Landing Gear Demonstration Procedure

NI Landing Gear Demonstration Unit

National Instruments

Revision 1.2

10/29/2019

Contents

1 Introduction and General Information

1.1 Introduction

The NI Landing Gear Demonstration Unit is designed to demonstrate the modular approach to signal conditioning and fault insertion of the National Instruments SLSC platform.

1.2 General information

This document is accompanied by a variety of additional documents. This document will refer to those documents when appropriate to avoid the duplication of information.

- Assembly Drawings
- Power Distribution and Cabling (electrical schematic)
- Detailed and Condensed Pin Trace
- Hardware User Manuals

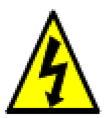
1.3 List of Items Furnished

A list of all items furnished is included in the assembly drawings. Product documentation for major system components is also included in the accompanying documentation package.

1.4 Safety

All necessary precautions shall be taken during testing to ensure the safety of personnel and equipment. Danger - High Voltage, 120-volt systems are exposed inside the rack enclosure when the doors are open or when the sides are removed. The following detailed warning and caution notes apply to the test set.

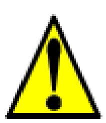
1.4.1 Definitions

Symbol	Definition
	**HIGH VOLTAGE:** This symbol indicates high voltage. It calls your attention to items or operations that could be dangerous to you and other people operating this equipment. Read the message and follow the instructions carefully.
	**WARNING:** Indicates a potentially hazardous situation which, if not avoided, can result in serious injury or death.
	**CAUTION:** Indicates a potentially hazardous situation which, if not avoided, can result in injury, or serious damage to the product.

1.4.2 Detailed Warning and Caution Notes

WARNING

EXERCISE EXTREME CARE TO AVOID CONTACT WITH POWER CIRCUITS. DANGEROUS VOLTAGES ARE PRESENT IN THE HARDWARE WHICH CAN CAUSE SEVERE SHOCK OR DEATH.



WARNING

PERFORM THE INITIAL INSPECTION AND SAFE TO TURN ON TESTS WITH THE MAIN POWER CORD DISCONNECTED FROM FACILITY POWER. DANGEROUS VOLTAGES ARE PRESENT IN THE HARDWARE WHICH CAN CAUSE SEVERE SHOCK OR DEATH.

WARNING

THIS HARDWARE GENERATES SIGNIFICANT AMOUNTS OF HEAT. PROPER CARE MUST BE TAKEN TO ENSURE PROPER VENTILATION AND CLEARANCE TO AVOID RISK OF BURNS AND/OR FIRE.

WARNING

THIS TEST SYSTEM IS TOP-HEAVY AND PRONE TO TIPPING WHEN ON INCLINED SURFACES OR EXPOSED TO SUDDEN ACCELERATION. THE OPERATOR IS RESPONSIBLE FOR ENSURING PROPER CARE IS TAKEN TO MAINTAIN A SAFE EXCLUSION AREA AROUND THE RACK WHEN MOVING IT TO PROTECT THEIR SAFETY AND THE SAFETY OF THOSE AROUND THEM.

CAUTION

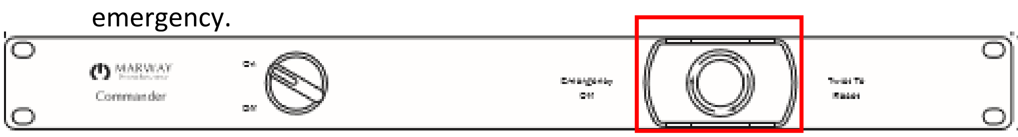
WHEN CONNECTING OR DISCONNECTING THE AVIONICS, MAKE SURE THAT THE AVIONICS POWER IS OFF.

CAUTION

THIS HARDWARE CONTAINS SENSITIVE ELECTRONIC COMPONENTS. CONSULT APPROPRIATE VENDOR LITERATURE BEFORE ATTEMPTING ANY SERVICE OR MAINTENANCE ON THIS EQUIPMENT.

1.5 Safety Precautions

- **Emergency stop button**. Use the emergency stop button to shut down power to the rack in an emergency.



- Don’t put hands inside rack.
- **Keep rack side panels attached and rear door closed when powered on**. High voltage lines in the rack can be hazardous if exposed. Before maintenance is performed, be sure to remove power from the system and disconnect from wall outlet. See Power Up Sequence under Operating Instructions for information on the location of power buttons.

- **Do not tip the rack**. When moving, ensure that wheels are unlocked before applying force.
- **Keep liquids away from rack area**. These can cause damage to electric components in the rack.
- **Do not drop external cables**. Connections in the cable can be damaged by impact.
- **Keep external cables out of way of foot traffic**. Pressure on the cords can damage internal connections.
- **Do not short two pins on panel**. This can damage internal equipment.

1.6 Special Tools and Test Equipment

2 PREPARATION FOR USE AND SHIPMENT

2.1 Preparation for Use

2.1.1 Unpacking

To unpack:

1. **Ensure that wheels are unlocked**.
2. **Remove rack from crate enclosure**. Carefully remove the rack from the crate, taking care to not tip the rack.
3. **Retrieve key.** The key is needed to open front, side, and back panels on the rack.
4. **If receiving after shipping,**
    a. **check the Tilt and Vibration sensors on the rack for possible damage.**
    b. **Remove packing material from interior of rack**. Using the key, unlock and remove the side panels to remove packing material.
5. **Collect external cables.** There should be four external cables for connection with the UUT- the J1, J2, J3, J4, J6, J5(LGCU) or J7(DCU), J8, J9, J10, and J11.

2.1.2 Location and Set Up

To set up:

1. **Move near power source**. The rack can plug into a standard 120VAC wall socket. Ensure that the rack is in a room without any equipment that may cause electromagnetic interference or noise.
2. **Ensure all power cords internal to the test rack are connected**.
   Check both ends of the following power cables:
    a. PXI connected into a PDU AC outlet.
    b. SLSC chassis connected to 24VDC output of PDU.
    c. Rack mount PC connected to a PDU AC outlet.
    d. NI Virtual Bench connected to a PDU AC outlet.
    e. Ethernet switch is connected to 24VDC output of PDU.

3. **Ensure all chassis grounds are connected.**

   Check the following components for chassis ground:

   a. PXI Chassis
   b. SLSC Chassis
   c. PDU
   d. Ethernet Switch
   e. NI Virtual Bench

3 Demonstration Procedure

3.1 Power Up Sequence

3.1.1 Initial Inspection

WARNING

PERFORM THE INITIAL INSPECTION TEST WITH THE MAIN POWER CORD DISCONNECTED FROM FACILITY POWER. DANGEROUS VOLTAGES ARE PRESENT IN THE HARDWARE WHICH CAN CAUSE SEVERE SHOCK OR DEATH.

The purpose of this section is to visually inspect the system to make sure everything looks ready to perform a test of the system.

1. Ensure the main power cord is disconnected from facility power.
2. Open the rear door of the system and remove the side panels.
3. Make sure that all cables are attached to the appropriate connector and no cables are disconnected. Refer to user's guide for cable label definition.
   Note: *there may be cables in the system that have no connection but are labelled/marked with "N/C".*

3.1.2 Safe to Power-On Checks

WARNING

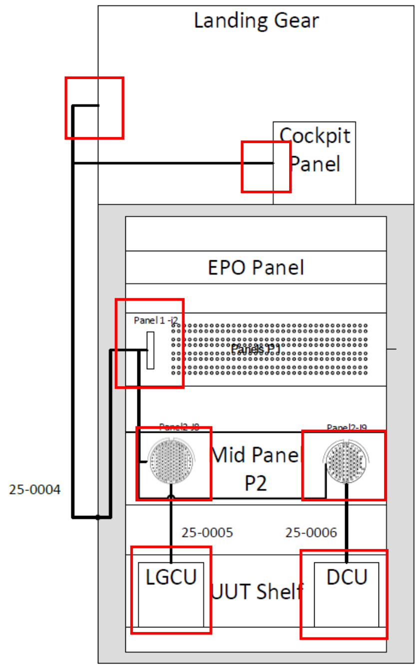
START THE SAFE TO TURN ON TEST WITH THE MAIN POWER CORD DISCONNECTED FROM FACILITY POWER. DANGEROUS VOLTAGES ARE PRESENT IN THE HARDWARE WHICH CAN CAUSE SEVERE SHOCK OR DEATH. ONLY CONNECT TO FACILITY POWER AS DIRECTED BY THE PROCEDURE.

The purpose of this section is to measure continuity of point-to-point power systems, eliminate wiring faults prior to first power on, and ensure that voltage and current measurements through the PDU are accurate.

