INSTALLATION, OPERATION and MAINTENANCE Manual

Type VSD - Intelligent Valve Controller w/ Bluetooth and Capacitor Backup Module

Basic Setup, Valve Diagnostics & Software Configuration

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1. General

This manual covers software version:

Software ID: DVC-SW-002

This document covers the use of the Valve Test and Valve Diagnostics facilities within the Type VSD Controller fitted with Bluetooth Functionality and Capacitor Backup Module.

Safety Instructions

This document is supplemented by documents VSD-IOM-002 and VSD-IOM-003 and Instructions on the field device itself which detail essential safety information pertaining to the VSD Valve Controller along with details on the setting of the independent Valve Position Monitoring System. For successful and safe installation and operation of the VSD Valve Controller, all 3 instruction documents should be available for reference and Safety information on the Product itself should be observed.

The information in this user manual is subject to changes without notice.

Application

The VSD is a valve controller that integrates valve position feedback with a Valve Test and Diagnostic capability.

The Type VSD system is easy to install and adjust and it offers a simple but efficient test of the ESD system. It can be easily fitted on new and existing installation.

The Type VSD Controller can operate an ON/OFF valve fitted with either a hydraulic or pneumatic control system.

The Type VSD Controller with Capacitor Backup module assumes a 24 VDC power supply to the solenoid that controls the actuated valve on which the device is fitted. The electronics in the Controller are parasitically powered from this Solenoid power line. **NOTE: The client should ensure the 24VDC supply has sufficient current to supply BOTH the solenoid valve and the VSD Controller.**

Where the VSD Controller with Bluetooth capability is to perform online testing, it can be operated in a number of ways, depending on the model selected:

- Locally with a control panel
- Semi locally with Bluetooth
- Remotely via a hard-wired discreet switch

All of the above options offer the ability to start the test at the valve location and get a pass/fail signal to indicate the result of the test. Detailed diagnostics (such as valve curves) can only be retrieved via the Bluetooth interface and analysed within the VCDC software (sold seperately).

The unit is configured using the Valvescan Configuration Software. Units are factory set to enable installation on the valve assembly, and testing to be performed, after auto-calibration has been completed. Factory PST set point is 20% and PST can be initiated by a switch

connection to Digital Input 1 (long push – around 1 sec) or by initiation from the Bluetooth interface. Test results are reported on the 3 x Digital Outputs from the device or on Bluetooth. These settings can be adjusted in the Valvescan Configuration Software, although some can be altered within the Bluetooth app (follow instructions within the app).

Where the user wishes to access the detailed diagnostic functions of the VSD Controller (e.g. Valve Test Graphical Plotting and Databasing) the VCDC Software Package should be purchased from Imtex Controls Ltd.

In addition, the VSD Controller with Capacitor backup module enables valve performance data to be harvested once the Solenoid Valve has been de-energised as the capacitor maintains power to the VSD Electronics for approximately 5 minutes. Information can be retrieved once the solenoid is re-energised.

2. Specifications

Environment

Operating temperature: -25 to 40˚C
Storage temperature: -40 to 80˚C

Relative Humidity: < 95% (No condensation)

Terminals

Screw torque: 0.4Nm (3.6Lb. in)
Wire diameter: 28-12 AWG 2.5mm^2

Dimension and Mounting

Dimensional drawings can be found on the Company's website - www.imtex-controls.com

Mounting: As per document VSD-IOM-002

Connect the Type VSD to ground to avoid electromagnetic interference.

Electrical Specifications

Power supply / ESD in	
Power supply	21.6 – 27.6VDC
Power, no position sensor/loop or valves are connected, Capacitor fully charged.	< 2W
Power, with maximum load on all inputs and outputs and Capacitor under Charge	< 5W
Capacitor Power Time	Approx 4 minutes (age dependent)
Digital output – DO	
Max load per digital output	up to 48W @24VDC
Max load total	up to 192W @24VDC
ESD out	
Max load per digital output	up to 48W @24VDC
Digital input - DI	
Type	Normally open / normally close
Cable length (unknown resistance)	20 meters
Maximum cable resistance	100 ohm
AO0	
Impedance	< 470 ohm @20mA and 9,4VDC
Linearity	< 0.1%
Temperature coefficient	0.025% / 1°C
HART	FSK, 1200Hz / 2200Hz 400-800mVpp
Galvanic isolated	
AI0	
Impedance	< 470 ohm @20mA and 9,4VDC
Linearity	< 0.1%
Temperature coefficient	0.01% / 1°C
HART	FSK, 1200Hz / 2200Hz 400-800mVpp
Galvanic isolated	
Analogue input – AI	
External position loop max Rload	585 ohm @20mA and 11.5VDC
Operating area	4 – 20mA
Minimum span	12mA
Cable length	1000 meters
Linearity	< 0.1%
Temperature coefficient	0.01% / 1°C

Connections – see Document VSD-IOM-003

Terminals for VSD – Electronics Board

See the chart below to see how to connect to the terminals on the Type VSD Electronics Board (also reproduced in VSD-IOM-002)

Passive analogue input (optional)

1. AI0 (+)
2. AI0 (-)

Passive analogue output (optional)

3. AO0 (+)
4. AO0 (-)

Power supply

5. 24 VDC power supply (+) – Internal Connection from Capacitor
6. External 24 VDC power supply (-)– Internal Connection from Capacitor
7. Ground

Not Used – 8, 9, 10

Active analogue input

11. AI1 (+)
12. AI1 (-)
13. AI2 (+)
14. AI2 (-)

Digital output

27. DO 1 (+)
28. DO 1 (-)
29. Ground
30. DO 2 (+)
31. DO 2 (-)
32. Ground
33. DO 3 (+)
34. DO 3 (-)

Digital input

39. DI 1 (+)
40. DI 1 (-)
41. DI 2 (+)
42. DI 2 (-)
43. DI 3 (+)
44. DI 3 (-)

ESD in / ESD power supply – From Safety System

21. ESD in (+)
22. ESD in (-)

ESD out – To Solenoid

23. ESD out (+)
24. ESD out (-)

Note: Terminal 7 must be connected to Ground. All grounds are connected internally.

Indicator LEDs

The Type VSD Controller is equipped with 2 LEDs on the PCB. The indicator lights work as follow:

	Green LED	Red LED
Loading data from Eeprom	Blinking	Off
System error	Off	On
System ok	On	Off
Application Software not Loaded	On	On

USB connector

The USB port on the PCB is used to connect the Type VSD Controller to a computer equipped with the Valvescan Configuration Software.

Push Button

The push button on the PCB, located next to the LEDs, enable the Auto Calibration function of the Type VSD to be initiated.

Auto Calibration – Local

To start Auto Calibration, press and hold the Push Button for 3 seconds.

Auto Calibration – Remote

Auto Calibration can be initiated either with Valvescan Software installed on a computer and connected to the VSD Controller by the USB port in the unit. Go to the 'Calibration' section of the software and follow the instructions.

Auto Calibration Sequence

The auto-calibration is performed in 6 steps:

- De-energise solenoid (actuator vent)
- Energise solenoid (pressure to actuator)
- De-energise and re-energise solenoid to obtain PST reference data
- De-energise solenoid (actuator vent)
- Energise solenoid (pressure to actuator)
- Pulse test solenoid

Alternatively, when calibrating from a Computer each of the 3 tests can be performed independently.

The data obtained from the Auto Calibration is stored within the Type VSD Controller for reference during diagnostic checks. Any subsequent re-calibration will overwrite this data.

NOTE: Unless the Controller includes the additional SD card (standard with the capacitor backup option), detailed graphical information for the last test or stroke of the valve only will be stored. In this case, it is important to calibrate the device 'step-by-step', downloading the graphical data after each of the calibration steps.

3. Software Configuration

SAFETY NOTICE: Connecting a PC directly to the Type VSD Controller with the Cover removed should only be done in a Non-Hazardous Area or in accordance with the Plant's Hot Work Procedures

The PC based configuration software is used to set up the Type VSD Controller to perform its required Valve Test and Diagnostic functions. **The unit will have been 'pre-configured' by Imtex prior to despatch based on information supplied by the Customer at time of order. However, the set up can be changed by connecting the Valvescan Configuration Software if required.** NOTE: This section assumes the software has been successfully installed on a PC and that the solenoid and ESD signal / power supply has already been connected to the Type VSD Controller in accordance with document VSD-IOM-002.

1. Connect USB Port within the Controller to the USB port on the Computer. Ensure the Type VSD Controller is powered up (actuator in 'ready' position).

2. Start the Configuration software.

3. From the 'Function' dropdown menu, select 'Connect'

4. Press the 'Auto Detect' button on the pop up screen. The computer should detect the connected Controller and load a Configuration page (can take up to 1 minute).

5. If the Auto Detect fails to find a Controller, check the USB connection and retry.

6. If the Auto Detect still fails to find a Controller, ensure that the computer is up-to-date with its Windows Drivers. To update, an Internet connection may be necessary and automatic Windows updates should be enabled.

