NIDays

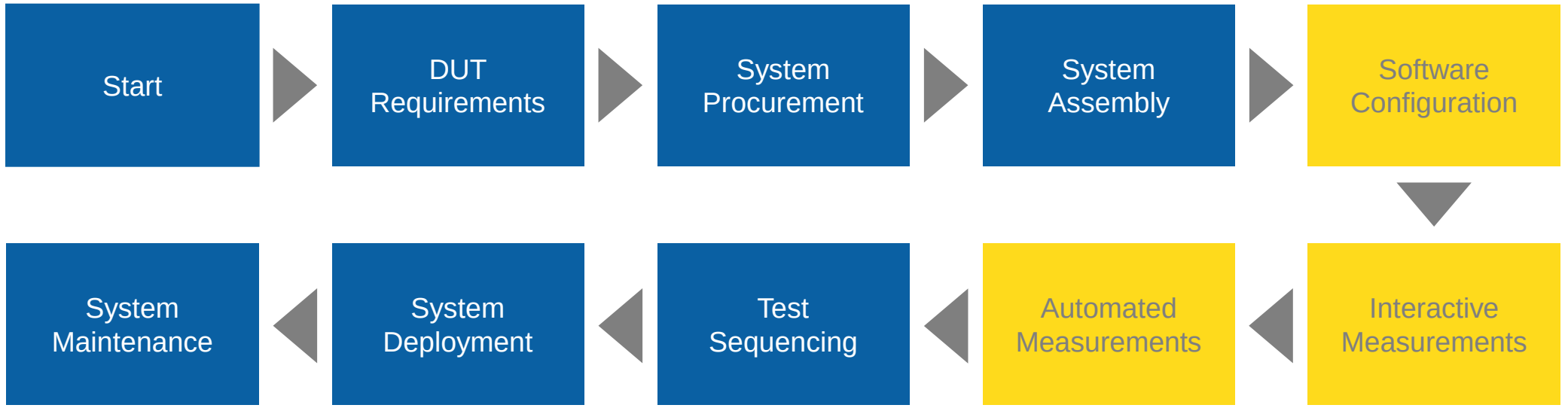
ENGINEER NEXT

Build an Automated Test System with LabVIEW NXG 2.0 and PXI

Name

Title

Building an Automated Test System Workflow



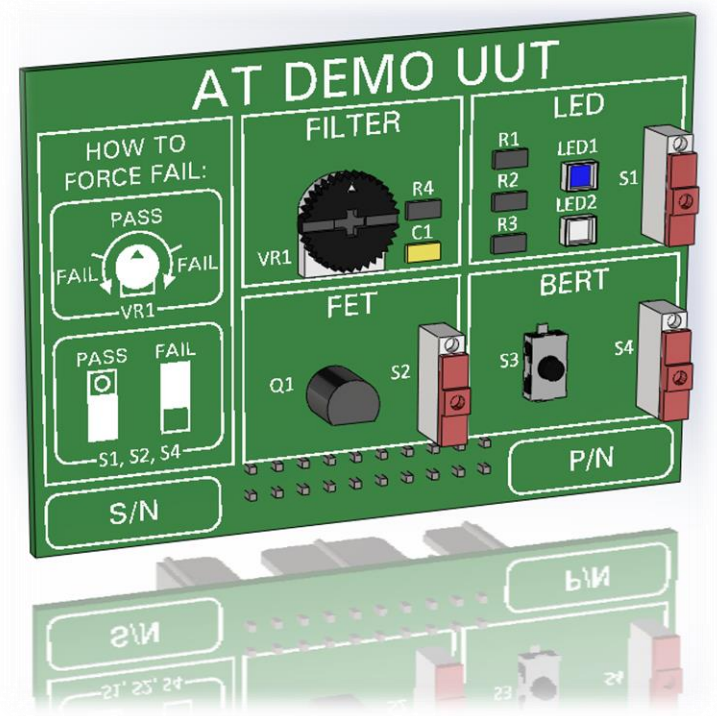
NATIONAL INSTRUMENTS

Denotes focus areas for exercises

DUT Requirements

Device Under Test (DUT)

- **Low-Pass Filter** — Frequency Response Test
- **Field Effect Transistor (FET)** — IV Characterization
- **Light Emitting Diode (LED)** — Diode Test
- **Transmission Lines** - Bit Error Rate (BER) Test



*Also known as Unit Under Test (UUT)

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System Procurement and Assembly

Today’s PXI Test System

PXI Modular Instruments
- PXI Oscilloscope
- PXI Arbitrary Waveform Generator
- PXI Digital Multimeter
- PXI Source Measure Unit (SMU)
- PXI Matrix Switch
- & More

PXI Chassis
8 slots

Software
- LabVIEW NXG 2.0 Beta
- Instrument Drivers
- Soft Front Panels
- & More

Test Fixture
4 Devices Under Test (DUTs)

PXI Controller
Windows OS

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Advantages of PXI Instrumentation

- High Measurement Quality
- Low Latency & High Throughput
- Software-Defined Functionality
- Integrated Timing and Sync
- High Performance Processing
- Reduced Size, Weight, and Power
- Complete Instrumentation Portfolio

NATIONAL INSTRUMENTS

Industry-Leading Test & Measurement Platform

PXIe-5162
PXI Oscilloscope
4ch, 1.5GHz, 10-bits

PXIe-4081
PXI Digital Multimeter
7½-digit, 1,000 V

PXIe-5668
PXI Vector Signal Analyzer
26.5 GHz, 765 MHz Bandwidth

PXIe-4135
PXI Source Measure Unit
10 fA Sensitivity

PXIe-1085
PXI Chassis
24 GB/s Throughput

PXIe-8880
PXI Controller
8-Core Intel Xeon

PXIe-5840
PXI Vector Signal Transceiver
1 GHz Instantaneous Bandwidth

PXIe-2543
PXI RF Multiplexer Switch
6 GHz, 8-ch, Solid-State

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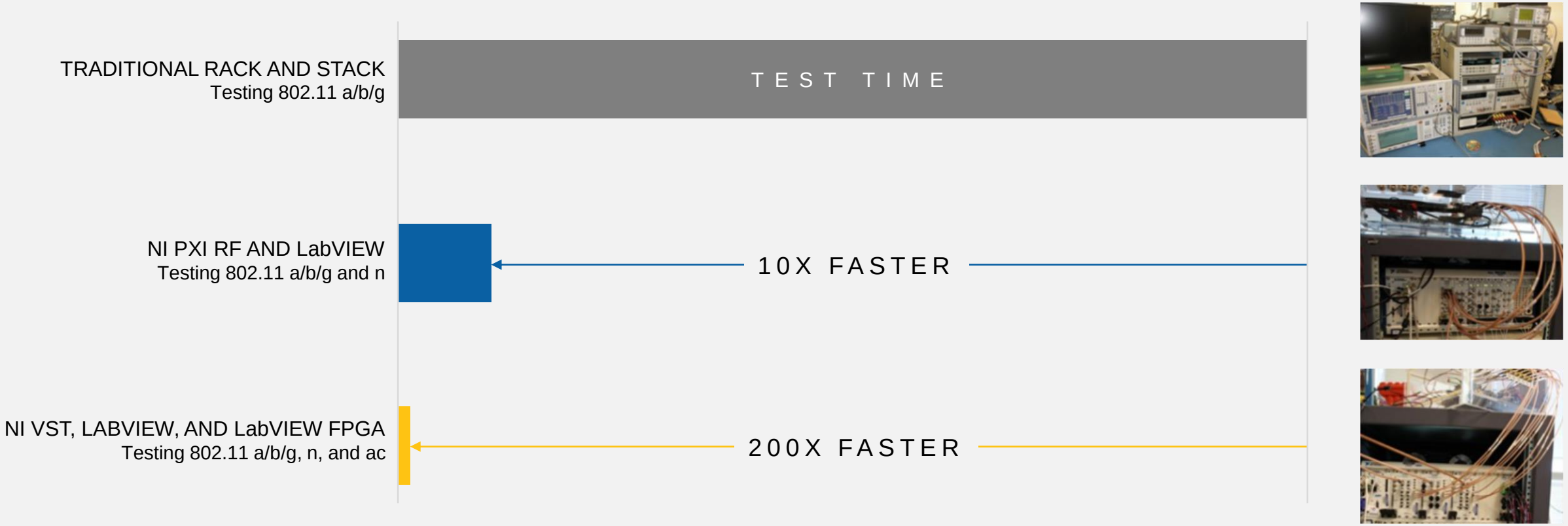


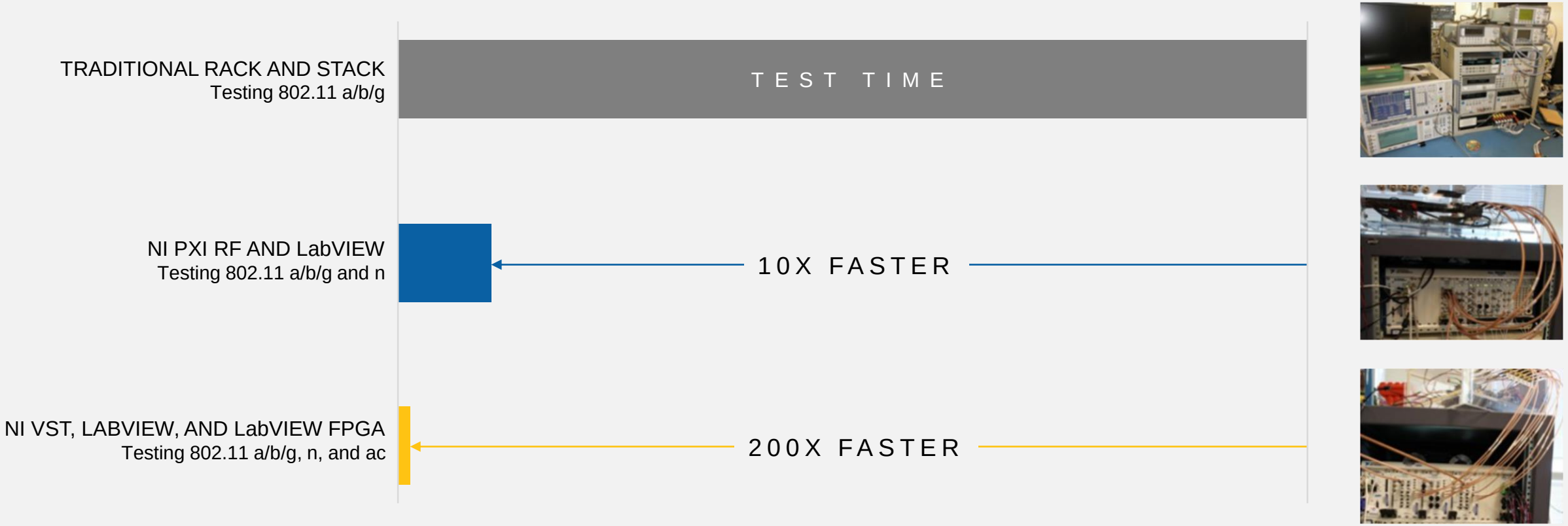
Qualcomm Atheros Reduces Test Times of RF Power Amplifiers

- 200X reduction in test time
- Lower test costs
- Achieves more complete device characterization

Qualcomm ATHEROS

NATIONAL INSTRUMENTS

ni.com



"Using the software-designed PXI Vector Signal Transceiver and the NI WLAN Measurement Suite, we improved test speeds by more than 200 times compared to traditional rack-and-stack instruments while significantly improving test coverage."