1. Ensure the main power cord is disconnected from facility power.
2. Observe the EPO panel and ensure the power switch is in the "OFF" position and that the emergency stop has been reset.
3. Using DMM:
   a. Check for open circuits from all power supply positive output terminals to the ground bar.

3.1.3 Attaching External Cables

External cable connections are boxed in the image below.



Provided cables are labelled with the panel number they connect to. Panel numbers are printed on the panels in the top left-hand corner.

3.1.4 Attach Monitors

Attach the monitors to the monitor mounts and connect the power and video cables.

3.1.5 Power Up Sequence

Power Distribution Unit

The power distribution unit is on the bottom of the rack. The main power switch must be set to ON.

Emergency Power Off

Ensure that the emergency stop is not active and set the power switch to on.

3.2 General Instructions

Login

Username: NI_SET_DEMO_1

Password: Tech180

File System

The necessary files for rack operation can be found in Desktop\Project\.

Project

The project folder contains necessary documents for an operator to run the test rack.

Builds

This folder contains the software builds for custom rack software. A Readme text file in Builds contains instructions for where files will go to replicate the rack software on another system.

Installers

This folder contains all necessary installers to replicate the rack software on another system.

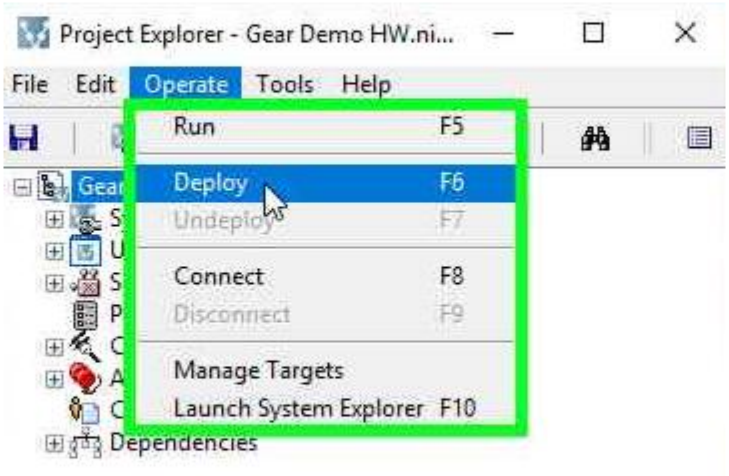
System Documentation

Refer to this folder for documentation on hardware and software components of the rack.

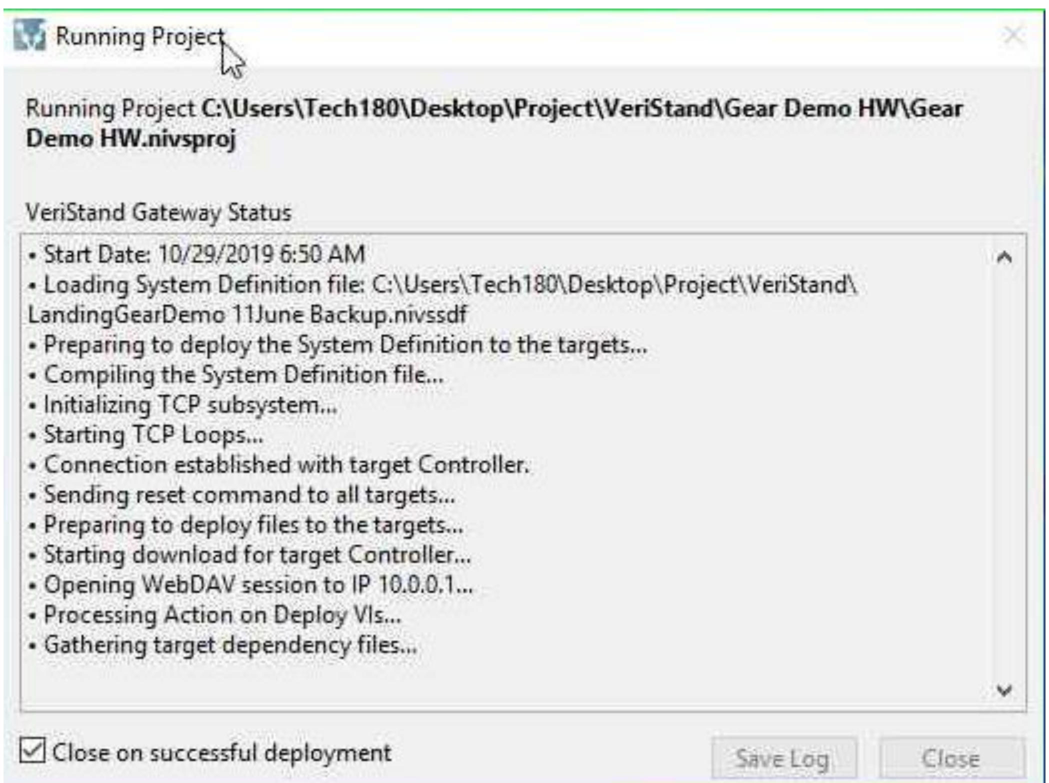
3.3 UUT Testing

Power Up Sequence for UUT

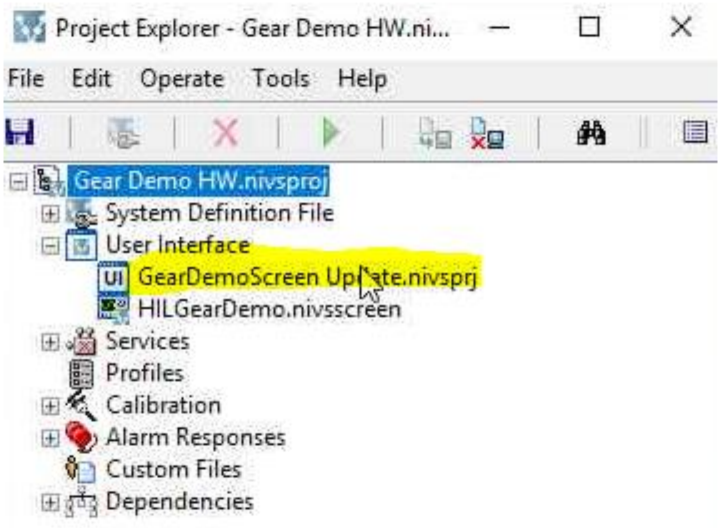
1. Open the project from the desktop shortcut “Gear Demo HW.nivsproj”
2. Select “Deploy” from the Project Explorer “Operate”



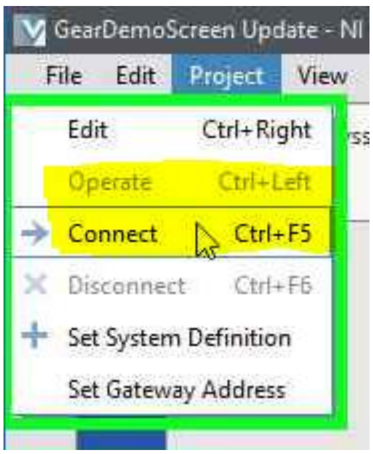
3. A dialog will display the Veristand gateway status during the deployment. This will close automatically on successfully deployment. If there is an error, it will remain open with the error details.



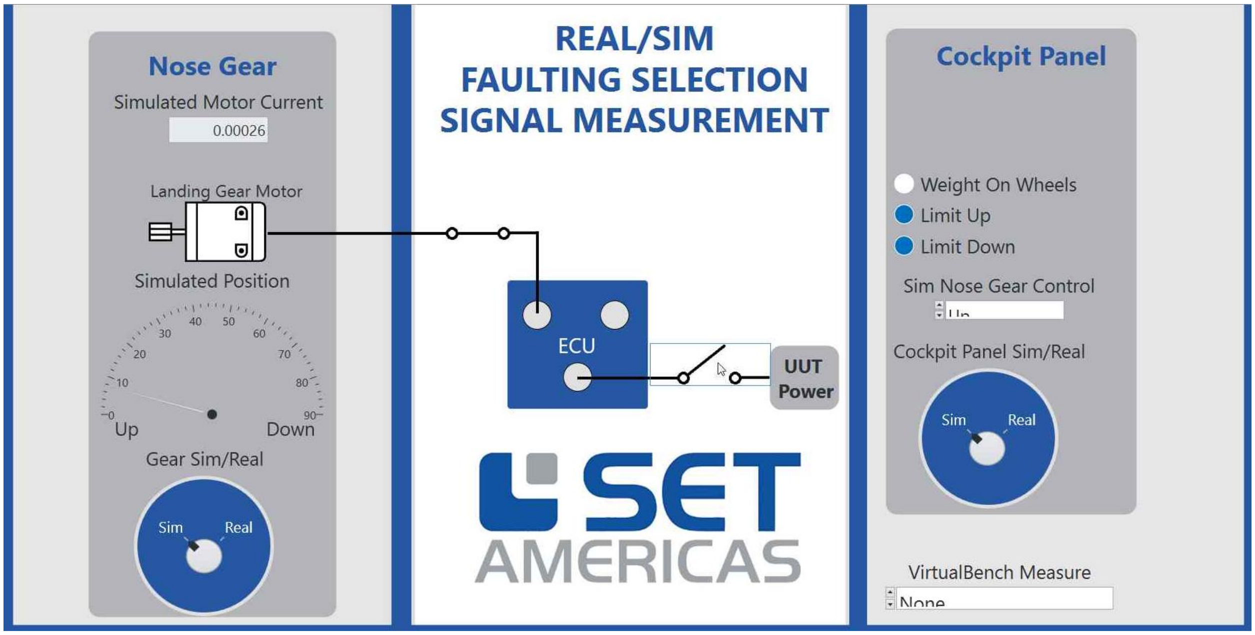
4. Open the “GearDemoScreen Update.nivsprj” file under the User Interface tree.