7. If the Auto Detect still fails to find a Controller, contact Imtex

8. Once the Configuration pages are loaded, press the 'Read All' button at the bottom of the Configuration screen. This will upload the current set up stored on the Controller.

9. In the configuration screen, configure the Controller settings as desired. (see below)

10. Once complete, press the 'Write All' button at the bottom of the Configuration screen to transmit the set up to the Type VSD Controller.

11. Run a Calibration to complete the Configuration process.

Parameter List

NOTE: The Parameter List includes a number of parameters that relate to other Partial Stroke Systems available from Imtex Controls that can also be configured in the Valvescan Software. Those that are not relevant to the Type VSD Controller are shown in Italics.

LOG		
System error log		System Log Messages
Number of errors	0	Number of entries in the log
System error 1	0	Value of Newest System Error
System error 2	0	Value of error
System error 3	0	Value of error
System error 4	0	Value of error
System error 5	0	Value of error
System error 6	0	Value of error
System error 7	0	Value of error
System error 8	0	Value of error
System error 9	0	Value of error
System error 10	0	Value of oldest error, if a new error occurs this value will be removed.
Test log		Test Log
Number of errors	0	Number of entries in the log
Test error 1	0	Value of newest test logging
Test error 2	0	Value of test logging
Test error 3	0	Value of test logging
Test error 4	0	Value of test logging
Test error 5	0	Value of test logging
Test error 6	0	Value of test logging
Test error 7	0	Value of test logging
Test error 8	0	Value of test logging
Test error 9	0	Value of test logging
Test error 10	0	Value of oldest test logging, if a new error occurs this value will be removed

LIVE STATUS			
Live Status			
Position – travel	0.0%		Position in % For Switches 0% and 100% are shown)
End position – 100%	0		
End position – 0%	0		
Digital Inputs			
DI1	0		Current value of the input
DI2	0		Current value of the input
DI3	0		Current value of the input
DI4	*0*		*Current value of the input*
DI5	*0*		*Current value of the input*
DI6	*0*		*Current value of the input*
DI7	*0*		*Current value of the input*
DI8	*0*		*Current value of the input*
DI9	*0*		*Current value of the input*
DI10	*0*		*Current value of the input*
DI11	*0*		*Current value of the input*
DI12	*0*		*Current value of the input*
DI13	*0*		*Current value of the input*
DI14	*0*		*Current value of the input*
DI15	*0*		*Current value of the input*
DI16	*0*		*Current value of the input*
DI17	*0*		*Current value of the input*
Digital Outputs			
DO1	Off		Current status of DO1
DO2	Off		Current status of DO2
DO3	Off		Current status of DO3
DO4	*Off*		*Current status of DO4*
DO5	*Off*		*Current status of DO5*
DO6	*Off*		*Current status of DO6*

Analogue Inputs			
Analogue Input 0			
AI0 - unit	0		Value measured in a given unit
AI0 - mA	0		mA value of the input
Analogue Input 1			
AI1 - unit	0		Value Measured at the input
AI1 - mA	0		mA value of the input
Analogue Input 2			
AI2 - unit	0		Value measured in a given unit
AI2 - mA	0		mA value of the input
Analogue Input 3			
AI3 - unit	*0*		*Value measured in a given unit*
AI3 - mA	*0*		*mA value of the input*
Analogue Input 4			
AI4 - unit	*0*		*Value measured in a given unit*
AI4 - mA	*0*		*mA value of the input*

VALVE TEST STATUS			
Latest tests			
Last PST result	No Test		Result of the last Partial Stroke Test
Last FST result	No Test		Result of the last Full Stroke Test
Last SOT result	No Test		Result of the last Solenoid Valve Test
Partial Stroke Test			
Last Test			Last Partial Stroke Test Measurements
PST breakaway time	0		Breakaway Time
PST closing time	0		Closing Time
PST opening time	0		Opening Time
PST total time	0		Total Time
PST max travel	0		Maximum travel distance
Reference Test			Partial Stroke Reference Measurements
PST breakaway time	0		Breakaway Time
PST closing time	0		Closing Time
PST opening time	0		Opening Time
PST total time	0		Total Time
PST max travel	0		Maximum travel distance
Full Stroke Test			
Last Test			Last Full Stroke Test Measurements
FST breakaway time	0		Breakaway Time
FST closing time	0		Closing Time
FST opening time	0		Opening Time
FST total time	0		Total Time
Reference Test			Full Stroke Reference Measurements
FST breakaway time	0		Breakaway Time
FST closing time	0		Closing Time
FST opening time	0		Opening Time
FST total time	0		Total Time
Solenoid Test			
Last Test			Last Solenoid Test Measurements
Start pressure	0		Start pressure at SOV test
Reaction time	0		SOV reaction time
Breakaway time	0		SOV breakaway time

Breakaway pressure	0		SOV breakaway pressure
Total time	0		Total time
Reference Test			Solenoid Reference Measurements
Start pressure	0		Start pressure at SOV test
Reaction time	0		SOV reaction time
Breakaway time	0		SOV breakaway time
Breakaway pressure	0		SOV breakaway pressure
Total time	0		Total time

CONFIGURATION			
Valve configuration			
Valve function			Configure how to operate the valve
Valve open - DO1	Not Used		Open valve DO1
Valve open - DO2	Not Used		Open valve DO2
Valve open - DO3	Not Used		Open valve DO3
Valve open - DO4	*Not Used*		*Open valve DO4*
Valve open - DO5	*Not Used*		*Open valve DO5*
Valve open - DO6	*Not Used*		*Open valve DO6*
Valve open - SIL	On		Open valve SIL relay
Valve close - DO1	Not Used		Close valve DO1
Valve close - DO2	Not Used		Close valve DO2
Valve close - DO3	Not Used		Close valve DO3
Valve close - DO4	*Not Used*		*Close valve DO4*
Valve close - DO5	*Not Used*		*Close valve DO5*
Valve close - DO6	*Not Used*		*Close valve DO6*
Valve close - SIL	Off		Close valve SIL relay
Position input Signal			
Position input	AI1 (position input)		Position input signal
Position input Switches			
Position switch 100% - For Opening	*DI1 cont*		*Set the 100% switch, only if position input is switches*
Position switch 0% - For Closing	*DI2 cont*		*Set the 0% switch, only if position input is switches*
Transmitter AO0			
Fail Position	None		Set the transmitter output to this value if there is a system error

SIGNAL CONFIGURATION			
Digital input configuration			
DI1 - Type	Normally open		Digital Input type
DI2 - Type	Normally open		Digital Input type
DI3 - Type	Normally open		Digital Input type
DI4 - Type	*Not Used on VSD*		
DI5 - Type	*Not Used on VSD*		
DI6 - Type	*Not Used on VSD*		
DI7 - Type	*Not Used on VSD*		
DI8 - Type	*Not Used on VSD*		
DI9 (Pot High) - Type	*Not Used on VSD*		
DI10 (Pot W) - Type	*Not Used on VSD*		
DI11 (Pot Low) - Type	*Not Used on VSD*		
DI12 (AI0) - Type	*Not Used on VSD*		
DI13 (AI1) - Type	*Not Used on VSD*		
DI14 (AI2) - Type	*Not Used on VSD*		
DI15 (AI3) - Type	*Not Used on VSD*		
DI16 (AI4) - Type	*Not Used on VSD*		
DI17 (AI5) - Type	*Not Used on VSD*		
Analogue input configuration			
Analogue Input 0			Calibration and setup of Analogue Input 0
AI0 - Unit 0% value	0.00	Eg: 0 for 0.0 Bar	Unit Conversion scale value
AI0 - Unit 100% value	100.00	Eg: 25000 for 250.0 Bar	Unit Conversion scale value
AI0 - 0% value adc			
AI0 - 100% value adc			
AI0 - 4mA adc			4mA Signal Calibration value
AI0 - 20mA adc			20mA Signal Calibration value
Analogue Input 1			Calibration and setup of Analogue Input 1
AI1 - Unit 1 value	0.00	Eg: 0 for 0.0 degree	Unit Conversion scale value
AI1 - Unit 2 value	100.00	Eg: 90 for 90.0 degree	Unit Conversion scale value
AI1 - 1 value adc			
AI1 - 2 value adc			
AI1 - 4mA adc			4mA Signal Calibration value

AI1 - 20mA adc			20mA Signal Calibration value
Analogue Input 2			Calibration and setup of Analogue Input 2
AI2 - Unit 1 value	0.00	Eg: 0 for 0.0 degree	Unit Conversion scale value
AI2 - Unit 2 value	100.00	Eg: 90 for 90.0 degree	Unit Conversion scale value
AI2 - 1 value adc			
AI2 - 2 value adc			
AI2 - 4mA adc			4mA Signal Calibration value
AI2 - 20mA adc			20mA Signal Calibration value
AI3, AI4, AI5	*Not Used on VSD*		
Analogue output Configuration			
Analogue Output 0			Calibration and setup of Analogue Output 0
Direction	Direct		Direct or Reverse
AO0 - 4mA dac			Signal Calibration for 4mA output value
AO0 - 20mA dac			Signal Calibration for 20mA output value
AO0 - set dac			
AO0 - set Fail value	Undefined		
AO0 - set Direction	Undefined		

