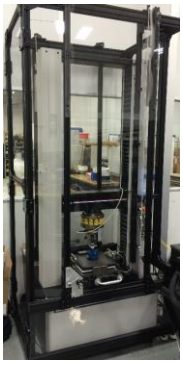
Operations Manual

ATLAS

ATLS-0150



Atlas Load Frame Operations Manual ATLS-0150-9900 [Rev. A]

HUMANETICS®
Innovative Solutions

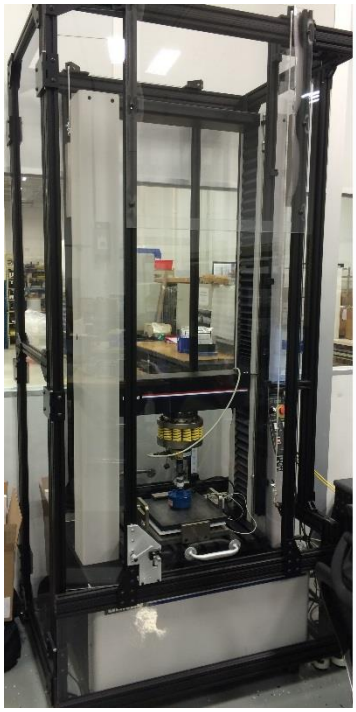



Table of Contents

List of Figures

List of Tables

Section 1. Overview

The Humanetics Load Cell Test Station can test and verify 1 – 6 unit under test (UUT) bridge circuits as analog or DTI digital signals, and Pelvic Plug and Body Block materials. Bridge resistance, insulation resistance, and shunt calibration measurements are automatically collected for the UUT circuits. With manual intervention, each UUT is loaded to capacity and verified against a specified reference load cell. Hysteresis, non-linearity, crosstalk, sensitivity, zero offset, scale and offset are some of the parameters measured.

If configured, WorldSID TEDS data for each analog UUT is written at the end of a successful test. For DTI testing, TEDS data is written at the end of the test if the technician approves it. If configured, IEEE1451 TEDS is read from the reference load cell and verified for the selected device.

The data from each calibration is stored as a test record. This data is used to generate reports and can also be exported as .CAL or .CSV files. A Zebra label printer is used to print pass or fail labels.

1.1 Formatting Conventions

The following formatting conventions are used in this manual.

Table 1-1 Formatting Conventions

This Format	Indicates
italic	Software controls, document names, field or indicator names, or emphasized text.
BOLD SMALL CAPS	Test station hardware controls and keyboard keys.
`Courier font`	Data entry or computer-generated text.

Also included throughout the manual are some useful tips and critical information. This is defined below.

NOTICE

Indicates useful tips, recommendations and information for an improved or more efficient and trouble-free operation.

CAUTION

Critical information for proper use of the product. If procedures are not followed correctly, machinery may be damaged or personal injury may result.

	**WARNING** Refers to a potentially dangerous situation, which may lead to death or serious injury if not prevented.

Section 2. Hardware Components

Listed in the figure below are the hardware components.

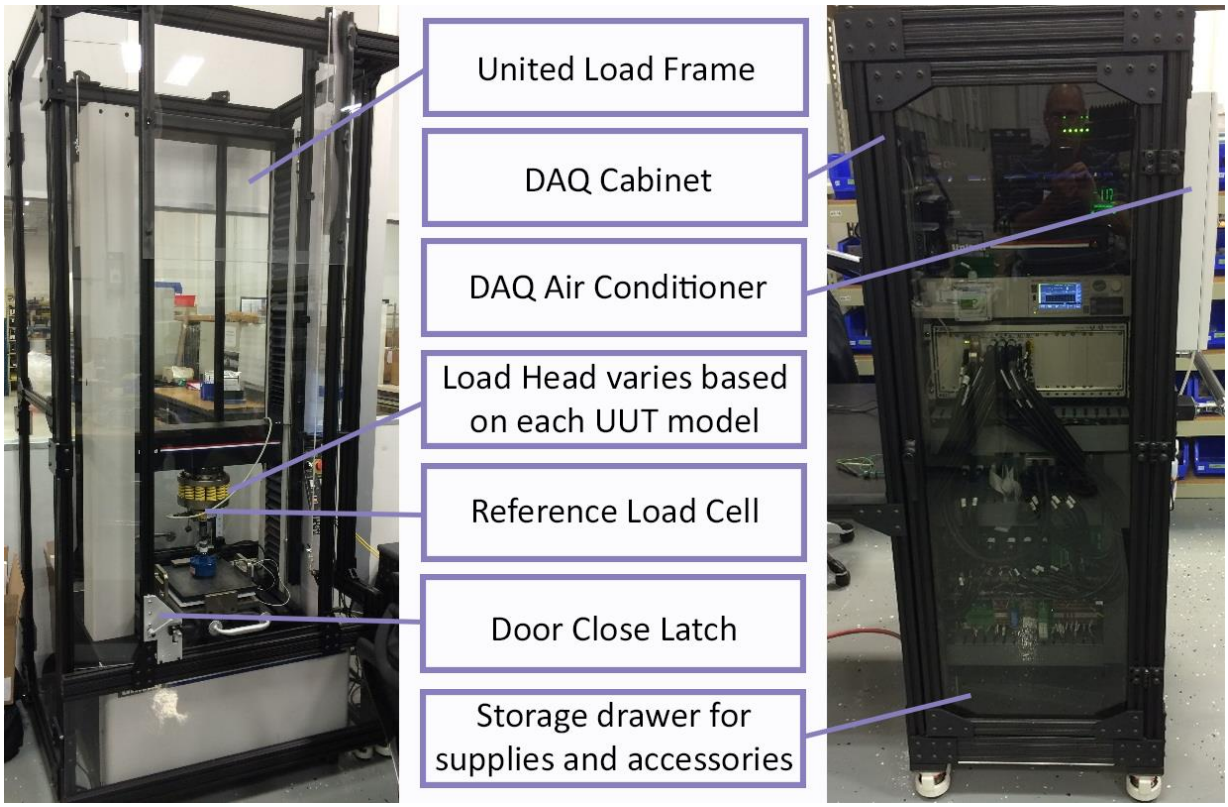


Figure 2.1 Hardware Components

2.1 United Load Frame

The United Load Frame uses USB connection for control and position feedback to the PC. Manual jog toggle switches on the front of the United Load Frame are used by the technician during the UUT Calibration test steps. These jog buttons are disabled (see indicator on main PC window) during most of the test.

When the motion is downward, the position feedback increases and the load produced is compression. When the motion is upward, the position feedback decreases and the load produced is tension. The reference load cell provides the force feedback for the Load Frame. Positive force is compression; negative force is tension.

2.2 Load Frame Enclosure

There are two (2) door switches on the Load Frame Enclosure. These doors must be closed before the PC controls the United Load Frame. For those stations without the enclosure, the door switch monitor can be disabled via stand parameter

2.3 DAQ Cabinet

The air-conditioned data acquisition (DAQ) cabinet contains the PC, the PXI chassis, the UPS, the specialized circuit boards, the Keysight high voltage meter, the United Load Frame controller, two (2) circuit breakers, temperature and humidity sensors, and the shunt resistors.

The front of the DAQ cabinet is DC power. The rear of the DAQ cabinet is AC power.

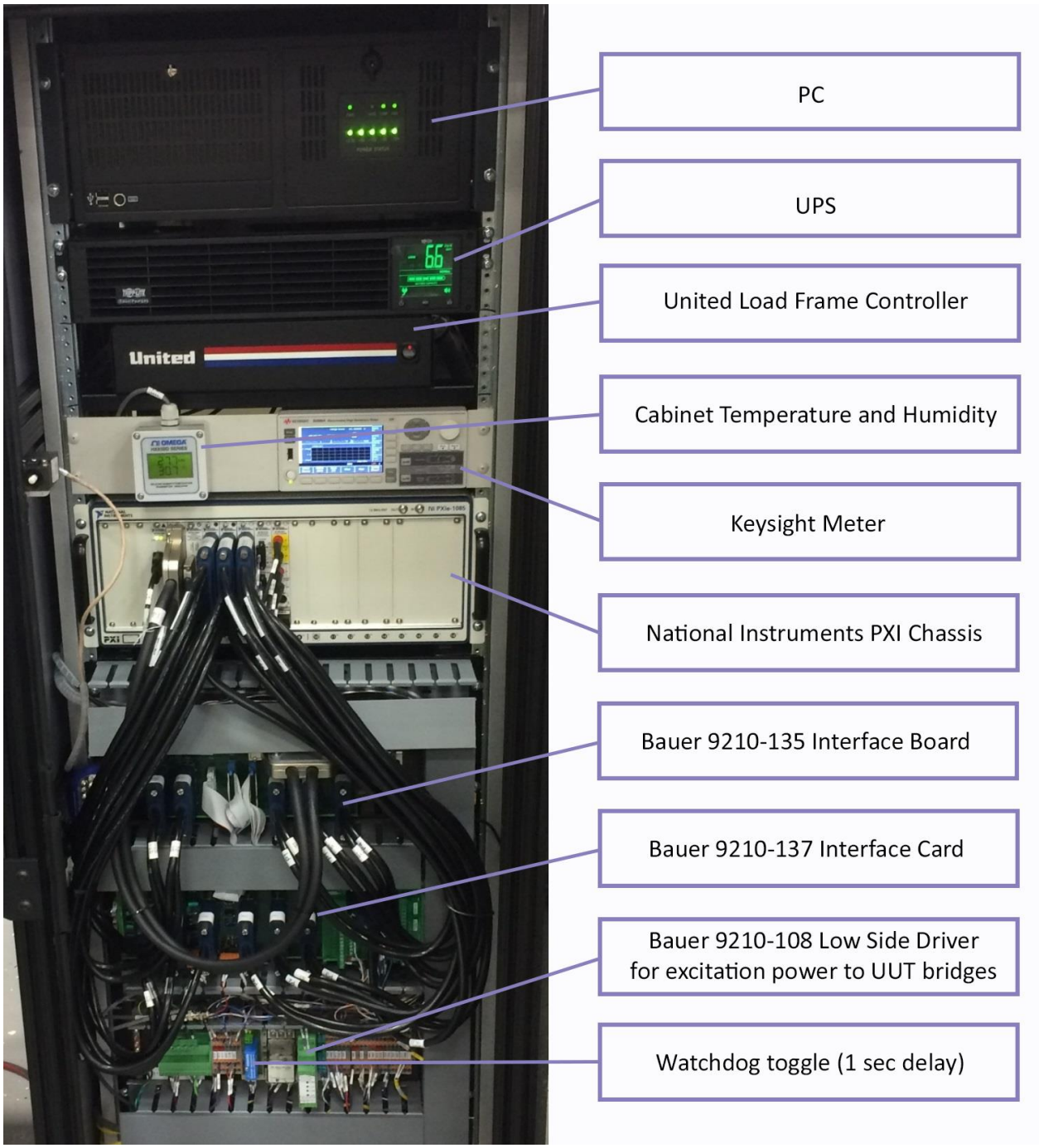


Figure 2.2 DAQ Cabinet

2.4 Keysight B2985A

The Keysight meter provides the voltage supply and resistance measurement during the insulation resistance tests.

2.5 PXI Chassis

The PXI chassis contains the following boards:

- NI 4339 Bridge Measurement Board
  - Performs ratiometric (mV/V) measurements of the UUT and reference load cells
  - Provides excitation voltage to the reference load cell
- NI 2521 Relay Board
  - Provides relays used to connect the Keysight to the bridges during insulation resistance tests
  - Provides relays used to connect the NI 4339 board to the bridges during UUT Calibration and Shunt Calibration tests
- NI 2525 Relay Boards (2)
  - Provides relays used to connect the bridges to the DMM for bridge resistance measurements
  - Provides relays used to connect the TEDS from the bridges to the LinkUSB 1-wire communications
  - Provides relays used during system checks
  - Provides relays used to connect the selected shunt resistors to the bridges during the Shunt Calibration test
- NI 4110 Power Supply
  - Provides excitation voltage to the UUT bridges
- NI 4071 DMM Digital Multi-Meter
  - Performs bridge resistance tests
  - Performs system checks to verify electrical integrity of the measurement system

For optimal performance, these are the switch settings at the back of the NI PXI chassis. Three (3) large fans obstruct the back of the PXI chassis.

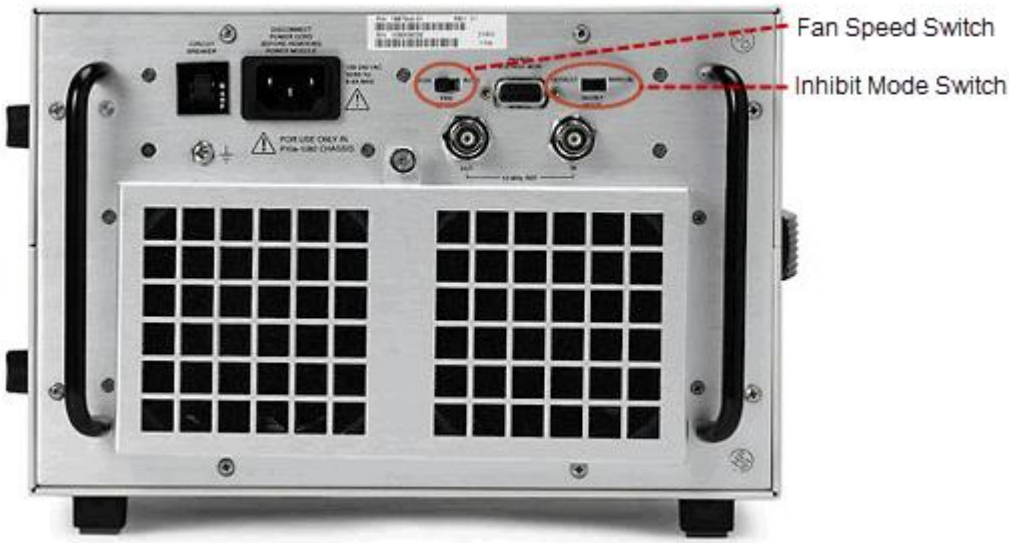


Figure 2.3 Fan Speed Switch

- **FAN SPEED SWITCH** is set to *High*.
- **INHIBIT MODE SWITCH** is set to the *Manual* position, which allows the PXI chassis to power on automatically.

2.6 LinkUSB

1-wire communication device for reading and writing TEDS. The LinkUSB devices have serial identification. If the LinkUSB device is replaced, the PCS Message log contains the serial ID for the device. This serial ID must be written to the PCS Hardware manager. An example of the message in the message log where the serial ID is AJ03FERC:

FTDI: Found device 'AJ03FERC'.

2.7 Pin Box

The pin box is specially designed for this application. It is located on the work table between the United Load Frame cabinet and the DAQ cabinet. The pin box is used to connect the wires from the UUT and reference load cell. A cable from the pin box connects to the 9210-135 inside the DAQ cabinet.

For the UUT connections, there are two options: a) individual wires as shown in the photo or, b) two LEMO connectors on the front of the pin box.

Figure 2.4 Pin Box

2.8 Temperature/Humidity Sensor

One (1) temperature and humidity sensor is located inside the DAQ cabinet and one (1) is located near the ambient conditions of the United Load Frame. Temperature and humidity are measured and recorded at various times during the test. If the temperature or humidity is outside of acceptable range, the test aborts.

2.9 Reference Load Cell (Ref LC)

The calibrated reference load (Newtons or kg-force) is measured by the reference load cell. The load cell is electrically connected via a round Amphenol connector to the pin box and is wired to bridge number 8 of the PXI-4339. The technician must mechanically connect the reference load cell to the United Load Frame prior to starting a test. At the start of testing, the technician selects the reference load cell from the Part Information window.

2.10 Reference Position (Ref Pos)

A Mitutoyo linear scale is physically installed on the United Load Frame. The signal from the linear scale is read by the PXI-6363. It provides a 1 kHz update measurement of the load frame crossbar position. It is used for materials testing and to verify United encoder feedback. An embedded IEEE1451 TEDS compatible chip identifies the linear scale serial ID and scale factor. The reference position is only used as a measurement for materials testing. It is also used to verify the UNITED_ENCODER_CONSTANT is properly configured when the load frame is moving.

2.11 DTI Recorder

A Kistler DTI Data Recorder is used for DTI testing. It is not needed for analog load cells or materials testing. Refer to DTI testing for more details. The DTI data recorder is connected to the PC via Ethernet. The Ethernet wire must be plugged into a port with a static IP address. The recommended IP address of the port on the PC is 192.0.0.1 with subnet 255.255.255.0.

Figure 2.5 DTI Recorder

2.12 Zebra Printer

A Zebra ZD500 printer is used to print labels. A USB connection is required to communicate with the printer. Labels have different format depending on the site and the part type. The labels may print single labels or double identical labels depending on the label media. See Zebra Printer Appendix for more details.

Figure 2.6 Zebra Printer

2.13 Fixture

Each different model type of UUT requires a specific fixture to mechanically connect to the united load frame. The fixture is rotated by the technician during the UUT Calibration step to achieve the desired loading on the UUT.

2.14 PC

The Advantech industrial PC has a dual redundant power supply and three (3) front access hard drives. The PC uses a Windows 7 64 bit operating system and contains the Bauer Controls PCS (PC Control Stream) software and drivers. The PCS software acquires the data, analyzes the data, reports the results, and controls the test. The PC is connected to the PXI chassis via PXI cable. The Keysight meter, United Load Frame controller, and LinkUSB communications are each connected via USB to the PC.

The PC is plugged into a UPS via USB and will automatically shut down the PCS software and Windows if the battery level is too low. The thresholds are configurable see Preferences.

2.15 Grace Ports

On the side of the DAQ cabinet are two (2) Grace accessory ports. AC power and USB connections are available at the access ports. There are several different cabinet designs. Some cabinets are not capable of providing power for the USB ports. Therefore, USB memory sticks and the ACE cDAQ USB connection may require an external powered USB hub depending on the Atlas cabinet design.

Figure 2.7 Grace Port

2.16 ACE Calibration Box

A special external device including 8 bridges with shunt resistors and relays can be connected to the pin box for calibration and verification of the Atlas calibration test stand. Refer to Section 12.8 ACE Calibration Box for details. The Amphenol “ACE” must be disconnected prior to starting any Load Cell or Material test. The technician is prompted to disconnect the ACE box.

Figure 2.8 ACE Box Connected to Atlas

Section 3. Safety

The following safety guidelines provide a general outline for any employee who is using the PCS software installed on a test or assembly machine. Always heed corporate and plant safety procedures.

3.1 General Safety

The general safety guidelines, outlined below, are an overview of the safety topics covered in this section. While these guidelines provide information that will help prevent personnel injury and damage to equipment, the entire section should be reviewed for a thorough understanding of safety practices and specific devices related to this equipment.

- Become thoroughly familiar with the station operation before working on any part of it.
- Adopt good work habits regarding safety when working on or around the system.
- Avoid working on the system when poor physical or mental health may affect job-related judgment.
- Always dress properly for the job and use appropriate sight and hearing protection.
- Maintain clean and safe work areas at all times.
- Read and obey all signs posted on and around the system.
- Know the location of all Energy Control and Power Lockout (ECPL) placards and properly follow all posted procedures.
- Use tools properly and safely whenever working on the system.
- Understand all system color coding.

Become thoroughly familiar with the location and function of all safety devices on the system including emergency stop buttons.

3.2 System Operating Safety

System-specific operating safety is outlined below:

- Only qualified personnel, trained in both safety and system functions, should be allowed to operate the system.
- Do not power-up until the entire system has been checked. Ensure all safety gates, doors or guards are closed and properly interlocked. Inform all personnel in the system area of the power-up.
- While the system is operating, be attentive to all machine and production processes. Excessive vibration, unusual sounds or strange odors can indicate serious problems. If a problem is suspected, contact the appropriate plant personnel to determine what action(s) to take.
- Do not open or remove safety barriers while the machine is operating. If the system must be accessed, follow all plant ECPL procedures first.
- Never bypass—mechanically, electrically or otherwise—any system safety features or devices.

- For best practices, turn off power before unplugging and plugging cables inside the DAQ cabinet.
- Before removing or replacing PXI cards, power down the PXI chassis and PC.

The UUT and reference load cells are extremely sensitive to very small movements. The Load Frame is extremely powerful. Use extreme care when using the jog buttons to move the load head.

3.3 Safety Monitors

While the software is Online, the following are monitored. If the condition occurs, the test stops and the station facilities are brought to a safe condition. The user is notified of the specific problem.

- When the PCS software is online, this window remains on top of all windows. If this button is clicked, the test stops and station facilities are brought to a safe condition.

Figure 3.1 Stop Test Icon

- The database connection
- The cabinet temperature failure and warning levels
- The connection to the United Load Frame controller
- The connection to the Keysight controller
- United Load Frame servo errors
- The Keysight voltage output not exceed a limit
- The Excitation voltage feedback to be within requested setpoint
- United encoder position feedback (via USB) and Mitutoyo reference position delta is within acceptable limits
- DTI recorder ports connected (only when running DTI load cells)

While a load is applied to the UUT, the following are monitored. If the condition occurs, the test stops and the station facilities are brought to a safe condition. The user is notified of the specific problem. It is important to understand these monitors are only active when the bridges are activated for measurement.

- Each UUT (mV/V reading) is monitored to not exceed the maximum and minimum output value (AXIS_RATED_OUTPUT) within a safety tolerance. The parameters “axis_safety_tol” define the safety tolerance for each UUT.
- Each DTI axis (LSB reading) is monitored to not exceed the maximum and minimum output value within a safety tolerance. The parameters “axis_safety_tol” define the safety tolerance for each UUT. The AXIS_RATED_OUTPUT for DTI is not known. The parameter DTI_LSB_MAX_LOADED_LIMIT defines the maximum output value.

- For the reference load cell, the mV/V and the corresponding units are monitored to not exceed the maximum and minimum output value within a safety tolerance. The parameter “ref_lc_safety_tol” defines the safety tolerance for the reference load cell.

At the start of automatic load frame motion, the following are monitored. If the condition occurs, the test stops and the station facilities are brought to a safe condition. The user is notified of the problem.

- The reference load cell shows tension, when it should be compression or vice versa.
- The reference load cell does not show any load within a timeout.
- The UUT under load does not show loading in the proper polarity after the reference load cell shows load.

During automatic load frame motion, the following are monitored. If the condition occurs, the test stops and the station facilities are brought to a safe condition. The user is notified of the problem.

- Either door switch (if equipped) indicates opened condition
- The reference load cell measurement drops out
- The United Load Frame indicates it is not enabled for motion
- Another abort occurs in the system
- The position measurement from United Load Frame stops
- The requested force or position is not completed in the allotted time period
  Once the doors (if installed) are closed and the PC is controlling the Load Frame motion, if there is an abort, the load frame will automatically retract to the original zero position. During the automatic retract, the same conditions are monitored for safety.

CAUTION

Although the door switches indicate a closed condition, the load frame enclosure door latch may be adjusted in a way that exposes the load frame motion to the technician or any person in the area of the load frame. Exercise extreme caution when operating the load frame

3.4 Lifting Guide for SFM Machines with Eyebolts

WARNING

- Never use to lift machine over people.
- Never lift more than machine weight (remove all items except load cell and fixture from any surface of the machine before lifting)

3.4.1 Vertical Lifting (Eyebolts)

- Eyebolts are for **vertical lifting only**.
- Hoist line must be plumb at all times.
- Machine must remain in vertical orientation during lifting.
- Always use both eyebolts at the same time.
- Do not lift machine using only one eyebolt at any time.
- Tighten the slack out of the hoist line before lifting to prevent sudden loading.
- Never suspend the machine for an extended period of time.
- Never leave a suspended load unattended.

Proper rigging and lifting techniques are the responsibility of the operator. Check all applicable safety codes, regulations, and other applicable laws for further information about the safe use of your lifting equipment. United Testing Systems shall not be held liable to and shall not accept any liability, obligation or responsibility whatsoever for any loss or damage arising from improper use of the eyebolts and/or your lifting equipment.

Use for **<u>Vertical Lifting only</u>** using **both eyebolts at all times**

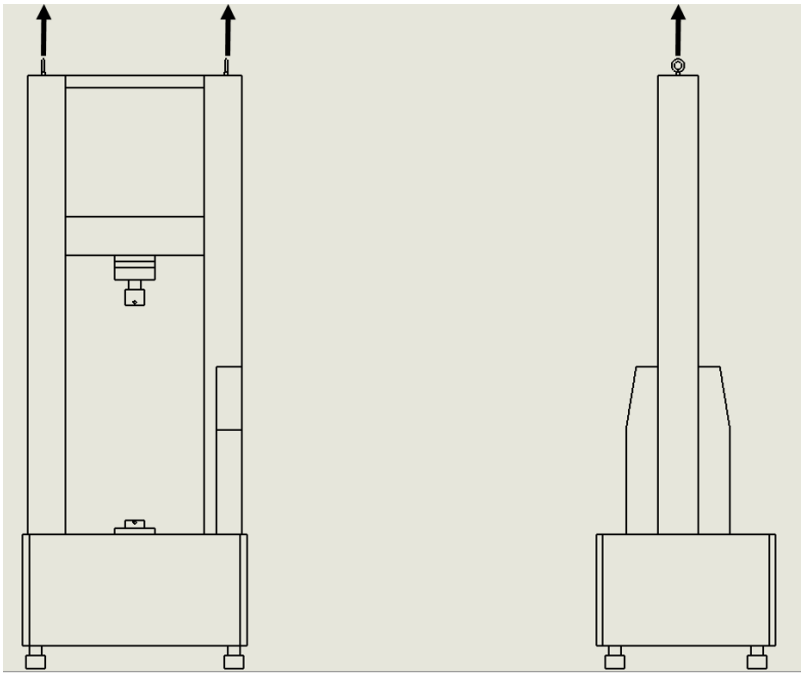


Figure 3.2 Vertical Lifting for both Eyebolts

3.4.2 Horizontal Lifting/Tilting Instructions

WARNING

Always make sure plug (as shown in photo) is installed before any tilting operation to prevent fluid leaking from the port. (Instructions for inspection denoted below)

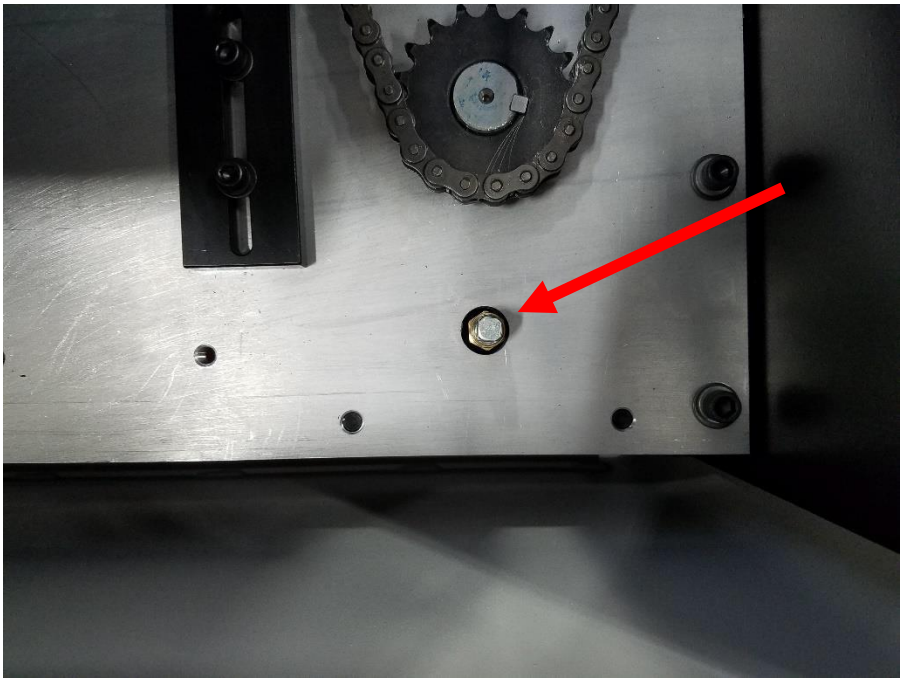


Figure 3.3 Install Plug Properly

Plug size/type: ¼" NPT Male Plug

NOTE: In typical operation while machine is vertical, an oil breather cap will be installed in place of a plug after machine setup.

3.4.3 Inspection procedure

1). Lift and remove rear wooden board (under rubber protective mat) from top of machine base frame.

2). Locate port with plug or oil breather cap near the lower right corner (shown in above photo).

3). Verify whether plug (as shown in above photo) or oil breather cap is installed.

Use rigging and lifting slings rated for minimum of 5000lbs in Choker Hitch Capacity rating.

Round sling used at UTS (provided for reference): 6ft SpanSet Endless Roundsling (red) with Choker Hitch Capacity rated at 10,600 lbs.

NEVER tilt machine towards the front or rear sides.

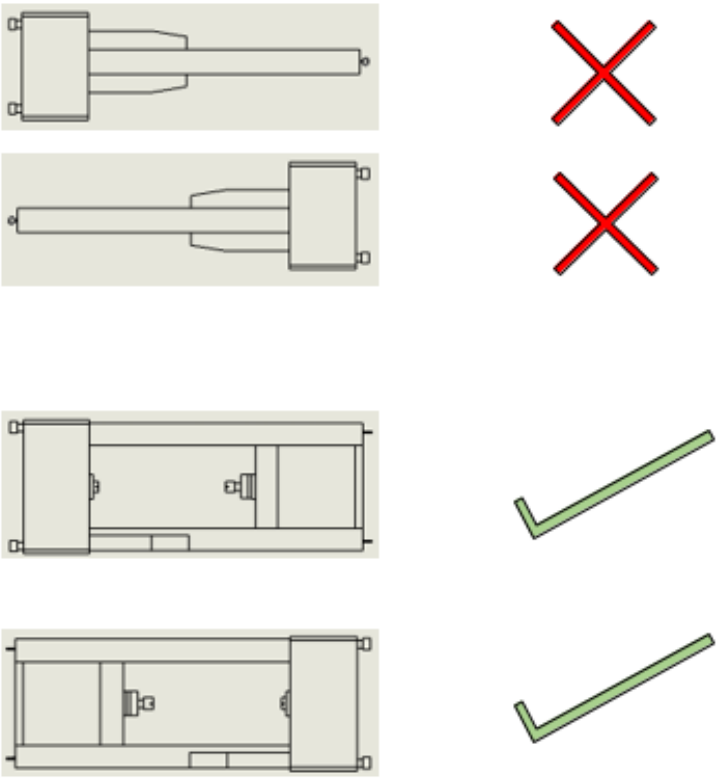


Figure 3.4 Correct Tilting Position

3.4.4 Horizontal Lifting Procedure

1. Make sure that the plug is installed in fluid port
2. Lift from far side of machine from the desired tilting side with a choker hitch loop around the stationary crosshead, and slowly lift in a smooth motion as the sling transition over the corner between stationary crosshead and column, until the machine is fully horizontally tilted on its side.
3. (reverse procedure for tilting from horizontal to vertical orientation)
4. Replace plug with an oil breather cap after the machine is in vertical orientation and ready to be used.

Section 4. System Power On

A warm-up period (typically one hour) is required for the system to reach optimal stable conditions. Advanced users can bypass the warm-up (not recommended) using the *Tools > Bypass Warm-Up* menu pick.

1. Open the DAQ cabinet front door.
2. Press and hold the UPS power button until the UPS indicates it is powered on.
3. The system is designed to automatically apply power to the PXI chassis first and delay 7 seconds before automatically applying power to the PC. Verify the power LED on the PXI chassis indicates ON. The PXI chassis must **always** be powered ON before the PC.
4. The United controller switch should be toggled to the ON position.
5. The Keysight should already be ON.

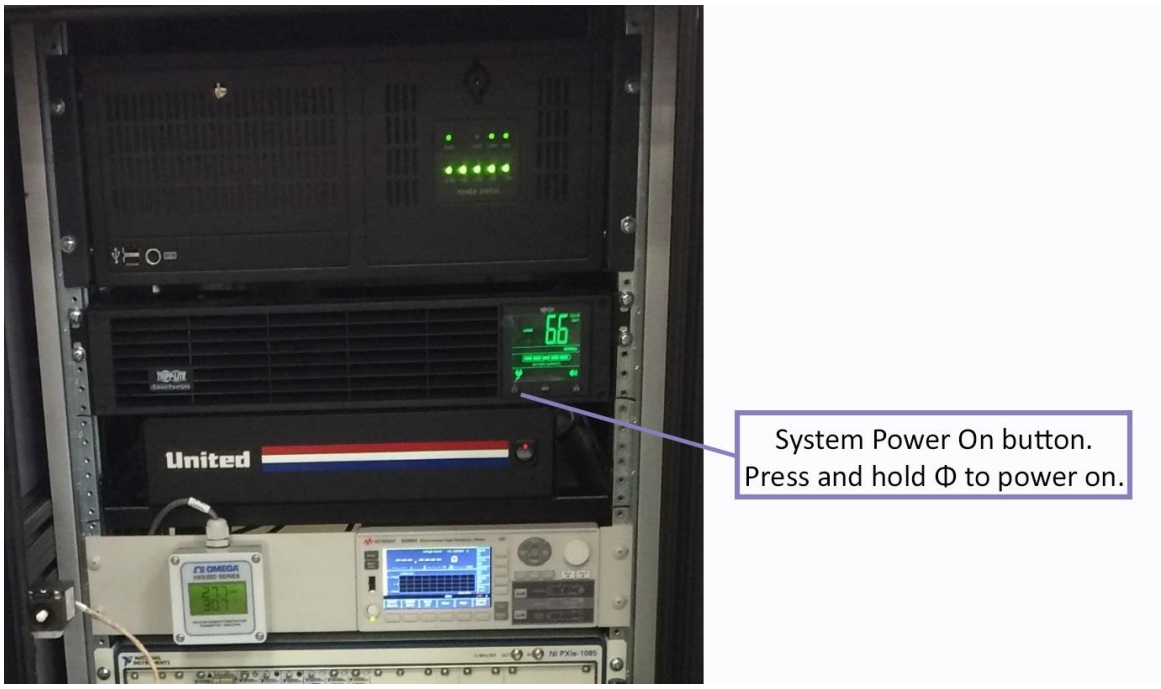


Figure 4.1 System Power On Button

6. Open the DAQ cabinet rear door. Verify the two (2) circuit breakers near the bottom of the cabinet are switched ON (up position).
7. Verify the GFI circuit is not tripped; red LED is OFF.

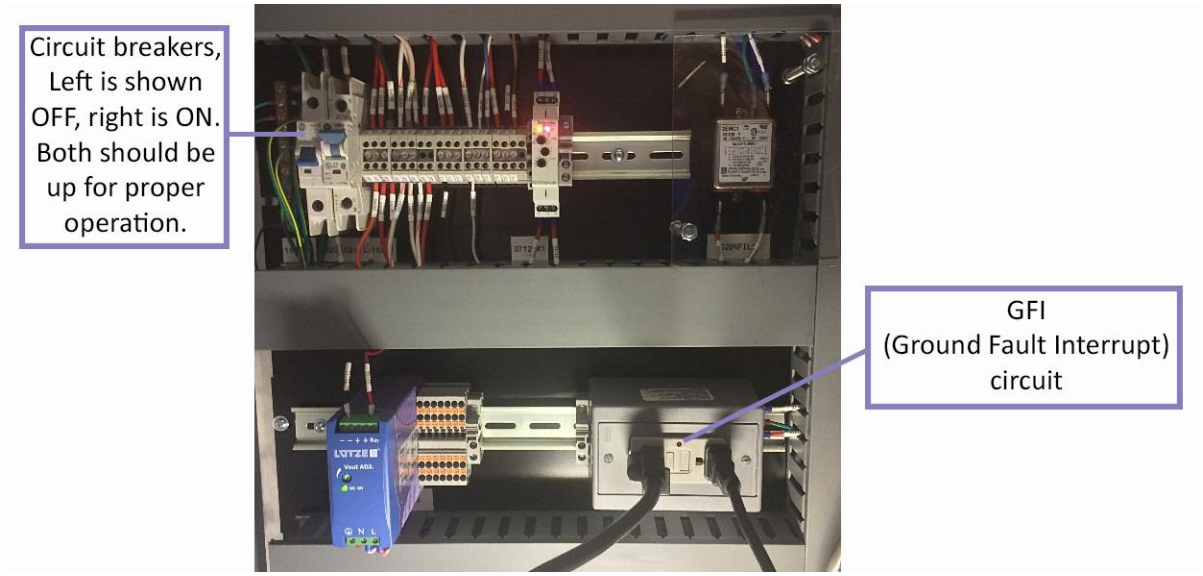


Figure 4.2 DAQ Rear Access Breakers

8. Close the two (2) DAQ cabinet doors. Verify the air conditioner on the side of the DAQ cabinet status LED is solid green. If the status LED is off, verify the doors are completely closed and the door switches are activated. If the status LED is flashing there is a problem with the air conditioner.

	NOTICE During some portions of the test, a relay is energized to disable the A/C. The reason is to reduce the electrical noise on the measurements.

9. Verify the United load frame power switch on the back of the United load frame is switched ON.
10. Verify the E-Stop on the United Load Frame is pulled out.
11. Power on the United load frame power switch on the front of the United load frame.
12. The United rocker power switch cannot be switched ON until PCS is *Online* and the E-Stop is pulled out.

Section 5. System Power Off

5.1 Stop the Software

1. If there is a test pending, either 1) save the result or 2) discard the result (*Edit > Discard Test Result*).
2. Click the *Offline* button.
3. Click the Exit button to stop the PCS software.
3. Allow PCS to shut down completely, then close all other programs.
4. Select *Start > Shut down* from the *Start* button in the task bar to exit Windows.
5. Wait for the PC to shut down fully, then power down the UPS and DAQ cabinet.

5.2 Power down the Load Frame

Power off the Load Frame from the front switch on the load frame.

5.3 Power down the DAQ Cabinet

Power off the DAQ cabinet by pressing and holding the power off button.

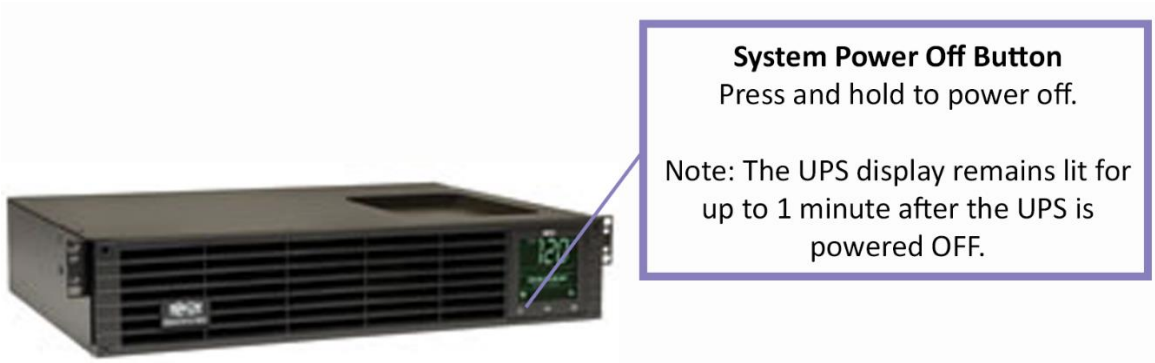


Figure 5.1 System Power Off Button

Section 6. Sequence of Operation

NOTE: The primary focus of this section of the manual is for analog Load Cell Calibrations. The sequence for testing other Part Types is similar. An appendix for each part type is included to highlight differences in testing the remaining part types.

6.1 Start the Software

If the software is not running, double-click the icon from the desktop.

The software has two (2) modes. It is necessary for the software to be *Offline* to make edits to the profiles or create new profiles. It is necessary for the software to be *Online* to run tests, read bridge values, and use many of the troubleshooting windows.

6.2 Go Online

Click the *online* button to prepare the software to be ready for running tests.

6.2.1 Screen Elements

The *Stand Information* box indicates the current status of the machine.

Table 6-1 Stand Information

Status	Description
Offline	Software must be *Online* to perform any tests. Some functions are only enabled when the software is *Offline*. See appendix for list of functions available.
FAULTED / ABORTED	An abort or fault condition occurred, check the bottom of the screen and click to open the Message Log for details. Clear the fault with *Fault Reset* button.
Waiting for Part Info	Click the button to enter part information.
Ready to Start Test	Click the button to start the test.
Testing	View the results in the *Measurement* list.

The *Part Information* box indicates the current unit under test information. The box changes color depending on the current testing state:

Table 6-2 Part Information Box Color

Part Information Box Color	Condition
Green	UUT test state is accepted or conditions are ready to continue
Red	UUT test state is rejected
Orange	UUT test state is aborted or station state is aborted or faulted

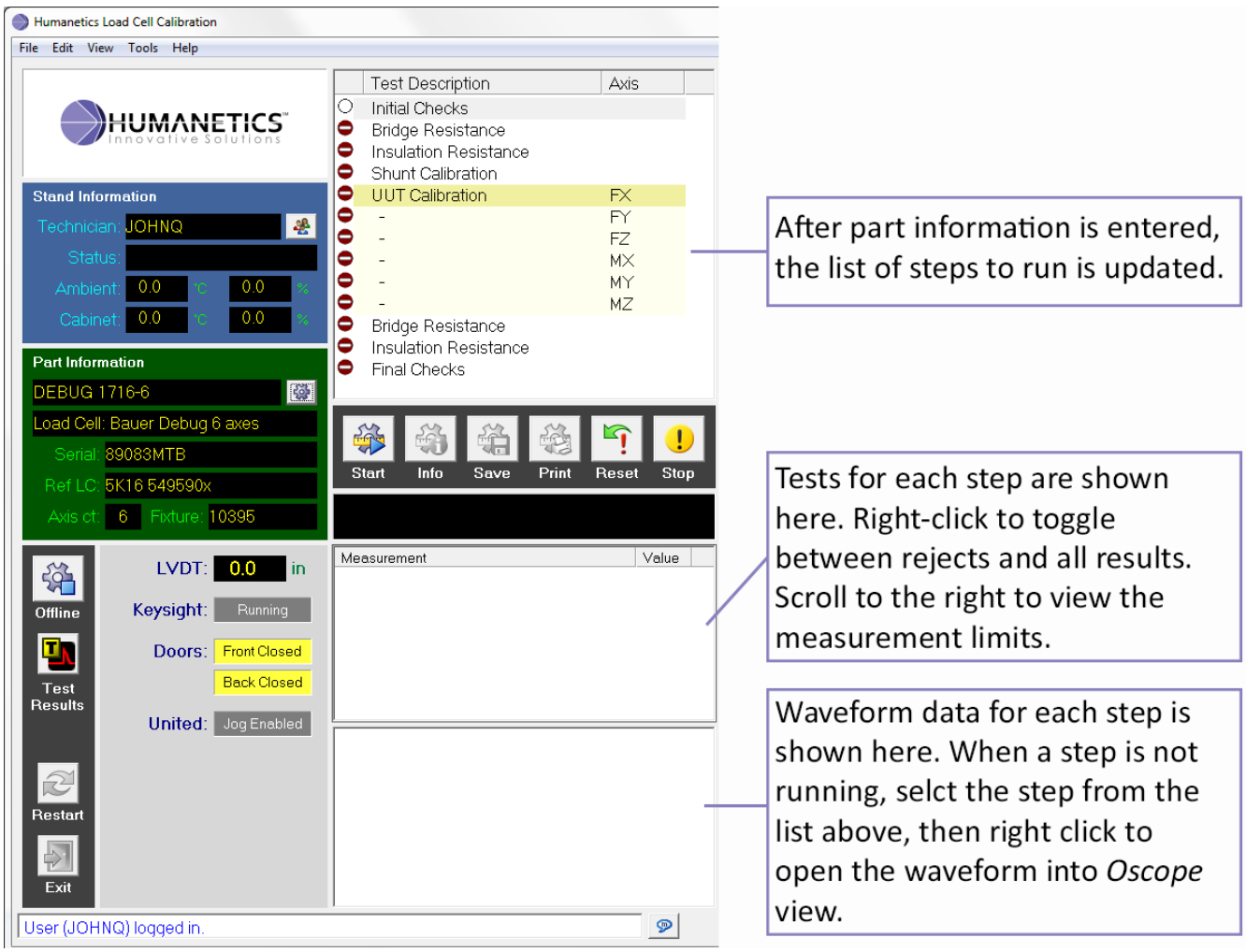


Figure 6.1 Main Screen

6.2.2 Status Bar

The *Status Bar* is an indicator at the bottom of the window that shows messages related to the current status of the Test Station or test step. See Reviewing System Messages for more information on status messages.

Table 6-3 Status Bar

This icon...	Indicates this...
	One or more active messages exist. The latest active message is displayed in the Status Bar.
	One or more active messages have been cleared, but one or more active messages still exist.

Indicators to the right of the Status Bar show the current status of the Host connection and Central Control (CC) updates. These fields can contain any of the following messages.

