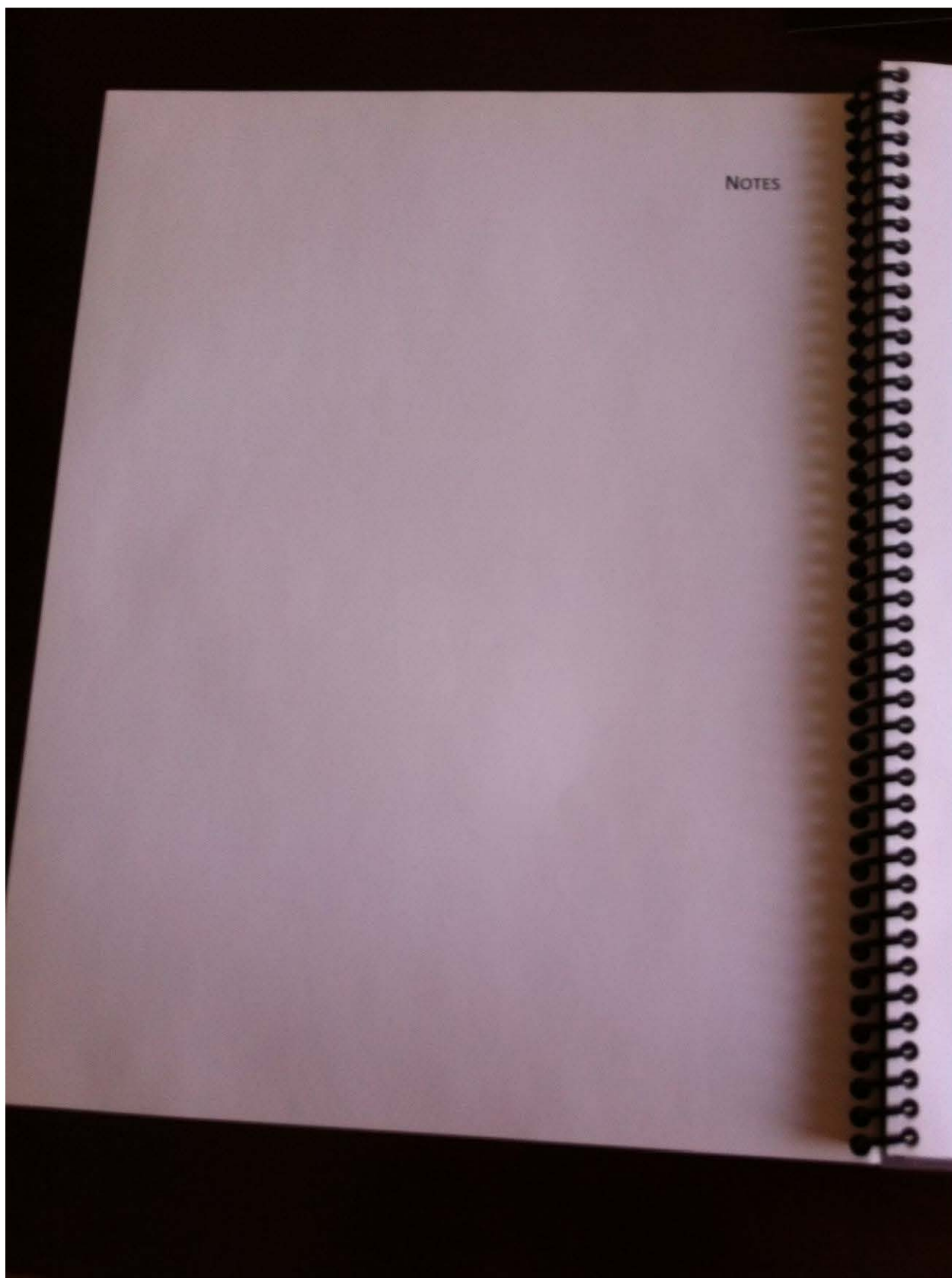


VDT-3600i User Guide



Revision 2.3
January 2015



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INTRODUCTION

Overview

This user guide describes the operation and installation of the VDT-3600i Valve Durability Tester manufactured by Biomedical Device Consultants and Laboratories (BDC Laboratories). The VDT-3600i is a test system used for mechanical fatigue testing and dynamic characterization of materials and test specimens. The system employs efficient and low friction independent electromagnetic technology to provide a wide range of testing frequencies and pressure conditions. The system is easily controlled with BDC Laboratories' Statys™ test software which provides a powerful and versatile platform for test management.

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Contact Information

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Wheat Ridge, CO 80033
303.456.4665
www.bdcclabs.com

Symbols



Hazardous Voltages

Dangerous voltages exist within the test system. Use extreme caution and ensure system power is disconnected.



Warning

Caution Required



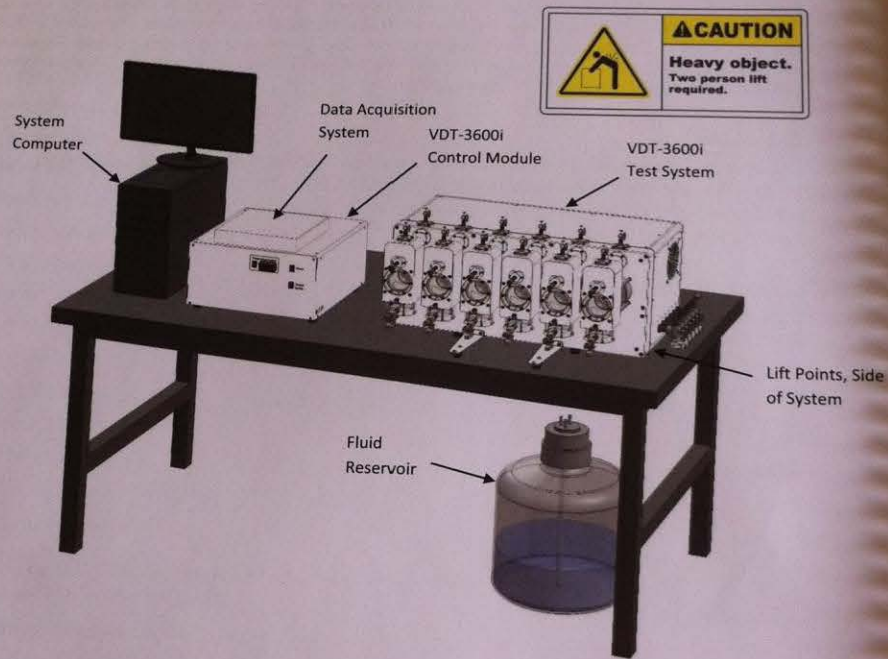
TIP

Additional information about specific functions

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SETUP

VDT-3600i SYSTEM



The VDT-3600i consists of up to six independent dynamic pressure drives, capable of a high frequency oscillatory motion, coupled with sample fixtures, a Pressure Distribution Chamber and a Test Head. Samples may be mounted through a variety of fixtures interfacing with the Test Head and Pressure distribution system. The system is filled with a working fluid, typically a saline solution, and temperature controlled.

Initial Set Up:

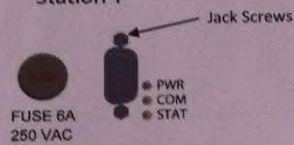
1. Unpack/uncrate the system checking for damage that may have occurred during shipping
 - a. If damage is evident, immediately contact BDC Laboratories' personnel
2. Move the system to a flat, stable location, near a suitable standard power source and pressurized air supply, (see pg. 53 for power and air specifications)

3. System may be setup as shown above or in another configuration so long as the Control Module, Data Acquisition System, and Computer are level with, or above, the VDT-3600I and Fluid Reservoir.

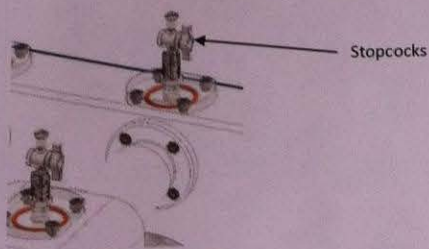
 **Control Module, Data Acquisition System, and Computer are *not* meant for a Wet Location and should not be setup in a location where fluid may ingress, drip, or otherwise interact with the module. Neither the Control Module nor Data Acquisition system should be setup under the VDT-3600I system.**

4. Make fluid and air connections to the VDTI-3600I (see Appendix E – Generic Fluid Connection Diagram)
 5. Make all necessary electrical connections (see Appendix F – Electrical Connection Diagram)
 a. Be sure to tighten all jack screws on Motor, DAQ, and Serial Cables

Station 1



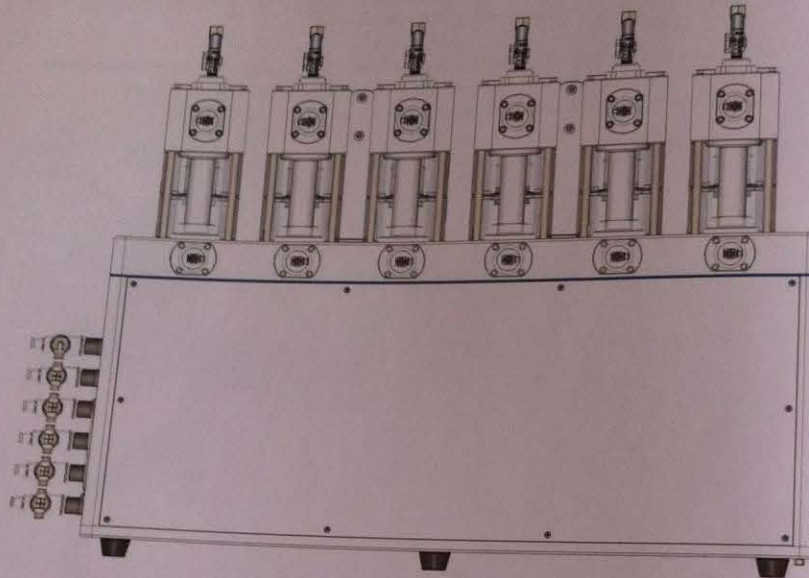
6. Attach stopcocks to all luer connections



7. Turn on computer, ensure Keylok device (looks like a USB thumb drive) is plugged in, and launch Statys VDT software

VERTICAL ORIENTATION

The VDT-3600i may optionally be mounted in a vertical orientation as shown below if the test article requires.



