HART DD® USER GUIDE

INSTALLATION AND OPERATING INSTRUCTIONS

5.4.5.3 Start new maintenance PST

This menu entry allows the user to perform the maintenance PST test. Upon a successful test, the device will store this data as a Maintenance PST data. The user can only perform the maintenance PST after successful completion of a baseline PST. Upon completion of the test, the device will compare the data to the baseline PST data. Any deviation from the specified hysteresis limits will generate an alarm. Follow the instructions on the screen to perform this test from DD.



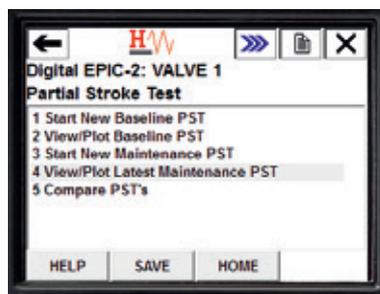
From Partial Stroke Test sub-menu, select Start New Maintenance PST then press Enter or double-click. As shown above, a warning will appear indicating that the valve position will momentarily change and will over-write any current Maintenance PST signature. It asks if you want to continue. Click OK to continue or click ABORT if you do not want to continue.



From Partial Stroke Test sub-menu, select Start New Maintenance PST then press Enter or double-click. As shown above, a warning will appear indicating that the valve position will momentarily change and will over-write any current Maintenance PST signature. It asks if you want to continue. Click OK to continue or click ABORT if you do not want to continue.

5.4.5.4 View/plot maintenance PST

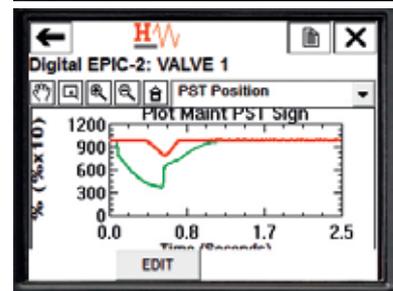
This menu selection will only be available if the user has performed the maintenance PST on the device. Once selected, it will show the maintenance PST data captured by the device as shown in the picture on the next page.



From Partial Stroke Test sub-menu, select View/Plot Latest Maintenance PST then press Enter or double-click. The screen above will appear showing many captured parameters during the PST.

If the device has the signature option enabled, it will also be possible to download the signature data from the device and plot it as a graph. Select the "Plot Maint PST Sign" option to download the signature data. Once all signature data is downloaded, the DD will plot a graph of signature data while downloading, which will be displayed as a pressure and position vs. time as shown in the screen below.

In the plot, all parameters are displayed in % times 10. For example, 13.5% position will be displayed as 135. The position will be displayed in the black, pressure sensor-1 in blue and pressure sensor-2 in green color. Furthermore, if the pressure sensor-2 is disabled, the graph will not show the data for the pressure sensor-2. Note, the top buttons on the screen allow the user to zoom-in or zoom-out the plot if desired. Click on Back Arrow twice to return back to the Partial Stroke Test sub-menu.

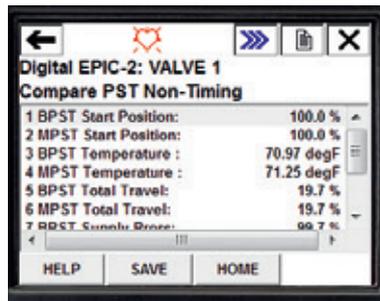


DIGITAL EPIC-2® HART DD® USER GUIDE

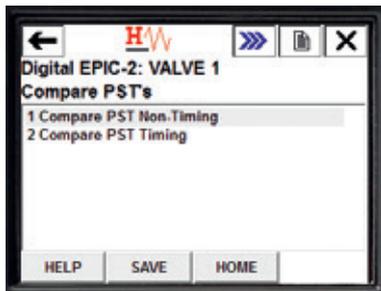
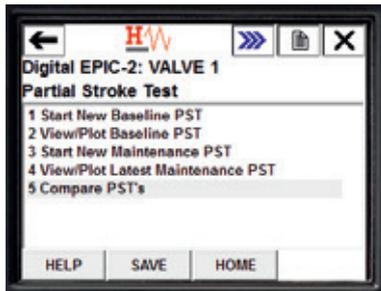
INSTALLATION AND OPERATING INSTRUCTIONS

5.4.5.5 Compare PST's

This menu will only be available if the device has the Baseline PST and Maintenance PST performed. It will allow user to compare the Maintenance PST data to the Baseline PST data side by side to find any deviation in the critical parameters.