Table 6-4 Current Status

This field...	Indicates this...
Host	When the test is saved, data is transferred automatically to a database (Host). This field indicates the status of Host communication: • <empty>—No host has been configured. • *RUNNING*—Test Station is connected to the host. • *ERROR*—A network error is preventing data transfer. • *XFR REC*—Transferring recording data to the host. • *XFR TR*—Transferring test result data to the host. • *XFR CT*—Transferring component tracking data to the host. • *XFR AF*—Transferring attached file to the host.
Cencon	Shows the status of Central Control: • <Name of snapshot>—The station is running the proper snapshot. • *PENDING*—Central Control is waiting for a PCS restart to import commanded changes. • *DISABLED*—Central Control is disabled or no Central Control snapshot is set. • *ERROR*—Central Control error occurred. • *Off* – Central Control is switched off from the Stand and Station Configuration window

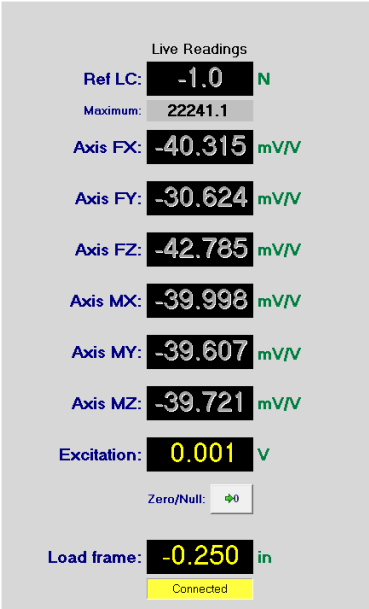


Figure 6.2 Live Readings Disabled when Relays not Activated

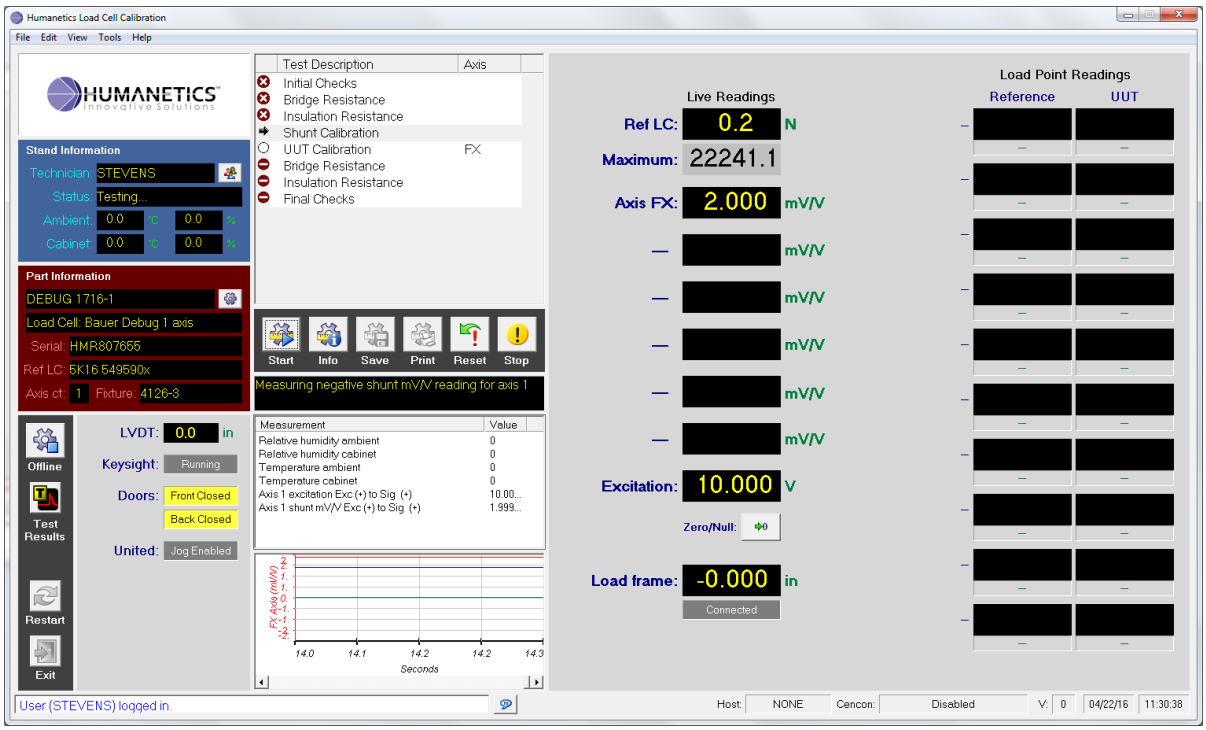


Figure 6.3 Live Readings and Load Point Readings

6.3 Technical Login

There are 5 levels of privilege. See appendix for more detail on user access levels.

1. Operator – no edit capability. Can run the test.
2. Maintenance – currently same as Operator
3. Engineer – can edit the parameter values and add new profiles + maintenance capabilities
4. Guru – can add new users + engineer capabilities
5. Advanced user – Advanced features require this level + guru capabilities

There are three (3) ways to logon.

1. *Tools > Login…*
2. Click the button from the main screen
3. As prompted from the software when login is required

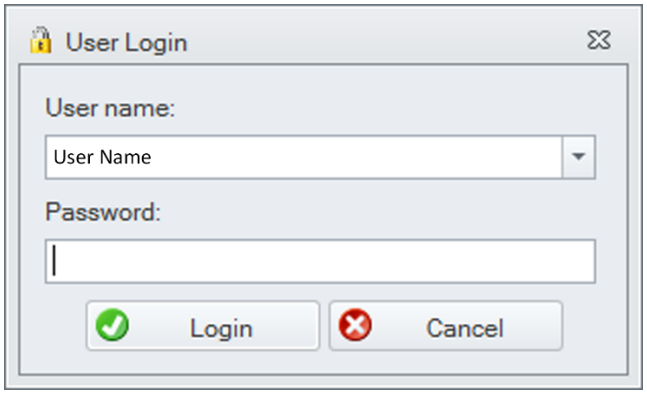


Figure 6.4 User Login Window

6.4 Prepare Machine

6.4.1 Mount Reference Load Cell and Fixture

Mechanically mount the reference load cell and fixture in the Load Frame.

6.4.2 Connect UUT to Pin Box

Instructions for connecting each UUT wire (analog only) to the pin box are available using the menu: *Help > Current UUT*. UUT bridges may be connected via individual wires on the top of the pin box or via two LEMO connectors on the front of the pin box. One LEMO connector is for bridges 1, 2, and 3. The other LEMO connector is for bridges 4, 5, and 6.

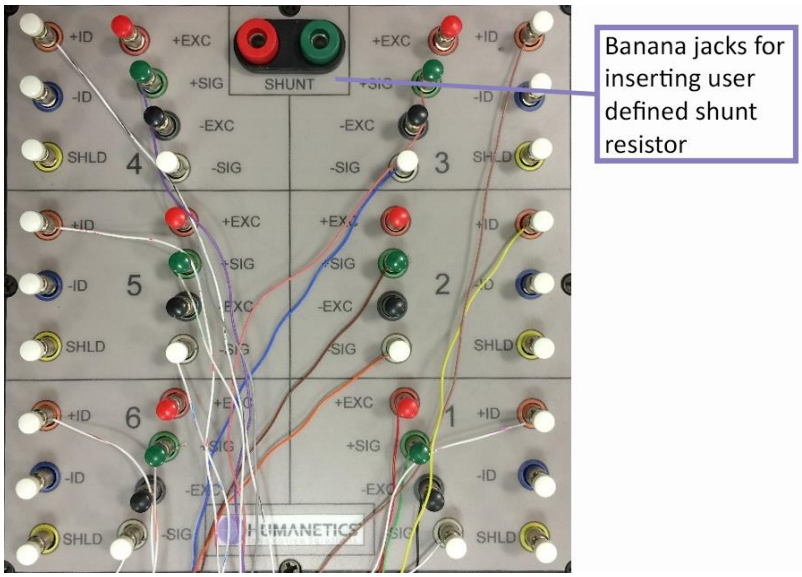


Figure 6.5 Pin Box UUT Connections

6.4.3 Connect Reference Load Cell to Pin Box

Connect the reference load cell to the pin box using the round Amphenol connector.

Figure 6.6 Pin Box Reference Load Cell Connection

6.4.4 Electrically Isolate the UUT from the Load Frame

The Insulation Resistance measurements require the UUT and fixture are electrically isolated from the Load Frame ground. If the UUT is electrically connected to the Load Frame ground, all Insulation Resistance (IR) measurements, including the System Checks for all three GOhm measurements fail with a reading of 0.0 GOhms.

6.4.5 Connect Ground Clip

The ground clip must be attached to the UUT for proper insulation resistance measurements.

Figure 6.7 Ground Clip

6.4.6 Load Frame

Verify the Load Frame is powered ON and there is no load applied to the UUT.

6.5 Enter Part Information

Prior to starting a test, information about the test must be defined. Click the button to enter part information. Parameter values cannot be changed in this window. The column "*Idx*" indicates the axis for the parameter. If "*Idx*" = "-", the parameter values do not vary by axis. "*Idx*" = 1 indicates axis 1 parameter values. The items labeled in **bold type** are required.

If information was previously entered and no test is in progress, the technician can choose to keep the previously entered information. Click *No* at this prompt.

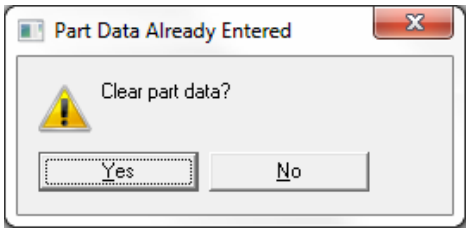


Figure 6.8 Part Data Already Entered Window

Restricted users can modify parameter values in the *Project Editor*. See Configuring the Software section for details on changing parameter values. Once a test is started, the *Serial* and items in *Calibration Details* section information may be changed by the technician.

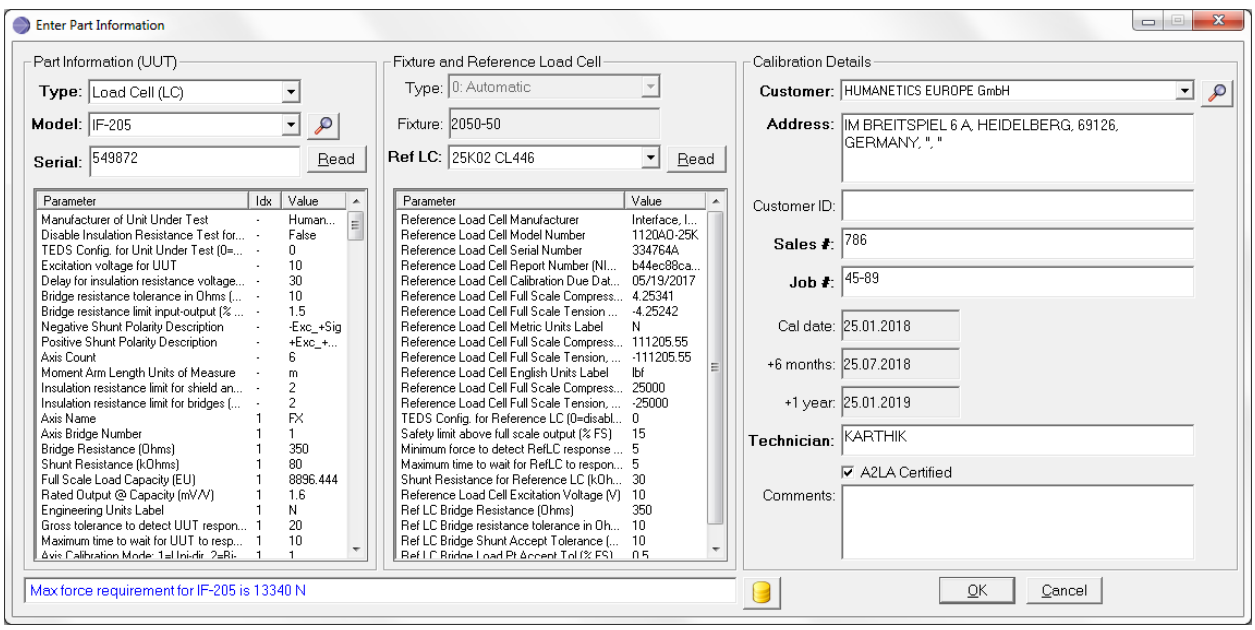


Figure 6.9 Enter Part Information Window

If there are problems with the configuration, the fields are highlighted in red.

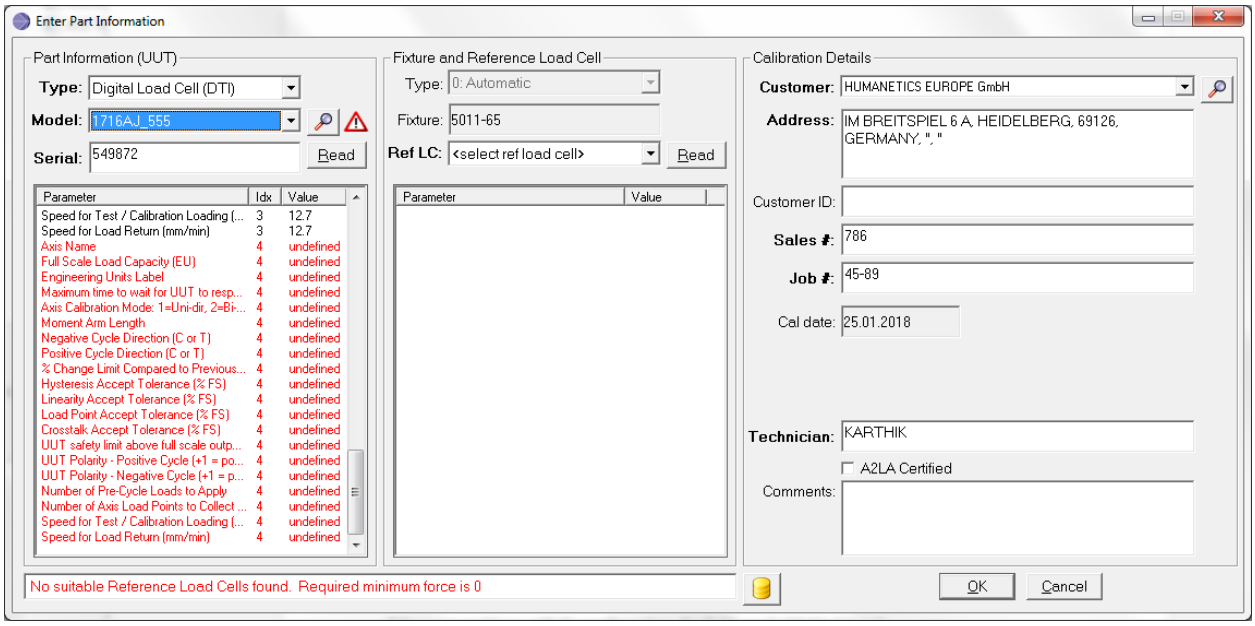


Figure 6.10 Enter Part Information Window, Problems with Configurations Highlighted in Red

6.5.1 Select UUT

Select a *Type* to filter the *Model* list.

Click the button to search for a specific model or select a *Model*.

Once the model is selected, special handling is required for DTI. See DTI Part Entry.

After selecting *Type* and *Model*, enter the *Serial* number for the specific UUT.

For the *Serial*, perform one (1) of the following:

1) If the UUT has WorldSID TEDS configured, click the UUT *Read* button to acquire the *Serial* ID from TEDS. The software automatically enables the relays and attempts to read the TEDS information from axis 1 chip. If there is a problem with the connection, the software automatically attempts to read TEDS through the other connections on axis 1 chip.
2) Type the *Serial* number into the field.

When the **TAB** key is pressed or another field is clicked, the software automatically searches the database for any previous calibrations for this *Serial* number. The latest accepted calibration is shown in the UUT Previous Results window. At the end of the UUT Calibration step, the newly calculated sensitivity value is compared to the previous accepted sensitivity result.

The UUT previous accepted results window can also be opened by clicking the button.

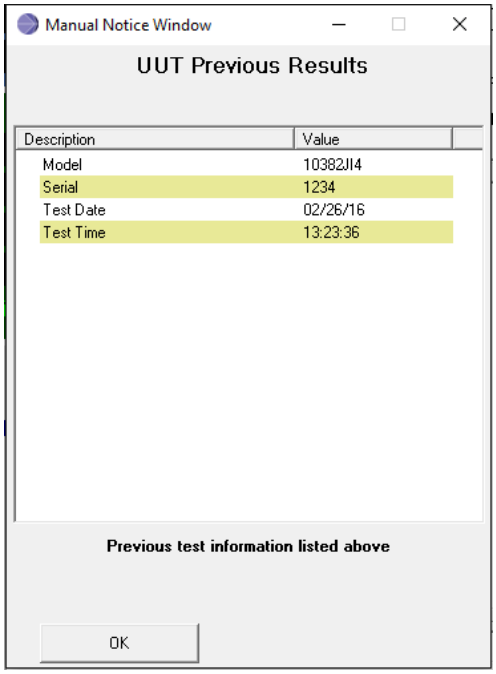


Figure 6.11 UUT Previous Accepted Results Window

6.5.2 Calibration Type

The calibration type defines how the UUT Calibration test is performed. The calibration type is specified within the profile for the UUT. It cannot be changed from the *Enter Part Information* screen.

0. Automatic – Reference Load Cell is used as the known load feedback. The PC controls the load frame automatically using a continuous motion at a rate defined by the profile.
1. Manual – Reference Load Cell is used as the known load feedback. The Load Frame is not used. The technician physically applies a load to the UUT. The technician is prompted to apply each load point. The PC monitors the reference load cell to be stable and within a range and collects the UUT measurements.

6.5.3 Select Reference Load Cell

The list of available reference load cells is filtered based on the maximum required load for the selected UUT. For the *Ref LC*, perform one (1) of the following:

1) If the reference load cell has IEEE TEDS configured and connected, click the Ref LC *Read* button to read the model and serial ID from TEDS. If the reference load cell is found in the list, the screen automatically selects it.
2) Select the reference load cell from the list.

6.5.4 Complete Customer Details

To complete the customer details, follow steps belw.

1. Click the button to search for a specific customer.
2. Complete the remaining customer fields.

6.5.5 A2LA Certification

The technician can enable or disable the A2LA box. Some sites do not have A2LA Certification. If the parameter LAB_CERT_ENABLED = False, the checkbox for A2LA is not visible and the final report will not show the A2LA logo.

6.5.6 Complete Part Entry

Click the *OK* button from the *Enter Part Information* window. The *Part Information* fields on the main screen are automatically updated with the information entered.

6.6 Start the Test

If there is a FAULT or ABORT present, click the *Reset* button to clear the fault.

Click the *Start* button to start the first test step.

- For the current step, is displayed to indicate this step is executing.
- If the test step accepts, is displayed to the left of the step in the step list. Except for the UUT calibration steps, the next step automatically starts.
- If the test step rejects, is displayed to the left of the step in the step list. The technician can select to run the step again or select the next step and click the "Start" button.
- If the test step aborts, is displayed to the left of the step in the step list. The technician must click the *Reset* button, then select the same step again or select the next step to run and click the *Start* button.
- For any step, you may select the step and click the *Info* button for information about the step.

NOTE: At the start of analog load cell tests, install the Ground Clip and move the UUT and fixture to the work table such that the fixture is not touching the Load Frame.

6.6.1 Initial Checks

Initial Checks step is used to verify the Atlas system is in working order and to verify signal connection of the load cells. The test aborts if there is a problem. If Initial Checks fails or aborts, an advanced user is required to continue to run any other test step.

If configured, IEEE1451 TEDS information is read from the reference load cell and verified to assure the serial number and calibration is valid for the selected reference load cell. If there is a problem with the wiring connection to TEDS, the technician is prompted to verify wiring.

If the reference load cell information from TEDS does not match the data from the parameter entry, the technician is notified and an advanced user must logon to continue.

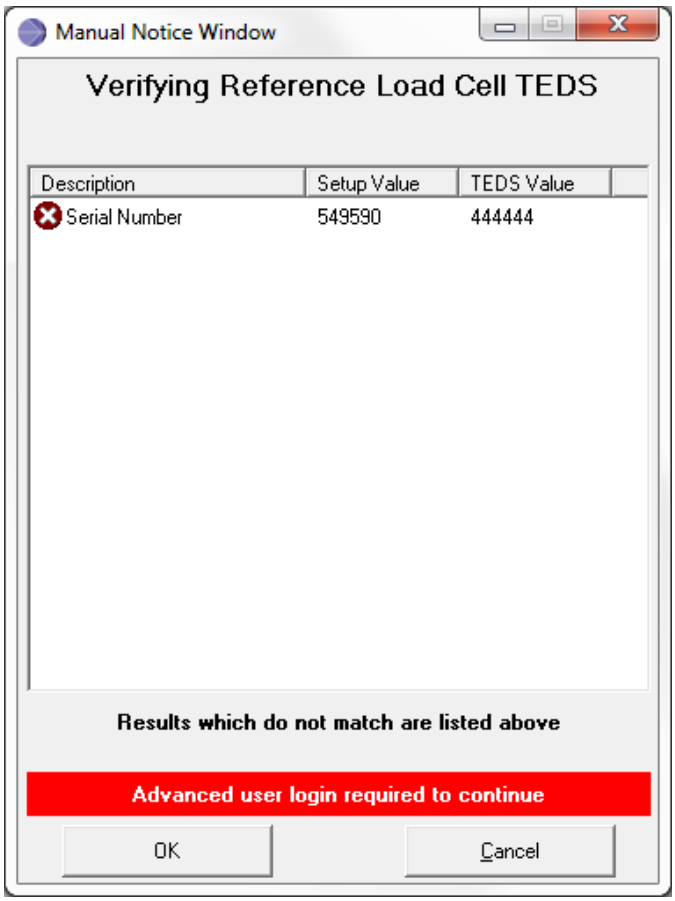


Figure 6.12 Verifying Reference Load Cell TEDS Window

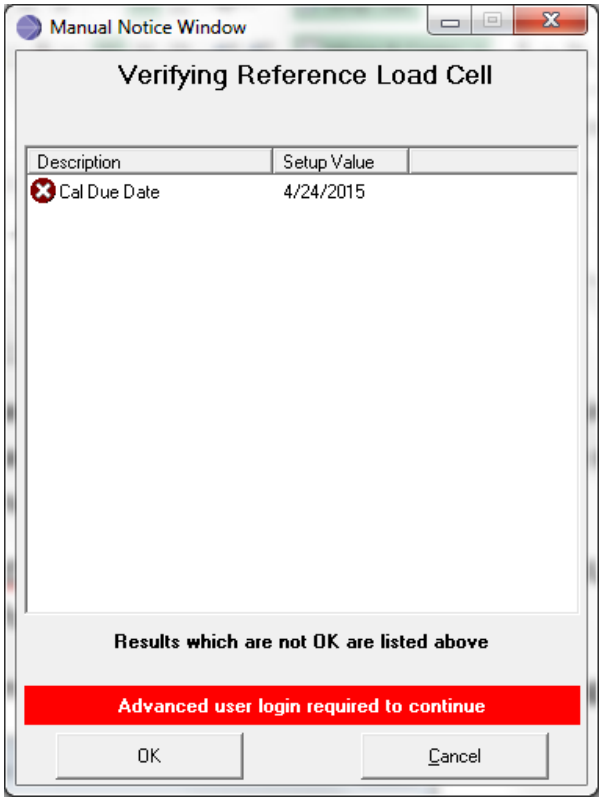


Figure 6.13 Advanced User Login Required to Continue Window

Figure 6.14 User not Configured with Required Privilege Message

When the reference load cell information is verified, the minimum and maximum output mV/V and full scale compression and tension and units are written into the data acquisition channel to convert mV/V to engineering units for the remaining tests.

For DTI load cells, the reference load cell DTI conversion from analog to DTI is verified. Please see topic DTI Initial Checks and DTI Reference Load Cell Calibration for details.

If configured, WorldSID TEDS information is read from each UUT (analog) and verified to assure the serial number and model is valid for the selected reference load cell.

Bridge circuits are energized for technician to verify by viewing the main screen.

Technician verification 1: Press on each axis and verify the value changes for the appropriate axis on the main screen. The values should increase or decrease from a value close to 0.0. The signals have not been nulled yet, so a slight offset from 0.0 is OK. You can adjust the wiring before clicking *OK*. Click *Cancel* if the signals are not responding properly and cannot be resolved. The test aborts and must be started again.

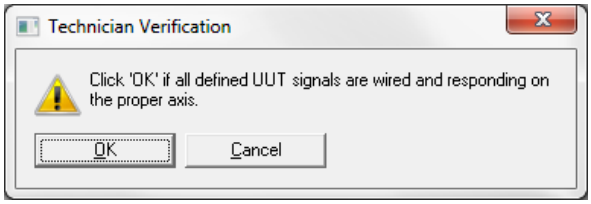


Figure 6.15 Technician Verification 1

Technician verification 2: This verification is omitted if there is no reference load cell (deadweight test). Press on the reference load cell axis and verify the value at the top of live readings changes. The values should increase or decrease from 0.0. The signal has not been nulled yet, so a slight offset from 0.0 is OK. Adjust the wiring before clicking *OK*. Click *Cancel* if the signal is not responding properly and cannot be resolved. The test aborts and must be started again.

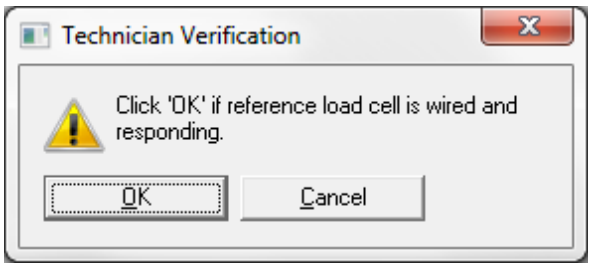


Figure 6.16 Technician Verification 2

Technician verification 3: This verification is omitted if there is no reference load cell (deadweight test). Press on the reference load cell axis and verify the value at the top of live readings increases and is positive (+) with push force. Click *Cancel* if the signal is not responding properly. The test aborts and must be started again.

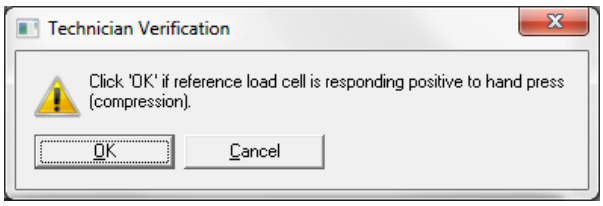


Figure 6.17 Technician Verification 3

Initial bridge values are tested to assure the initial natural mV/V offset (unbalance) is not too high. The bridges remain as natural values until the Shunt Calibration test step runs.

The measurement system is verified to be in optimal working condition for analog testing only.

- NI 4339 bridge measurements are compared to the DMM measured voltages.
- Shunt resistors required for this UUT are measured by the DMM.
- Excitation voltage is measured by DMM and analog input and compared to the expected voltage.
- 100 Ohm fixed resistor is measured by DMM.
- Three (3) known GOhm resistances are measured using the insulation resistance measurement circuit.
- Relative humidity and temperature are measured inside the DAQ cabinet and inside the Load Frame.

If any tests fail during Initial Checks, advanced user logon is required to start the next step. If Initial Checks runs without any failures, the Bridge Resistance test starts automatically without any user intervention.

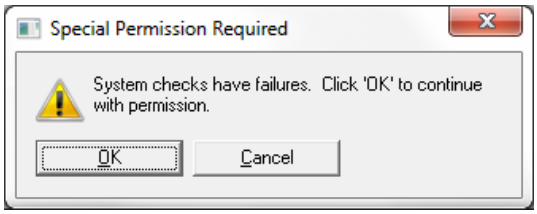


Figure 6.18 Special Permission Required Message

Figure 6.19 User not Configured with Required Privilege Message

6.6.2 Bridge Resistance (Analog Load Cells Only)

Excitation (+) to Excitation (-) resistance is measured by DMM for all UUT bridges. Signal (+) to Signal (-) resistance is measured by DMM for all UUT bridges. Bridge mV/V measurements are disabled during this test. The main screen shows the *Live Readings* as disabled. Bridge resistance tests are performed before (Pre-Cal) and after (Post-Cal) the UUT calibration steps.

Parameters in the profile define the expected bridge resistance and the tolerance (as a percentage of the expected resistance) are used to determine the limits for the testpoints.

6.6.3 Insulation Resistance (analog load cells only)

Insulation resistance (IR) is measured for each bridge and the shield and TEDS wires using the Keysight device to produce 50 V and measure the resistance in GOhms. Bridge mV/V measurements are disabled during this test. The main screen shows the *Live Readings* as disabled. These tests are performed before (Pre-Cal) and after (Post-Cal) the UUT calibration steps.

WARNING

Remove the UUT and fixture from the Load Frame before starting the IR tests. Install the Ground Clip. Do not touch or move the wires or the UUT during IR tests.

Insulation resistance measurements are performed using seven test blocks which measure the combination of many bridge circuits at one time. If a test block fails, the individual circuits within that test block are measured to identify the specific circuit on the UUT with the problem.

6.6.4 Shunt Calibration

The bridge measurements are enabled for each UUT and the reference load cell. The bridge measurements are nulled before making any shunt measurement. The Live Readings show green when the bridge measurements are nulled.

The equivalent term for shunt as used for DTI is Stimulation. See topic DTI Stimulation for details.

During the shunt calibration, a shunt resistor is automatically inserted into the bridge circuit using relays inside the DAQ cabinet. The specific resistor to use for each bridge (including the reference load cell) is defined by parameters in the profile. Refer to the drawing package for the list of predefined resistors. If the resistor value as defined in the profile does not exist, the technician is prompted to insert the resistor into the banana jacks on the pin box.

Figure 6.20: Prompt to Insert Shunt Resistor

If the shunt resistor is not the proper size or if there is a problem with the bridge circuit, the test fails. There are two criteria:

1. The calculated bridge resistance from the shunt measurement must be within a percentage of the expected bridge resistance. If it fails, the corresponding testpoint fails and the following prompt appears:

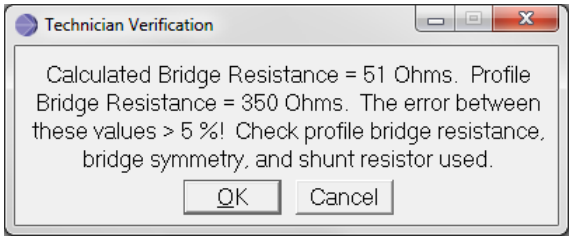


Figure 6.21 Calculated Bridge Resistance Fail Message

2. The shunt measurement (in mV/V) must be less than the rated output for the bridge.

A TOOL IS AVAILABLE TO CALCULATE SHUNT RESISTANCE: TOOLS > CALCULATE SHUNT RESISTOR. THE TECHNICIAN IS PROMPTED FOR THE EXPECTED BRIDGE RESISTANCE AND FULL SCALE MV/V RATED OUTPUT.

6.6.5 UUT Calibration

Select any axis to calibrate in any order. The term *Positive* refers to the 1st directional loading. If required for this UUT, the 2nd directional load is referred to as *negative* loading. The technician is responsible for properly loading the fixture so the load frame and reference load cell contact the proper axis during each step.

The following illustrates the automatic calibration procedure. Depending on the UUT parameter, calibration may also be performed by manually applying a load or by using deadweight calibration equipment in place of the load frame.

Measurements from all axes and the reference load cell are collected during this test.

The doors on the Load Frame Enclosure must be closed any time the Load Frame is moving under automatic control.

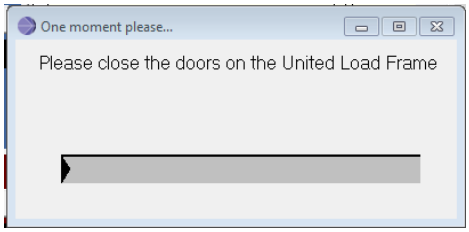


Figure 6.22 Close Doors Message

6.6.5.1 Pre-Conditions

At the start of each test, the following pre-condition steps occur automatically:

- The full scale force to be applied during this axis test is shown to the right of the *Maximum:* below the Ref LC: *Live Reading*.
- The jog buttons on the United are disabled.
- The null is removed from all bridges so the bridge readings are natural.
- All bridges are energized for measuring.

6.6.5.2 Place Fixture

The technician is instructed to place the fixture into the Load Frame based on the selected axis.

Technician Verification 1: Press on the selected axis to observe a response on the main screen. Click *OK* to confirm the response.

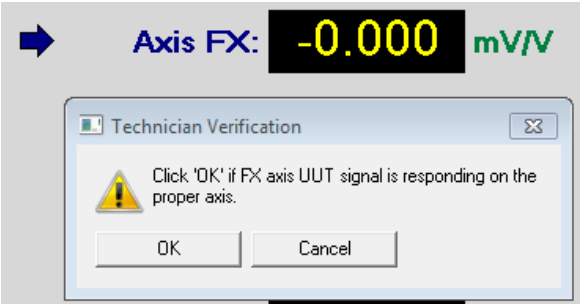


Figure 6.23 Click OK to Confirm FX Axis Message

WARNING

The UUT and reference load cells are extremely sensitive to very small movements. The Load Frame is extremely powerful. Use extreme care when using the jog buttons to move the load head. Use the speed control knob and slow jog button to move the load head slowly to line up the fixture.

WARNING

Although the door switches indicate a closed condition, the load frame enclosure door latch may be adjusted in a way that exposes the load frame motion to the technician or any person in the area of the load frame. Exercise extreme caution when operating the load frame and running the automatic UUT calibration test steps.

Use the manual jog buttons on the Load Frame to place the selected axis under the reference load cell. It is important to place the fixture properly and for either *Positive* or *Negative* loading based on the selected step. For best results, move the load head as close as possible to the fixture. Be careful not to side-load the fixture.

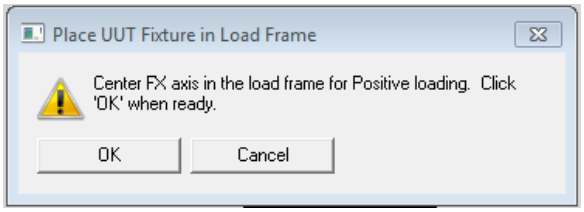


Figure 6.24 Center FX Axis for Positive Loading Message

6.6.5.3 Autozero/Null Bridges

The United jog buttons are disabled.

If the doors are not closed, the technician is prompted to close the doors. This is necessary because during the time when the bridge is nulled, the bridge must not be touched. If either door is opened during the null function, the test aborts.

The reference load cell is measured before it is nulled. If the natural value of the reference load cell during centering is not within the reference load cell offset minimum and maximum parameter values, the test aborts. This helps detect if there is too much load applied to the UUT during the centering. It can also detect a problem with the reference load cell. If the reference load cell natural value is within limits, the reference load cell, and all UUT bridges are energized and nulled.

6.6.5.4 Move to Initial Position

During the Initial Position phase, the rate of motion is defined from the Pre-Load speed in the profile.

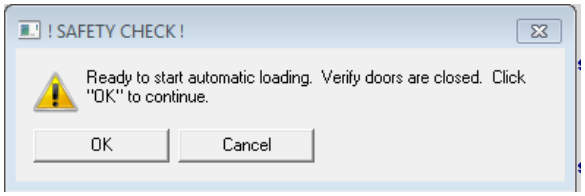


Figure 6.25 Safety Check, Verify Doors Closed Message

Once the doors are closed, the position measurement on the United is reset to zero. If there is an abort while the crossbar is loading, the software commands the United back to zero position.

The software seeks the initial crosshead position which is 1/N * the maximum load, where *N* is the number of loading points. See the safety section for all the conditions monitored at this point.

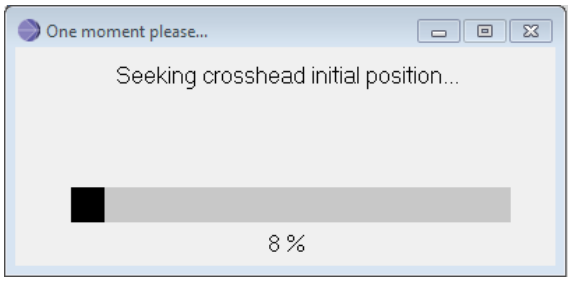


Figure 6.26 Seeking Crosshead Initial Position Process Bar Message

At the start of the motion, if the reference load cell is not reporting the expected load within a time limit, the test aborts. Possible reasons include:

a) The load head was too far from the fixture at the start of motion
b) The load frame is not powered on, connected, and ready for motion
c) The reference load cell is measuring opposite the desired force (compression must be positive)
d) The reference load cell is not scaled properly

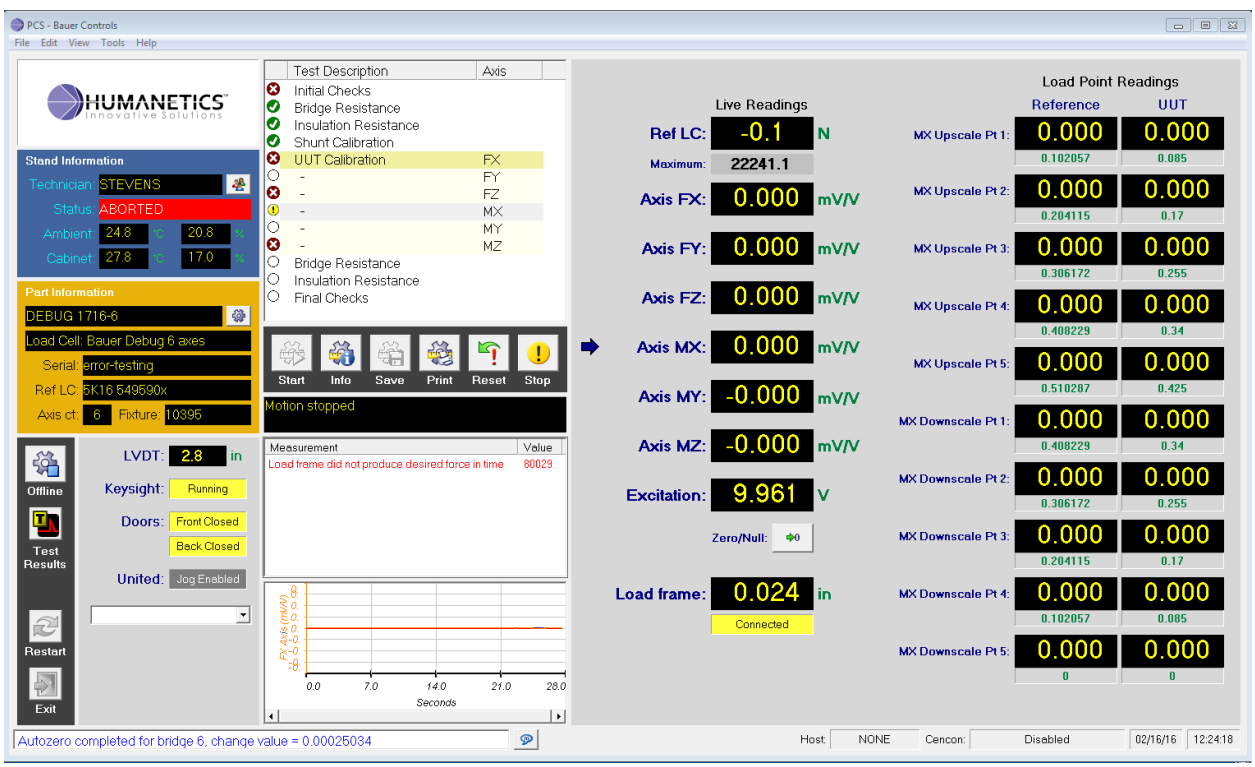


Figure 6.27 Reference Load Cell Readings

If the bridge reading for the selected axis is not within the expected range at the peak of the crosshead initial position, the test aborts. The technician has the ability to continue or abort.

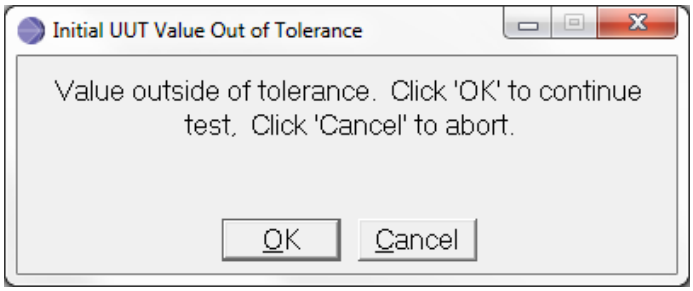


Figure 6.28 Initial UUT Value Out of Tolerance

Possible reasons include:

a) The wrong UUT axis is centered under the load head
b) The wrong UUT axis direction point was centered under the load head. Direction 1 (Positive) versus Direction 2 (Negative)
c) The axis on the UUT is damaged and not working properly
d) The bridge is wired to the pin box wrong
e) The polarity of the bridge for the selected direction is defined (parameter) wrong

The initial load is removed.

6.6.5.5 Pre-Load

Depending on the parameter for number of pre-load cycles, the software automatically applies and releases full load to the UUTs.

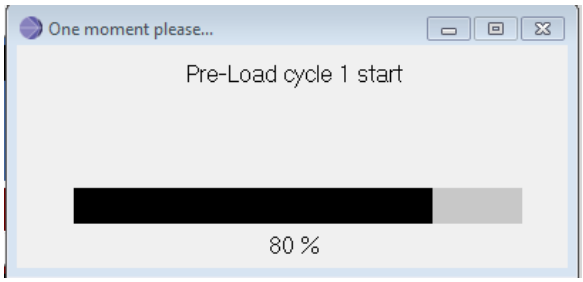


Figure 6.29 Pre-Load Cycle 1 Start Process Bar Message

6.6.5.6 Collect UUT Calibration Data

During the collection phase the software controls the United based on the axis load speed parameter and the maximum required load. The data is collected into a recording buffer and analyzed after the movement is completed. The *upscale* raw load points are measured and shown on the main screen. An optional dwell period is held at the maximum load.

Figure 6.30 Upscale Raw Load Points

The axis return speed parameter defines the rate of motion removing the load. The *downscale* raw load points are shown on the main screen.

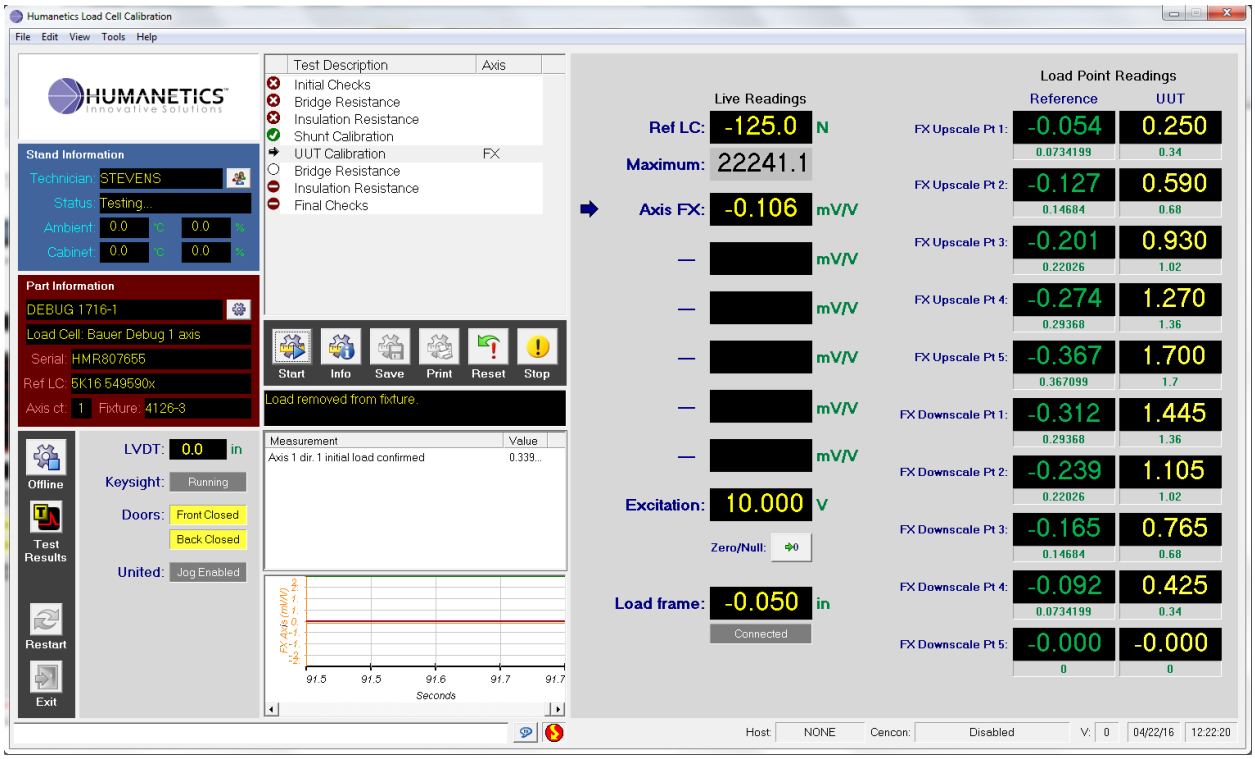


Figure 6.31 Downscale Raw Load Points

At the end of the calibration step, the load is removed from the fixture to a position of 2 inches.

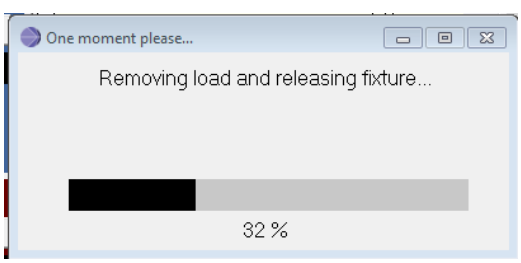


Figure 6.32 Removing Load and Releasing Fixture Process Bar Message

The data is evaluated and results are shown for approval.

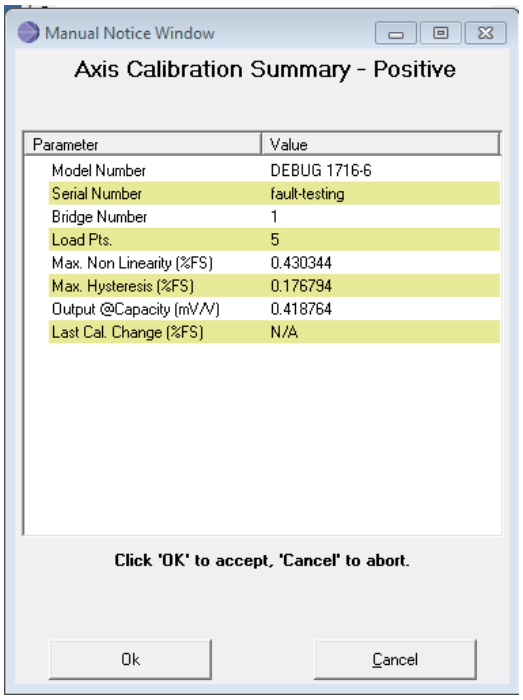


Figure 6.33 Calibration Result Confirmation

Complete the UUT Calibration for all steps listed. Any step may be repeated.

6.6.6 Bridge Resistance (Analog Load Cells Only)

After all UUT Calibration steps are completed, select the Bridge Resistance step and click the button. The same test procedure is performed as before the UUT Calibration.

The Post-Cal measurements are displayed in the final report as “Bridge Impedance Measurements”.

6.6.7 Insulation Resistance (Analog Load Cells Only)

Post calibration step is performed the same as the pre-calibration step. Test block #1 includes all the bridge to ground measurements. If test block #1 is accepted, the measurement for test block #1 is stored as the result for all bridge to ground measurements. If test block #1 fails, all finite measurements within test block #1 are measured and recorded. These include the measurements for bridge to ground.