Care must be taken to ensure a leak free system in a vertical orientation which may cause damage to the dynamic drives. A horizontal orientation is recommended for general use.

SOFTWARE

The VDT-3600i is provided with Statys™ software for full control of test set up and monitoring. Statys™ is compatible with Microsoft Windows based computers and is easily installed.

1. Insert supplied Statys™ CD
2. Complete installation process

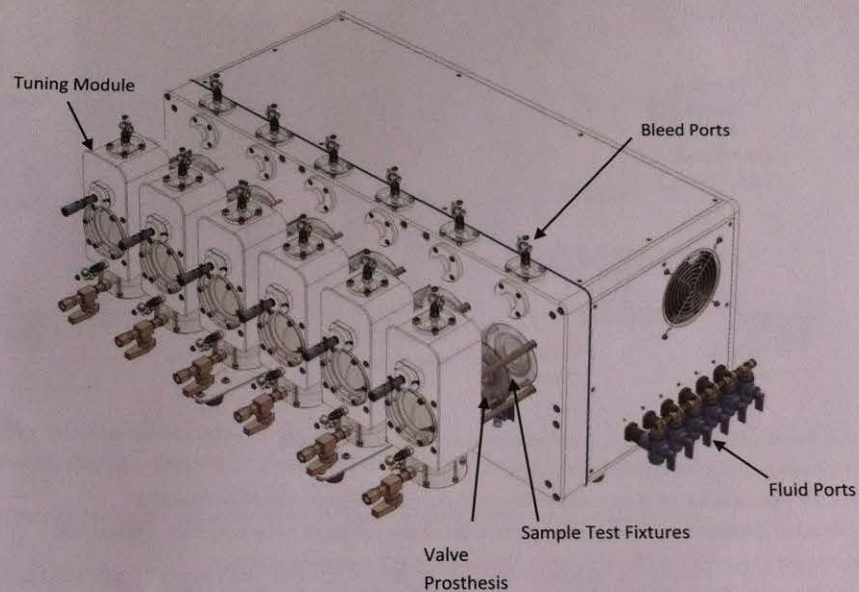
The installation program will place icons on the desktop that can be used to launch the program. All data files will be stored in directories specified during the installation process.

OPERATION

VDT-3600i TEST SYSTEM

OVERVIEW

The VDT-3600i Test System contains up to six independent computer controlled fluid actuators coupled with pressure and flow conditioning systems. Fluid is moved by the Dynamic Drive through the valve prosthesis and into the Tuning Module for pressure and flow conditioning. The loading pressure and wave shape is modulated by the tuning of elements contained in the Tuning Module. The fluid is then routed back to the Dynamic Drive.



Component Descriptions

TUNING MODULE – The loading pressure amplitude and waveform is modulated by the tuning elements contained in the conditioning module

VALVE PROSTHESIS – Valve Test Prosthesis

FLUID PORTS – System fill and drain location, connected to mean pressure during operation

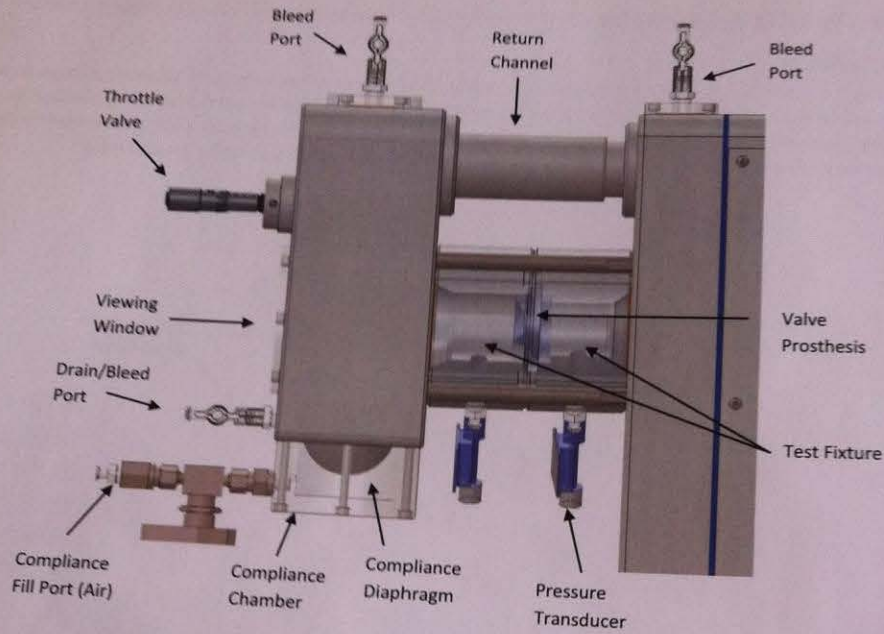
BLEED PORTS – Air bleed location, supplied with standard 2 way stopcock



Hazardous voltages exist within the system; only BDC Laboratories qualified personnel should remove panels.

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TUNING MODULE



- BLEED PORTS** – Air bleed location, supplied with standard 2 way stopcock
- TEST FIXTURE** – Valve Prosthesis Test Fixturing
- PRESSURE TRANSDUCER** – Pressure measurement at the valve inflow and outflow locations
- COMPLIANCE DIAPHRAGM** – Flexible diaphragm isolating the compliant air volume from the test fluid
- COMPLIANCE CHAMBER** – Air filled chamber which serves as a compliant element
- COMPLIANCE FILL PORT** – Air fill and drain location for the compliance housing chamber
- VIEWING WINDOW** – Viewing window for Valve Prosthesis
- THROTTLE VALVE** – Adjustable throttle element, allows the user to control the valve loading pressure

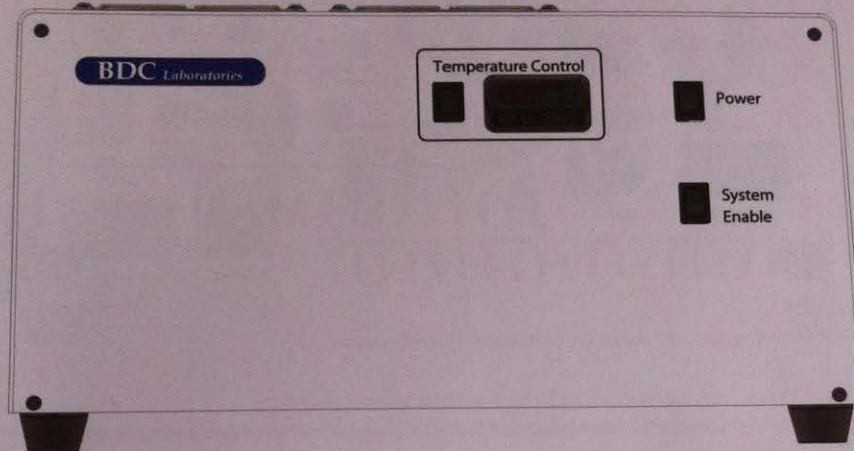
VDT-3600i CONTROL MODULE

The VDT-3600i Control Module connects the VDT-3600 Test System and provides a control and drive interface for the dynamic fluid drivers and heating system.



Removal of any control module panels will result in a void warranty.

FRONT PANEL



POWER (On/Off) – Main power switch

SYSTEM ENABLE (On/Off) – Motor Enable switch, when activated fluid drive motion is allowed



Activating the enable switch will allow for Dynamic Drive motion on all active stations

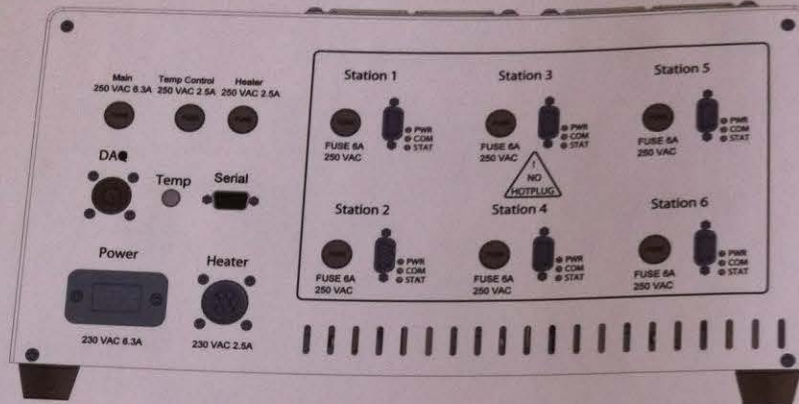
TEMPERATURE CONTROL – Temperature controller for the internal fluid heater, target temperature default is 37 °C. To adjust the target temperature, use the up and down arrows on the controller interface. Current temperature is displayed in red; target temperature is displayed in green.

TEMPERATURE CONTROL SWITCH (On/Off) – Turns the internal fluid heater circuit on or off



Hazardous voltages exist within the system; only BDC Laboratories qualified personnel should remove panels.