5. Select “Operate” and then “Connect” from the project menu of the UI manager.



6. The UUT Power will be open faulted by default. To power on the UUT Power, click on the open switch contact to close it.



Please see the Feature Demonstrations section of this guide for detailed instructions on performing demonstrations.

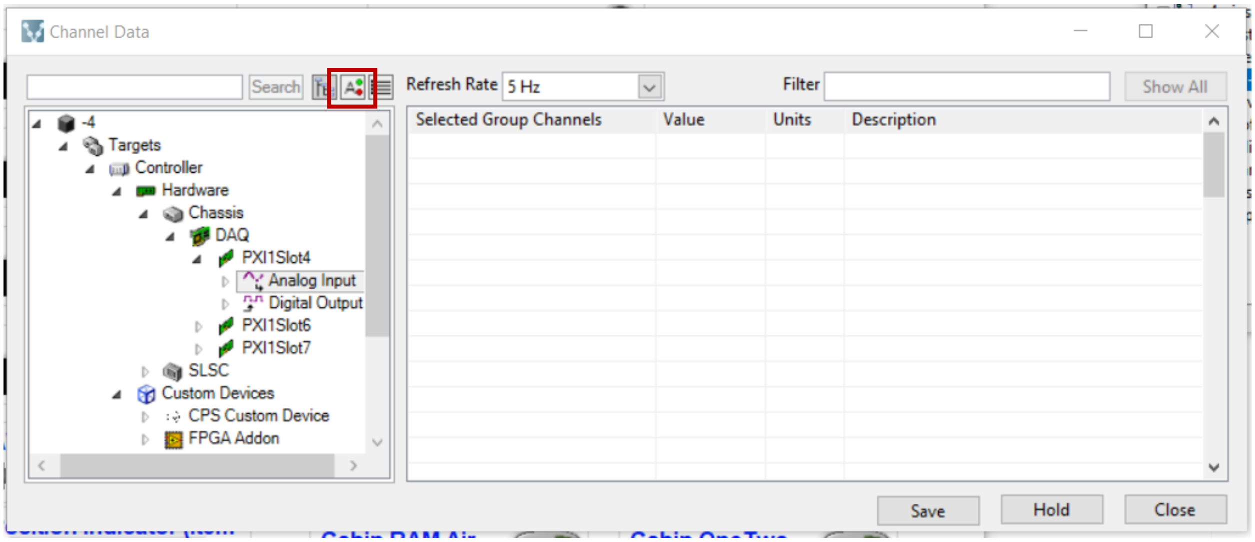
3.4 Modifying a System Definition

The system definition should not be modified for any reason. If the system definition is modified, there is a backup file that can be found in folder name "Archive" on the desktop.

3.5 Monitoring Signal Behavior

Reference this section for information on the software tools and techniques for monitoring signals when the UUT is powered on.

Channel Data Viewer



The Channel Data Viewer allows the operator to see VeriStand channel data in real time. This can be used to view signals quickly without having to place an indicator on the Workspace. To view the values of signal aliases, click the icon boxed in red in the above image. This can be useful for debugging as values for an entire DAQ card can be displayed at once.

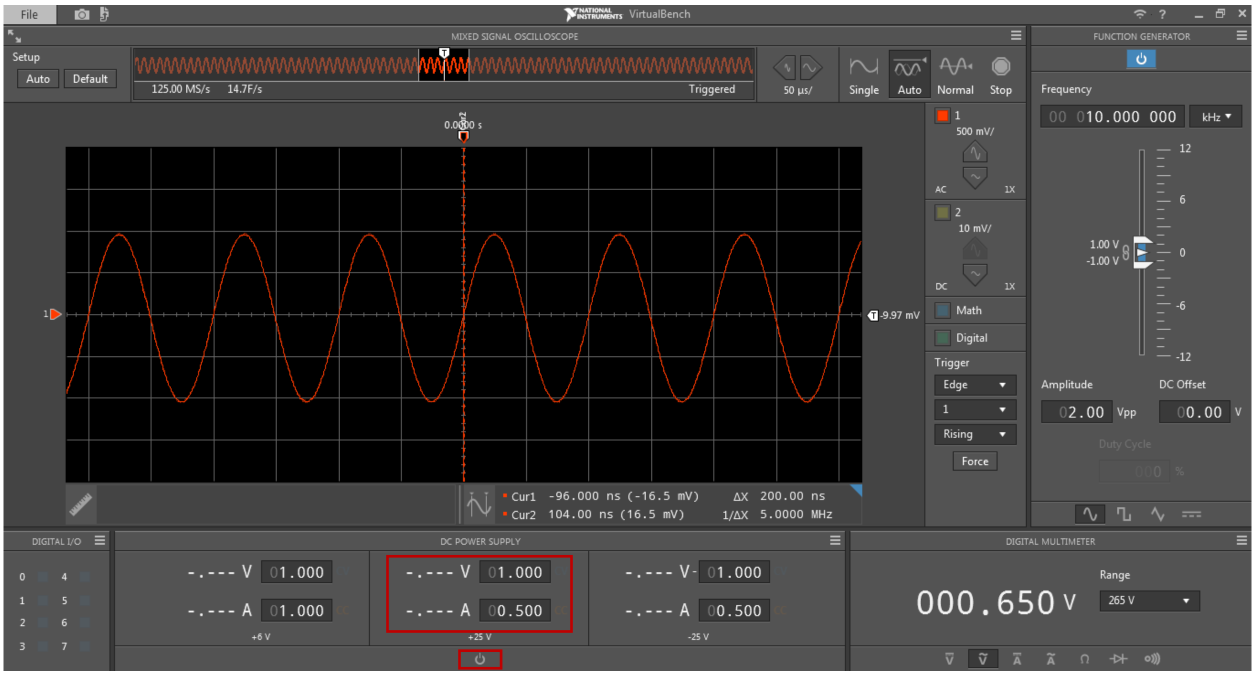
VirtualBench

The VirtualBench is an instrument manufactured by National Instruments which includes a frequency generator, oscilloscope, DMM, DC power supply, and digital I/O.

To open the VirtualBench software:

1. **In the search bar, type in VirtualBench and select the NI VirtualBench desktop app**.
2. **Select Search for Device**. The table should populate with the name of the VirtualBench installed in the rack. If the VirtualBench is not found, confirm that it is turned on and check if it can be seen in NI MAX.
3. **Select the VirtualBench name available to open the VirtualBench soft front panel**.

DC Power Supply Operation



For the DC power supply, the second channel, boxed in the above figure, is used for the Manual VirtualBench tool. The other two channels are available for external use.

The VirtualBench will stay in Constant Current mode until the current limit (set in the lower text box in the DC supply section) is reached, at which point the voltage will be limited. Operators should ensure that the current limit set is at a reasonable level before applying any voltage in the system.

The DC power supply has a power button, boxed in the above figure. If the power button is not pressed, no voltage or current will be output and the voltage and current settings will be "-.---" as shown in the image. When manually applying voltage, first ensure that the current limit is set properly and then power on/enable the DC supply for VirtualBench.

For any questions on the VirtualBench, refer to National Instruments documentation.

For a detailed guide to demonstrating the VirtualBench in this system please refer to the Feature Demonstrations section of this document.

3.6 Feature Demonstrations

The following set of demonstrations can be done in part, their entirety, and in any order.

CAUTION

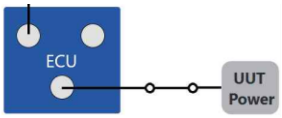
Please exercise care when operating any real components. The landing gear lever on the cockpit panel <u>must be pulled up before it is moved forward or backward</u>. The landing gear enclosure should be free from any foreign objects and body parts while the unit is powered on.