The bridge to ground measurements are displayed in the final report as “Bridge High Short Measurement”. If the measurements are greater than 2.0 GOhms, the report shows the measurement as > 2.0 GOhms.

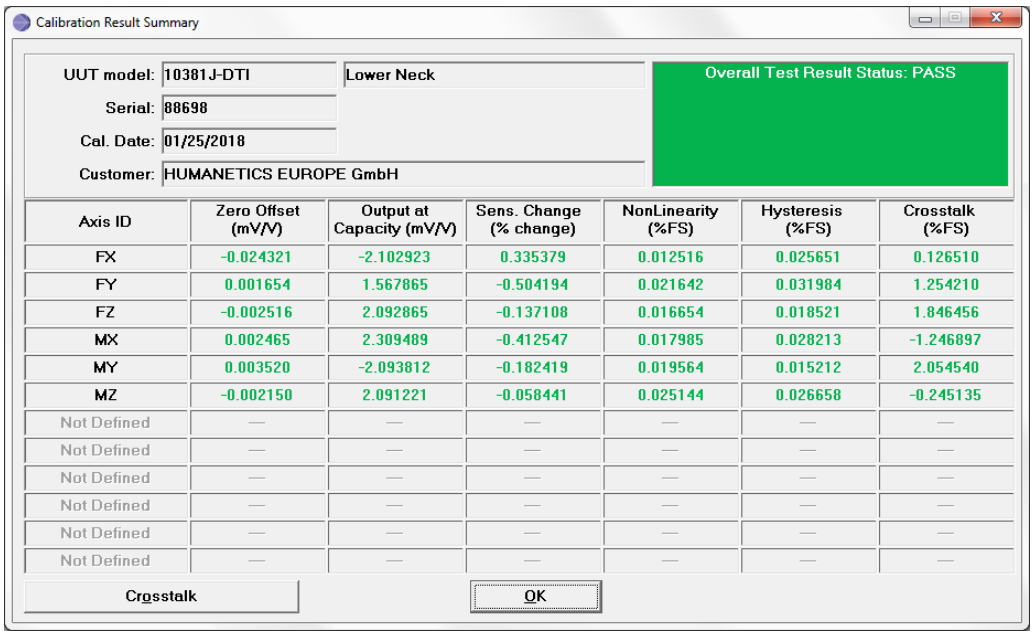
6.6.8 Final Checks

If configured for the UUT and the test is accepted, new sensitivity data, bridge resistance, and calibration date are written to WorldSID TEDS. If configured for the UUT and the test is rejected, the advanced user can override and allow the TEDS to be written. Before any data is written to TEDS, the data is verified to be within acceptable range for WorldSID protocol. If any part of the data is not valid, no TEDS data is written. Once the TEDS data is written, it is read back and compare to verify the values were properly written.

For the axes which completed UUT calibration, equivalent shunt calculations and percent full scale crosstalk calculations are performed. There are no crosstalk calculations for single-axis UUT or chest bands.

The natural offset values are recorded for all axes.

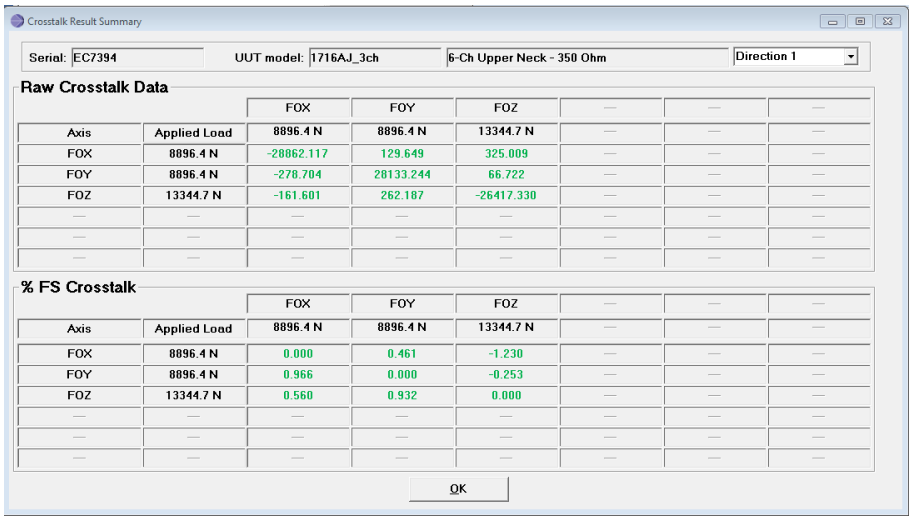
This window opens automatically to allow the technician to review the data. This window can be opened at any time from *View > Test Summary*.



Axis ID	Zero Offset (mV/V)	Output at Capacity (mV/V)	Sens. Change (% change)	NonLinearity (%FS)	Hysteresis (%FS)	Crosstalk (%FS)
FX	-0.024321	-2.102923	0.335379	0.012516	0.025651	0.126510
FY	0.001654	1.567865	-0.504194	0.021642	0.031984	1.254210
FZ	-0.002516	2.092865	-0.137108	0.016654	0.018521	1.846456
MX	0.002465	2.309489	-0.412547	0.017985	0.028213	-1.246897
MY	0.003520	-2.093812	-0.182419	0.019564	0.015212	2.054540
MZ	-0.002150	2.091221	-0.058441	0.025144	0.026658	-0.245135
Not Defined	—	—	—	—	—	—
Not Defined	—	—	—	—	—	—
Not Defined	—	—	—	—	—	—
Not Defined	—	—	—	—	—	—
Not Defined	—	—	—	—	—	—
Not Defined	—	—	—	—	—	—

Figure 6.34 Calibration Result Summary Window

If there are multiple axes, click the *Crosstalk* button to open a second window to view crosstalk data. If there are two UUT Calibration loading cycles (Positive and Negative) for the axes, select Direction 1 or Direction 2 from the upper right corner.



Crosstalk Result Summary

Serial: EC7394 UUT model: 1716AJ_3ch 6-Ch Upper Neck - 350 Ohm Direction 1

Raw Crosstalk Data

Axis	Applied Load	FOX	FOY	FOZ	—	—	—
		8896.4 N	8896.4 N	13344.7 N	—	—	—
FOX	8896.4 N	-28862.117	129.649	325.009	—	—	—
FOY	8896.4 N	-278.704	28133.244	66.722	—	—	—
FOZ	13344.7 N	-161.601	262.187	-26417.330	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—

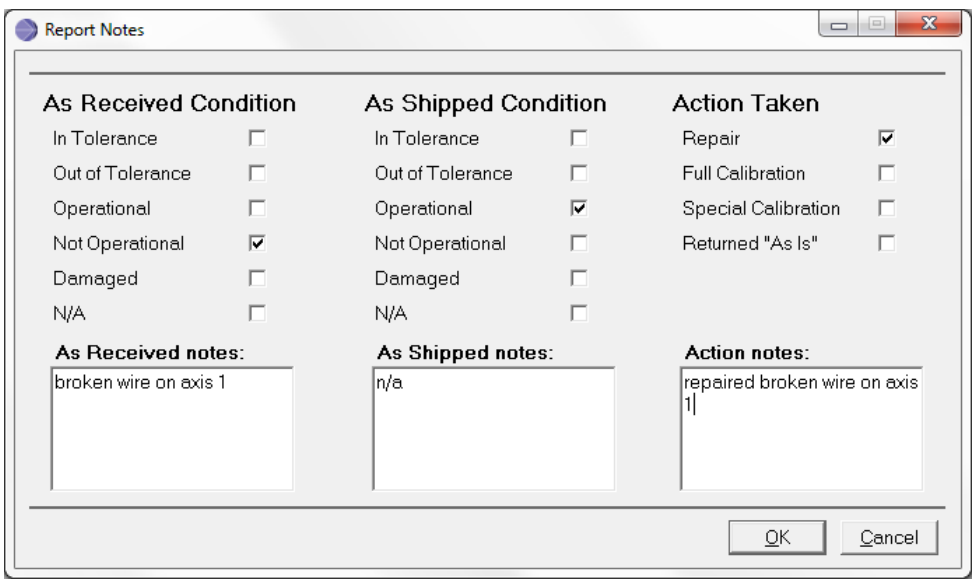
% FS Crosstalk

Axis	Applied Load	FOX	FOY	FOZ	—	—	—
		8896.4 N	8896.4 N	13344.7 N	—	—	—
FOX	8896.4 N	0.000	0.461	-1.230	—	—	—
FOY	8896.4 N	0.966	0.000	-0.253	—	—	—
FOZ	13344.7 N	0.560	0.932	0.000	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—

OK

Figure 6.35 Crosstalk Summary Window

The window opens automatically to allow the technician to complete the As Received, As Shipped, Action. This information is stored in the test record as it is useful for keeping records, refer to Summary Report Page topic for how this information is used. Use *Tools > Update Report Notes* to open this window any time after the test started and before the test is saved.



Report Notes

As Received Condition		As Shipped Condition		Action Taken	
In Tolerance	☐	In Tolerance	☐	Repair	☑
Out of Tolerance	☐	Out of Tolerance	☐	Full Calibration	☐
Operational	☐	Operational	☑	Special Calibration	☐
Not Operational	☑	Not Operational	☐	Returned "As Is"	☐
Damaged	☐	Damaged	☐		
N/A	☐	N/A	☐		

As Received notes: broken wire on axis 1

As Shipped notes: n/a

Action notes: repaired broken wire on axis 1

OK Cancel

Figure 6.36 Report Notes Window

6.7 Save the Result

Review the results before saving.

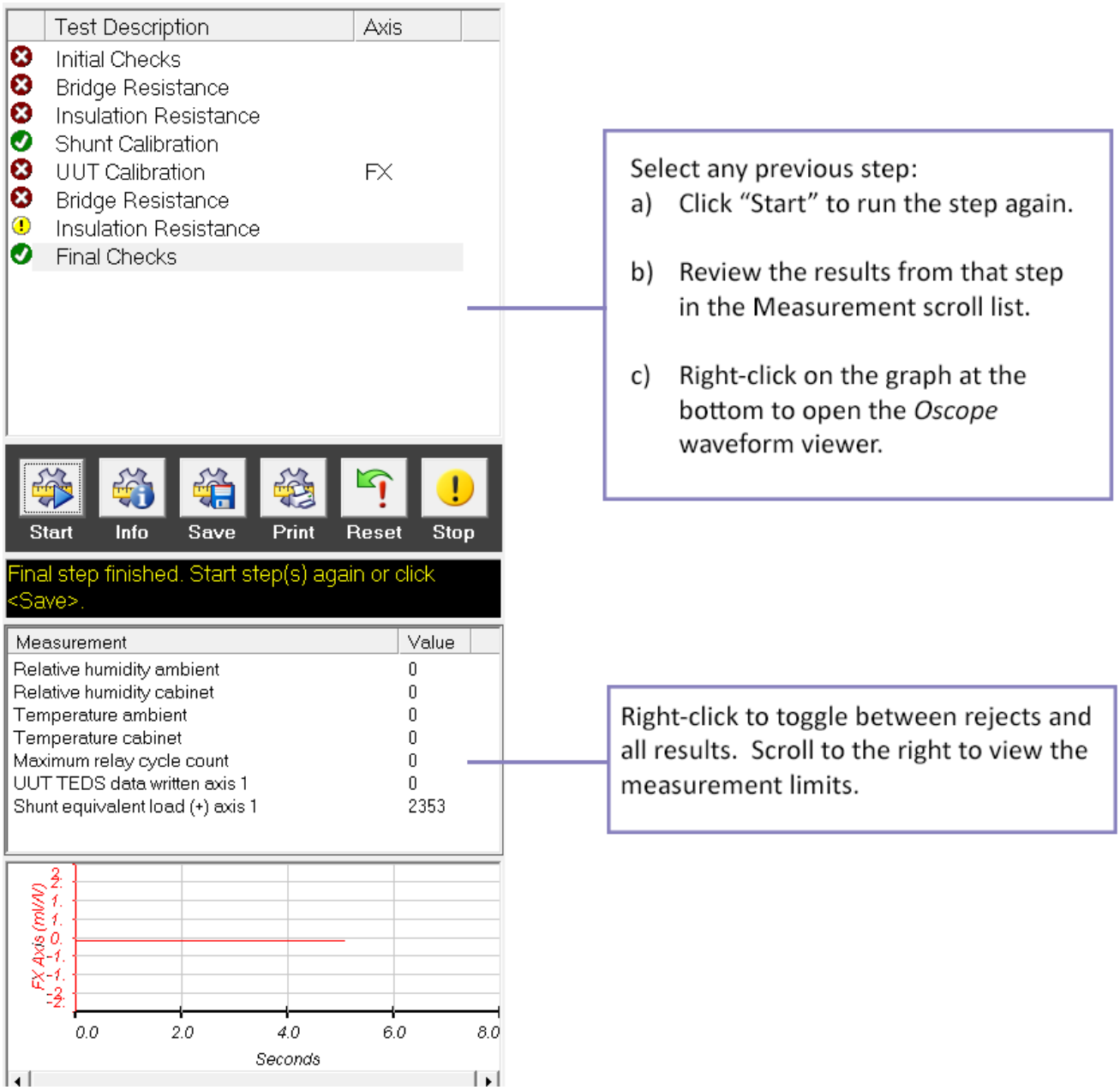


Figure 6.37 Review Results before Saving

Click the *Save* button to finalize the result when finished with this unit. If not all steps completed successfully, a prompt appears to allow the technician to *Cancel* and re-run any steps.

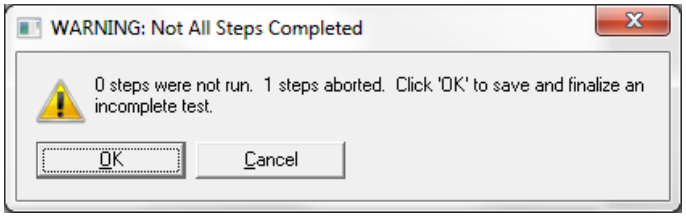
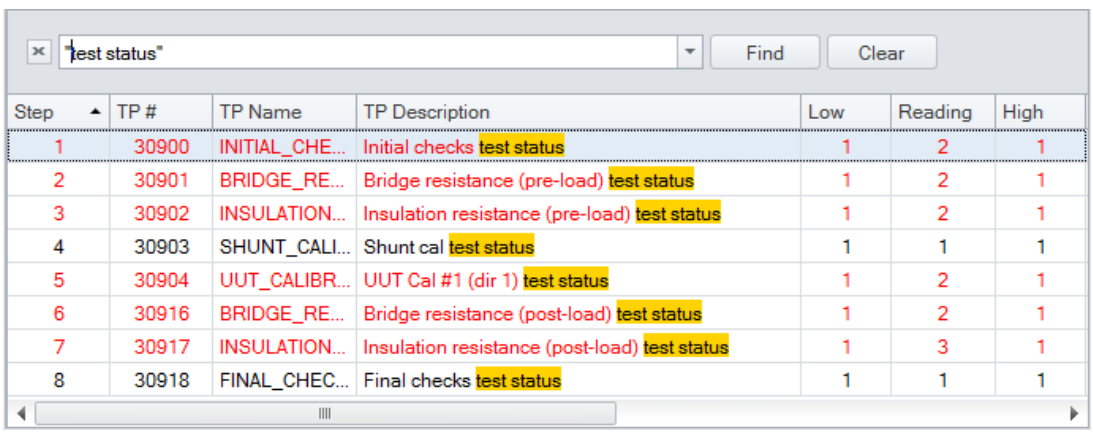


Figure 6.38 Warning: Not All Steps Completed Message

If the result is saved, the status of each step is recorded and any step not accepted is a failure.

Table 6-5 Result Status

Status	Description
1	accepted
2	rejected
3	aborted



Step	TP #	TP Name	TP Description	Low	Reading	High
1	30900	INITIAL_CHE...	Initial checks test status	1	2	1
2	30901	BRIDGE_RE...	Bridge resistance (pre-load) test status	1	2	1
3	30902	INSULATION...	Insulation resistance (pre-load) test status	1	2	1
4	30903	SHUNT_CALI...	Shunt cal test status	1	1	1
5	30904	UUT_CALIBR...	UUT Cal #1 (dir 1) test status	1	2	1
6	30916	BRIDGE_RE...	Bridge resistance (post-load) test status	1	2	1
7	30917	INSULATION...	Insulation resistance (post-load) test status	1	3	1
8	30918	FINAL_CHEC...	Final checks test status	1	1	1

Figure 6.39 Test Status

A prompt to print a label may or may not appear. Click OK to print the label for this UUT test. See Zebra Printer for more details.

To completely delete the test, select *Edit > Discard Test Result*. Once a test is discarded, the data is completely deleted, there is no return.

For Body Block testing, the original result is stored locally. Please see the topic BB Finalize the Test Result for details.

For Pelvic Plug testing, the user is prompted. Please see the topic PP Saving the Result for details.

Section 7. Viewing Results

7.1 Test Result History Window

To view results from any previous test, perform either of the following:

1) Click the  button, or
2) Select *View > Test Results* (**F7**)

By default, the Test Result History window runs a query to access the data from the database[1]. To view the local results, click the  button in the Test Results History window.

Inside the *Test Result History* window, access online help via **F1** or *Help > About this window*. The Online Help includes information how to search for specific serial numbers, models, and how to change the date and time range of the search.

Some test results in the database may have been converted and imported from an older database. These test results have no waveform data. These test results include a special test property "DATABASE_SOURCE" which is likely "Paradox" or "Access". This property is used to identify whether the data was converted or measured directly from the Atlas system.

[1] A default query defined by the "host_all.xml" file executes when the window is opened. Typically, this query includes a connection to this site's database for a relatively short duration such as one month. If this file does not exist, the test result opens to the local queue (test results on the hard drive only).

7.2 Custom Reports

Custom Reports are created from inside the Test Result History window. The available reports are filtered based on the Part Type.

Option 1:

1. Select the specific test result from list shown below.
2. Select the *Report* view from the top of the Test Result History window.

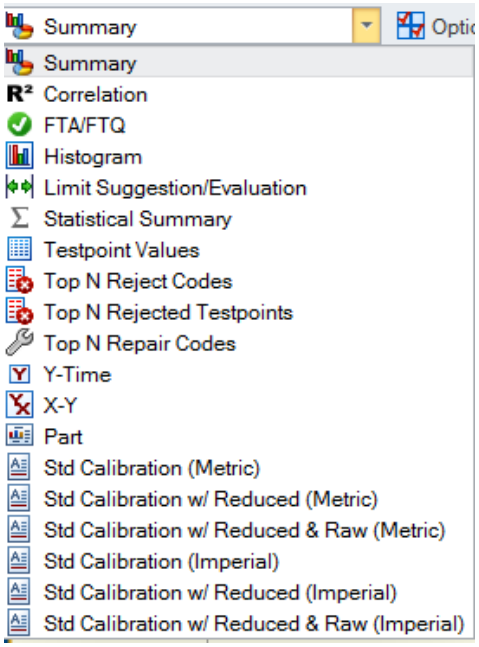


Figure 7.1 Summary Pull Down Menu

Option 2:

1. Select the specific test result from the list above.
2. Right click and select the report to run.

7.2.1 Reports by Part Type

For Load Cell part type, there are six different possible reports:

Table 7-1 Report Types

Load Cell Report Name	Description
Std Calibration (Metric)	Summary[2] + Voltage Calibration + Loading Sequence + Crosstalk + Impedance. 5 pages for uni-directional, 7 pages for bi-directional. For single-axis uni-directional, 4 pages – no Crosstalk page. Data is metric.
Std Calibration w/ Reduced (Metric)	Includes "Std" + Reduced loading points for each axis. 11 pages for 6-axis unidirectional. 19 pages for 6-axis bi-directional. Data is metric.
Std Calibration w/ Reduced & Raw (Metric)	Includes "Std" + Reduced + Raw loading points for each axis. 17 pages for 6-axis unidirectional. 31 pages for 6-axis bi-directional. Data is metric.
Std Calibration (Imperial)	Same as metric, but data is in Imperial units.
Std Calibration w/ Reduced (Imperial)	Same as metric, but data is in Imperial units.
Std Calibration w/ Reduced & Raw (Imperial)	Same as metric, but data is in Imperial units.

The Deadweight part type reports are similar to the Load Cell reports, except the Deadweight reports do not include "Reduced" or "Raw Load Points" pages. There is no Reference Load Cell for Deadweight, therefore the information listed under the Reference Load Cell section is empty.

There is only one report choice for part types DTI, Chestband, Pelvic Plug, and Body Block.

[2] The Summary Report page is not included for any report for the Heidelberg site.

7.2.2 Report Restrictions

There are some rounding errors that cannot be avoided when attempting to convert the imported data. For that reason, the imported test results cannot be converted from imperial to metric or from metric to imperial. When attempting to run a report or export data which is not allowed, one of the following prompts appears.

Figure 7.2 Incompatible Data, Imperial to Metric Error Message

Figure 7.3 Incompatible Data, Metric to Imperial Error Message

7.2.3 Report Site Specific Considerations

The date format used when rendering the report (e.g. DD.MM.YYYY. or MM/DD/yy) is defined by the PCS.INI file of the software from which the report is run. There is also a test property stored inside the test result called DATE_FORMAT. This is used by the report software to properly interpret the dates that are listed within the test result.

The numeric decimal format (“.” or “,”) in the report is defined by Windows regional settings of the PC from which the report is run.

When a test result is stored, one of the fields inside the test result identifies the site from which the test result was created. This is the site used when creating the report[3].

[3] This applies to reports generated directly from the database. If a test result is exported from the test result history window and imported into a local queue, the site used when creating the report is based on the site defined in the Stand and Station Definition window of the local queue.

7.3 Custom Exports

There are seven (7) different exported files which can be generated from inside the Test Result History window using the right click option *Custom Export*. “To multiple files” indicates that each axis and for each highlighted test result, a separate file is created. “To single file” indicates that one file is created for all axes in all highlighted test results.

Table 7-2 Export File Name and Description

Export Name	Description
CSV Export Metric (to multiple files)	Create one or more .csv files containing information about the tested result for each axis in a row of comma separated values. Values are metric.
CSV Export Imperial (to multiple files)	Same as metric, but data is in Imperial units.
CSV Export Metric (to single file)	Create one .csv file containing information about the tested result for each axis in a row of comma separated values. Values are metric.
CSV Export Imperial (to single file)	Same as metric, but data is in Imperial units.
CAL Export Metric (to multiple files)	Create one or more cal files (also referred to as E-Data files) containing information about the tested result for each axis. The file is a text file. Values are metric.
CAL Export Imperial (to multiple files)	Same as metric, but data is in Imperial units.
E2X Export (to single file)	Create one file containing information about the tested result for each axis. The file is a special XML file. Values are always metric. The data is currently supported only for DTI part types. The data is extracted from the XML files which are attached to the test result. The property DTI_XML_FILENAME[x] is used to specify which files to use to create the E2X file.

7.4 Modifying Results

To modify select information from previous results, from the main screen (not the Test Result Screen), select *Tools > Host Result Lookup*. The following information in the database may be modified by anyone using this window.

- CUSTOMER_ADDRESS
- CUSTOMER_ID
- CUSTOMER_NAME
- TECHNICIAN_ID
- TEST_COMMENTS
- JOB_NUMBER
- SALES_NUMBER
- Any of the Report Notes as found on the summary report page

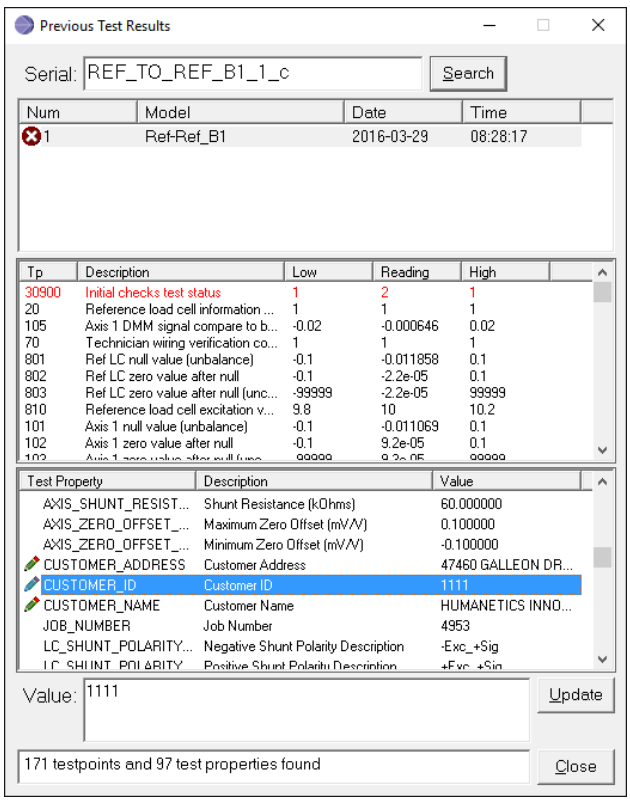
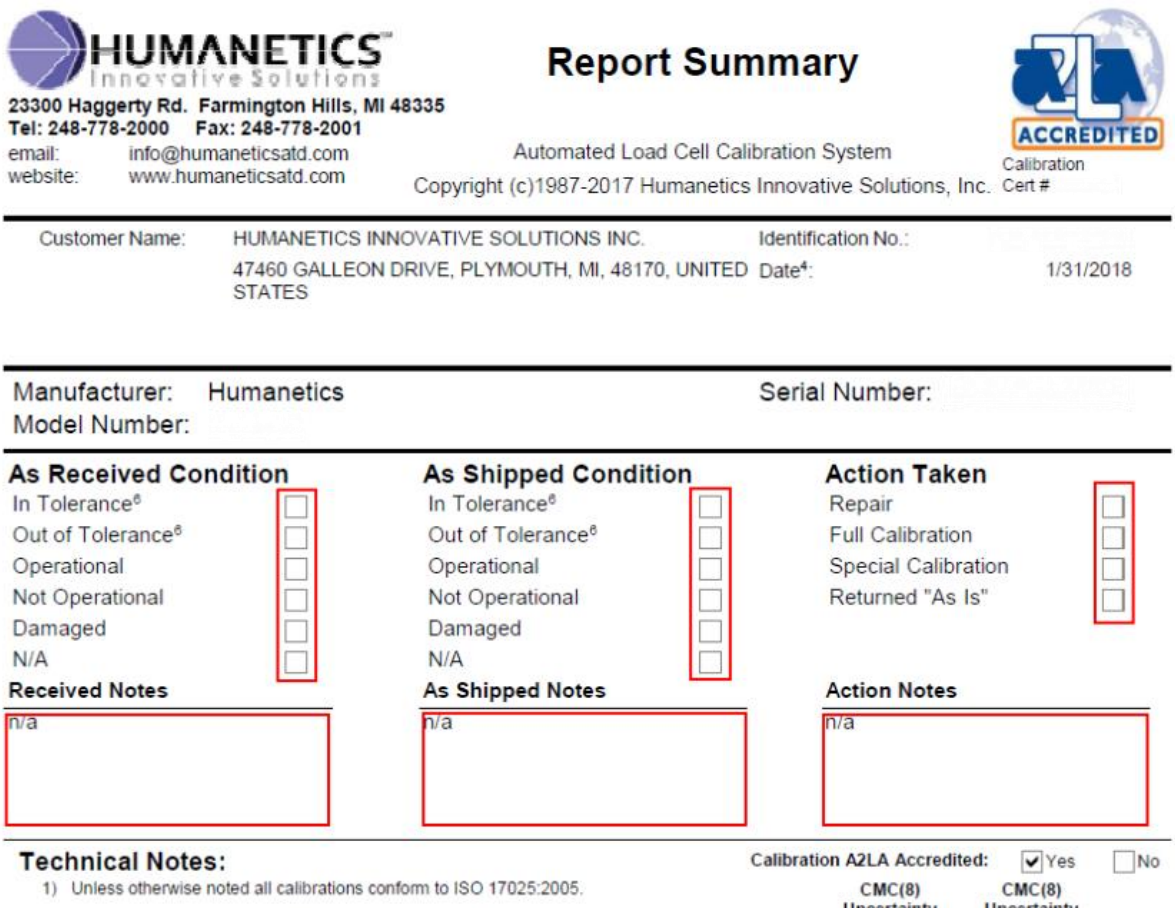


Figure 7.4 Host Result Modification Window

1. Search for the test results by serial number.
2. Select the specific test result
3. Select the editable property as indicated by the icon.
4. Enter a new value in the “Value” field.
5. Click the *Update* button.

7.5 Summary Report Page

The first page of the Load Cell, Deadweight, Chestband, and DTI part types is the Summary Report[4]. The information in the Summary Report page is defined by the technician at the end of the test. See Figure 6.36 Report Notes Window. This information may also be modified using the *Tools > Host Result Lookup* menu pick after a test is completed and saved to the database. To modify the Report Summary page, the following Report Notes fields highlighted in red boxes are editable.



HUMANETICS Innovative Solutions

23300 Haggerty Rd. Farmington Hills, MI 48335
Tel: 248-778-2000 Fax: 248-778-2001
email: info@humaneticsatd.com
website: www.humaneticsatd.com

Report Summary

Automated Load Cell Calibration System
Copyright (c)1987-2017 Humanetics Innovative Solutions, Inc.

A2LA ACCREDITED
Calibration Cert #

Customer Name: HUMANETICS INNOVATIVE SOLUTIONS INC.
47460 GALLEON DRIVE, PLYMOUTH, MI, 48170, UNITED STATES
Identification No.:
Date[4]: 1/31/2018

Manufacturer: Humanetics
Model Number:
Serial Number:

As Received Condition		As Shipped Condition		Action Taken	
In Tolerance[6]	☐	In Tolerance[6]	☐	Repair	☐
Out of Tolerance[6]	☐	Out of Tolerance[6]	☐	Full Calibration	☐
Operational	☐	Operational	☐	Special Calibration	☐
Not Operational	☐	Not Operational	☐	Returned "As Is"	☐
Damaged	☐	Damaged	☐		
N/A	☐	N/A	☐		

Received Notes: n/a
As Shipped Notes: n/a
Action Notes: n/a

Technical Notes:
1) Unless otherwise noted all calibrations conform to ISO 17025:2005.

Calibration A2LA Accredited: ☑ Yes ☐ No
CMC(8) CMC(8)

Figure 7.5 Example of Report Summary

[4] The Summary Report page is not included for any report for the Heidelberg site.

Section 8. Troubleshooting

8.1 Anti-Virus configuration

The anti-virus real time scanner can interfere with the critical PCS processes. The solution is to disable the anti-virus real-time scanner for the PCS folder for any user that logs into the system.

8.2 Multi-User Login

The PCS application does not support simultaneous multi-user login. For example, if a user logs in and runs PCS and leaves it running and another user wants to log in and run PCS they will get an error that PCS is already running. A procedure needs to be established whereby a user exits PCS when logging out.

8.3 Reviewing System Messages

Messages showing information, faults, and warnings are logged to a circular file in the software with the date and time of the occurrence. To view these messages, do one of the following:

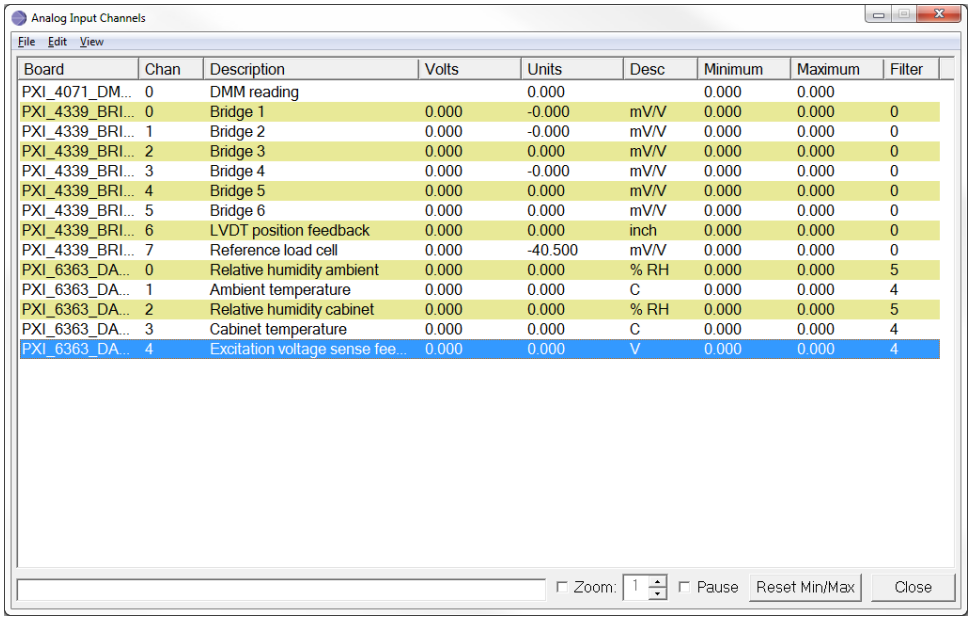
1) *View > Message Log*
2) Click the button on the bottom of the main screen.

The highest priority active message is shown at the bottom of the main screen. The icon indicates there are one or more active messages to view. The top portion of the *Message Log Viewer* shows all active messages.

The message log can be exported for diagnosis. *File > Export*.

8.4 Analog Input Window

View > Analog Inputs. At any time, this window can be opened by anyone. The analog input readings are live and represent the values read by the PXI cards. The *Desc* column represents the *units* description for the *Units* column for each channel. The bridge *Volts* column represents uncalibrated V/V.



Board	Chan	Description	Volts	Units	Desc	Minimum	Maximum	Filter
PXI_4071_DM...	0	DMM reading		0.000		0.000	0.000	
PXI_4339_BRI...	0	Bridge 1	0.000	-0.000	mV/V	0.000	0.000	0
PXI_4339_BRI...	1	Bridge 2	0.000	-0.000	mV/V	0.000	0.000	0
PXI_4339_BRI...	2	Bridge 3	0.000	0.000	mV/V	0.000	0.000	0
PXI_4339_BRI...	3	Bridge 4	0.000	-0.000	mV/V	0.000	0.000	0
PXI_4339_BRI...	4	Bridge 5	0.000	0.000	mV/V	0.000	0.000	0
PXI_4339_BRI...	5	Bridge 6	0.000	0.000	mV/V	0.000	0.000	0
PXI_4339_BRI...	6	LVDT position feedback	0.000	0.000	inch	0.000	0.000	0
PXI_4339_BRI...	7	Reference load cell	0.000	-40.500	mV/V	0.000	0.000	0
PXI_6363_DA...	0	Relative humidity ambient	0.000	0.000	% RH	0.000	0.000	5
PXI_6363_DA...	1	Ambient temperature	0.000	0.000	C	0.000	0.000	4
PXI_6363_DA...	2	Relative humidity cabinet	0.000	0.000	% RH	0.000	0.000	5
PXI_6363_DA...	3	Cabinet temperature	0.000	0.000	C	0.000	0.000	4
PXI_6363_DA...	4	Excitation voltage sense fee...	0.000	0.000	V	0.000	0.000	4

Figure 8.1 Analog Input Channels Window

8.5 Digital I/O Window

View > Digital I/O. The outputs from this window are only active when PCS is Online. For example, this window contains the request to enable the relay **O_EN_EXCITATION** which is external to the PXI chassis.

The channels on the NI_9476_ACE board are only available when the ACE cDAQ is connected and communicating with the Atlas computer. The NI_9476_ACE relays are all contained inside the ACE box.

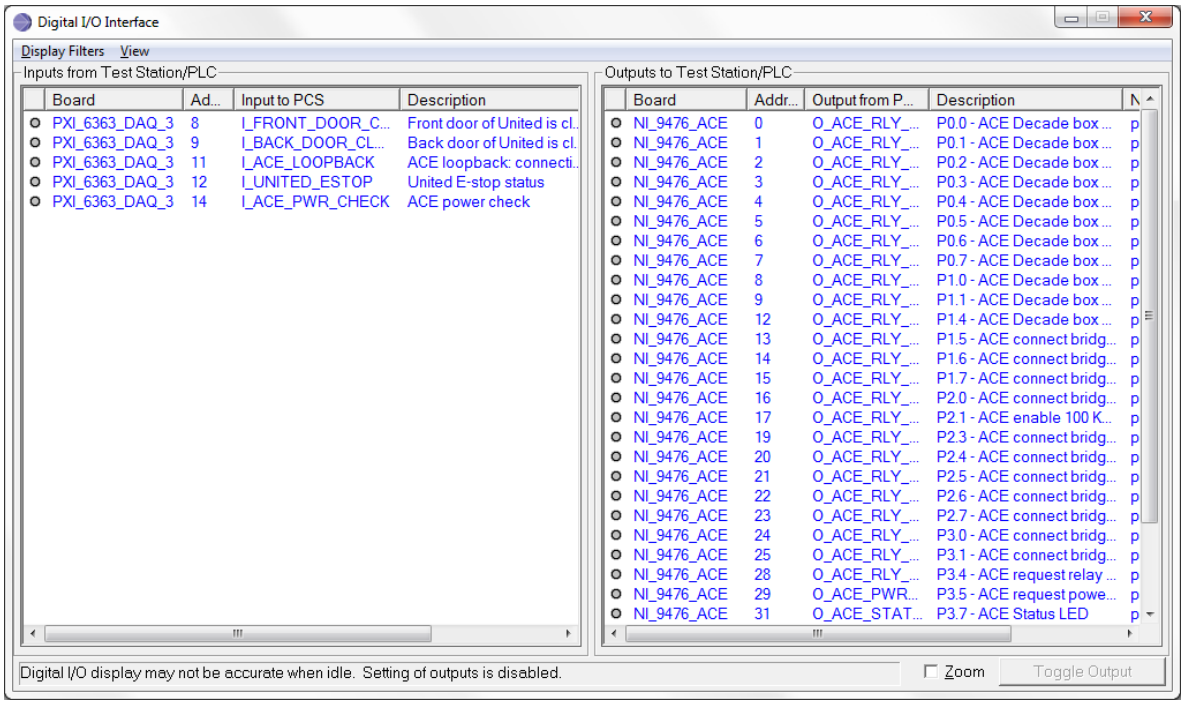


Figure 8.2 Digital I/O Interface

8.6 Relay Window

Tools > NI Relays

There are approximately 200 relays inside the PXI cards in the Humanetics Load Cell Test Station. This window shows the state of all PXI relays to any user. Engineer and higher level users may control the relays unless there is a conflict in control. No relays may be controlled from this window while a test is in progress. Relays which are not allowed to be energized simultaneously can only be energized by an advanced user and after the advanced user accepts the warning.

An excerpt from the NI 2525 manual shows the "*Bank*" naming and "k" names for the relays. For more detail on the function of the NI 2525 multiplexer board, refer to the NI manual.

Internal relays are the relays necessary to route the multiplexed inputs and outputs of the NI 2525 cards. The *Internal* relays have names starting with “kbc”. The “External” relays are associated with a channel “CH” and have a direct connection from the NI 2525 card to outside the card. Both *internal* and *external* relays are resident on the NI 2525 card.

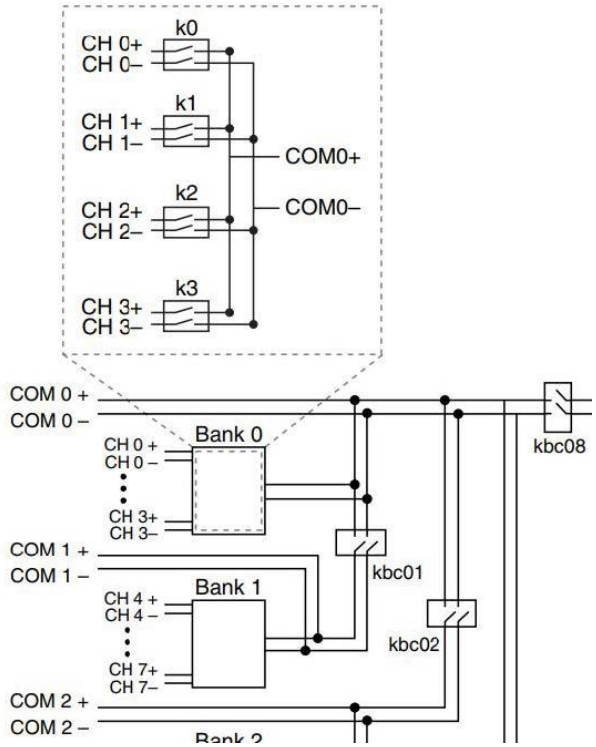


Figure 8.3 Internal and External Relays

The G*roup* columns are used internally by the software to control the relays together. The *Name* column is useful for referencing to the Bridge Relay Troubleshooting window and the electrical schematics. The *Cycles* column indicates the number of times a relay is toggled on the board. The NI Measurement and Automation software is the only location to clear the number of cycles. During the Initial Checks, there is a testpoint that records the relay with the highest number of cycles.

When manually energizing relays using the NI Relay window or the Bridge Troubleshooting window, specific combinations of relays may not be energized at the same time. If the user attempts to energize a relay, the status bar shows the reason why the relay cannot be energized. There is an override for advanced users. Advanced users are warned and can cancel the request before energizing a relay which should not be energized.

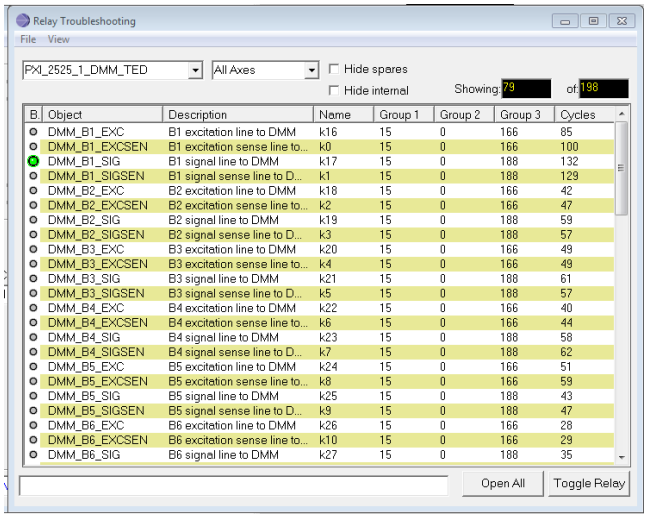


Figure 8.4 Relay Window

8.7 Bridge Relay Troubleshooting

Advanced user access only. *Tools > Bridge and Relay Troubleshooting*

Control of each analog measurement system is exercised through this window. The overview circuit diagram provided in the electrical drawing package is helpful for understanding this window. The window is divided into each measurement system and by bridge circuit. Functions from this window are only available when PCS is Online and no test is in progress.

This window should be used for troubleshooting purposes, not for repeatability studies. Use the designated repeatability window for repeatability measurements.

When opening this window, the previously selected bridge circuit is activated. When a bridge is selected in this manner or when the user selects a new bridge,

- Relays required to read this bridge on the NI 4339 are closed
- Relays required to connect the signal from the bridge to the NI 4071 are closed
- Default excitation voltage is applied to this bridge
- The DMM is configured to read the signal voltage
- All other relays are opened

When closing this window, all relays are opened (unless a test is in progress).

Logic prevents users from energizing relays in certain combinations. Advanced users can override this feature by using the Relay window.

Table 8-1 Relay Screen Element and Description

Screen Element	Description
-| |-	Relay does not vary based on bridge or selection. Relay is open. Toggle open and closed.
-|/|-	Relay does not vary based on bridge or selection. Relay is closed. Toggle open and closed.
-|k0|-	Relay is different depending on bridge and/or selection. “k0” is the name of the relay. Relay is open. Toggle open and closed.
-|/k1|-	Relay is different depending on bridge and/or selection. “k1” is the name of the relay. Relay is closed. Toggle open and closed.
	Close the relays for the selected bridge and specific settings for the system defined by the group box label. If applicable, report the measurement in the status bar.
■	Open the relays for the selected bridge and specific settings for the system defined by the group box label.
Detail	In the Keysight Insulation Resistance box, initiate the full detail insulation resistance test for all bridges. During the detail test, the detail button blinks between light and dark green to indicate it is running. Results are written to the PCS message log. Stop the test with the ■ button.
All	In the *PXIe-4339* box, energize all necessary relays and supply excitation voltage to enable measurement of all bridge circuits.
Cancel	In the *PXIe-4339* box, remove the autozero/null for the selected bridge to make the reading natural.
Null	In the *PXIe-4339* box, perform the autozero/null for the selected bridge.
Bridge	In the *Shunt* box, perform the shunt voltage measurement (mV/V) of the selected bridge using the selected shunt resistor. At the end of the measurement, the result is compared to expected bridge resistance. If the difference is more than 10%, an error message is displayed.
Ohms	In the *Shunt* box, use the DMM to measure 2-wire resistance of the selected shunt resistor.
Open All	Open all relays.