LOCAL CONTROL PANEL			
Local/remote			
Local mode signal input	None		Set the controller in local mode with this digital input, Remote is the default
Local open signal input	None		Push button to open the valve when in local mode
Local close signal input	None		Push button to close the valve when in local mode
Local continuously open signal input	None		Digital input which must be connected to open the valve when in local mode
Remote open signal input	DI2 long push		Push button to open the valve when in remote mode
Remote close signal input	DI3 long push		Push button to close the valve when in remote mode
Remote continuously open signal input	None		Digital input which must be connected to open the valve when in remote mode
End position deadband	0		The deadband used to determine if the valve is at 0% or 100%
0% signal output	None		Output to indicate that the valve is at 0%
100% signal output	None		Output to indicate that the valve is at 100%
ESD Reset Configuration			
Reset input signal	None		Digital input to set the pump controller in manual mode
Ready to reset output signal	None		Digital input to start the pump when the pump controller is in manual mode
Valve test			
Partial Stroke Test			
PST start input signal	DI1 Short Push		Push button to start a partial stroke
PST in progress output signal	None		Digital output to show that a partial stroke is in progress
PST OK output signal	None		Digital output to show that the latest partial stroke was successful
PST Fail output signal	None		Digital output to show that the

			latest partial stroke failed
PST Warning output signal	None		Digital output to show that the latest partial stroke ended with a warning
Full stroke test			
FST start input signal	None		Push button to start a full stroke
FST in progress output signal	None		Digital output to show that a full stroke is in progress
FST OK output signal	None		Digital output to show that the latest full stroke was successful
FST Fail output signal	None		Digital output to show that the latest full stroke failed
FST Warning output signal	None		Digital output to show that the latest full stroke ended with a warning
Solenoid test			
SOT start input signal	None		Push button to start a solenoid test
SOT in progress output signal	None		Digital output to show that a solenoid test is in progress
SOT OK output signal	None		Digital output to show that the latest solenoid test was successful
SOT Fail output signal	None		Digital output to show that the latest solenoid test failed
SOT Warning output signal	None		Digital output to show that the latest solenoid test ended with a warning

PUMP CONTROLLER			
Pump Controller			
Pump control active	Always Off		Activate the pump controller
Pump output signal	None		Output to activate the pump
Stop pump on ESD	No		Stop the pump when an ESD is detected
Motor Safety relay			
Input signal	None		Input for the motor safety relay
Output signal	None		Output to show that there is an error on the safety relay
Max running time			
Status	Off		Turn on the max running time function
Time	120 sec		The maximum running time limit in sec
Output signal	None		Output which is activated when the maximum running time is reached
Pressure			
Pressure analogue input signal	None		The pressure input sensor
Pressure low digital input signal	None		Pressure low input switch
Pressure high digital input signal	None		Pressure high input switch
Pressure low limit	0		Start the pump below this value
Pressure high limit	0		Stop the pump above this value
Pressure low output signal	None		Output which is active when the pressure is low
Pressure high output signal	None		Output which is active when the pressure is high
Temperature			
Temperature analogue input signal	None		The temperature input sensor
Temperature low digital input signal	None		Temperature low input switch
Temperature high digital input signal	None		Temperature high input switch
Temperature low limit	50		Temperature error below this limit
Temperature high limit	0		Temperature error above this limit

Temperature low output signal	None		Output which is active when the temperature is low
Temperature high output signal	None		Output which is active when the temperature is high
Temperature stop on error	Yes		Stop the pump on a temperature error
Level			
Level analogue input signal	None		The level input sensor
Level low digital input signal	None		Level low input switch
Level low limit	0		Level high input switch
Level limit output signal	None		Output which is active when the level is low
Level stop on error	Yes		Stop the pump on a level error

PST CONFIGURATION			
Valve configuration			
DO1	Not Used		PST close valve DO1
DO2	Not Used		PST close valve DO2
DO3	Not Used		PST close valve DO3
DO4	*Not Used in VSD*		
DO5	*Not Used in VSD*		
DO6	*Not Used in VSD*		
Valve PST close - SIL	Off		PST close valve SIL relay
PST position			
SP switch signal input	*None*		*Set the PST switch, only if position input is switches*
Position deadband	0		Set the partial stroke deadband, only if position input is AI1
PST travel	0		The partial stroke travel, only if position input is AI1
PST Error parameters			
Disable all errors	Yes		Disable all PST errors
PST breakaway timeout	0		Breakaway timeout for the partial stroke test
PST closing timeout	0		Closing time out for the partial stroke
PST total timeout	0		Total timeout for the partial stroke
PST Warning parameters			
Disable all warnings	Yes		Disable all PST warnings
PST breakaway time low	0		Low limit for breakaway time warning
PST breakaway time high	0		High limit for breakaway time warning
PST closing time low	0		Low limit for closing time warning
PST closing time high	0		High limit for closing time warning
PST total time low	0		Low limit for total time warning
PST total time high	0		High limit for total time warning
FST CONFIGURATION			
Valve configuration			

DO1	Not Used		FST close valve DO1
DO2	Not Used		FST close valve DO2
DO3	Not Used		FST close valve DO3
DO4	*Not Used in VSD*		
DO5	*Not Used in VSD*		
DO6	*Not Used in VSD*		
Valve FST close - SIL	Off		FST close valve SIL relay
FST Error parameters			
Disable all errors	No		Ignore all FST errors
FST breakaway timeout	0		Breakaway timeout for the full stroke test
FST closing timeout	0		Closing time out for the partial stroke
FST total timeout	0		Total timeout for the partial stroke
FST Warning parameters			
Disable all warnings	Yes		Disable all FST warnings
FST breakaway time low	0		Low limit for breakaway time warning
FST breakaway time high	0		High limit for breakaway time warning
FST closing time low	0		Low limit for closing time warning
FST closing time high	0		High limit for closing time warning
FST total time low	0		Low limit for total time warning
FST total time high	0		High limit for total time warning
FST configuration			
Wait at fail pos during reference			Wait for pressure to drop during calibration
SOV activate time	0		Auto set during calibration based on FST closing time and wait at fail position

SOT CONFIGURATION			
DO1	Not Used		SOT close valve DO1
DO2	Not Used		SOT close valve DO2
DO3	Not Used		SOT close valve DO3
DO4	*Not Used*		
DO5	*Not Used*		
DO6	*Not Used*		
Valve SOT close - SIL	Off		SOT close valve SIL
SOT Error parameters			
Disable all errors	No		Disable all SOT warnings
Timeout	0		The timeout, before which a pressure drop must occur
Start pressure high	0		High limit for the start pressure
Start pressure low	0		Low limit for the start pressure
SOT configuration			
SOT pressure input	None		The input for the pressure sensor. To perform SOT without pressure sensor set to None
Pressure deadband	0		The pressure deadband which is used to determine if the SOV has reacted

COMMUNICATION			
Modbus Network Parameters			Modbus Parameters
Node ID	1		Select Node ID
Baudrate	600:57600 Baud		Select Baudrate
Parity	Even Parity		Select Parity
Stopbits	1 Stopbit		Select Stopbits