- **Compare PST timing:** this will allow the user to compare the PST parameters that are based on time such as travel time, date/time stamp etc. as shown below.



From Partial Stroke Test sub-menu, select "Compare PST's" then press Enter or double-click. The screen below will appear providing a choice of how you want to compare the Baseline and Maintenance PSTs. This menu will be divided into two sections as shown below.

- **Compare PST non-timing:** this will allow the user to compare the PST parameters that are not based on time such as pressure, temperature etc. as shown below. This will show a comparison of all Baseline (B) vs Maintenance (M) PST non-timing related data points captured. Use the scroll bar at right to scroll down to see all data as shown below. You can select any specific data item and then click HELP to get more information about the data. Click back arrow to return to Compare PST's sub-menu.

This will show a comparison of all Baseline (B) vs Maintenance (M) PST timing related data points captured. You can select any specific data item and then click HELP to get more information about the data. Click back arrow to return to Compare PST's sub-menu.

DIGITAL EPIC-2® HART DD® USER GUIDE

INSTALLATION AND OPERATING INSTRUCTIONS

5.4.6 SOVT

This menu entry will only be available if the device has the Factory PST/SOVT and signature option enabled and the user has enabled the PST/SOVT and signature setting under the Configuration menu. The user can only perform the SOVT after the baseline PST is successfully finished, mainly due to parameters established during a baseline PST are used to help determine if an SOVT is successful. By performing this test, the user can diagnose any issue with the solenoid, which can prevent the valve moving to the fail safe position during an emergency shut down situation. During the test, the device removes the solenoid voltage through a relay on the board, which in turn starts dropping the air pressure inside the actuator chamber which would move the valve towards the fail safe position. However unlike PST test, this test re-applies the solenoid voltage back when the air pressure inside the actuator chamber drops to about 50% of the difference between the Nominal Supply Pressure and the Baseline PST break pressure and thereby stopping before any valve movement occurs during this test. This verifies that the solenoid is operating correctly by checking the drop in the air pressure but not making any actual valve movement.

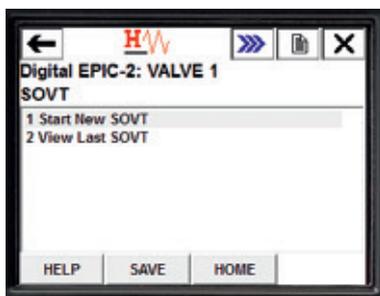
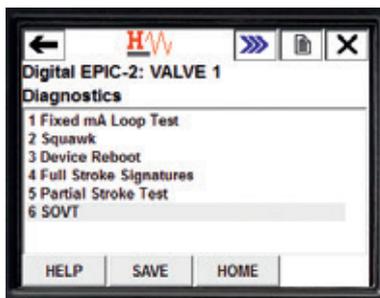
5.4.6.1 Start new SOVT

This menu entry will allow the user to perform the SOVT. Select this option to start a new SOV test. Before starting the test, the DD will check if the baseline PST was performed and there is no other test or calibration running. Follow the instruction displayed on the screen to perform this test from the field communicator. After finishing the test, it will display the result of the test.

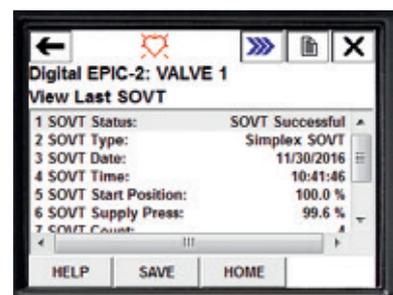
5.4.6.2 View last SOVT

This menu will allow the user to view the status and parameters captured for the last SOVT performed on the device. When selected, it will download all data from the device and the DD will display the data on screen as shown below.

From SOVT sub-menu, select "View Last SOVT" then press Enter or double-click. The screen above will appear showing many captured parameters during the SOVT.



From Diagnostic Menu, scroll to or select "SOVT" and press Enter or double click. The following section describes the functions available under this menu.

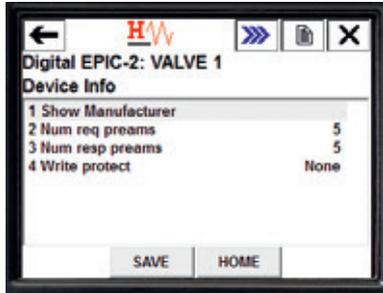


DIGITAL EPIC-2® HART DD® USER GUIDE

INSTALLATION AND OPERATING INSTRUCTIONS

5.5 Device info

This menu provides the device related information as shown below.