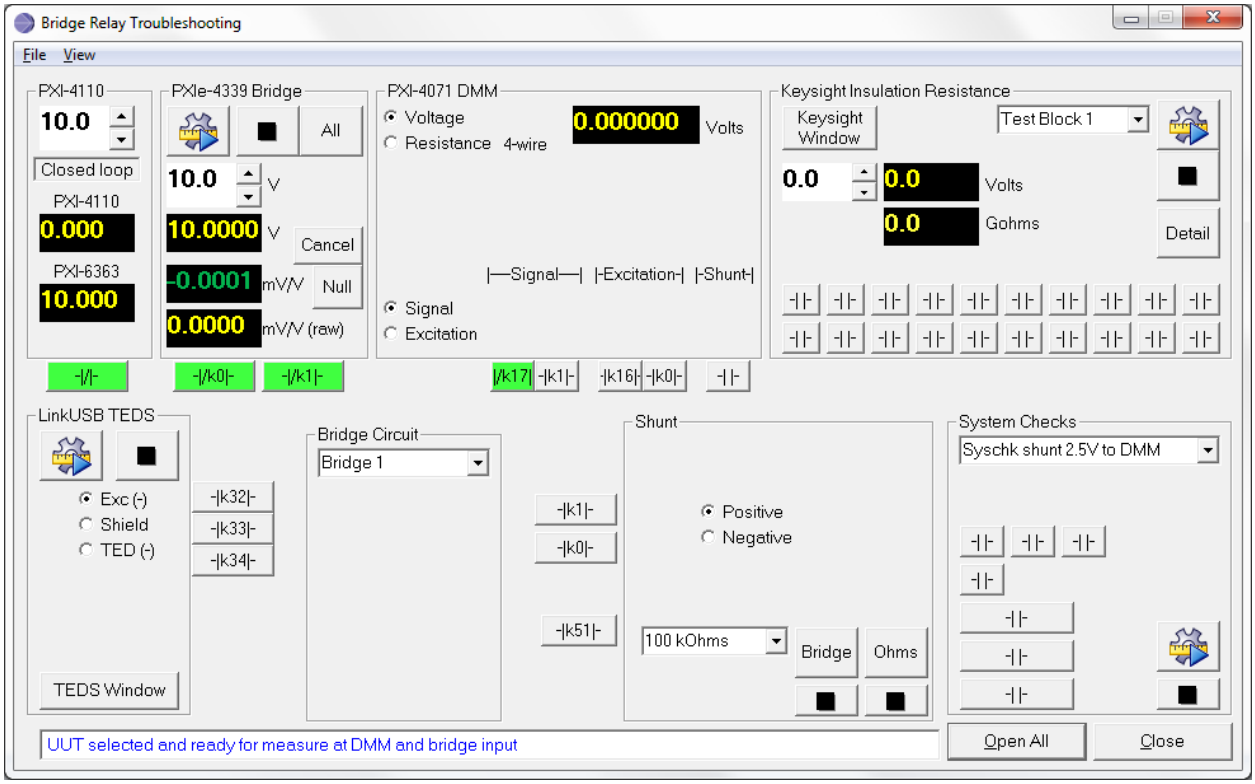


Figure 8.5 Bridge Relay Troubleshooting Window

8.8 IEEE1451 TEDS window

Advanced user access only. *Tools > IEEE1451 TEDS Window*

For both the IEEE1451 TEDS and WorldSID windows, a companion window opens to allow the user to select the relays to connect to the TEDS port on the UUT or reference load cell.

Figure 8.6 TEDS Relay Window

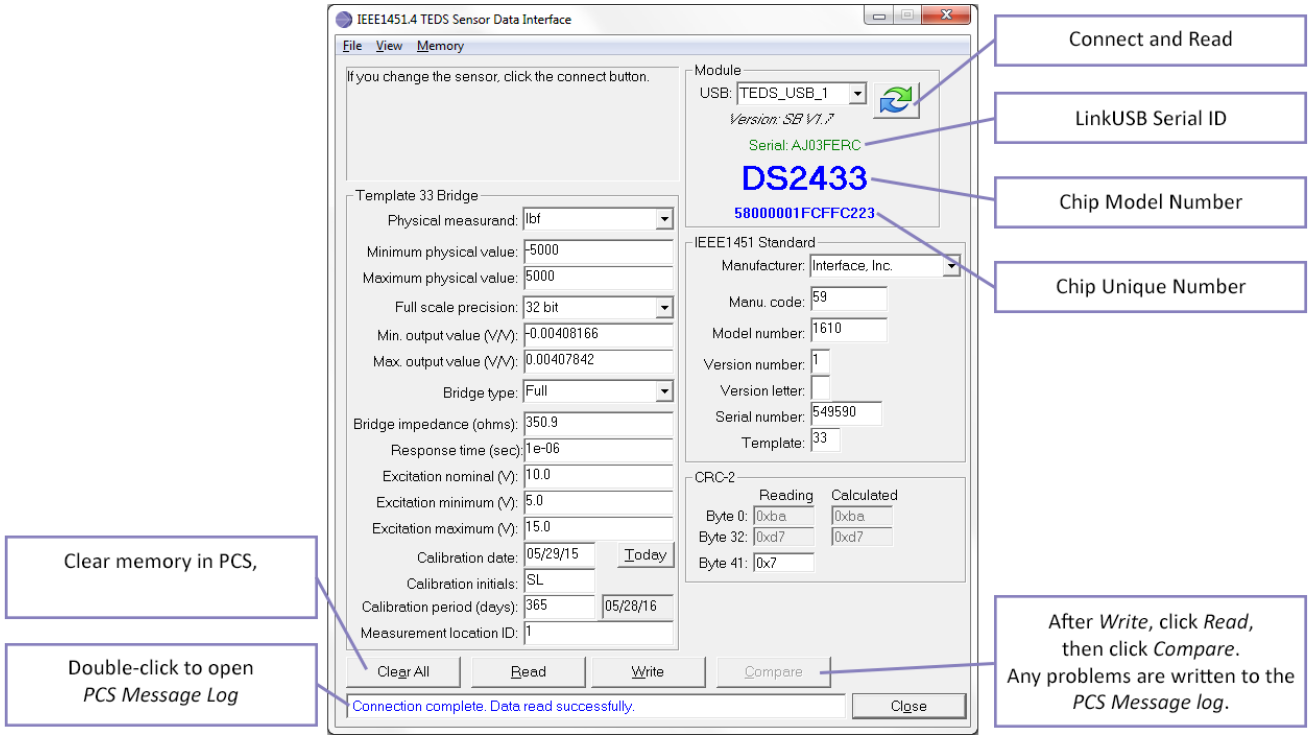


Figure 8.7 IEEE1451 TEDS Window

The following menu picks apply to both TEDS windows.

Table 8-2 TEDS Command and Description

Command	Description
File > Backup Values from Read	Store the last values read from the chip to an .xml file which is specified by the user
File > Restore	User selects an .xml file (created by the backup) and this data is written to the chip
File > Allow Write	If the chip is empty or the data is not valid, the *Write* button is disabled. Use this menu pick to enable the *Write* button. Only advanced users can enable the *Write* button.
Memory > Dump to Text	Read all the raw data from the chip and write the information to a .txt file.

8.9 WorldSID Information Window

Advanced user access only. *Tools > WorldSID Window*

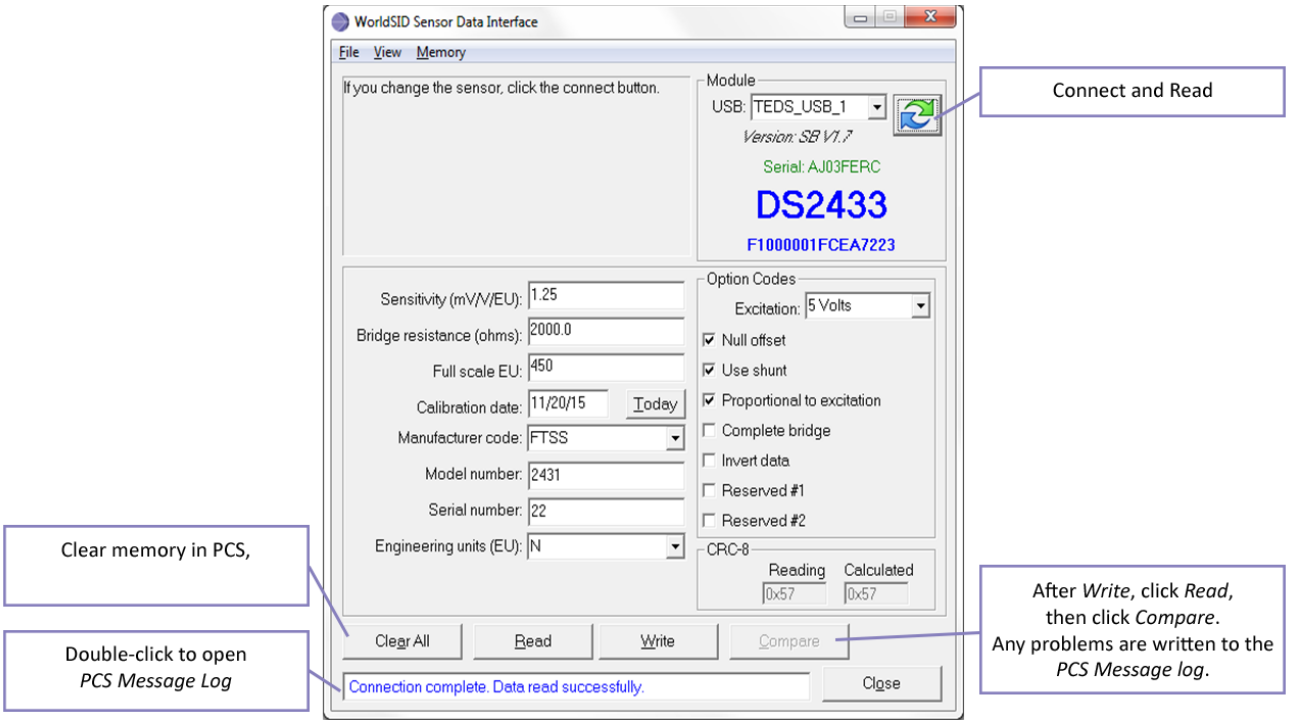


Figure 8.8 WorldSID Data Window

8.10 United Load Frame Manual Control Window

Advanced user access only. *Tools > United Load Frame Manual Control*. This window can be used to manually move the load frame to achieve a desired force.

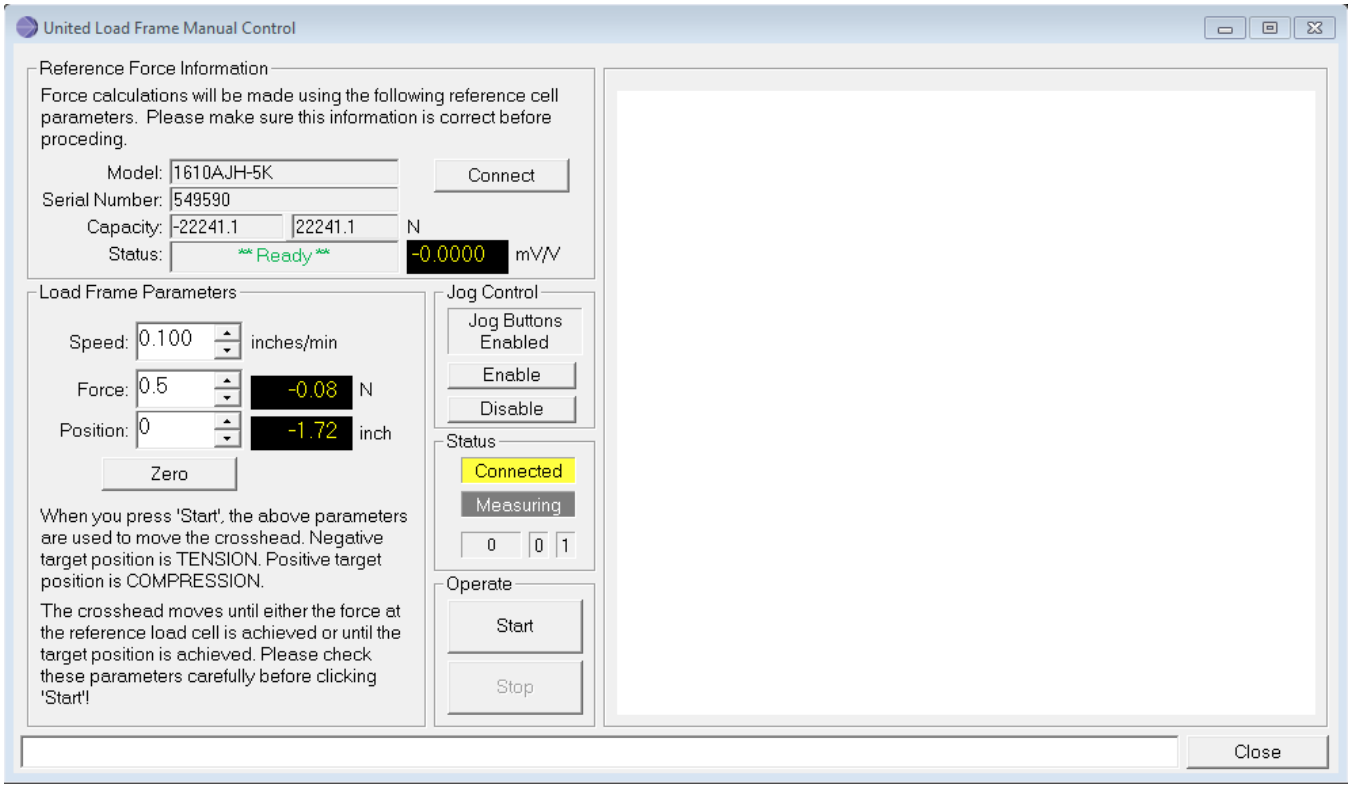


Figure 8.9 United Manual Control Window

No control is allowed until the UUT and reference load cell are defined using the Part Entry Window.

- Click *Connect* if the *United Manual Control* window is opened before defining *Part Information*.
- Close and Open the *United Manual Control* window after defining *Part Information*.

The status reports "**Ready**" when the necessary information is defined and the appropriate measurement circuits are nulled and active. All safeties are active when the status is "**Ready**".

	**WARNING** The UUT and reference load cells are extremely sensitive to very small movements. The Load Frame is extremely powerful. Use extreme care when using the jog buttons to move the load head. Use the speed control knob and slow jog button to move the load head slowly to line up the fixture.

	**WARNING** Although the door switches indicate a closed condition, the load frame enclosure door latch may be adjusted in a way that exposes the load frame motion to the technician or any person in the area of the load frame. Exercise extreme caution when operating the load frame.

	**WARNING** If the reference load cell is not measuring force properly, the United Load frame will attempt to move to the target position. It is recommended to verify the reference load cell is functioning properly and indicates a positive load with hand press.

- To move the load head up (tension or release compression), a negative position must be entered.
- To move the load head down (compression or release tension), a positive position must be entered.

When the user clicks *Start*, the load head moves in the direction specified by the *Position* at the rate specified in *Speed*. The motion continues until either the force limit is reached or the position is reached or the user clicks *Stop*.

The graph can be opened into *Oscope* for diagnostic purposes.

8.11 Keysight Communications

Advanced User Access only. *Tools > Debug > Keysight Meter Window*

This window is used for debug and troubleshooting of the communications between the PC and the Keysight meter. Voltage commands can be requested using this window.

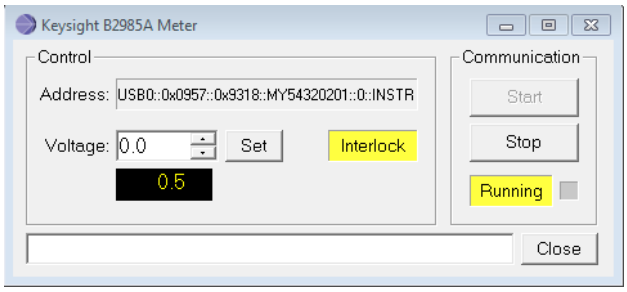


Figure 8.10 Keysight Meter Window

8.12 DTI Window

Use the *Tools > DTI Window* to troubleshoot DTI DiMods. All DTI actions can be manually performed using this window. Most functions are not allowed while a test is running.

When the window opens, all connected DiMods are listed in DTI Channels. LSB is updated with the current value from the background readings. All channels listed below a specific port are connected to that physical port on the DTI recorder.

The right click menu options from the DTI Channels are listed below.

Table 8-3 DTI Channels Right Click Menu Option and Description

Right Click Option	Description
Toggle collection for this channel	Prior to click on Collect Online, Collect Crash, Collect ZMO it is necessary to select which channels to collect. Right click to toggle between the green dot and the empty dot. Green dot indicates channels to collect.
Read TEDS	Read TEDS for the selected channel.
Command Stimulation	An Online recording is collected with the requested stimulation activated for the duration requested by the technician.
Null DTI Channel	An Online recording is collected to determine the offset. User is prompted to continue or not if the offset is more than the expected maximum offset. The offset is applied if the user replies Yes or the offset is within the normal range.

Right Click Option	Description
Cancel Null for Channel	Remove the offset for the selected channel.
Edit ISOLocation	Change the ISOLocation inside the DiMod for the selected channel.
Identify as Reference LC	Change the ISOLocation inside the DiMod for the selected channel and force it to be recognized as the Reference Load Cell.

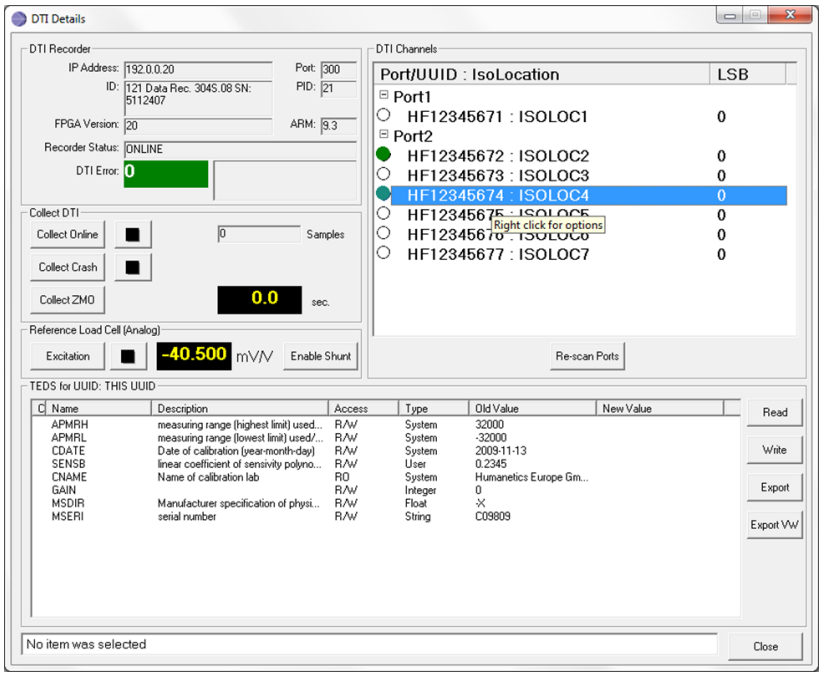


Figure 8.11 DTI Details Window

Table 8-4 DTI Details Button and Description

Button	Description
Collect Online	Collect all channels with green dot as Online collection type. Channels are collected at the maximum rate possible based on the number of channels selected. User is prompted for duration and whether to allow all samples to collect. Typical usage is to click *Yes* to allow all samples to collect. User is prompted to open the collection when it is finished.
Collect Crash	Similar to Collect Online except channels are sampled at 20 kHz.
Collect ZMO	Perform Collect Crash and evaluate the ZMO for selected channels. Values are shown in a window for the user to use to write the DiMod if desired.
Excitation	Enable 10 Volts to the reference load cell and enable the relays to measure the reference load cell with the PXI-4339.

Button	Description
■	Stop the action requested by the button immediately to the left. Expect a significant delay in the request to stop the collections.
Enable Shunt	Use a selected shunt resistor inside the Atlas cabinet to apply to the reference load cell. This can be used to verify the response of the reference load cell both the analog and DTI reading.
Re-Scan Ports	Whenever DTI ports are connected or disconnected, the DTI recording must be refreshed. Click this button to perform the refresh.
Read	Red the TEDS for the selected channel.
Write	Inside the TEDS list, right click on each tag to enter a new value. After changing all desired tags, click this button to write the values to the DiMod.
Export	Export the TEDS tags using normal export format.
Export VW	Export the TEDS tags using Volkswagen special export format.

Section 9. Maintenance

The following preventative maintenance activities should be followed to assure the system continues to perform at optimal conditions.

Table 9-1 Preventive Maintenance Activities Frequency and Description

Frequency	Description
Every Day	• Verify air conditioner LED is solid green when DAQ doors are closed • Check air conditioner condensation bottle, empty as needed • Verify PC LEDs indicate proper working condition when PC is ON
Monthly	• Visually and audibly inspect all PXI fans to assure the fans are spinning freely and air flow is unobstructed. • Visually and audibly inspect all computer fans to assure the fans are spinning freely and air flow is unobstructed. • Remove filter(s) for the computer fans and clean with compressed air. Replace after cleaning.
6 Months	• Copy most recent PC image from the E: drive to plant network or similar safe storage location
As required for certification	• Remove NI 4071 DMM and send for certification • Perform bridge calibrations • Perform repeatability and drift tests
Automatic	• Initial Checks test step verifies and records the measurement system integrity at the start of every test • Windows defragmentation procedure is automatic • Hard drive backups are daily

9.1 Backing Up and Restoring the Hard Drive

To protect against the loss or corruption of programs and files on the PCS computer, the Bauer hard drive backup system provides the following features:

- A Solid-State Drive (SSD) storage device that contains the PCS software, OPC server software, and the Windows operating system. An SSD allows the system to boot more quickly, and increases the speed at which PCS operates.
- Automatic backups. The PC includes Acronis® software which automatically backs up the software every day. Information from the SSD is imaged from the top (**1st or Primary**) slot to the middle (**2nd or Storage**) slot (E: Storage). No user intervention is required for automatic backups.

Table 9-2 Backup System Drive, Function, and Slot

Drive	Function	Slot
SSD	C:/D: Primary	1
HDD #1	E: Storage	2
HDD #2	Recovery	3

- Easy recovery from software problems on the SSD. Incremental Acronis backups occur daily. Users can revert to a previous backup when any of the following problems occur:
    - Improper shutdown of the PC.
    - Windows file management problems.
    - National Instrument database corruption issues.
    - Viruses.
- The SSD, Hard Disk Drives (HDDs) and status indicators are accessed from the front panel. SSD failures may be recovered easily. On the PC, the HDD at the bottom **(3rd or Recovery**) slot is configured with Acronis Recovery Manager. When the 3rd HDD is moved into the 1st slot, it is bootable and can be used to recover the image from the middle (**2nd or Storage**) slot.

9.1.1 Solid State Drive and Hard Disk Drive Setup

When Advantech ACP-4000 PCs are shipped from Bauer Controls, they are configured as follows:

- Front panel access for one (1) SSD and two (2) HDD mechanical hard drives.
- Status LED for drives 1 and 2.
- Top drive (**1st or Primary**) is SSD and is configured with C: and D: partitions.
  - Windows operating system and any required installed programs (such as Kepware OPC or PLC software) are installed to C:.
  - If there is a D: drive, PCS is installed to D: drive. If no D: drive, PCS is installed to C:.
- Middle drive (**2nd or Storage**) is HDD and is connected to the PC. It is configured as E: (Storage).
  - Acronis backups are stored to E:.
  - Other large files (such as the installation files) are also stored on E:.
- Bottom drive (**3rd or Recovery**) is HDD is NOT connected. It is configured with Acronis Recovery Manager.

Figure 9.1 View of Top, Middle, Bottom Drive Slot

9.1.2 Recovering from an SSD Failure

WARNING

HDDs are NOT hot-pluggable or hot-swappable. Power down the PC using proper Windows shutdown procedures before removing or replacing drives.

If the Primary drive fails to the point where it cannot run, the Recovery drive can be used to restore the system so that the machine can run again.

To recover from an SSD failure...

1. Power down the PC.
2. Remove the Primary drive from Slot 1. Send it for repair or order a replacement.
3. Remove the Recovery drive from Slot 3.
4. Install the Recovery drive to Slot 1.
5. Power on the PC. During boot-up, the system displays an option to activate the Recovery Console.
6. Press the **F11** key to activate the Recovery Console.

9.1.3 Recovering from Storage Drive Failure

WARNING

HDDs are NOT hot-pluggable or hot-swappable. Power down the PC using proper Windows shutdown procedures before removing or replacing drives.

If the Storage drive fails, the following will occur:

- The Primary drive will continue to run without issue, and the PC will continue to run.
- The 2nd status light on the front panel is RED.
- The E: drive cannot be accessed.
- Automatic backups will fail.

To recover from a storage drive failure (short term)...

1. Power down the PC.
2. Remove the Storage drive from **Slot 2,** and replace it with the Recovery drive from **Slot 3**.
3. Power on the PC.
4. Create the necessary folders on the new E: drive for the Acronis backups.

To recover from a storage drive failure (long term)...

1. Replace the short term **Storage** hard drive with a properly formatted Storage hard drive.

9.2 DMM Calibration

The NI 4071 DMM card is used as the master verification unit. This card must be removed and sent to National Instruments (NI) for certification. Power down the PC and PXI chassis before removing this card.

When installing a different NI 4071 DMM card in the PXI chassis, it is necessary to “register” this card with the NI database which is stored on the PC. A similar procedure is required when replacing any NI card.

1. Power on the PXI chassis
2. Power on the PC
3. Verify the PCS software is not running.
4. Open the NI Measurement and Automation (NI Max) software.
5. Browse to the 4071 card to “register” this card with the NI database.
6. Close the NI Max software.
7. Start the PCS software. Verify there are no problems on startup with “drivers”.

9.3 Station Certification

The ACE Calibration external hardware and Keysight DMM are required to perform these tests. Refer to Section 12.8 ACE Calibration Box for details.

Section 10. Configuring the Software

10.1 Central Control

The mechanism for keeping a backup and distributing the software to other machines of the same operation type is **Central Control**. For more information on Central Control, contact your Humanetics representative.

10.2 Project Editor (PE)

Parameters and testpoints are defined in the **Project Editor**.

10.3 Testpoints and Test Records

The software evaluates measurements and calculations against high and low limits. Each evaluation has a unique testpoint which has a unique number and a unique name. Each testpoint name, number, value, description, unit description, high limit, and low limit is stored in a test record. The test record is stored locally on the PC and sent to a server for insertion into a database. All testpoints are numeric and the precision (number of digits used for evaluation and display) of the testpoint is defined in the **Project Editor**.

10.4 Parameters

The software uses parameters to define characteristics of the UUT, reference load cell, and the test procedure. Parameters may be constants or vary by model, test step, or stand. Parameter values used during the specific test are stored with the test record as test properties. The test properties can be viewed from the **Test Result History** window using “Details” view.

A parameter with the comment “no value should be set for this parameter” receives its value outside of the PE. For example, CUSTOMER_ID is a parameter in the PE, but the value of this parameter is modified by the technician in the Part Information window. CUSTOMER_ID is defined in the PE to allow for multilingual description support.

10.5 Model Fragments and Models

Each Load Cell UUT is defined as a model fragment in the PCS software. The prefix of the model fragment must be “LC_” for Load Cells. Each reference load cell is defined as a model fragment in the software. The prefix of the model fragment must be “REF_LC_”. Parameters within the model fragments define the specific characteristics of the UUT and reference load cells.

The *Enter Part Information* window displays the defined “LC_” and “REF_LC_” model fragments for the technician to select. No edits can be made from the “Enter Part Information” window. When the user clicks “OK” from the “Enter Part Information” window, the software builds a “model” from the selected “model fragments”.

NOTICE

Re Parameters defined in “LC_” fragments must NOT be defined in “REF_LC_” fragments and vice versa. This is because when the model is created, if the parameter was defined for both “LC_” and “REF_LC_” model fragments, there is ambiguity. A test will not start if there is an overlap in parameters defined.

10.6 Maintaining User List and Privilege

Edit > Security

Refer to appendix for details on the different access levels. Please note, the procedure for adding an advanced user is not shown here, by design.

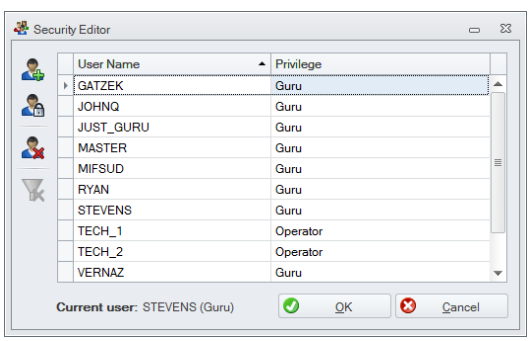


Figure 10.1 User Name and Privilege Window

10.7 Modifying UUT Parameter Values

Edit > Project Editor

Edits can only be made by users with Engineer or higher privilege. Edits can only be made when the software is *Offline*. If opened from *Online*, the editor is opened for read-only access. If a test is in progress, the test result must be saved or discarded prior to opening the **Project Editor**.

File > Save will save any edits made. *File > Exit* and answer *No* to the prompt to save and unsaved edits are discarded.

A list of all parameters may be obtained by selecting *View > Report* from the PE. An .html file is generated and can be used for documentation purposes.

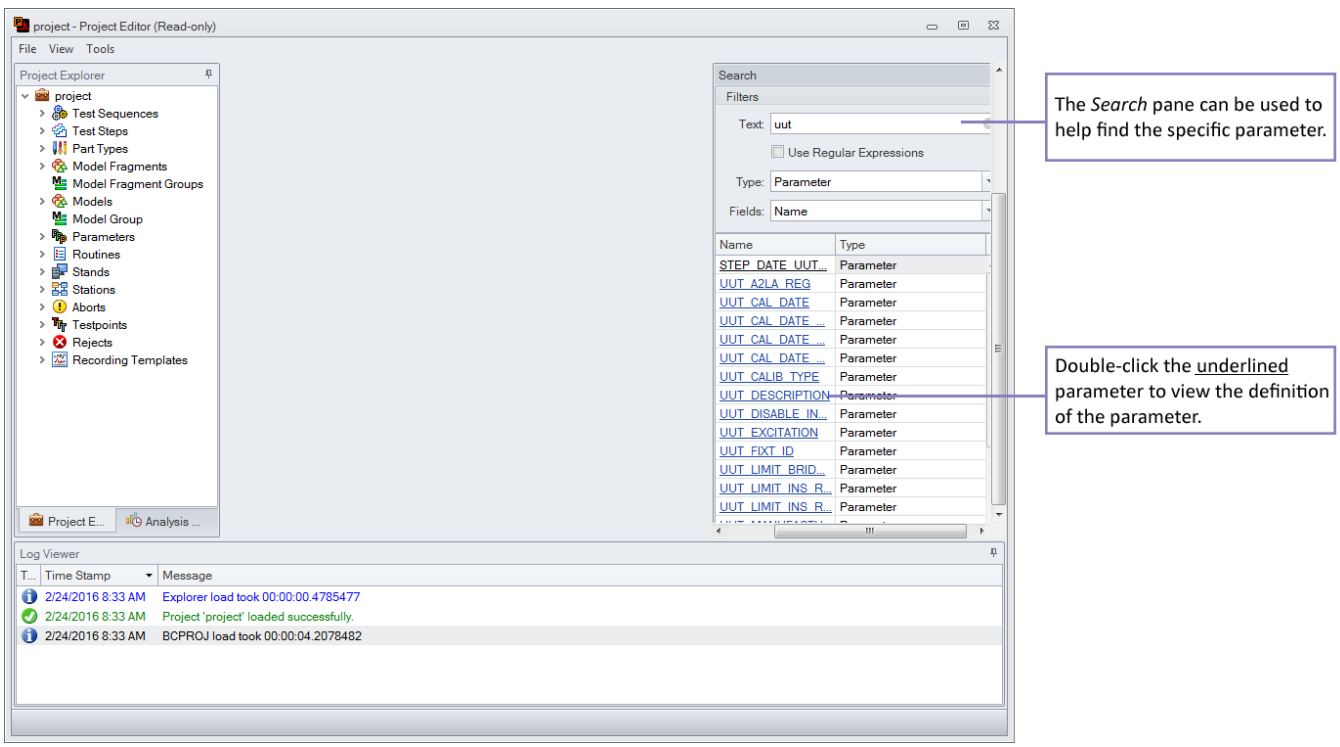


Figure 10.2 Project Editor Window

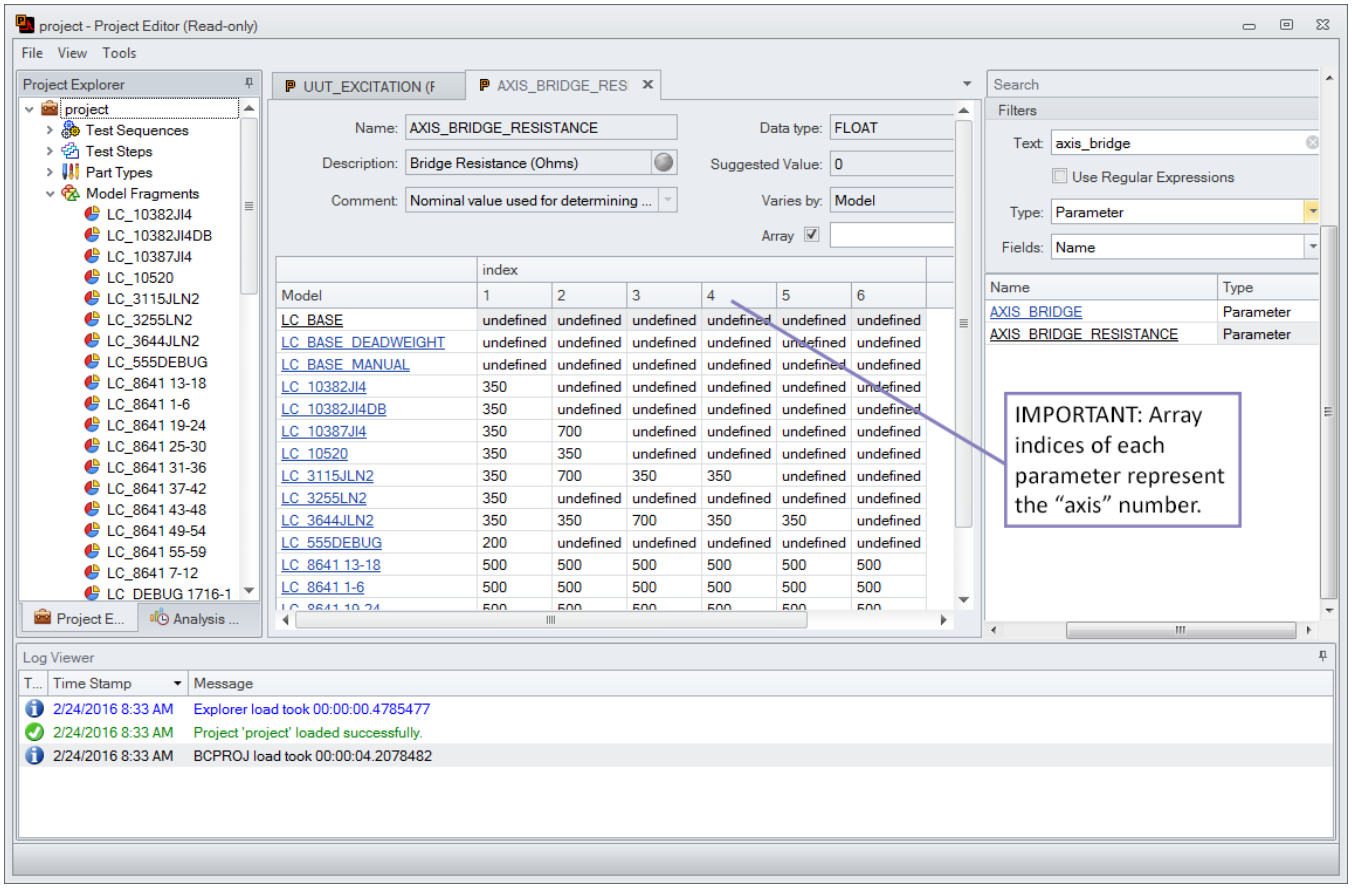


Figure 10.3 Project Editor, Index Represent Axis Number

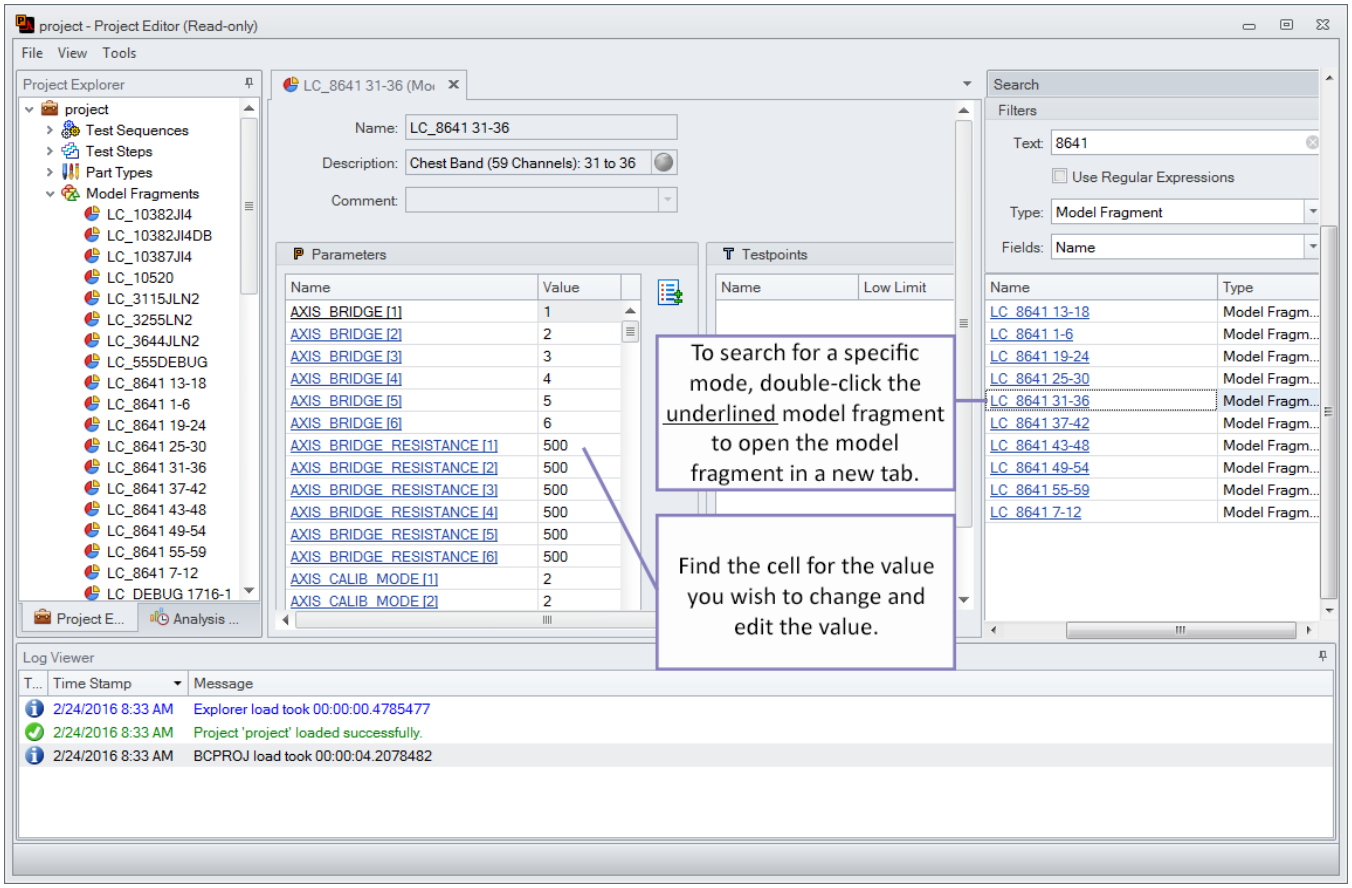


Figure 10.4 Project Editor, Model Fragment Edit

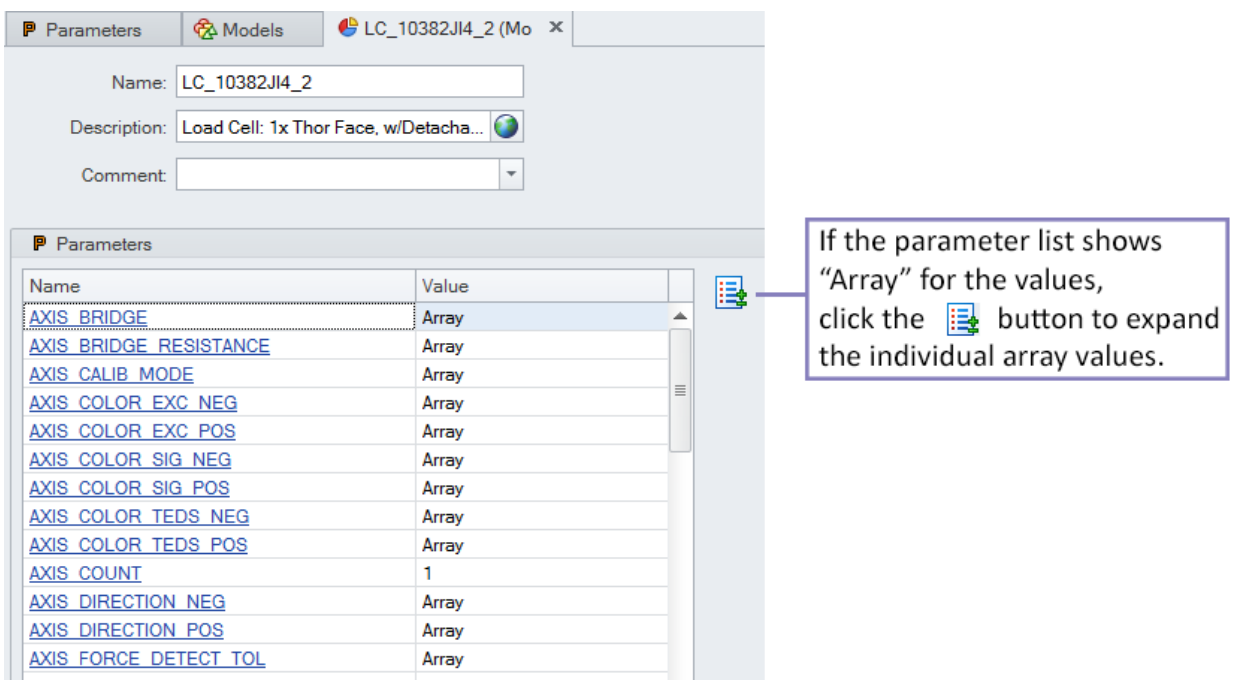


Figure 10.5 Array Value

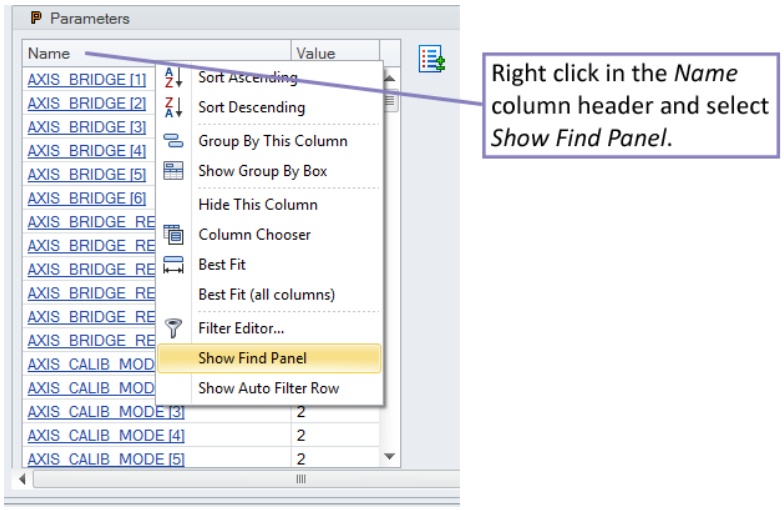


Figure 10.6 Parameters, Name Column

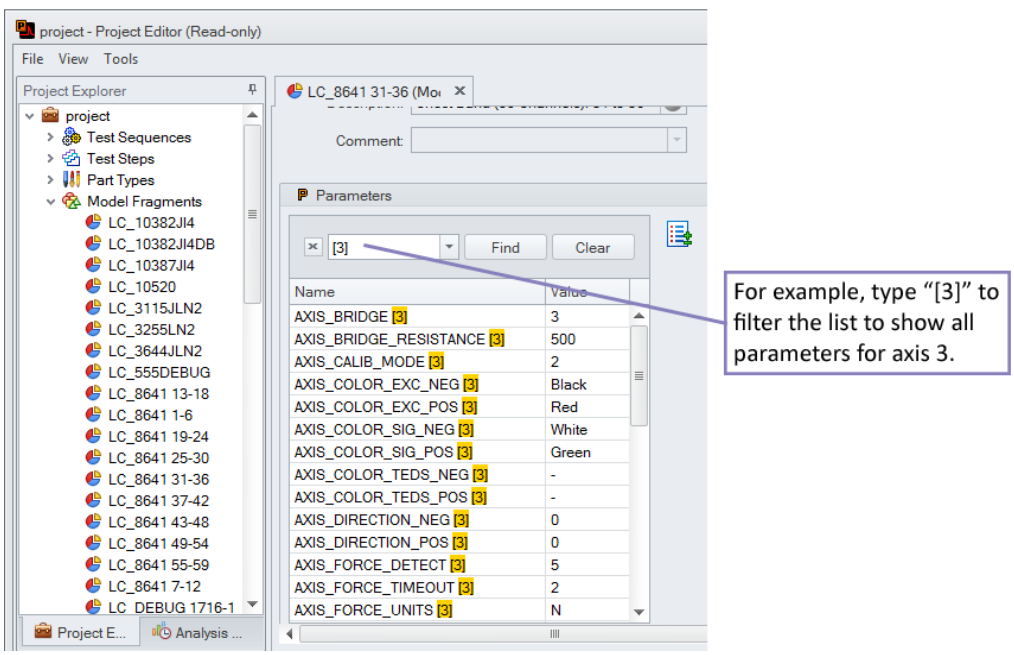


Figure 10.7 Example of Parameter for all Axis 3

10.8 Modifying Reference Load Cell Parameter Values

To change a reference load cell parameter value, follow a similar procedure to edit the load cell parameter values. The model fragments and parameter names begin with “REF_LC_” prefix.

10.9 Multi-Lingual Application

If multiple languages are supported on the application, it is recommended to make the Description of the Model Fragment the same in all languages. The description of the UUT Model Fragment is recorded in the report.

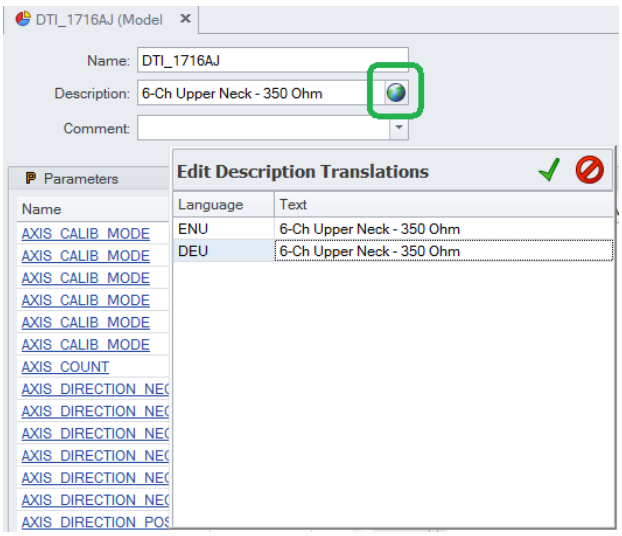


Figure 10.8 Description of Model Fragment Same in All Languages

10.10 Adding a New UUT

There are three (3) primary options for adding a new UUT model fragment.