4. Valve Test

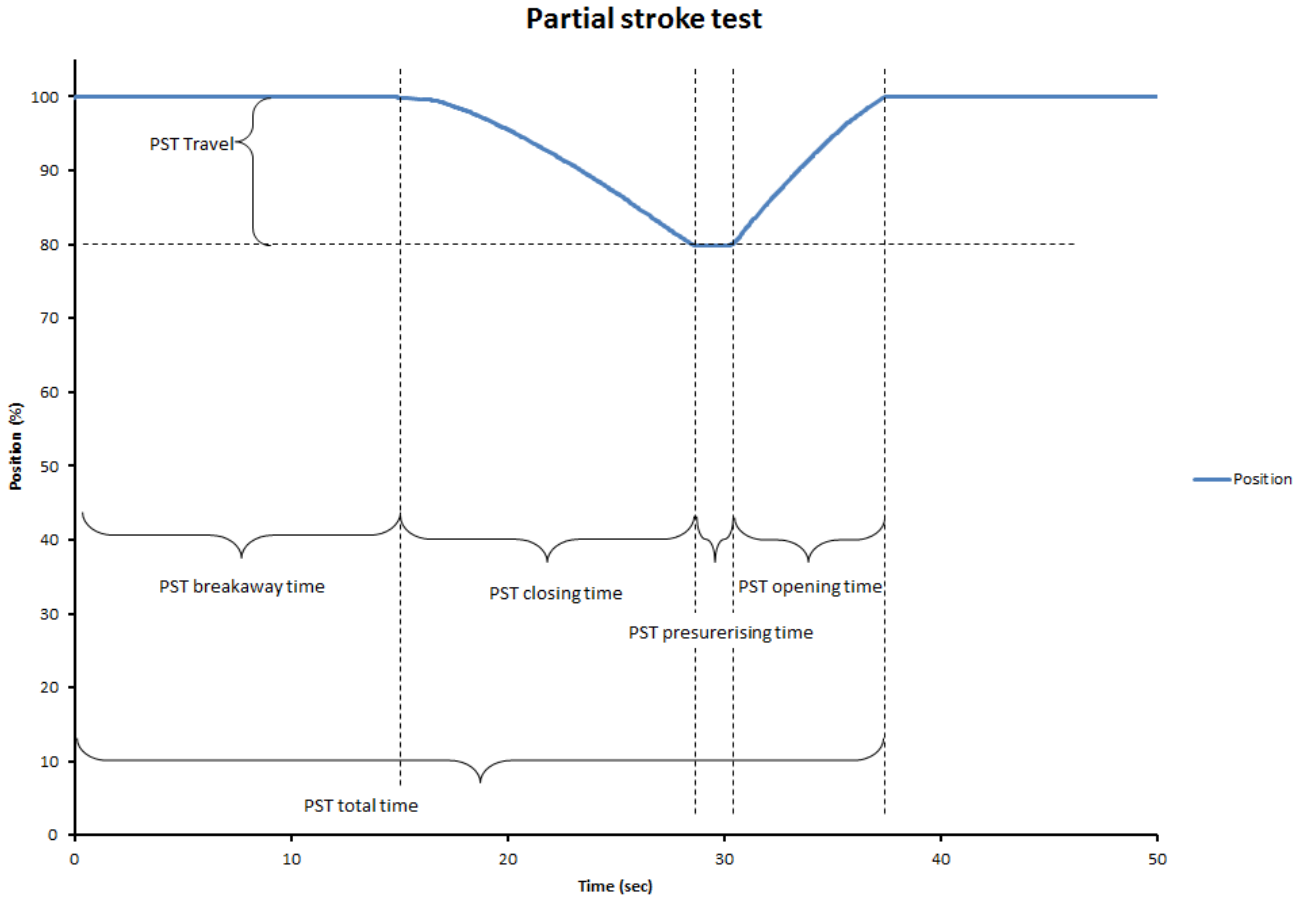
NOTE: The graphs shown in this section are to illustrate the definitions described below. The graphs can be downloaded from the VSD Controller and viewed only if the VCDC Diagnostic Software has been purchased and installed.

Partial Stroke Test (PST)

The partial stroke exercises the actuator and the valve and confirms that the actuator can move the valve.

The actuator will move the distance specified by the PST and then go back to its operating position. A short travel will only impact the flow in the valve insignificantly and therefore can the test be performed while the system is in production.

Below is a signature from typical partial stroke shown, including definitions on the different terms further used within this manual.



When a partial stroke is started the position is evaluated. The valve must be full open before the partial stroke can start.

The VSD Controller monitors the position during the partial stroke. The VSD aborts the partial stroke and report an error if the limits in the error parameters are reached.

If a partial stroke does not reach the limits it will be carried out in full and then the warning parameters are evaluated.

Error Definitions

PST start condition: Not fully open (Error: 401)
The valve must be fully open to perform a partial stroke. All measured times depend on the valve being fully opened.

PST error: No breakaway (Error: 411)
This arises if the position signal has not changed within the breakaway timeout.

This can occur if the solenoid valve is not reacting or the output of the solenoid valve is blocked.

PST error: Timeout while closing (Error: 415)
This arises if the PST Closing Time falls outside the time constraints.

PST error: Timeout while opening. (Error: 416)
This arises if the valve is unable to open again.

The cause of this problem may be no supply pressure or that the solenoid valve cannot be energized.

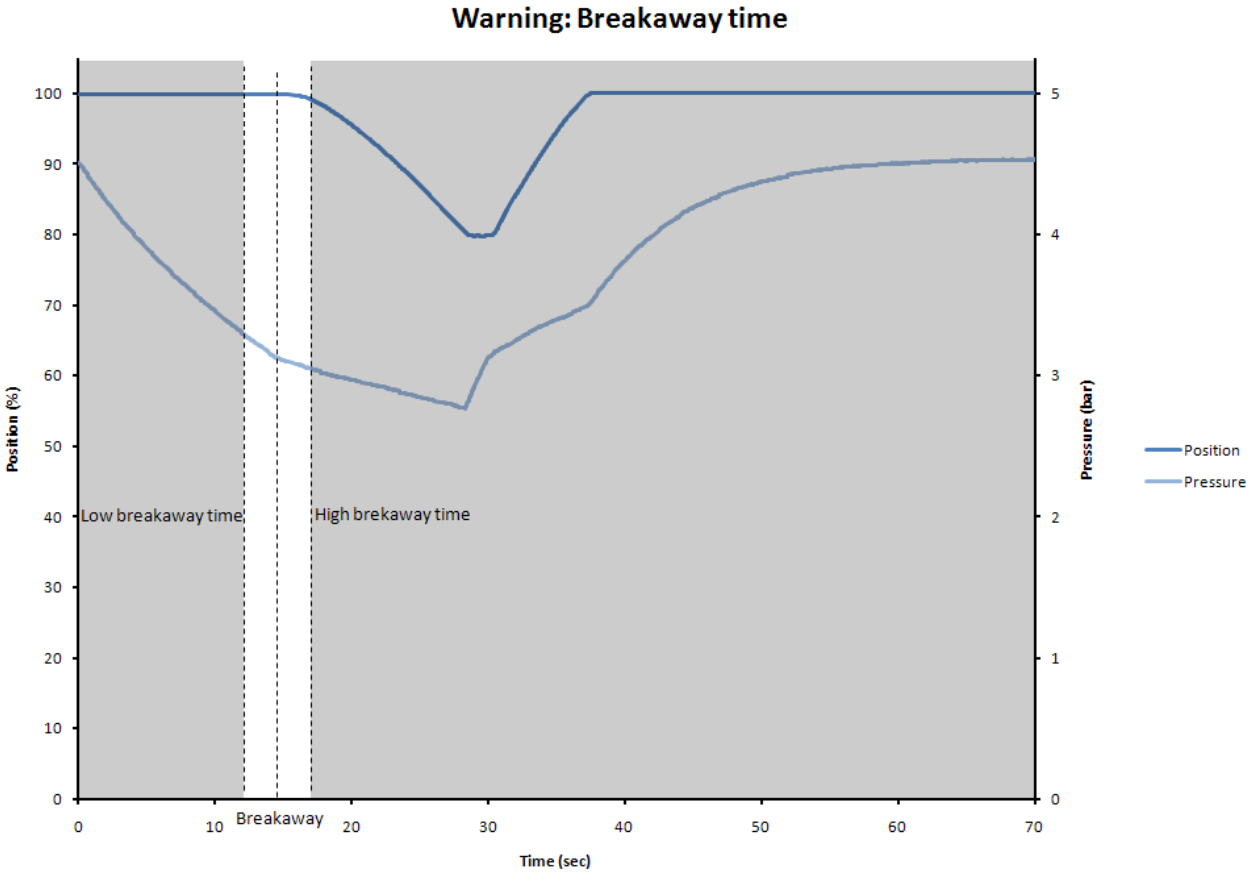
Warning Definitions

Warnings can be used to notify the operator that the actuator or valve has changed characteristics. For both breakaway time and travel time it is possible to set a high and low error level in the Test Configuration sections of the Valvescan Software (see Parameter List section 3 above). It requires knowledge of the physical system to determine reasonable error and warning limits as they depend on several factors, e.g. variation in pressure in the hydraulic/pneumatic system. If the measured times exceed the alarm limits, an error is raised. The error can only be removed by performing a successful subsequent test.

