



UNIVERSITÀ  
DEGLI STUDI  
DI TRIESTE



Dipartimento di  
Ingegneria  
e Architettura

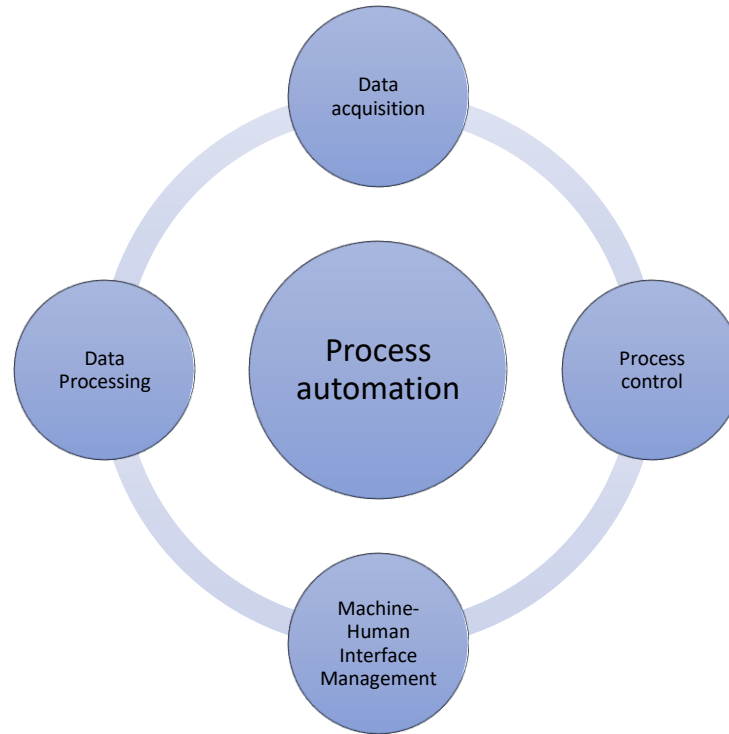
# LABVIEW

## *AN INTRODUCTION*

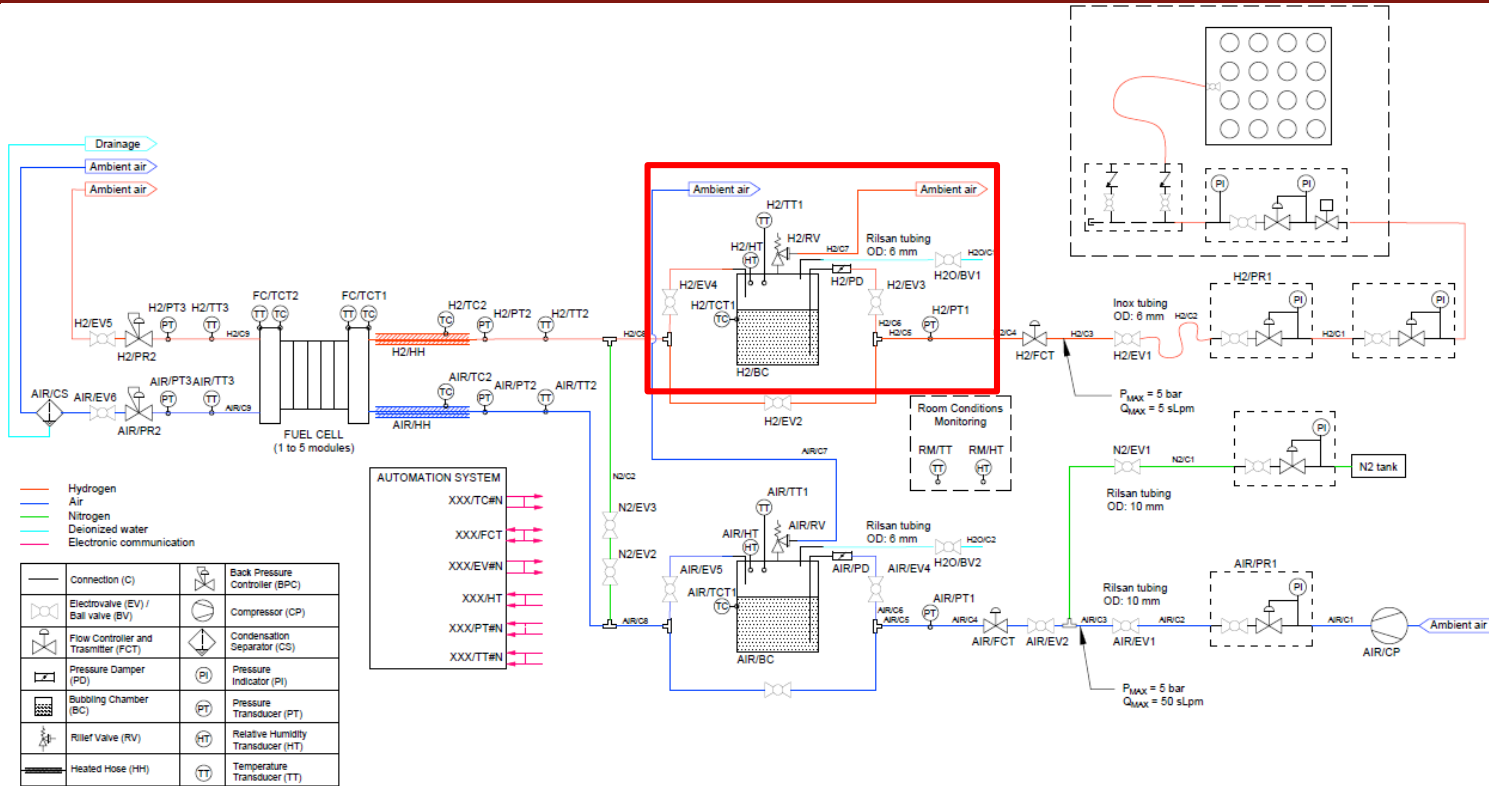
*Prof. Marco Bogar*

*A.A. 2023-2024*

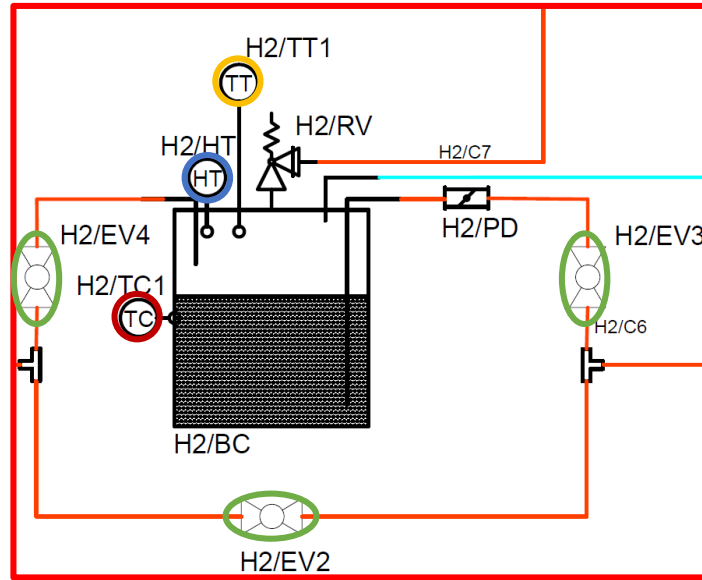
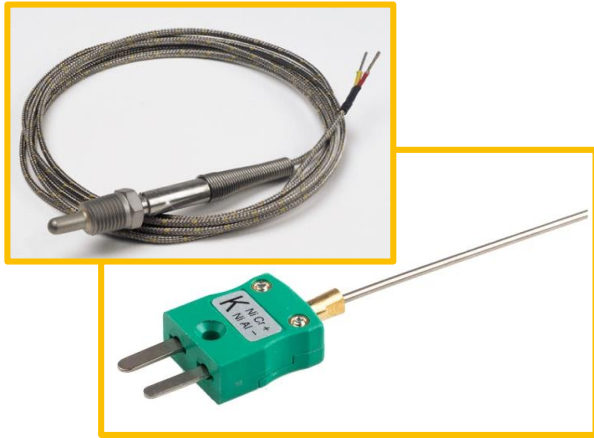
# INTRODUCTION



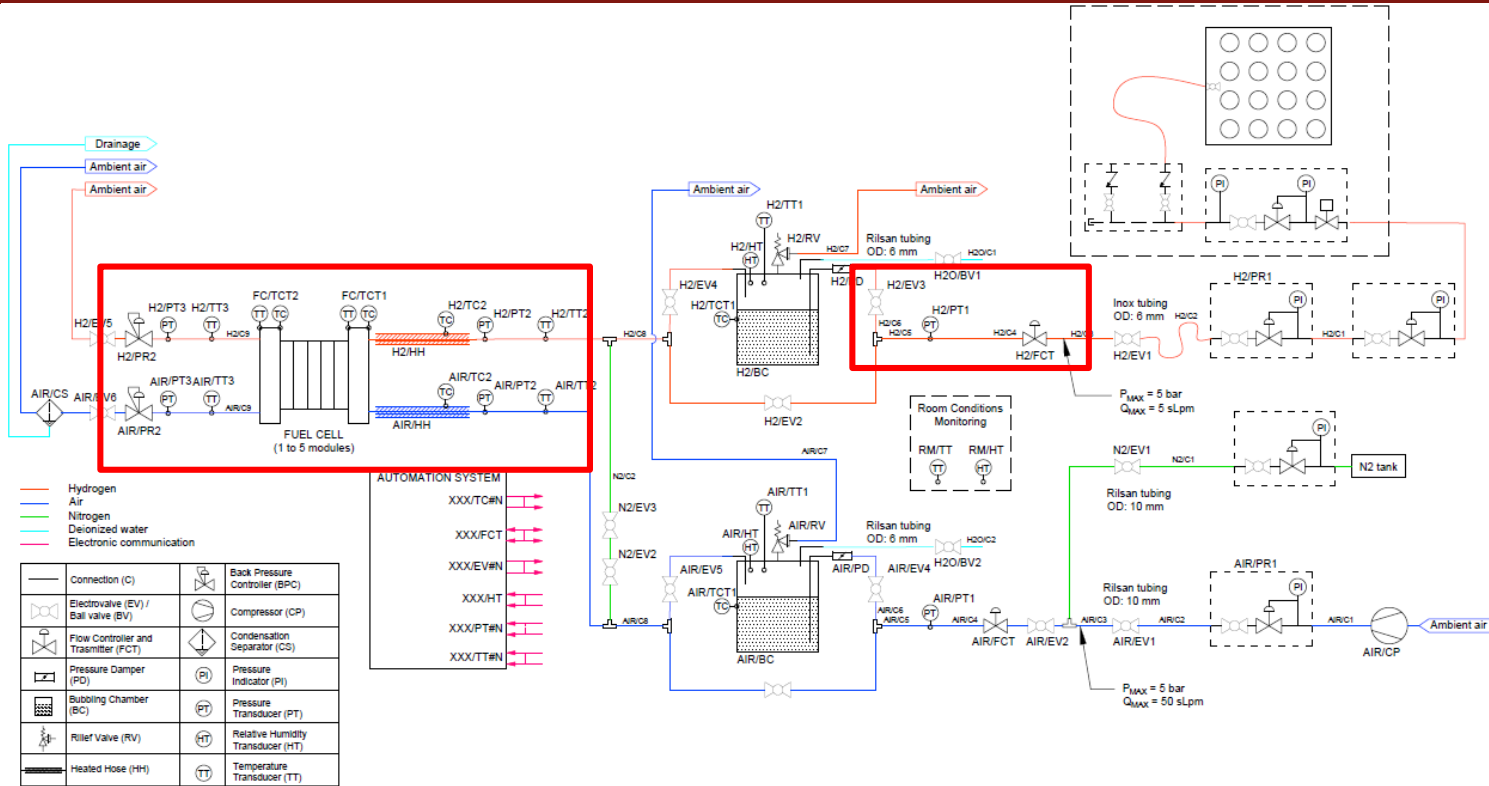
# PLANT DESIGN AND DATA ACQUISITION



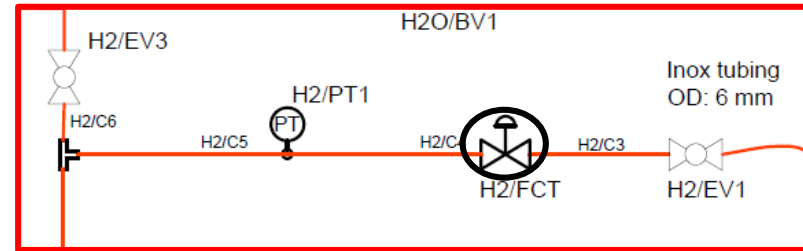
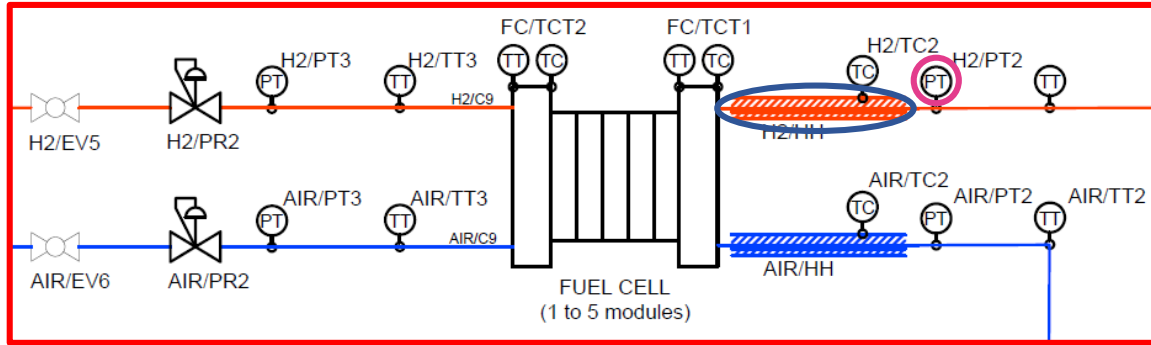
# PLANT DESIGN AND DATA ACQUISITION