Option 1: Copy an existing model fragment with similar characteristics, then modify the parameter values using the Project Editor as shown above.

Option 2: From an existing test result, use Test Result History window to create a .csv file to import into the Project Editor. Test results from the previous Humanetics database were imported into the Bauer database. One reason for this is to allow previously calibrated load cells to be able to calculate percent change from the previous calibration. Another reason is to allow an easier migration of models into the Bauer Project Editor.

Option 3: From an existing project, create a project export with the profiles (model fragments) for the UUT and/or the reference load cell model fragment(s). Import to another project.

10.10.1 Option 1

1. Select the model fragment to copy from the Project Explorer tree view. It is recommended to start with a UUT with the same “AXIS_COUNT” as the new UUT.
2. Right click and select *Copy*
3. The new model fragment is shown in a new tab in the Project Editor
4. Change the name and description of the model fragment to the desired new UUT model. For Load Cell type UUT, the prefix of the name must be “LC_”. See Part Type table for appropriate prefix.
5. Change the parameter values in the new model.
6. For the description please refer to the note about multi-lingual applications.

10.10.2 Option 2

1. PCS must be *Offline*.
2. Open Test Result History Window
3. Select the test result for the model to add
4. Right click, select *Custom Export > Create Model*.
5. The Project Editor opens automatically.
    a. If the model fragment already exists, there is no change.

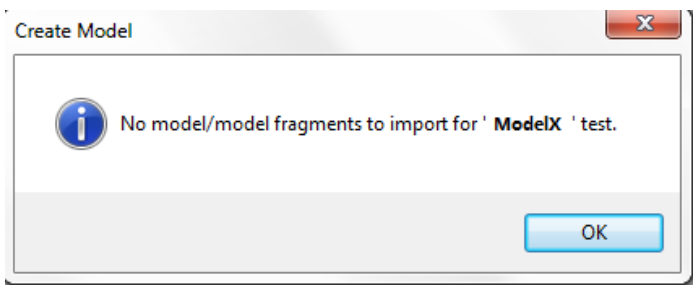


Figure 10.9 Create Model Message

    b. If there is an error, a detailed error is listed at the bottom of the Project Editor.
    c. If the model is created successfully, a message is shown at the bottom of the Project Editor: “New Model Fragment: LC_10380JI4 added to the project”
6. For the description please refer to the note about multi-lingual applications.
7. If satisfied with the changes, File > Save.

10.10.3 Option 3

1. From the Project Editor (Source) containing an existing profile to copy, *File > Export > Project…*
2. Expand the Model Fragments from the tree view. Select only the model fragments (profiles) you wish to import into a different project. **When importing, it is not possible to select individual components from within the exported project file.**

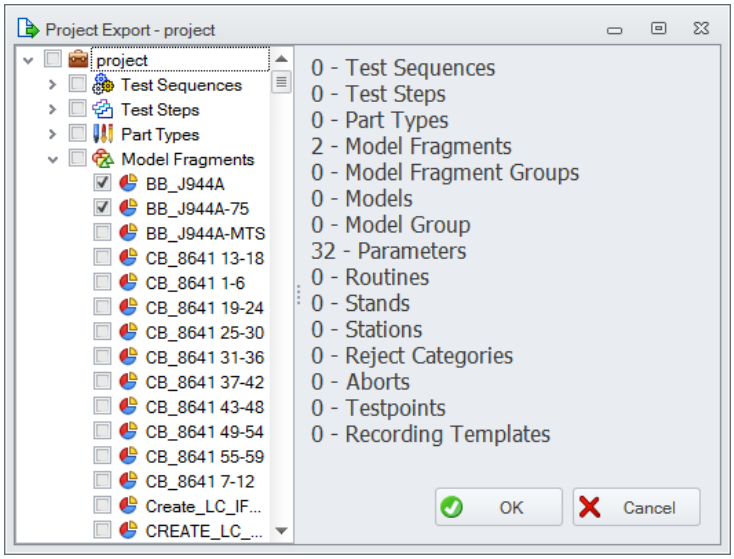


Figure 10.10 Model Fragments Import Tree View Window

3. Click *OK*
4. Browse to a location to store this exported project file and enter a name to help identify it in the future.

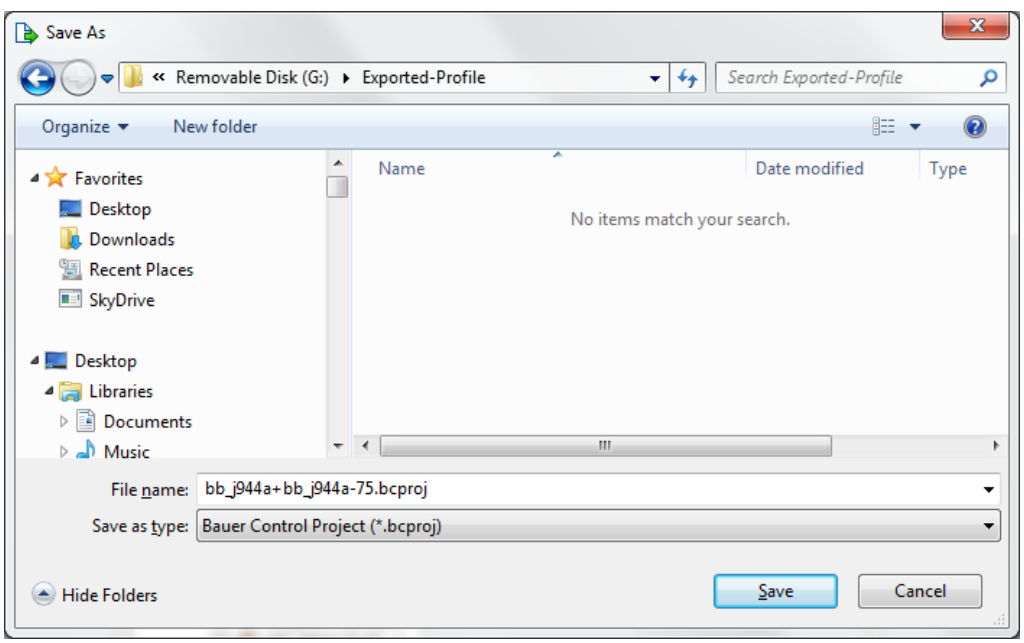


Figure 10.11 Save As Location of Exported-Profile Window

5. Click *Save*
6. Close the Project Editor (Source).
7. Open the Project Editor (Destination) for the project that needs the updated profile.
8. Select *File > Import > Project…*
9. Browse to the location of the file to import. Click *Open*.

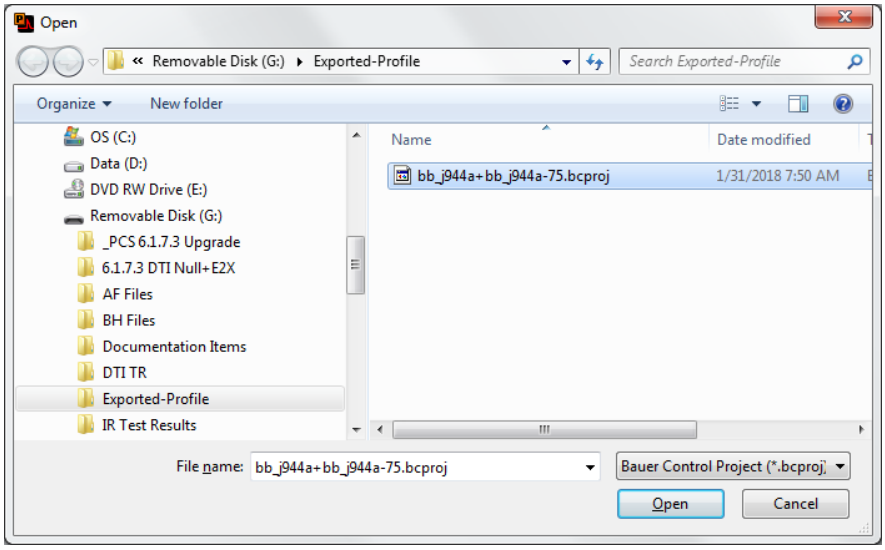


Figure 10.12 Open File to Import Window

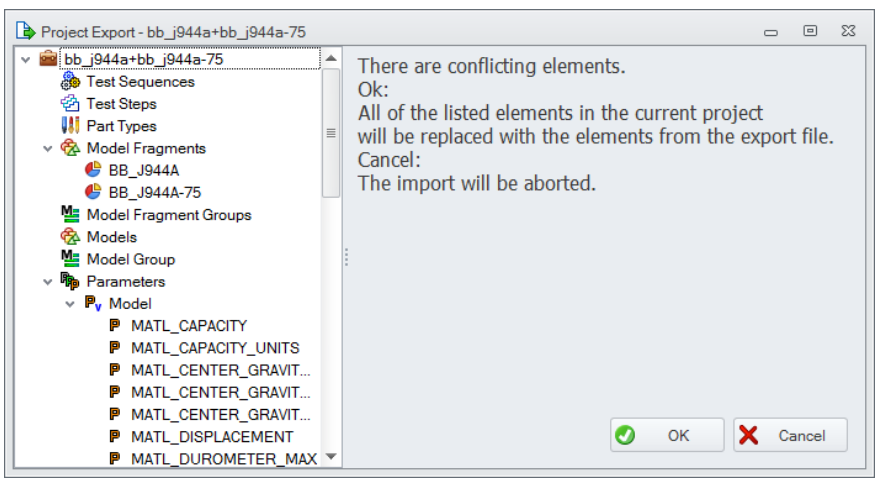


Figure 10.13 Conflicting Elements Message

10. As instructed,
    - Click *OK* to import all the contents of the export file. It is normal to have conflicting elements. The profiles contain model parameters with values for the selected model fragments.
    - Click *Cancel* to stop the import completely.
11. Look for a message similar to the following in the log viewer at the bottom of the Project Editor: "Import of 'G:\Exported-Profile\bb_j944a+bb_j944a-75.bcproj' completed."
12. When finished and satisfied with the change, select *File > Save*.

10.11 Adding a New Reference Load Cell

There are two (2) primary options for adding a new Reference Load Cell model fragment.

10.11.1 Option 1

1. Select the model fragment to copy from the Project Explorer tree view. It is recommended to start with a reference load cell similar to the new reference load cell.
2. Right click and select *Copy*
3. The new model fragment is shown in a new tab in the Project Editor
4. Change the name and description of the model fragment to the desired new reference load cell model. The prefix of the name must be "REF_LC_".
5. Change the parameter values in the new model.

10.11.2 Option 2

1. Similar to Option 3 for adding a UUT, use the Project Editor *File > Export > Project…* feature.
2. The model fragment(s) starting with "REF_LC_" are the Reference Load Cell model fragments.

10.12 Configuring Reports

To modify a Humanetics report, PCS software and Microsoft DevEx software must be installed on the PC. A description for how to make DevEx modifications is beyond the scope of this manual. Many of the report files are site-specific. Care must be exercised when modifying reports.

Section 11. Glossary

Term	Definitions
Analog Calibration Table	A binary file stored on the PC that contains pairs of values at each calibration point for each analog channel. The file also contains the date and time when the relationship was defined and the technician who performed it. The pairs of values are the known measurement and the raw measurement at that known point from the PXI-4339 or the PXI-6363. The calibration table is loaded when Atlas software starts. The calibration table is also loaded at the end of the Bridge Calibration step and the Calibrate Excitation Feedback step if new values were written to the table.
Axis 1	Index 1 in the testing and reporting order. The axis name is typically "FX" or "Force1" and may be physically connected to any of the first six bridge circuits on the pin box. A parameter "Axis bridge number" is used to define to which bridge circuit the axis is connected
Bridge 1	The electronic circuit connection on the pin box channel 1
cDAQ	National Instruments compact data acquisition rack and module
Compensated Crosstalk	If the crosstalk calculated is more than 10% of full scale for the UUT and the axis is a moment axis, the actual loading value is subtracted from the expected loading before computing the percent of full scale crosstalk. Otherwise, the computed crosstalk is reported as the compensated crosstalk. The subtraction is only valid when the applied load (row as shown in the crosstalk report) is a moment and the axis acted upon (column as shown in the crosstalk report) is NOT a moment. This means the lower left quadrant of the report.
Compensated units	Measurement made by the PXI-4339 or PXI-6363 and converted using a calibration table. Up to 64 points can be used to convert the raw value into units. The Atlas software driver uses a piecewise linear interpolation to convert from raw measurement to units. Compensated units are the readings reported by the Atlas during the Atlas Load Cell tests.[5] In the Analog Input display from the Atlas main screen *View > Analog Inputs*, the value in the column "Units" is compensated.
Crosstalk	The force measured by an axis which is not the axis being calibrated. Crosstalk is measured during each of the UUT Calibration test steps. Crosstalk is calculated during the Final Checks test step
Decade box system	A precision 350 ohm bridge with a network of shunt resistors that can be switched using high precision, low noise relays to provide nine (9) different loads on the bridge

[5] There is one testpoint for each bridge made during the Initial Checks which is the raw value. All other values are compensated.

DiMOD	The circuit inside a DTI load cell. The DiMod converts the analog signal from the load cell to digital LSB and is read by the DTI recorder
DTI Background readings	Values shown in "real time" on the user screens. During high DiMod activity such as TEDS read, write, export, crash recording, background readings are paused. During Online recordings, these values are updated at a lower priority and will lag behind the real DiMod values which are captured in the Online Recording.
DTI Crash Recording	Channels are collected at 20 kHz. Data is stored in a PCS recording file. Background readings are paused during crash recordings.
DTI Online Recording	Channels are collected at 1 – 20 kHz depending on the number of channels to be collected. The more channels, the lower the collection rate can be. Data is stored in a PCS recording file.
DTI TEDS	Specific TEDS protocol used by DTI. The DiMod contains the TEDS information for each axis.
EU	Engineering Unit. For metric systems the EU may be Newtons or kg-f for force or Newton-meters for moments
Gain	The PXI-4339 bridge inputs have a configurable gain (100, 50, 20, 1). The default gain is 100. The default excitation voltage is 10 V. The gain affects the available measurement range of the input. The decade bridge output of 12.0 mV/V cannot be measured by the PXI-4339 when the gain is 100. Calibration tables may only be applied and saved if the gain is 100.

Table 11-1 Gain Input

		Ratio Mode Input Range (mV/V)	
Wide Bandwidth Analog Output Gain	**Voltage Mode Input Range (V)**	**Excitation voltage > 2.5 V**	**Excitation voltage < 2.5 V**
100	+/- 0.1	+/- 10	+/- 40
50	+/- 0.2	+/- 20	+/- 80
20	+/- 0.5	+/- 50	+/- 200
1	+/- 10	+/- 1000	+/- 4000

The ACE window has a gain configuration that is used only for the automatic tests. At the start of an automatic test, the gain is configured for all bridges. At the end of the automatic test, the gain is configured to the default. Every test record saved from the ACE includes an array of properties that defines the gain used for that test.

Term	Definitions
Hysteresis	Calculated during the UUT Calibration test step. Provides an indication for the deviation in sensor response to increasing and decreasing load
IEEE1451 TEDS	Specific TEDS protocol used by the reference load cell, reference position, and ACE box
LSB	The value reported by the DTI data recorder. LSB may also be referred to as “counts”
Moment	When the load applied to a UUT is located a distance from the UUT center, the applied load is a moment. The parameter AXIS_MOMENT_ARM_LEN is used to define whether the bridge is a force or a moment. If the AXIS_MOMENT_ARM_LEN > 0, the bridge is a moment measurement
Natural Value	The mV/V (or LSB) measurement before the null procedure is performed. When the bridge is actively measuring and the value is natural, the *Live Reading* on the main screen is yellow on black background
Non-Linearity	Calculated during the UUT Calibration test step. Provides an indication of the sensor proportional response as the load is increased
Null or Autozero	Measure the mV/V (or LSB) value at no load and subtract this value from all subsequent measurements. After the bridge is “nulled”, the *Live Reading* on the main screen is green on black background
Output at Capacity	Calculated during the UUT Calibration test step. Provides an indication of the maximum expected mV/V (or LSB) reading at the maximum load
Parameters	The software uses parameters to define characteristics of the UUT, reference load cell, and the test procedure. Parameters may be constants or vary by model, test step, or stand. Parameter values used during the specific test are stored with the test record as test properties. The test properties can be viewed from the **Test Result History** window using “Details” view. A parameter with the comment “no value should be set for this parameter” receives its value outside of the PE. For example, CUSTOMER_ID is a parameter in the PE, but the value of this parameter is modified by the technician in the Part Information window. CUSTOMER_ID is defined in the PE to allow for multilingual description support.

Term	Definitions
Part Type	A group of profiles that are tested in a similar manner. The Part Type defines which reports can be generated from a test result. The *Type* for a selected UUT is selected from the *Enter Part Information* window. The prefix is used to filter the list of all profiles to identify the part type. The following part types are currently supported.

Table 11-2 Part Type

Part Type	Prefix	Description
Load Cell	LC	Analog UUT bridges using reference load cell. The United Load frame is used to apply loads during UUT Calibration step.
Digital Load Cell	DTI	Digital UUT DiMods using reference load cell. The United Load frame is used to apply loads during UUT Calibration step.
Deadweight	DW	Analog UUT bridges with no reference load cell. Calibrated weights are used as the known load. The Load Frame is not used. The technician is prompted to apply each load point. When the technician acknowledges the load is applied, the UUT measurements are recorded.
Body Block	BB	No UUT bridges. Reference load cell and reference position are monitored and analyzed while the United Load Frame applies a load during the UUT Calibration step. The report includes a graph of the result.
Pelvic Plug	PP	No UUT bridges. Reference load cell and reference position are monitored and analyzed while the United Load Frame applies a load during the UUT Calibration step. The report includes a graph of the result.
Chestband	CB	Analog UUT bridges with no reference load cell. A calibrated fixture of varying bend radii is used as the known load. The Load Frame is not used. The technician is prompted to apply each load point. When the technician acknowledges the load is applied, the UUT measurements are recorded. The results of Chestband are completely different from the other Load Cell tests.

Term	Definitions
PCS	PC Control System is the software that runs the Atlas Load Cell Test System
Positive vs. Negative Loading	Positive loading is the primary or direction 1 loading of an axis. The "Negative" loading is the secondary or direction 2 loading of an axis. If the Positive loading is compression, the secondary loading may be tension, but that is only an example and is not a rule. Positive and negative loading have no relationship to the polarity of the signal value
Profile	The configuration of the UUT. Parameters are used to define the number of axes on the UUT, the configuration of bridge wiring to axis, wire colors, rate of load frame motion, acceptable tolerances for UUT tests, maximum output in mV/V and maximum range in EU, etc. The profile is configured within the PCS Project Editor. The profile for a selected UUT can be viewed in the *Enter Part Information* window. The profile information from a previously tested UUT can be viewed using Details view of the Test Result History window. Observe the profile details in the Test Properties section.
PE	Project Editor defines parameters and testpoints
Ratiometric measurement (mV/V)	The NI 4339 board reports the analog measurements by calculating the ratio = mV sensor output (SIG) / measured excitation voltage (EXC)
Ratiometric measurement (mV/V)	The PXI-4339 board reports the analog measurements by calculating the ratio = mV sensor output (SIG) / measured excitation voltage (EXC). The Keysight DMM can also be used to measure the signal output and the excitation voltage of the decade box bridge by switching relays inside the ACE box.
Raw (uncompensated) measurement	Measurement made directly by the PXI-4339 or PXI-6363. In the Analog Input display from the Atlas main screen *View > Analog Inputs*, the value in the column "Volts" is raw.
Raw data	The mV/V (or LSB) readings collected during the UUT Calibration test step. All bridge measurements during the loading phase of the UUT Calibration step are made after the bridges are "nulled". Compare with "reduced"
Reduced data	The compensated mV/V (or LSB) values which are calculated from the "raw" data and normalized to the specific load points as measured by the reference load cell
Sensitivity	Calculated during the UUT Calibration test step. Sensitivity indicates the relationship of mV/V (or LSB) to the actual force applied. Units are mV/V/EU (or LSB/EU)
Site	Some report formats, date formats, number formats, printed label formats, and features may be site-specific. The site name and line number as defined in the Stand and Station Definition window is used to define the site.

Term	Definitions
TEDS	Transducer Electronic Data Sheet is information containing a serial number, model, full scale range, output response, calibration date. TEDS data is specific to the UUT and is stored on a chip in the UUT
Testpoint	A measured or calculated value compared to low and high limits. Many testpoint limits are defined by parameters within the profile. Most of the limits are defined as a percentage of full scale. Testpoint results appear on the main window. Previous test result may be viewed in the Test Result History window. Some, but not all testpoints are used when generating the Humanetics report. All testpoints are numeric and the precision (number of digits used for evaluation and display) of the testpoint is defined in the **Project Editor**.
Test Record	Each testpoint name, number, value, description, unit description, high limit, and low limit is stored in a test record. The test record is stored locally on the PC and sent to a server for insertion into a database.
UUT	Unit Under Test
WorldSID TEDS	Specific TEDS protocol used by the UUT
Zero Offset	Natural mV/V value after load is removed during Final Checks test step

Section 12. Appendix

12.1 User Levels

Appendix Table 12-1 User Level Feature, Menu Option, and Min. Privilege

Feature	Menu Option	Minimum Privilege	Offline	Online
Restart PCS	File > Restart	All	Yes	No
Exit PCS	File > Exit	All	Yes	No
Discard Test Result	Edit > Discard Test Result	All	No	Yes
Define Stand and Station Settings	Edit > Stand and Station Definition	Engineer	Yes	No
Project Editor	Edit > Project Editor	Engineer	Yes	No
Project Preferences	Edit > Preferences	Engineer	Yes	No
Define/Set System Languages	Edit > Languages	Engineer	Yes	Yes
Configurator	Edit > Configurator	Engineer	Yes	No
Hardware Manager	Edit > Hardware Manager	Engineer	Yes	No
Security Editor	Edit > Security	Engineer	Yes	No
Central Control	Edit > Central Control	Engineer	Yes	No
Message Editor	Edit > Messages	Engineer	Yes	No
Oscope	View > Oscope	All	Yes	Yes
Test Results History	View > Test Results	All	Yes	Yes
UUT Calibration Result Summary	View > Test Summary	All	Yes	Yes
Message Log (History)	View > Message Log	All	Yes	Yes
Edit Log (History)	View > Edit Log	All	Yes	Yes
Digital Inputs / Outputs Status & Control	View > Digital I/O	All*	Yes	Yes
Analog Inputs	View > Analog Inputs	All	Yes	Yes

Feature	Menu Option	Minimum Privilege	Offline	Online
Login	Tools > Login	All	Yes	Yes
Logout	Tools > Logout	All	Yes	Yes
Report Notes Window	Tools > Update Report Notes	All	Yes	Yes
Engineering Unit Conversion	Tools > Unit Conversion	All	Yes	Yes
Calculate Shunt Resistor	Tools > Calculate Shunt Resistor	All	Yes	Yes
Bypass System Warm-Up Time	Tools > Bypass Warm-Up	Advanced user	Yes	Yes
Enable United jog button on front panel	Tools > Enable Jog Button	Operator	No	Yes
Disable United jog button on front panel	Tools > Disable Jog Button	Operator	No	Yes
Backup/Restore Project Application Files	Tools > Project Backup / Restore	Engineer	Yes	Yes
WorldSID Window (UUT)	Tools > WorldSID Window	Operator	Yes	Yes
IEEE TEDS Window (Ref LC)	Tools > IEEE TEDS Window	Operator	Yes	Yes
DTI channel viewer and manual functions	Tools > DTI Window	Operator	Yes	Yes
Test Stand Bridge & Relay Troubleshooting	Tools > Bridge and Relay Troubleshooting	Advanced user	No	Yes
NI Relay Status & Control	Tools > NI Relays	All*	Yes	Yes
United Load Frame Control	Tools > United Load Frame Manual Control	Advanced user	No	Yes
Repeatability and Self Tests using ACE box	Tools > Station Certification > ACE Test Window	Advanced user	No	Yes
Bridge Calibration using external DMM and external decade box	Tools > Station Certification > Bridge Manual Calibration	Advanced user	No	Yes
Lookup Result for Previous Test and edit selected fields	Tools > Host Result Lookup	All	Yes	Yes
Enter Center of Gravity and Weight for selected Body Block test	Tools > Finalize Body Block Test	Operator	Yes	Yes

Feature	Menu Option	Minimum Privilege	Offline	Online
United Load Frame Low Level Control	Tools > Debug > United Load Frame Low Level	Advanced user	No	Yes
Keysight Insulation Resistance Meter Window	Tools > Debug > Keysight IR Meter Window	Advanced user	No	Yes
Keysight External DMM Meter Window	Tools > Debug > Keysight DMM Meter Window	Advanced user	Yes	Yes
Ramp / Monitor Status	Tools > Debug > Ramp/Monitor Status	Engineer	No	Yes
PID Tuning (UUT Power Supply)	Tools > Debug > PID Tuning Window	Advanced user	No	Yes
Print Test Label using the Zebra printer	Tools > Debug > Print Test Label	All	Yes	Yes
I-Basic Debugger	Tools > Debug > I-Basic Debugger	Engineer	Yes	Yes
Set / View RTDD Attribute Values	Tools > Debug > View / Set RTDD Attribute	Engineer	Yes	Yes
Run Debug Method	Tools > Debug > Run Debug Method	Guru	Yes	Yes
Run Any Method	Tools > Debug > Run Any Method	Engineer	Yes	Yes
View Periodic Performance Status	Tools > Debug > Periodic Performance	Engineer	Yes	Yes
Search System Message Text / Code	Tools > Message Search	All	Yes	Yes
Help Options	Help menu (all)	All	Yes	Yes

[All*] Engineer level required for output control

12.2 Preferences

Edit > Preferences

Use PCS Online Help (**F1**) for details.

12.2.1 General Preferences

Contains

- Security auto logout configuration
- PC Power Monitor configuration

12.3 Zebra Printer

The Zebra ZD500 printer is used to print labels from the results. There are different labels printed depending on the part type and the site. A template file is used to define the content and specific format of the labels. There is a specific label for Pelvic Plug and DTI part types. All other part types will print a general label.

Site 1 corresponds to Line 1. Site 2 corresponds to Line 2. If more sites/lines are needed, additional mapping files must be added.

Each of the labels has either single or double print format. All are currently using double print format.[6]

Appendix Table 12-2 Label Type and Description

Label Type	Description of Differences
General Label – site 1	Uses “+6 Mo” and “+12 Mo” terminology for calibration due date
General Label – site 2	Uses CALDUE and a single date
Pelvic Plug	Includes 3mm testpoint data and PASS / FAIL indicator. Much different than the General Label.
DTI	Currently the same content and format as site 2 General Label

[6] The .\bin\plugins\trh\exports\settings.csv file defines whether the single or double template is to be used. This file also defines which template to use based on part type.

12.3.1 Printing a UUT Label

There are two (2) options for printing a UUT label from a specific test result.

12.3.1.1 Option 1

A stand parameter in the Project file controls whether the technician is prompted to print a label after clicking the *Save* button to store the result. If the parameter is *False*, the prompt is not displayed.

12.3.1.2 Option 2

From the Test Result History window, it is possible to print a label from any previous result.

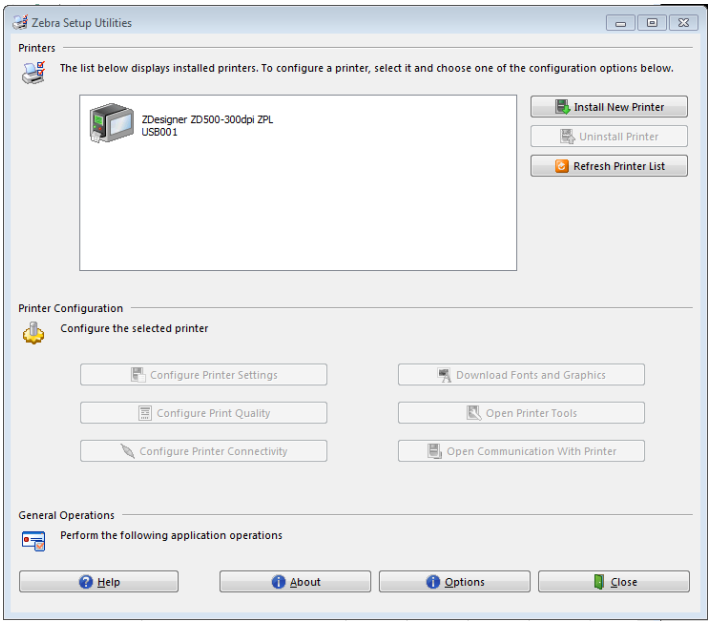
1. Select the test result
2. Right click and select *Custom Export > Print Label*.

12.4 Aligning the Zebra Printer

Occasionally, the printer requires alignment if the text is not fitting on the label properly.

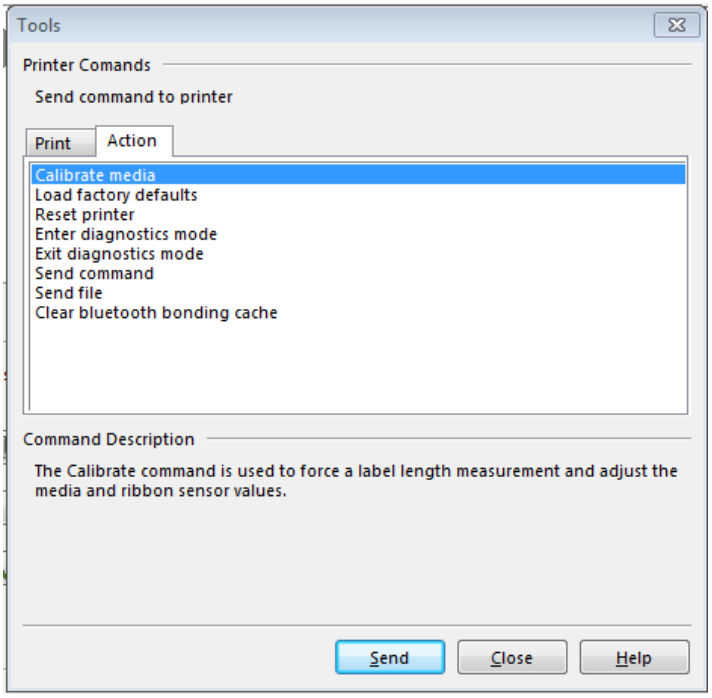
	NOTICE This procedure wastes approximately 10 labels every time it is run. The printer may fix itself if you simply try to print a few more labels.

1. Run the Zebra Setup Utility



Appendix Figure 12.1 Zebra Setup Utilities Window

2. Select the Zebra printer which is connected by USB cable.
3. Click *Open Printer Tools*



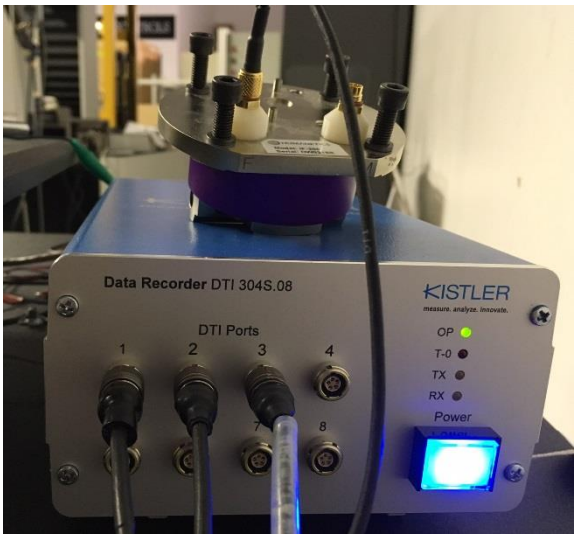
Appendix Figure 12.2 Printer Tools Window

4. Select the *Action* tab and click on *Calibrate media*.
5. Click *Send*. Approximately 10 blank labels are expelled from the printer.

12.5 DTI Special Considerations

12.5.1 DTI Party Entry

1. DTI Recorder is plugged in, blue power light on, green OP LED solid on, amber LEDs flashing to indicate communications.

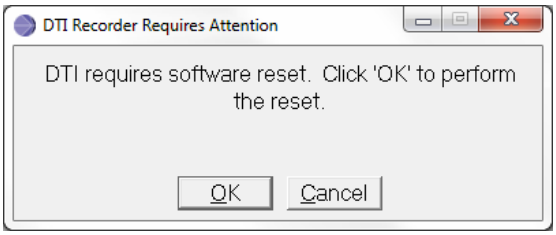


Appendix Figure 12.3 DTI Data Recorder Connections

2. Technician plugs in the UUT DiMods into the recorder
    a. UUT can be plugged into any port. The testing software is designed for a maximum of 6 channels for the UUT.
    b. The reference load cell is connected to a dedicated port using DiMod 307.11s for single channel.
3. Technician connects the Reference Load cell into the DTI recorder. The DiMod for the reference is a part of the machine. It is not unique for each reference load cell. The UUID for the reference load cell is stored as a test property for the test result.

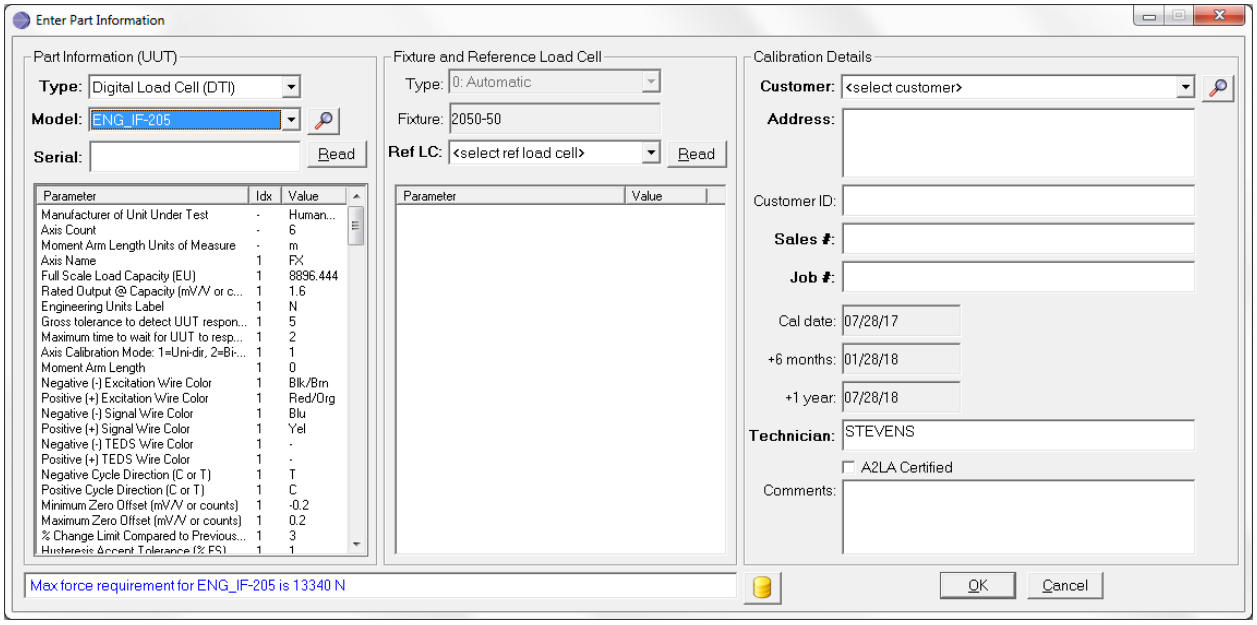
NOTICE

Any time ports are connected or disconnected after starting the test, the test must be discarded and started again. This is only true for DTI part type.



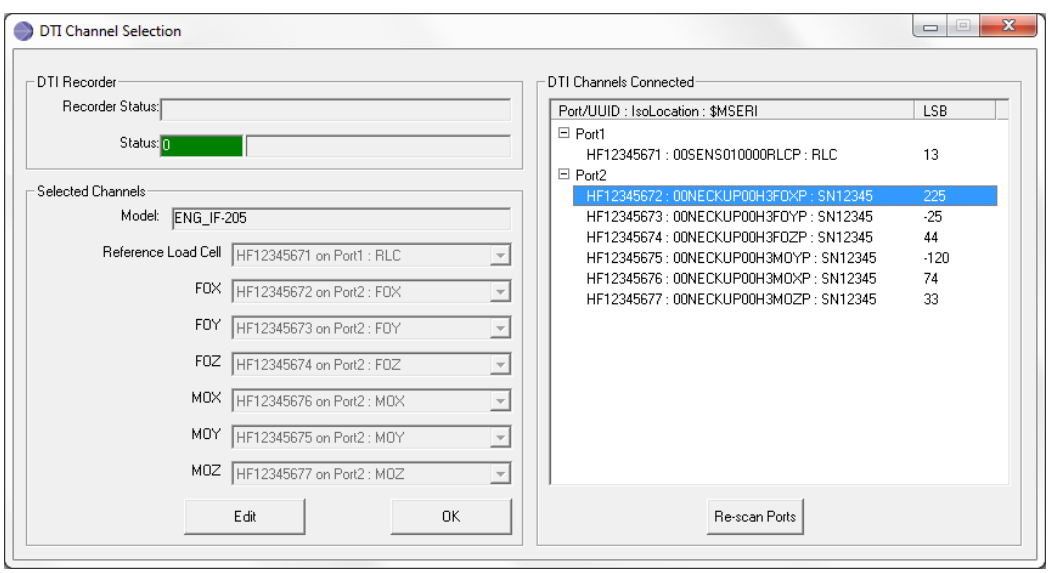
Appendix Figure 12.4 DTI Recorder Requires Attention Message

4. Technician logs on.
5. Technician clicks the Enter Part Information button. This opens the *Enter Part Information* window.
6. Technician selects DTI part type and DTI model.



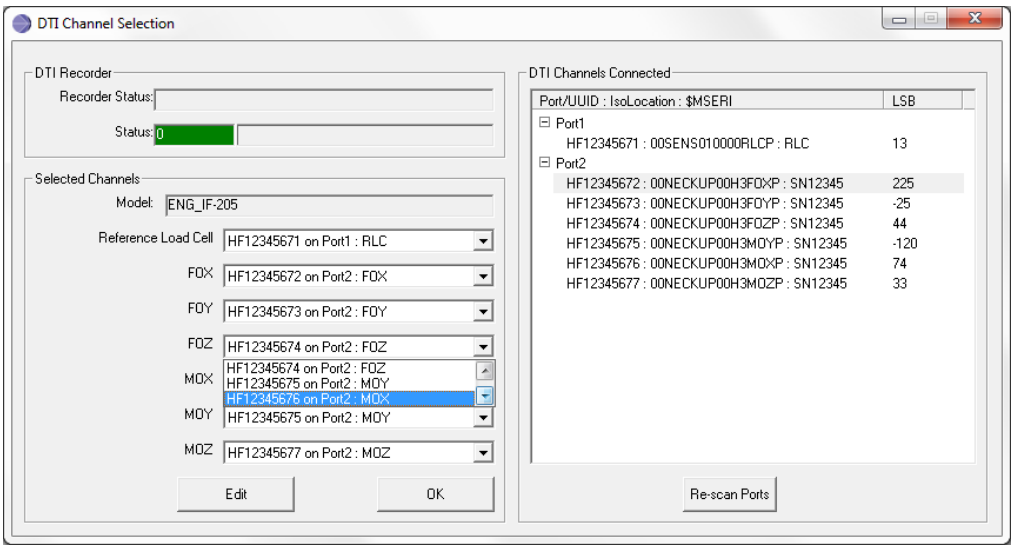
Appendix Figure 12.5 Select DTI Part Type and Model Window

7. The *DTI Channel Selection* window opens. Selected channels section is filled in based on the AXIS_COUNT and the AXIS_NAME[] from the selected model. The DTI Connected Channels shows the connected DiMods and the default channel mapping for each axis. The ISOLocation, UUID and port information is read from each DiMod and shown in the DTI Channels Connected section of the window. The pictures below demonstrate a 6 axis load cell.
   The counts values are updated for each channel to assist the technician in defining some of the axes. For example, it is possible FOX may exist on more than one channel.



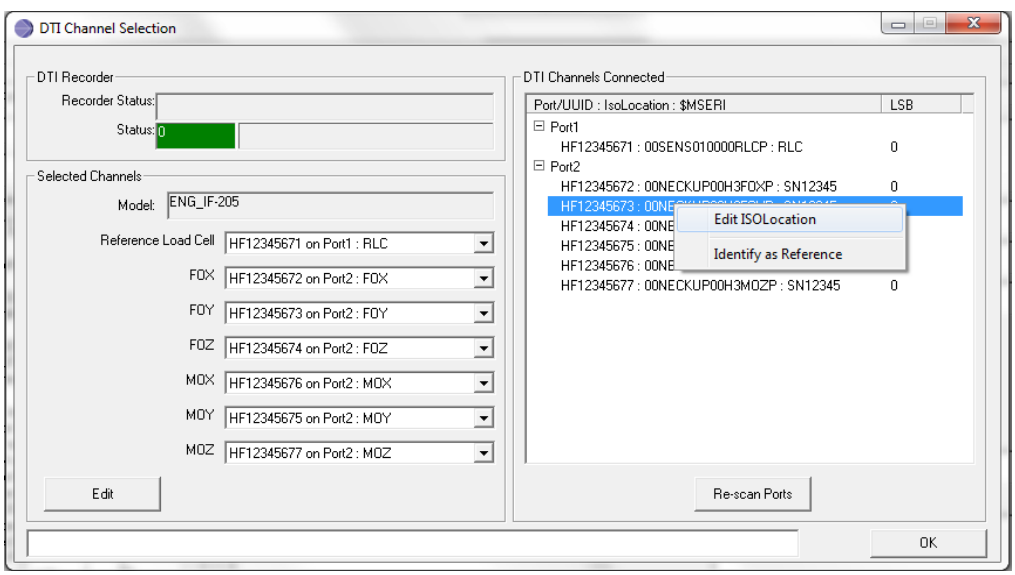
Appendix Figure 12.6 DTI Channel Selection Window

8. The technician clicks *Edit* and may select from the list of available channels for each axis and the reference load cell.



Appendix Figure 12.7 DTI Channel Selection and Reference Load Cell Window

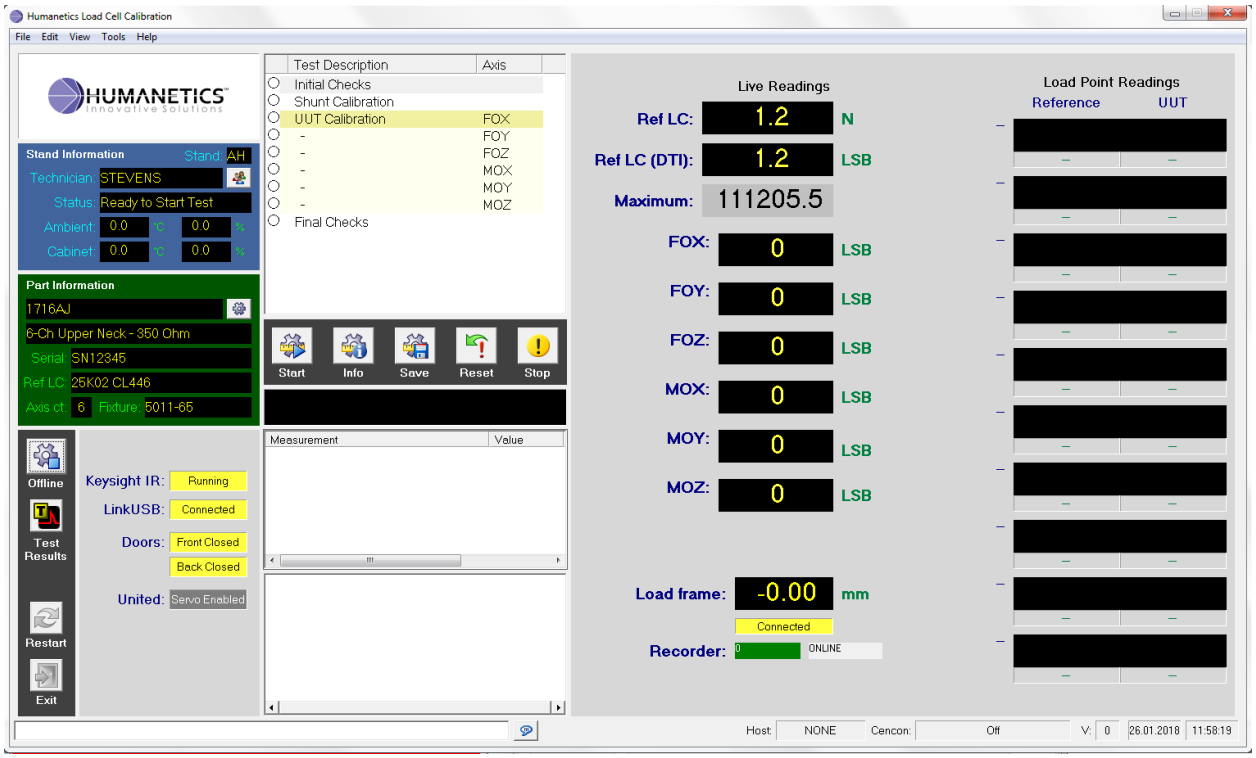
a. Using the *Edit* mode the technician has the ability to change the ISOLocation or to identify a channel as a reference load cell.