PST warning: Breakaway time (Error: 433 and 434)

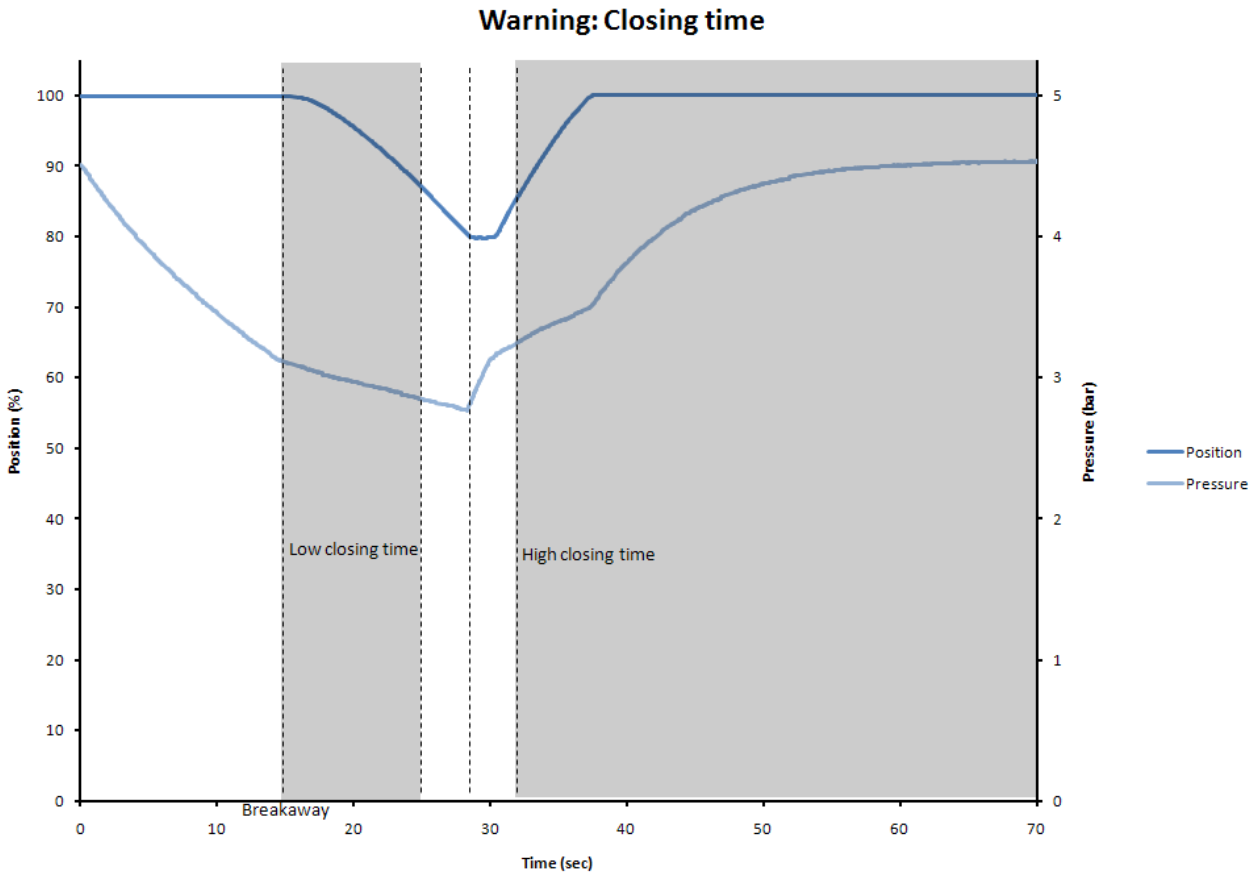
The breakaway time is measured from the point when the test is initiated to when the valve position is measured to have changed, accounting for any deadband defined in the advanced setup menu (2.5).

A long breakaway time may indicate that the valve is stuck in the operational position and then when it breaks away moves fast as there is build-up of pressure in the hydraulic/pneumatic system.



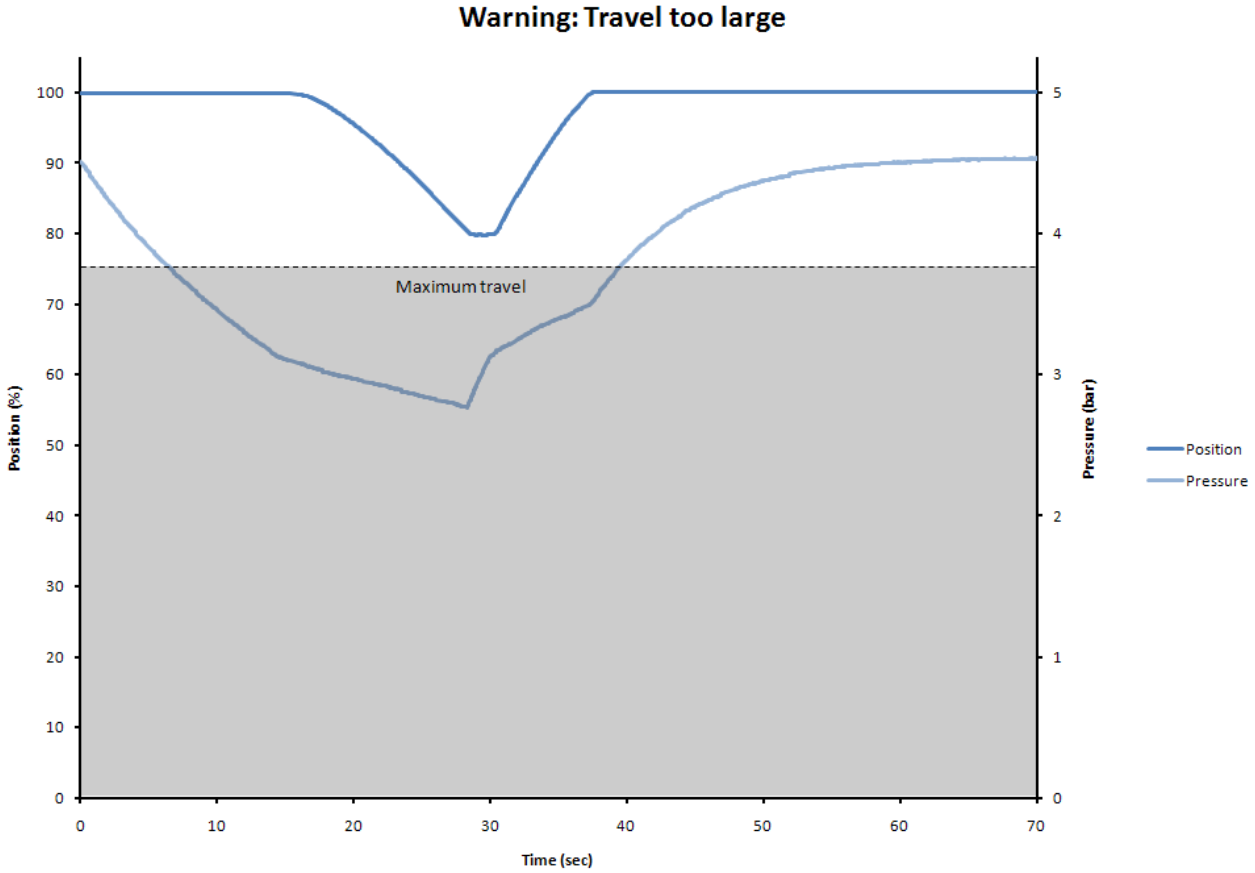
PST warning: Closing time (Error: 435 and 436)
The closing time is defined as the time it takes to move from fully open to the PST set point.

If the partial stroke closing time has changed it can indicate that the full stoke closing time may also have changed.

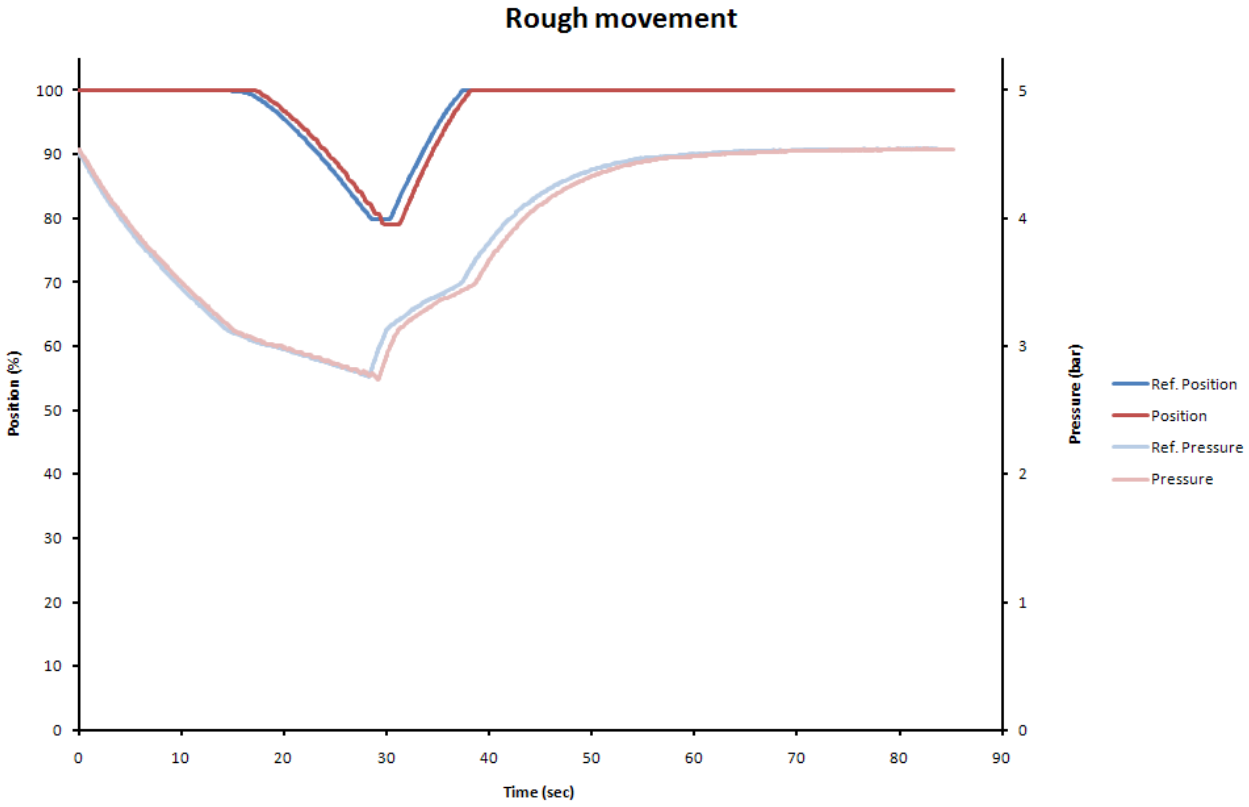


PST warning: Travel too large (Error: 437)