—Doug Johnson, Qualcomm Atheros

Qualcomm ATHEROS

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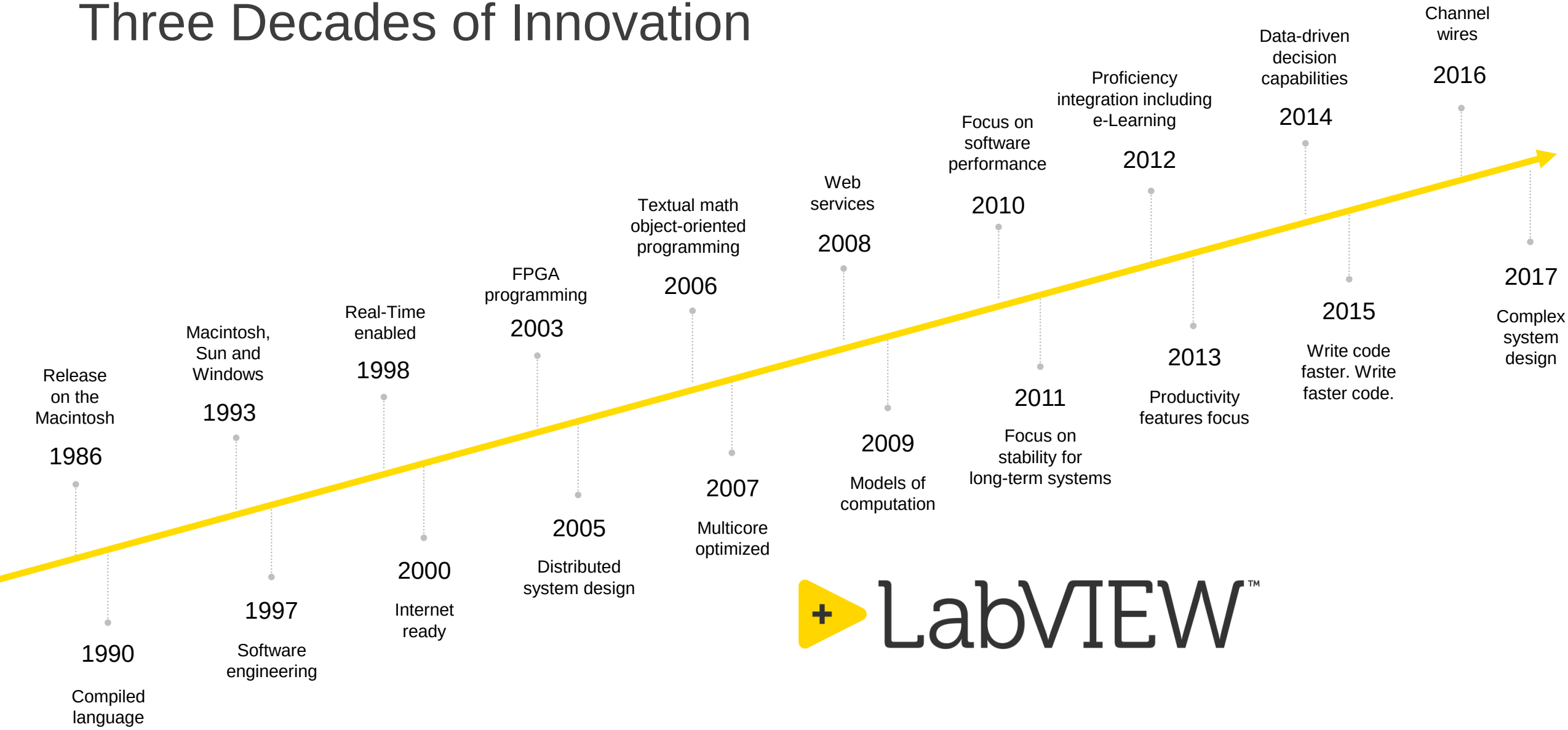
Software Configuration

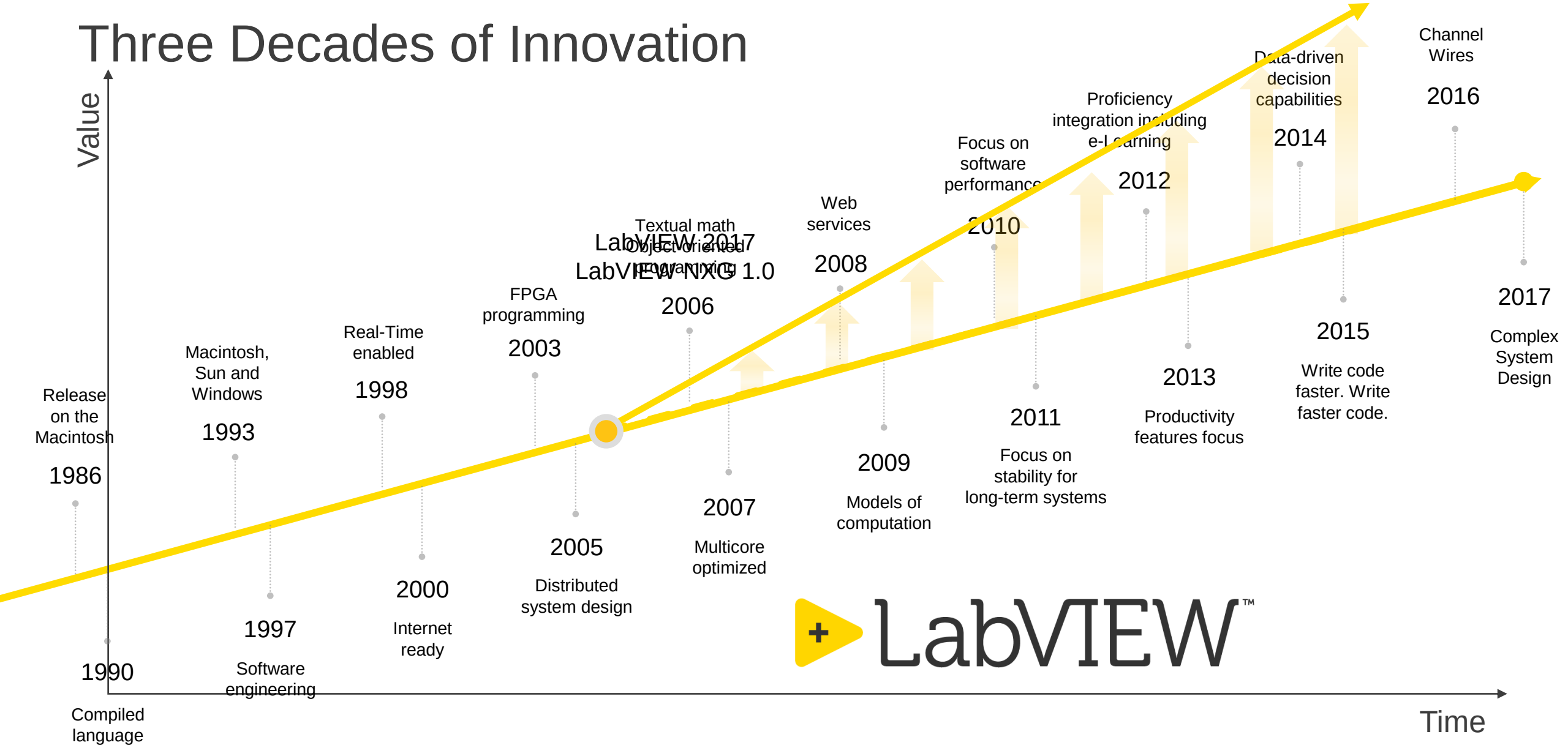
Three Decades of Innovation



LabVIEW™

NATIONAL INSTRUMENTS™

Three Decades of Innovation



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LabVIEW™ NXG 2.0

Experience the next generation of configuring and automating measurements

- Discover and Document Instrumentation
- Start from Guided, Instrument-Specific Examples
- Reuse Tests and Functions
- Design User Interfaces
- Explore Engineering Data
- Build Scalable Libraries and Deployments
- View Results from Anywhere

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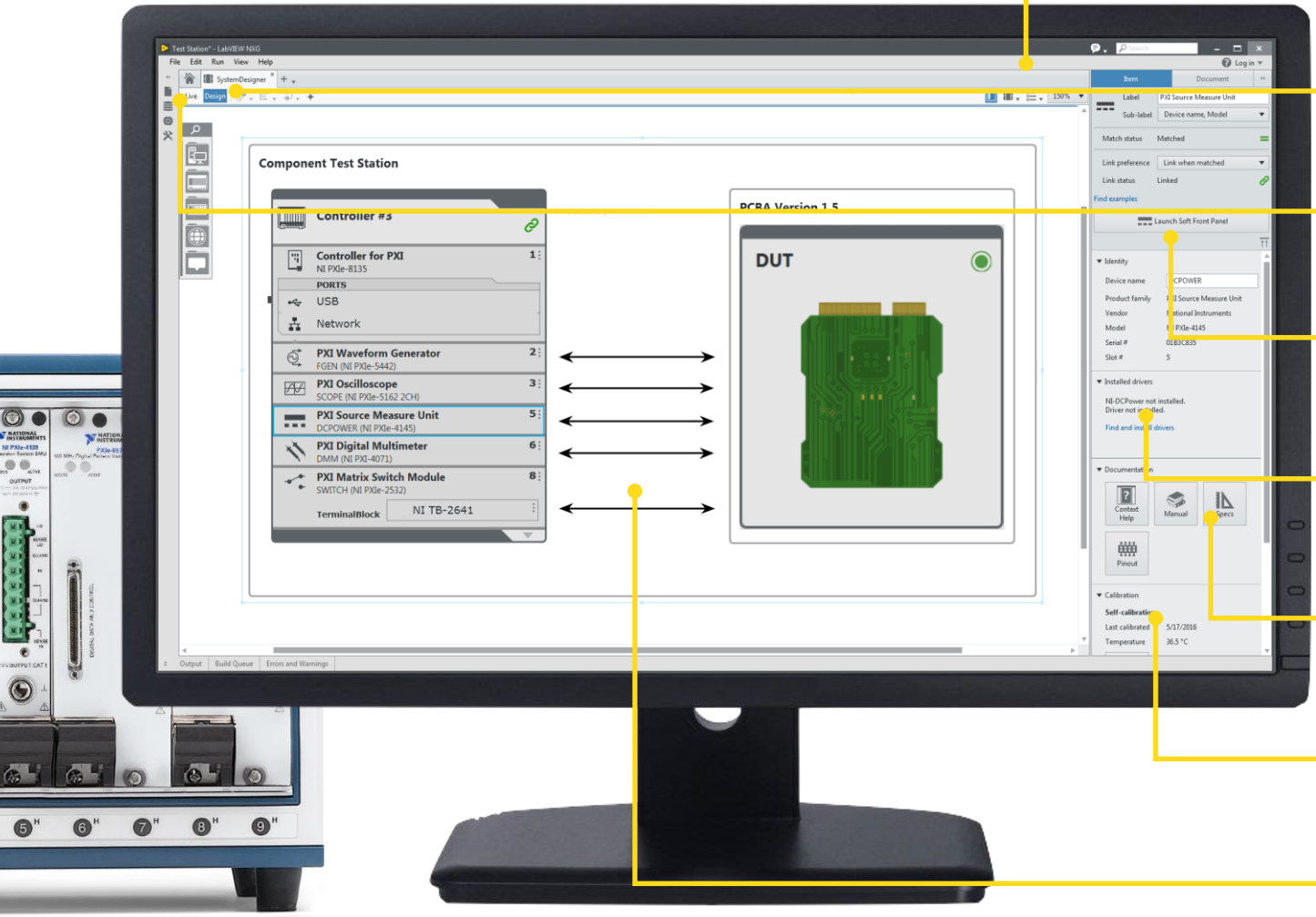
SystemDesigner - Discover and Document Instrumentation



Option to view as diagram (shown) or list

Live view for automatic discovery of hardware connected to system controller;

Design view for offline or simulated system documentation and configuration

Launch soft front panel for interactive measurements

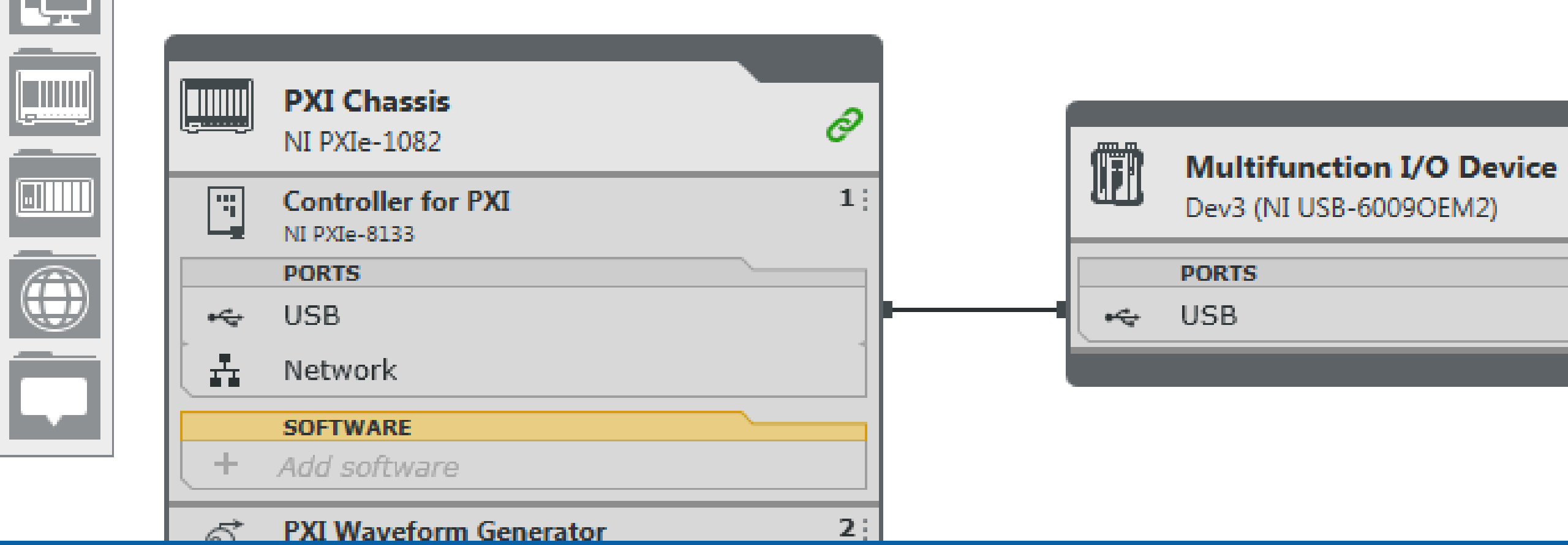
View installed drivers and direct link to available drivers if not installed on system controller