Appendix Figure 12.8 Change ISOLocation or ID Channel as Reference LC Window

9. The technician clicks *OK*. The software verifies the following conditions before allowing the technician to continue:
    a. All required load cell channels are defined. Reference is always required.
    b. All channels are unique.
    c. The reference load cell is on a port with no other channels.
    d. Reference load cell ISOLocation = “00SENS010000RLCP”
    e. AXIS_NAME[] and the selected ISOLocation must match. For example, if the AXIS_NAME = “FOX” and the IsoLocation contains “FOX”, this is a match. If the AXIS_NAME = “Fx” and the IsoLocation contains “FOX”, this is a match. If the AXIS_NAME = “MOX” and the IsoLocation contains “FOX”, this is **not** a match. If the AXIS_NAME = “FOX (M)” and the IsoLocation contains “FOX”, this is a match.
    f. All UUT $MSERI values must be the same unless this is a “Volkswagen” part. This value is automatically written to the *Serial:* field on the *Enter Part Information* window.
    g. If the $MSERI contains the UUID, read $UNAME for the first axis. If the $UNAME contains “Volkswagen” (not case sensitive), the technician is prompted to enter the serial ID for this load cell.
10. When the *DTI Channel Selection* window closes.
    a. A window opens to show the previous calibrations for this load cell. Previous accepted calibrations are searched by serial ID and model from the Bauer Test Result Database.
11. Technician clicks OK and the information is validated before the *Enter Part Information* window closes.
12. When the *Enter Part Information* window closes the following actions are automatically performed by the software,
    a. The *Main* screen is updated for the number of UUT using:
        i. The AXIS_NAME[] for the 1st line of the text label and
        ii. The 10 character UUID (Universal Unique Identification Data read from TEDS address range 0000h to 0009h) for the 2nd line of the text label.
    b. The screen elements are linked to the specific ports on the DiMods to show the counts for each channel in Online collection mode.
    c. The Reference Load cell shows “N”, not counts. Both the “analog” from PXI-4339 and “DTI” from the recorder reference load cell readings are displayed.
    d. The list of test steps is updated for this UUT

13. Technician clicks the “Start” button on the *Main* screen.



Appendix Figure 12.9 Main Screen Start Button Window

12.5.2 DTI Initial Checks

1. The software automatically measures and records the ambient and cabinet temperature and humidity using the sensors connected to the Data Acquisition panel.
2. The software uses pre-determined calibration values (counts to units) for this Reference Load Cell to define the output in units.
    a. The software searches for the appropriate DTI calibration file for the selected reference load cell to convert counts (LSB) to units (N).
    b. If the DTI calibration file exists for this reference load cell, this Atlas test stand, and is not expired, the test can proceed. The software uses the table defined within the calibration file to interpolate the counts and convert to engineering units. The maximum number of calibration points is 64 points.
    c. If the calibration file is not valid, the technician must perform the reference load cell calibration routine. Refer to Reference Load Cell Calibration section below for more details.
3. Reference Load cell TEDS is verified against the defined Model Parameters and calibration date, etc. similar to analog.
4. UUT TEDS is verified to determine which version of TEDS tags are available on the DiMods. If the required tags are not present, the Technician is alerted and not allowed to continue.
    a. For $UNAME contains “Volkswagen”, the $UIDNR must be defined. If not, the test will fail.

b. The AXIS_UID_NUMBER[1] is used to fill in the data for ID-no on the report. The AXIS_UID_NUMBER[1] is constructed from $UIDNR. If there is more than one axis, the AXIS_UID_NUMBER[1] is the first $UIDNR – last $UIDNR.

5. Measuring relays and excitation are enabled for reference load cell.
6. Similar to Analog, Technician verifies:
    a. Reference Load Cell responding
    b. Reference Load Cell positive for compression
    c. UUT each sensor responding
7. ZMO for each UUT is measured. The DTI null offset is removed such that the values are natural for each DTI DiMod is prior to collecting ZMO data. Crash recorder mode is used to collect and analyze the signals. Mean, standard deviation, and curve fit angle: α are calculated.

$$m = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$m = \tan\alpha \Rightarrow \alpha = \arctan m$$

    a. The ZMO results for each channel are evaluated as testpoints.
    b. The recommended limits for mean are -DTI_UUT_ZMO_OFFSET_MAX = -1500 counts; DTI_UUT_ZMO_OFFSET_MAX = 1500 counts.
    c. The recommended limit for standard deviation are DTI_UUT_ZMO_STDDEV_MAX = 10 counts.
    d. The recommended limit for curve fit is DTI_UUT_ZMO_PCNT_DEVIATION = 0.4.
    e. If the measured offset is outside of the minimum and maximum range, the technician is warned and only an advanced user may continue if desired.

12.5.3 DTI Stimulation

1. The null offset for each DiMod including the reference load cell is measured and removed from each channel. The on-screen value is shown in GREEN text when the channel is nulled. The value is shown in YELLOW text when the channel is natural (not nulled).
2. Recorder is requested to perform positive and negative stimulation for all UUT channels. alues are recorded as testpoints. Limits are determined by $CSTRN, $CSTRP, and $STMTO (typical value = 3, units are %) TEDS values:
    a. If $CSTRN or $CSTRP are not defined (new UUT), limits DTI_LSB_MIN_LOADED_LIMIT=+/-1000, DTI_LSB_MAX_LOADED_LIMIT=+/-32000 are used.
    b. If $CSTRN and $CSTRP are defined, these are the target expected values.
    For example, $CSTRN = -8000, $STMTO = 3.
    The low limit for negative stimulation is -8000 – 240 = -8240 LSB
    The high limit for negative stimulation is -8000 + 240 = 7760 LSB
    c. The Reference Load Cell DTI stimulation is not wired on the DiMod.
3. Reference Load Cell for the analog input is nulled.
4. For the reference load cell analog signal input to PXI-4339, positive and negative shunt resistance using PXI relays and DAQ panel resistors are applied. The same verification as for analog is used to verify REF_LC_BRIDGE_RESISTANCE using REF_LC_LIMIT_SHUNT for the limits. Ratio of analog / DTI units is recorded as testpoints. The intention of this test is a “self-test” of the reference load cell.

12.5.4 DTI UUT Calibration

1. Technician selects which axis to run from the list of test steps.
2. The null for each DTI DiMod and the analog reference load cell is canceled so all values are natural.
3. All UUT data is collected and reported in counts. Reference Load Cell is in engineering units. Data is collected using Online Collection at the maximum achievable rate. The reference load cell is always collected and is located on a separate port from any UUT. The maximum rate depends on the number of channels and the ports. 1 kHz for 5-7 channels. 10 kHz for 4 channels (one channel is the Reference on a different port). 20 kHz for 2-3 channels.
4. Technician uses his/her hand to apply a force to verify the channel to be loaded is responding.
5. Technician places the UUT in the Load Frame based on compression or tension loading. Compression and tension are defined by model parameters: AXIS_DIRECTION_POS and AXIS_DIRECTION_NEG. This is the same as analog.
6. When the prompt is clicked, the DiMod channels are nulled as is the analog reference load cell.
7. The initial load is automatically applied based on model parameter: AXIS_PRE_LOAD_SPEED and the target is AXIS_FULL_SCALE divided by the AXIS_LOAD_PTS. Moment axes use a force compensated by the moment arm length.
8. The parameters: DTI_LSB_MAX_LOADED_LIMIT = 1000 and DTI_LSB_MAX_LOADED_LIMIT = 32000 are used to determine the tolerance for the initial load. The parameter AXIS_POLARITY_POS is used to determine the polarity of the reading. If the initial load fails, the technician is prompted to continue the test or not.
9. Initial load is automatically removed.
10. Pre-load cycles are automatically performed.
11. Full force load is applied.
    a. During the load and unload, the *Load Point Readings* on the right side of the display are updated. The reference is in Newtons as read by the analog channel. The UUT values are in LSB.
12. Crossbar is automatically moved away from the fixture by 50.8 mm (2 inches) at maximum United speed.
13. The “unloaded” value is recorded as a testpoint: uut_cal_<direction>_zero_<axis>. This value is not in the report.
14. Calculations are performed for the following:
    a. No CFC filter is applied to the data.
    b. Find the “up” loading and “down” loading points.
    c. Calculate reduced points. Use the same techniques as in analog to calculate using counts instead of mV/V.
    d. Hysteresis. Calculation the same as analog.
    e. Non-Linearity. Calculation the same as analog.
    f. Sensitivity (as absolute value). This value is later written to $SENSB as 1 / sensitivity.
    g. Output at capacity (as absolute value). The value is calculated the same as for analog, but is rounded to the nearest whole number for DTI. This value is later written to either $CLMRH if compression or $CLMRL if tension.
    h. Percent sensitivity change. Calculation the same as analog.
    i. Raw crosstalk. Calculation the same as analog.

j. Scale factor and offset (Linearization in the report). These calculations are explicitly different from analog.

$$Scale = \frac{1}{Sensitivity}$$

$$Offset = 0.0$$

15. A hysteresis plot to UUT counts vs. Reference Load Cell units is created.
16. Results are shown to the technician for confirmation.
17. Repeat this procedure for each axis

12.5.5 DTI Final Checks

1. The software automatically measures and records the ambient and cabinet temperature and humidity using the sensors connected to the Data Acquisition panel.
2. Technician is prompted to rotate the fixture to the neutral position. This is necessary to achieve a consistent ZMO reading.
3. ZMO is measured for each UUT the same as Initial Checks.
4. Equivalent shunt values based on measured sensitivity are calculated for use on the report.
5. Percent crosstalk is calculated.
6. Summary result window opens showing hysteresis etc. for all axes.

12.5.6 DTI Finalize the Result

1. If the result is satisfactory, technician clicks the “Save” button.
2. The technician is prompted to save the TEDS to EEPROM or not. Only TEDS version 3 is written to the DiMod.
3. Before writing TEDS information, information is validated to assure the values are within an acceptable range. If there is a problem with any value, the results are shown to the technician. Invalid values will not be written to the EEPROM. The technician can retry or cancel.

4. If the values are all valid, the program automatically writes of TEDS information to the EEPROM memory of each DiMod. If there is a problem writing the TEDS, the technician is notified with details. The technician can retry or cancel.

Appendix Table 12-3 Tag Identifier and Explanation

Tag Identifier	Explanation
$CALNR	calibration certificate number. Calibration_ID property. The Calibration ID is 12 characters. [nnyymmddhhmm] where nn=2 character machine unique name, yy=2 digit year, mm=2 digit month, dd=2 digit day, hh=2 digit hour, mm=2 digit minutes. This value is always unique.
$CDATE=2000-12-31	calibration date [yyyy-mm-dd]
$CFDAT=1998-12-24	first time calibration date [yyyy-mm-dd] Write only if empty
$CLINT=12	calibration interval [month] Default: 12. Write only if empty. The value of $CLINT is used to determine the calibration due date.
$CLMRH=200	measuring range (highest limit) covered by calibration in physical units full scale capacity or zero depending if compression or tension
$CLMRL=-200	measuring range (lowest limit) covered by calibration in physical units zero or full scale capacity depending if compression or tension
$CLTYP=string	one-word description of calibration method Force: compression, tension
$CNAME=string	name of calibration lab. This is defined by the parameter LAB_NAME in the software.
$CSTRN	ADC increments for negative stimulation acquired in calibration This is also the target value for the verification of measured negative stimulation. If empty or zero, limits are open.
$CSTRP	ADC increments for positive stimulation acquired in calibration This is also the target value for the verification of measured positive stimulation. If empty or zero, limits are open.
$CZMOR	ADC increments for ZMO acquired in calibration Limits for ZMO mean are +/- 1500 LSB. The parameter DTI_UUT_ZMO_OFFSET_MAX defines this limit.
$MUNCT=1	typical measurement uncertainty in +/- % FS

$MANUF	From the profile parameter: UUT_MANUFACTURER
$SENSB=0.12	linear coefficient of sensitivity polynom, physical units per ADC increment. his is 1/sensitivity and always written positive.
$ORDNR	For Volkswagen only. This is the *Sales Number* entered by the technician from the *Part Entry* window. The $ORDNR is a user tag. If the user tag does not already exist, the DLL for writing TEDS does not allow to write this tag.

5. TEDS information is read to confirm the data is written. If the comparison fails, the technician is notified of the failures. The technician can retry or cancel.
6. If there was a problem writing TEDS, the technician is prompted to save the result or cancel.
7. If the result is saved, the technician may or may not be prompted to print the label. See Zebra Label Printer for more information.
8. If the TEDS was written successfully, an XML export for each axis is automatically generated and attached to the test result. There are two completely different formats used to export the result. Volkswagen has a special XML format. For Volkswagen parts, both formats are exported to facilitate E2X export. The naming convention of the formats is also different.
    a. Naming convention if $UNAME = “Volkswagen*”:
       <Sales Number>_<UUID>_<yyyymmdd>.xml
    b. Other naming convention:
       <model>_<serial>_<axis name>_<yyyymmdd>.xml
9. If the TEDS were written successfully, the XML export files for each axis are copied to a network location. Project Editor stand-dependent parameter: LAB_XML_PATH is the path name to define the location.
10. There is a separate testpoint for each axis to record whether TEDS was written for that axis or not.
11. Full test results are saved locally on the hard drive and sent to the database.
12. Technician unplugs the DiMods from the recorder and removes the UUT from the load frame.

12.5.7 DTI Reference Load Cell Calibration

The reference load cell is used to measure the load applied to the UUT axes during the UUT Calibration test step. The Reference Load Cell (RefLC) produces an analog signal that is measured by the Atlas test machine using Analog Devices PXI-4339 card. The analog signal is used to control the force applied by the United Load Frame and to monitor the force to assure maximum force is not exceeded. The United Load Frame has no internal force feedback. The PXI-4339 card includes an output in millivolts that is conditioned by a custom module and input to a DiMod 307.11s circuit. The output from the RefLC DiMod is processed by the DTI recorder.

The UUT load cells are connected to DiMod circuits. The output from the UUT DiMods are processed by the same DTI recorder. The data from each UUT and the Reference Load Cell DiMods is simultaneously collected by the DTI recorder and processed by the Atlas test control system and presented as counts (LSB).

It is necessary to convert the DTI counts (LSB) to engineering units (Newtons) for the reference load cell so the data collected by the DTI recorder for each UUT load cell is compared to an actual force. The process of converting counts to units is calibration.

There are several possible methods to achieve the counts to units conversion. At this time, only Method 1 is supported.

12.5.7.1 Automatic United Static Load

Using this method, the test software controls the United Load Frame and collects the analog signal and DTI reported values from the reference load cell. Loads are automatically applied to the reference load cell by the United Load Frame. All data is automatically analyzed by the test software. The parameter REC_LC_CAL_UNITED_PTS determines the number of static loading points applied.

This procedure requires the technician to select the reference load cell using the *Enter Part Information* window. Once the information is entered, the technician can either

1. (Only if the technician is an advanced user), click the "*Calibrate*" button to the left of the *Ref LC:* label on the main screen, or
2. Click the "*Start*" button on the main screen. If the selected reference load cell does not have a valid calibration table for this machine, the technician is prompted to start the procedure or not. If there is no valid calibration table, the test cannot proceed. The calibration date is stored in the calibration table.

Calibration file is not valid if any of these conditions exist:

- Calibration date in the table is older than the calibration date of the reference load cell (from TEDS)
- Number of calibration points < 2
- The DiMod UUID of the calibration file does not match the DiMod for this reference load cell
- The reference load Cell ID of the calibration file does not match this reference load Cell ID
- The previous calibration was created without null of the DiMod reference load cell and null is required.
- The previous calibration was created with null of the DiMod reference load cell and null is not required.

This is the procedure.

1. The software automatically loads the pre-defined sensitivity of the selected reference load cell to the analog channel. The parameter REF_LC_ID is used to identify the reference load cell. The sensitivity is defined in the profile for the reference load cell. This allows the reading on the *main screen* to show in units (e.g. Newtons).
2. The software energizes the analog circuit to read the reference load cell.
3. If there is an existing DTI calibration table for this sensor, it is applied. This allows the DTI reading on the *main* screen to show in units.
4. If there is a load currently applied, the jog buttons on the United are enabled and the technician is requested to remove the load.
    a. If the offset is too high (> 50 N), the procedure will not continue. There is likely a problem with the reference load cell or a load is applied to the load cell.

5. The software nulls the analog circuit and the DiMod for the reference load cell.
6. The technician verifies the reference load cell is responding properly.
7. The technician is requested to insert the reference load cell calibration fixture and use the jog buttons on the United to move the crosshead.

CAUTION

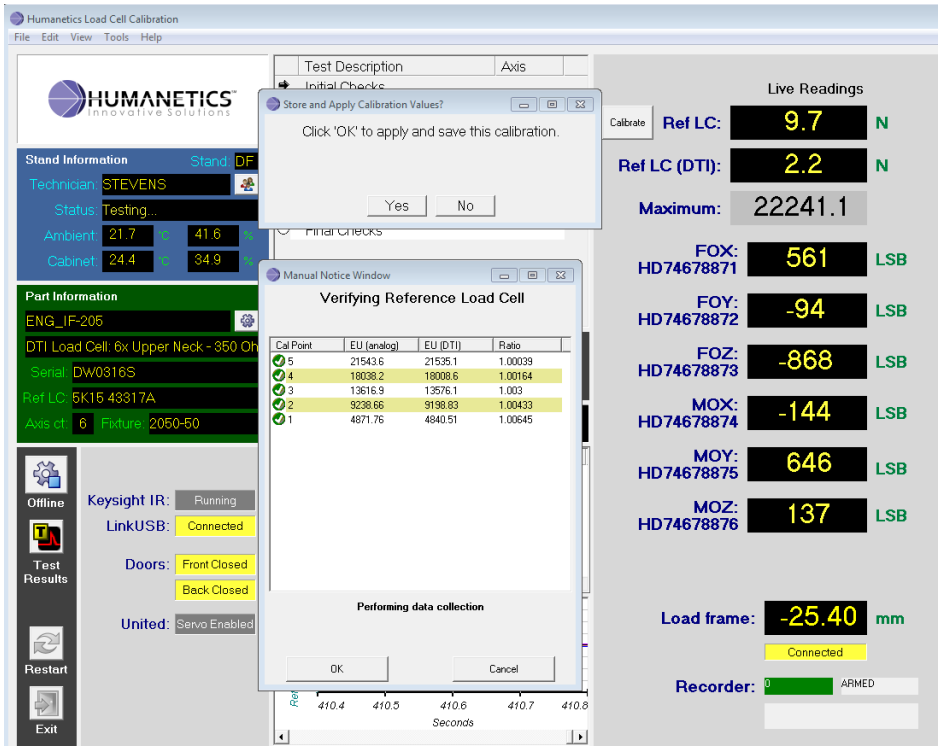
The fixture for calibrating the Reference Load Cell is rigid. Use slow jog very carefully when aligning the load frame. Possible damage to the Reference Load Cell can occur.

8. The software automatically controls the United to apply static loads to the RefLC calibration fixture based on the maximum load defined for this reference load cell, the rate (REF_LC_CAL_UNITED_RATE), and the number of points (REF_LC_CAL_UNITED_PTS). At each static point, there is a 10.0 second delay (REF_LC_CAL_UNITED_DELAY), then the DTI data is collected for 1.0 second @ 1 kHz. The DTI counts data is averaged. At the same time, the analog signal in units is averaged @ 1 kHz for 1.0 second. This data is stored internally to the test system. It will not be stored to the calibration table until it is validated.
    a. The zero load point is not used for the calibration points.
    b. Progress at each static point is shown on the screen.
    c. The standard deviation of the LSB reading is used as the criteria for each point. The limit is defined by parameter REF_LC_STDDEV_AUTOCAL_1.
9. Once all points are collected, the calibration points are temporarily applied to the DTI signal. The test software device driver uses a piecewise linear interpolation for each measured point to calculate the units from the measured counts.
10. The software automatically controls the United to remove the load to the same static points as before. The same delay and averaging is applied at each point. The measurements are used to verify the new calibration for the DTI.
11. The criteria for the validation is a ratio. The closer this ratio is to 1.0, the better the calibration.

$$ratio = (Analog\ units)/(DTI\ counts\ converted\ to\ units)$$

12. The ratio calculated at each static point must be within 1.0 +/- REF_LC_LIMIT_AUTOCAL_1 for the calibration to be valid.

13. The technician is prompted to apply and save the calibration.



Appendix Figure 12.10 Save Calibration Message

14. If the calibration is saved, the counts (from DTI) and units (from analog) and the validation ratio at each point are stored to the calibration file for this test machine and this reference load cell. The date and time of the calibration and the method used are also stored to the calibration file.
15. If the calibration is not valid, the test cannot continue.

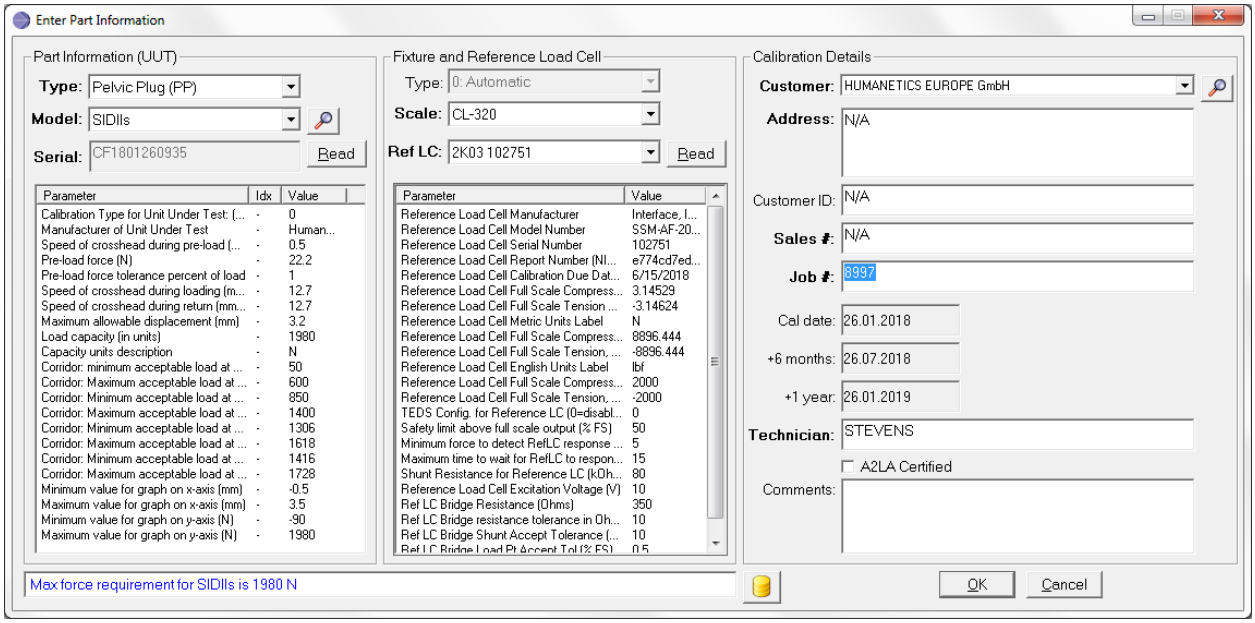
12.6 Pelvic Plug Special Conditions

The figure below shows a picture of the Pelvic Plug (PP).

Appendix Figure 12.11 Pelvic Plug

12.6.1 PP Part Entry

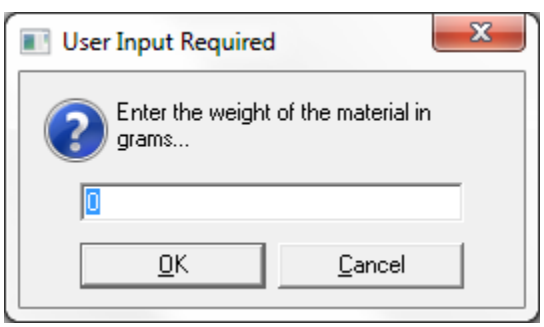
The Serial ID is automatically generated. The Scale must be selected as well as the Ref LC. The Customer, Address, and Sales number are automatically filled in. The technician must enter the Job #.



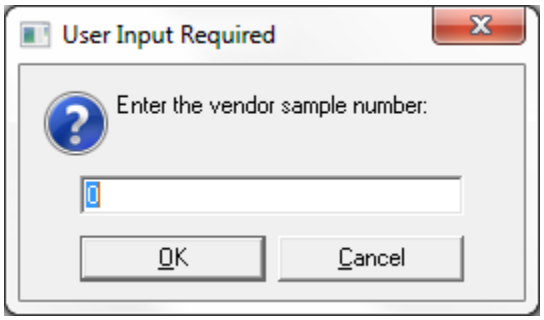
Appendix Figure 12.12 Enter Part Information, Job #

12.6.2 PP Initial Checks

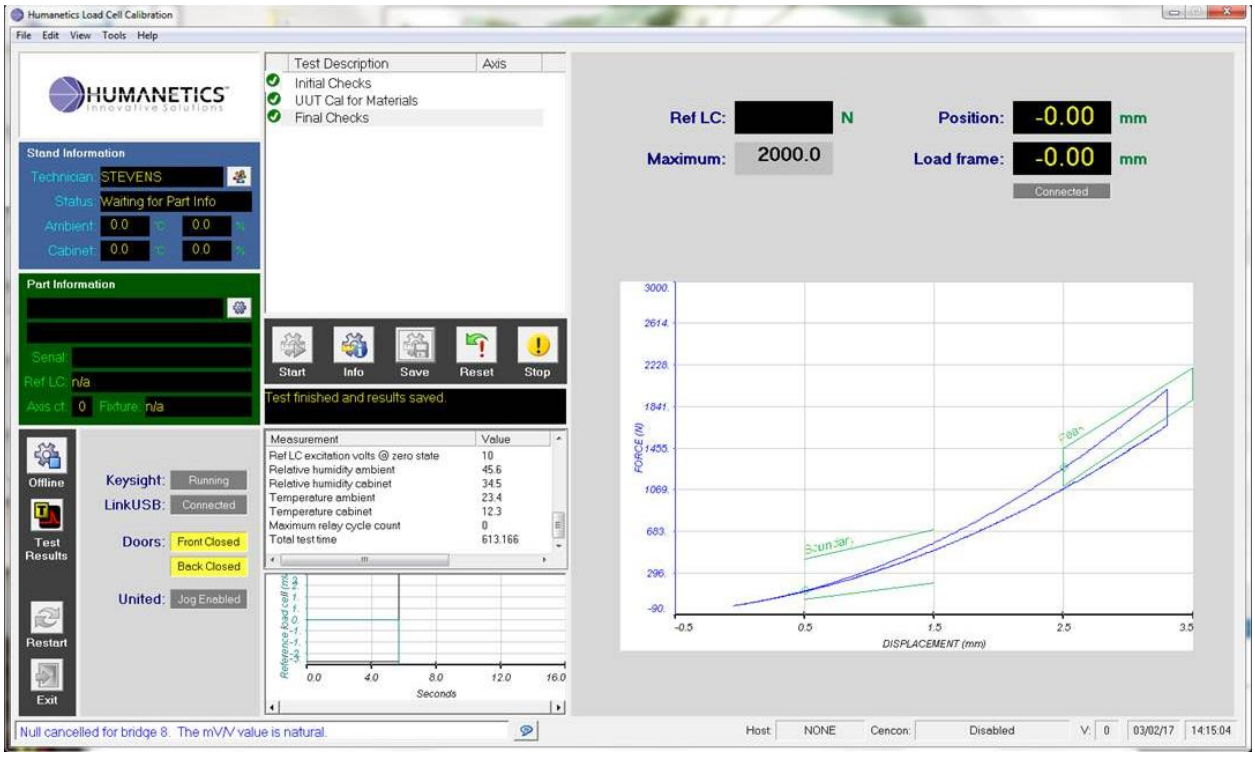
User entry required during the Initial Checks.



Appendix Figure 12.13 User Input Required Message, Weight of Material



Appendix Figure 12.14 User Input Required Message, Vendor Sample Number



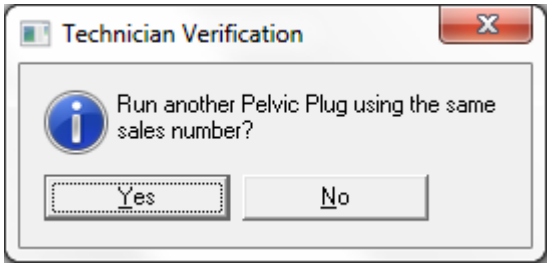
Appendix Figure 12.15 UUT Calibration for Pelvic Plug

12.6.3 PP UUT Calibration Step

The Reference Load Cell force and Reference Position are collected and plotted as an X-Y graph as the pelvic plug is slowly depressed and released by the United Load Frame crossbar. A CFC-60 filter is applied to the force measurement. The CFC-60 filter is only valid when the collection rate is 1000 Hz.

12.6.4 PP Saving the Result

Pelvic Plugs are often run in batches for the same job number. To facilitate this, the Part Information is entered once by the technician, then after clicking *Save* at the end of the test, the technician is prompted to run another test for the same job number.



Appendix Figure 12.16 Technician Verification Message

Select *Yes*, to run another Pelvic Plug for the same sales number, same reference scale and same reference load cell. The Serial number is automatically generated to be unique. Select *No*, to clear all the part information.

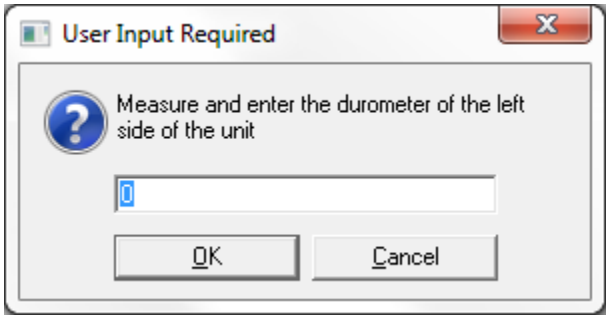
12.7 Body Block Special Considerations

The setup fixture and conditioning of the Body Block is not described here.

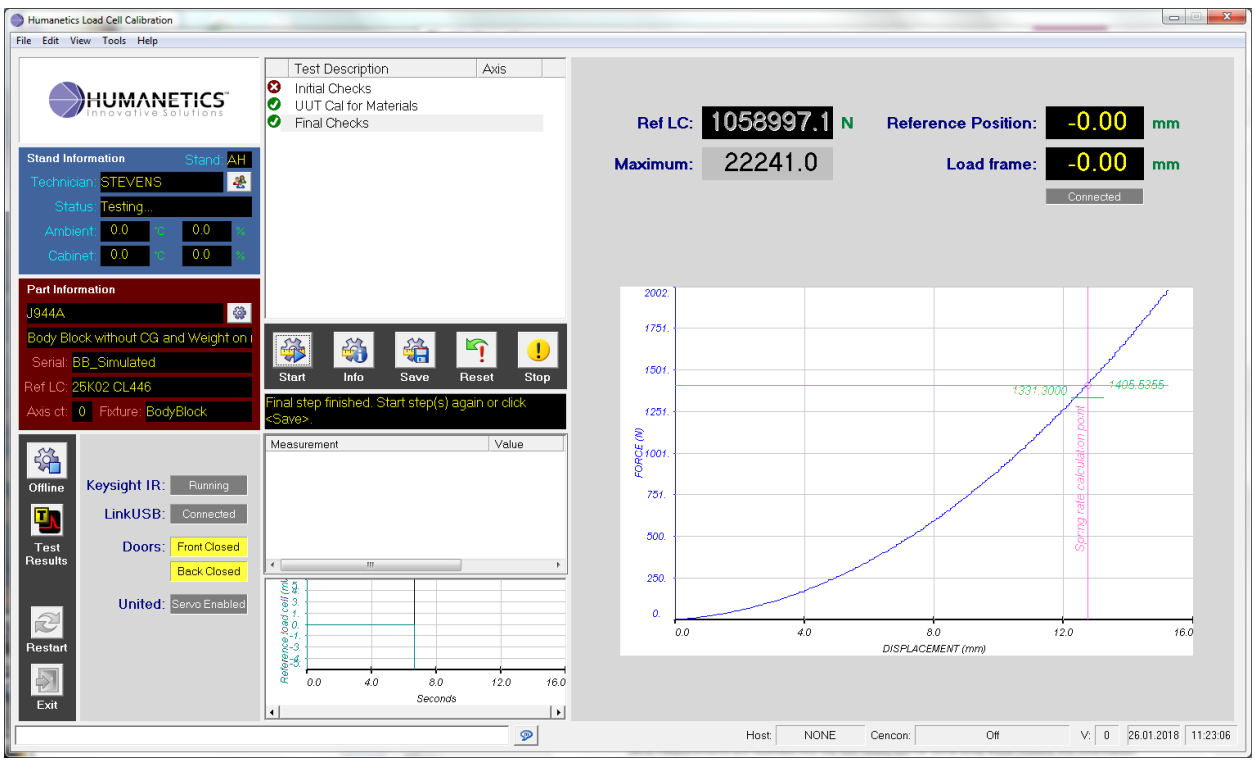
Appendix Figure 12.17 Body Block

12.7.1 BB Initial Checks

User entry required. Physical measurements for durometer left, center, and right must be made by the technician and entered at the prompts.



Appendix Figure 12.18 User Input Required Message, Durometer



Appendix Figure 12.19 Body Block Calibration Data Window

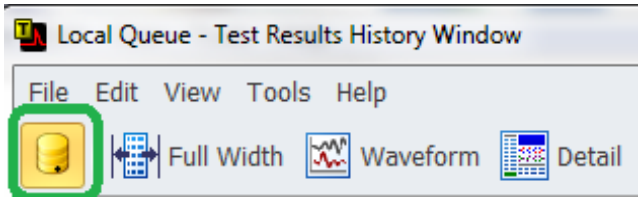
12.7.2 BB UUT Calibration Step

The Reference Load Cell force and Reference Position are collected and plotted as an X-Y graph as the body block is slowly depressed and released by the United Load Frame crossbar. A CFC-60 filter is applied to the force measurement. The CFC-60 filter is only valid when the collection rate is 1000 Hz.

12.7.3 BB Finalize the Test Result

There are two main models of Body Block. The testing process is the same for all Body Blocks. All the same measurements are recorded into the test result, but for some Body Block models, this information is not reported in the final report.

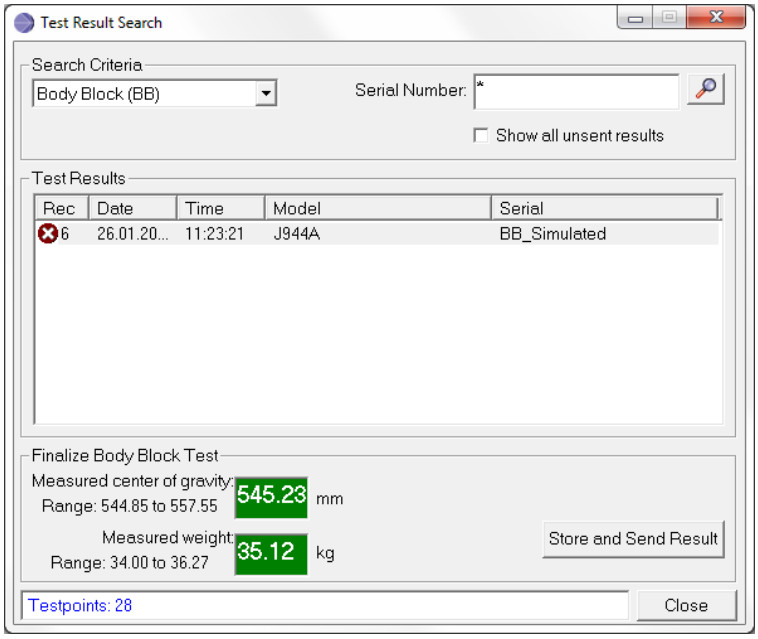
After running and saving a test, the technician must make physical measurements of the Body Block. These measurements may be completed days after the original test was run. For this reason, the data is stored locally on the hard drive and not sent to the database until the technician finalizes the report. To view the local results, click the  button in the Test Results History window. The Test Result Window must be opened from the Test Stand that was used to test the Body Block.



Appendix Figure 12.20 Test Results History Window

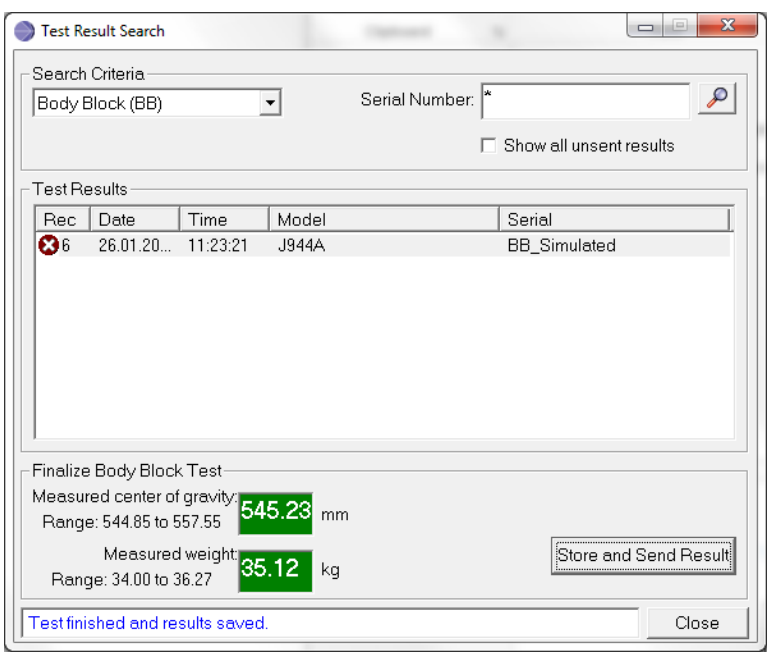
To finalize the test result, select Tools > Finalize Body Block Test from the PCS main screen (not the Test Result History window). Only test results which are not already finalized for Body Block are shown in the window.

Select the test result then enter the weight and center of gravity.



Appendix Figure 12.21 Test Result, Enter Weight and Center of Gravity

Click *Store and Send Result*.



Appendix Figure 12.22 Test Result, Store and Send Result

A test result is created by copying all of the testpoints from the original test result. If the model requires center of gravity and weight measurements in the report, test properties are updated with the values entered from the technician. In all cases, two new testpoints are added to this test record and this test record will be sent to the database.

Step	TP #	Testpoint Name	TP Description	Low	Reading	High	Units
1000	30050	fc_cg	Center of gravity (final)	544.85	545.23	557.55	mm
1000	30051	fc_weight	Weight measured in kg (final)	34.00	35.12	36.27	kg

Appendix Figure 12.23 Example Test Record

12.8 ACE Calibration Box

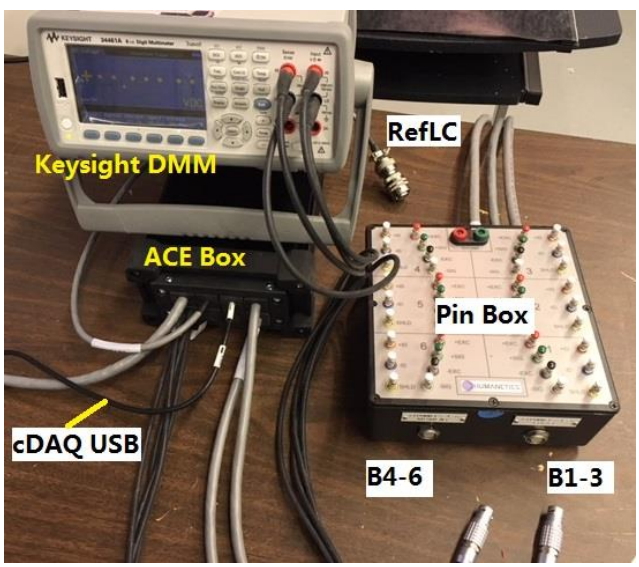
12.8.1 Introduction

The ACE (**A**utomated **C**alibration **E**quipment) Calibration box contains a custom-designed circuit board and a one slot National Instruments cDAQ rack with one module. When the ACE box is connected to the pin box of the Atlas, six individual 350 ohm bridges are used to simulate a six-axis UUT and one 350 ohm bridge is used to simulate the reference load cell. The ACE box is used:

- During checkout of the Atlas system
  - To troubleshoot bridge connections through the pin box
  - To troubleshoot TEDS chip connection through the pin box
- During runoff of the Atlas system
  - To perform repeatability measurement tests
  - To perform signal drift measurement over extended time periods
- To calibrate the bridge mV/V readings
- To verify the bridge mV/V readings
- To calibrate the excitation voltage feedback
- To verify the excitation voltage feedback
- To check the functionality of the analog load cell electrical measurements
  - Self Test
  - Noise Test
- During certification of the Atlas system
  - To perform repeatability measurement tests

12.8.2 Hardware Components

Listed in the figure below are the hardware components for the ACE Calibration System components.



Appendix Figure 12.24 Hardware Components for ACE Calibration System

The following components are housed within the ACE box:

- (1) National Instruments cDAQ-9171 one-slot rack
- (1) National Instruments cDAQ-9476 32 channel sourcing digital output module
- (1) Precision bridge with shunt resistors capable of providing 0.25, 0.5, 1.0, 1.5, 2.0, 3.0, 5.0, 12.0 mV/V both positive and negative on a 350 ohm bridge. This is referred to as the *Decade box* bridge to help distinguish it from the individual lower precision bridges listed below. All resistors for the decade box are 0.01 % precision. The decade box system of resistors is used for the calibration and verification of the analog bridges. It is also used during one of the drift tests.
- (7) individual full bridges of 350 ohms. These resistors are 0.1 % precision. The individual bridges are used during the runoff repeatability tests, the functionality check, and the noise check. They are also used during one of the drift tests.
- (7) shunt resistors of 100K ohms. 0.1 % precision. A shunt resistor for each bridge is used during the runoff repeatability tests, the functionality check, and the noise check. They are also used during one of the drift tests.
- (22) 1 GOhm resistors. 1.0 % precision. Two (2) 1 GOhm resistors are installed in series for each of the eleven circuits (B1, B2, B3, B4, B5, B6, B8, TED123, TED456, SHLD123, SHLD456). **The presence of these 1 GOhm resistors is one aspect that makes the ACE box an imperfect simulation of a UUT. In a real UUT, the insulation resistance to ground is much higher. There is no physical "insulation" resistor in a real UUT.** These resistors along with the 7 individual bridges are used during the functionality check and one of the repeatability tests.
- (1) Honeywell 135-103LAG-J01 thermistor to measure internal ACE box temperature. This measurement is for reference only. Internal ACE box temperature is recorded at the start and end of each set of tests. It is also used to attain stable ACE box temperature before running calibration, verification, and repeatability tests.
- (8) TEDS chips. (1) chip to identify the ACE box. (1) chip for each of the 7 "individual" bridges
- Numerous relays to control of the decade box system, to switch the measurement of the Keysight DMM between excitation and signal, to switch the bridge output from either the decade box bridge or the individual bridges.
- (2) LEDS on the outside of the box.
    - Green LED = Power indicator. Amphenol connection to Atlas is completed.
    - Blue LED = Testing indicator. Illuminated during an ACE automated test cycle.

12.8.2.1 Thermal Design of the ACE Box

The ACE box is an enclosed system of electrical components that create heat when energized. The resistance of components changes with temperature change. This affects the readings and may be referred to as drift. The Signal Drift test is used to measure the drift.

The ACE box components, the placement of the components on the circuit board, and the processes used to manufacture the circuit board are all designed to minimize drift due to heat. For some tests it is important to allow the ACE box to reach *thermal stability* before making critical measurements.

12.8.2.2 Keysight DMM

An external DMM is used to measure voltage and resistance of the signals/components inside the ACE box. The Atlas system uses a USB connection to communicate with the Keysight DMM. There is second DMM inside the Atlas cabinet which is used during the repeatability tests and the self test. The PXI-4071 DMM is located inside the Atlas.

12.8.2.3 Pin Box

The pin box is specially designed for this application. It is located on the work table between the United Load Frame cabinet and the DAQ cabinet. The pin box is used to connect the LEMO connectors and the Reference Load Cell Amphenol connector from the ACE box to the Atlas cabinet.

12.8.2.4 Grace Ports

On the side of the DAQ cabinet are Grace accessory ports. There are several different Atlas cabinet designs. Some cabinets are not capable of providing power for the USB ports. Therefore, USB memory sticks and the ACE cDAQ USB connection may require an externally powered USB hub depending on the Atlas cabinet design.

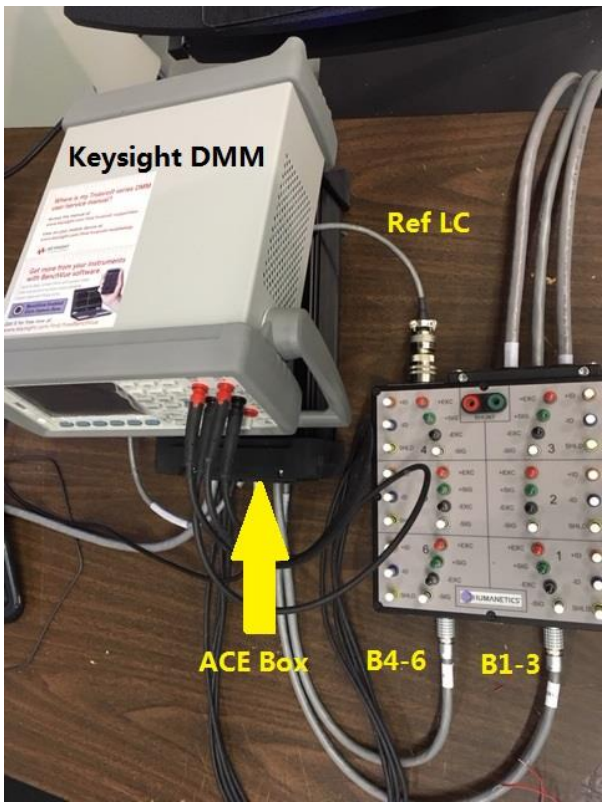
Appendix Figure 12.25 Grace Port (USB Ports not Capable of Supplying Power)

Appendix Figure 12.26 ACE Box connected to Atlas (Sufficient Power is Supplied by USB Ports)

12.8.3 Verification and Calibration Connections

The ACE box has the following cables:

- One large Amphenol connector. This cable is used to provide:
  - power to the ACE box,
  - a loop-back signal to indicate when the ACE box is connected to the Atlas cabinet,
  - a power check signal to indicate when the ACE box is powered,
  - a 1-wire communication path to the TEDS chip for the ACE box
- One USB cable to provide the communications to the NI cDAQ-9171 one-slot rack
- Four (4) DMM cables: (2) Red and (2) Black to connect the Keysight DMM to the ACE box



Appendix Figure 12.27 Top View of ACE Connected to Pin Box and DMM

A special window was developed to interface with the ACE box as well as provide a similar interface to perform repeatability, drift, and noise tests for DTI signals.