Demonstration Procedures

3.6.1 Demo 1 - Routing Mode Demonstration

All UUT signals can be routed to their real components or simulated from the HITL test unit. The routing of the signals can be automatically switched from the UI screen. The signals are switched in groups. All signals for the landing gear can be switched from the “Gear Sim/Real” control and all signals for the Cockpit Panel can be switched from the “Cockpit Panel Sim/Real” control. To demonstrate this, perform the following procedure:

1. Apply power to the UUT by closing the UUT power contact.



   a. The status lights of the controller units should turn green.

2. Set “Cockpit Panel Sim/Real” and “Gear Sim/Real” to “Real”. The landing gear indicators “NOSE”, “L”, and “R” will light up green.

3. Set the lever to the down position. The landing gear indicators will indicate red while the landing gear is between the up and down positions.

4. Observe the landing gear move to the down position.
5. Set the “Cockpit Panel Sim/Real” to Sim.

6. Set the “Sim Nose Gear Control” to Up.

7. Observe the landing gear move to the up position.
8. Set the “Gear Sim/Real” to Sim.

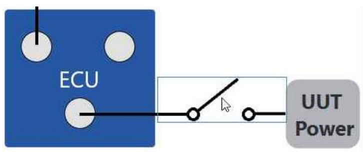
9. Set “Sim Nose Gear Control” to Down.

10. Observe the "Simulated Position" move to the Down position (45 degrees.)

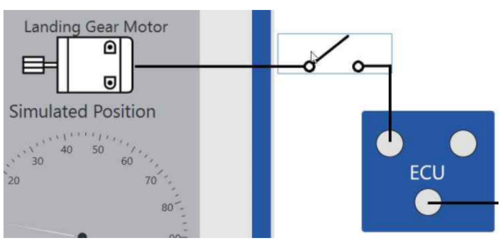
3.6.2 Demo 2 – Open Faulting Demonstration

The SLSC platform provides a method for open faulting UUT signals via software command. The UI exposes two signals for automated open faulting: UUT power and motor current.

1. Move the landing gear to the down position by following steps 1-4 of Demo 1.
2. While the landing gear is in motion, open fault the UUT power by clicking on the UUT power contact.



3. Observe that the landing gear stops moving and the controller units' status LED turns off.
4. Closing the UUT power contact will allow the landing gear to continue moving.
5. Move the landing gear to the up position.
6. While the landing gear is in motion, open fault the motor current signal by clicking on the contact.



7. Observe that the landing gear stops moving, the error light turns red, and the buzzer sounds.

8. Closing the motor current contact will allow the landing gear to continue moving.

3.6.3 Demo 3 – Communication Faulting Demonstration

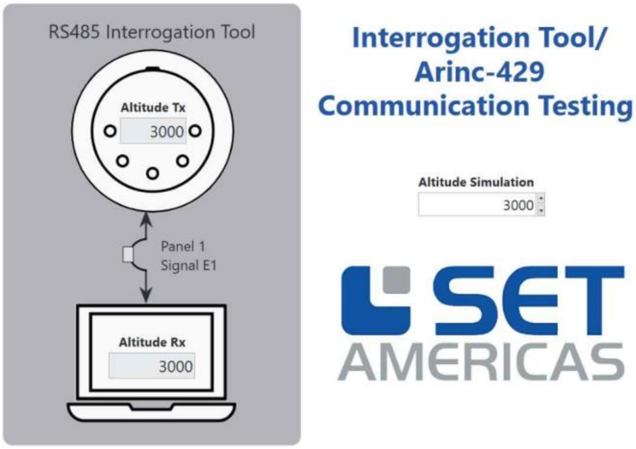
The demonstration unit can test and open fault communication between the LGCU and the DCU and communication between the LGCU and an interrogation tool. The communication between the LGCU and the DCU is ARINC-429. The communication between the LGCU and the interrogation tool is RS485. The second page of the UI (Interrogation Tool.nivsscr) is dedicated to communication testing.

1. Switch to the "Interrogation Tool" tab of the UI Manager.
2. Set the "Altitude Simulation" control to the value 2,000.
3. Change the "Altitude Simulation" control up and down.
4. Observe that the "Altitude Rx" of the RS485 Interrogation Tool reads the value of "Altitude Tx" of the RS485 Interrogation Tool Port.

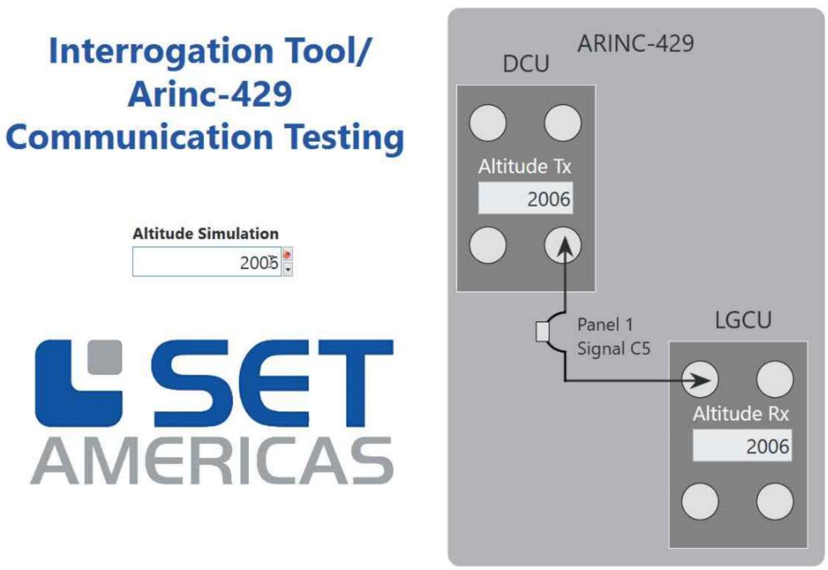
5. Remove the panel jumper of Panel 1 at signal E1 to manually open fault the communication.
6. Change the "Altitude Simulation" control up and down.
7. Observe that the Interrogation tool stops receiving the updates from the Interrogation tool port.

8. Reinstall the panel jumper of Panel 1 signal E1.

9. Observe that the Interrogation tool updates to the Interrogation tool port value.

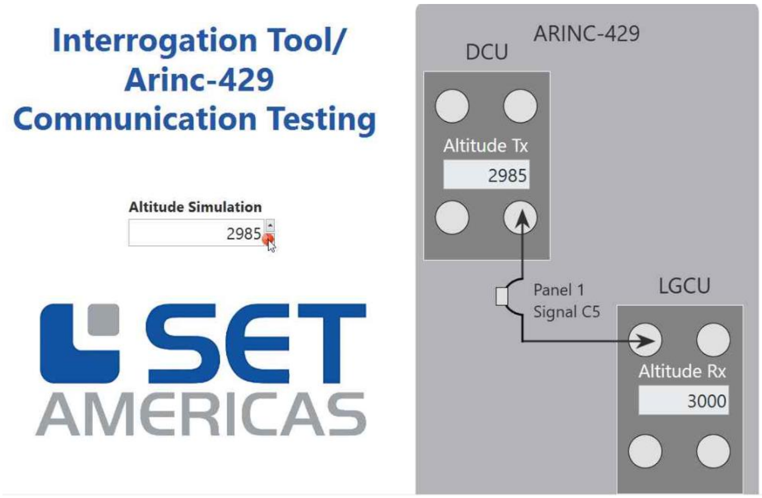


10. Change the “Altitude Simulation” control up and down.
11. Observe that the LGCU receives the ARINC-429 messages from the DCU ARINC-429 port.

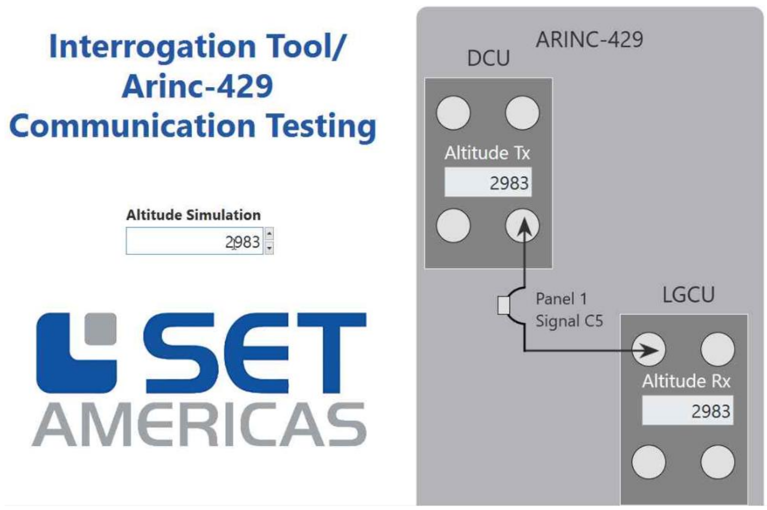


12. Remove the panel jumper at Panel 1 signal C5.
13. Change the “Altitude Simulation” control.

14. Observe that the LGCU stops receiving the ARINC-429 messages from the DCU ARINC-429 port.



15. Reinstall the panel jumper of Panel 1 signal C5.
16. Observe that the LGCU receives the ARINC-429 messages from the DCU ARINC-429 port.