Link to specifications and pinouts

Calibrate instrument and view calibration information

Annotate with labels, wires, images, and shapes

NATIONAL INSTRUMENTS



Exercise 1 - Introduction to LabVIEW NXG 2.0 and SystemDesigner

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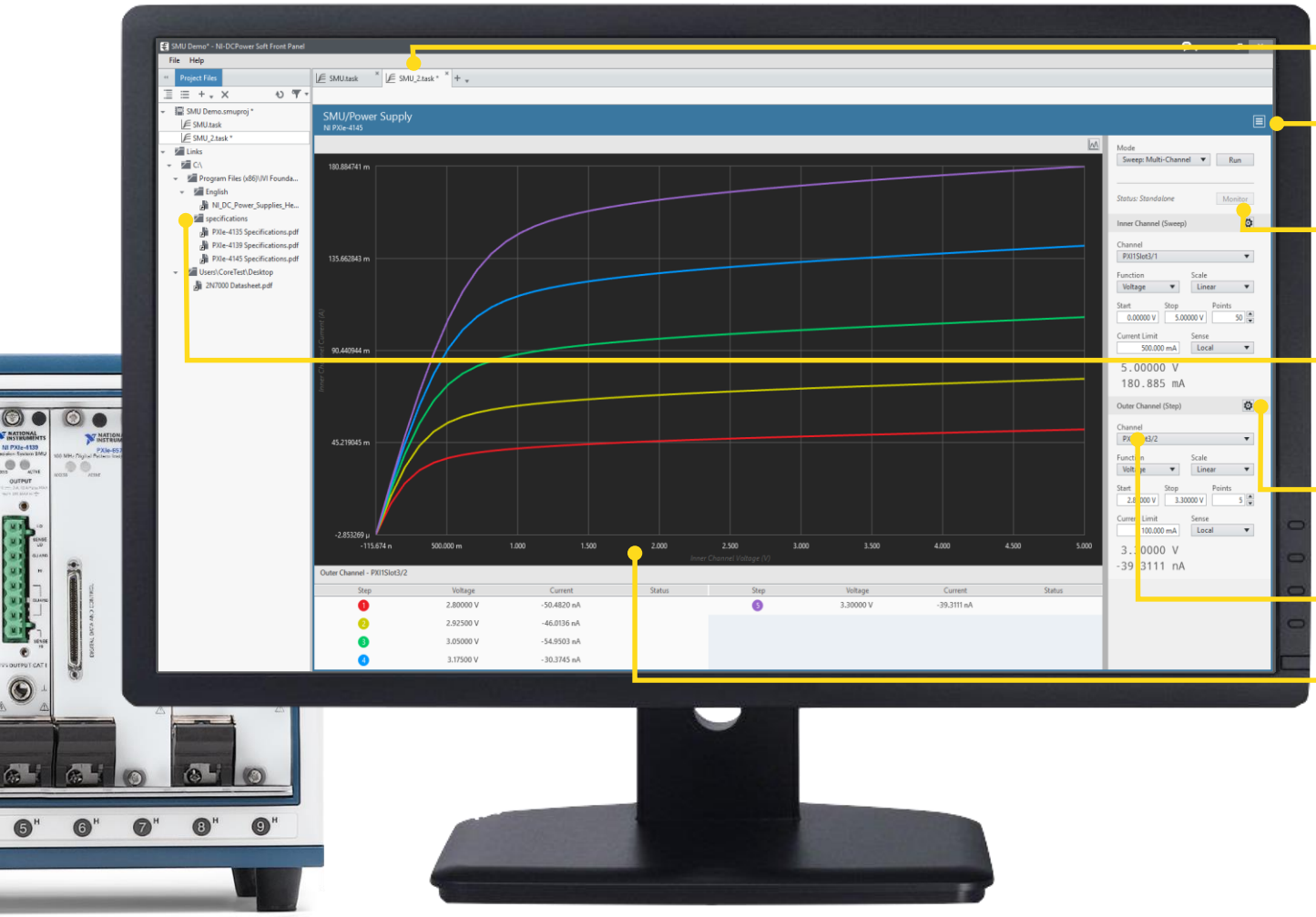
Time to complete: 5 minutes

Interactive Measurements

Soft Front Panels - Interactive Measurements



Save and load configurations

Export data

Monitor instrument output with Debug Driver Technology

Quickly access files (e.g. data sheets or user manuals)

Access advanced timing and measurement settings

Rename channels

Run 1 or 2 channel sweep

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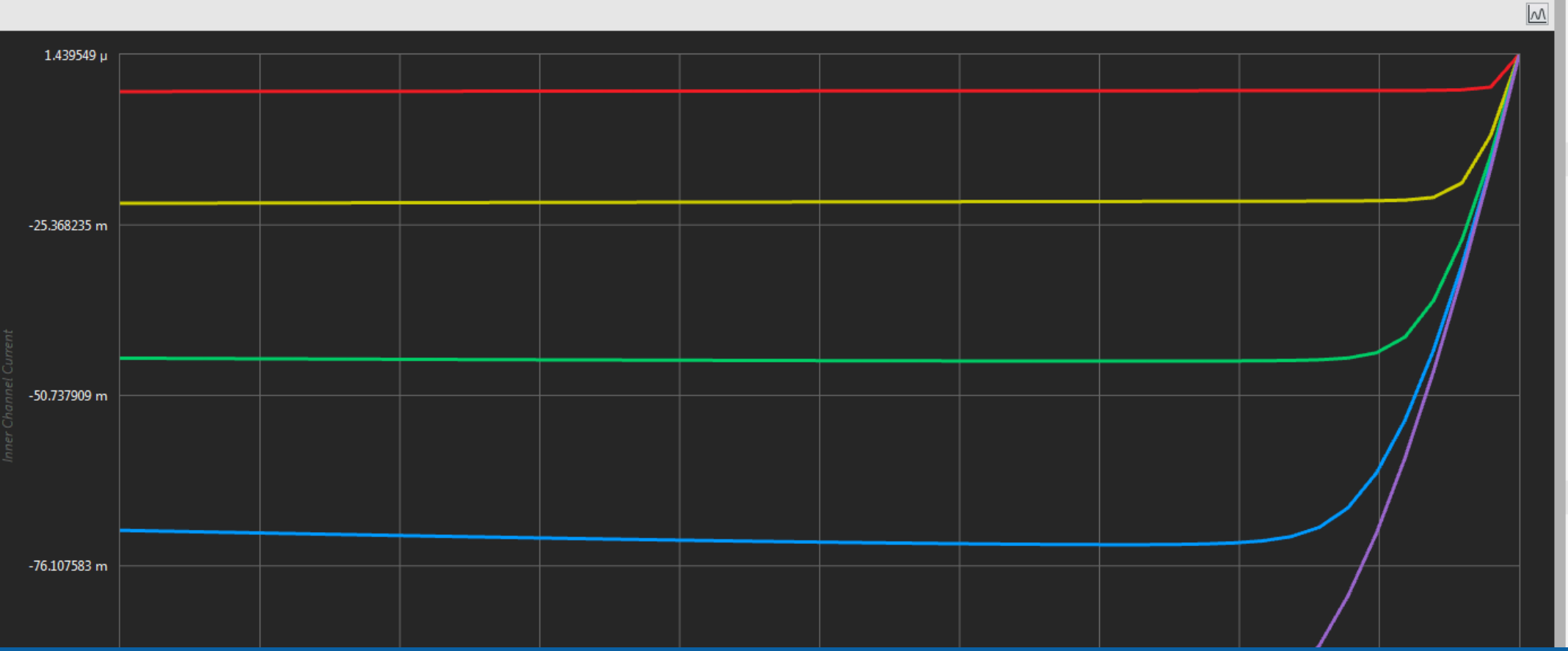

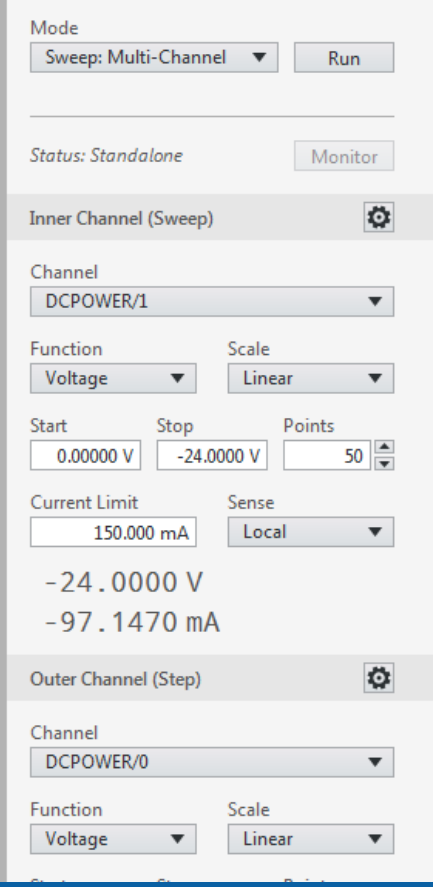

Exercise 2 - Introduction to Soft Front Panels

- **Exercise 2.1** - Exploring the SMU Soft Front Panel
- **Exercise 2.2** - Perform an IV Sweep with the SMU Soft Front Panel

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Time to complete: 10 minutes

Automated Measurements

LabVIEW™ NXG 2.0

Experience the next generation of configuring and automating measurements

- Discover and Document Instrumentation
- Start from Guided, Instrument-Specific Examples
- Reuse Tests and Functions
- Design User Interfaces
- Explore Engineering Data
- Build Scalable Libraries and Deployments
- View Results from Anywhere