The Verification and Calibration Window can be used in automatic mode or manual mode. In automatic mode, data is stored in a PCS test result. Data consists of testpoints, test properties, waveforms, and an attached .csv file. No data is stored in manual mode.

There are two types of testing that can be initiated from the window. Analog signal tests require the use of the ACE box. DTI tests requires a DTI recorder and a 6 axis DTI load cell and a Reference Load Cell connected to the DTI recorder. The test type is listed in parentheses. If not listed, the test is analog only.

The following table briefly describes the tests that can be run in automatic mode. More complete descriptions are listed in the Test Step Detailed Descriptions section.

Appendix Table 12-4 ACE Test Steps, Signal Type, Required Hardware, and Description

	Signal Type		Required Hardware			
Test Steps	**Analog**	**DTI**	**ACE**	**Kistler**	**DMM**	**Brief Description**
Self_Test Sequence						
Decade Resistance Test	Yes	No	Yes	No	Yes	Measure decade box resistances using DMM
ACE Self Diagnostic	Yes	No	Yes	No	Optional	Measure components within the ACE box
Noise Testing (Analog)	Yes	No	Yes	No	No	Measure bridges and evaluate electrical noise
Noise Testing (DTI)	No	Yes	No	Yes	No	Measure DTI and evaluate electrical noise
Exercise TEDS (Analog)	Yes	No	Yes	No	No	Perform 1 to 10 read cycles of analog TEDS
Exercise TEDS (DTI)	No	Yes	No	Yes	No	Perform 1 to 10 read and export cycles of DTI TEDS
Drift Sequence						
Signal Drift (Analog)	Yes	No	Yes	No	Optional	Record bridge mV/V steady-state signal from 1 to 360 minutes
Signal Drift (DTI)	No	Yes	No	Yes	No	Record the LSB steady-state value from 1 to 360 minutes
Calibration Sequence						
Bridge Calibration	Yes	No	Yes	No	Yes	Calibrate all 7 PXI-4339 bridge inputs based on Keysight DMM signal / excitation measurements
Calibrate Excitation Feedback	Yes	No	Yes	No	No	Calibrate PXI-6363 excitation feedback based on PXI-4071 DMM voltage measurements
Verification Sequence						
Bridge Verification	Yes	No	Yes	No	Yes	Compare all 7 PXI-4339 bridge inputs versus Keysight DMM signal / excitation measurements
Verify Excitation Feedback	Yes	No	Yes	No	No	Compare PXI-6363 excitation feedback versus PXI-4071 DMM voltage measurements

	Signal Type		Required Hardware			
Test Steps	**Analog**	**DTI**	**ACE**	**Kistler**	**DMM**	**Brief Description**
Repeatability Sequence						
NI DMM Repeatability	Yes	No	Yes	No	Yes	Use PXI-4071 to measure and record resistances of the 7 bridges up to 10 times. Calculate average and standard deviation.
IR Repeatability	Yes	No	Yes	No	Yes	Use Keysight IR meter to measure and record 20 insulation resistances up to 10 times. Calculate average and standard deviation.
Bridge Repeatability	Yes	No	Yes	No	Yes	Use PXI-4339 to measure and record mV/V of the 7 bridges up to 10 times. Use the ACE 100 kOhm shunt resistors to measure zero and non-zero values. Calculate average and standard deviation.
Shunt Repeatability (Analog)	Yes	No	Yes	No	Yes	Use PXI-4339 to measure and record mV/V of the 7 bridges up to 10 times. Use the Atlas 100 kOhm shunt resistor and PXI-2525 relays to apply positive and negative shunt. Calculate average and standard deviation.
Shunt Repeatability (DTI)	No	Yes	No	Yes	No	Use DTI recorder to apply positive and negative stimulation to the selected axes up to 10 times. Calculate average and standard deviation.
United Position	N/A	N/A	No	No	No	Allow the United to move up and down automatically. Measurements are made by the Mitutoyo (PXI-6363) and United encoder (USB).

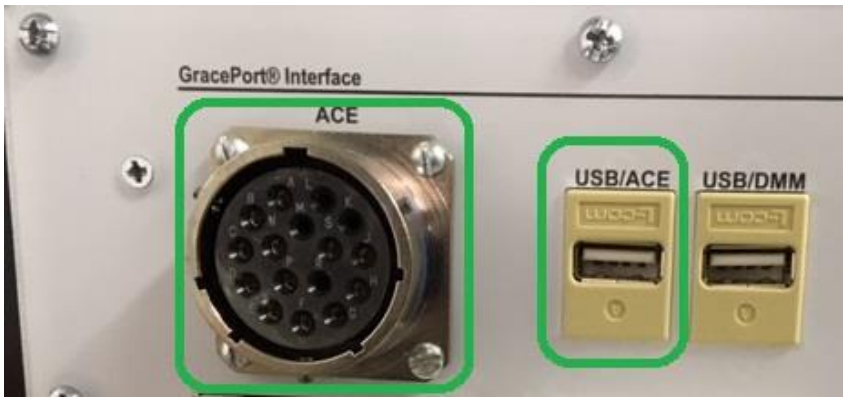
Depending on the desired tests to run (see Appendix Table 12-4 ACE Test Steps, Signal Type, Required Hardware), make the necessary connections from the ACE box.

12.8.3.1 If ACE is Required Hardware

1. Connect ACE Amphenol to Atlas

2. Connect ACE cDAQ USB cable to Atlas. See the Grace Port description above for an important note about connecting the cDAQ USB and the power requirement.

3. Connect ACE cDAQ using National Instruments software



Appendix Figure 12.28 ACE Ports on Atlas Cabinet Side Panel (Sufficient Power Supplied by USB)

12.8.3.2 If DMM is Required Hardware

1. Connect (4) DMM leads from ACE to DMM. Red to red ports, black to black ports. There are 2 of each, as long as the color matches, the connection is OK.

2. Connect USB cable from DMM to Atlas into *USB/DMM* port.

3. Confirm software connection using Keysight Connection Expert software.

12.8.3.3 If Using Analog Mode

1. Connect the two (2) LEMO connectors on the front of the pin box. One LEMO connector is for bridges 1, 2, and 3. The other LEMO connector is for bridges 4, 5, and 6.

2. Connect the reference load cell to the pin box using the round Amphenol connector.

12.8.3.4 If Using DTI Mode

1. Connect a 6-axis UUT and Reference Load Cell to DTI Recorder.

12.8.4 Using the Verification and Calibration Window

	NOTICE The Verification and Calibration window is restricted to Advanced Users.

12.8.4.1 Go Online

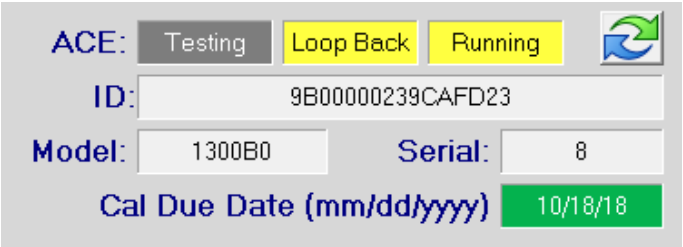
Click the *online* button  to prepare the software.

Select from the main screen, Tools > Station Certification > ACE Test Window. The window is not allowed to open if a test is currently in process.

When the window opens, it attempts to communicate with the ACE box, the cDAQ inside the ACE, and the DMM.

a. If no ACE is required, click OK to the prompt: "ACE box USB communications is not running. Check USB cable and NI software configuration."
b. If no ACE is required, click "OK" to the prompt: "TEDS data could not be read for ACE device. Check wiring."
c. If no DMM is required, click "OK" to the prompt: "Keysight DMM USB communications is not running. Check USB cable and DMM power."
d. If there is an error and the device is needed for the tests, then follow the prompts.
e. If there is a fault, click the "Reset" button.

Status of the ACE connections are shown on the top right of the window:



Appendix Figure 12.29 ACE Connections Status Window

Appendix Table 12-5 ACE Connections Status and Description

Status	Description
Testing	Highlighted yellow when a test is in progress
Loop Back	Highlighted yellow when the Amphenol is connected.
Running	Highlighted yellow when the cDAQ is communicating with PCS.
	Read the ACE TEDS chip and attempt to reconnect with the cDAQ.
ID	Unique identifier of the TEDS chip
Model	Read from the ACE TEDS chip
Serial	Read from the ACE TEDS chip
Cal Due Date	Read from the ACE TEDS chip

12.8.4.2 Select a Mode: Analog or DTI

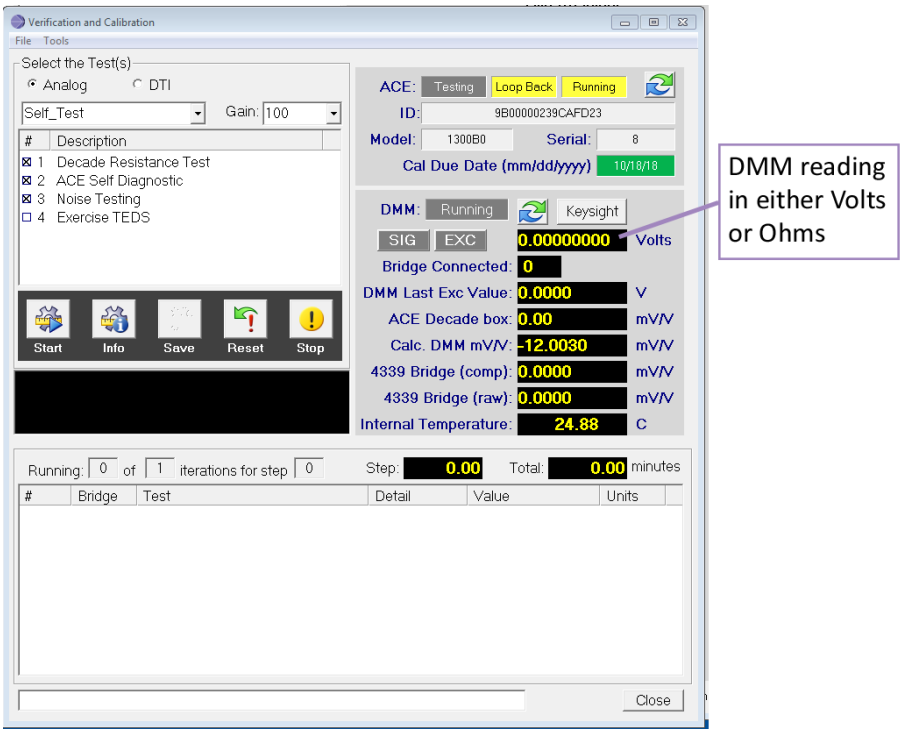
Analog mode uses the ACE box and may or may not use the DMM. DTI mode interfaces with the DTI Recorder and does not use the ACE box or the DMM.

NOTICE

When selecting DTI mode, the DTI channel window opens to define which channels to use as the 6 UUT channels during testing.

Appendix Table 12-6 Button and Description

Button	Description
Start	Start the automated test as specified by the selected steps
Info	For future use. Could open this manual.
Save	Save the test result from the automated test.
Reset	Clear any faults.
Stop	Request a stop of the currently running test.



Appendix Figure 12.30 Verification and Calibration Window

Appendix Table 12-7 Label and Description

Label	Description
SIG / EXC	Identifies whether the DMM is reading signal or excitation. The units label changes to "Ohms" when resistance is shown in the field. In Manual operation, these buttons toggle the relays to change how the DMM is connected.
Bridge Connected	1 = UUT bridges 1-6 connected to the Keysight DMM 8 = reference load cell bridge 8 connected to the DMM
DMM Last Exc Value	Measured voltage the last time the DMM was connected to the Excitation via relay.
ACE Decade box	Requested mV/V setting based on the proper shunt resistor applied to the precision 350 ohm bridge. Field has blue background when the output is negative polarity.
Calc. DMM mV/V	Calculated ratiometric value of the precision bridge using the last DMM excitation measurement and the latest DMM signal measurement
4339 Bridge (comp)	Based on the Bridge Connected, this represents the current compensated units reading from the PXI-4339.
4339 Bridge (raw)	Based on the Bridge Connected, this represents the raw mV/V reading from the PXI-4339.
Internal Temperature	ACE thermistor last measured value. The resistance is measured by the DMM and converted to degrees C. It is measured at the beginning and end of every test step in the automated test.

12.8.5 Automatic Operations

12.8.5.1 Running a Test

1. Select a Test Sequence
2. Select a Gain. See notes about gain.
3. Double-click the steps to mark with an "X" the steps to run in automatic mode. See test steps for descriptions.
4. Click the Start button. Depending on the Test Sequence, there may be a prompt or prompts:
    a. For repeatability, enter the number of cycles to run
    b. For drift, enter the length, and whether to use individual bridges or single decade bridge
        - *Individual* = energize the seven 350 ohm bridges and connect to all seven PXI-4339 bridge inputs. Generates the most heat.
        - *Decade* = energize the single decade bridge and connect to all seven PXI-4339 bridge input
    c. For calibration, whether to store the calibration values or not.
        - *Prompt* = Prompt user to store or not store analog calibration values for each bridge. User can review results before deciding.
        - *No* = Do not store any analog calibration values

Delay for Thermal Stability

Some test steps have a "Delay for Thermal Stability". Due to the enclosed ACE box and heat generated by voltage input to resistive elements, it is necessary to either heat the box to a stable temperature or delay to allow the box to cool. The ACE box components, the placement of the components on the circuit board, and the processes used to manufacture the circuit board are designed to minimize drift due to heat. However, it is still important to allow the ACE box to reach thermal stability before making critical measurements.

There is a thermistor inside the ACE box and an ambient temperature measured by the Atlas. As long as the DMM is connected to Atlas, the test steps that need to delay will delay for thermal stability before measurements are taken. If heating is required, then the appropriate bridges are energized. If cooling is required, no bridges are energized. The delay is based on a delta temperature between the ambient and the internal ACE box temperature and has a maximum time.

Each time either a warm-up or cool-down cycle is performed, the bridge values are measured at the start and the end. These start and end values are subtracted and shown in the scroll list.

5. During the test, use the *Tools > Open Step Graph* to see the waveform for the currently executing step up to this point in the test.
6. Allow all tests to complete, or click *Abort* to request a stop. The abort does not immediately stop the test. The current substep completes, then a final sequence completes.

7. Optionally click the *Save* button to store the results as a test result. The test result contains one or more of the following:
   - Testpoints
   - Waveforms
   - Properties
     a. ACE TEDS unique chip device ID
     b. ACE Calibration Date
     c. ACE Serial ID
     d. ACE Model
     e. Ambient and cabinet temperature and humidity conditions
     f. Technician ID
     g. UUT Excitation and gain settings
   - Attached comma separated file contains all the details from the scroll list that was written during the tests
8. The serial ID and model identify the test sequence. For example, if you run the Repeatability Tests, the serial ID is “SN Repeatability” and the model is “ACE_Repeatability”.
9. The Pallet ID is populated with the ACE serial ID. The Pallet ID is a column of the test result history window and makes for easy sorting and filtering.
10. If you attempt to run a new test or close the window, you are asked to save the last test or not.

12.8.6 Test Step Detailed Descriptions

12.8.6.1 Decade Resistance Test

Use the relays inside the ACE box to select the 0,0, 0.25, 0.5, 1.0, 1.5, 2.0, 3.0, 5.0, 12.0 mV/V settings on the DMM. No excitation voltage is applied to the bridge. Measurements are made only by the Keysight DMM in 4-wire resistance mode. The ACE internal thermistor is also measured.

Appendix Table 12-8 Decade Resistance Testpoints and Description

Testpoints	Description	Measurement by
33060 - 33068	All decade box selections output resistances	Keysight 34461A DMM
33079	Internal ACE thermistor converted to temperature in degrees C	Keysight 34461A DMM

12.8.6.2 Self-Test

The purpose of the Self-Test is to verify the ACE box is fully connected and working properly. It can also be used to diagnose problems with the pin box. All eight bridges inside the ACE box are measured. When the ACE is connected to the pin box, a dedicated 350 ohm bridge is connected to each bridge input of the pin box. Measurements are made to mimic the electrical tests of the Atlas Load Cell analog test. Verify the TEDS chip for each bridge can be read and written.

The results shown on the screen are red when there is a failure. The specific test that fails is shown. When a group of tests accepts, one line is written to show the group accepted.

Appendix Table 12-9 Self-Test Testpoints and Description

Testpoints	Description	Measurement by
33001 - 33002	True / False indication of connections. If any of 33013 – 33019 fail, identify as a potential connector issue.	PXI-6363 digital bit input
33003 - 33005	True / False indication of connections. If any of 33013 – 33019 fail, identify as a potential connector issue.	PXI-4339 ratiometric readings
33006 - 33012	Energize all 7 individual bridges with 10 volts. Null offset of the individual bridges	PXI-4339 ratiometric readings
33013 - 33019	Energize all 7 individual bridges with 10 volts. Bridge voltage with ACE 100 kOhm shunt resistor applied	PXI-4339 ratiometric readings
33021	Excitation compare between PXI-6363 and DMM.	Keysight 34461A DMM and PXI-6363
33022	Excitation measured by DMM	Keysight 34461A DMM
33030 - 33036	Energize the decade box bridge and connect via ACE relays the decade box bridge to all 7 PXI-4339 bridge inputs. Measure the null offset value.	PXI-4339 ratiometric readings
33038 - 33053	Switch the Keysight DMM between signal and excitation. Calculate mV/V and record for all decade box voltages (positive and negative).	Keysight 34461A DMM
33080 - 33093	TEDS function for 7 TEDS chips connected through the pin box. Write IEEE1451 format model, serial, and today's date to each chip. Read back the data to confirm it was written. Record the device ID as a property in the test result.	LinkUSB in Atlas cabinet
33100 - 33109	Turn off all excitation and connect the individual bridges to the pin box. Measure IR resistances (bridge/shld/teds to ground. One circuit connected to 50V with all other circuits grounded.)	Keysight B2985A IR meter inside the Atlas

Testpoints	Description	Measurement by
33120 – 33132	Turn off all excitation and connect the individual bridges to the pin box. Measure signal +/- and excitation +/- resistance.	PXI-4071 DMM in 4-wire resistance mode
33140 – 33153	Enable excitation to all individual bridges and connect to pin box. Use the 100 kOhm shunt inside the Atlas cabinet. Measure positive and negative shunt readings.	PXI-4339 ratiometric readings

12.8.6.3 Noise Test

The purpose of the noise test is to identify excessive electrical noise on the bridge inputs. It can help detect a loose connection in the pin box (analog only). It can help identify if the DTI recorder is switched for the wrong input voltage source frequency.

The compressor for the air conditioner (A/C) inside the Atlas cabinet is specifically NOT disabled for this noise test. This way, the noise can be measured if the A/C is running or not. It is important to know that for the critical UUT Calibration test performed during an Atlas Calibration Test, the A/C is switched off.

For analog, energize all 7 individual bridges. For DTI energize the reference load cell (bridge 8). Collect and record all axes at 20 kHz for 5 seconds. Analyze the data in both the time and frequency domains. For frequency domain, zero Hz (DC-level) is ignored. Analog channels are collected via PXI-4339. DTI channels are collected via Kistler DTI recorder using crash mode.

Appendix Table 12-10 Noise Test Testpoints and Description

Testpoints	Description
33201 - 33207	Peak-to-peak signal level in time domain.
33212 – 33218	Standard deviation of signal level in time domain.
33223 – 33229	Maximum noise level amplitude in the frequency domain.
33234 – 33240	Frequency of the maximum amplitude

12.8.6.4 Exercise TEDS

By default, this step is typically disabled because the purpose is to exercise the systems that read TEDS from each axis. The Self Test performs this function one time for analog. This is a read-only exercise. There is potential concern over the number of write cycles for a chip. There are no testpoints recorded for this test. For analog, read each of the 7 bridge TEDS chips one at a time for 1 to 10 cycles.

For DTI, read each DiMod, then export the 6 UUT DiMods in VW format, then export all 7 DiMods in non-VW format. The folder location is ".\data\temp\". The file names are "DTI_Export_x.xml" and "DTI_Export_VW_x.xml" where "x" is the axis. The files are overwritten on purpose to keep the folder from growing. Repeat the sequence for up to nine more times.

12.8.6.5 Signal Drift

The purpose of the Signal Drift test is to measure the change in signals over a long duration of time. The Signal Drift test can also be used to measure the required warm-up time of the Atlas system.

The ACE box is an enclosed system of electrical components that create heat when energized. Resistors change their resistance with temperature change. This affects the readings and may be referred to as drift. *The ACE box components, the placement of the components on the circuit board, and the processes used to manufacture the circuit board are all designed to minimize drift due to heat.*

Signals collected during the drift test are heavily filtered to help reduce the impact of electrical noise on the measurement. The duration is specified by the user from 1 to 360 minutes. For all tests, the ambient and cabinet temperature and humidity are recorded for the duration of the test.

The Signal Drift can be run in 3 ways.

1. DTI mode. Use PCS Online collect mode to record DTI channel readings.
2. Analog mode with 7 individual bridges. Energize the 7 individual bridges with 10 V excitation and enable the ACE 100 kOhm shunt resistors to produce approximately 0.8 mV/V reading on all PXI-4339 bridge inputs. Connect the Atlas system check 100 ohm resistor to the PXI-4071 to record resistance. The 100 ohm reading will fluctuate with the cabinet temperature. Use the Keysight DMM to record the ACE box internal thermistor. Record the excitation voltage feedback.
3. Analog mode with 1 decade box bridge. Energize the decade box bridge with 10 V excitation and enable the shunt relays to produce 0.25 mV/V reading on all PXI-4339 bridge inputs. Use the Keysight DMM to record the ACE box internal thermistor. Record the excitation voltage feedback.

Appendix Table 12-11 Signal Drift Testpoints and Description

Testpoints	Description
33900 – 33906	Null offset of the 7 bridges
33910 – 33923	Minimum value of the recorded data over the duration
33930 - 33943	Maximum value of the recorded data over the duration
33934 – 33957	Range = maximum – minimum value

12.8.6.6 Bridge Calibration

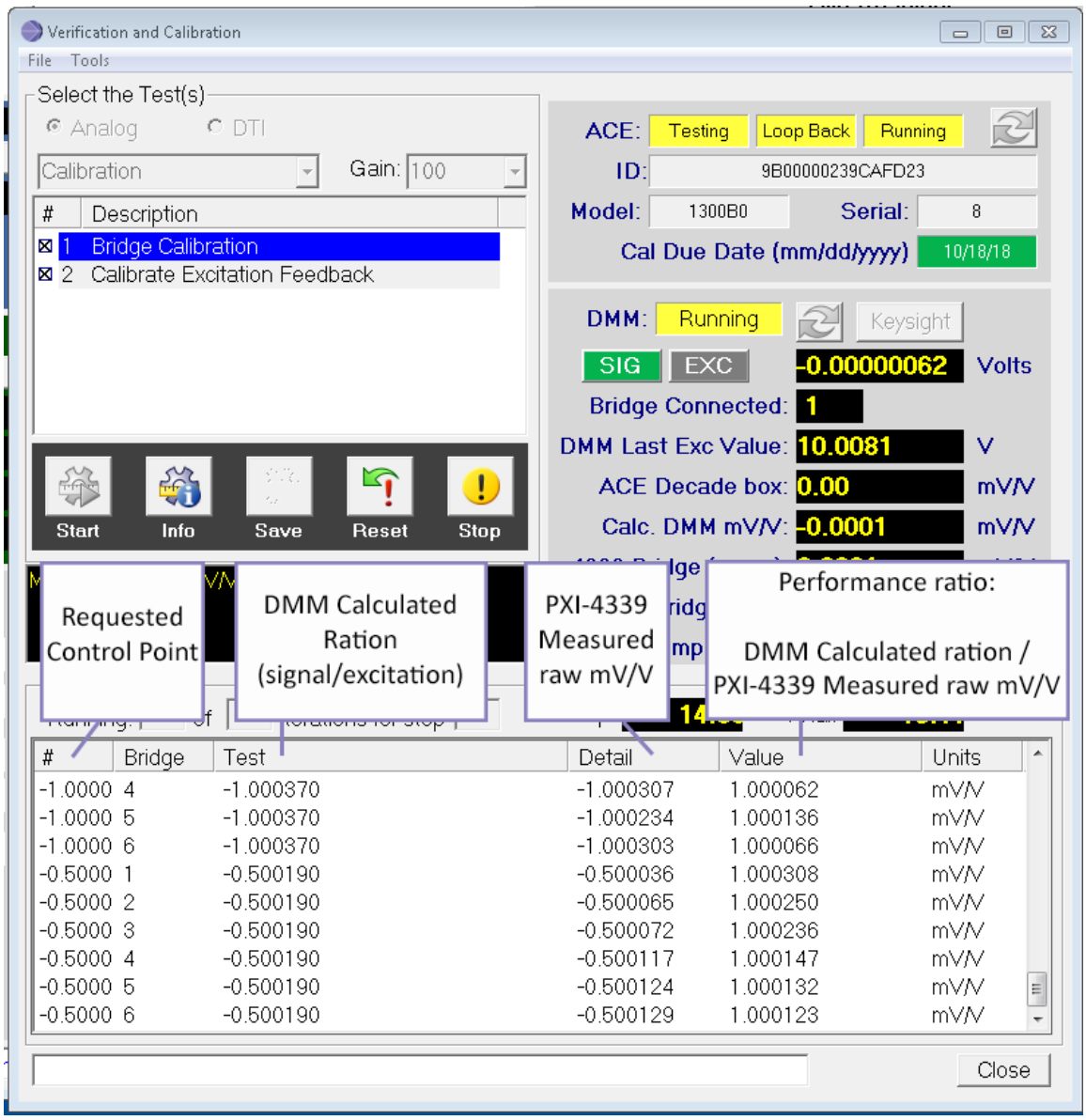
The purpose of Bridge Calibration is to measure multiple mV/V readings using the Keysight DMM and use it to update the calibration table and to convert the PXI-4339 mV/V raw values to mV/V compensated units.

The decade box bridge system is energized and signals are routed to the PXI-4339. The calibration is performed in two groups, a) six UUT bridges which use the PXI-4110 for power supply and b) one reference load cell which uses the PXI-4339 for power.

Calibration tables may only be applied and saved if the gain is 100. See notes about gain.

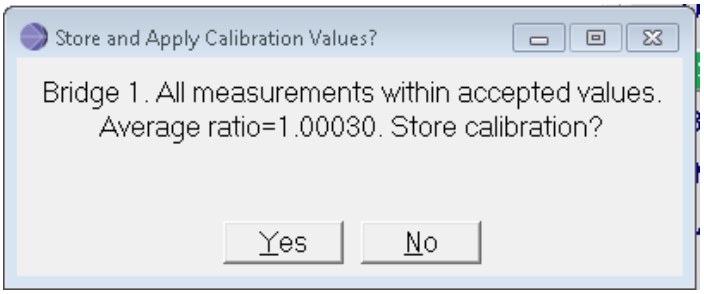
1. The previous calibration date and time for each bridge is recorded as test properties.
2. The warm-up thermal delay is a maximum of 15 minutes. If the ACE box temperature – ambient temperature > 4 degrees, the thermal delay is stopped before 15 minutes.
3. Disable the A/C compressor.
4. Depending on whether this is group (a) or group (b), apply excitation to the appropriate bridges. Autozero the bridges and record the null offset values.
5. Perform the following for each shunt resistor. Start with negative, then record zero, then positive.
    a. Remove the shunt resistor from the precision bridge and delay for stability. Output is 0.0 mV/V.
    b. Autozero the bridges.
    c. Apply the shunt resistor and delay for stability.
    d. Use the ACE relays to connect the Keysight DMM to excitation. Store this value for later calculation.
    e. Use the ACE relays to connect the Keysight DMM to signal. Calculate the ratio from the excitation measured above and this reading, then record. This is the known ratiometric reading.
    f. Calculate a performance ratio to use to determine how close the PXI-4339 is to the DMM. The ratio is DMM reading / raw PXI-4339 reading. This ratio is not calculated for the zero point.

6. Average all the performance ratios for each bridge. Unless the user selected *No* at the initial prompt to save any calibration data, the user is prompted for each bridge to apply and save the calibration or not. The ratios must be within +/- 0.0015 of 1.0 to be "accepted".



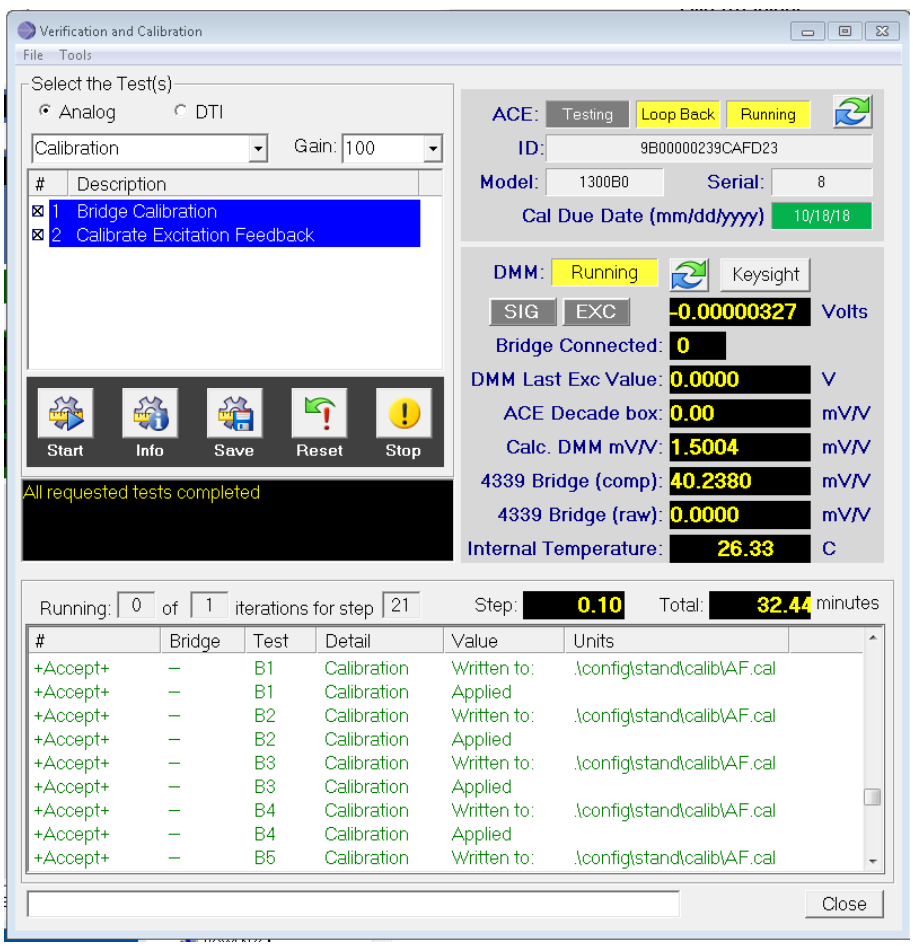
Appendix Figure 12.31 Calibration Screen During Calibration

7. Perform the steps 4 – 6 for bridge 8.



Appendix Figure 12.32 Store and Apply Calibration Values Window

8. The scroll list is updated with information based on the status of the calibration file
9. Allow the A/C compressor. The test is complete.



Appendix Figure 12.33 Calibration Applied for Each Bridge

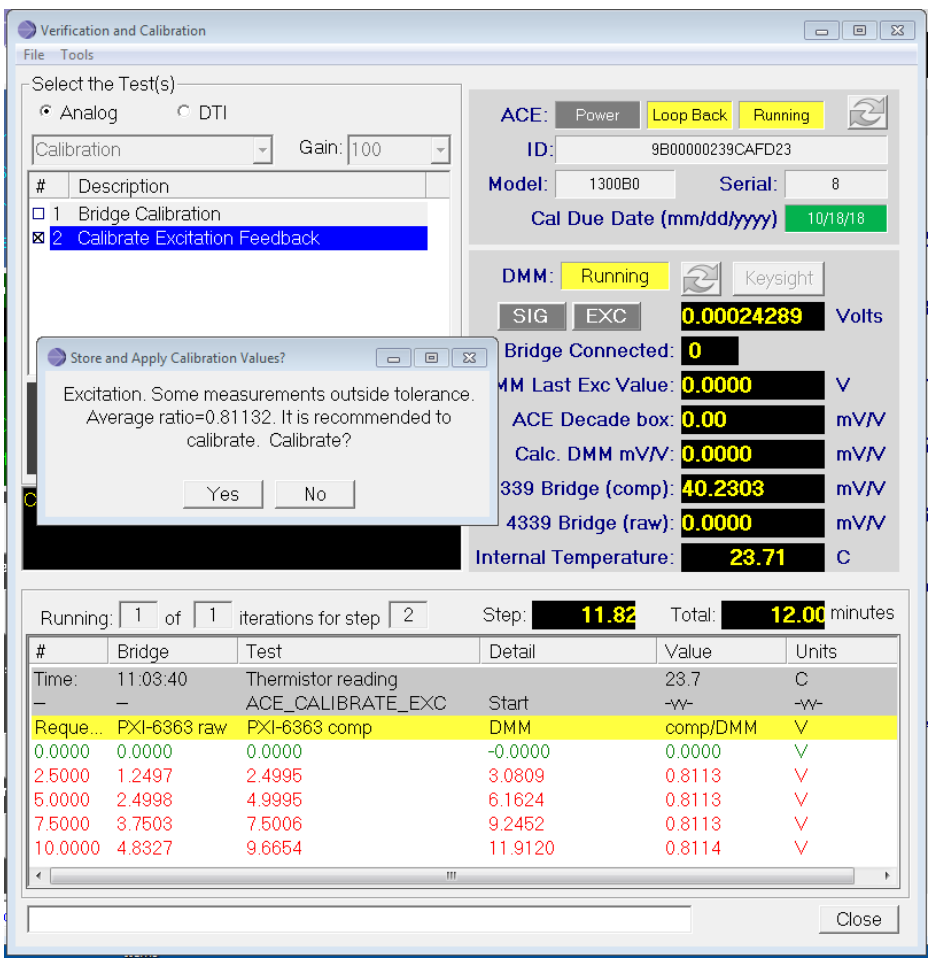
Appendix Table 12-12 Testpoint Name ace_cal_br and Description

Testpoint Name	Description
ace_cal_br*_offset	Null offset of each bridge
ace_cal_br*_raw_mvv_*	Raw mV/V reading from PXI-4339 at each control point
ace_cal_br*_comp_mvv_*	Current compensated reading from PXI-4339 at each control point. This value represents the as-found condition before applying the new calibration.
ace_cal_br*_ratio_*	Performance ratio = DMM calculated / raw mV/V

12.8.6.7 Calibrate Excitation Feedback

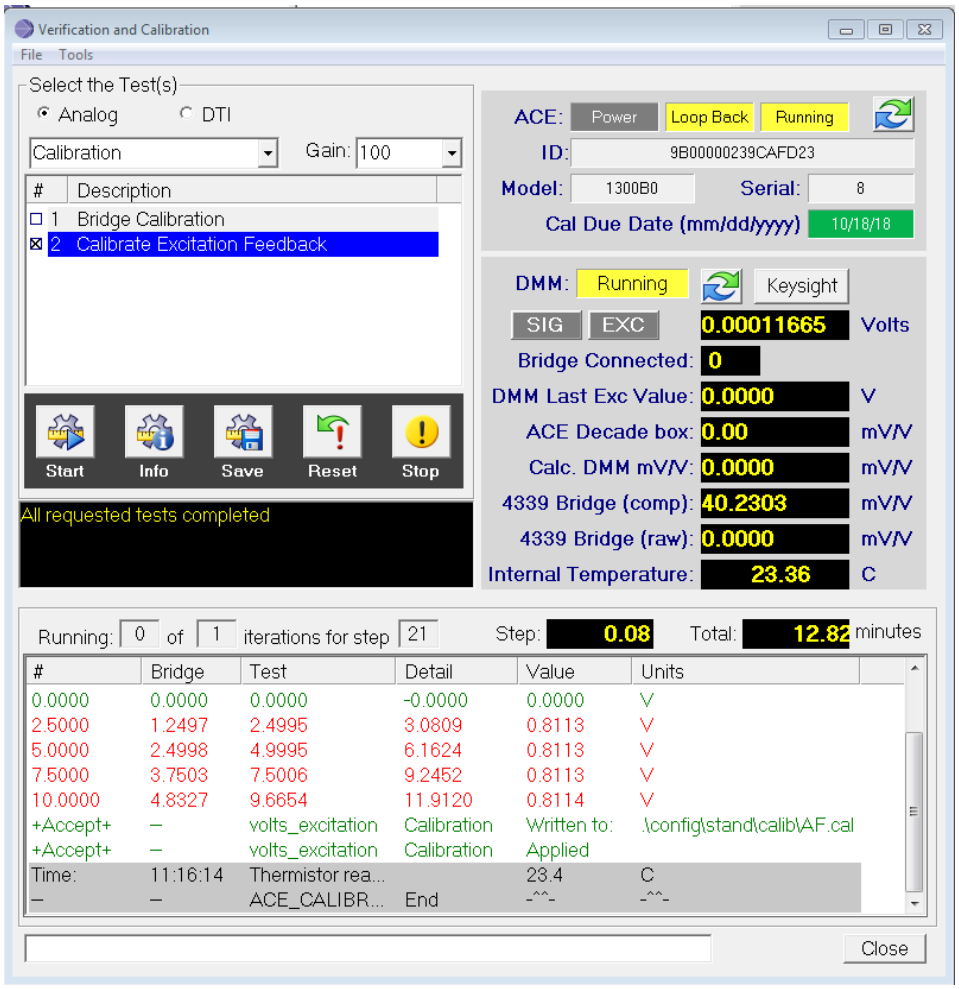
The purpose of Calibrate Excitation Feedback is to measure the excitation voltage at multiple levels using the PXI-4071 DMM and use it to update the Calibration table and convert the PXI-6363 raw voltage values to compensated units.

1. The previous calibration date and time for each excitation feedback is recorded as test properties.
2. Disable the A/C compressor.
3. Apply excitation from PXI-4110 to one UUT bridge.
4. Perform the following for each of these excitation control points (0.0, 2.5, 5.0, 7.5, 10.0 Volts):
    a. Apply the voltage and allow the reading to stabilize.
    b. Measure the raw voltage and current compensated readings from the PXI-6363.
    c. Use the PXI-4071 DMM to measure the voltage across the excitation for the UUT bridge.
    d. Calculate a performance ratio to use to determine how close the PXI-4339 is to the DMM. The ratio is DMM reading / raw PXI-4339 reading. This ratio is not calculated for the zero point.
5. Average all the performance ratios. Unless the user selected *No* at the initial prompt to save any calibration data, the user is prompted to apply and save the calibration or not. The ratios must be within +/- 0.0015 of 1.0 to be "accepted".



Appendix Figure 12.34 Example of Failing Ratio

6. The scroll list is updated with information based on the status of the calibration file.
7. Allow the A/C compressor. The test is complete.



Appendix Figure 12.35 Test Complete Window

12.8.6.8 Bridge Verification

The purpose of Bridge Verification is to measure the PXI-4339 compensated readings against the Keysight DMM. If the compensated readings are not acceptable, it is recommended to perform a Bridge Calibration. Bridge verification executes the same as Bridge Calibration with two exceptions.

- In verification, the user is not prompted to store calibrations. No calibrations are applied or saved to the calibration tables.
- In verification, the performance ratio is calculated differently. The performance ratio shown in the display and recorded as testpoints ace_cal_br*_ratio_* is DMM ratiometric / PXI-4339 *compensated* value.

12.8.6.9 Verify Excitation Feedback

The purpose of Verify Excitation Feedback is to measure the PXI-6363 compensated readings against the PXI-4071 DMM. If the compensated readings are not acceptable, it is recommended to perform a Calibrate Excitation Feedback. Verify Excitation Feedback executes the same as Calibrate Excitation Feedback with one exception.

- In verification, the user is not prompted to store calibrations. No calibrations are applied or saved to the calibration tables.

12.8.6.10 NI DMM Repeatability

The purpose of DMM repeatability is to evaluate the repeatability of a measurement which is typically performed during the UUT Load Cell Calibration Test sequence. Specifically, the measurement is the resistance (Exc+ to Exc- and Sig+ to Sig-) of each bridge using the PXI-4071 DMM.

1. All excitation voltage is switched off.
2. The resistance measurements are highly susceptible to temperature change. For this reason, there is a cool down delay at the start of the DMM measurements. The cool-down thermal delay is a maximum of 20 minutes. If the ACE box temperature – ambient temperature < 2.5 degrees, the thermal delay is stopped before 20 minutes.
3. Perform the following from 1 to 10 times.
    a. Measure and record the resistance (Exc+ to Exc- and Sig+ to Sig-) of each bridge using the PXI-4071 DMM. *Note: Bridge 8 does not the proper relays available to measure Sig+ to Sig-.*
4. Calculate and evaluate the average and standard deviation of each measurement. Calculate the average of standard deviations and the full scale percent deviation. Full scale output is 1000.

Appendix Table 12-13 Testpoint Name ace_dmmr and Description

Testpoint Name	Description
ace_dmmr_br*_pt1_avg	Average resistance for point #1 (Exc+ to Exc-)
ace_dmmr_br*_pt2_avg	Standard deviation of resistances for point #1 (Exc+ to Exc-)
ace_dmmr_br*_pt1_std	Average resistance for point #2 (Sig+ to Sig-)
ace_dmmr_br*_pt2_std	Standard deviation of resistances for point #2 (Sig+ to Sig-)
ace_dmmr_avg_std	Average of all ace_dmmr_br*_pt1_std and ace_dmmr_br*_pt2_std
ace_dmmr_pcnt_fs	100 * Ace_dmmr_avg_std / 1000
Ace_dmmr_step_time	Time in minutes it took to run this step

12.8.6.11 IR Repeatability

The purpose of IR repeatability is to evaluate the repeatability of a measurement which is performed during the UUT Load Cell Calibration Test sequence. Specifically, the measurement is the insulation resistance for each circuit using the Keysight B2985A.

i	NOTICE This is a long test. Each iteration is 30 minutes.

1. All excitation voltage is switched off.
2. The insulation resistance measurements are less susceptible to temperature change. For this reason, there is a small cool down delay at the start of the IR measurements. The cool-down thermal delay is a maximum of 5 minutes. If the ACE box temperature – ambient temperature < 2.5 degrees, the thermal delay is stopped before 5 minutes.
3. Perform the following from 1 to 10 times.
    a. For each circuit (B1, B2, B3, B4, B5, B6, SHLD123, SHLD456, TED123, TED456) measure the following:
        i. Apply 50 Volts to the circuit and test the combinations as highlighted below.
        ii. The total number of measurements for each circuit is 10.

			Test Case									
			Bridge #1	Bridge #2	Bridge #3	Bridge #4	Bridge #5	Bridge #6	TEDS 123	TEDS 456	Shield 123	Shield 456
Bridge\ Circuit	1	Bridge #1		X	X	X	X	X	X	X	X	X
	2	Bridge #2	X		X	X	X	X	X	X	X	X
	3	Bridge #3	X	X		X	X	X	X	X	X	X
	4	Bridge #4	X	X	X		X	X	X	X	X	X
	5	Bridge #5	X	X	X	X		X	X	X	X	X
	6	Bridge #6	X	X	X	X	X		X	X	X	X
	7	TEDS 123	X	X	X	X	X	X		X	X	X
	8	TEDS 456	X	X	X	X	X	X	X		X	X
	9	Shield 123	X	X	X	X	X	X	X	X		X
	10	Shield 456	X	X	X	X	X	X	X	X	X	
	11	CASE GND	X	X	X	X	X	X	X	X	X	X

Appendix Figure 12.36 Example of Bridge/Circuit Test Case Table

4. Calculate and evaluate the average and standard deviation of each measurement. Calculate the average, maximum, and minimum of standard deviations.

Appendix Table 12-14 Testpoint Name Ace_ir and Description

Testpoint name	Description
Ace_ir_*_GND_avg	Circuit to ground measurements averaged
Ace_ir_*_*_avg	Point to point measurements averaged
Ace_ir_*_GND_std	Standard deviation of circuit to ground measurements
Ace_ir_*_*_std	Standard deviation of point to point measurements
Ace_ir_max_std	Maximum of all the standard deviations
Ace_ir_min_std	Minimum of all the standard deviations
Ace_ir_avg_std	Average of all the standard deviations

12.8.6.12 Bridge Repeatability

The purpose of Bridge repeatability is to evaluate the repeatability of the PXI-4339 measurement. All bridges are enabled and measured together. This condition is representative of the UUT calibration test step. Specifically, the measurement is the ratiometric measurement while a 100 kOhm shunt (located inside the ACE box) is applied and removed from the circuit.

1. Excitation voltage to all bridges enabled to 10 Volts.
2. The ratiometric measurements are susceptible to temperature change. For this reason, there is a warm up delay at the start of the bridge measurements. The warm-up thermal delay is a maximum of 15 minutes. If the ACE box temperature – ambient temperature < 4.0 degrees, the thermal delay is stopped before 15 minutes.
3. Disable excitation voltage.
4. Perform the following from 1 to 10 times.
    - *a.* Remove any null offset for all bridges. All bridges are natural.
    - *b.* Enable excitation voltage to all bridges.
    - *c.* Autozero all bridges.
    - *d.* Only for the first iteration, record the null offset value as a testpoint.
    - *e.* Point 1: Measure the ratiometric value of each bridge using the PXI-4339. Should be 0.
    - *f.* Point 2: Apply the 100 kOhm shunt resistors from the ACE box and allow the readings to stabilize. Measure the ratiometric value of each bridge.
    - *g.* Point 3: Remove the 100 kOhm shunt resistors. Measure the ratiometric value of each bridge. Should be 0.
    - h. Disable the excitation voltage for all bridges.

5. Calculate and evaluate the average and standard deviation of each measurement. Calculate the average of standard deviations and the full scale percent deviation. Full scale output is 1.0.