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REAR PANEL

Panel marking may vary depending on the system configuration

MAIN – System Fuse, see Specifications pg.53 for fuse replacement information

TEMP CONTROL – Temperature Controller Fuse, see Specifications pg.53 for fuse replacement information

HEATER – Fluid Heater Fuse, see appendix Specifications pg.53 for fuse replacement information

DAQ – Connect to data acquisition system with DAQ cable, 14C-002

TEMP – Connect to VDT-3600i heater block temperature probe

SERIAL – Connect to control computer serial communication port with supplied cable

POWER – Connect to VAC power, see appendix Specifications pg.53 for power specifications

HEATER – Connect to Heater Cable, 14C-001, see appendix Specifications pg.53 for power specifications

STATION 1 – STATION 6

FUSE – Motor Fuse, see appendix Specifications pg.53 for fuse replacement information

MOTOR CONNECTOR – Dynamic Drive connection point, connect to cable 14C-004

PWR INDICATOR – The Blue Power light indicates power is connected to the unit

COM INDICATOR – The Red Indicator displays the communication status, blinking when communication is active

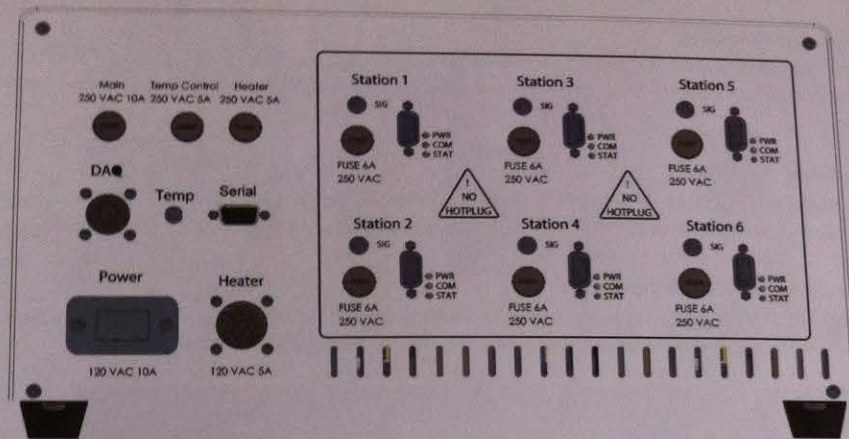
STAT INDICATOR – The Green Status light varies in intensity with the dynamic drive power usage, it also displays error code



Hazardous voltages exist within the system; only BDC Laboratories qualified personnel should remove panels.

MOTOR OUTPUT (OPTIONAL)

The VDT-3600i system can be configured with optional analog output signals for each station motor position and power output.



SIG – Station motor position and power output, 0-10VDC signals. Connect to 14F18C-002 Motor Output Y Cable.

Pin	Color	Function
1	Blue	Position
3	Brown	Power
4	Black	Ground

Approximate Output Scaling

Signal	Slope	Intercept	Scaled Output
Position	0.64	-3.30	mm (± 3 mm)
Power	-20	100	Power ($\pm 100\%$)

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DATA ACQUISITION SYSTEM

The VDT-3600i employs proven National Instruments (NI) hardware for reliable data acquisition and system control. The system is configured to read up to eight differential pressure inputs. Additional channels and measurement types are available, contact BDC Laboratories for more information.

Main Components

DATA ACQUISITION CARD – NI PCIe-6321, installed in the host computer PCI slot

DATA ACQUISITION CHASSIS – NI SC-2345, provides input/output connection points as well as module installation slots.

Modules

FULL BRIDGE INPUT MODULE– NI SCC-SG24, 2 channel input module used for reading the system pressure transducers

RDT INPUT (TEMPERATURE) NI SCC-RTD01, 2-channel module for 2, 3, and 4-wire platinum RTD inputs

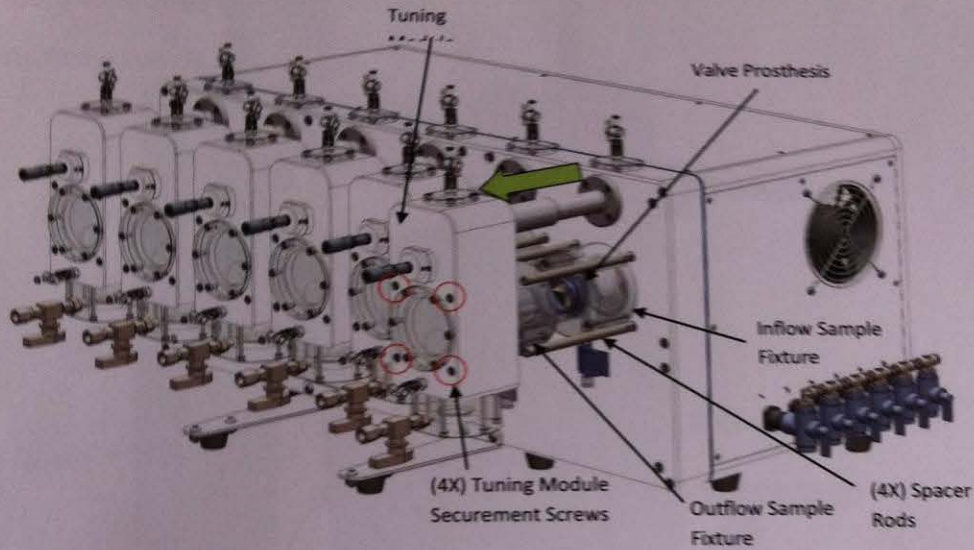
PRESSURE OUTPUT (OPTIONAL)

The VDT-3600i data acquisition system can be configured with optional analog output signals for pressure transducer signals. The configuration provides BNC connections for each pressure line

**Approximate Output Scaling**

Signal	Slope	Scaled Output
Pressure	200	mm Hg

SAMPLE MOUNTING



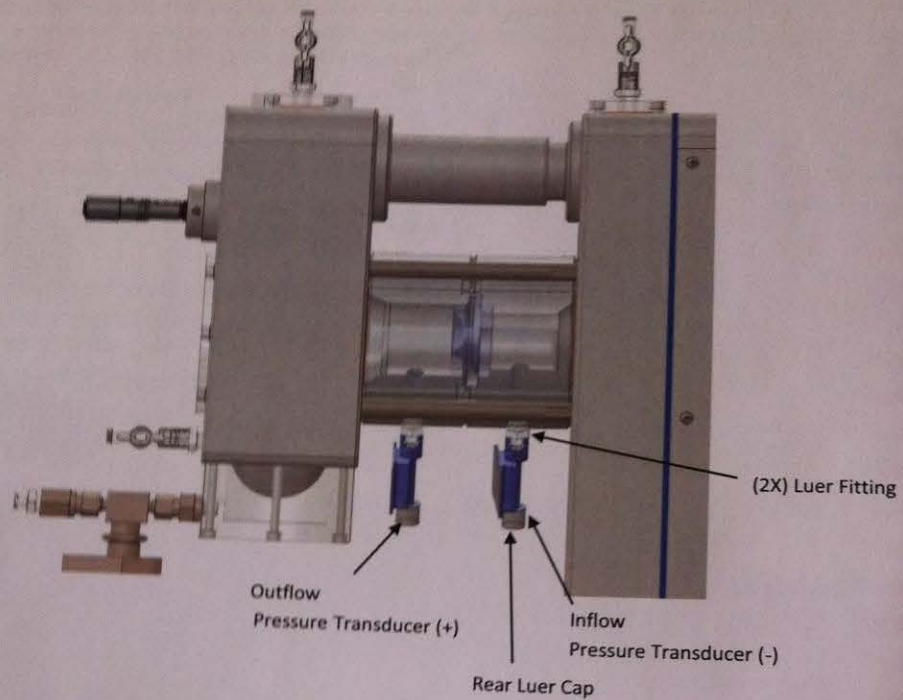
Sample Mounting:

1. Loosen and remove the 4X 10-32 socket head cap screws with a 5/32" hex key
2. Slide the Tuning Module away from the VDT-3600i Test System
3. Install the appropriate inflow and outflow test fixtures on the Test system, see Appendix A - Fixtures for mounting details.
4. Install the test Valve Prosthesis into the sample fixture
5. Slide the Tuning Module back on the VDT-3600i Test System
6. Secure with 4X 10-32 socket head cap screws and tighten with a 5/32" hex key
7. Repeat for all active test stations



The distance between the VDT-3600i front plate and the Tuning Module can be increased or decreased by changing the reference Spacer Rod lengths, facilitating accommodation of different test fixtures or sample mounting methods. Altering the spacing notably may require an alternative return channel, contact BDC Laboratories personnel for additional details.

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PRESSURE TRANSDUCERS**Pressure Transducer Mounting:**

1. Install the inflow and outflow pressure transducers onto the sample fixtures and secure the luer connectors
2. To aid in pressure transducer verification, a stopcock may be installed between the pressure transducer and fixture luer fitting
3. Once the system has been pressurized, bleed all air from the transducer loosening the rear luer cap.

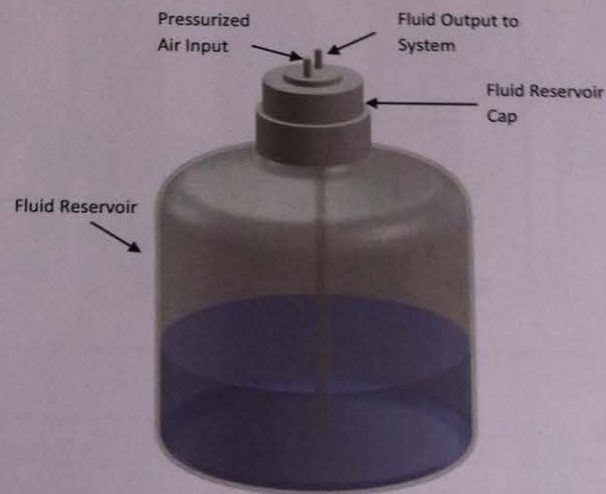


For additional information on the pressure transducers used in the VDT-3600i see Appendix C – Sensor Specifications. The pressure transducers can be calibrated on the system by utilizing a stopcock between the pressure transducer and fixture luer fitting.

SYSTEM FILLING AND DRAINING

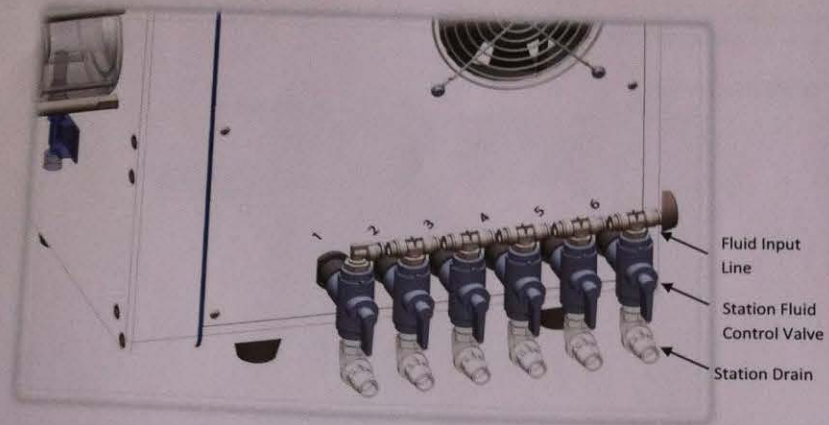
Before initiating testing, the system is to be filled with the desired working fluid. The VDT-3600i is compatible with water or saline type solutions.