During the partial stroke the Type VSD monitors the maximum travel from fully open. The alarm on the travel can be used to ensure that the partial stroke does not interrupt the production by moving the valve too much.



Rough movement



The Type VSD Controller will not report errors if the deviations from the reference curve are small. In cases like this the signatures must be extracted and analysed visually in the VCDC Software

The above example shows a curve from a valve with increased torque which leads to uneven movement. The measured times and pressures do not give an error but in time the performance may deteriorate to a point that errors will be given.

Full Stroke Test (FST)

The Type VSD Controller can perform a Full Stroke Test (fully operating the Valve). This test works and reports exactly in the same way as the PST apart from operating the Valve over its full range.

The pause time (time between valve completing the vent stroke and re-energising of the solenoid) can be set in the FST Configuration section of the Valvescan Software.

Solenoid Test (SOT)

The Type VSD Controller enables an independent solenoid test to be performed. This is a useful feature for when 2 solenoids are used to control the valve (configuration supported by the VSD Controller). A two solenoid solution might be required if:

- The valve is to be controlled by separate Control Systems e.g. A Plant Control System and a Emergency Shutdown System. One solenoid is then used for PST (normally the PCS Solenoid) whilst the primary ESD Solenoid still requires testing.

- The valve is very fast operating and there are concerns that running a partial stroke on a single solenoid might cause significant over-travel. A second solenoid with exhaust restriction can be used to run a PST to prevent this but the primary solenoid still requires testing.

The SOT can be performed in 2 ways:

By Position – this is similar to running a PST or FST. In this case, the VSD Controller de-energises the Solenoid until a movement of the valve is detected at which point the Solenoid is re-energised and the test data recorded/reported.

By Pressure – a 4-20mA pressure transmitter is installed in the Pressure Supply line to the Actuator, downstream of the solenoid to be tested. The transmitter is wired into Analogue Input 2 within the VSD Controller. When a test is initiated, the VSD Controller de-energises the Solenoid until a specified pressure drop is measured by the Pressure Transmitter at which point the Solenoid is re-energised. This means the test can be performed without any movement of the Valve occurring.

The preferred test option is specified in the Solenoid Test Configuration section within the Valvescan Software. If the Pressure Test is to be used, it is necessary to specify the Pressure Range that the transmitter can measure over (full scale) and what drop in pressure is to be detected before the VSD Controller re-energises the Solenoid. Take care to get the scaling correct to prevent testing problems.

5. Calibration Referencing

Automatic

The automatic calibration performs a reference partial stroke, full stroke and solenoid test. The reference stroke is used to set the error and warning parameters. These parameters are used further on to determine the state of the actuator and valve during a later test.

The automatic calibration is started as described previously.