Appendix Table 12-15 Testpoint Name Ace_br and Description

Testpoint Name	Description
Ace_br_br*_offset	Null offset measurement from first iteration only
Ace_br_br*_pt1_avg	Average reading for point #1 (no shunt)
Ace_br_br*_pt1_std	Standard deviation of readings for point #1 (no shunt)
Ace_br_br*_pt2_avg	Average reading for point #2 (shunted)
Ace_br_br*_pt2_std	Standard deviation of reading for point #2 (shunted)
Ace_br_avg_std	Average of all ace_br_br*_pt2_std
Ace_br_pcnt_fs	100 * Ace_br_avg_std / 1.0
Ace_br_step_time	Time in minutes it took to run this step

12.8.6.13 Shunt Repeatability

The purpose of Shunt repeatability is to evaluate the repeatability a measurement which is performed during the UUT Load Cell Calibration Test sequence. For analog, the measurement is the ratiometric measurement while a 100 kOhm shunt (located inside the Atlas cabinet) is applied and removed from each circuit. Because there is only one shunt resistor, the measurements are made for each bridge one at a time. For DTI, the DTI recorder is commanded to perform stimulation positive and stimulation negative. All UUT DiMods are stimulated at the same time. There is no signal wire to the reference load cell DiMod to control the stimulation circuit.

12.8.6.13.1 Analog Procedure

1. Excitation voltage to all bridges enabled to 10 Volts.
2. The ratiometric measurements are susceptible to temperature change. For this reason, there is a warm up delay at the start of the bridge measurements. The warm-up thermal delay is a maximum of 15 minutes. If the ACE box temperature – ambient temperature < 4.0 degrees, the thermal delay is stopped before 15 minutes.
3. Disable excitation voltage.
4. Record the shunt resistor used as a test property.
5. Perform the following from 1 to 10 times.
    - *a.* Remove any null offset for all bridges. All bridges are natural.
    - *b.* Enable excitation voltage to all bridges.
    - *c.* Autozero all bridges.
    - d. Only for the first iteration, record the null offset value as a testpoint

e. For each bridge perform the following:
    i. Point 0: Measure the ratiometric value of the bridge using the PXI-4339. Should be 0.
    ii. Point 1: Apply the 100 kOhm shunt resistors from the Atlas cabinet on the positive side of the bridge and allow the readings to stabilize. Measure the ratiometric value of the bridge.
    iii. Point 2: Apply the 100 kOhm shunt resistors from the Atlas cabinet on the negative side of the bridge and allow the readings to stabilize. Measure the ratiometric value of the bridge.
    iv. Point 3: Open the relays to remove the shunt. Measure the ratiometric value of the bridge.
f. Disable the excitation voltage for all bridges.

6. Calculate and evaluate the average and standard deviation of each measurement. Calculate the average of standard deviations and the full scale percent deviation. Full scale output is 1.0.

12.8.6.13.2 DTI Procedure

1. Perform the following from 1 to 10 times.
    a. Remove any null offset for all DiMods and bridge 8. All bridges are natural.
    b. Enable the Excitation for reference load cell bridge 8 only.
    c. Autozero all bridges.
    d. For each bridge perform the following:
        i. Request from the DTI recorder 1000 Hz 1.0 second with no stimulation.
        ii. Point 1: Request from the DTI recorder 1000 Hz 1.0 second with positive stimulation. Record this value for each DiMod.
        iii. Point 2: Request from the DTI recorder 1000 Hz 1.0 second with negative stimulation. Record this value for each DiMod.
        iv. Point 3: Request from the DTI recorder 1000 Hz 1.0 second with no stimulation.
2. Calculate and evaluate the average and standard deviation of each measurement. Calculate the average of standard deviations and the full scale percent deviation. Full scale output is 32768.
3. Calculate and evaluate the average and standard deviation of each measurement. Calculate the average of standard deviations and the full scale percent deviation. Full scale output is 1.0.

Appendix Table 12-16 Testpoint Name Ace_shr and Description

Testpoint Name	Description
Ace_shr_br*_pt1_avg	Average reading for point #1 (positive shunt)
Ace_shr_br*_pt1_std	Standard deviation of readings for point #1 (positive shunt)
Ace_shr_br*_pt2_avg	Average reading for point #2 (negative shunt)
Ace_shr_br*_pt2_std	Standard deviation of reading for point #2 (negative shunt)
Ace_shr_avg_std	Average of all ace_bsh_br*_pt1_std and ace_bsh_br*_pt2_std
Ace_shr_pcnt_fs	100 * Ace_br_avg_std / 32768
Ace_shr_step_time	Time in minutes it took to run this step

12.8.6.14 United Position

The purpose of the United Position test is to measure and record the position of the United as it is commanded to move up and down. Position measurements are made by the Mitutoyo reference position device and the United via USB-conditioned position from the internal United Load Frame encoder.

CAUTION

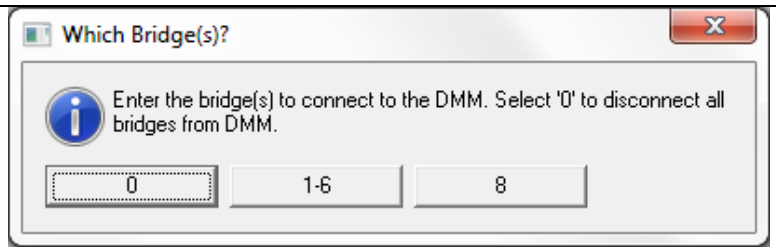
There are no force safeties activated during this test. It is the technician's responsibility to assure the crosshead will not cause any damage to any materials or persons within the United Load Frame while the crosshead is moving up and down.

1. Jog buttons are enabled. User is prompted to center the United Load Frame crossbar prior to starting. Once the test starts, the motion will be downward first.
2. User is prompted to enter the target position in millimeters. The limits on the target are currently 1.0 to 100.0 mm. If the entered value is not within this range, the test is aborted.
3. User is prompted to enter the target rate in millimeters/minute. The limits on the target are currently 1.0 to 1000.0 mm/min. If the entered value is not within this range, the test is aborted.
4. The jog buttons are disabled from this point.
5. The position is zeroed for both the United feedback and the Mitutoyo.
6. Perform the following 1 to 10 times.
    a. If doors switches are enabled, the doors must be closed and cannot be opened while the motion is in progress. Test aborts if the doors are opened prematurely.
    b. United servo is commanded to the requested position (downward first).
    c. Once the servo is in position is at the expected position, the servo is commanded a Stop command.
    d. Point 1: Positions are recorded from the two measurement devices.
    e. United servo is commanded to return to the original position (upward).
    f. Once the servo is in position is at the expected position, the servo is commanded a Stop command.
    g. Point 2: Positions are recorded from the two measurement devices.
7. Calculate the average and standard deviation of each position for both measurement devices.
8. Analyze the recorded waveform. Using the 10% and 90% position points, calculate the rate of motion up and down.

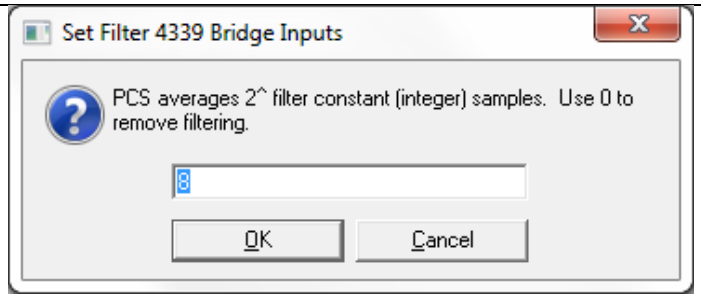
12.8.7 Manual Operation

Menu picks from the Verification and Calibration window can be used to manually control the relays inside the ACE box. Most of the menu picks are not allowed while an automatic test is running.

Appendix Table 12-17 Menu Pick and Description

Menu Pick	**Description**
File > Save	Save the last result from automatic tests
File > View Calibrations	Opens the Analog Calibration window to view the current calibrations for each analog channel. There is a feature to export the calibration file from the binary calibration file to a text file. View > Current Calibration Report. There is a feature to restore a calibration from a previous set of calibrations. View > Historical Calibration Report.
File > Exit	Close the Verification and Calibration window.
Tools > Open Step Graph	While an automatic test is running, select this to view the data in the waveform which is currently collected to this point.
Tools > Connect ACE box	Read the ACE TEDS and attempt to connect the cDAQ.
Tools > **DMM Control** > Connect DMM	Use the .NET program to connect to the Keysight 34461A DMM. See Keysight Connection for more details.
Tools > DMM Control > Open DMM Window	Opens a window for the DMM control. See Keysight DMM Window.
Tools > DMM Control > Select Bridge	 Connect bridge from the ACE to the Keysight DMM. 0 = no bridges connected to DMM 1-6 = the 6 UUT bridges connect to the DMM 8 = only bridge 8 connected to the DMM
Tools > DMM Control > Measure DC Volts	Command the Keysight DMM to use voltage measurement mode.

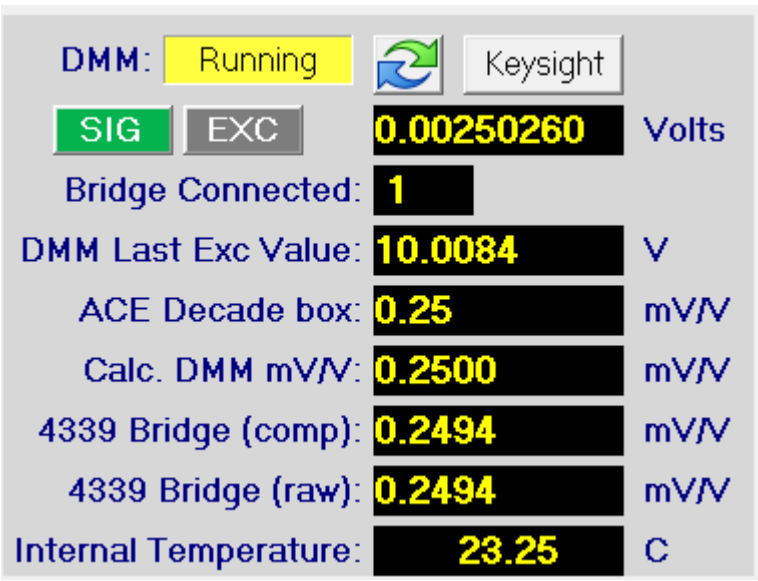
Menu Pick	Description
Tools > DMM Control > Measure 4-wire Resistance	Command the Keysight DMM to use resistance measurement mode. Excitation to all bridges is automatically commanded to zero before a remote command is issued to the DMM.
Tools > DMM Control > Measure Bridge Signal	Commands the relays in the ACE to route the DMM measurement to the bridge signals. If no bridge was selected (Tools > DMM Control > *Select Bridge*), the user is automatically requested to select the bridge first. The *SIG* button on the screen also controls these relays.
Tools > DMM Control > Measure Bridge Excitation	Commands the relays in the ACE to route the DMM measurement to the bridge excitation. If no bridge was selected (Tools > DMM Control > *Select Bridge*), the user is automatically requested to select the bridge first. The *EXC* button on the screen also controls these relays.
Tools > DMM Control > Isolate DMM	Opens relays to remove the DMM connection from the ACE. 1. Switch the DMM to voltage mode. 2. Open all relays that connect the DMM to the ACE. 3. Open all the relays in the decade box system.
Tools > **Decade Box Control** > Select mV/V Input	Applies necessary relays inside the ACE to activate the desired decade box system control point. 1. User is prompted to select one of the options: 0.0, 0.25, 0.5, 1.0, 1.5, 2.0, 3.0, 5.0, 12.0 mV/V. 2. User is prompted to select *Positive or Negative*
Tools > Decade Box Control > Toggle Polarity	Toggles the relay that controls positive versus negative application of the shunt for the decade box system. If the current decade box selection is 0.0, there is no effect.
Tools > **Relay Control** > Toggle 100 kOhm Relay	Toggles the relay that enables or disables a 100 kOhm shunt resistor to all individual 350 ohm bridges in the ACE box.
Tools > Relay Control > Toggle Power Check Relay	Toggle the relay that controls the power check circuit. There is an input I_ACE_PWR_CHECK that should reflect the state of O_ACE_PWR_CHECK.
Tools > Relay Control > Toggle Status LED	This menu pick is not working. The status LED is illuminated when a test is in progress or not. When a test is not in progress, the LED is forced off.

Menu Pick	Description
Tools > Read Thermistor	If the Keysight DMM is connected, the thermistor resistance is read by the DMM and converted to degrees C. The *Internal Temperature* field on the window is updated with the latest reading from the thermistor.
Tools > **4339 Bridge Measurements** > Enable all Bridges	Connect all 7 bridge measurements to the PXI-4339 and enable 10 Volt excitation for all bridges.
Tools > 4339 Bridge Measurements > Disable all Bridges	Disconnect all 7 bridge measurements from the PXI-4339.
Tools > 4339 Bridge Measurements > Null all Bridges	Autozero all 7 bridge measurements as measured by the PXI-4339.
Tools > 4339 Bridge Measurements > Cancel all Bridges	Remove the null offset from all 7 bridge measurements as measured by the PXI-4339. The readings are all natural.
Tools > Set Bridge Filter	 Use this option to set filtering of the analog inputs to PXI-4339 and PXI-6363. The following tests override this configuration: • Drift tests; filter is 8. • Calibration tests; filter is 8. • Verification tests; filter is 8. The following actions reset the filters to the defaults: • completion of the set of automatic tests • closing the Verification and Calibration window

12.8.7.1 Example Manual Usage

12.8.7.1.1 To request 0.25 mV/V from the decade box voltages on bridges 1-6

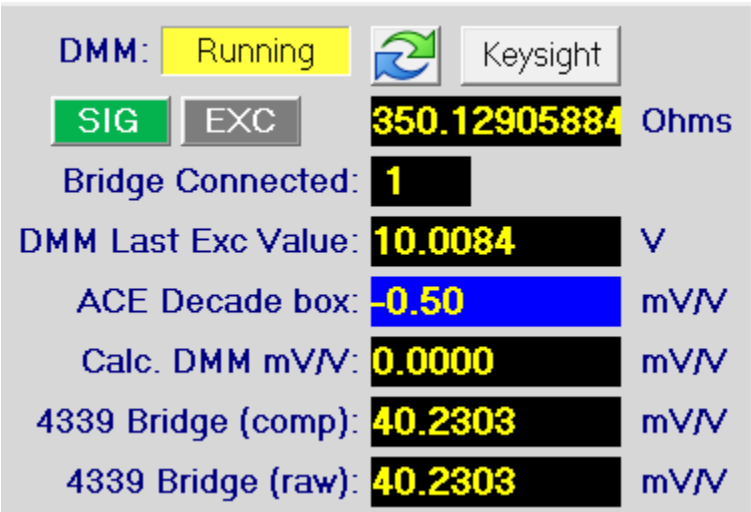
1. Select *Tools > 4339 Bridge Measurements > Enable All Bridges*
2. Select *Tools > DMM Control > Measure DC Volts*
3. Select *Tools > DMM Control > Select Bridges*
    a. At the prompt select *1-6*
4. Select *Tools > Decade Box Control > Select mV/V Input*
    a. At the prompt select *0.25*.
    b. At the prompt select the polarity (*Positive*)
    c. Click *EXC* to measure with DMM the excitation voltage
    d. Click *SIG* to measure with DMM the signal voltage
    e. The resulting calculated ratio is shown to the right of *Calc.DMM mV/V*



Appendix Figure 12.37 Calc. DMM mV/V Window

12.8.7.1.2 To request -0.5 mV/V setting and measure decade box resistance

1. Select *Tools > 4339 Bridge Measurements > Disable All Bridges*
2. Select *Tools > DMM Control > Measure 4-Wire Resistance*
3. Select *Tools > DMM Control > Select Bridges*
    a. Select 1 – 6
4. Select *Tools > Decade Box Control > Select mV/V Input*
    a. Select *0.5*
    b. Select *Negative*



Appendix Figure 12.38 Negative ACE Decade Box Value

12.8.7.1.3 To apply the 100kOhm shunt resistors to all individual ACE bridges

1. Select Tools > DMM Control > Isolate DMM
2. Select *Tools > 4339 Bridge Measurements > Enable All Bridges*
3. Select Tools > Relay Control > Toggle 100 kOhm Relay

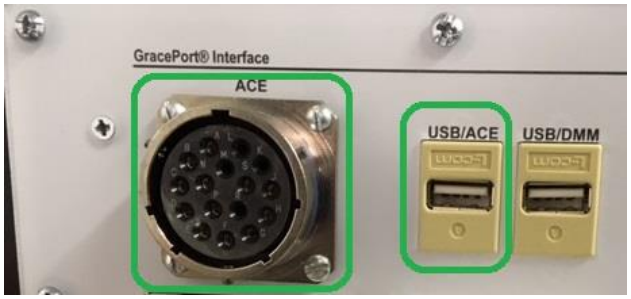
12.8.8 ACE Interaction with Atlas Tests

- The Verification Window cannot be opened while a real Atlas test is in progress. There is a prompt.
- The Verification Window must be closed before a real Atlas test can be started. There is a prompt. When the Verification window is closed, the following actions occur:
    - If an ACE test was not yet saved, user can save it now.
    - Any pending tests are stopped.
    - The default GAIN is restored to all PXI-4339 bridge inputs.
    - The default filter is restored to all PXI-4339 and PXI-6363 inputs.
    - The PXI-4339 bridge inputs null offset is removed.
    - The Analog Calibration Window and Calibration History window are closed.
    - Communications with the Keysight DMM are stopped.
    - All relays for ACE are opened.
- The ACE Amphenol connector must be removed before the test can be started. There is a prompt to the user.
- The LEMO connectors from ACE must be removed and the proper reference load cell cable installed to the pin box. The Initial Checks portion of the real Atlas test will likely fail if these connectors are still installed.

12.8.9 cDAQ Configuration using NI Max

National Instruments Measurement and Automation (NI M&A) is required to connect the cDAQ 1-slot rack and module.

1. Connect the ACE Amphenol connector to the Atlas side panel. This provides power to the ACE cDAQ inside the ACE box.
2. Connect the ACE USB cable to the Atlas side panel.

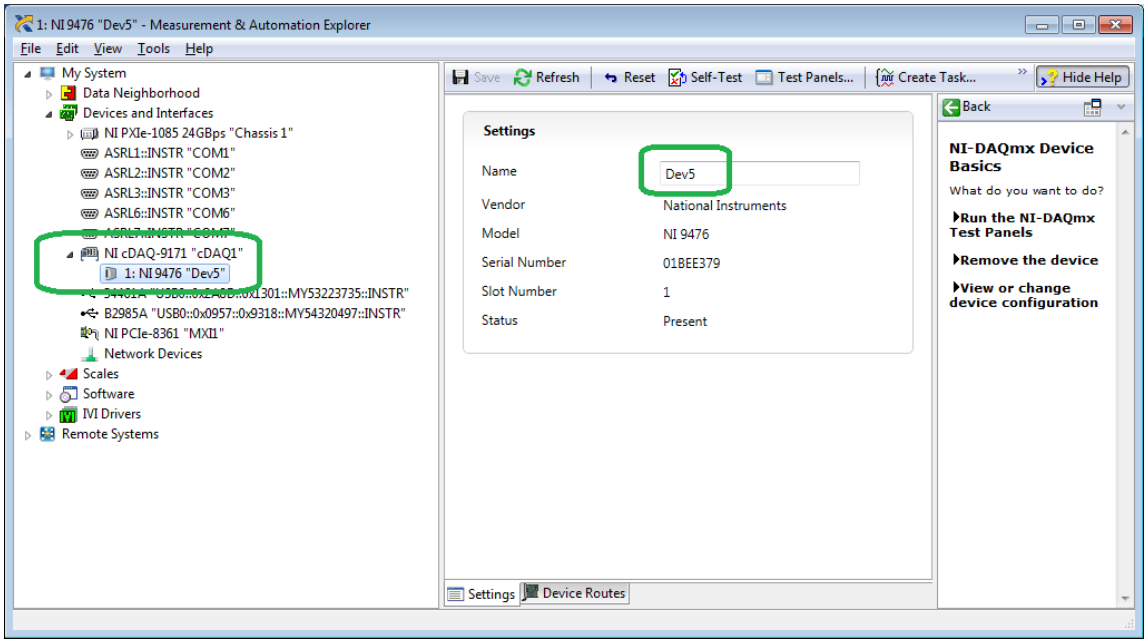


Appendix Figure 12.39 ACE and USB/ACE Connection

3. Close the PCS ACE window
4. Open NI Measurement and Automation NI-M&A software
5. Expand Devices and Interfaces
6. Expand NI cDAQ-9171 "cDAQ1"

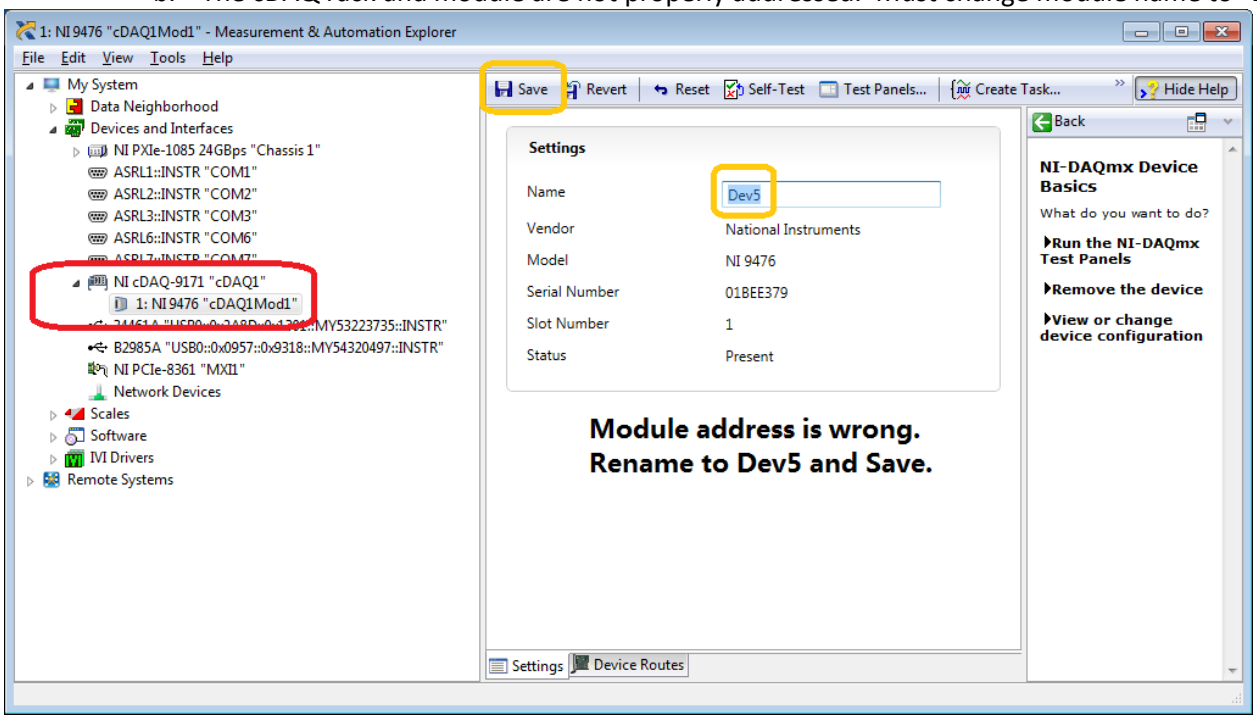
There are four (4) possibilities.

a. The cDAQ rack and module are properly addressed. Communications is OK. Close NI M&A.



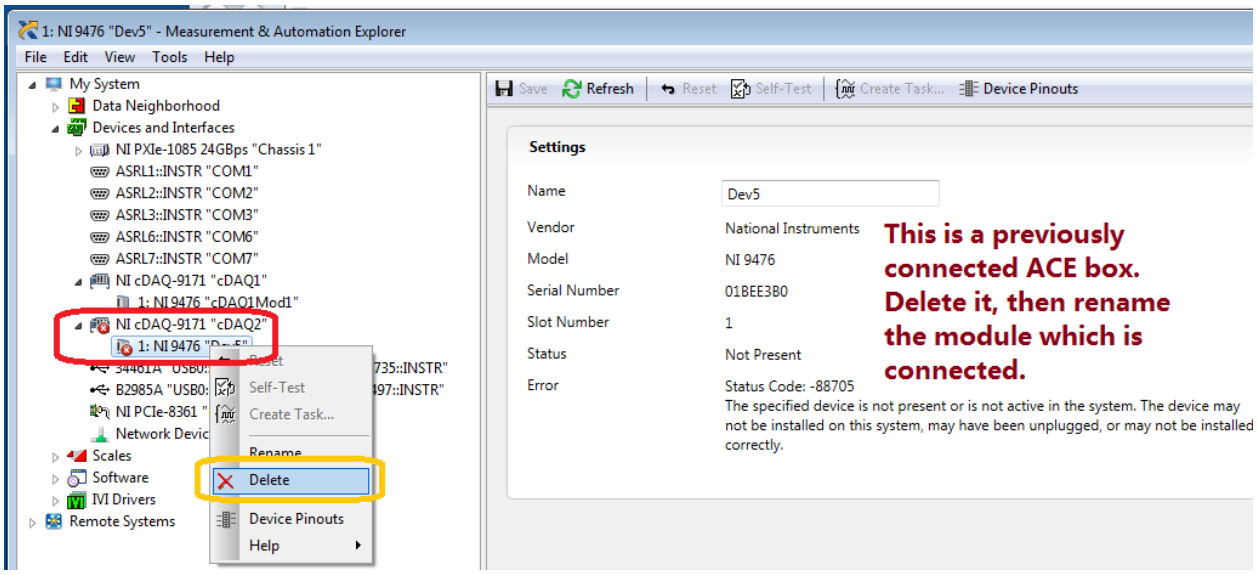
Appendix Figure 12.40 cDAQ Possibility 1

b. The cDAQ rack and module are not properly addressed. Must change module name to "Dev5".



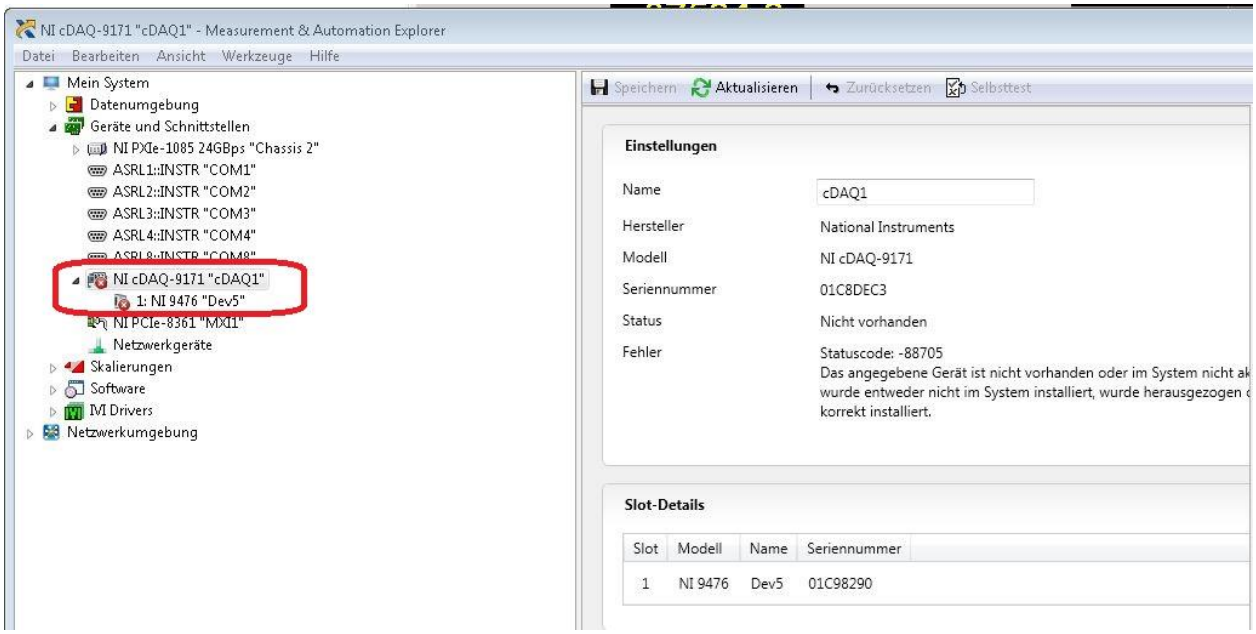
Appendix Figure 12.41 cDAQ Possibility 2

c. There are extra cDAQ racks listed. They won't cause an error, but should be deleted to reduce confusion.



Appendix Figure 12.42 cDAQ Possibility 3

d. No cDAQ racks are connected. The red "X" indicates a connection problem. Verify the USB is connected.



Appendix Figure 12.43 cDAQ Possibility 4

12.8.10 Keysight Configuration in Connection Expert

There are two (2) Keysight meters used for testing on the Atlas system.

1. Keysight B2985A meter is located inside the Atlas panel. It is used for high short or insulation resistance (IR) measurements.
    - The measurement leads are hard-wired from the Keysight to the Atlas circuit boards inside the panel.
    - Measurements from the bridges connected to the pin box are switched by relays contained within the PXI-2521 card.
2. Keysight 34461A external DMM is used with the ACE box to measure voltages and resistances.
    - Keysight 34461A meter is connected to Atlas via USB/DMM port on the side of the Atlas cabinet.
    - Keysight 43361A meter is used during ACE calibration and verification tests.

PCS software communications to each Keysight meter is established by using a VISA address or alias. The Keysight meter must be powered on and the startup screen must complete its initialization prior to assigning the VISA alias.

Use the Keysight Connection Expert to assign and manage VISA addresses.

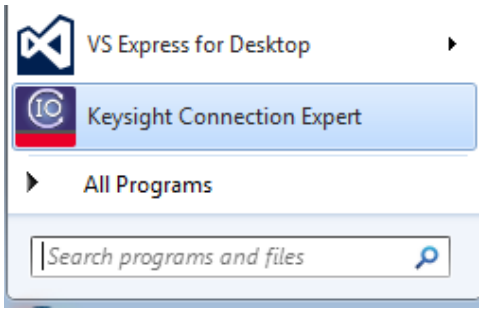
The VISA addresses are defined with a template value set in PCS. These names should be used even if the model name changes in the future.

Appendix Table 12-18 Value Set and Alias

	Alias
IR	B2985A
DMM	34461A

12.8.10.1 Connecting the Keysight

1. From the Windows Start menu or Desktop: select Keysight Connection Expert

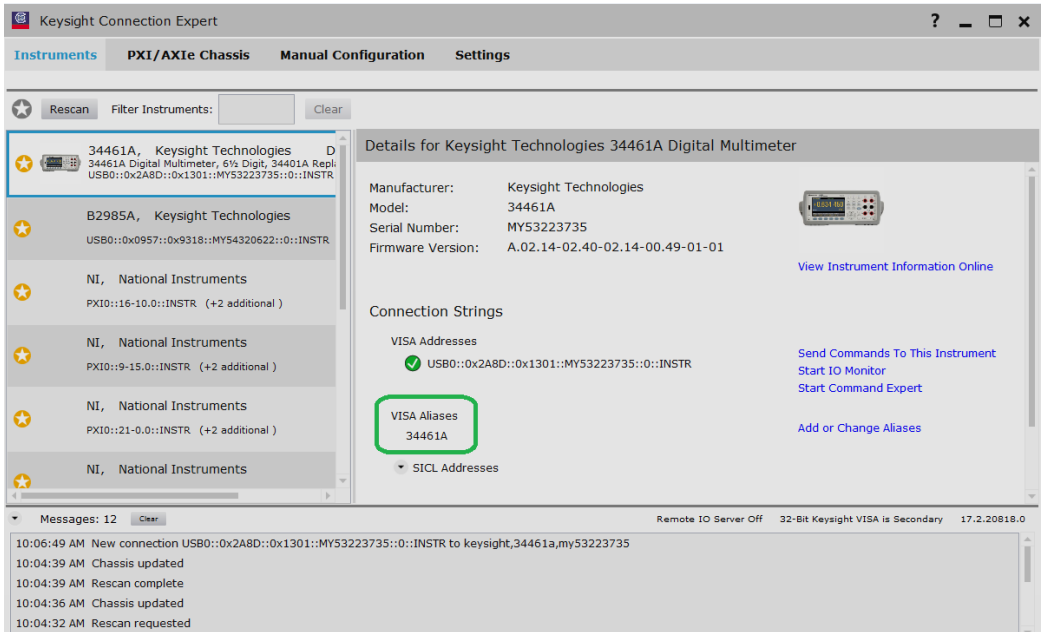


Appendix Figure 12.44 Select Keysight Connection Expert

Instruments are listed by model. Do not be confused by the NI VISA instruments listed. Ignore them.

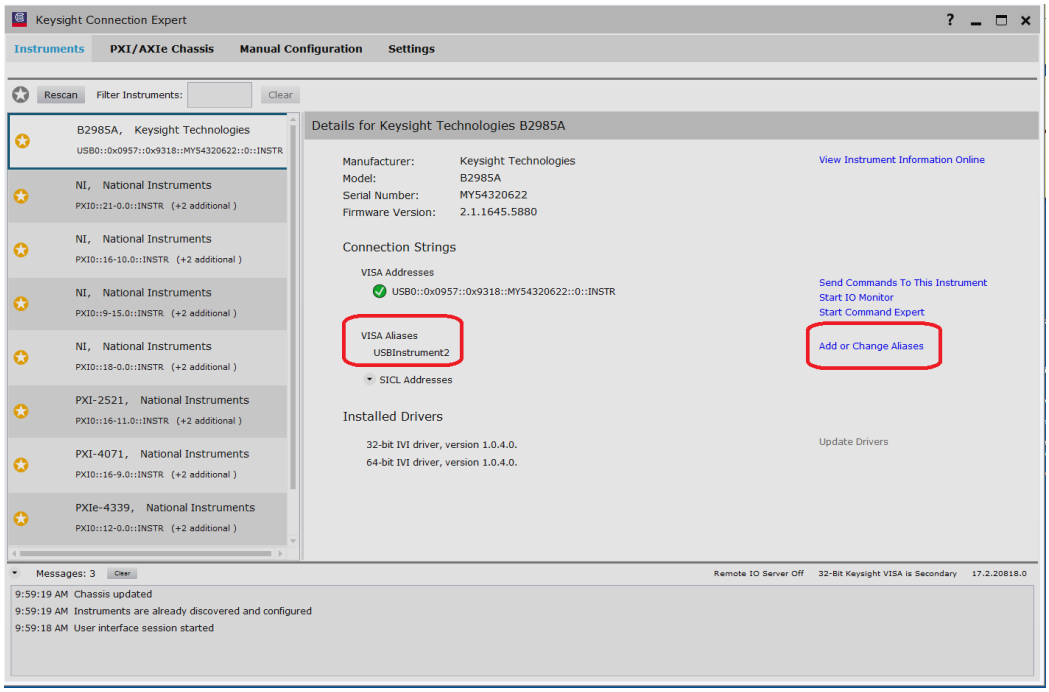
There are four (4) possible conditions:

a. All instruments connected via USB and powered on are listed with proper Alias. All is OK.

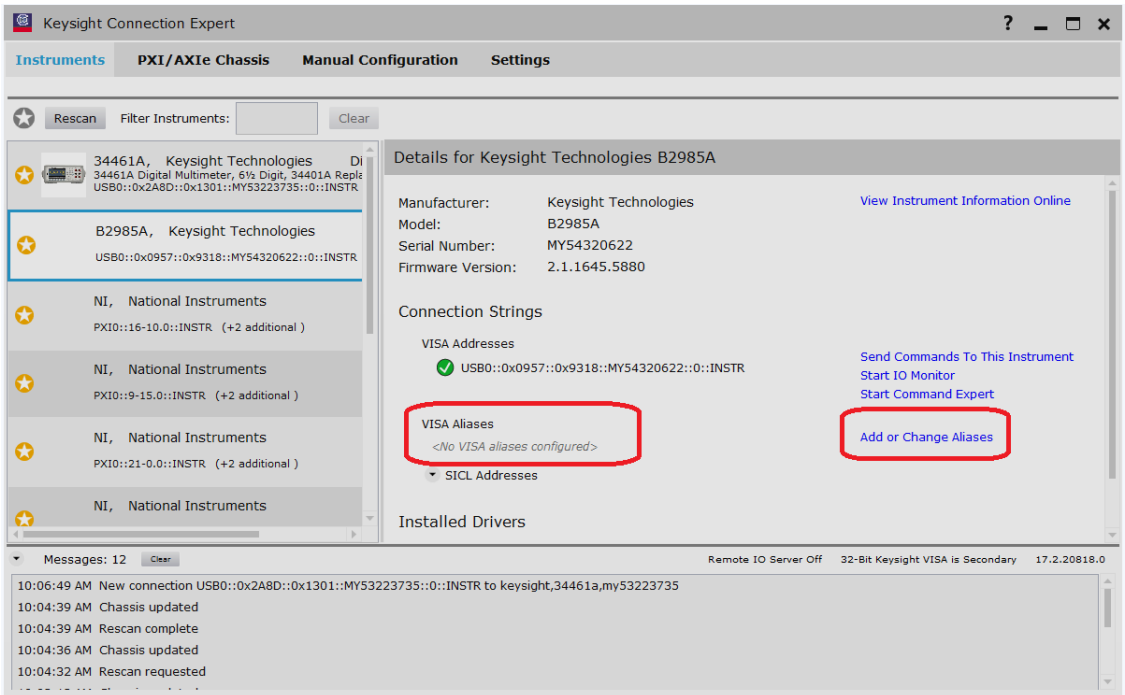


Appendix Figure 12.45 VISA Alias for DMM 34461A

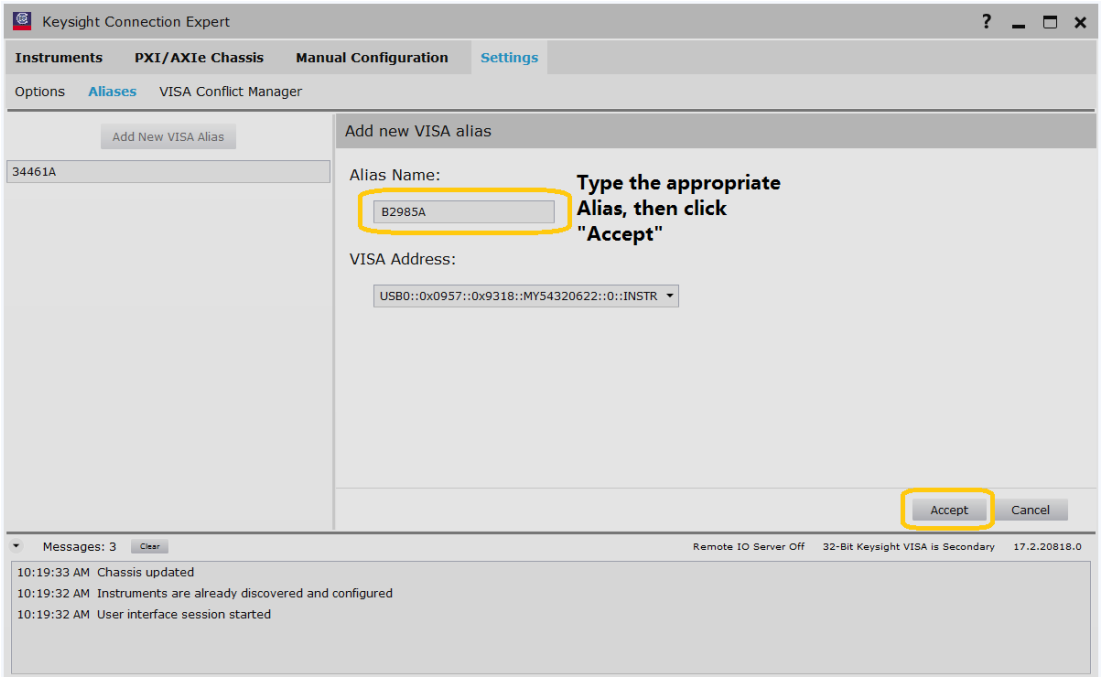
b. Connected instruments are listed with the wrong Alias. Need to "Add or Change Aliases".



Appendix Figure 12.46 Add or Change Alias – Existing Wrong



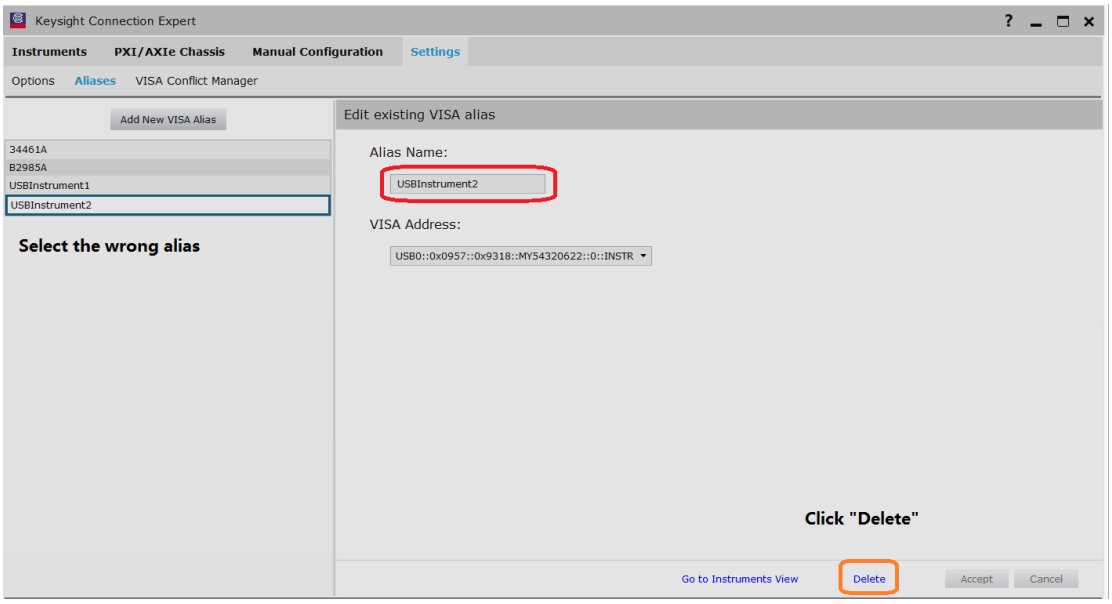
Appendix Figure 12.48 Add or Change Alias – No Alias Exists



Appendix Figure 12.47 Enter Name of Alias

c. One or more connected instruments is missing. Need to "Rescan". Then "Add or Change Alias".

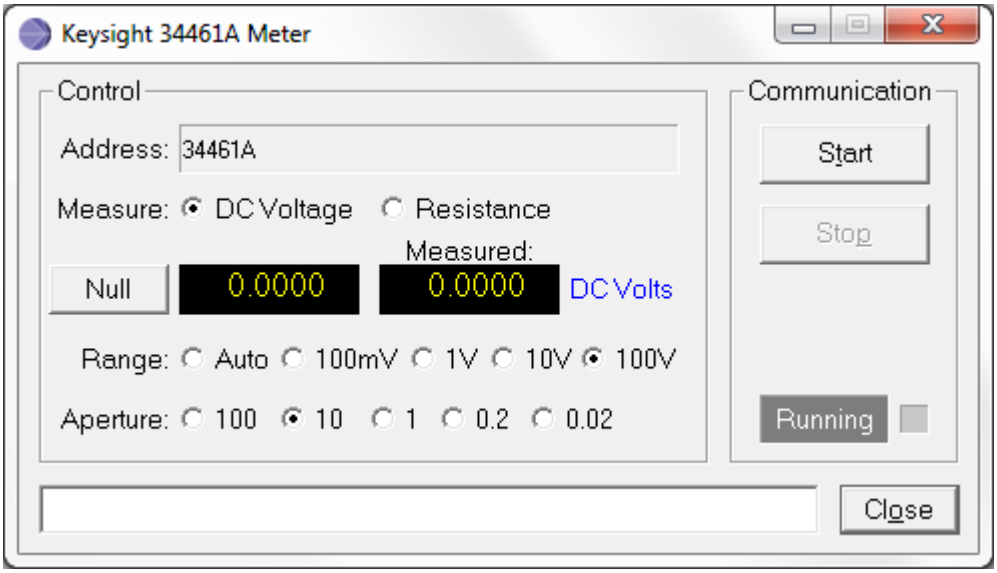
d. Too many instruments are listed. Need to "Delete" some Aliases



Appendix Figure 12.49 Need to Delete on Alias

12.8.10.2 Keysight DMM Window

Use *Tools > DMM Control > Connect DMM* or click the *Keysight* button from the Verification and Calibration window to open the interface to communicate with the Keysight DMM using the remote control.



Appendix Figure 12.50 Keysight Meter Window

Section 13. Legal Disclaimer and Notices

13.1 Disclaimer

The information in this manual is furnished for informational use only, and is subject to change without notice. Humanetics Innovative Solutions Inc. assumes no responsibility for liability on errors or inaccuracies that may appear in this manual.

13.2 Proprietary Statement

No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, photocopying, recording, mechanical, or otherwise, without the expressed written consent of Humanetics Innovative Solutions Inc.

13.3 Notice of Lead Content in Product

The product referred to in this manual may contain lead. A list of components that may contain lead is being maintained on the Humanetics website by ATD (test dummy) type and subcomponents. The list includes items that may currently or in the past have contained or a lead-based alloy. Please refer to www.humaneticsatd.com/Lead_Disclosure for information regarding possible lead content in this product.

13.4 About Humanetics

Humanetics Innovative Solutions Inc. is a global company whose strategy is to harness the best of today's technologies for the creation of high-quality products which play an important role in improving safety, comfort, and protection of people and their environment. Humanetics is the world's leading supplier in the design and manufacture of sophisticated crash test dummies, associated technical support, and laboratory services and load cell crash wall systems. Furthermore, Humanetics develops and supplies finite element software-based dummy models for computerized crash test simulations, and specializes in static and dynamic strain measurements.

For additional information on Humanetics and its products and services, please refer to
www.humaneticsatd.com
or contact:

Humanetics Innovative Solutions Inc.
23300 Haggerty Road
Farmington Hills, Michigan 48335 USA
Telephone: +1 (248) 778-2000
Fax: +1 (248) 778-2001

For information on Safety Technology Holdings, please refer to http://www.stholdingsinc.com/our-companies

Section 14. User Manual Update Log

Revision Level	Revision Date	Revision Author	Revision Description
A	Oct. 2018	MGT	Initial Release

www.humaneticsatd.com