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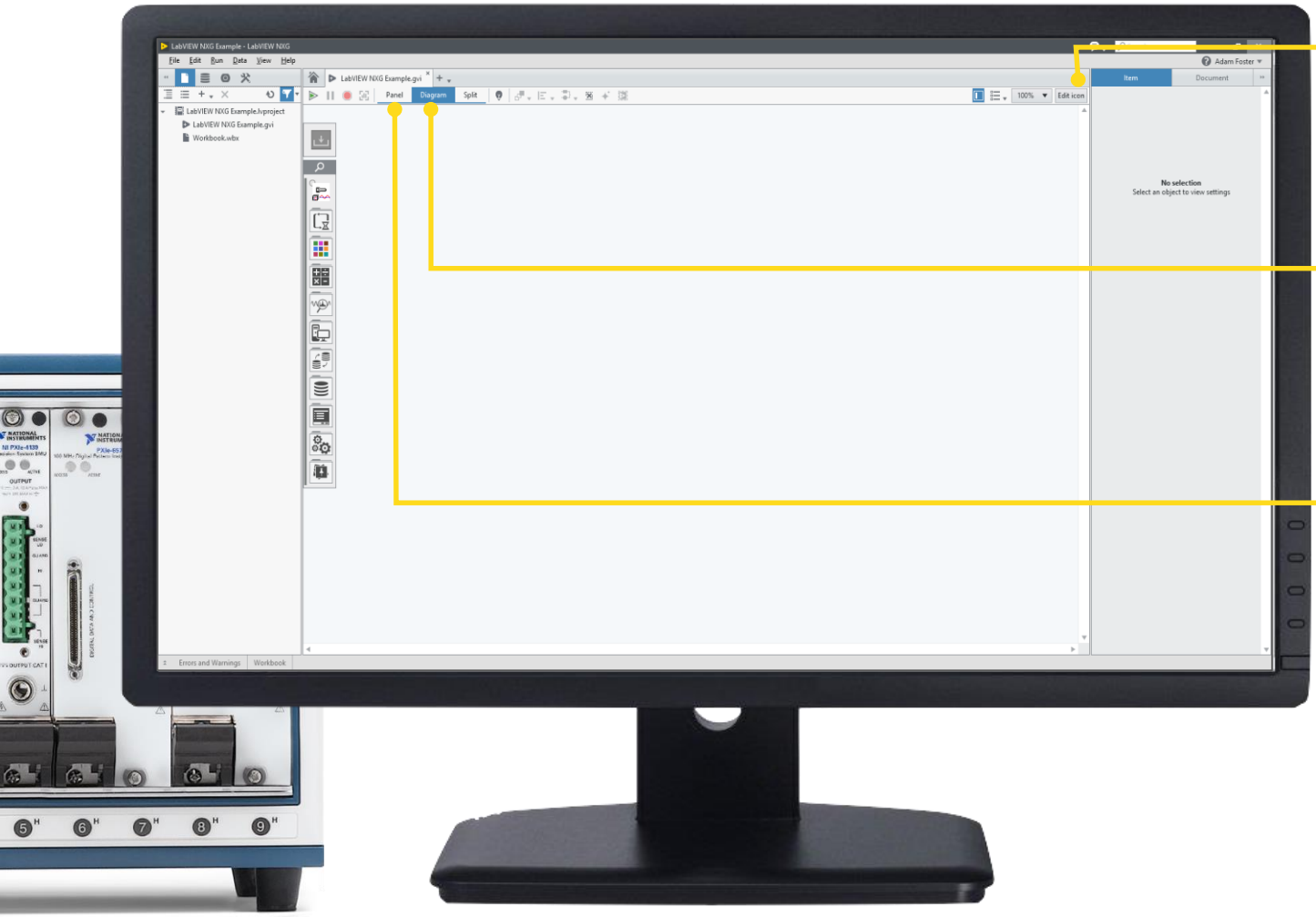
LabVIEW NXG Building Blocks Are Virtual Instruments (VIs)

(*.GVIs)



Icon and Connector Pane
Maps inputs and outputs

Diagram
The source code of a VI

Panel
The user interface of a VI

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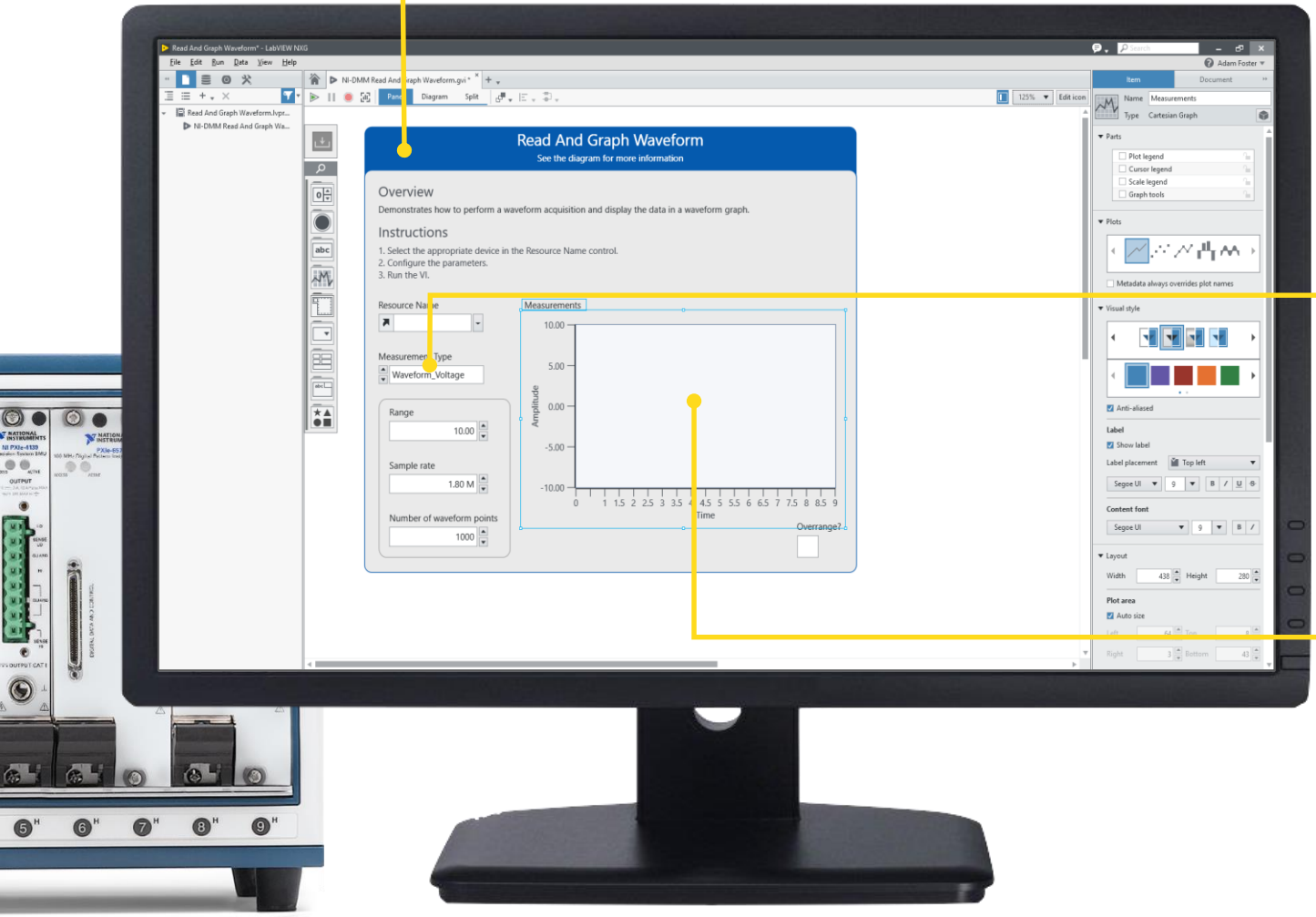
Front Panel Objects



Decorations

Decorative elements and imagery

- Text
- Arrows
- Callouts
- Lines
- Images
- …and more

Customizable Controls

Receive input from a user

- Knobs and dials
- Sliders
- Buttons
- Numbers
- Strings and paths
- …and more

Customizable Indicators

Convey outputs to a user

- Graphs and charts
- Progress bars
- Gauges and meters
- LEDs
- Numbers
- Strings and paths
- …and more

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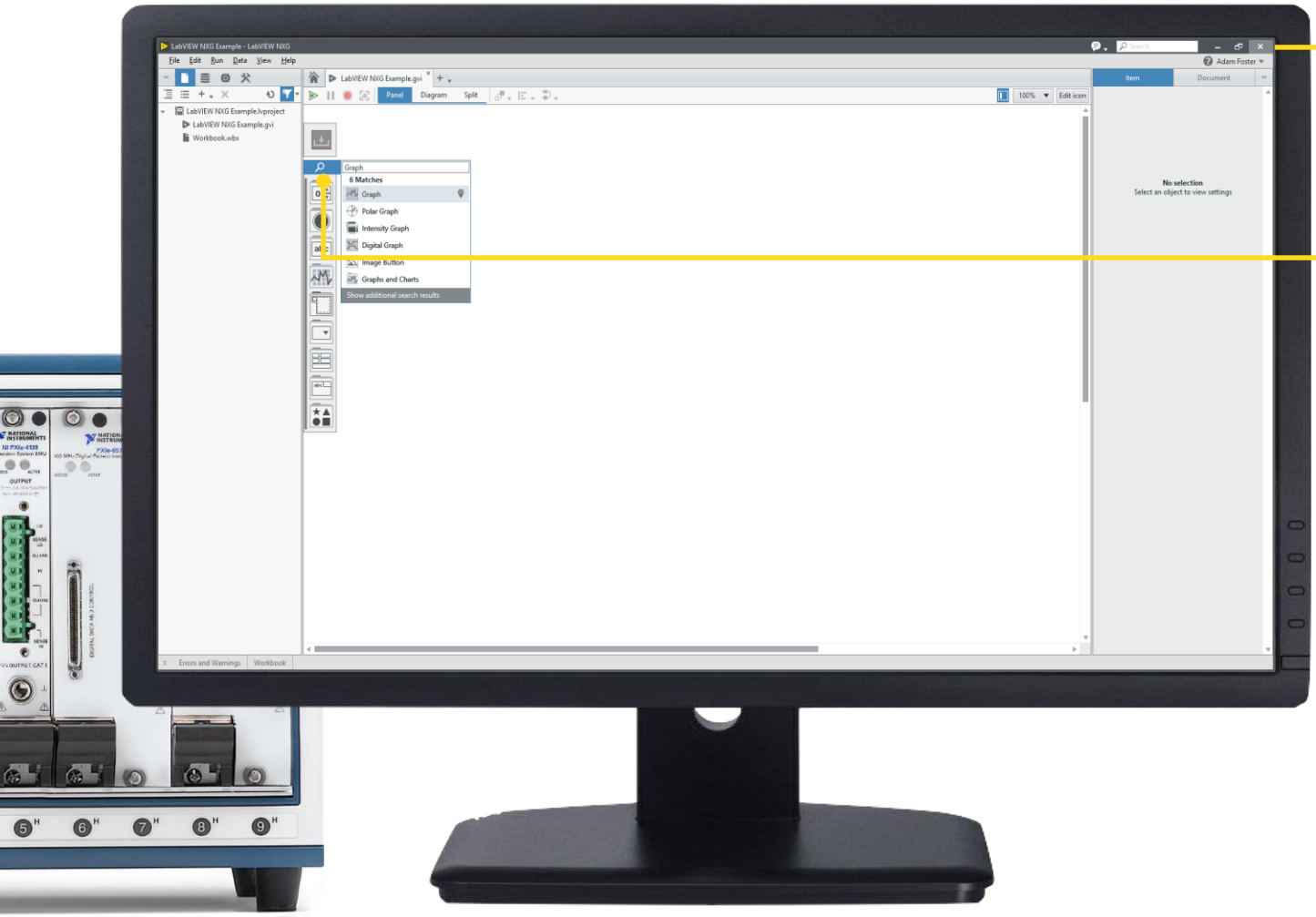
Creating a LabVIEW Panel