To Fill the System



1. Ensure all stations are stopped and the motors are disabled
2. Fill the fluid reservoir with the desired test fluid, see Specifications pg.53 for volumetric details
3. Install the Fluid Reservoir Cap onto the Fluid Reservoir
4. Connect the regulated air pressure line to the pressurized air input port
 - a. This is the port with the short inner extension tube

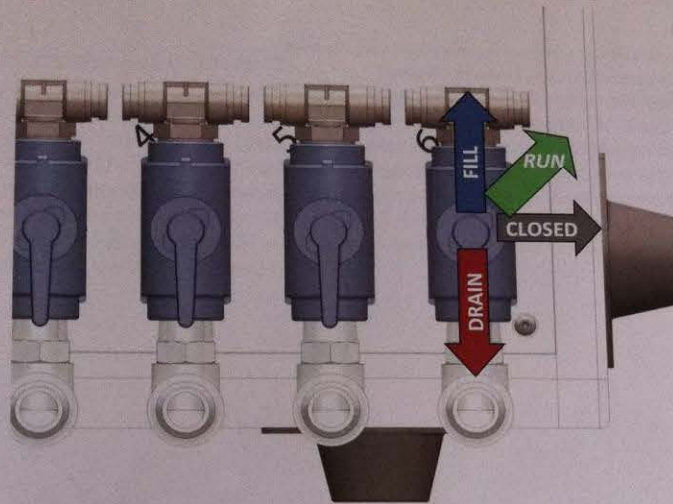




5. Connect the Fluid output port to the VDT-3600i Test System fluid input line
 - a. The VDT-3600i utilizes push to connect fittings, to connect the line push the tubing firmly into the fitting, to remove the line slide the fitting collar away from the tubing and slide the tubing out of the connector



6. Open all active station Bleed Stopcocks



7. Open all active station fluid valves to the **FILL** position and slowly increase fluid source pressure until the system begins to fill with fluid. Inactive stations should be in the **CLOSED** position
 - a. If running the system with less than 6 valve prosthesis mount the first valve in station 6 and then in descending order. This will allow the system to be filled and drained with the inactive stations closed.
8. Watch the active stations and close the Bleed Stopcocks as the fluid reached the top of the Tuning Module
9. Bleed any residual air from the Test System and Tuning Module
10. Move the fluid valve to the **RUN** position (approximately 45°)
11. Increase mean pressure to 250-300 mm Hg.



*Due to the nature of the dynamic drive system, the system pressure must remain positive while testing. The recommended mean pressure value is **250-300 mm Hg**. If the mean pressure falls below 200 mm Hg during testing the system will automatically halt to protect the dynamic drives*

Single Station Drain

1. Ensure the station of interest is stopped and the motor is disabled
2. Disable the Station pressure channels in Statys VDT to prevent a mean pressure alarm from occurring
3. Connect a length of ½" ID tubing to the station drain port, place the other end of the hose near a drain or inside a container
4. Move the station of interest fluid valve to the **DRAIN** Position
5. Open the station of interest Bleed Stopcocks
6. Any Residual fluid can be removed through the bleed port located on the front of the Tuning Module

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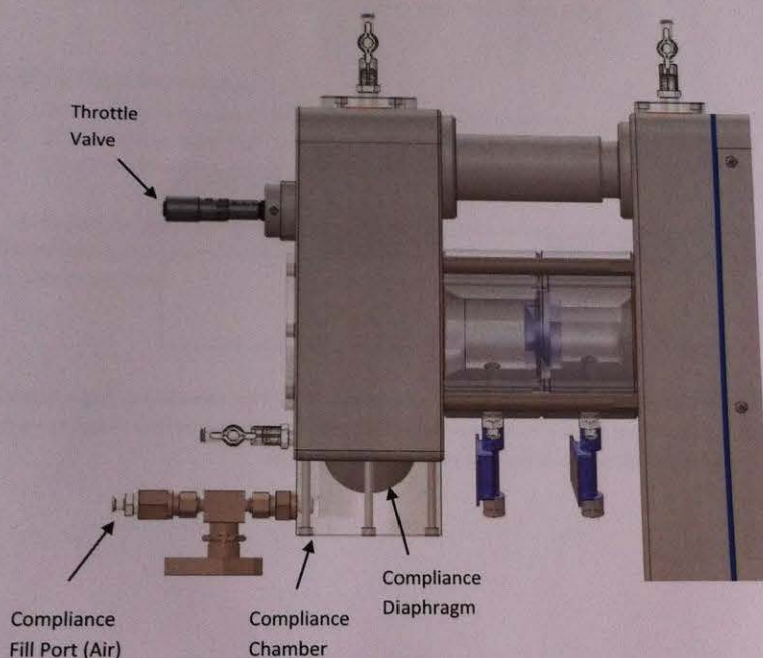
System Drain

1. Ensure all stations are stopped and the motors are disabled
2. Move the station fluid valve to the FILL Position
3. Release the pressure in the Fluid Reservoir by decreasing the airline input pressure
4. Open all station Bleed Stopcocks
5. The fluid will now drain back into the fluid reservoir
 - a. This process may take several minutes
6. Any Residual fluid can be removed through the bleed port located on the front of the Tuning Modules

TUNING

FLOW RESTRICTION AND COMPLIANCE

The compliance and flow resistance for each station is individually adjustable on the VDT-3600i. The compliance chamber acts as air springs and during operation allow energy to collect momentarily in the chamber during the pressurization portion of the test cycle. During the depressurization portion of the cycle, energy is released from the compliance chamber. The throttle valve controls the leakage rate of the stored compliance energy back into the main flow channel. The differential pressure can be tuned at each station by adjusting the throttle valve at that station. The greater the restriction (tighter the valve) the higher the differential pressure on the test article will be at that station. These parameters should be set to accommodate the particular test samples. See Appendix G – System Adjustment Flow Chart for a tuning outline.



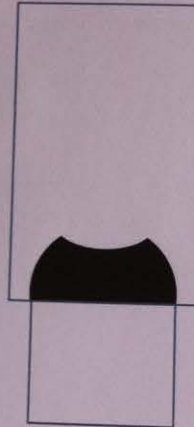
Adjusting Compliance

1. System can be running or stationary while adjusting the station compliance. If running, ensure system is at desired frequency and displacement.
2. Attach the pressure bulb or a syringe to the Compliance Fill Port
3. Ensure the Fluid Fill valve is in the run position (connected to a regulated pressure source)
4. Inject or Extract the desired air volume from the compliance chamber.
5. Close the Compliance Fill Port and remove syringe

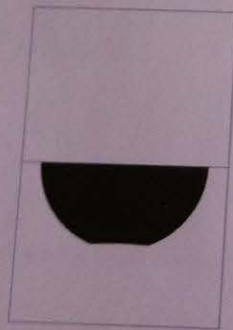
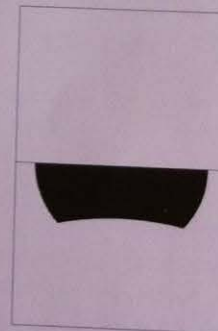
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COMPLIANCE LEVEL

For normal system use, the compliance diaphragm should be configured to point away from the system, see Normal Compliance level shown below. However, if the motor power exceeds 60%, a High Compliance level is recommended to reduce total system load. To transition from Normal Compliance to High Compliance, air is added through the Compliance Fill Port until the diaphragm inverts as shown below.

Normal Compliance**High Compliance**

To optimize the life of the compliance diaphragm, folding of the fabric should be minimized during operation. This will minimize abrasion wear. During use, the diaphragm should be slightly indented at the end of the motor forward stroke. The same applies to a diaphragm configured in High Compliance mode.

**Diaphragm Max****Diaphragm Min**

Compliance Level Maintenance

During testing, a very gradual loss of air in the compliance chamber over the duration of the test is normal. Regular inspection of the compliance chamber is recommended. When necessary, air can be added to the station by following the below procedure during testing.

1. Widen station alarm parameters alarms to prevent test stoppage while adjusting compliance level
2. Attach pressure bulb assembly to compliance chamber port
3. Close the bleed knob on the pressure bulb assembly
4. Gradually open the compliance fill port (only open enough to allow for addition of air)
5. Add or remove air from the compliance chamber as necessary
 - a. To add air, apply pressure to the bulb
 - b. To remove air, slowly loosen the bleed knob
6. Close the compliance fill port and remove the pressure bulb assembly

Adjusting Flow Resistance

1. Ensure system is running at desired frequency and displacement
2. Tighten Throttle Valve to increase the differential peak pressure
3. Loosen Throttle Valve to decrease the differential peak pressure



When first tuning the system, the Throttle Valves should be between 5-10mm. The stroke is then adjusted until the desired valve opening is achieved. The compliance chamber and throttle valve can then be adjusted to reach the desired loading pressure.



SOFTWARE

LAUNCHING SOFTWARE

Double click on the Statys™ icon on the windows desktop.



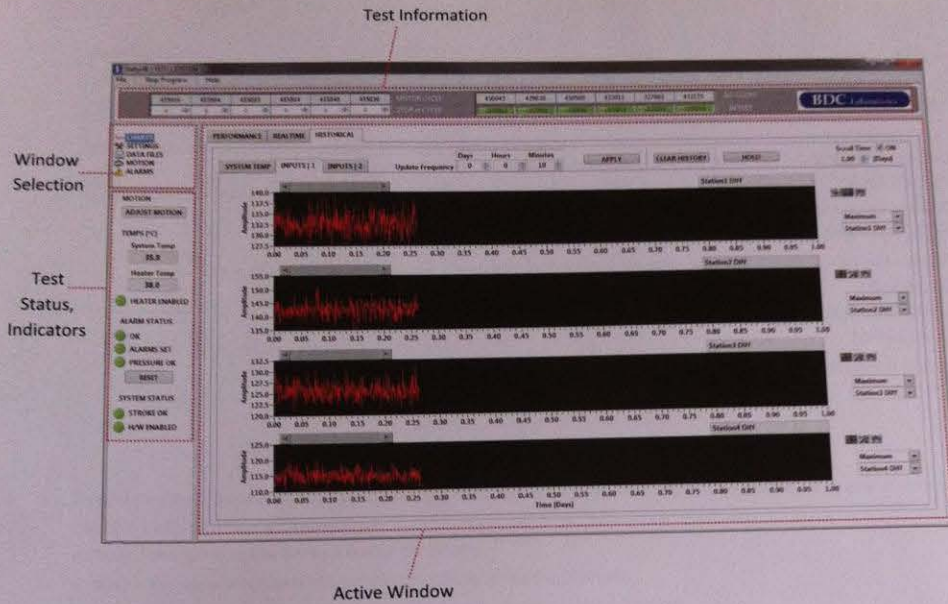
Alternatively, the software can be launched by navigating to the Statys™ icon through the Microsoft Windows start menu.