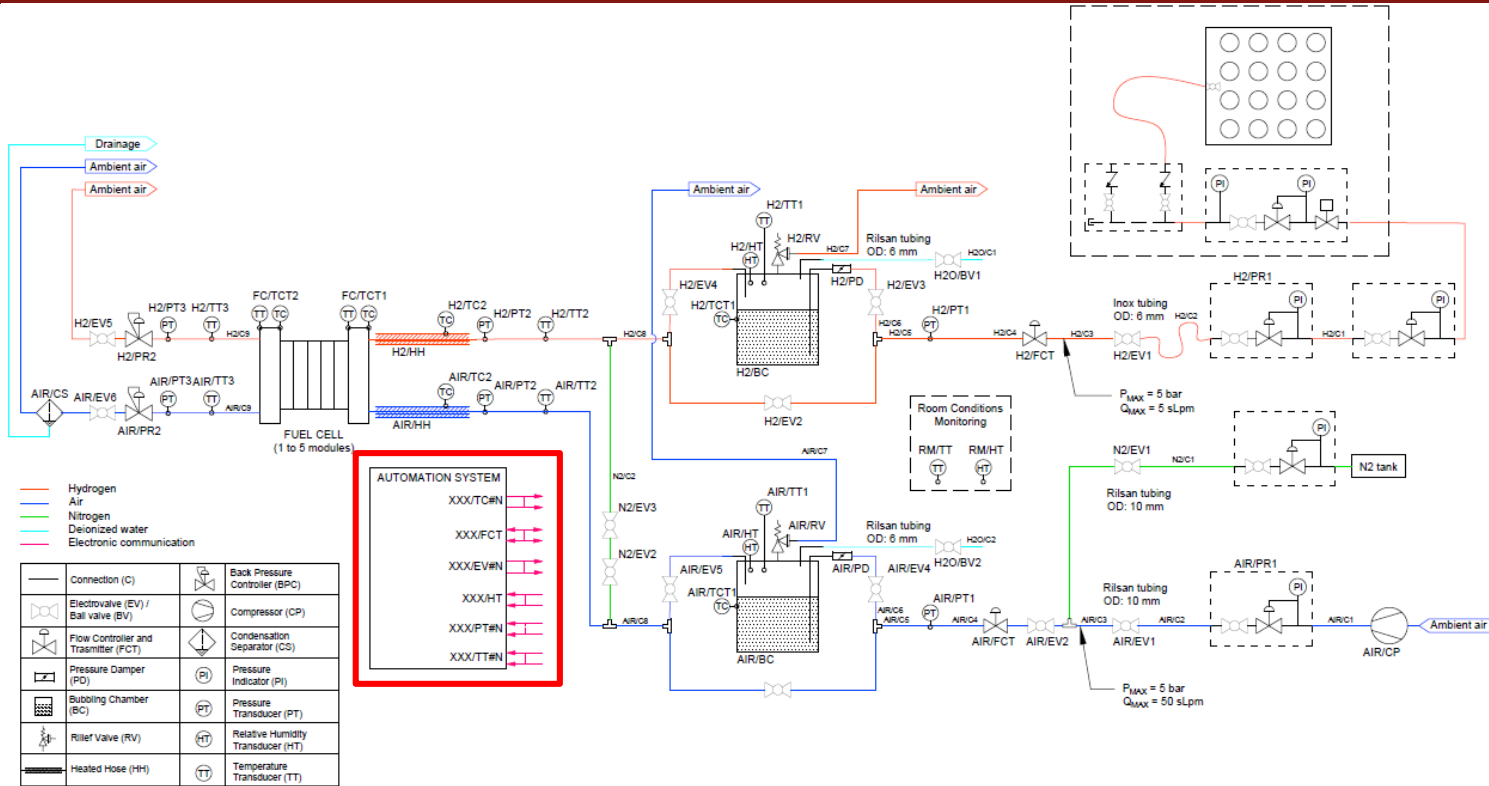
# PLANT DESIGN AND DATA ACQUISITION



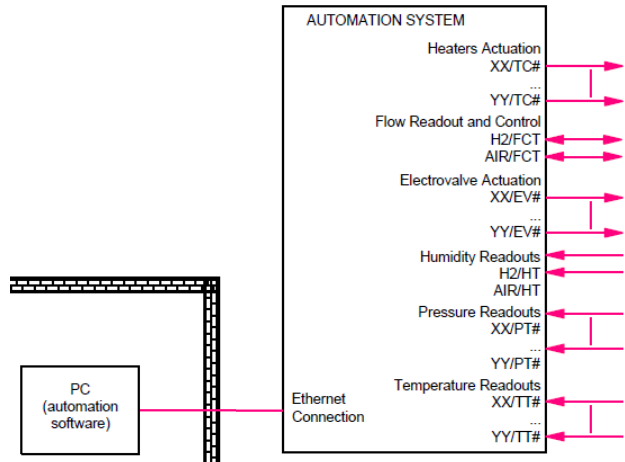
# PLANT DESIGN AND DATA ACQUISITION



# PLANT DESIGN AND DATA ACQUISITION



# PLANT DESIGN AND DATA ACQUISITION



To relays

Digital communication (ETH, RS-232, RS-485, ...)

Digital output

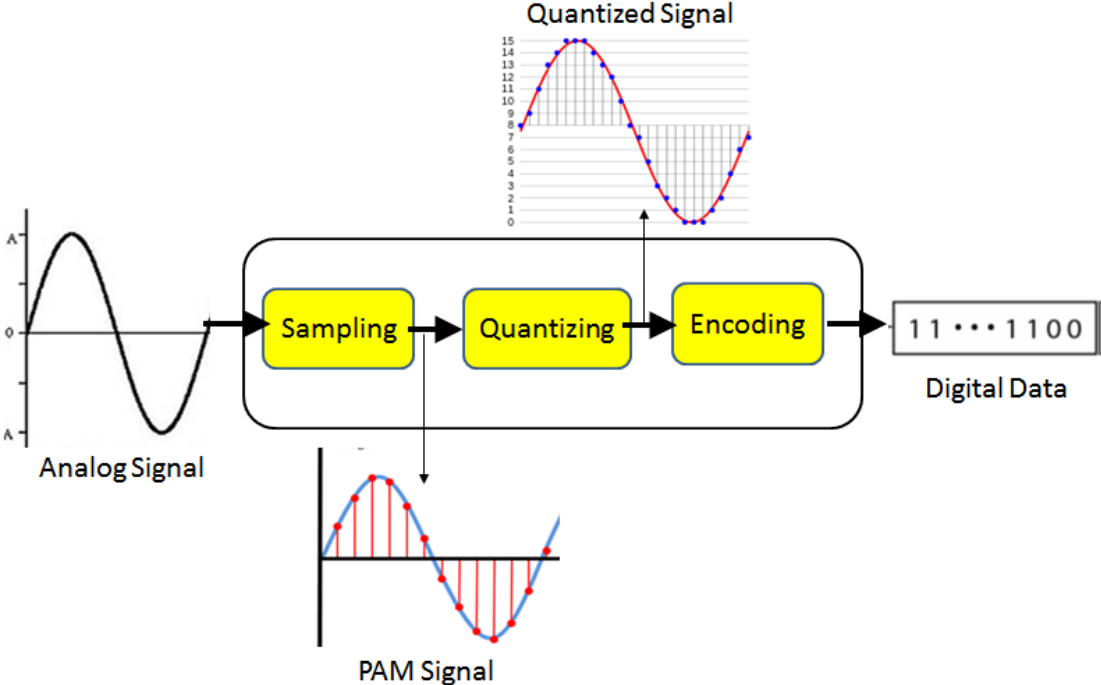
Analogue voltage input

Analogue current input (power supply to be externally provided)

Differential voltage input



# DATA ACQUISITION / ADC



# PLC



## Programmable Logic Controller

- Short response time
- Suitable for operating in harsh environments
- Easy connection system and programming language



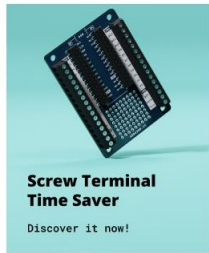
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Help

# ARDUINO

## Boards

			
Arduino UNO R3	Arduino Mega 2560 Rev3	Arduino Leonardo	Arduino UNO Mini Limited Edition
			
Arduino Due	Arduino Micro	Arduino Zero	Arduino UNO WiFi Rev2

## Shields

		
Arduino Motor Shield Rev3	Arduino 4 Relay Shield	Arduino Ethernet Shield Rev2

ReadAnalogVoltage | Arduino 1.8.19

File Modifica Sketch Strumenti Aiuto

```
ReadAnalogVoltage
/*
  ReadAnalogVoltage

  Reads an analog input on pin 0, converts it to voltage, and prints the result to the Serial Monitor.
  Graphical representation is available using Serial Plotter (Tools > Serial Plotter menu).
  Attach the center pin of a potentiometer to pin A0, and the outside pins to +5V and ground.

  This example code is in the public domain.

  https://www.arduino.cc/en/Tutorial/BuiltInExamples/ReadAnalogVoltage
  */

// the setup routine runs once when you press reset:
void setup() {
  // initialize serial communication at 9600 bits per second:
  Serial.begin(9600);
}

// the loop routine runs over and over again forever:
void loop() {
  // read the input on analog pin 0:
  int sensorValue = analogRead(A0);
  // Convert the analog reading (which goes from 0 - 1023) to a voltage (0 - 5V):
  float voltage = sensorValue * (5.0 / 1023.0);
  // print out the value you read:
  Serial.println(voltage);
}
```

# NATIONAL INSTRUMENTS

## PXI

Meet demanding test objectives with the widest portfolio of industry-leading modular instruments and configurable software interfaces.



## LabVIEW

Create applications using an intuitive graphical programming language with unparalleled hardware connectivity and extensive IP libraries.



## DAQ Products

Explore data acquisition products with sensor-specific, conditioned I/O for accurate and precise measurements.



# NATIONAL INSTRUMENTS

## PXI

Meet demanding test objectives with the widest portfolio of industry-leading modular instruments and configurable software interfaces.



## What is PXI?

NI PXI systems provide high-performance modular instruments and other I/O modules that feature specialized synchronization and key software features for test and measurement applications from device validation to automated production test. NI is the PXI industry leader, with the broadest array of best-in-class products and services on the market.



More on PXI

[WATCH THE VIDEO](#)



# NATIONAL INSTRUMENTS

## PXI

Meet demanding test objectives with the widest portfolio of industry-leading modular instruments and configurable software interfaces.



## Controller

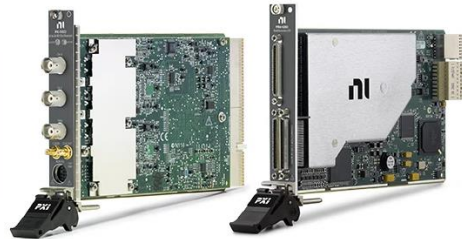
PXI controllers are either integrated or remote. Integrated controllers contain everything you need to run your PXI system without an external PC, while remote controllers let you control your PXI system from desktops, laptops, or server computers.

[View PXI controllers](#)



## Modules

Ni offers more than 600 PXI modules that acquire data, trigger and synchronize devices, generate and route signals, and make a variety of measurements ranging from DC to mmWave. Also, the PXI portfolio includes modular instruments—such as oscilloscopes and digital multimeters—that can replace traditional box instruments and with which you can integrate PXI switches in a variety of topologies. Because PXI is an open industry standard, nearly 1,500 products are available from more than 70 different instrument vendors.



[PXI Multifunction I/O Module](#) → [PXI Digital I/O Module](#) →  
[Device for PXI Remote Control](#) → [PXI Digital Multimeter](#) →

# NATIONAL INSTRUMENTS

## PXI

Meet demanding test objectives with the widest portfolio of industry-leading modular instruments and configurable software interfaces.



## Chassis

The chassis—the PXI system backbone—is comparable to a desktop PC's mechanical enclosure and motherboard. It provides power, cooling, and a communication bus to the system, and supports multiple instrumentation modules within the same enclosure. PXI uses commercial PC-based PCI and PCI Express bus technology while combining rugged CompactPCI modular packaging, as well as key timing and synchronization features. Chassis range in size from four to 18 slots to fit the needs of any application, whether you require a portable, benchtop, rack-mount, or embedded system.

[View PXI chassis](#)



# NATIONAL INSTRUMENTS

## PXI

Meet demanding test objectives with the widest portfolio of industry-leading modular instruments and configurable software interfaces.



## Industry-Standard

NI led the creation of the PXI standards body to create an open standard, so you can augment your NI system with specialty modules from up to 60 other vendors.



## Scalable

PXI's architecture makes it possible to synchronize measurements across multiple modules or multiple chassis, so you can add to your systems as requirements change.



## High-Performance

NI PXI hardware utilizes the latest technology, incorporating powerful multicore processors, FPGAs, and other technology to increase measurement range and performance.



## Accurate

PXI offers some of the highest frequency and accuracy specifications, so you can ensure your test systems deliver the production test results you need.

# NATIONAL INSTRUMENTS

## DAQ Products

Explore data acquisition products with sensor-specific, conditioned I/O for accurate and precise measurements.



## Data Acquisition (DAQ)

Create DAQ systems with NI devices, sensors, and software.



## What is DAQ?

Data acquisition (DAQ) is the process of measuring an electrical or physical phenomenon, such as voltage, current, temperature, pressure, or sound. A DAQ system consists of sensors, DAQ measurement hardware, and a computer with programmable software.



**Data Acquisition Basics and Technology**

[WATCH VIDEO](#)

# NATIONAL INSTRUMENTS CRIO



# NATIONAL INSTRUMENTS DAQ PRODUCTS



## PC-Based Systems

Achieve electrical and physical measurements with a customizable, accurate, yet cost-effective way to conduct benchtop measurements.



## CompactDAQ

This portable, flexible approach is ideal for applications with a wide mix of measurement types, where scalability and flexibility are important. Hardware ruggedness makes it a great fit for high-channel-count distributed applications in the field.



## CompactRIO

Take advantage of real-time data processing capabilities, sensor-specific conditioned I/O, and a closely integrated software toolchain for long-running, industrial data acquisition applications.



## PXI

Use this modular approach for high-channel-count data acquisition and sensor measurement applications. Systems range from tens to hundreds of channels, mixing and matching measurement functionality and output capabilities.

# NATIONAL INSTRUMENTS

## DAQ Products

Explore data acquisition products with sensor-specific, conditioned I/O for accurate and precise measurements.