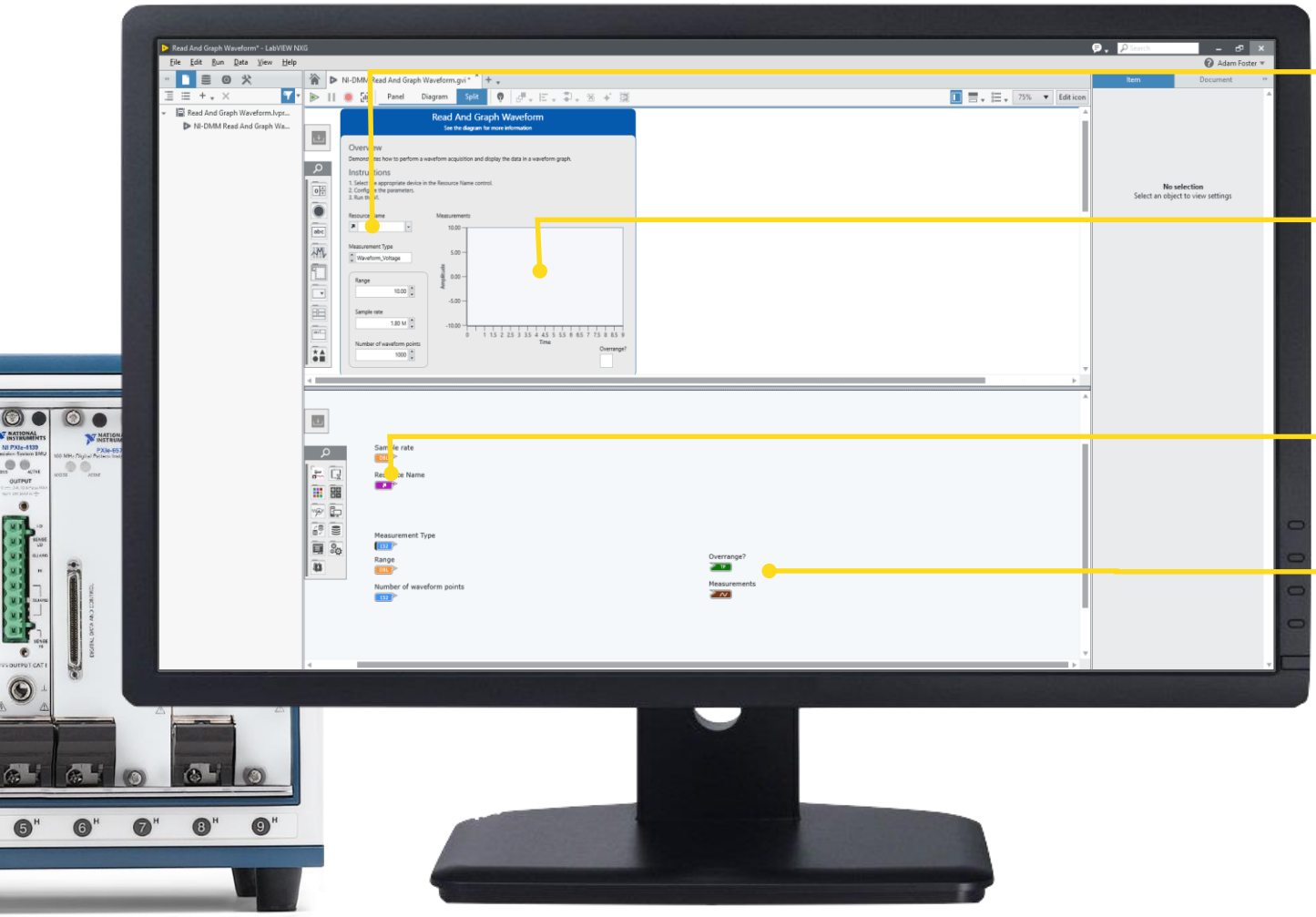


Controls Palette
Hierarchical palette of all panel elements

Quick Drop (Ctrl-Space)
Search by object name

NATIONAL INSTRUMENTS

All Panel Elements Have Diagram Terminals



Customizable Controls
Receive input from a user

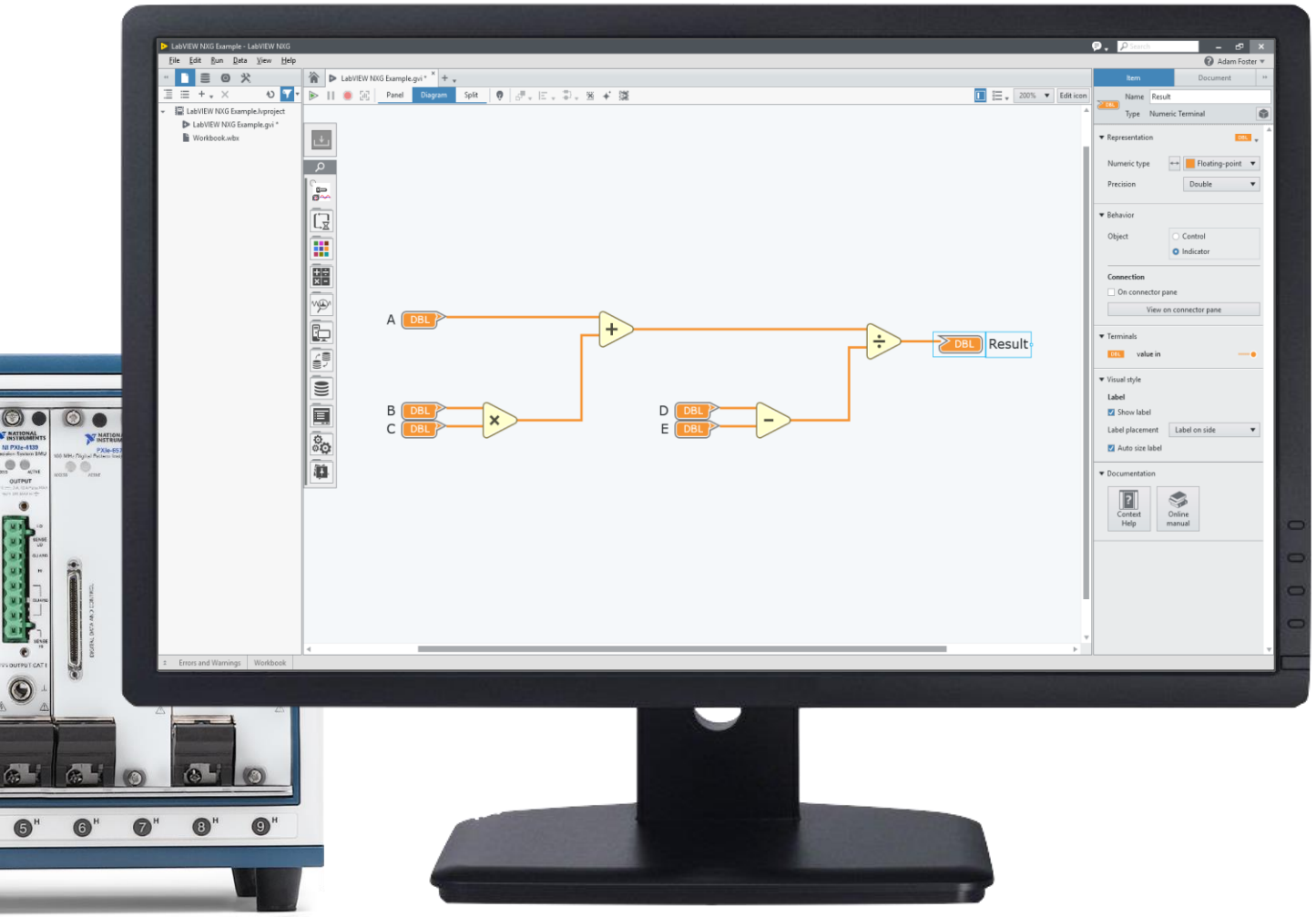
Customizable Indicators
Convey outputs to a user

Control Terminals
Receive input from a user

Indicator Terminals
Convey outputs to a user

NATIONAL INSTRUMENTS

What Is Data Flow?



- Each diagram node executes only when it receives all inputs
- Each node produces output data after execution
- Data flows along a path defined by wires
- The movement of data determines execution order

- **Challenge:** What is the result of the formula?
  - Result = $\frac{A+(B\times C)}{D-E}$

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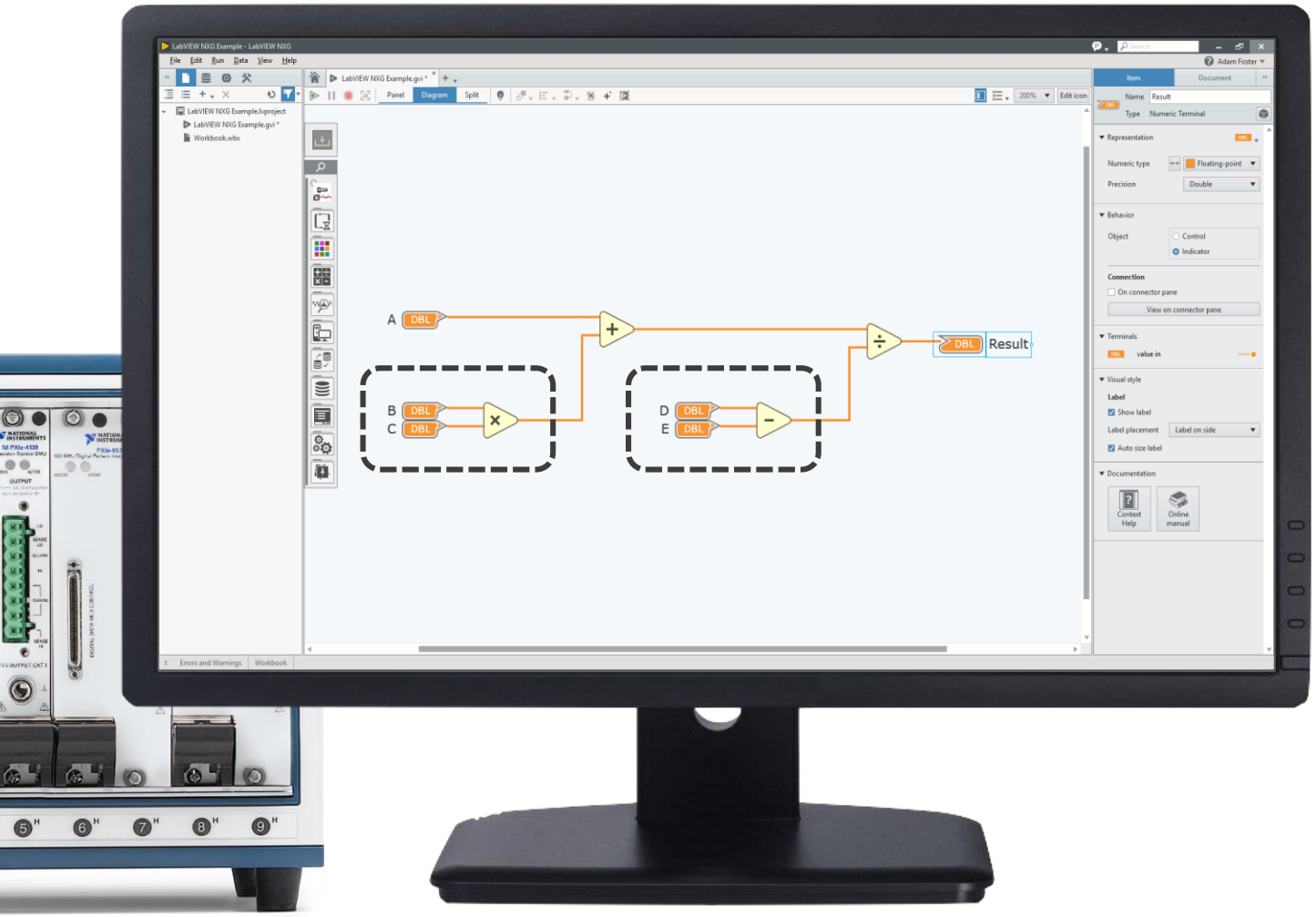
What Is Data Flow?



- Each diagram node executes only when it receives all inputs
- Each node produces output data after execution
- Data flows along a path defined by wires
- The movement of data determines execution order

- **Challenge:** Which operation will finish first? Multiplication or subtraction?
  - The [multiplication] and [subtraction] operations can execute at the same time, since they don't have any data dependencies.

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Wires - Color, Style, and Thickness

Wire Type	Scalar	1D Array	2D Array	Color
Floating Point				Orange
Integer				Blue
Boolean				Green
String				Pink
Error				Yellow

A "broken wire" represents a data type conflict that LabVIEW cannot automatically resolve. Fix it, or your code won't run!