OVERVIEW

The VDT-3600i is supplied with Statys™ test software which enables full system control and test monitoring through a simple interface. The software provides several key functions:

- Test Setup
- Motion Control
 - Arbitrary Waveform Control (Optional)
- Temperature Motoring
- Differential Loading Analyzer (Optional)
- Test Alarms
- Data logging
- Real Time data acquisition

The user interface is split into two main sections, the active window and the front panel. The active window is selectable and is used to configure the system, set testing parameters and display data. The front panel wraps around the active window and displays critical information and controls.



Test Information

455916	455904	455885	455864	455848	455836	MOTOR CYCLE
0	0	0	0	0	0	STOP at CYCLE

MOTOR CYCLE – Current Station cycle count (Station 1 is on the left, Station 6 is on the right)

STOP CYCLE – Target cycle value (0 is infinite). Note that the system will stop motion on the selected station, but continue to log data once the “Stop Cycle” value has been reached.

0	0	0	0	0	0
LOGGING	LOGGING	HOLDING	OFF	OFF	OFF

ISO COUNT – Current Station ISO cycle count (Station 1 is on the left, Station 6 is on the right). See pg. 29 for details on ISO 5840 calculation

IN TEST – Indicator showing the status of the station data file logging

- **LOGGING** (Green) – Station logging is active, data is saved to the data file and software historical charts
- **LOGGING** (Yellow) – Station data logging is active, however, due to the test configuration, the error associated with the ISO count is above $\pm 2.5\%$
- **HOLDING** (Blue) – Station data logging is paused
- **OFF** (Gray) – Station data logging is off

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Window Selection

CHARTS

Displays historical and real time plots in the Active Window

SETTINGS

Displays the system settings in the Active Window

DATA FILES

Displays the data file and collection settings in the Active Window

MOTION

Displays the motion settings in the Active Window

ALARMS

Displays the alarm settings in the Active Window

Test Status

MOTION

ADJUST MOTION

ADJUST MOTION – Adjust the motion parameters while in motion

A change in motion will result

STATION 5	ACTUAL STROKE 1.39
STROKE Stroke Increment [mm] 0.10 + - New Stroke [mm] 1.60	FREQUENCY Frequency Increment [Hz] 1.0 + - New Freq [Hz] 20.0
DONE	

STATION – Select the station to adjust. Note – if AutoPilot is enabled on the selected station, adjustment will not be possible until AutoPilot is disabled.

ACTUAL STROKE – displays the current motor stroke

STROKE – Increase or decrease the station stroke by a fixed increment

FREQUENCY – Increase or decrease the station frequency by a fixed increment

DONE – Close the adjust motion screen

TEMPS [°C]

System Temp

37.2

Heater Temp

38.5

HEATER ENABLED

SYSTEM TEMP – Displays the fluid system temperature in °C

HEATER TEMP – Displays the temperature of the Fluid Heater in °C



The Heater Temperature probe is located directly on the system heater located inside the Test System. The System Temperature probe is an independent sensor which can be placed in any active station. The system will reach temperature equilibrium while actively cycling. This may take up to an hour depending upon running conditions.

HEATER INDICATOR

- HEATER ENABLED** (Green) – System is actively heating
- HEATER OFF** (Gray) – Heating is disabled, check the Heater switch located on the system front panel

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Indicators**ALARM STATUS**

-  OK
 -  NO ALARMS SET
 -  PRESSURE OK
- 

ALARM

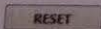
-  **OK** (Green) - No alarms triggered, motion enables
-  **!ALARM!** (Red) - Alarm triggered, motion has been halted. Check alarm panel
-  **ALARM OVERRIDE** - (Red) Alarm override is enabled. Warning, motion will not halt if values exceed the alarm set points.

ALARM CONFIG

-  **ALARM CONFIG** (Green) - At least one alarm is active in the Alarms window
-  **NO ALARM CONFIG** (Red) - No alarms are configured or active in the Alarms window

SYSTEM PRESSURE ALARM

-  **PRESSURE OK** (Green) - All global pressure alarms are within range
-  **PRESSURE ALARM** (Red) - A global pressure alarm has been triggered, the motors are disabled and motion is not allowed



RESET - Reset the global pressure alarms once the condition has been corrected

SYSTEM STATUS

-  **STROKE OK**
-  **H/W ENABLED**

SYSTEM STATUS

-  **STROKE OK** (Green) - Stroke is within limits set in the Auto Pilot feature
-  **STROKE LIMIT** (Red) - Stroke is outside limits set in the Auto Pilot feature
-  **H/W ENABLED** (Green) - The System Enable switch on the Control Module front panel is on. The motors are allowed to be enabled and move.
-  **H/W DISABLED** (Red) - The System Enable switch on the Control Module front panel is off. The motors are not allowed to be enabled or move.

CHARTS

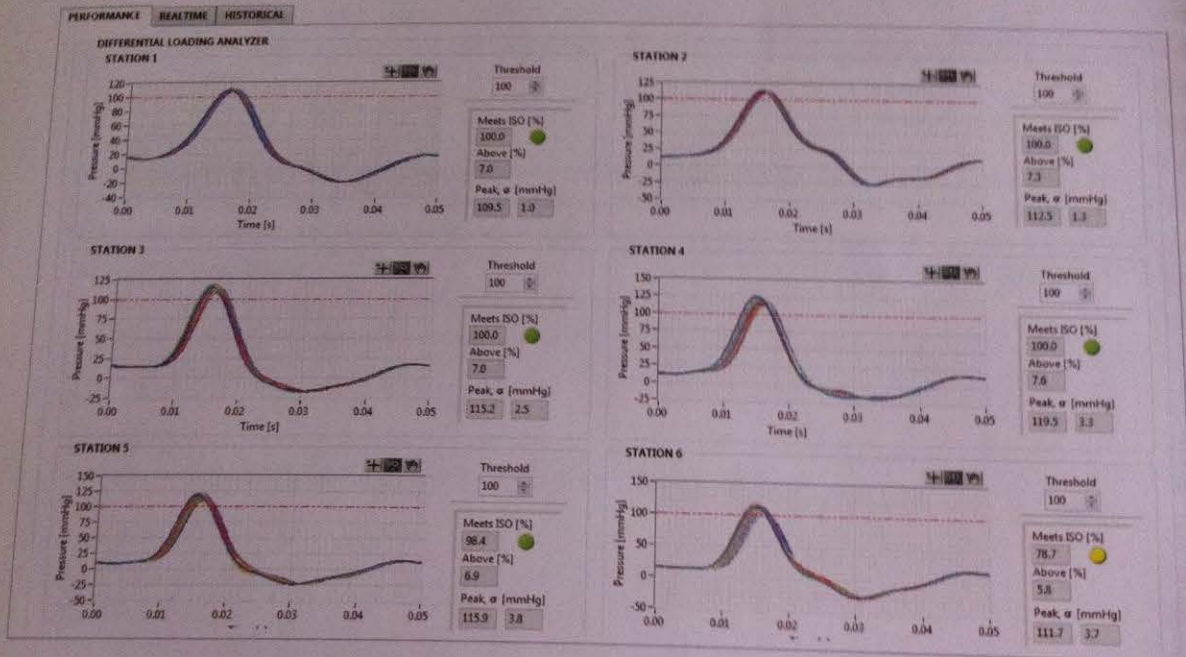
The Statys™ test software enables the user to view data streams in real time, while also logging historical data to uncover important trends which may occur over greater time scales. The charts window is split into three categories:

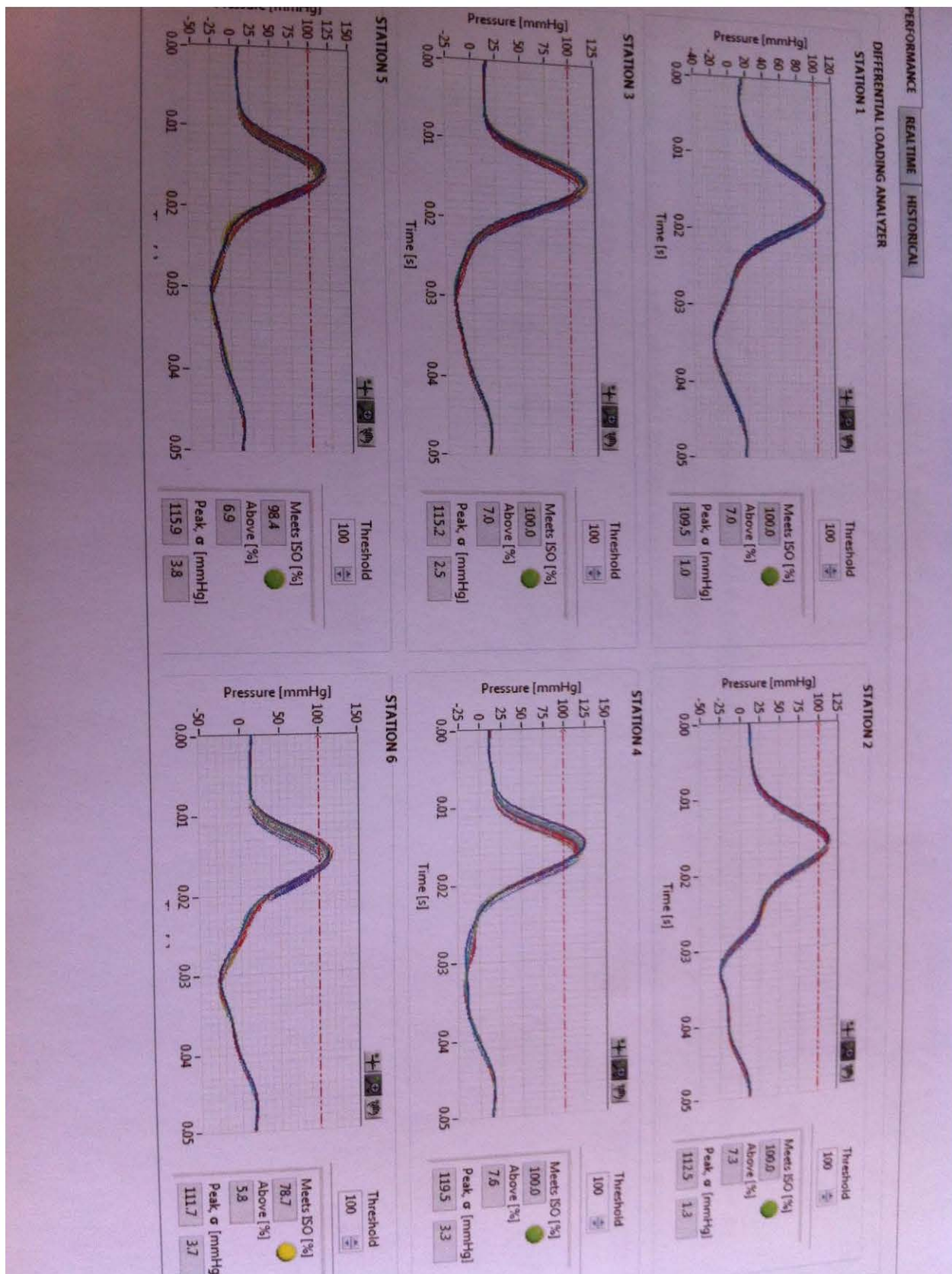
- **Performance**
- **Realtime**
 - Motion
 - Inputs 1, Inputs 2
 - Data Table
- **Historical**
 - System Temp
 - Inputs 1
 - Inputs 2

The performance tab contains a Differential Loading Analyzer tool which allows the user to view the loading characteristics of the valve in real time. The Realtime tab charts the current data stream with a small time lapse between the time of the event and its appearance in the charts. The historical tab contains charts which plot specific parameters at determined periodic time intervals.

PERFORMANCE – DIFFERENTIAL LOADING ANALYZER (OPTIONAL)

The Differential Loading Analyzer is a toolkit which allows the user to calculate the valve loading performance in real time. The Analyzer collects a segment of data and then breaks the data stream into single pulse data sets. Each pulse is processed to determine the percentage of the pulse over the user set threshold. If the percentage is greater than the user set target passing percentage, the cycle passes. After all of the pulses have been processed the statistical results are displayed to the user along with an overlay chart of the raw data. The number of cycles passed is then stored in the ISO count indicator. This data is also available in the data log files.





ISO COUNT ACCURACY

The ISO count calculation provides an estimate of the actual number of cycles meeting the user set loading criteria during a test. The algorithm analyzes N-1 waveforms during the data collection time, where N is the total number of waveform samples collected. The samples are analyzed to determine the percentage which meet the loading criteria. The total number of pulses (N) is multiplied by the percentage (Meet ISO) to determine the number of pulses meeting the loading criteria during the data collection period. This procedure is repeated throughout the duration of the test and the ISO count is updated once every cycle.

VARIABLES

f = Station Test Frequency (Hz)

T = Data Collection Time (sec) as defined on the Settings page

N = Number of Pulses in a data Set

Meet ISO = Percentage of Pulses meeting user set loading criteria in data set (%)

FORMULAS

$$N = f * T$$

The total number of pulses in the data set is defined as the Station Test Frequency (Hz) multiplied by the Data Collection Time (seconds)

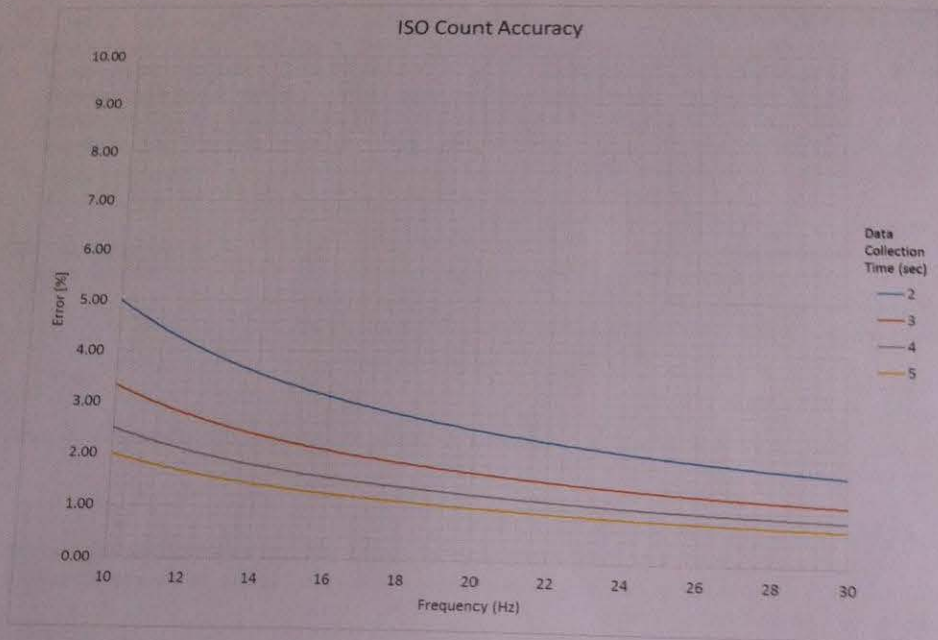
$$\text{Data Set ISO Count} = \text{Meet ISO}[\%] * N$$

The number of pulses meeting the user set loading criteria in the data set is defined as the percentage calculated to meet the criteria (Meet ISO (%)) multiplied by the total number of pulses in the data set. The Data Set ISO Count is added to the Total ISO Count every cycle.

UNCERTAINTY

$$\delta \text{Meet ISO}[\%] = \left(1 - \frac{(N-1)}{N} \right) * 100$$

The uncertainty of the Meet ISO percentage is calculated using the formula above since N-1 pulses are analyzed over a given data set.



To minimize the ISO count error, run the system with a Data Collection Time of 5 seconds during extended tests. To increase the system responsiveness during station tuning and sample setup, the data collection time can be reduced to 2 seconds. If the current test settings yield an error greater than $\pm 2.5\%$, the data logging indicator will be yellow.

Example:**VARIABLES**

$f = 15 \text{ Hz}$ (Station Test Frequency)

$T = 5 \text{ seconds}$ (Data Collection time in Setting page)

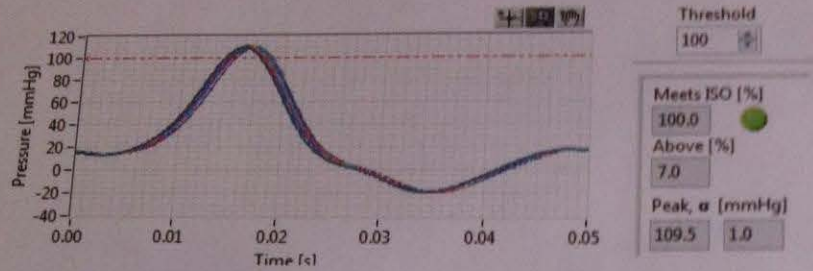
Meet ISO = 100% (Result throughout the duration of the test)

ISO Count = 200,000,000 (total count from software)

$$N = 15 \text{ Hz} * 5 \text{ s} = 75 \text{ samples}$$

$$\delta \text{Meet ISO}[\%] = \left(1 - \frac{(75-1)}{75} \right) * 100 = 1.33\%$$

$$\text{ISO Count} \pm \delta \text{ISO Count} = 200,000,000 \pm 2,660,000 (1.33\%)$$



THRESHOLD [MM HG] – Set the target differential pressure threshold. The threshold setting is shown as a red dashed line on the plot

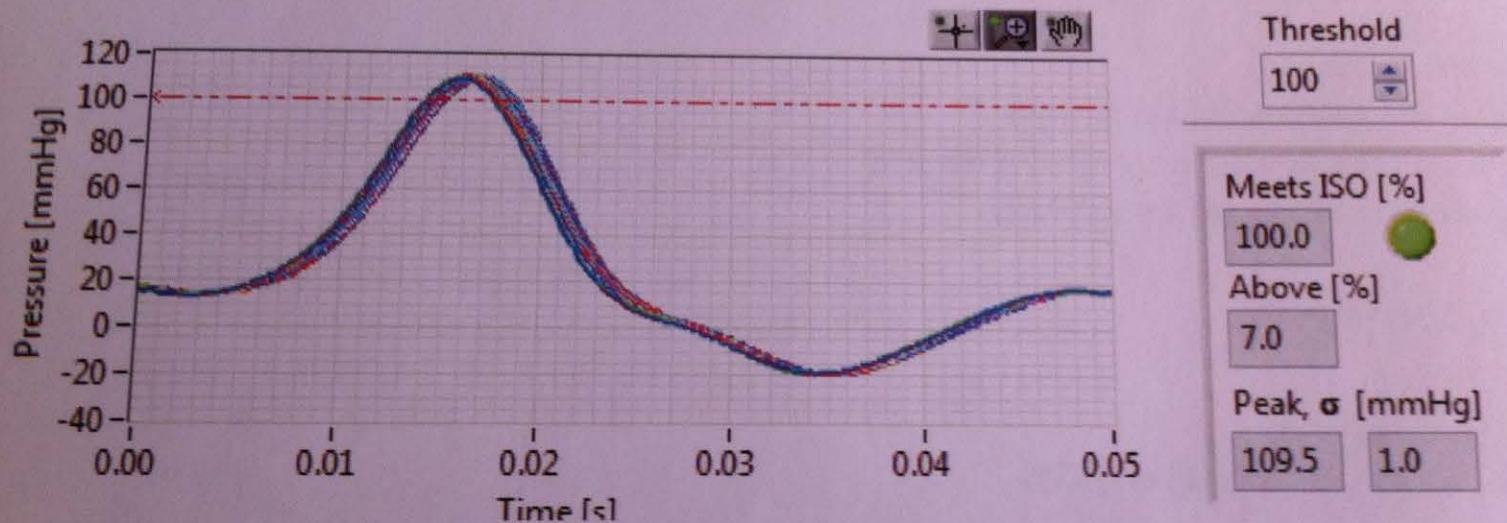
MEETS ISO [%] – Shows the percentage of passed cycles in current data set