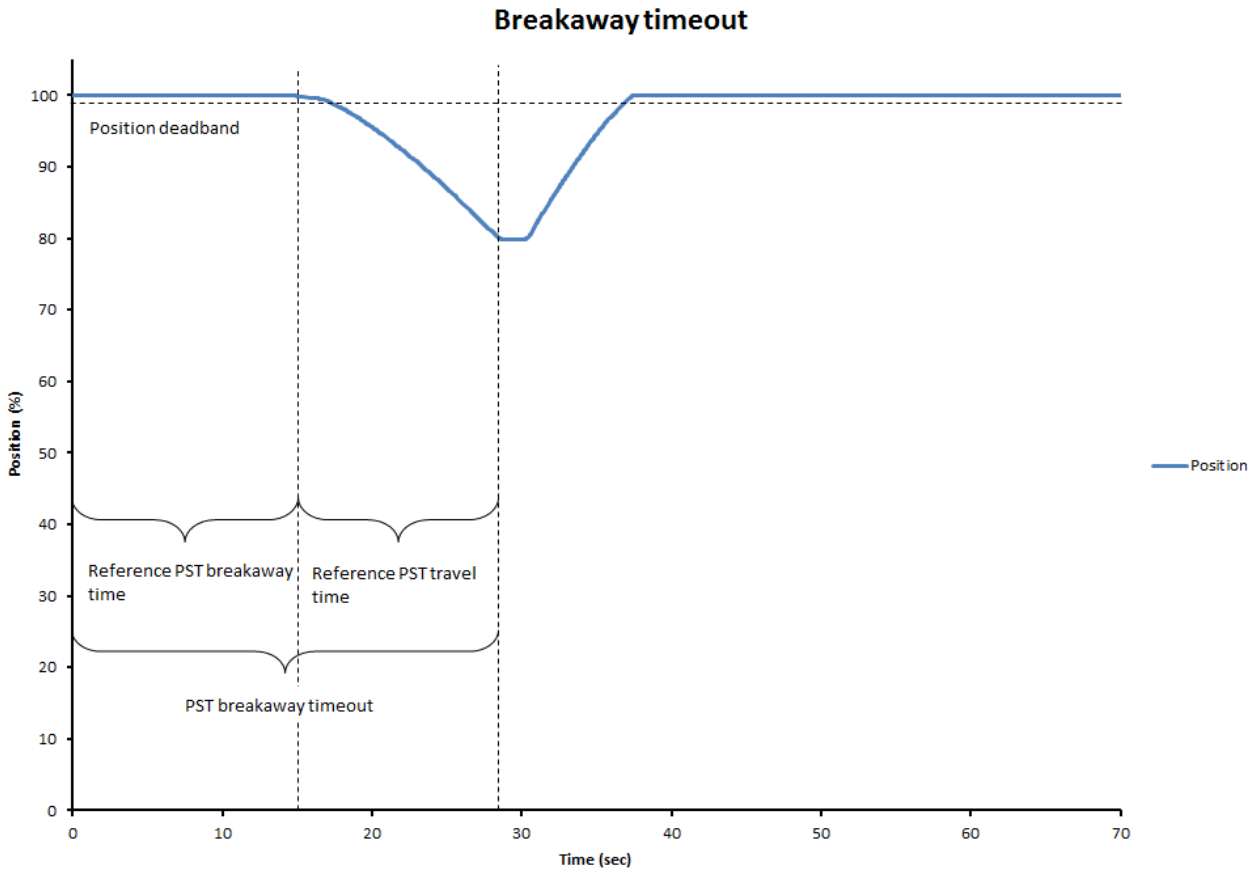
Test References

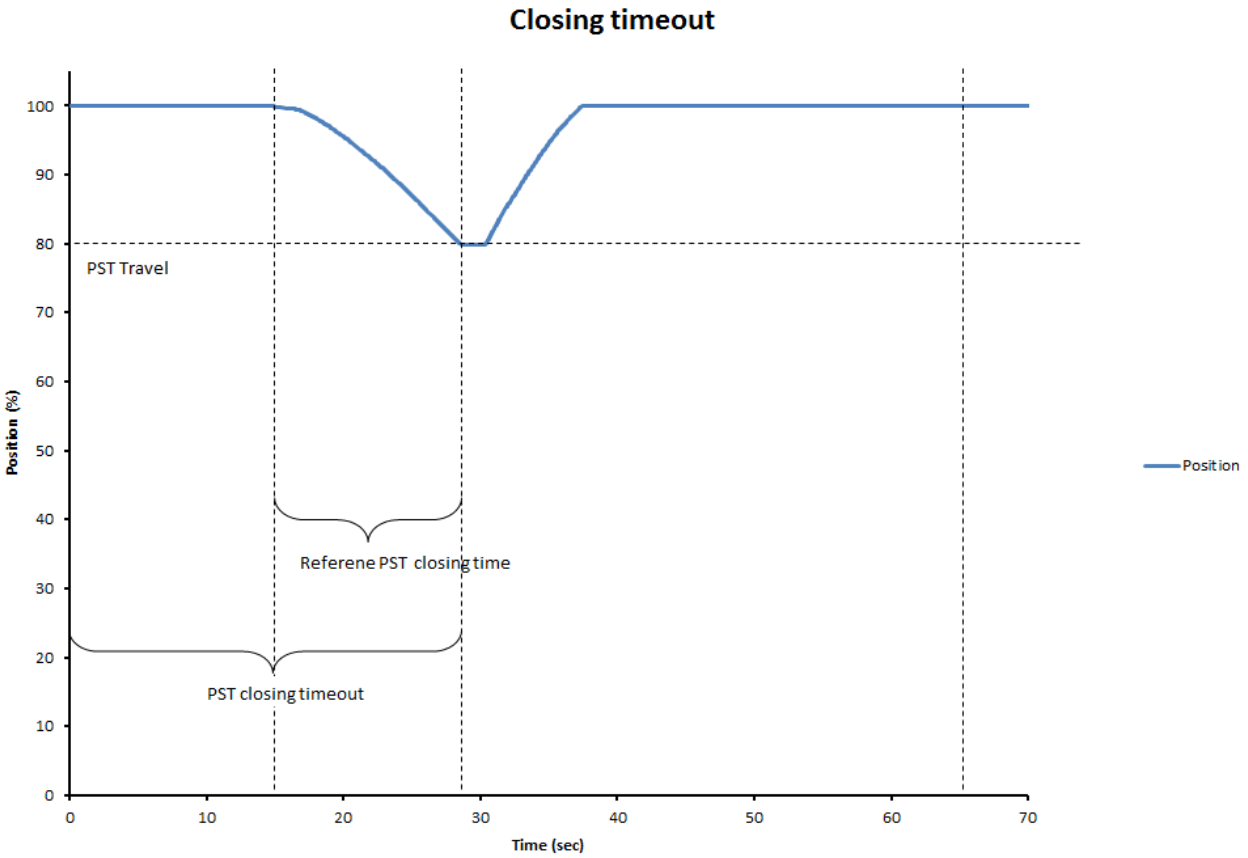
Perform an Auto-calibration to establish a reference data set for each of the test options available from the unit and set the error and warning parameters.

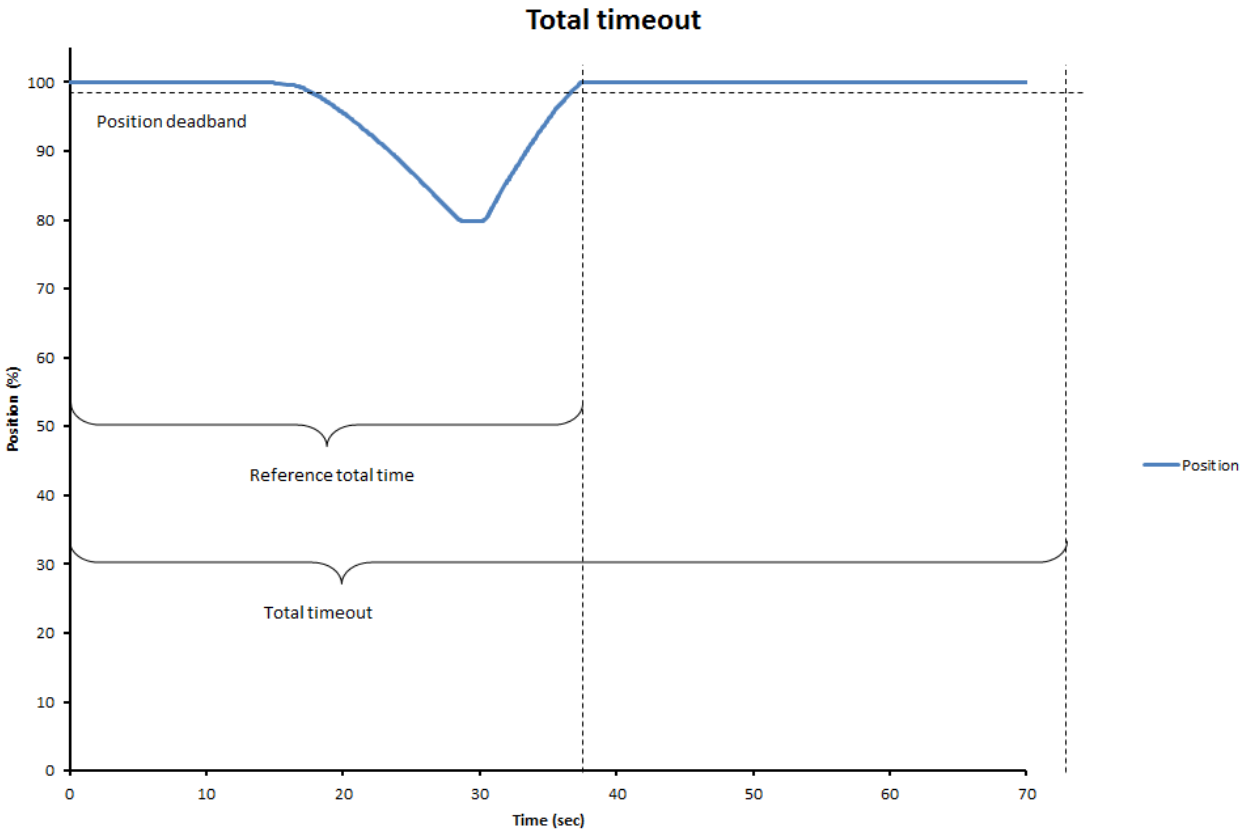
Each of the tests will assign default error and warning levels based on the reference test as follows::

- Breakaway timeout = Reference breakaway time + reference closing time
- Closing timeout = Reference Full Test time
- Total timeout = 2 * Reference Full Test time

The error and warning levels can be adjusted in the Valvescan Software if desired. The criteria for the Error and Warning levels are shown graphically below, using a Partial Stroke Test to illustrate.


Breakaway timeout
Position deadband
Reference PST breakaway time
Reference PST travel time
PST breakaway timeout
Position (%)
Time (sec)
Position
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70


Closing timeout
100
90
80
70
60
50
40
30
20
10
0
Position (%)
PST Travel
Referene PST closing time
PST closing timeout
0
10
20
30
40
50
60
70
Time (sec)
Position



The partial stroke warning parameters are set to the following values:

- Low breakaway time = Reference breakaway time – 50%
- High breakaway time = Reference breakaway time + 50%
- Low closing time = Reference closing time – 50%
- High closing time = Reference closing time + 50%

6 . Other Options

Unit Memory

The basic VSD Controller has an internal memory that stores the following information:

- Reference Data for PST
- Reference Data for FST
- Reference Data for SOT
- Data gathered from last Test or Operation performed

Each time a subsequent test is performed, the data gathered overwrites the previous test. If the user wishes to store data from more tests, the Enhanced Memory version of the VSD Controller should be requested although this is included as standard when the Capacitor Back Up system is supplied. Contact Imtex Controls for details.

If fitted, no additional configuration is required by the user.

Advanced Diagnostics

The advanced diagnostics option allows the VSD Controller to gather data from an external transmitter, such as a pressure transmitter, whenever the Valve is stroked. This provides further information for any diagnostic analysis of the Valve carried out within the VCDC Software. If required, the 'Advanced Diagnostic' option should be requested at quotation– contact Imtex Controls for details.

If fitted, additional configuration is required by the user within the Valvescan Configuration Software to confirm the scale range of the transmitter. Go to the 'Analogue Input Configuration' section.

Event Time/Date Stamp

The VSD Controller has the ability to date stamp any test that occurs. This is an additional feature that should be requested from Imtex Controls, although is supplied as standard when the Capacitor Backup option is included.

If this feature is activated in the supplied unit, the units Date/Time can be set from the 'Control' screen within the Valvescan Software or from within the Bluetooth app. To maintain the setting, the VSD Controller needs to be continuously powered by a suitable Watch Battery this is fitted into the Battery slot on the Electronics Board. The Watch Battery should be replaced every 2 to 3 years as part of a routine maintenance programme. The Date/Time may require re-setting after a battery change.