### Accurate

Maximize the absolute accuracy of your measurements with NI's industry-leading performance for automated data acquisition.



### Flexible

Build mixed-measurement systems tailored to your needs and swap out or add hardware as your needs change.



### Scalable

Choose from hardware options that let you control multiple data acquisition systems as part of one synchronized application.



### Programmable

Program your hardware with the same API in your choice of language, including G, Python, ANSI C, C#, and .NET. Or, use interactive software without writing code.

# NATIONAL INSTRUMENTS LABVIEW

## LabVIEW

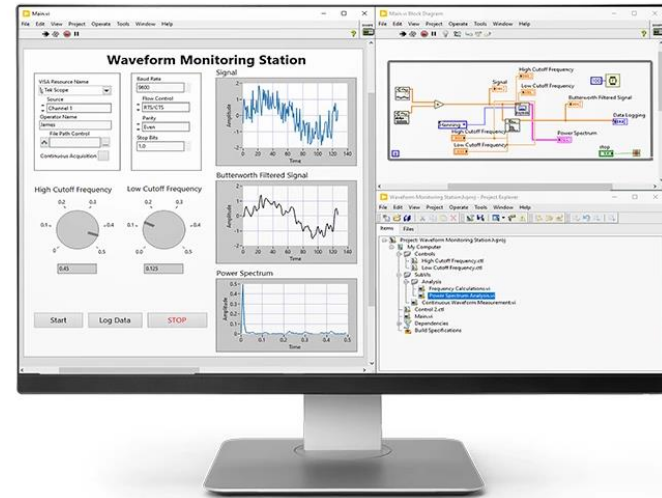
Create applications using an intuitive graphical programming language with unparalleled hardware connectivity and extensive IP libraries.



## What Is LabVIEW?

LabVIEW is a graphical programming environment engineers use to develop automated research, validation, and production test systems.

[See Pricing](#)



The screenshot shows a web browser window with the URL `ni.com/it-it/support/downloads/software-products/download.labview.html#460283`. The page header includes the NI logo and navigation menus for Solutions, Products, Perspectives, Support, and Community. The breadcrumb trail reads: HOME / SUPPORT / SOFTWARE AND DRIVER DOWNLOADS / DOWNLOAD DI PRODOTTI SOFTWARE NI / DOWNLOAD DETAIL PAGE.

## LabVIEW

LabVIEW è il software per la progettazione di sistemi pensato appositamente per lo sviluppo di applicazioni di test, misura e controllo con accesso rapido all'hardware e ai risultati.

[+ Leggi tutto](#)

### DOWNLOADS

**Sistema operativo supportato** ?  [Leggi il file ReadMe](#)

**Versione** ?

**Edizioni incluse** ?

- Base, Full, Professional
- Community
- Runtime

**Bit applicazione** ?

**Note:** LabVIEW (64-bit) does not work with all toolkits supported by LabVIEW (32-bit). Select the application bitness for LabVIEW that is compatible with any toolkits you want to use. [Per saperne di più](#)

### LabVIEW 2022 Q3 and Drivers

**Data di rilascio**  
23/07/22

**Versioni incluse**  
2022 Q3

- > Sistema operativo supportato
- > Lingua
- > Checksum

**Dimensioni file**  
6.46 MB

## LABoratory Virtual Instruments Engineering Workbench

Graphical programming language that allows for:

- instrument control
- data acquisition
- pre/post data processing

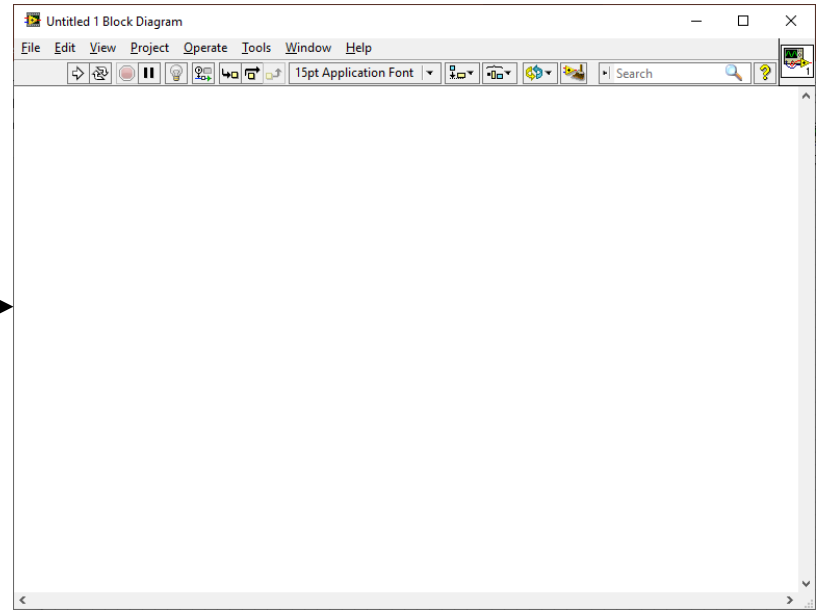
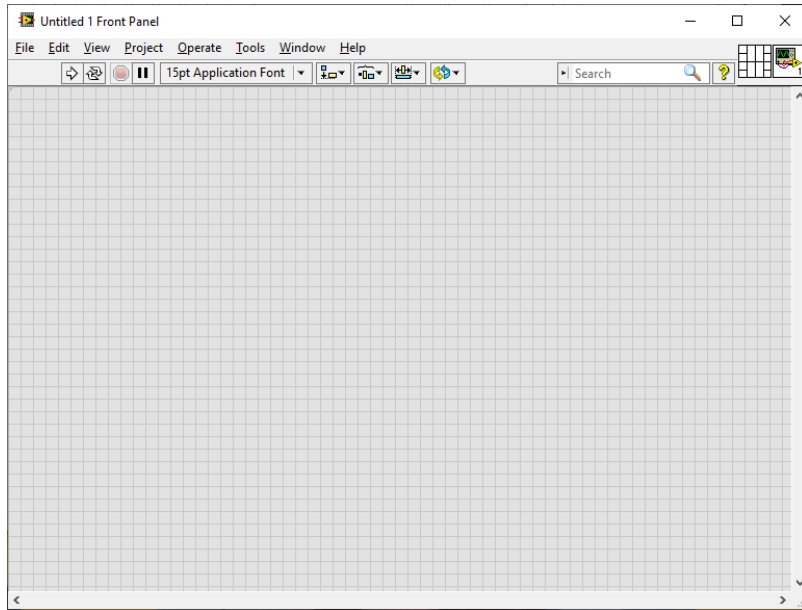
Graphical programming language: graphical symbols rather than textual language to describe programming actions

Such a software was born in 1986: up to date embeds lots of libraries for communicate with most of the hardware available on the market.

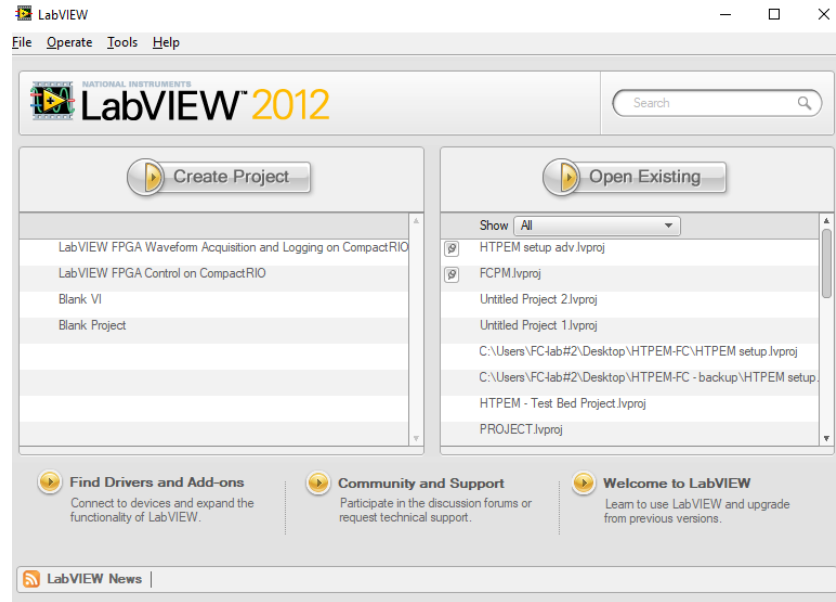


# LABVIEW

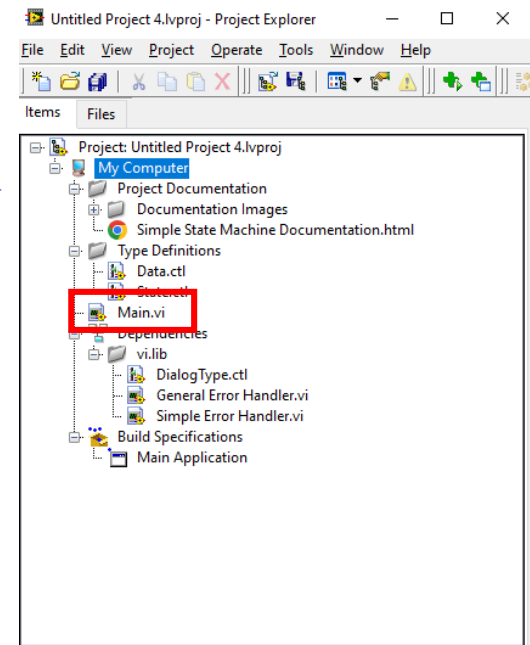
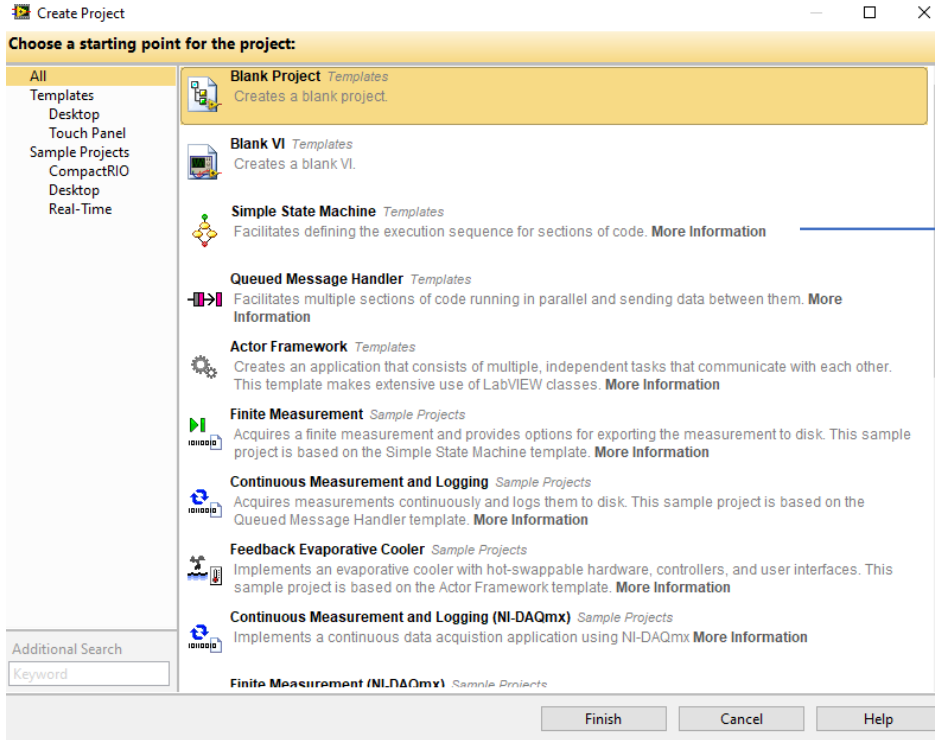
A program developed by means of LV is called Virtual Instrument (VI).



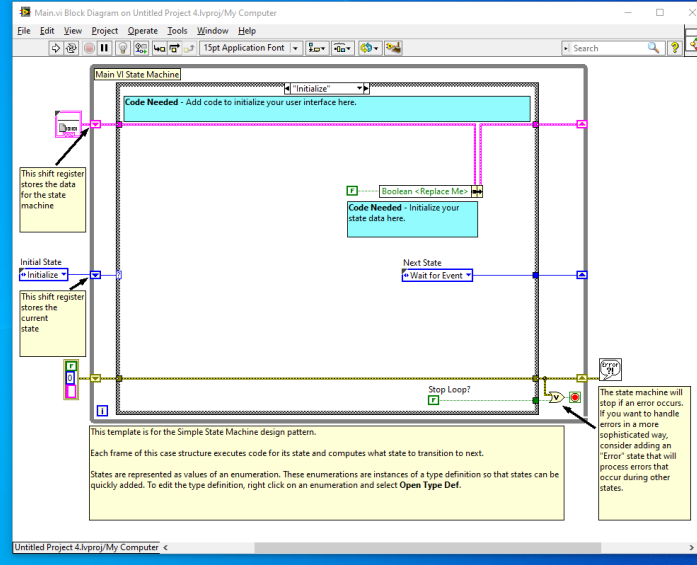
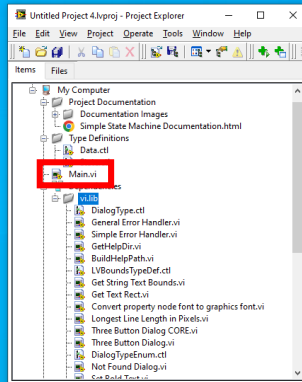
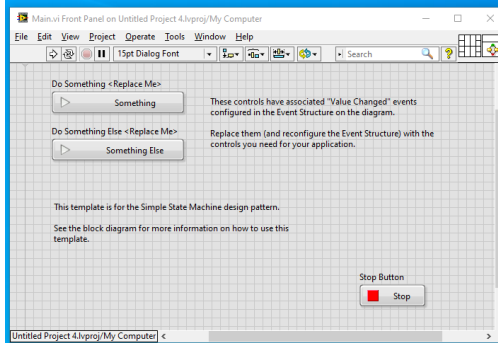
# LABVIEW