- 100% OF CYCLES ARE PASSING
- LESS THAN 100% OF CYCLES ARE PASSING
- NO CYCLES ARE PASSING

ABOVE [%] – Shows the average percentage above the Threshold in the current data set

PEAK [MM HG] – Shows the average peak differential pressure in the current data set

σ [MM HG] – Shows the standard deviation of the peak differential pressure in the current data set



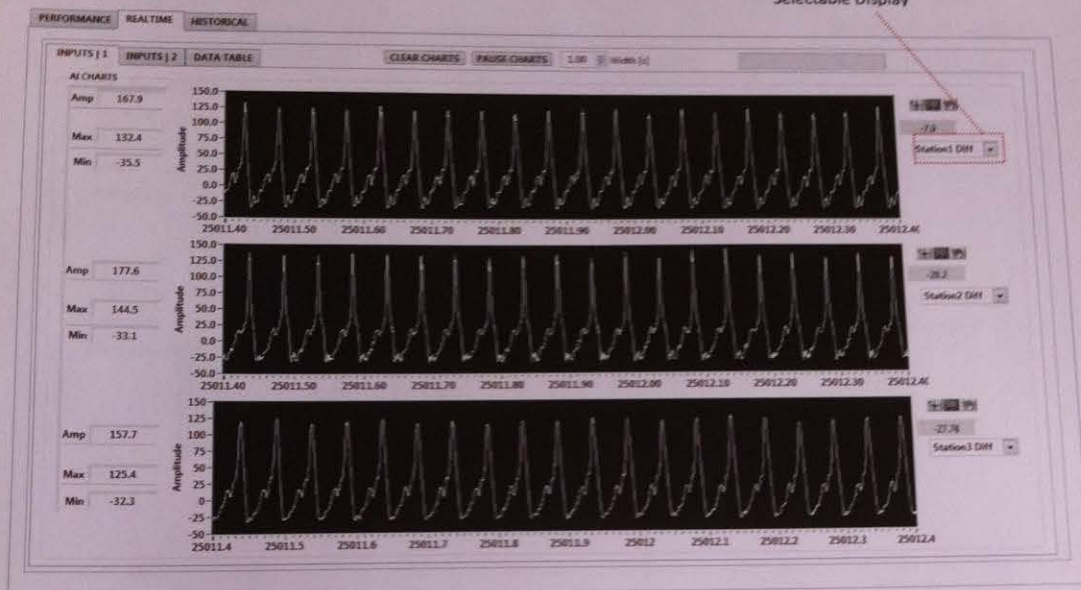
THRESHOLD [MM HG] – Set the target differential pressure threshold. The threshold setting is shown as a line on the plot

MEETS ISO [%] – Shows the percentage of passed cycles in current data set

- **100% OF CYCLES ARE PASSING**
- **LESS THAN 100% OF CYCLES ARE PASSING**
- **NO CYCLES ARE PASSING**

ABOVE [%] – Shows the average percentage above the Threshold in the current data set

REAL TIME - INPUTS

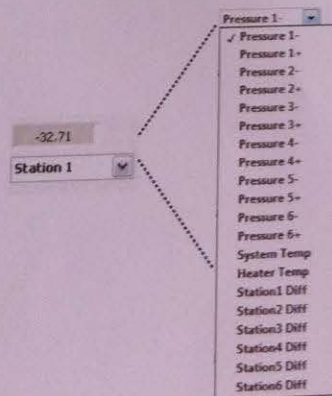


AMP- Displays the channel amplitude averaged over the time window

MAX- Displays the channel maximum averaged over the time window

MIN- Displays the channel minimum averaged over the time window

Selectable Display



To select the channel which is plotted on the adjacent chart, open the display menu and choose the desired channel.

BDC Laboratories

REAL TIME - INPUTS

PERFORMANCE REALTIME HISTORICAL

INPUTS | 1 INPUTS | 2 DATA TABLE

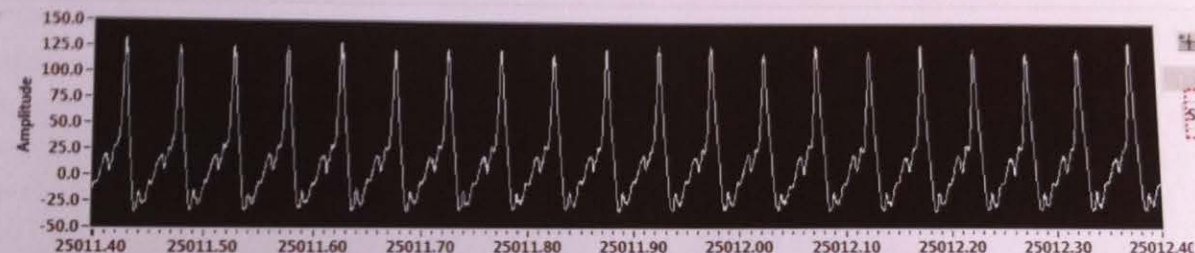
CLEAR CHARTS PAUSE CHARTS 1.00 Width [s]

AI CHARTS

Amp 167.9

Max 132.4

Min -35.5



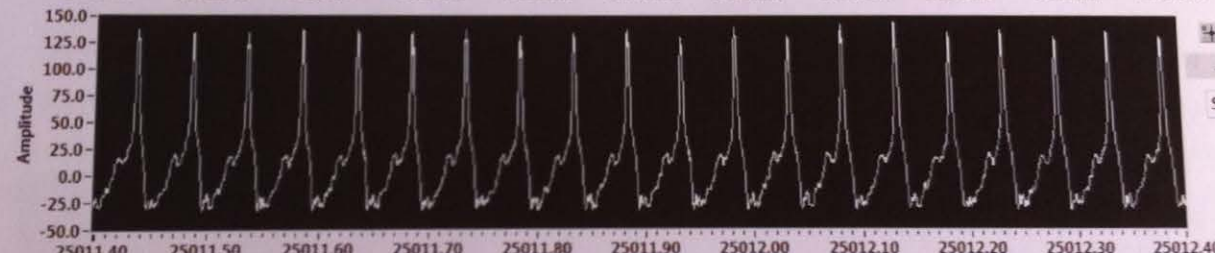
-7.9

Station1 Diff

Amp 177.6

Max 144.5

Min -33.1



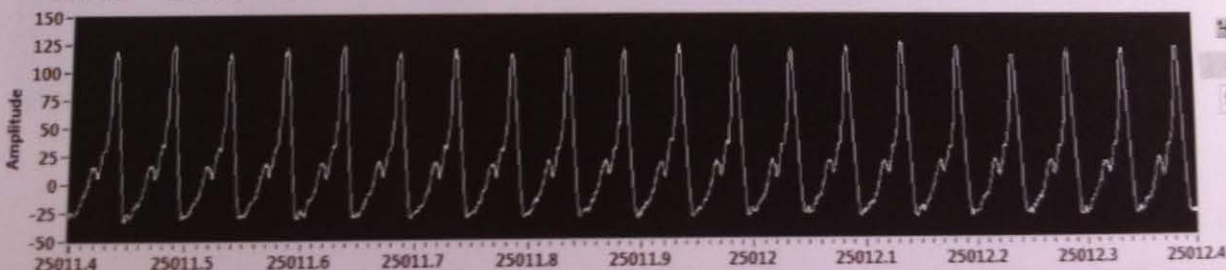
-28.2

Station2 Diff

Amp 157.7

Max 125.4

Min -32.3



-27.78

Station3 Diff

AMP- Displays the channel amplitude averaged over the time window

REAL TIME – DATA TABLE

PERFORMANCE

REALTIME

HISTORICAL

IMPUTS | 1

IMPUTS | 2

DATA TABLE

CLEAR CHARTS

PAUSE CHARTS

0.20

Width [s]

SINGLE ENDED CHANNELS [mm Hg]

CHANNEL	MAX	MEAN	MIN
Pressure 1-	286.2	217.3	148.3
Pressure 1+	282.3	263.9	245.5
Pressure 2-	284.4	217.9	151.3
Pressure 2+	281.5	264.7	247.8
Pressure 3-	272.8	203.0	133.2
Pressure 3+	277.1	255.9	234.8
Pressure 4-	276.9	202.7	128.4
Pressure 4+	277.6	255.2	232.9
Pressure 5-	283.3	210.9	138.4
Pressure 5+	282.7	259.0	235.4
Pressure 6-	281.2	211.0	140.8
Pressure 6+	274.5	254.4	234.4
System Temp	35.6	35.6	35.5
Motor2 Temp	32.0	31.9	31.9

DIFFERENTIAL CHANNELS [mm Hg]

CHANNEL	MAX	MEAN	MIN
Station1 Diff	110.3	45.2	-19.9
Station2 Diff	113.5	43.7	-26.1
Station3 Diff	116.8	49.7	-17.4
Station4 Diff	121.1	51.4	-18.3
Station5 Diff	114.9	45.3	-24.3
Station6 Diff	110.8	41.6	-27.6

MOTOR DATA

MOTOR	STROKE [mm]	POWER [%]	
Motor 1	1.0	27.4	POWER OK
Motor 2	1.1	18.8	POWER OK
Motor 3	1.2	22.7	POWER OK
Motor 4	1.1	21.4	POWER OK
Motor 5	1.3	18.3	POWER OK
Motor 6	1.2	18.0	POWER OK

CHANNEL- Displays the channel name

MAX – Displays the channel maximum averaged over the time window

MEAN – Displays the channel mean averaged over the time window

MIN– Displays the channel minimum averaged over the time window

SINGLE ENDED CHANNELS- Displays all system input channels, Temperature channels are in °C