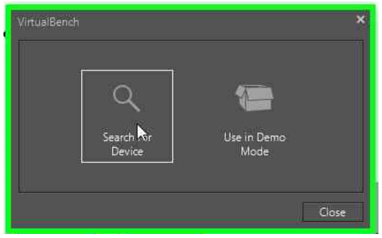


3.6.4 Demo 4 – Virtual Bench Routing Demonstration

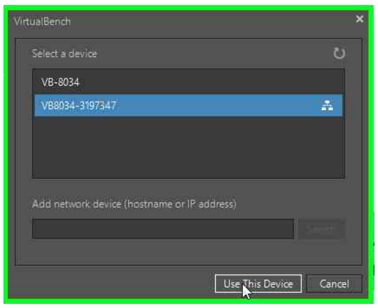
The landing gear demonstration unit can route signals to the NI VirtualBench for signal measurement and verification.

1. Open NI VirtualBench from the start menu.

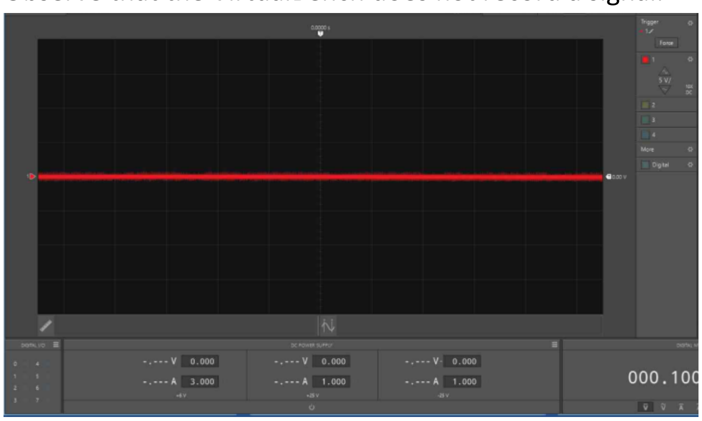
2. Select “Search for Device”



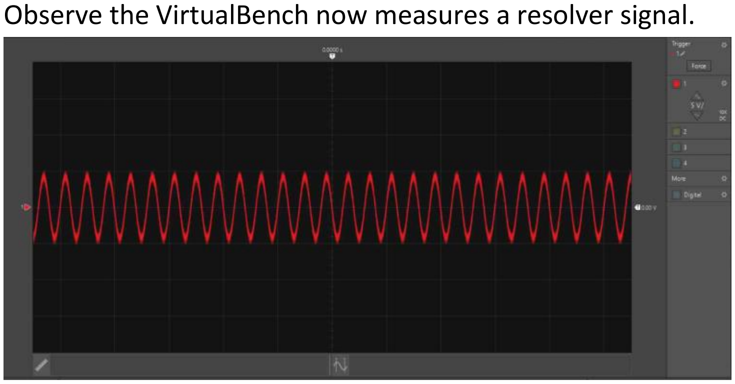
3. Select “VB8034-3197347” and “Use This Device”.



4. Set “Gear Sim/Real” to “Real” and “Cockpit Panel Sim/Real” to “Real”.
5. Observe that the VirtualBench does not record a signal.

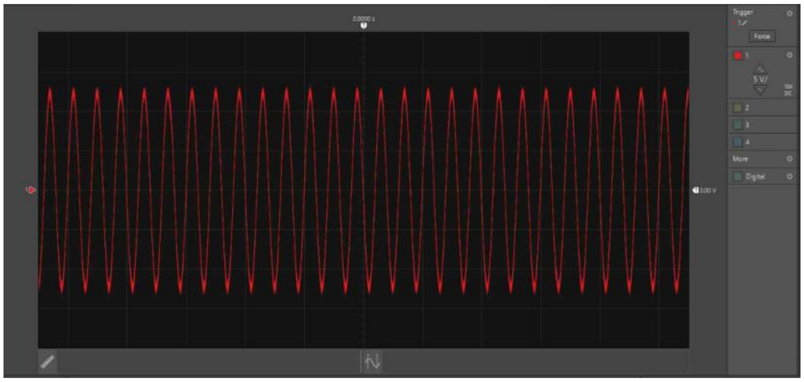


6. Set “VirtualBench Measure” to “Nose Gear Resolver Cos”
7. Observe the VirtualBench now measures a resolver signal.



8. Move the cockpit panel lever so that the landing gear moves.

9. Observe that the amplitude of the resolver signal changes with angle.

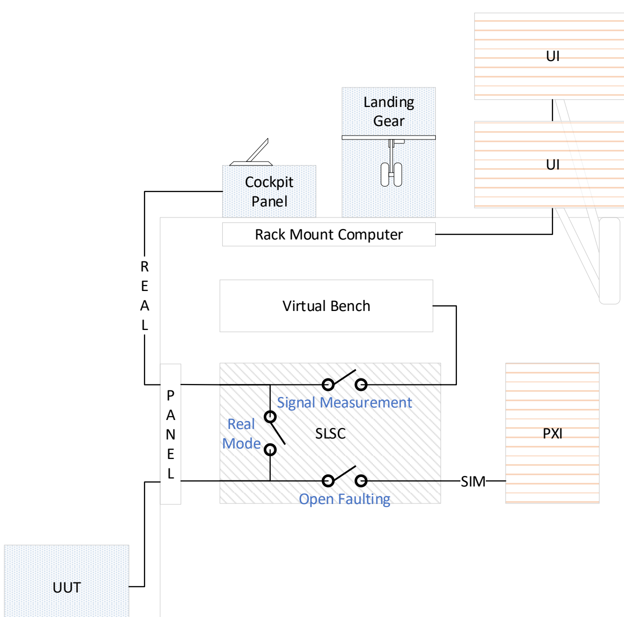


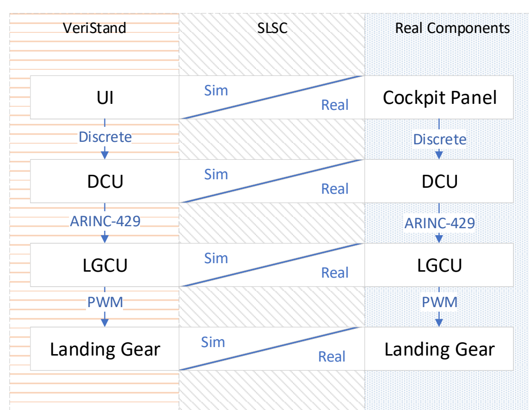
3.7 Power Down Procedure

1. Close all open programs including VeriStand.
2. Shutdown the rack mount computer.
3. Power off the PXI controller.
4. Turn off the power switch on the EPO Panel.
5. Turn off the PDU.

4 Theory of Operation

System Block Diagram





System Description

The system is comprised of a landing gear controller unit under test, a cockpit panel, landing gear, and the hardware in the loop test system. The signals can be switched between the real components and the simulated signals.

4.1 Hardware

The hardware architecture of the NI Landing Gear Demonstration is designed to use a standard interface panel, with optional signal conditioning using standard SLSC modules, and standard I/O with PXI. This architecture also takes advantage of a common connector pinout for SLSC modules. The result is a flexible and modular system comprised primarily of commercial off-the-shelf (COTS) parts and a fixed variety of cables.

4.1.1 Interface Panels

The interface panels on this system connect 160 real-world pins from the UUTs or other components via an i2 Micro iCon high density signal connector.

On the face of the interface panel are 160 test points with jumpers so that individual pins may be pulled to break the signal pathway and connect to other equipment for measurement or troubleshooting. **DO NOT LOSE THEM IF PULLED**. These jumpers are required to complete the signal pathway between the UUT and the NI Landing Gear Demonstration.

The rear of the interface panel divides the 160 pins into 20 groups of 8 pins each. Each 8-pin grouping is interfaced with a standard 9-pin D-sub connector, known commonly as a DB9, DE9, or D9 which connects to cabling that will route the signal to SLSC components in the system.

Also connected to the rear of the interface panels are 5 larger 44-pin D-sub connectors, commonly known as HD44 type, which carry signals to a large matrix switch for Self-Test capabilities further defined in section 4.5: Self-Test under Theory of Operation.