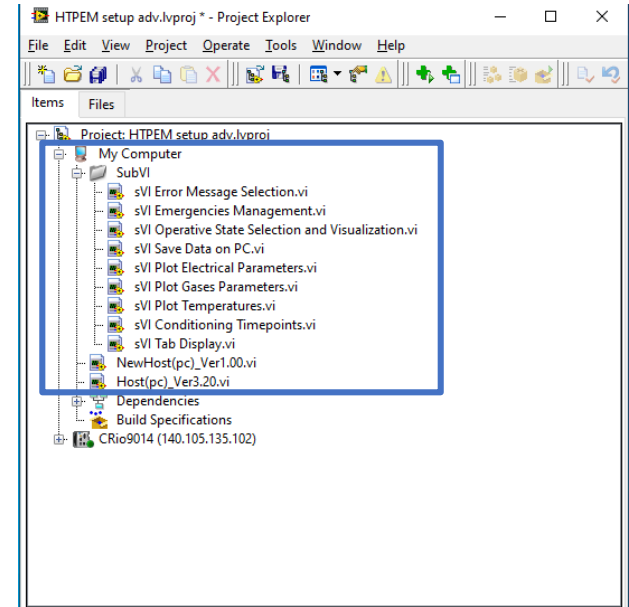
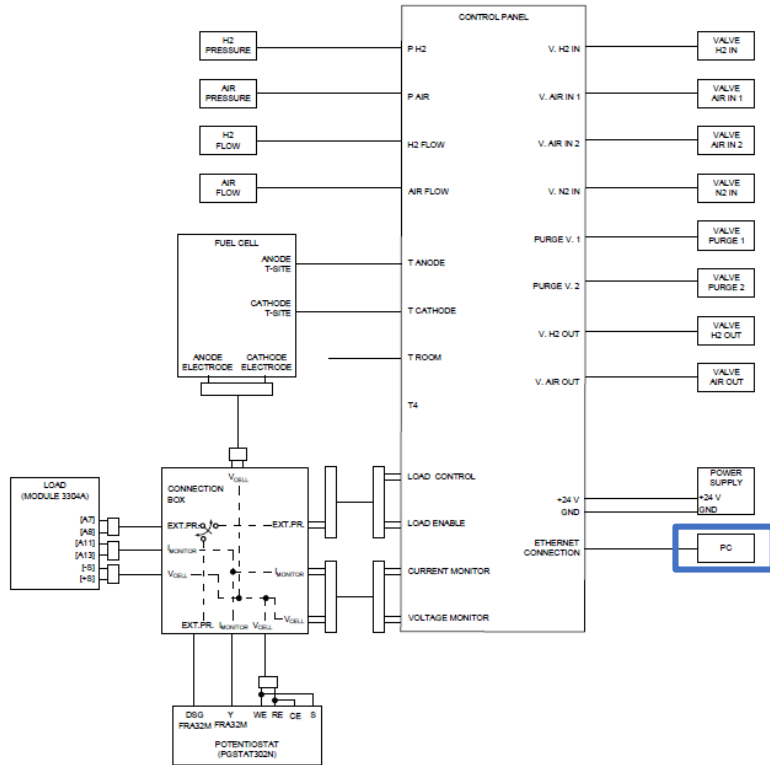
# LABVIEW



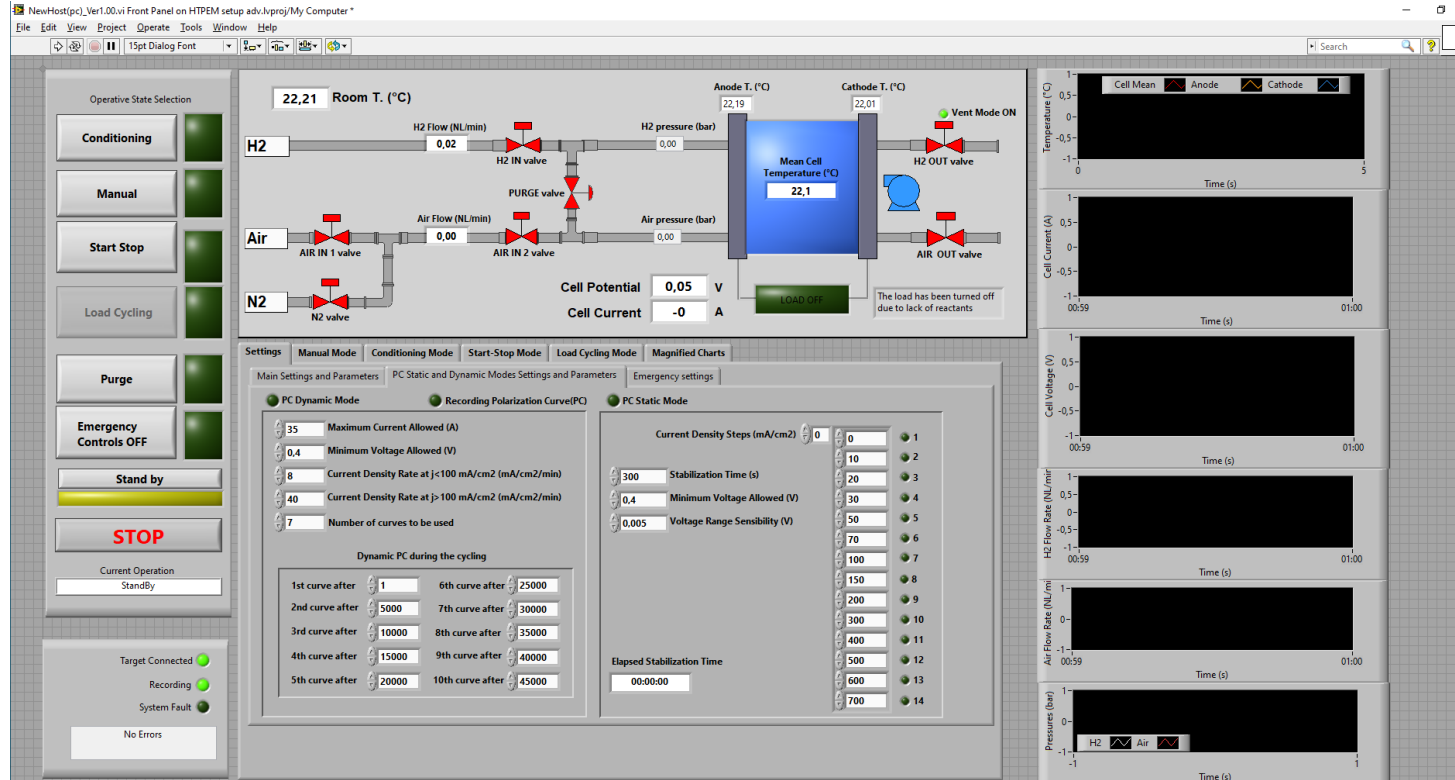
# LABVIEW



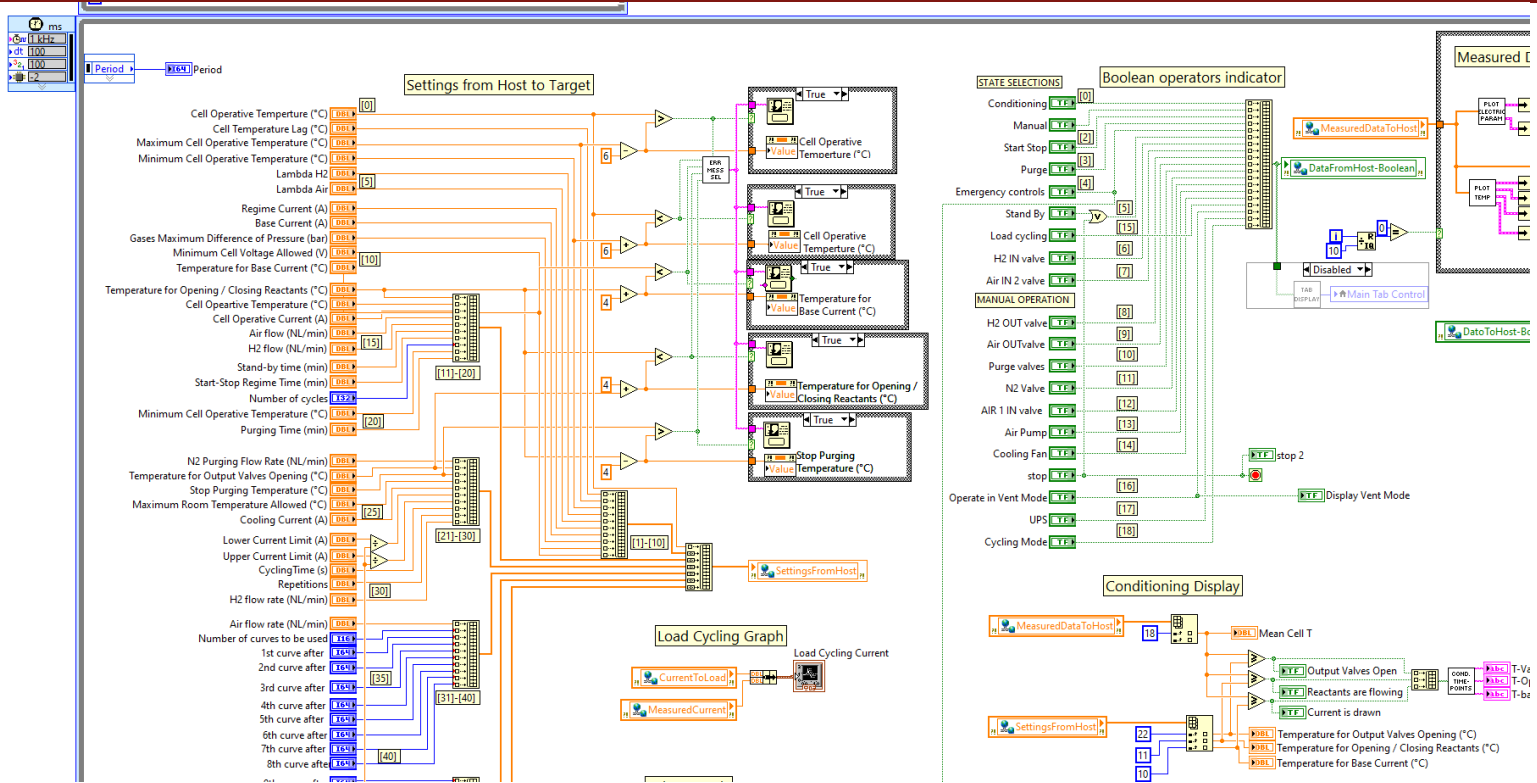
# LABVIEW PROJECT – AN EXAMPLE



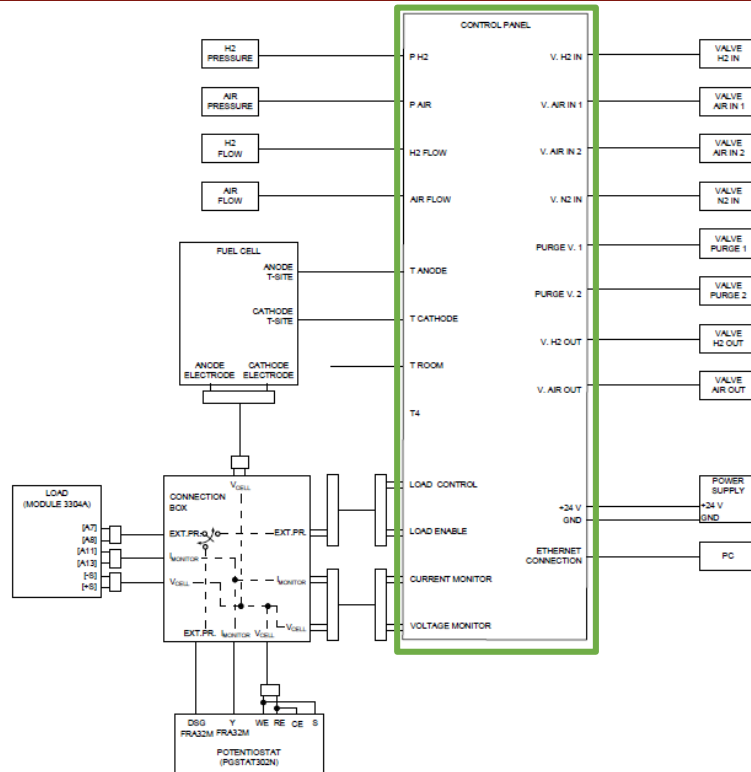
# LABVIEW PROJECTS – A REAL EXAMPLE (1)



# LABVIEW PROJECTS – A REAL EXAMPLE (1)

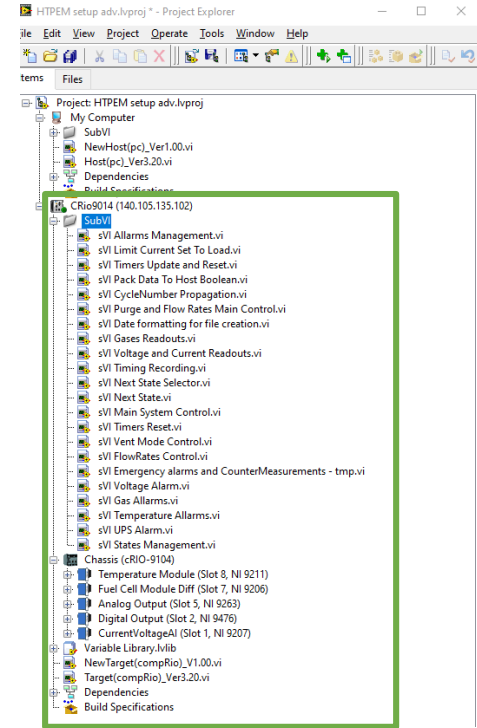
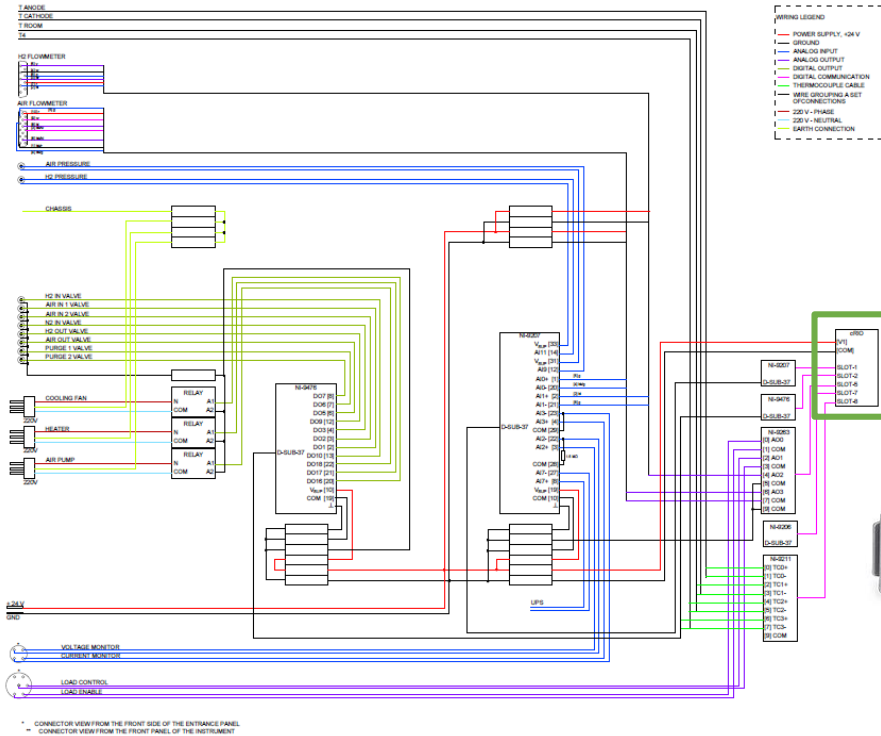