7. Test Errors

Partial Stroke Errors

No. 401	
Description	The valve is not fully open
Trouble shooting	This error can be solved by • Make sure the valve is fully open

No. 411	**PST Error: No breakaway**
Description	Breakaway is not detected
Trouble shooting	This error may be due to: • Blocked output of actuator • Solenoid valve is stuck This error can be solved by: • Clear the output of the actuator • Increasing the Breakaway timeout

No. 415	**PST error: Timeout while closing**
Description	The valve did not move the desired PST travel before the closing timeout
Trouble shooting	This error can occur if: • The valve gets stuck during the test, due to an obstruction in the hydraulic/pneumatic system • The valve is moving slow It can be solved by: • Resolve the mechanical problem • Increasing the Closing timeout

No. 416	PST error: Total timeout
Description	The valve did not open within the opening timeout
Trouble shooting	This error can be caused by: • No supply pressure • The valve is stuck • The valve is moving slow • The solenoid valve cannot be activated It can be solved by: • Resolve the mechanical problem • Increase Opening timeout

No. 433	PST warn: Breakaway time is too low
Description	The breakaway time is lower than the breakaway time low warning
Trouble shooting	This alarm can be solved by: • Resolve the mechanical problem • Decrease the partial stroke breakaway time low warning

No. 434	PST warn: Breakaway time is too high
Description	The breakaway time is higher than the breakaway time high warning
Trouble shooting	This alarm can be solved by: • Resolve the mechanical problem • Increase the partial stroke breakaway time high warning

No. 435	PST warn: Closing time is too low
Description	The travel time is lower than the Travel time low warning
Trouble shooting	This alarm can be solved by: • Resolve the mechanical problem • Increase the partial stroke closing time low warning

No. 436	PST warn: Closing time is too high
Description	The closing time is higher than the Travel time high warning
Trouble shooting	This alarm can be solved by: • Resolve the mechanical problem • Increase the partial stroke closing time high warning

No. 437	PST warn: Travel too large
Description	During the partial stroke did the actuator move more than maximum travel alarm
Trouble shooting	To remove this alarm: • Perform service on the actuator and valve • Increase Max travel

No. 438	PST warn: Total time is too low
Description	The total time is lower than the Total time low warning
Trouble shooting	This alarm can be solved by: • Resolve the mechanical problem • Increase the partial stroke total time low warning

No. 439	PST warn: Total time is too high
Description	The total time is higher than the Total time high warning
Trouble shooting	This alarm can be solved by: • Resolve the mechanical problem • Increase the partial stroke total time high warning

Full Stroke Errors

No. 451	FST start condition: Not full open
Description	The valve is not fully open
Trouble shooting	This error can be solved by • Make sure the valve is fully open • Perform an endpoint calibration. • Increase the full stroke position deadband

No. 464	FST error: Timeout while closing
Description	The valve did not close before the closing timeout
Trouble shooting	This error can occur if: • The valve gets stuck during the test, due to an obstruction in the hydraulic/pneumatic system • The valve is moving slow It can be solved by: • Resolve the mechanical problem • Increasing the Closing timeout

No. 466	FST error: Total timeout
Description	The valve did not open within the opening timeout
Trouble shooting	This error can be caused by: • No supply pressure • The valve is stuck • The valve is moving slow • The solenoid valve cannot be activated It can be solved by: • Resolve the mechanical problem • Increase full stroke total timeout

No. 483	FST warn: Breakaway time is too low
Description	The breakaway time is lower than the breakaway time low warning
Trouble shooting	This error can be solved by: • Resolve the mechanical problem • Decrease the full stroke breakaway time low warning

No. 484	FST warn: Breakaway time is too high
Description	The breakaway time is higher than the breakaway time high warning
Trouble shooting	This error can be solved by: • Resolve the mechanical problem • Increase the full stroke breakaway time high warning

No. 485	FST warn: Closing time is too low
Description	The closing time is lower than the closing time low warning
Trouble shooting	This error can be solved by: • Resolve the mechanical problem • Decrease the full stroke closing time low warning

No. 486	FST warn: Closing time is too high
Description	The closing time is higher than the closing time high warning
Trouble shooting	This error can be solved by: • Resolve the mechanical problem • Increase the full stroke closing time high

No. 487	FST warn: Total time is too low
Description	The closing time is lower than the total time low warning
Trouble shooting	This error can be solved by: • Resolve the mechanical problem • Decrease the full stroke total time low warning

No. 488	FST warn: Total time is too high
Description	The closing time is higher than the total time high warning
Trouble shooting	This error can be solved by: • Resolve the mechanical problem • Increase the full stroke total time high

Solenoid Valve Test

No. 501	SOT start condition: Not full open
Description	The valve is not fully open
Trouble shooting	This error can be solved by • Make sure the valve is fully open • Perform an endpoint calibration. Calibration menu (2) • Increase the solenoid position deadband in the Basic menu (4.1.2)

No. 502	SOT start condition: Low start pressure
Description	The measured pressure is below the start pressure minus the pressure deadband.
Trouble shooting	This error can be solved by: • Increase the pressure in the system • Decrease the Start pressure • Increase Pressure deadband

No. 503	SOT start condition: High start pressure
Description	The measured pressure is above the start pressure plus the pressure deadband.
Trouble shooting	This error can be solved by: • Decrease the pressure in the system • Increase Start pressure • Increase Pressure deadband

No. 511	SOT error: Timeout
Description	The pressure did not drop within max time
Trouble shooting	The solenoid valve did not react This error can be solved by: • Resolve the mechanical problem • Increase max time • Increase Pressure deadband

No. 512	SOT error: Breakaway, no pressure drop
Description	Breakaway is detected but there is no pressure drop
Trouble shooting	This error is generated when the pressure transmitter is not sensing the pressure drop. This error can be solved by: • Check pressure transmitter

8. Notes of Bluetooth Operation

The supplied unit is equipped with an Antenna (internally wired) and Bluetooth communication capability. This means that the Controller can be 'paired' with an android device and controlled by the Valvescan/Val Controls App running on the device.

The Bluetooth App allows the user to perform the following functions from a paired Bluetooth device:

- Partial Stroke Testing – Start test and receive Pass/Fail information
- Full Stroke Testing – Start test and receive Pass/Fail information
- Solenoid Testing – Start test and receive Pass/Fail information
- Open a Closed Valve (if ESD Line to solenoid is energised)
- Close an Open Valve (if ESD Line to solenoid is energised)
- Synchronise valve signatures and test data for Import into VCDC Diagnostic software (either loaded on the Android device itself or on a separate PC to which the data can be downloaded)

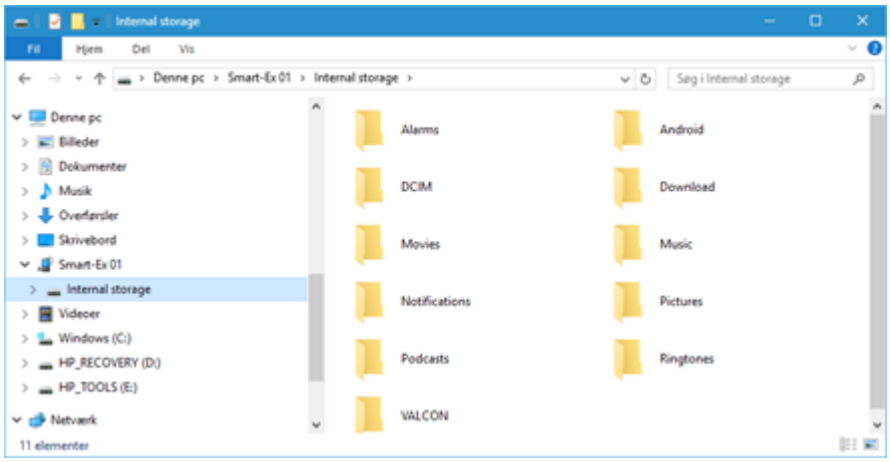
The Bluetooth App also displays the current status of the Controller to which it is connected.

The Bluetooth App can be downloaded from Google Play (standard installation on most Android devices). The App is call 'VCDC Mobile' from Val Controls.

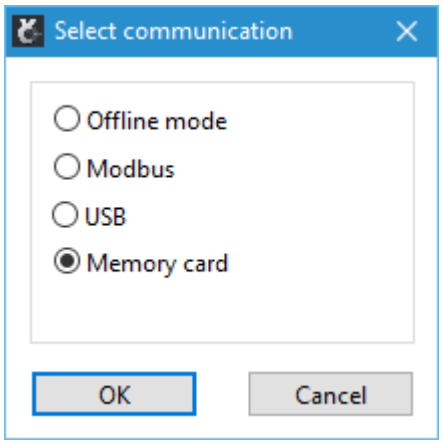
With the App open, connect to the VSD Controller by searching for the device (ensure Bluetooth is turned on on the Android device).

Once found, the Bluetooth App is simple to install and operate – just follow the instructions within the App. The 'LCP' enables tests to be performed whilst the 'SYNC' option enables the data within the VSD Controller to be downloaded to the tablet.

Once data is synchronised with the Android device, the data can be analysed within the VCDC software package. To do this, the data must be transferred to a PC running VCDC. Connect the Android device to the PC and locate the folder called 'VALCON'.



Drag this entire folder into a folder on the PC (name this folder with something identifiable e.g. 'Valvedata'.) Once the data is transferred, open VCDC, select 'Memory Card'



When asked for the target folder for the data, select the folder you created on the PC (‘Valvedata’).

The synchronised data can now be viewed in the graphical display.

For further information on Bluetooth operation, please contact Imtex – email sales@imtex-controls.com