4.1.2 Switches, Loads, and Signal Conditioning (SLSC)

SLSC extends PXI capabilities and consists of an Ethernet-connected chassis with modules. Signals pass through an SLSC module and continue to another SLSC card, a panel, or a PXI card, typically after some form of switching, isolation, or other signal conditioning is applied.

Each module has a Rear Transition Interface (RTI) which provides flexible standardized connectivity from SLSC to PXI and the interface panel. Additionally, an SLSC system has a standard pinout that allows for the use of standard cables and eliminates point-to-point wiring.

The SET-2010 module serves as the primary switching card in the system. It provides open faulting for signals that don’t already have that capability from another SLSC card type in the signal chain.

Additional documentation for SLSC components is included in the delivered folder that contains this document.

4.1.3 PXI

The PXI platform is used for a controller running a real-time operating system and modules for input and output with NI VeriStand. The VeriStand engine runs on this controller and can execute system models with real-time performance. The PXI chassis also includes a switch matrix card for connecting and disconnecting instruments used for Self-Test.

Additional documentation for PXI components is included in the delivered folder that contains this document.

4.1.4 NI VirtualBench

The NI VirtualBench is an All-in-One Instrument that combines a mixed-signal oscilloscope, an arbitrary waveform generator, a DMM, a programmable DC Power Supply, and digital I/O.

These instruments are used for Self-Test and are available for general troubleshooting by the operator.

Additional documentation for the NI VirtualBench is included in the delivered folder that contains this document.

Refer to Manual VirtualBench Tool under Operating Instructions above for usage instructions.

4.2 Software

Reference this section for general information on the software platforms used in this system. Operators of the rack should only require knowledge of TestStand and the VeriStand workspace to effectively use the system. Maintaining the rack will require knowledge of all the software components listed below.

4.2.1 National Instruments Software

For additional information on these software components, refer to the NI website, training courses, and support or reference documentation provided in the documentation package for this system.

VeriStand

VeriStand is a hardware-in-the-loop simulation software licensed by National Instruments that allows the operator to manipulate and view channel values going to and coming from the UUT to simulate environmental conditions under test. VeriStand allows the operator to add models that can allow the simulation to respond and change inputs to the UUT based on the UUT's outputs, providing its hardware-in-the-loop functionality. VeriStand is composed of several operator-configurable components, such as the System Definition, System Explorer, and the Workspace.

VeriStand System Definition

The VeriStand system definition contains information for the simulation to run on the target, such as system loop rate, hardware components and their channels and properties, custom devices, scales, models, and system mappings.

VeriStand System Explorer

The System Explorer is the VeriStand user interface used to configure the VeriStand system definition. Access the System Explorer by double-clicking on a ".nivssysdef" file or opening a VeriStand Project and launching the System Explorer from there.

VeriStand Workspace

The VeriStand Workspace is a configurable software space where the operator can add controls, indicators, and graphs to monitor VeriStand channel values when the VeriStand project is deployed to and running on the target. The workspace can be configured when the system definition is not deployed by opening the ".nivsscreen." The Workspace is also where the operator can access custom VeriStand Workspace tools in the Tools dropdown on the navigation bar. For more information on configuring the VeriStand Workspace, reference National Instruments documentation and training.

LabVIEW

LabVIEW is a graphical programming language manufactured by National Instruments.

4.2.2 SET Americas Software

Custom Devices

A custom device is a software component that expands the functionality of VeriStand. Expanding the functionality includes allowing the user to add non-DAQ devices, additional data processing, and data logging, among others. Questions regarding their use should be directed towards Tech180.
Custom devices are built in LabVIEW and can be added in the System Explorer if they are in the C:/Program Files (x86)/National Instruments/NI VeriStand 2018/Custom Devices folder.

Bitfile

The FPGA custom device is used in the system definition for capturing data going to the PXIe-7820R card by using a pre-compiled bitfile. The bitfile configures the FPGA on the PXIe-7820R and the SLSC Arinc card based on LabVIEW code.

Passthrough mode allows the prototype motor command signals to bypass any latching logic on the FPGA. When not in passthrough mode, the motor commands are determined by the torque demands and the motor control logic.

4.3 Signal Types

A signal, as referred to by this manual, is a time-varying quantity that simultaneously represents a circuit of one or more hardware pins and engineering units in software. Signals from the UUT are categorized into types that share a common electrical implementation. Software configuration settings and hardware faulting options may be different for signals of the same type, but they will otherwise share the same characteristics.

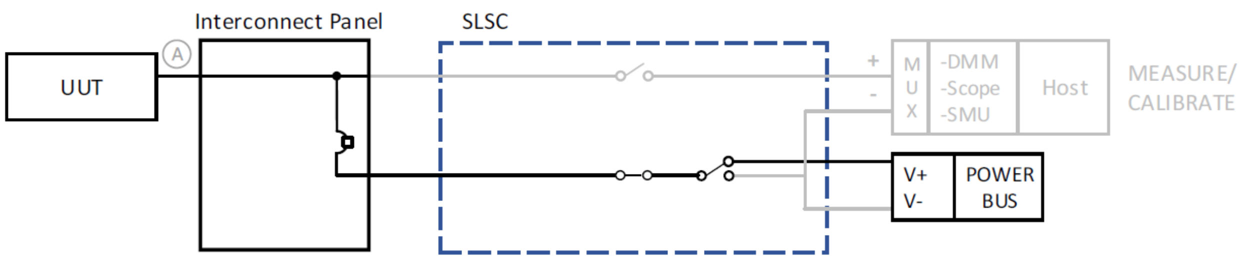
All signal types are defined from the perspective of the UUT and not of the tester. Every signal on the UUT has some combination of a pathway to the real-time simulation software, a pathway to VirtualBench instruments for Self-Test, open faulting, and short faulting.

All signals with connections to the real-time simulation software are represented by an 'Alias' in the VeriStand System Definition and are implemented by some combination of SLSC and PXI hardware. The name of the Alias matches the signal name on the UUT. The description for the 'Alias' includes the Signal Type. The linked 'Channel' for the Alias is a reference to the hardware that implements the signal. This hardware channel in VeriStand contains additional configuration options for the signal. Test scripts that reference the 'Alias' can often remain unchanged even when the hardware implementation for the Alias is modified.

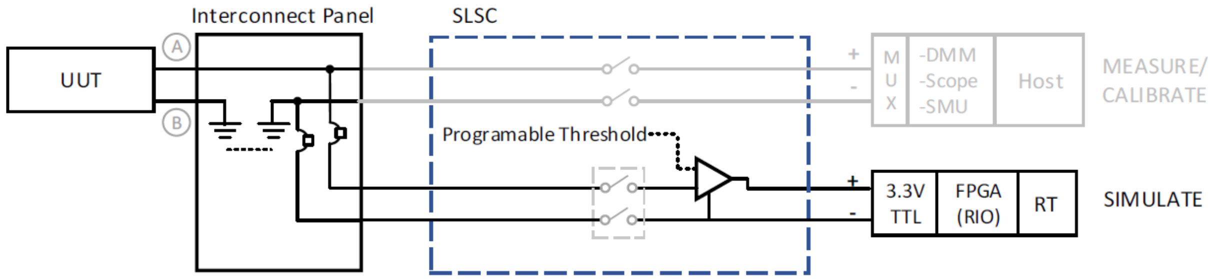
All signals with a pathway to self-test are multiplexed onto an instrument bus for either measurement or stimulus. Open faulting is included on most signals except for some digital signals, analog measurement signals, and potentiometers. Open and short faulting can also be implemented on any signal manually using the jumpers provided on the interface panel.

A conceptual circuit schematic for each signal type used in the system is included below.