# LABVIEW PROJECT – AN EXAMPLE

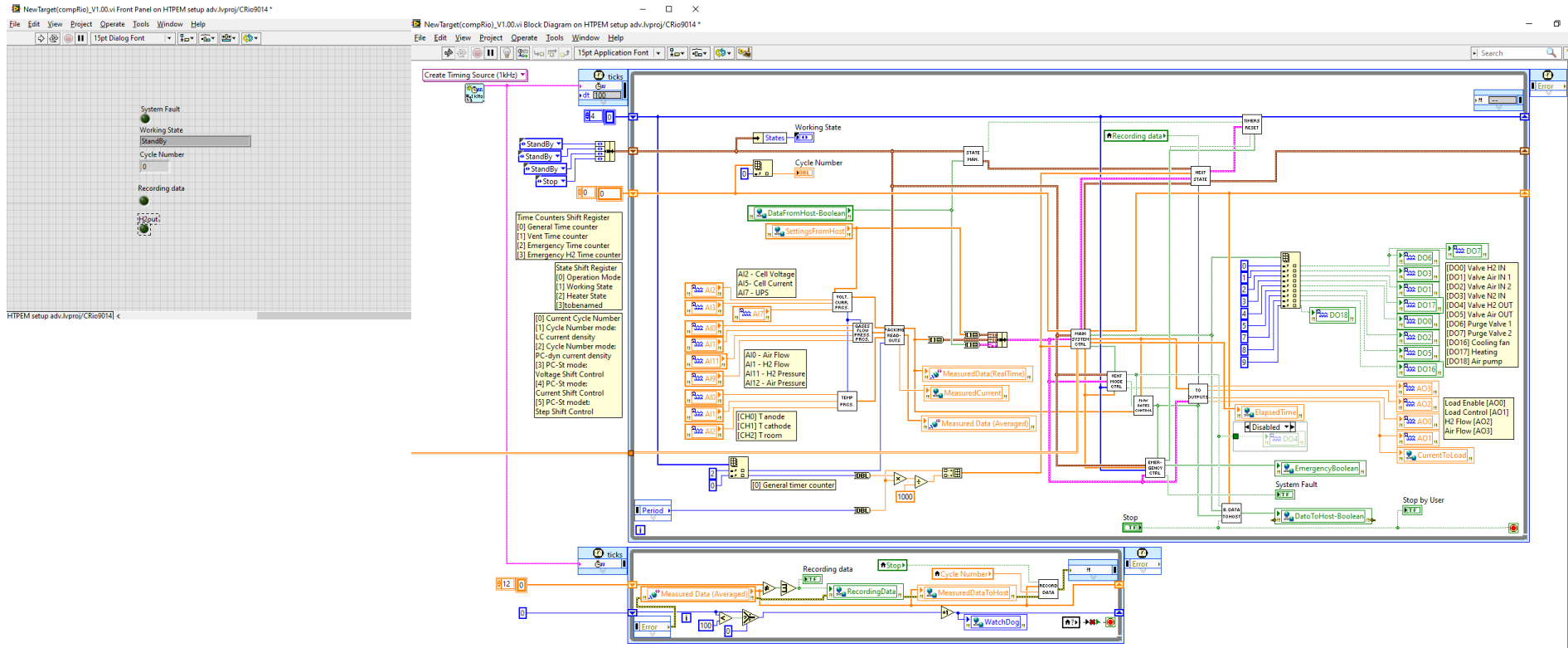




# LABVIEW PROJECT – AN EXAMPLE



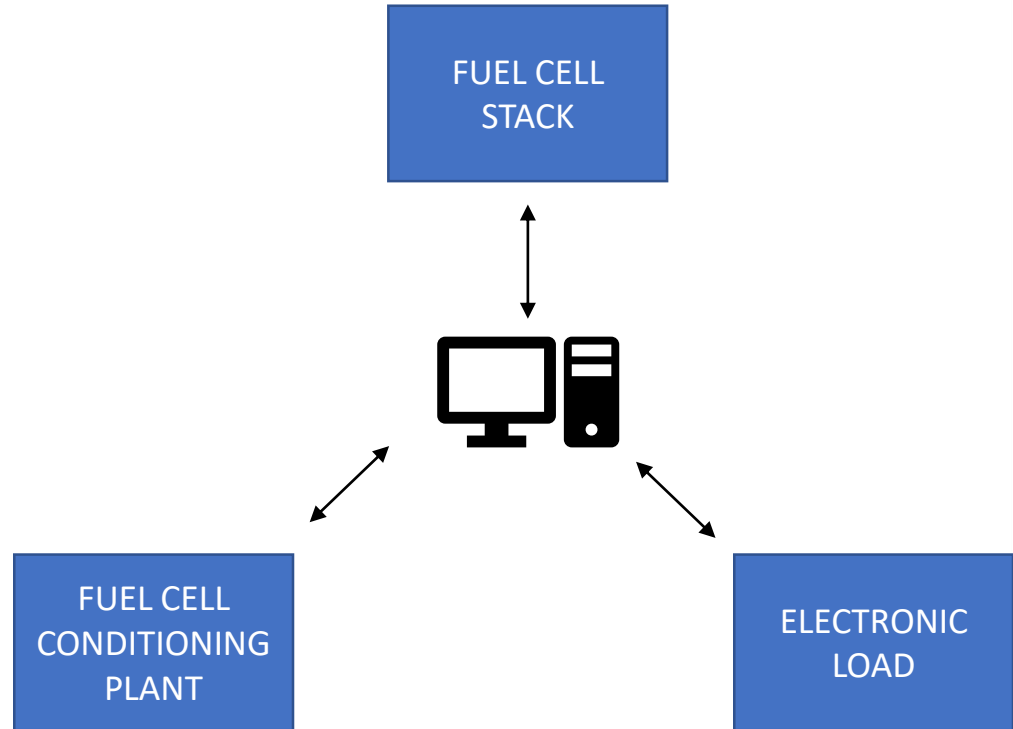
# LABVIEW PROJECT – AN EXAMPLE



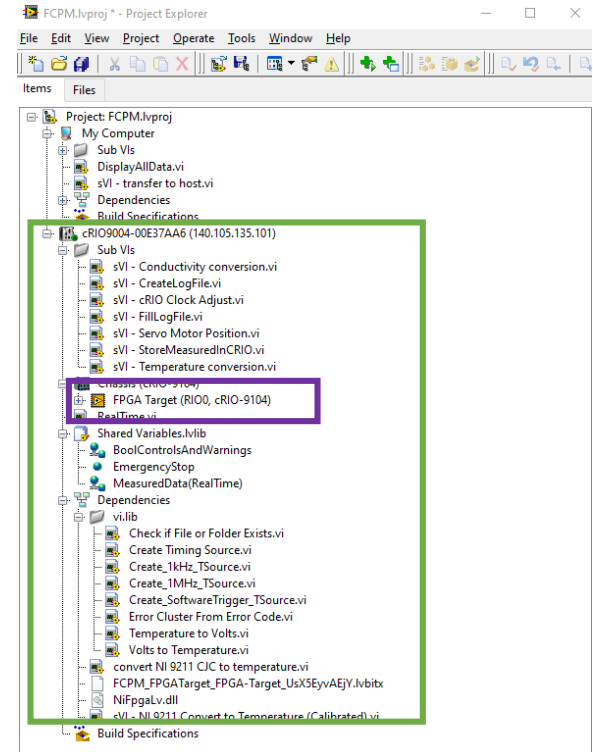
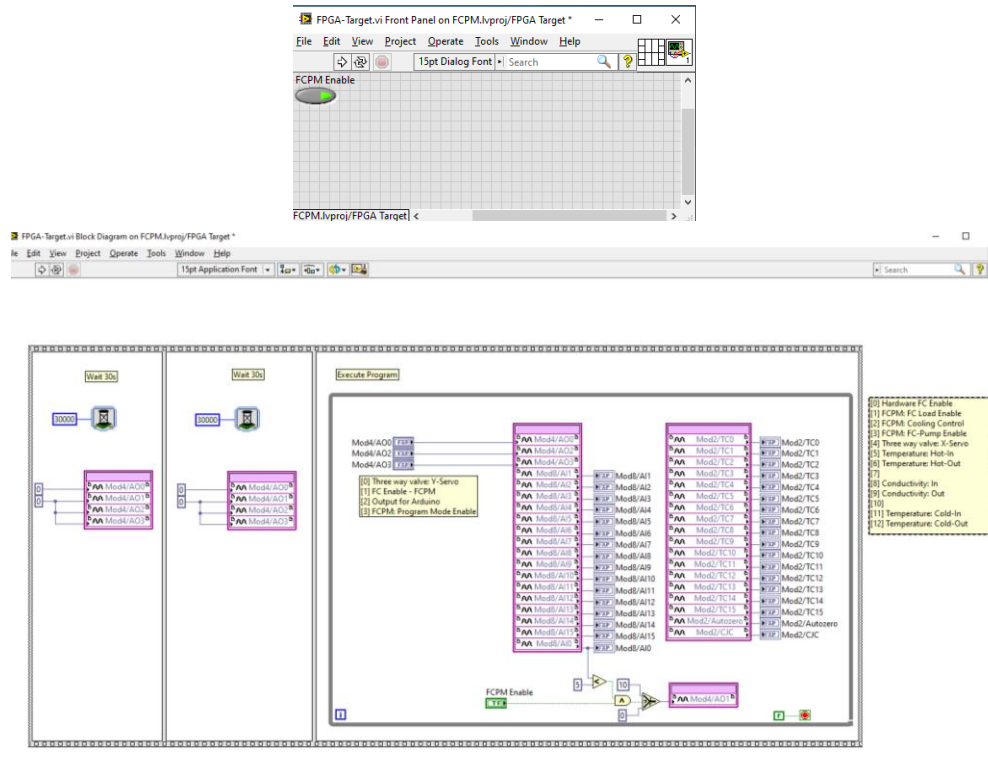
# LABVIEW PROJECTS – ANOTHER EXAMPLE



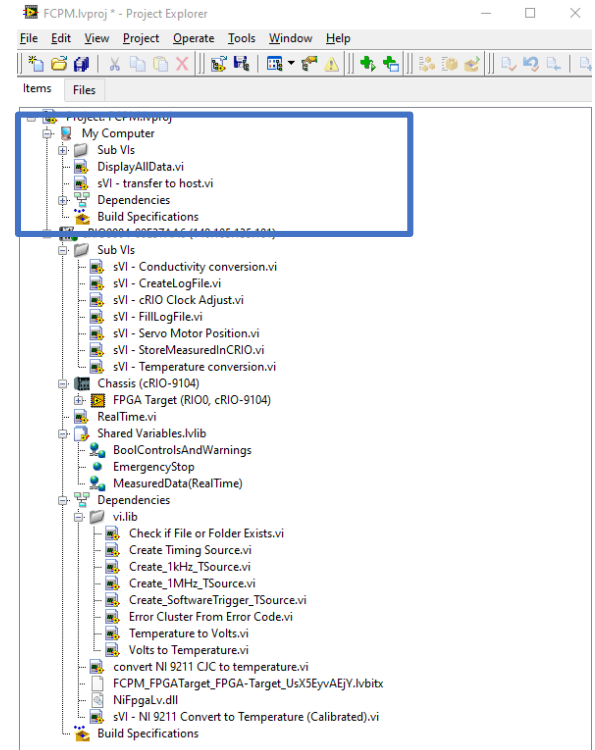
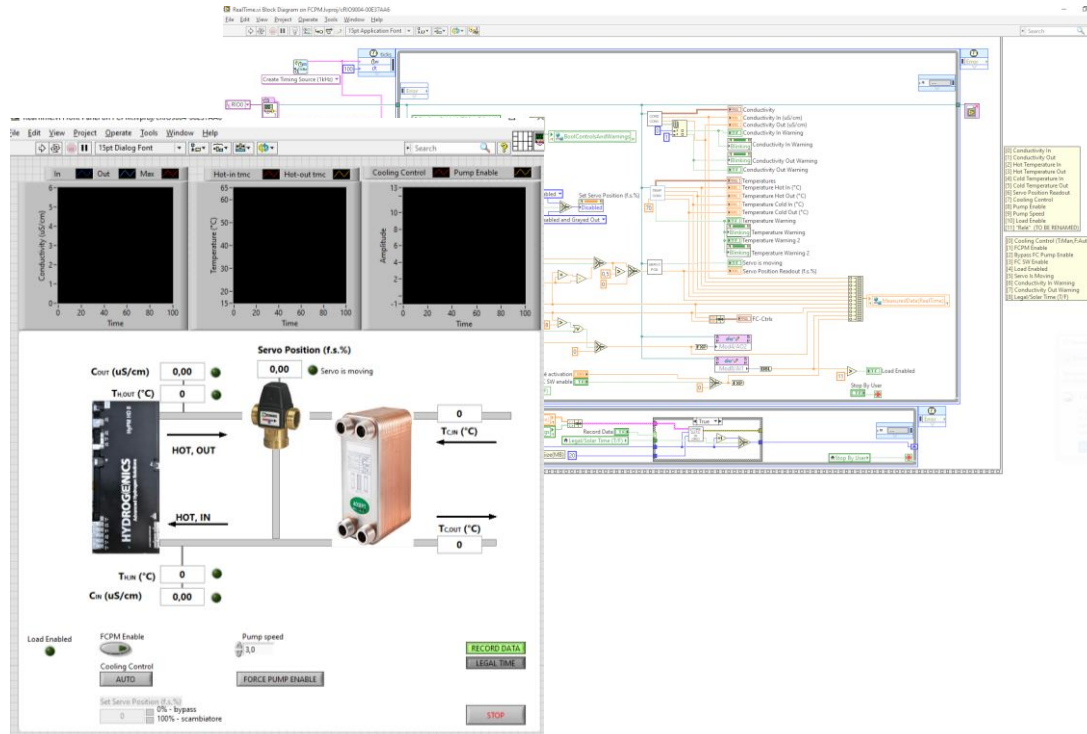
DRAWINGS®