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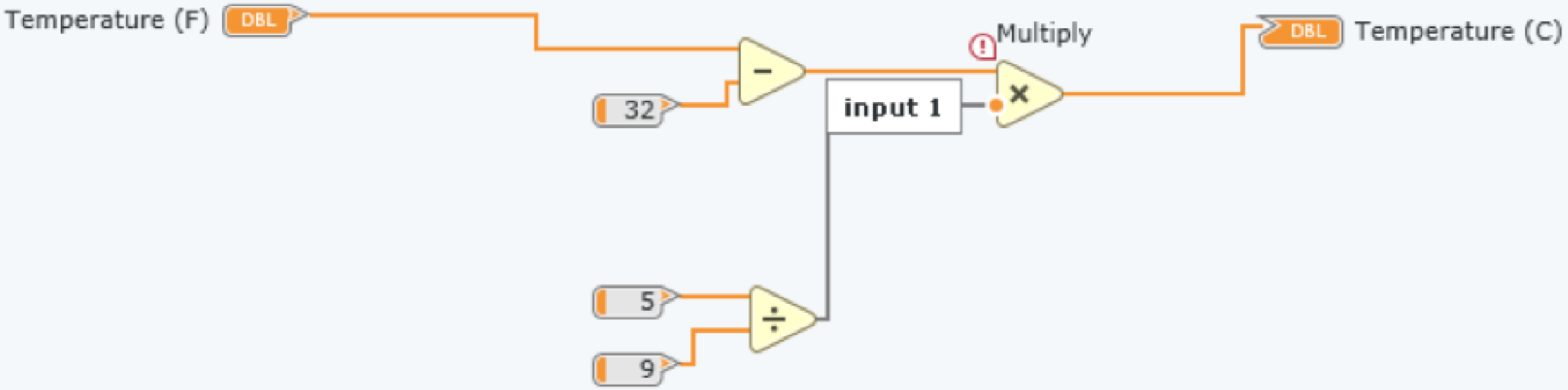


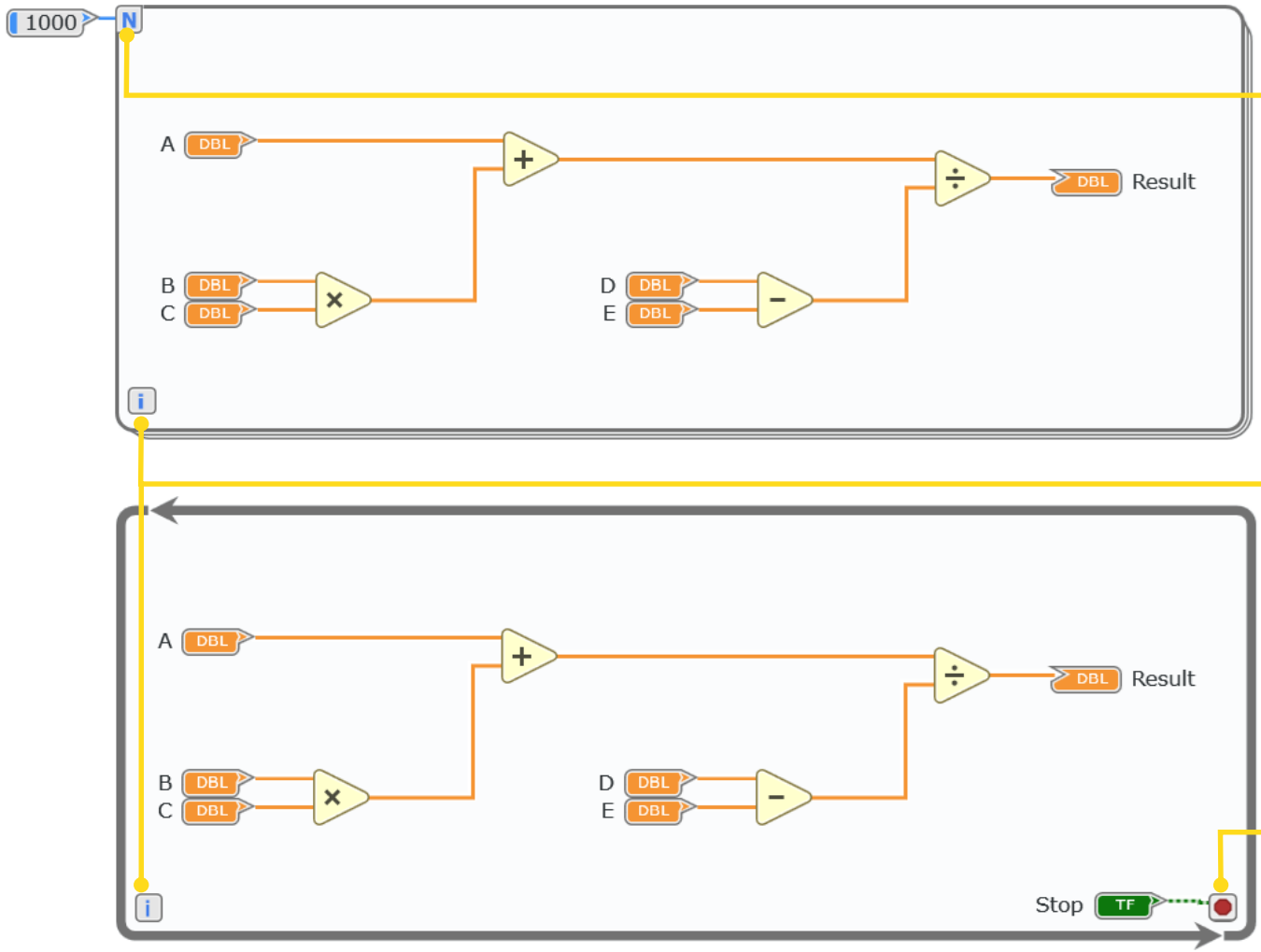
Exercise 3 - Programming in LabVIEW NXG

- **Exercise 3.1** - Create a Simple Conversion Tool

NATIONAL INSTRUMENTS

Time to complete: 5 minutes

Execution Control Structures: Loops



Count Terminal
The code contained within this For Loop will execute N times

Loop Iteration Terminals
This provides the current loop iteration count, which ranges from 0 to N-1

Conditional Terminal
The code within this While Loop will run until a True value is encountered

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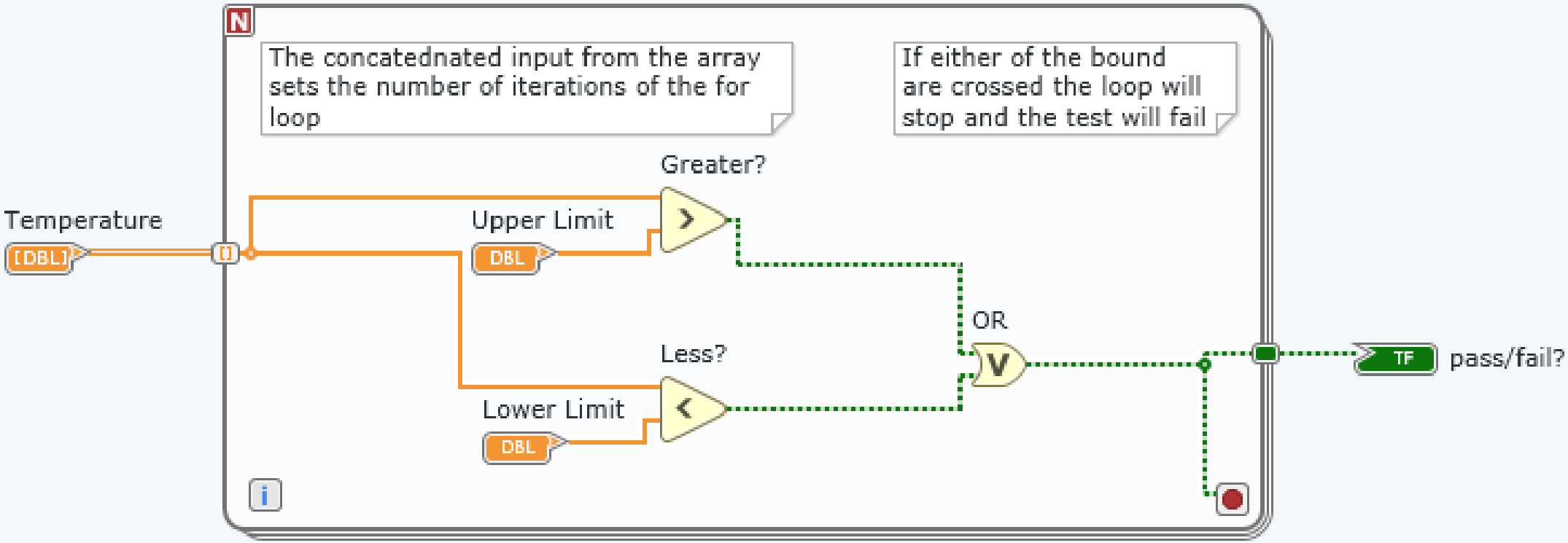

Exercise 3 - Programming in LabVIEW NXG

- **Exercise 3.2** - Using Loops in LabVIEW NXG
- **Exercise 3.3 (OPTIONAL)** - Charts and Graphs in LabVIEW NXG

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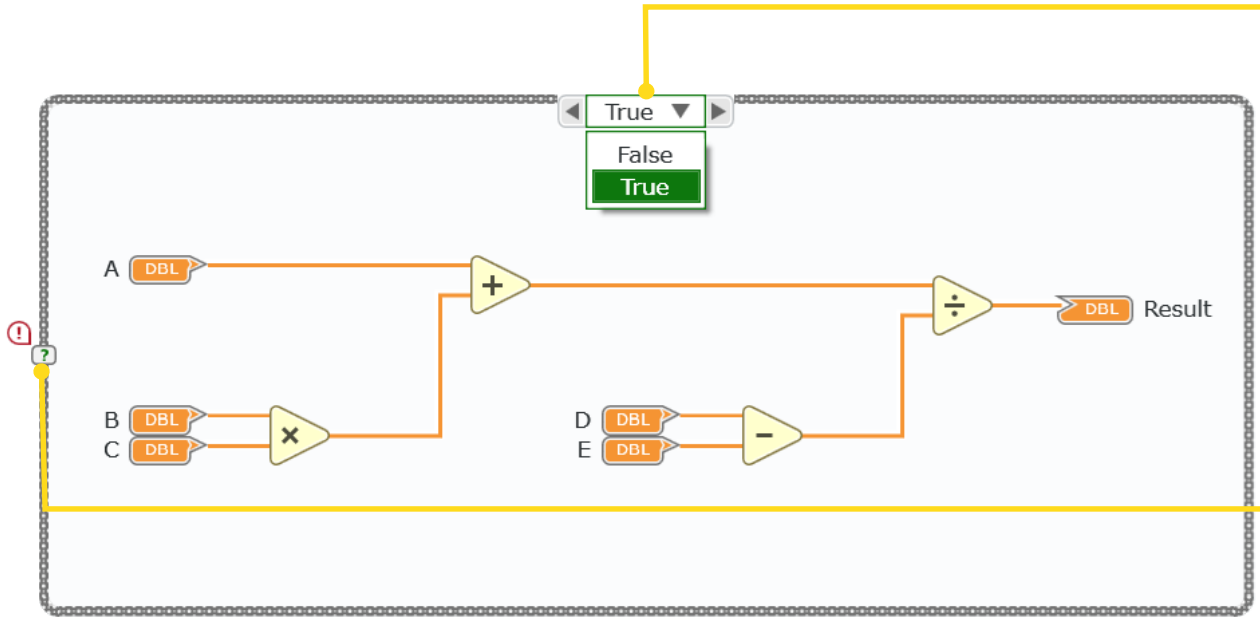
Time to complete: 10 minutes

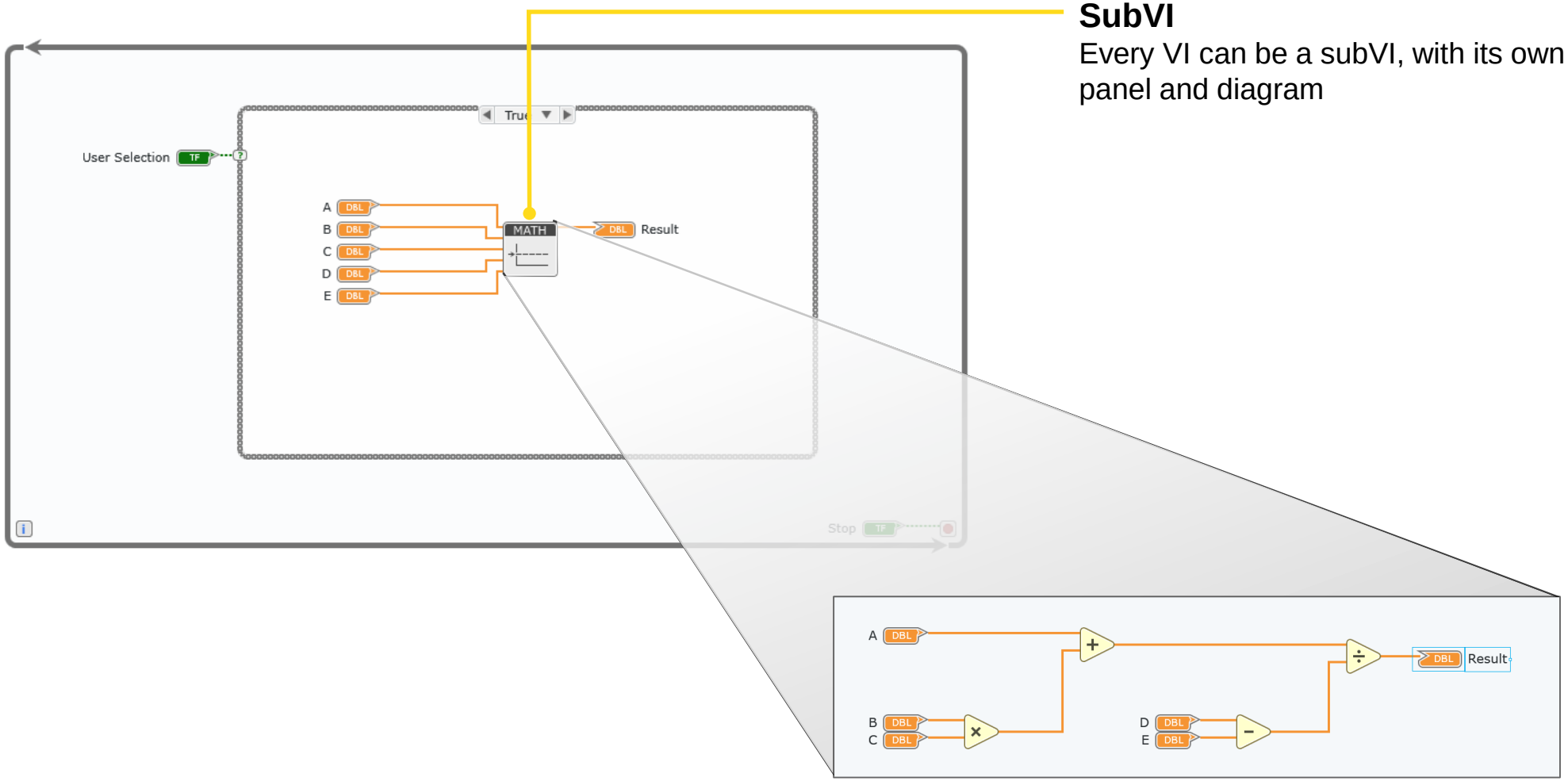
Execution Control Structures: Case Structure