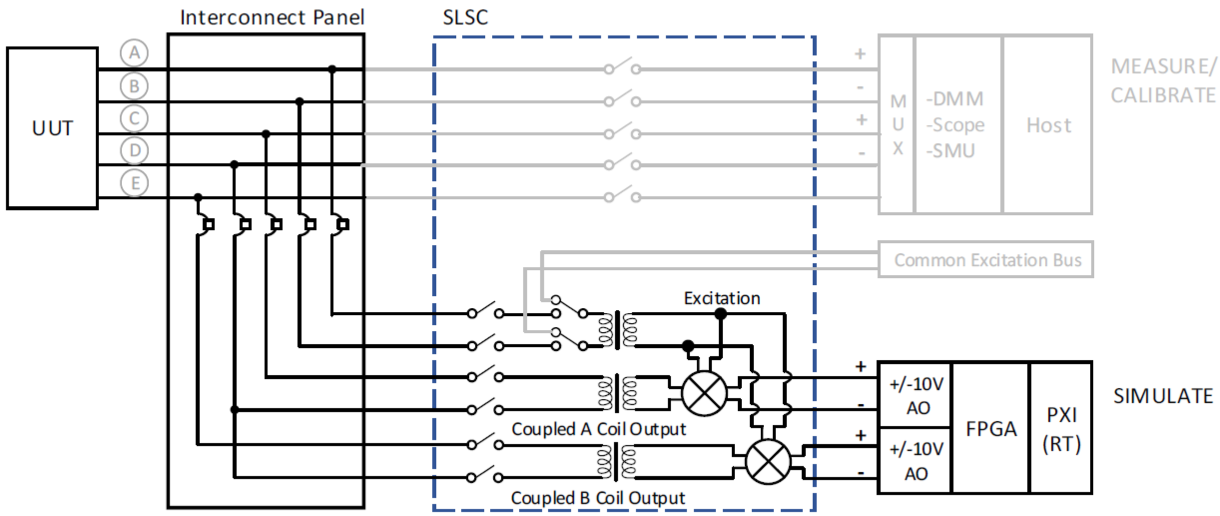
4.3.1 Input Discrete High/Gnd



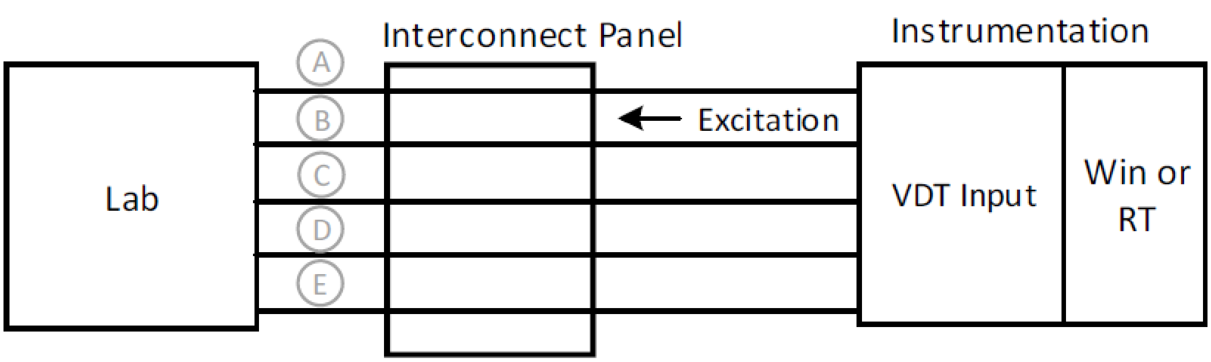
4.3.2 Output Discrete High/Gnd



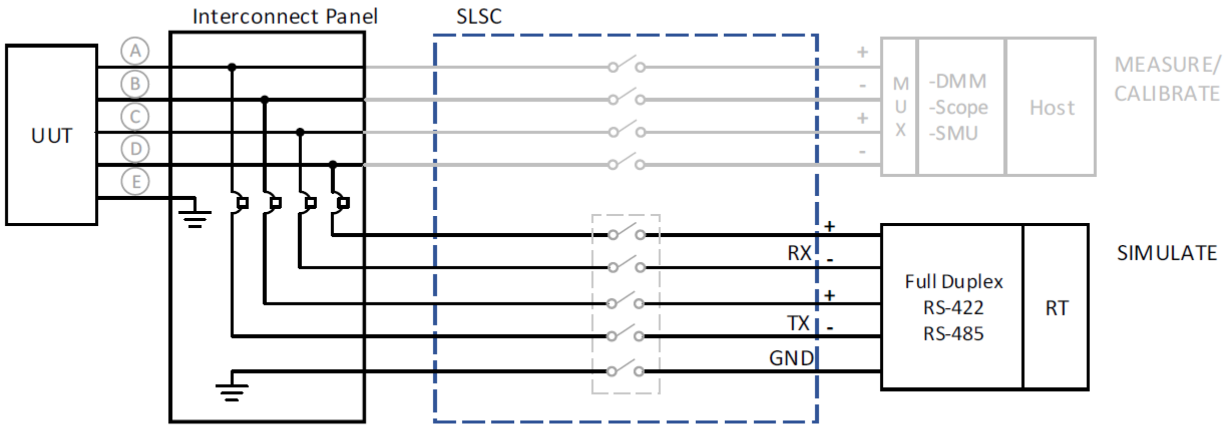
4.3.3 Input Resolver



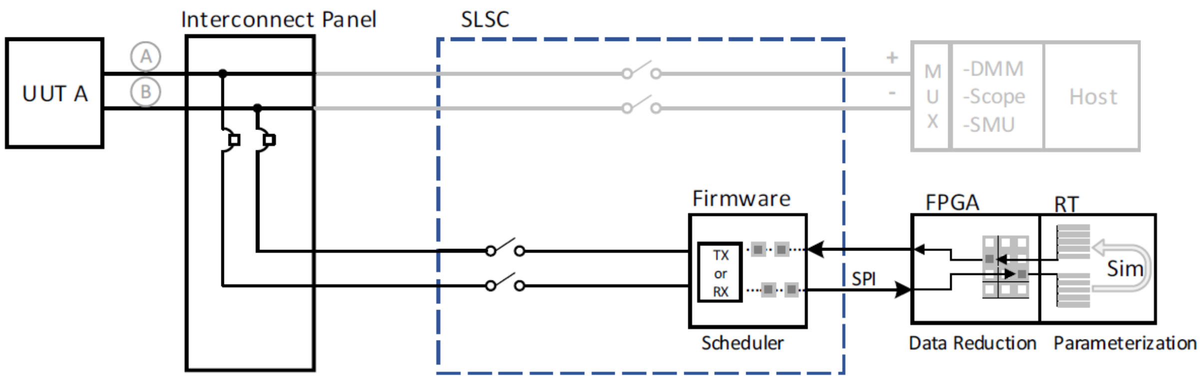
4.3.4 Lab Real 5/6-wire xVDT



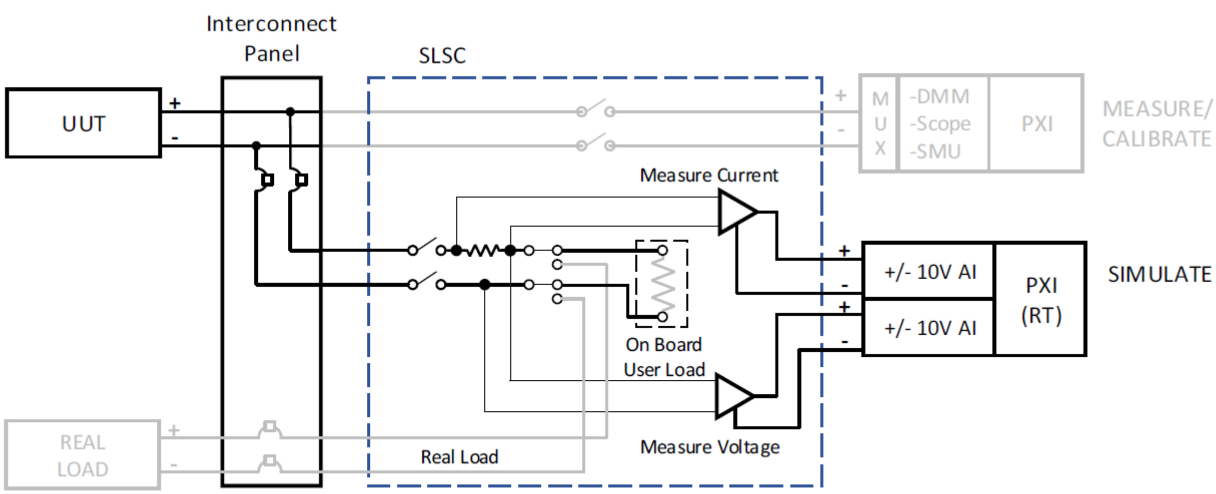
4.3.5 RS422/485 Full Duplex



4.3.6 ARINC 429 Tx/Rx



4.3.7 Fixed Small Load (<5W, <2A and 1in)



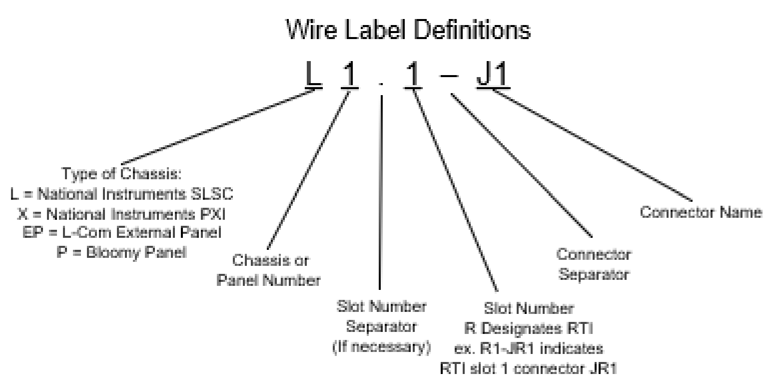
4.4 Pin Trace

The Pin Trace spreadsheets that are included with the system document the specific hardware implementation of each pin in each signal by detailing the chain of connections that are made within the ETS. The Detailed Pin Trace is intended to have as much detail as possible for the trace while the Condensed Pin Trace document is a subset intended to be printable on one page.