- **Num req preams:** this is the required number of Preambles that the HART host should send with all commands to the device which is defaulted to 5. This cannot be changed by the user.
- **Num res preams:** this displays 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 entering the desired value which can be from 5-20. Note by increasing, this increases the overhead in response HART messages.
- **Write protect:** displays a standard HART parameter but is not supported in this device and cannot be changed, default "None".

5.5.1 Show manufacturer

When the "Show Manufacturer" menu is expanded, it will display following information.

- **Manufacturer:** displays the name of the manufacturer of this device Westlock Controls.
- **Device type:** displays the model of this device, which is Digital Epic2 or AVID.
- **Device ID:** displays the factory pre-set Device ID of the device required for the HART communication.
- **Show revisions:** displays different hardware and software revision the device is currently using.

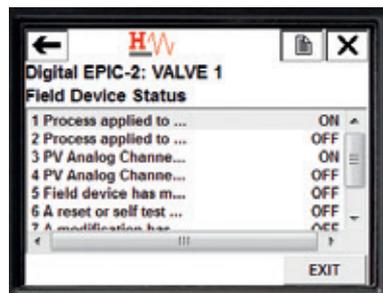
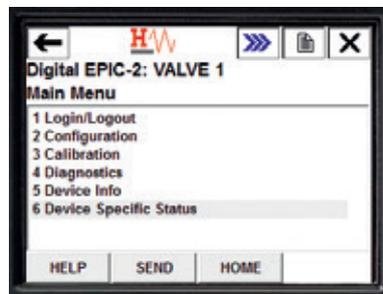


5.6 Device specific status

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 as shown below. Most of the information displayed under this menu is read only and can't be changed by the user.

5.6.1 Field device status

This menu shows the field device status as specified by the HART specifications. Please refer to the HART specifications for the details of each status bit available under this menu. Select any particular status from the list and press the Enter button to get more information.



DIGITAL EPIC-2® HART DD® USER GUIDE

INSTALLATION AND OPERATING INSTRUCTIONS

5.6.2 General alarm status

This menu shows the status (active or in-active) of general alarms if enabled in the general alarms under the basic configuration menu. 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. From this screen click on any individual alarm status to select then click on HELP to see more description. Scroll back to the main menu by pressing the Up arrow the number of times required.

- 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.
- Service alarm, if ON indicates that the user configurable time has elapsed notifying the user it may be time for valve/actuator maintenance.
- 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.
- ESD alarm, if ON indicates an Emergency Shut-Down has occurred, indicated by a loss of SIS voltage to the solenoid.

5.6.3 Calibration error alarms

This menu shows the status of any error that occurred during the last calibration on the device. If the alarm displays ON next to the calibration error, it means the calibration error is active otherwise it is in-active. Following table describes the meaning of each calibration error.

To get more information about a particular calibration error, select the error and press the HELP button.



DIGITAL EPIC-2® HART DD® USER GUIDE

INSTALLATION AND OPERATING INSTRUCTIONS

Following tables shows the details of each calibration error.

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.

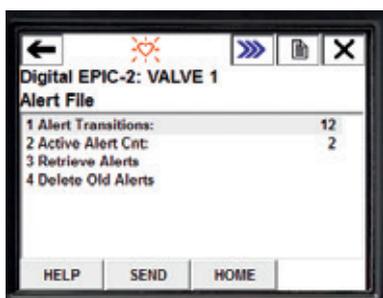


5.6.4 PST/SOVT fail alarm status
 This menu shows the status (active or in-active) of PST/SOVT alarms if enabled in the PST/SOVT Fail Alarms under the basic configuration menu. If it displays ON next to the alarm, it means the alarm is active otherwise it is in-active.
 To get more information about a particular calibration error, select the error and press the HELP button. Following tables shows the details of each calibration error.

5.6.5 Alert file
 This menu 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.
 The Alert File contains time/date stamped alerts detected by the firmware as deviations between Baseline and Maintenance Signatures of Full Stroke or Partial Stroke as well as a number of other dynamic process conditions. The device will store up to the last 16 alerts.