DIFFERENTIAL CHANNELS- Displays the calculated differential values, Station 1 Diff = (Station 1+) - (Station 1-)

MOTOR STROKE [MM] - Displays the station average stroke

REAL TIME - DATA TABLE

PERFORMANCE REAL TIME HISTORICAL

INPUTS 1 1 INPUTS 1 2 DATA TABLE

CLEAR CHARTS

PAUSE CHARTS

0.20 Width [s]

SINGLE ENDED CHANNELS [mm Hg]

CHANNEL	MAX	MEAN	MIN
Pressure 1-	286.2	217.3	148.3
Pressure 1+	282.3	263.9	245.5
Pressure 2-	284.4	217.9	151.3
Pressure 2+	281.5	264.7	247.8
Pressure 3-	272.8	203.0	133.2
Pressure 3+	277.1	255.9	234.8
Pressure 4-	276.9	202.7	128.4
Pressure 4+	277.6	255.2	232.9
Pressure 5-	283.3	210.9	138.4
Pressure 5+	282.7	259.0	235.4
Pressure 6-	281.2	211.0	140.8
Pressure 6+	274.5	254.4	234.4
System Temp	35.6	35.6	35.5
Motor2 Temp	32.0	31.9	31.9

DIFFERENTIAL CHANNELS [mm Hg]

CHANNEL	MAX	MEAN	MIN
Station1 Diff	110.3	45.2	-19.9
Station2 Diff	113.5	43.7	-26.1
Station3 Diff	116.8	49.7	-17.4
Station4 Diff	121.1	51.4	-18.3
Station5 Diff	114.9	45.3	-24.3
Station6 Diff	110.8	41.6	-27.6

MOTOR DATA

MOTOR	STROKE [mm]	POWER [%]	
Motor 1	1.0	27.4	POWER OK
Motor 2	1.1	18.8	POWER OK
Motor 3	1.2	22.7	POWER OK
Motor 4	1.1	21.4	POWER OK
Motor 5	1.3	18.3	POWER OK
Motor 6	1.2	18.0	POWER OK

POWER
[%]

27.4

POWER OK

POWER
[%]

92.2

WARNING

MOTOR POWER [%] - Displays the average station power usage, if the power use exceeds nominal use (10%-70%) the indicator will turn yellow and "Warning" will be displayed. High power use may cause deviations in the target stroke and/or frequency. Prolonged use at high power may lead to premature motor failure. To lower the station power usage, ensure the station mean pressure is set to the recommended value (250-300 mm Hg) and follow the mitigation steps outlined in Compliance Level on pg.20.



The differential channel statistical parameters (Max/Mean/Min) are calculated using the differential loading analyzer. To adjust the average time window, the user will need to adjust Diff Loading Analyzer collection time on the Settings page.

HISTORICAL

Update Frequency	Days	Hours	Minutes	APPLY	CLEAR HISTORY	Scroll Time ☒ ON 1.00 [Days]
	0	0	10			

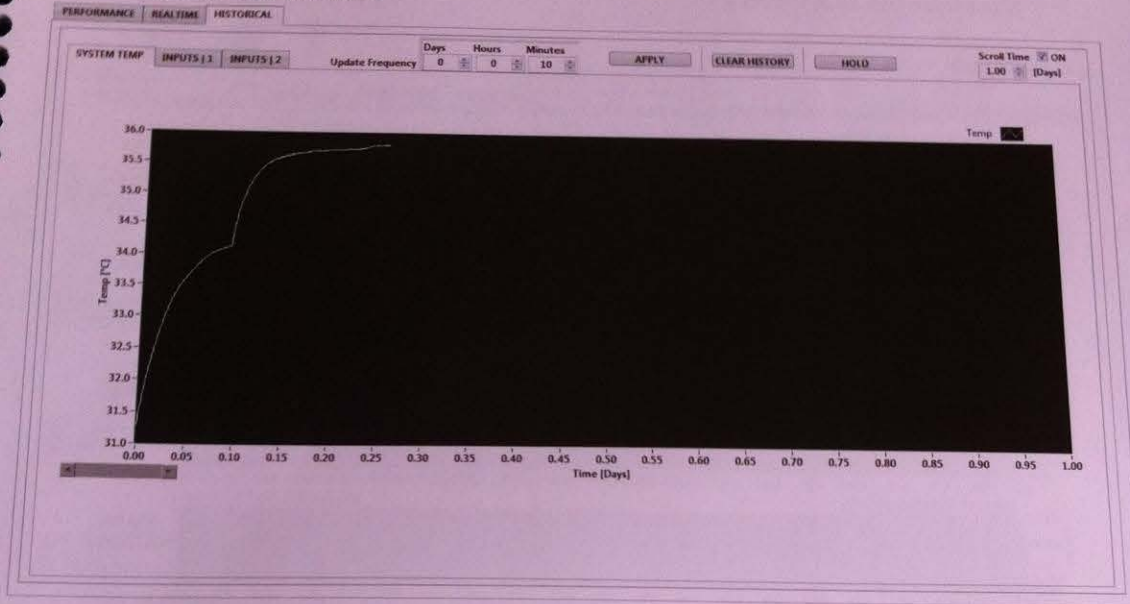
UPDATE FREQUENCY – Input the charting frequency in Days, Hours and Minutes. Note: this applies to all historical charts, but does not control the data logging rate to a data file.

APPLY – Updates the charting frequency

CLEAR HISTORY – Clears the displayed charting history. Note this does not affect the data log file.

SCROLL TIME (On/Off) – Enable and set the scroll window time. The scroll window will move with the data showing the indicated time history.

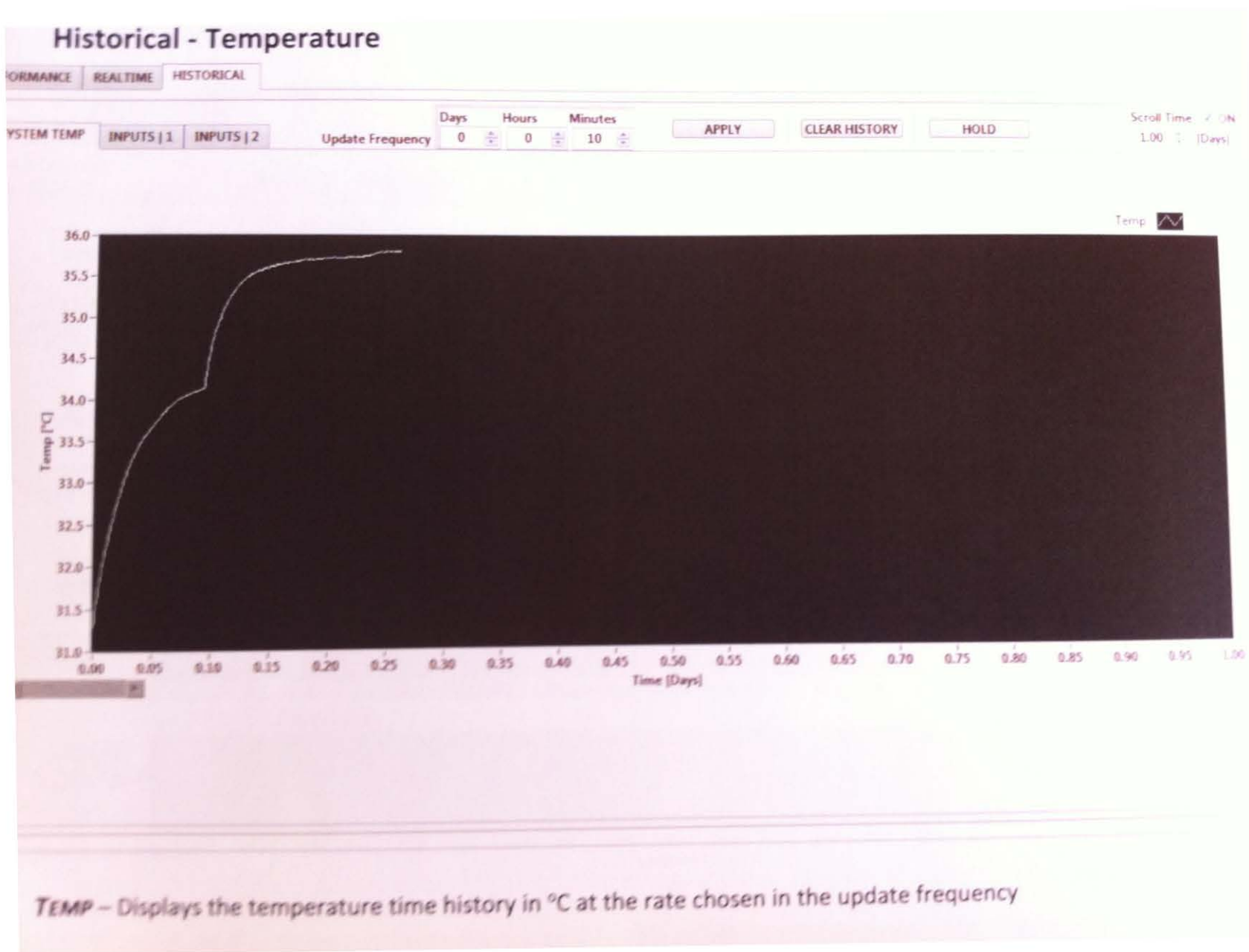
Historical - Temperature



TEMP – Displays the temperature time history in °C at the rate chosen in the update frequency



To compensate for ambient heat loss, the temperature controller may need to be set slightly above the desired system operating temperature

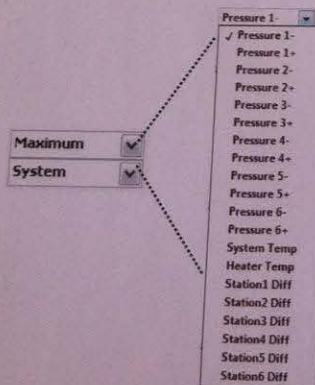


Historical – Inputs 1, Inputs 2



AMPLITUDE – Displays the time history of the selected channel and parameter (Maximum/Minimum/Amplitude or Mean)

Selectable Display



To select the channel which is plotted on the adjacent chart, open the display menu and choose the desired channel. The parameter of interest (minimum, maximum, mean or amplitude) can also be selectively displayed.