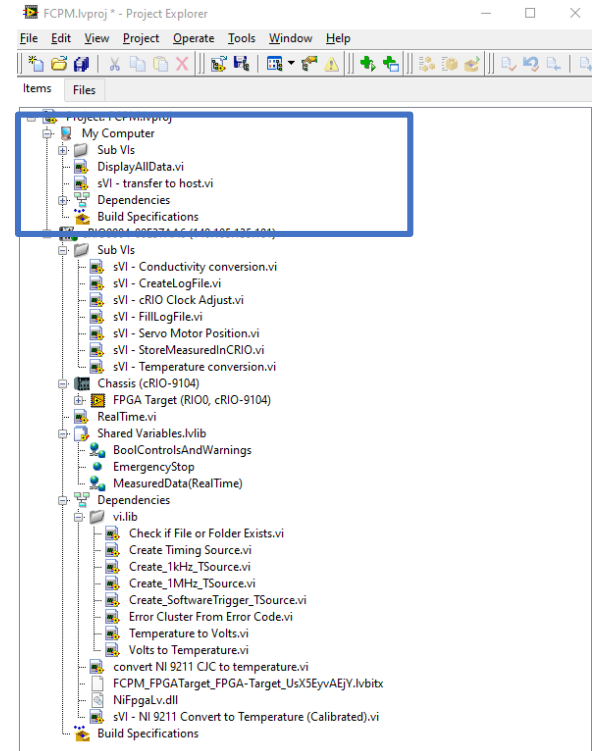
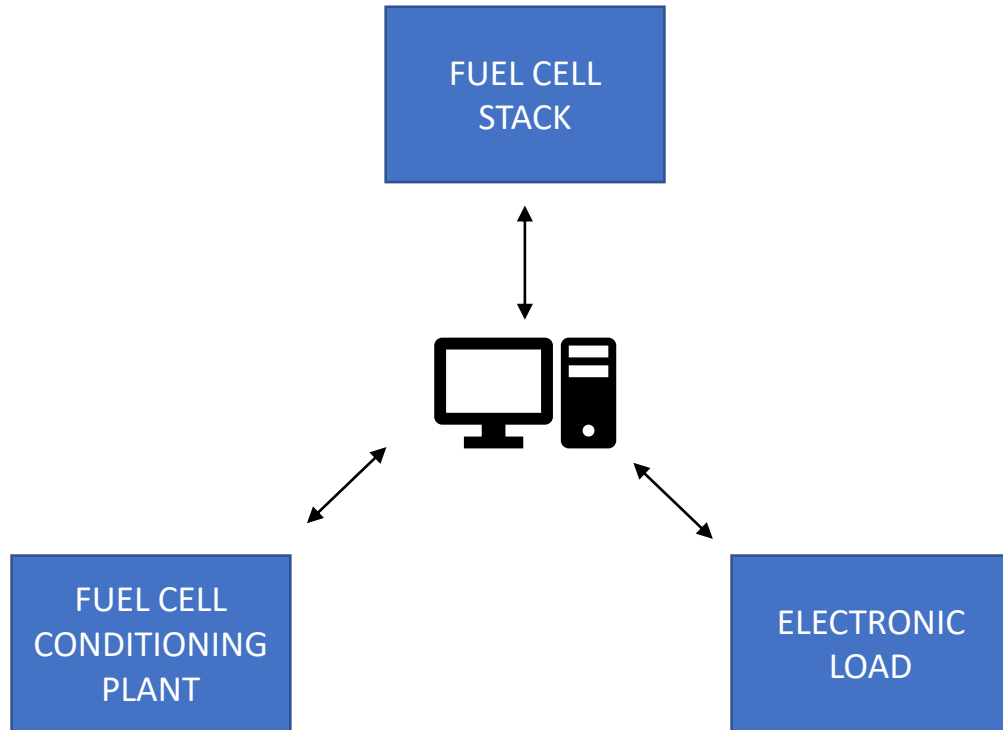
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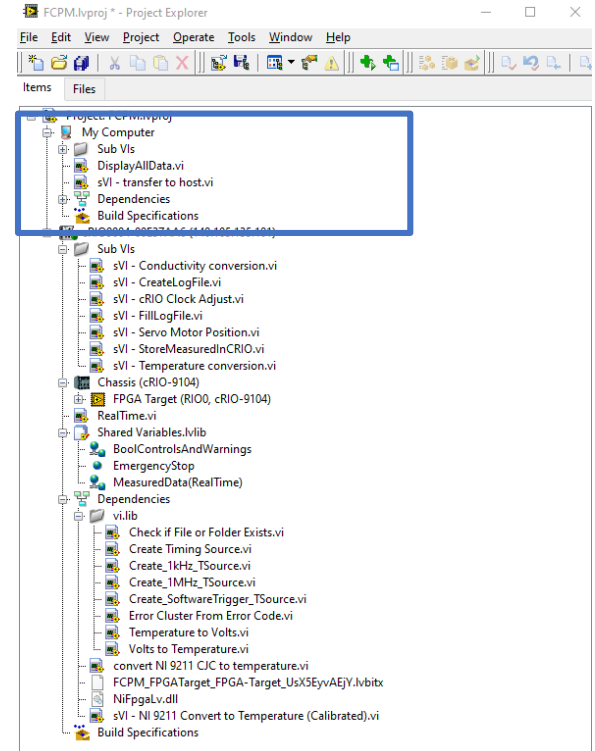
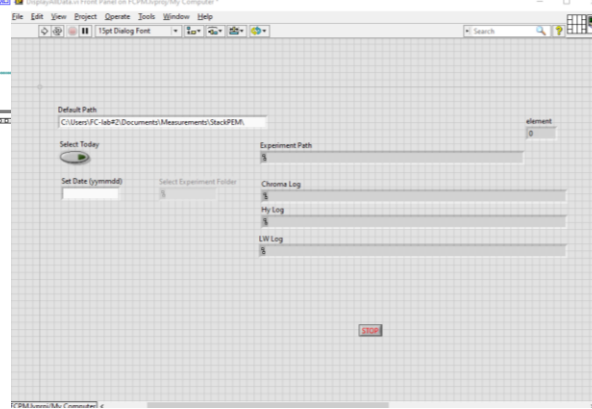
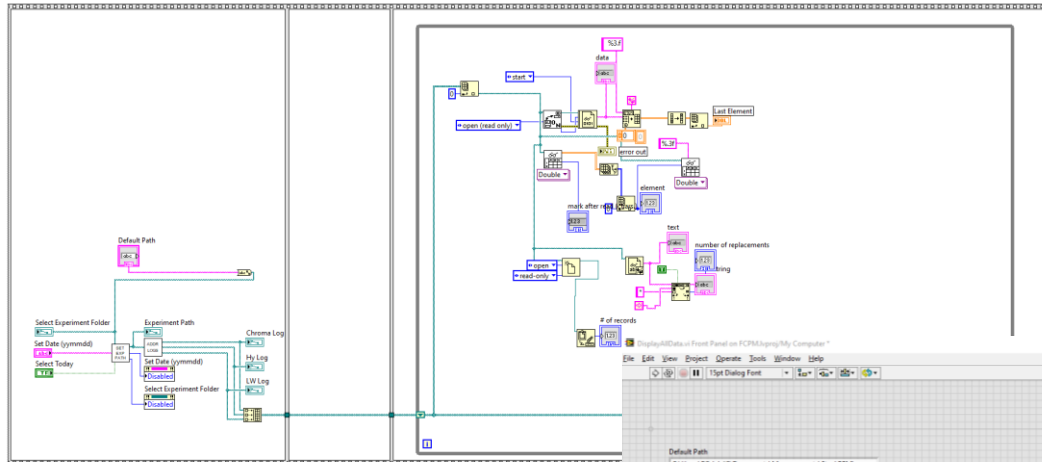
# LABVIEW PROJECTS – ANOTHER EXAMPLE



# LABVIEW PROJECTS – ANOTHER EXAMPLE

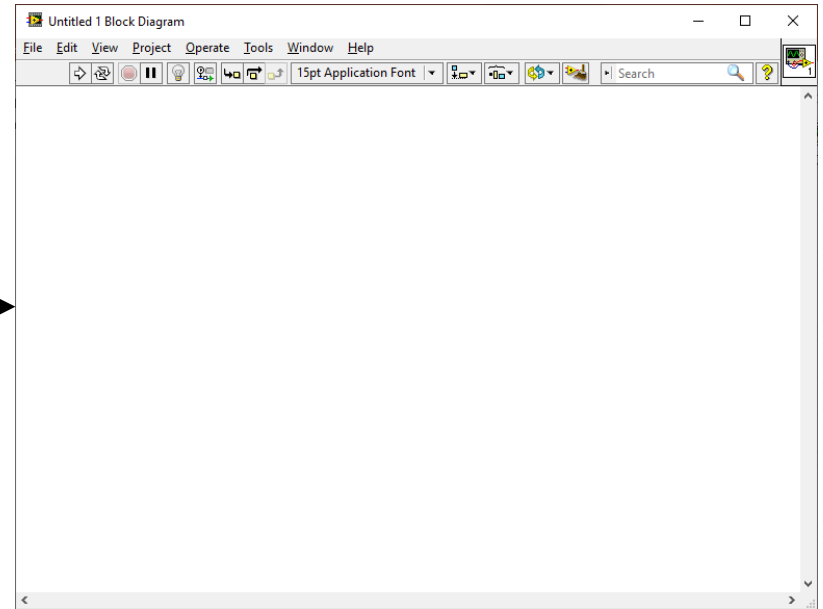
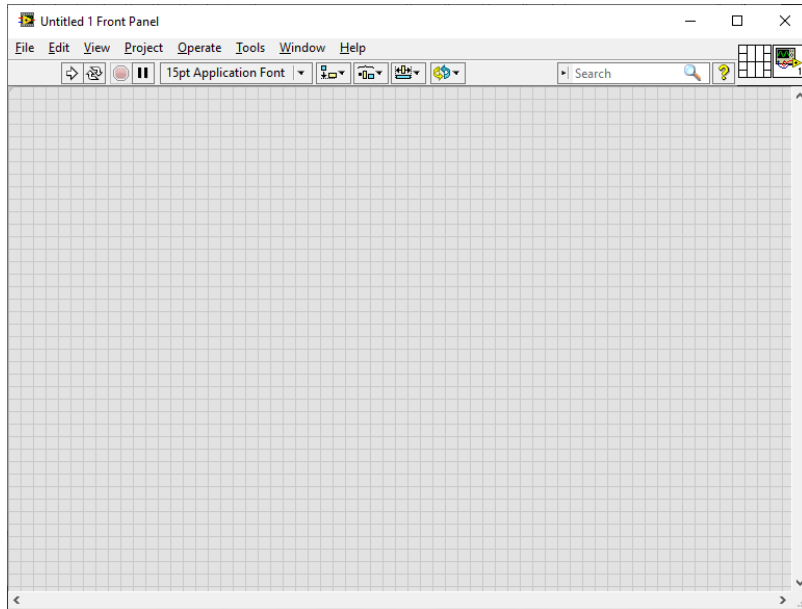


# LABVIEW PROJECTS – ANOTHER EXAMPLE



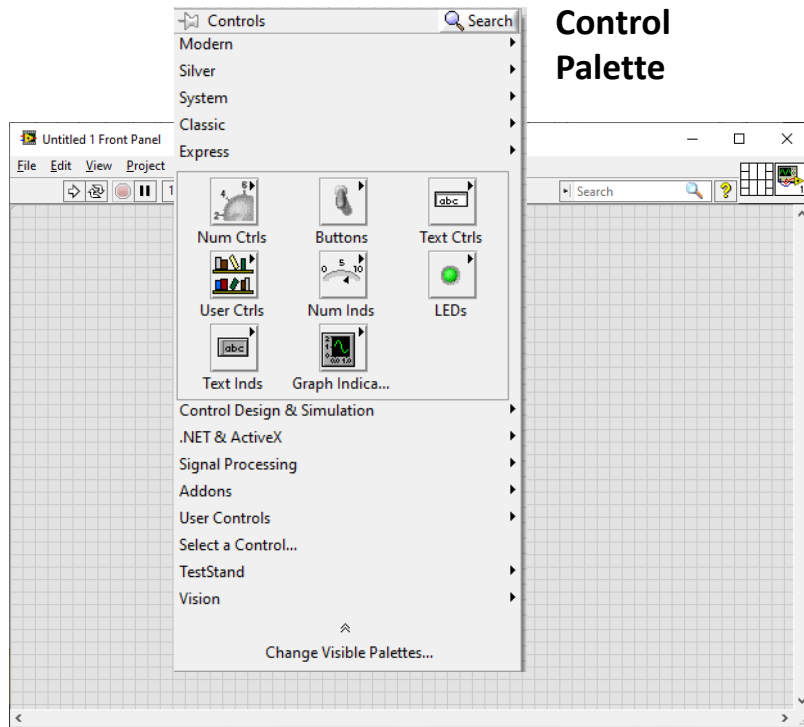
# LABVIEW: INTO THE SOFTWARE

A program developed by means of LV is called Virtual Instrument (VI).