Case Selector Label
This indicates which sub-diagram is visible

Selector Terminal
The value wired to this terminal determines which of the sub-diagrams, or cases, will execute

SubVIs: Using a VI Within Another VI



SubVI

Every VI can be a subVI, with its own panel and diagram

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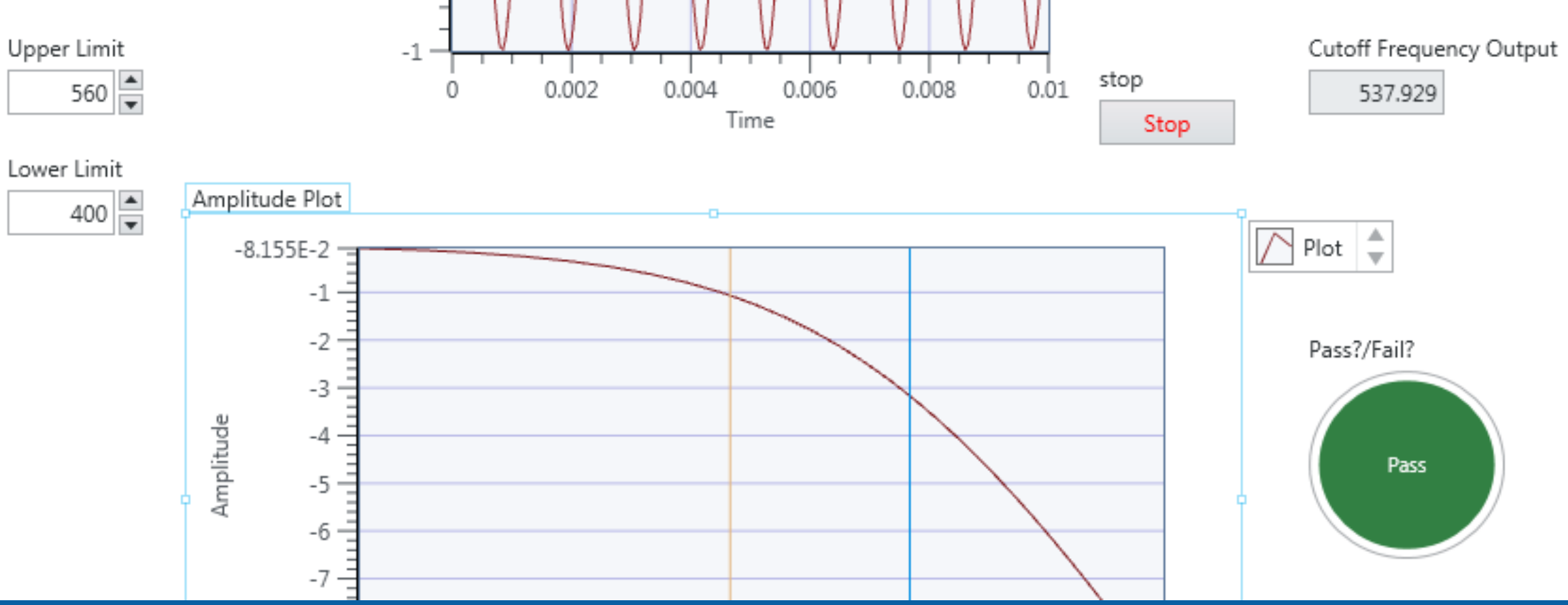

Exercise 4 - Simulated Frequency Response Test

- **Exercise 4.1** - Simulate and Plot a Signal
- **Exercise 4.2** - Build a Frequency Response Test

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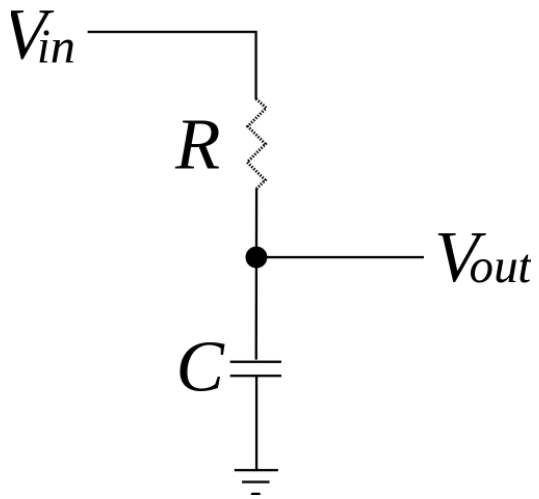
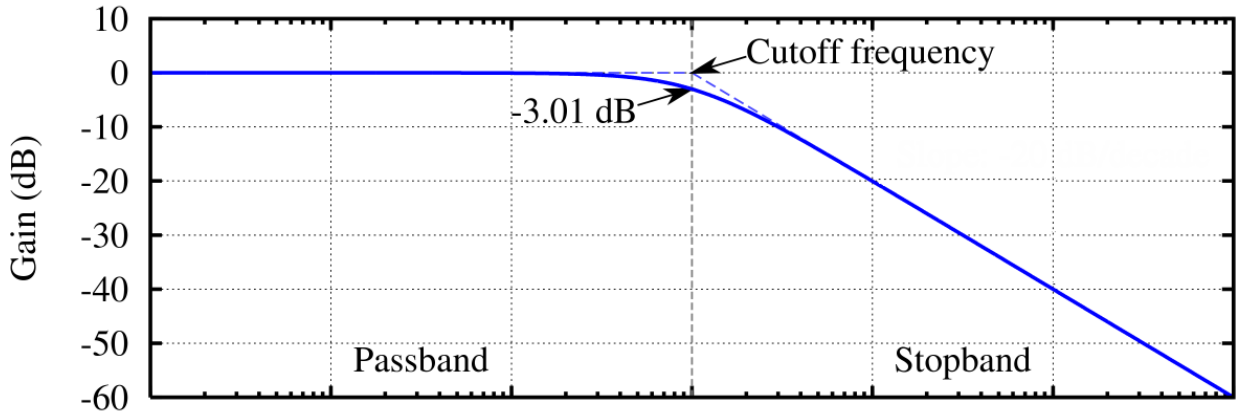
Time to complete: 20 minutes

Frequency Response Test of a Low-Pass Filter





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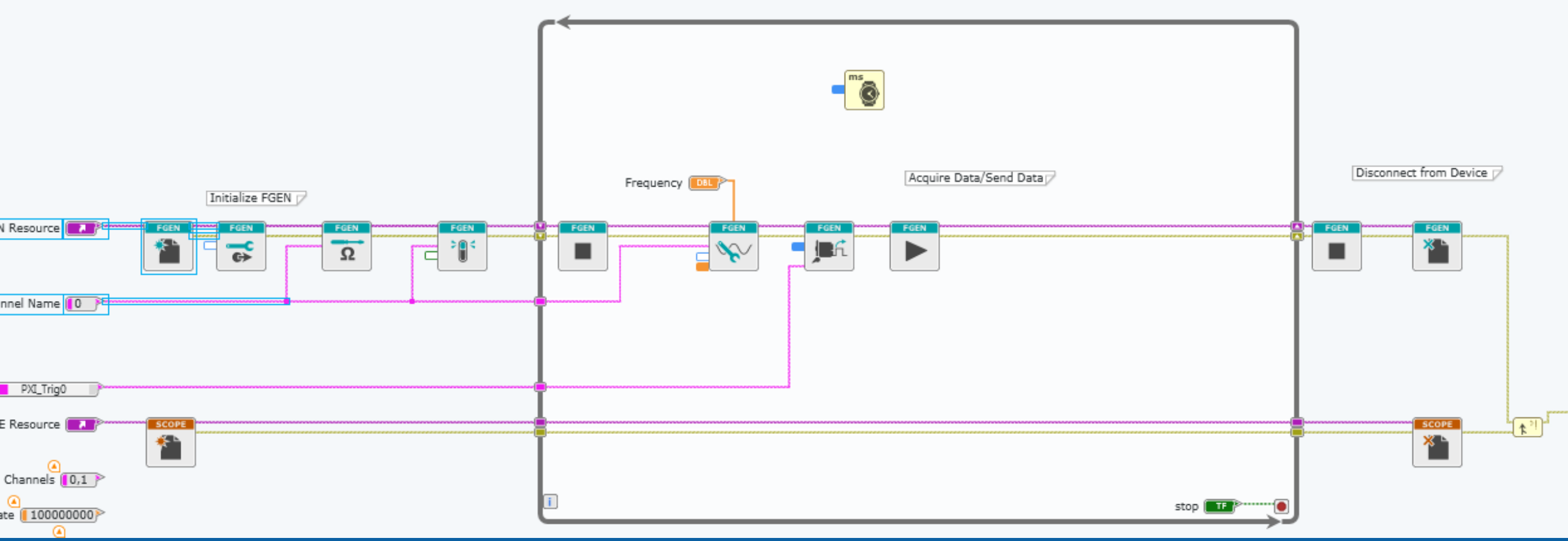

Exercise 5 - Final Frequency Response Test

- **Exercise 5.1** - Programming Modular Instruments with LabVIEW NXG
- **Exercise 5.2** - Frequency Response Test with Modular Instruments