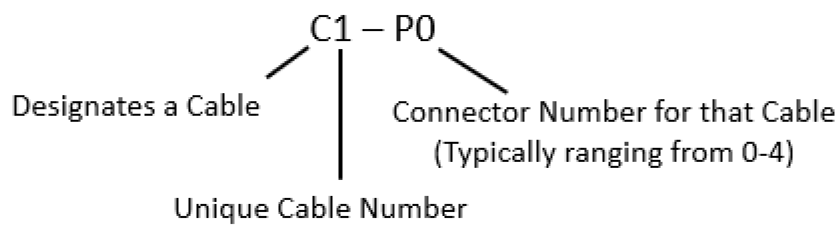
The Pin Trace is designed to be read from left to right where a signal travels through the following sections or zones in order: signal and UUT information, panel information, cable information, SLSC zone 1 information including the RTI, additional cable information, SLSC zone 2 information including the RTI, additional cable information, PXI information, and finally SLSC Self-Test information. Each section type in the document is color-coded so that they can be easily separated and identified.

A signal may only trace through a subset of these zones depending on the amount of hardware required for implementation. For example, a signal of type 'Input Discrete Open/Closed' is implemented using a single SLSC card. As a result, its SLSC zone 2, PXI, and additional cable information sections are all intentionally left blank as the signal does not trace through those zones.

Labels for Panel, SLSC, and PXI hardware, as well as their connectors, match the labels connected to the physical hardware and use the following key:



Labels for Cables, as well as their connectors, match the labels connected to the physical hardware and use the following key:



The Pin Trace documents have a variety of uses ranging from documenting where signal pins appear on a panel, documenting which PXI and SLSC hardware interacts with a signal, documenting which SLSC chassis is used for Self-Test of that signal, and other troubleshooting information.

5 TROUBLESHOOTING AND REPAIR

Ethernet/Serial Connection Issues

IP Settings

Items on the rack were shipped with pre-set static IP addresses. See the table below.

Device	Address
Rack Mount Computer	10.0.052
PXIe-8840	10.0.01
SLSC1	10.0.02
NI VirtualBench	10.0.0.3

Confirm that devices still use these IP addresses in NI MAX, unless IP addresses were intentionally changed.

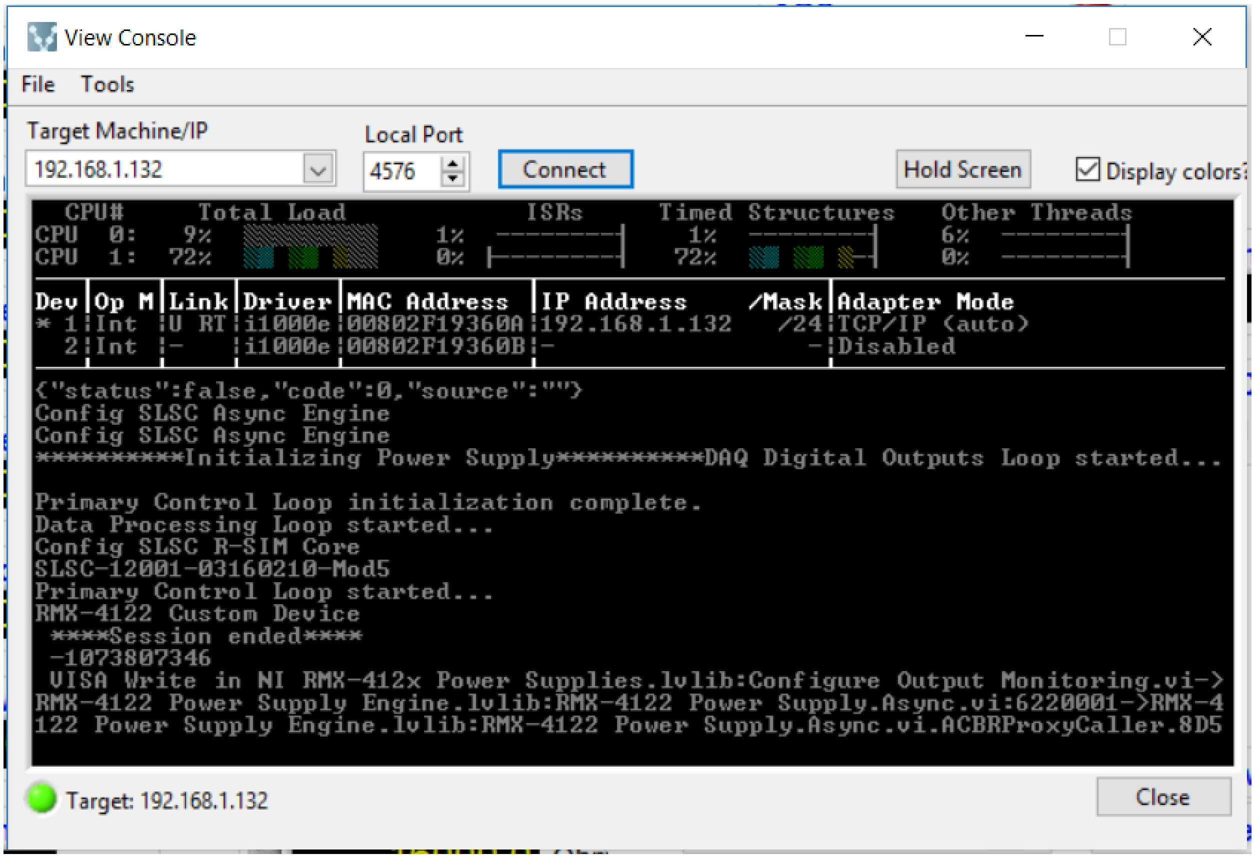
Power cycling

Connection errors can often be cleared by power cycling one or more devices. The PXI chassis, SLSC chassis, and VirtualBench can all be power cycled through NI MAX. For other instruments, manually power down the rack and power the rack back up.

Signal Troubleshooting

VeriStand Deployment Errors

For errors upon deploying the VeriStand system definition, the deployment window in VeriStand will display error information as well as an error code that can be useful for debugging. National Instruments has documentation available online that may cover experienced errors, so searching online for error codes can be useful in debugging. **If an error code is negative, do not include the "-" in your search term as it will exclude any material with that number from the search engine results**.



The VeriStand Console Viewer can also provide useful troubleshooting information as many of the software components will report their errors to the console with more information provided than the deployment window. To access the Console Viewer, navigate to **Tools >> Console Viewer** to open a connection. In the example above, the error code is listed above a description of where the error occurred.

VeriStand deployment errors can be caused by:

- Incorrect IP settings
- Devices in the rack not being powered on
- Incorrect model configuration

Appendix A: Glossary

VeriStand: See description under the Software section of “Theory of Operation”.
System Definition: See description under Software section of “Theory of Operation”.
Workspace: See description under Software section of “Theory of Operation”.
Custom Device: See description under Software section of “Theory of Operation”.
SLSC: Switch Load and Signal Conditioning.
DAQ: Data Acquisition.
PXI: PCI eXtension for Instrumentation. PXI is a standard platform for creating test and automation equipment. In the context of this document, PXI references a National Instruments chassis installed in the rack that follows the PXI standard.
Bitfile: See description under Software section of “Theory of Operation”.
NI MAX: National Instruments Measurement and Automation Explorer. MAX is a National Instruments software tool that allows the user to view information about and configure National Instruments products connected to the host, such as IP address, installed software, and network settings.
TestStand: See description under Software section of “Theory of Operation”.
Sequence file: A TestStand sequence. It contains a series of steps that execute a test on a UUT.
UUT: Unit Under Test.

VISA: A standard for communicating between hardware devices.

Pin trace: See description under “Theory of Operation”.
RMC: Rack Mount Computer.
DMM: Digital Multimeter.
FGEN: Function Generator.
RTI: Rear Transition Interface.

D9: D-Subminiature 9-pin connectors, also known as D-9, DE9, DE-9, DB9, DB-9 and D-Sub connectors.

HD44: 44 pin D-Subminiature connectors.

Daughter Card: A card inserted onto an SLSC routing card to provide custom functionality.

MUX: Multiplex.