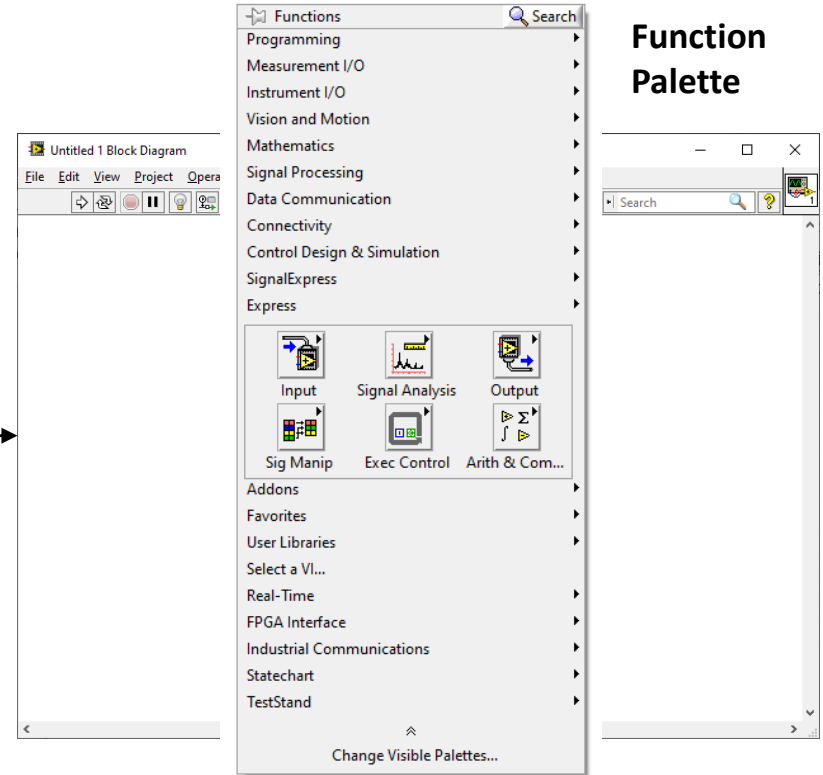




# LABVIEW: INTO THE SOFTWARE

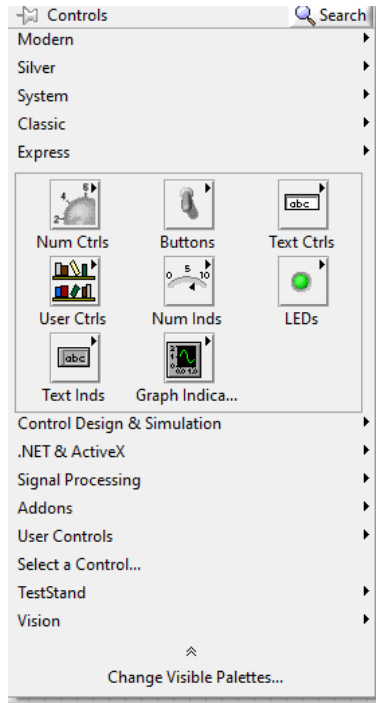


**Control  
Palette**

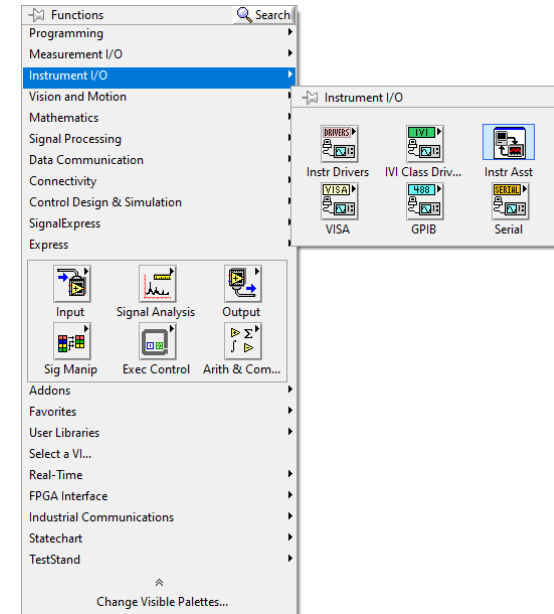
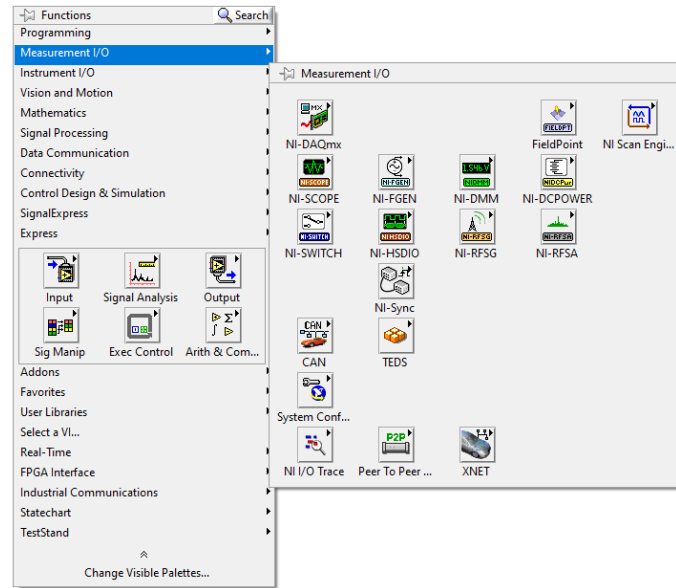
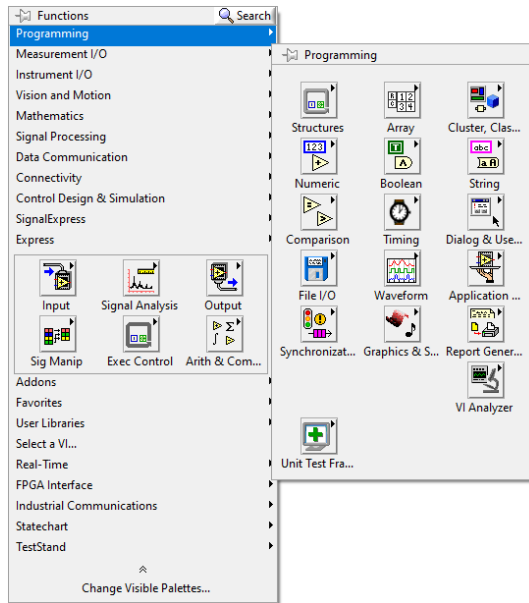


**Function  
Palette**

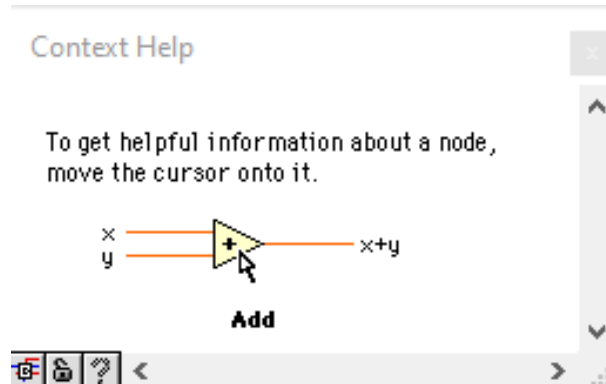
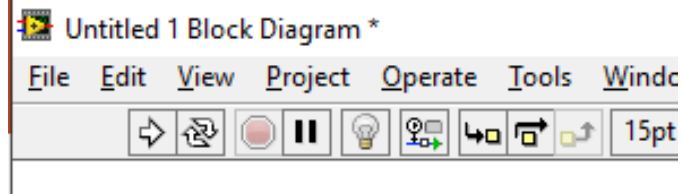
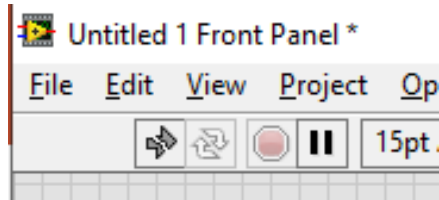
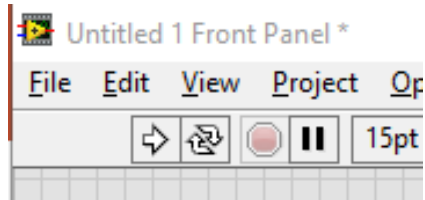
# THE FRONT PANEL - THE CONTROL PALETTE



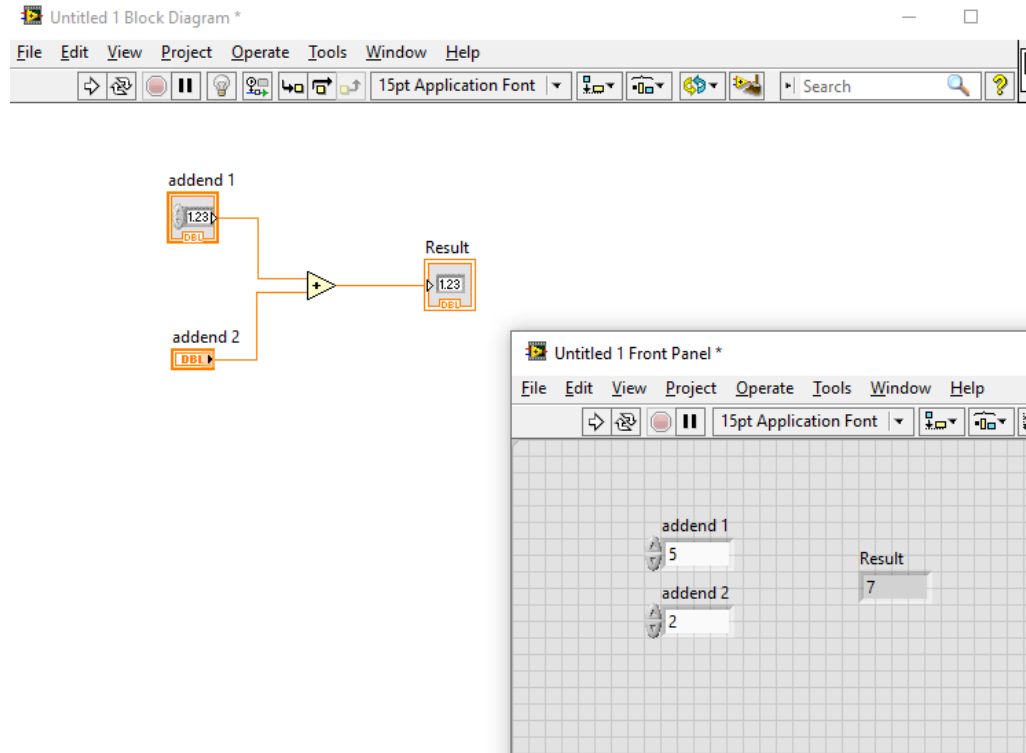
# THE BLOCK DIAGRAM - THE FUNCTION PALETTE



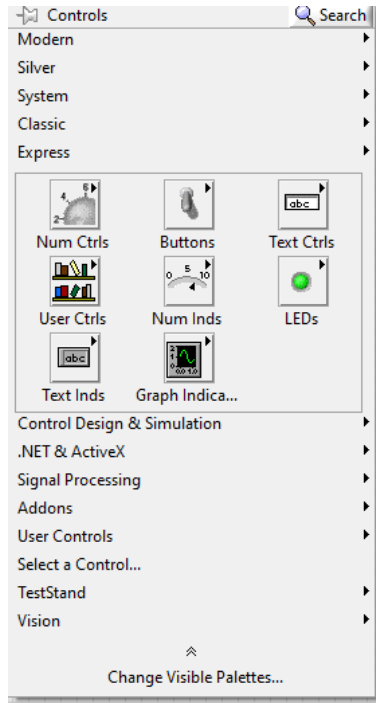
# MAIN CONTROLS AND AUXILIARY TOOLS



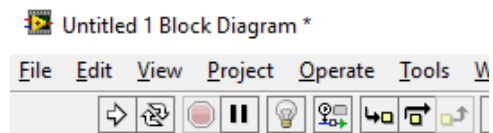
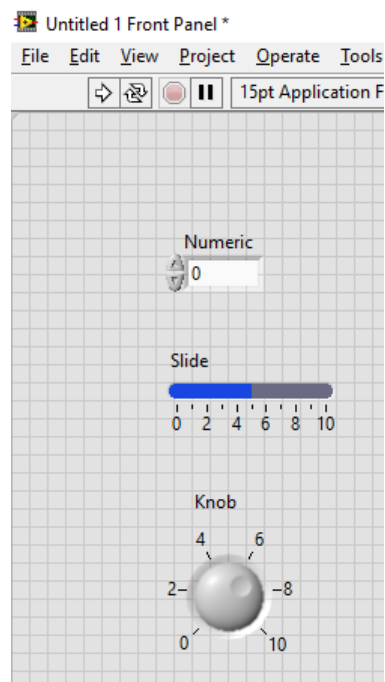
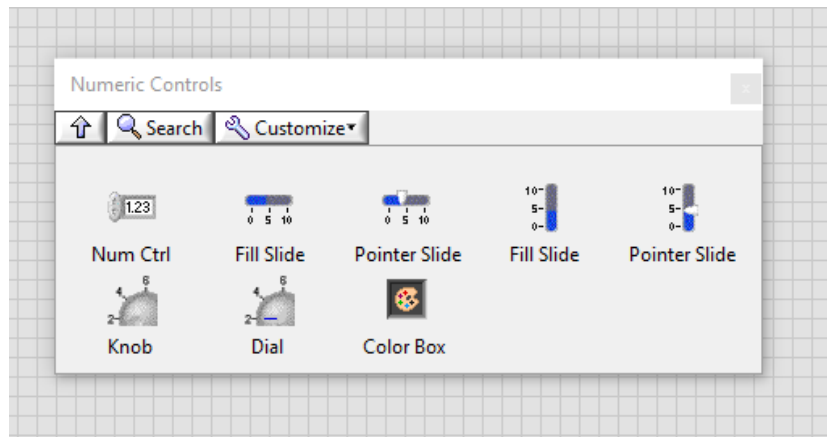
# ELEMENT DUALITY