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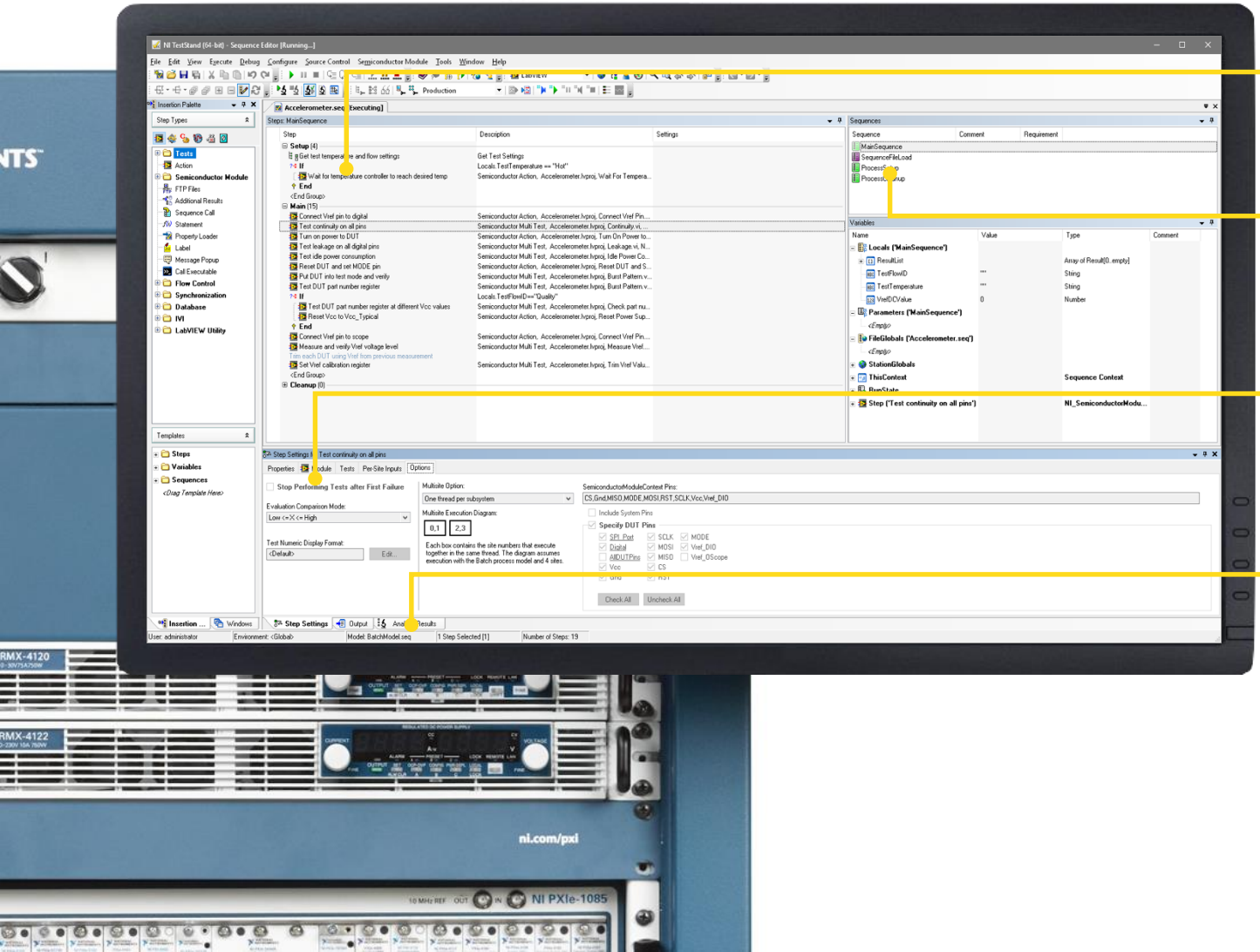
Time to complete: 20 minutes

Test Management and Sequencing

TestStand

Industry-Standard Test Management Software



Create test sequences that automate the execution of code modules written in any programming language

Reduce test time with parallel test and dynamic resource management

Each code module executes a test on the device under test and returns measurement information to TestStand

Log test result information in a report or database automatically

System Deployment and Maintenance

SystemLink

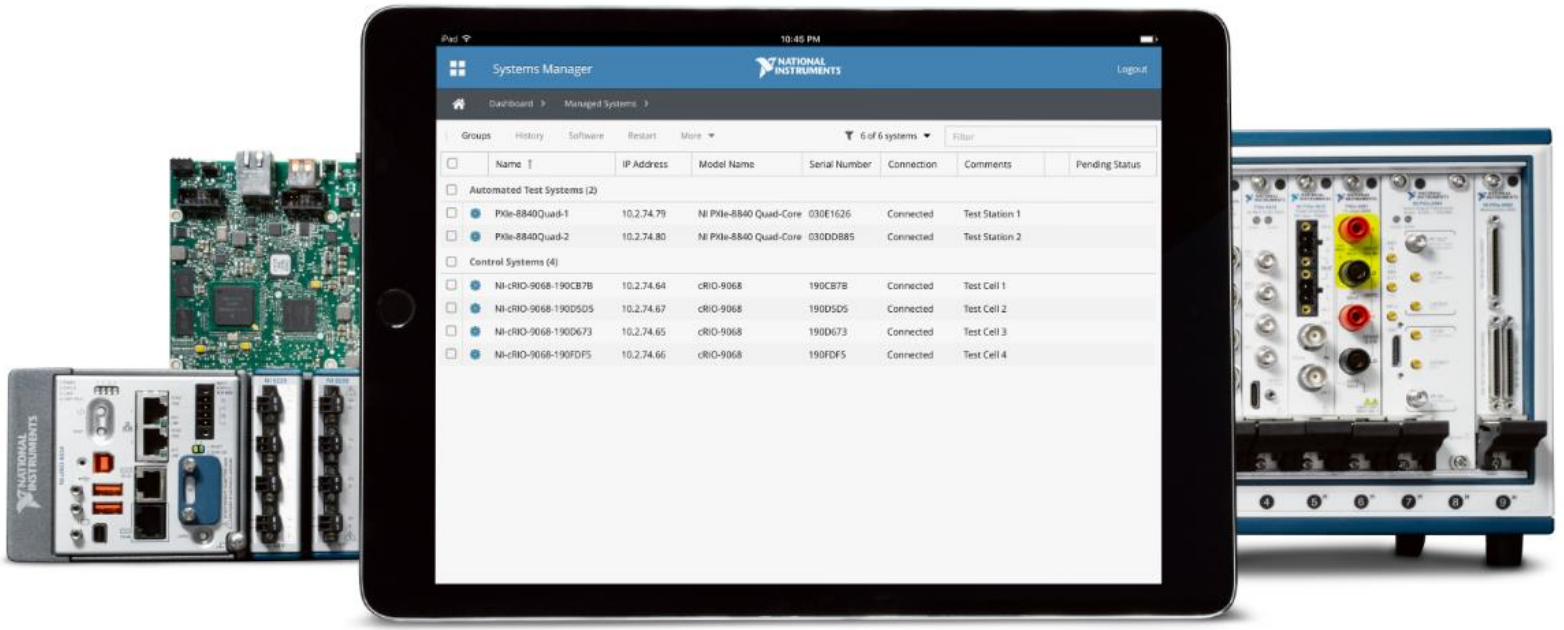
Systems Management Software

Features at a glance

- Device Management—track connection state, system settings, calibration data, and system diagnostics
- Software Deployment—mass deploy software with component-level updates, dependency awareness, and version history
- Data Services—use LabVIEW APIs to automate data communications from remote hardware to a central database

Application areas

- Automated Device Validation
- Physical Systems Test
- Semiconductor Device Test
- HIL Testing
- Embedded Control
- Monitoring



NATIONAL INSTRUMENTS

What’s Next for LabVIEW NXG?

LabVIEW™ NXG Roadmap

LabVIEW NXG 2.0

User Interfaces
- Manipulate front panels programmatically
- Configure and manage VIs to execute outside the editor
- Use new controls

Custom Algorithm Design
- Design custom machine vision algorithms

Distributed Applications
- Build and distribute EXEs, libraries, and installers

Interoperability
- Integrate LabVIEW NXG code with TestStand
- Call external DLLs

Data Management
- Publish tags and messages using simplified data communication VIs

Software Engineering
- Execute and control VIs dynamically
- Abstract code with object-oriented programming
- Compare VI source code with Diff Tool
- Use more event-driven programming options

Systems Management
- Connect, configure, and document hardware graphically with SystemDesigner
- Design hardware systems offline from a catalog of NI hardware

Web Technology
- Create simple browser-based HMIs using WebVIs for system configuration and operator interfaces
- Utilize Data Service APIs for Device to HMI communication

Hardware Support
- Control additional benchtop instruments
- Use additional electronic test and RF instrumentation
- Integrate machine vision hardware

NIWeek 2018

Custom Algorithm Design
- Design custom filters and control algorithms
- Deploy LabVIEW FPGA code for test systems

Interoperability
- Call external code (DLL and .NET)
- ActiveX Automation

Data Management
- Capture and view nonstandard data types
- Export project data in batches
- Launch DIAdem from data pane

Systems Management
- Track system configuration history
- Monitor calibration status
- Provide calibration reporting

Web Technology
- Connect data sources and dashboards across platforms using data binding

Hardware Support
- Deploy to most FlexRIO models

NIWeek 2019

User Interfaces
- Use and customize new controls

Custom Algorithm Design
- Abstract LabVIEW FPGA code with object-oriented programming

Manage Data
- Import and export from the data pane using DataPlugins
- Perform asynchronous writes to TDMS functionality

Interoperability
- Use additional file formats and transfer protocols

Software Engineering
- Debug LabVIEW-built binaries
- Profile desktop execution performance

Systems Management
- Deploy and control distributed systems using SystemDesigner and SystemLink

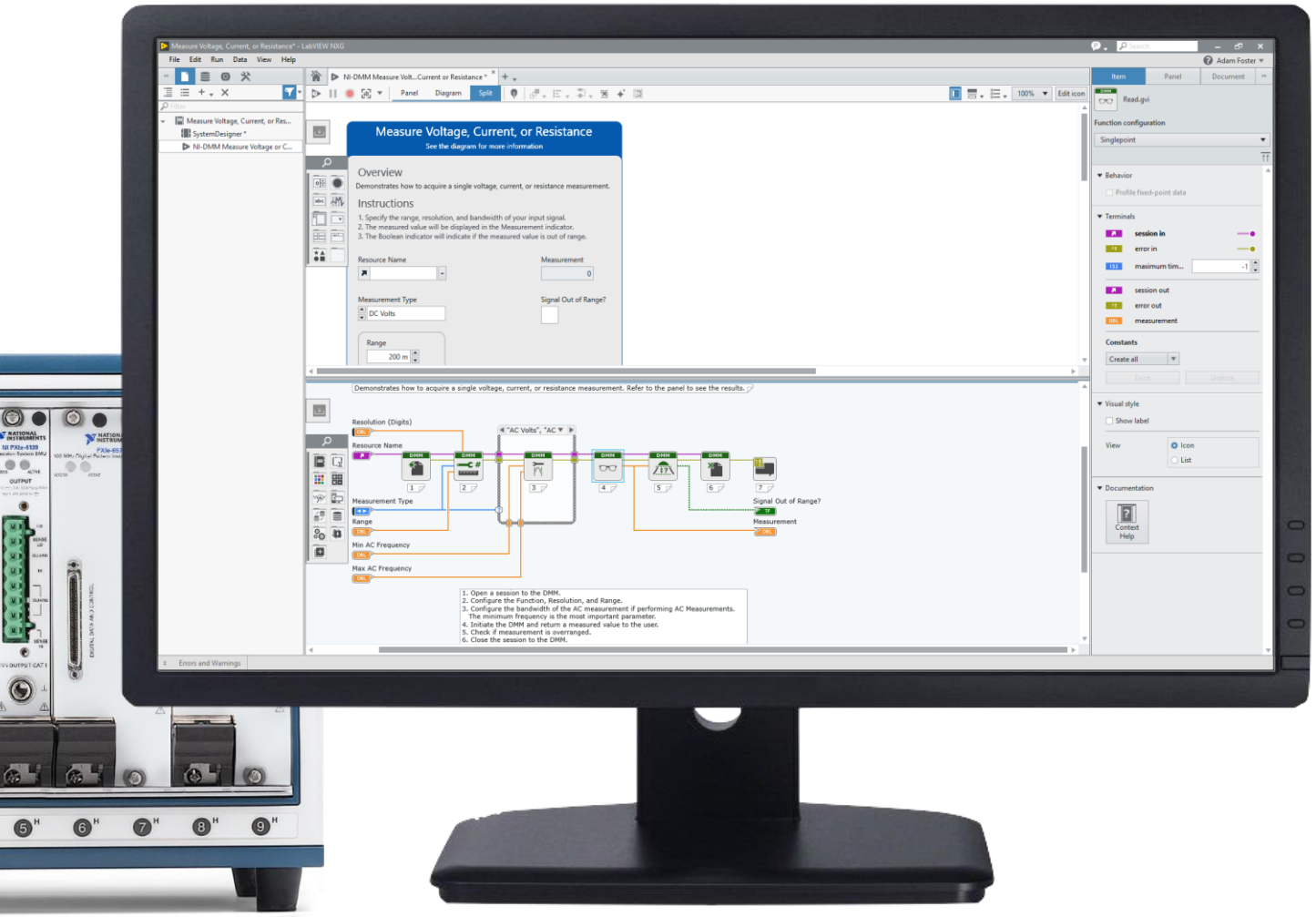
Web Technology
- Create complex, cross platform dashboard that adapt to desktops and mobile devices

Distributed Applications
- Implement deterministic applications with broad-based LabVIEW Real-Time support

Custom Algorithm Design
- Deploy LabVIEW FPGA code for embedded systems

Hardware Support
- Deploy to most embedded systems targets, including CompactRIO

Web Technology
- Customize dashboards with 3rd party widget import



LabVIEW™ NXG 2.0 Beta

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