- **Alert transitions:** the number of alerts transitions (active to in-active and vice versa) so far recorded on the device.
- **Active alert count:** the number of active alerts recorded so far on the device.
- **Retrieve alerts:** download all alerts (active or in-active) from the device to DD for review. After this method execution, the DD should show the date/time stamped alert tables of all alerts transitions and active alerts.
- **Delete old alerts:** this function will delete the alerts on the device that occurred before the last re-boot of the device. This is useful to track the alerts that occurred since the last re-boot.

5.6.6 Miscellaneous device status
 This menu shows the read only status information that might be useful to the end user or Westlock Controls factory personnel to troubleshoot any issue with the device.



DIGITAL EPIC-2® HART DD® USER GUIDE

INSTALLATION AND OPERATING INSTRUCTIONS

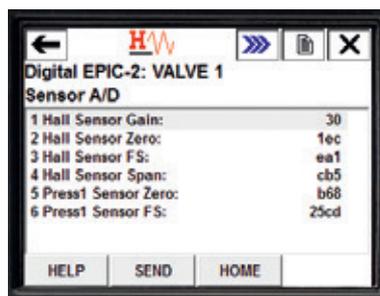
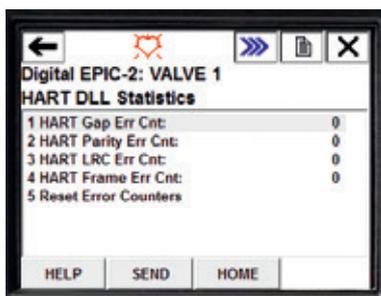
Following section describes each status parameter available on this screen:

- **Factory cycle count:** the value in this parameter represents the number of full stroke cycles the DEPIC-2 has recorded since it was built by the Westlock Controls.
- **Beacon orientation:** this parameter shows the orientation of the beacon or magnet assembly as detected by the DEPIC-2 during the full auto or manual calibration.
- **Open speed index:** this parameters shows the index calculated by the DEPIC-2 for the valve opening speed during the last full auto calibration. The value represents an index into the look-up tables that has different sample rates required to record the signature samples during PST or FST.
- **Close speed index:** this parameters shows the index calculated by the DEPIC-2 for the valve closing speed during the last full auto calibration. The value represents an index into the look-up tables that has different sample rates required to record the signature samples during PST or FST.
- **mA out reversed:** this parameter shows the mA output calibration as detected by the DEPIC-2 during the mA output calibration. The normal status indicates that the mA output current for the valve close position is less than the mA output current for the valve open position while the reverse status indicates the mA output current for the valve close position is more than the mA output current for the valve open position.
- **Device temperature:** displays the current temperature in configured units as recorded by the internal temperature sensor on the DEPIC-2.
- **HART DLL statistics:** shows the different kind of HART DLL communication errors occurred so far during the HART communication with the host software (DD, DTM etc.). The counter can be reset by the user to count new errors from that point on.

- **Gap error** - counts the number of illegal gaps in messages from a host.
- **Parity error** - counts the number of messages with parity errors from host.
- **LRC error** - counts the number of messages with Longitudinal Redundancy Check errors from the host.
- **Framing error** - counts the number of messages with framing errors from the host. Framing Error is defined as the absence of a Start bit.

- **Sensor A/D:** this screen shows the different analog to digital values recorded by the DEPIC-2 during the calibration and can be useful to the Westlock Controls factory personnel to troubleshoot the issue on the device.

This shows the calibrated values for the Hall Effect position sensor and the Pressure sensors. Note the Gain for the Hall sensor is in decimal where the everything else is displayed in Hex.



DIGITAL EPIC-2® HART DD® USER GUIDE

INSTALLATION AND OPERATING INSTRUCTIONS

6 ABBREVIATION

DEPIC-2	Digital EPIC-2
ESD	Emergency shut-down
PST	Partial stroke test
SOVT	Solenoid operated valve test
FST	Full stroke test
DTM	Device type manager
DD	Device description
DDL	Data link layer
FDT	Field device type
I/O	Input/output
LED	Light emitting diode
LCD	Liquid crystal display
UI	User interface

7 REFERENCES

- www.westlockcontrols.com
- www.hartcomm.org
- www.fdtgroup.org

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- Digital EPIC is the registered trademark of Westlock Controls.

Engineering document reference

This DD User Guide is based on the latest engineering document reference NPD-2015-015, and forms part of the document package 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-05046-EN as checked by our engineering team and therefore the original English document will prevail. No rights or liability can be derived from any translation.

Previous documents

VCIOM-05046 replaces all previous DD User Guides for the DEPIC-2 series, including NPD-2015-015.



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