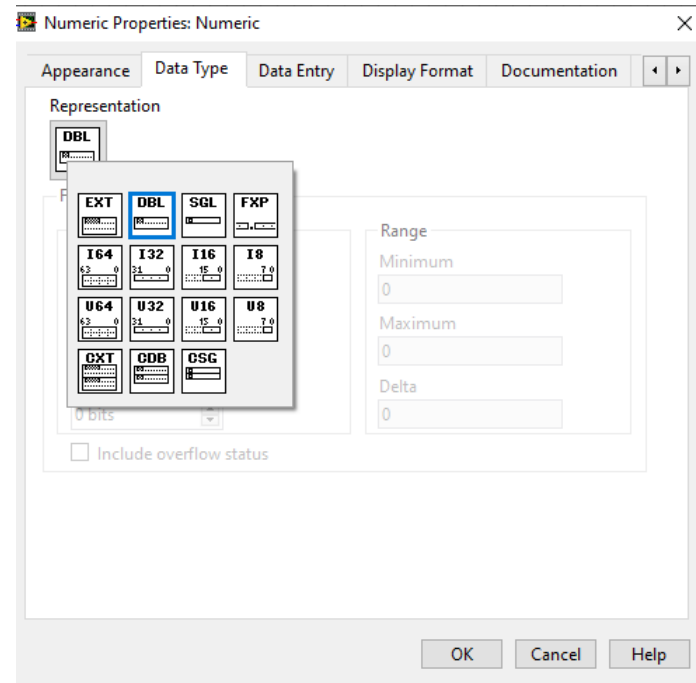
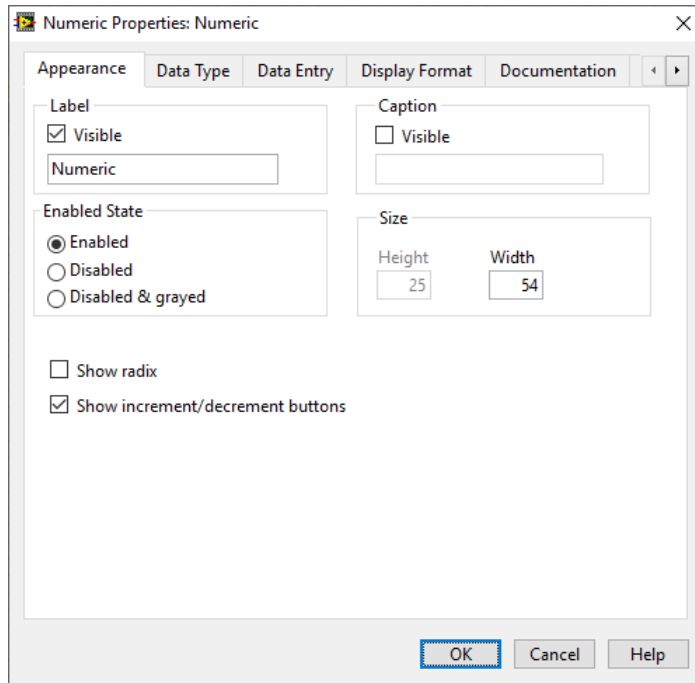
# MAIN ELEMENTS FROM THE CONTROL PALETTE



# NUMERIC CONTROLS

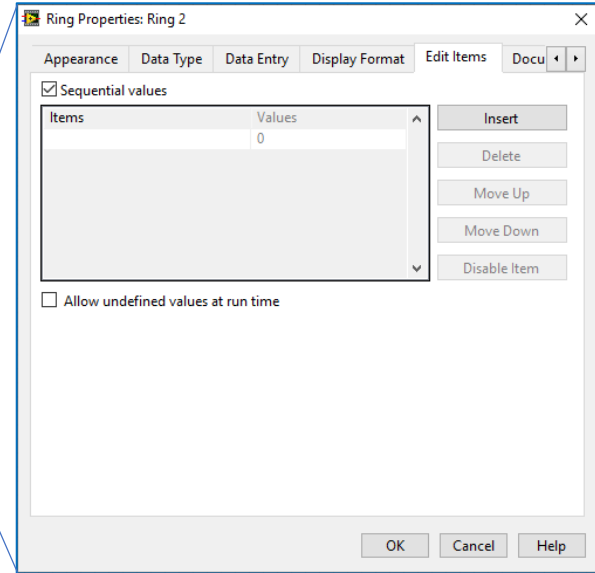
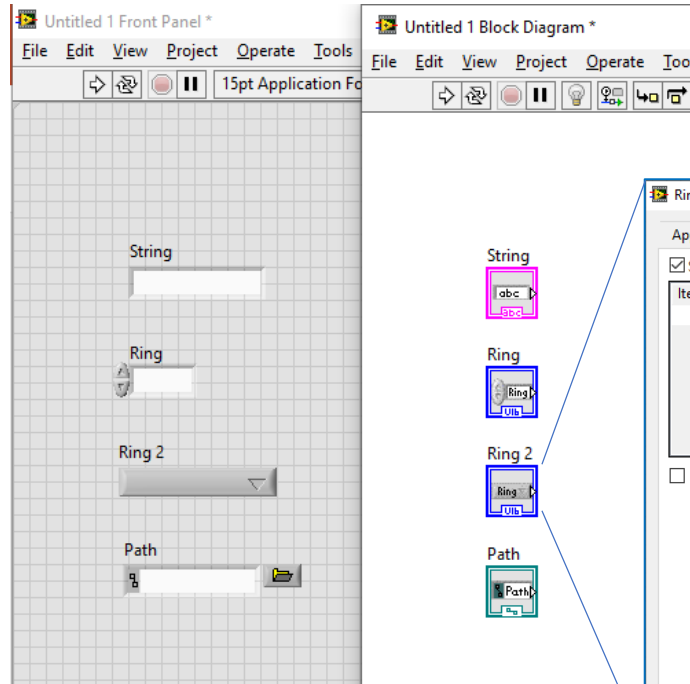
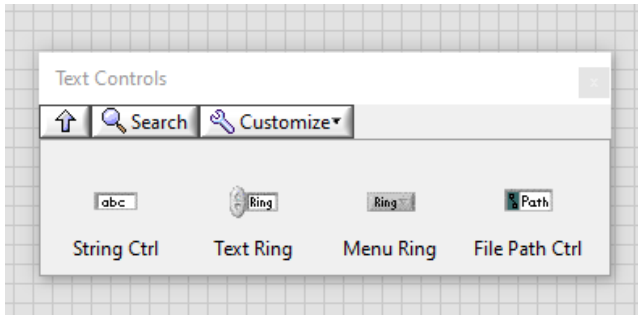


# NUMERIC CONTROLS

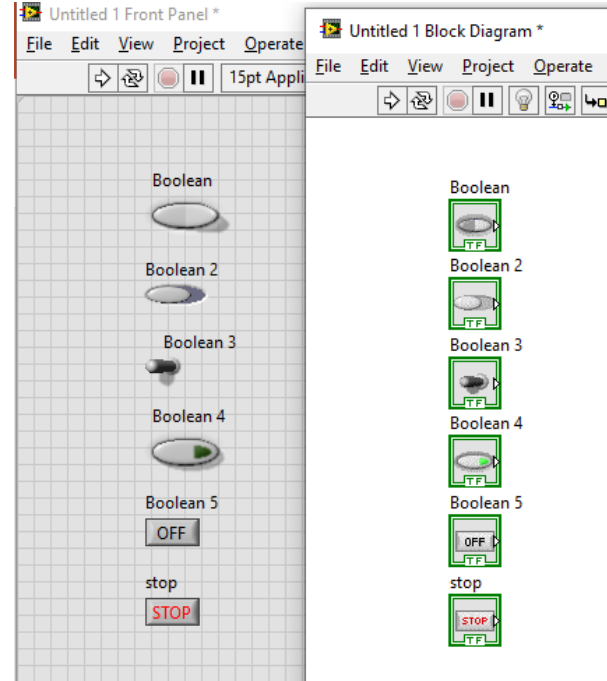
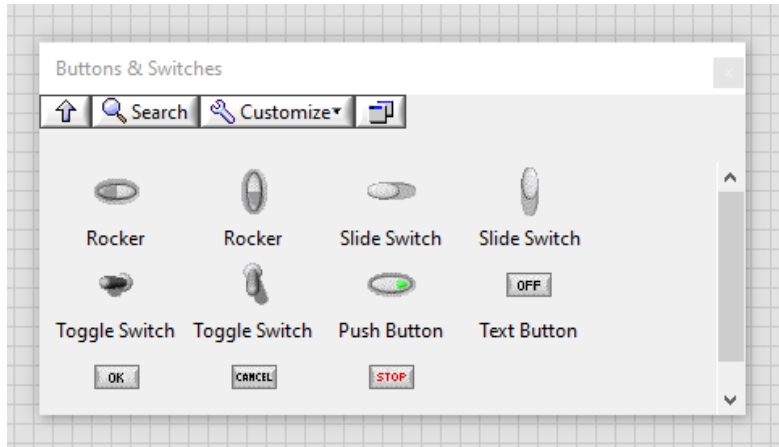




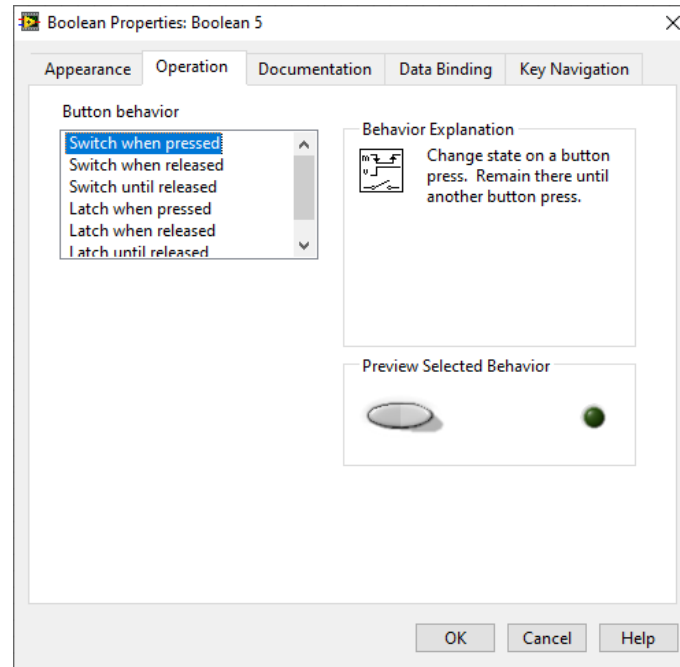
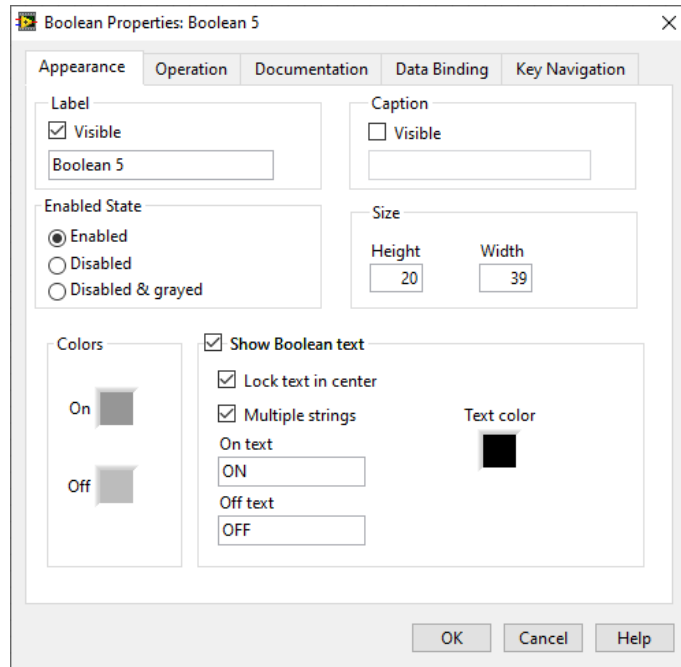
# STRING CONTROLS



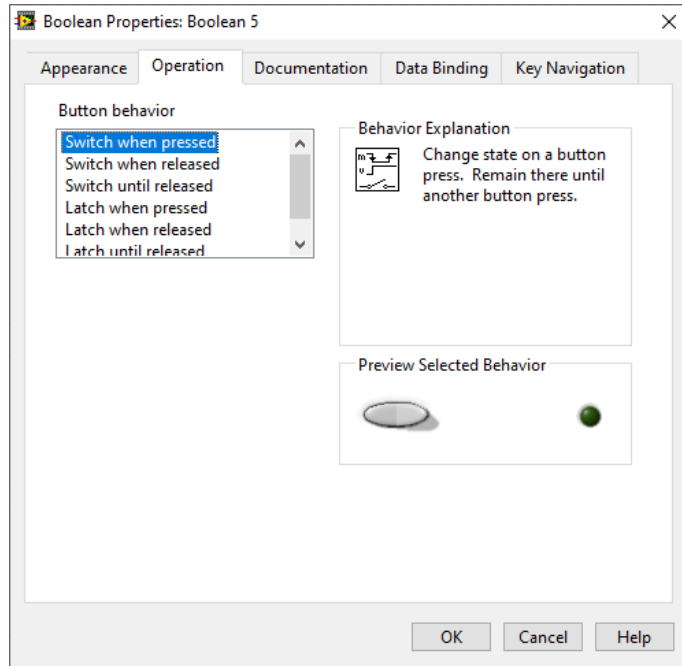
# BOOLEAN CONTROLS



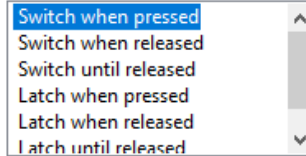
# BOOLEAN CONTROLS



# BOOLEAN CONTROLS



## Button behavior

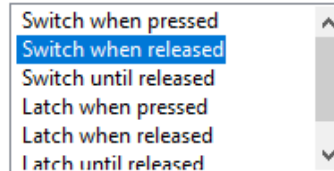


## Behavior Explanation



Change state on a button press. Remain there until another button press.

## Button behavior

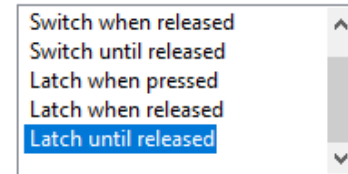


## Behavior Explanation



Change state on a button release. Remain there until another button release.

## Button behavior

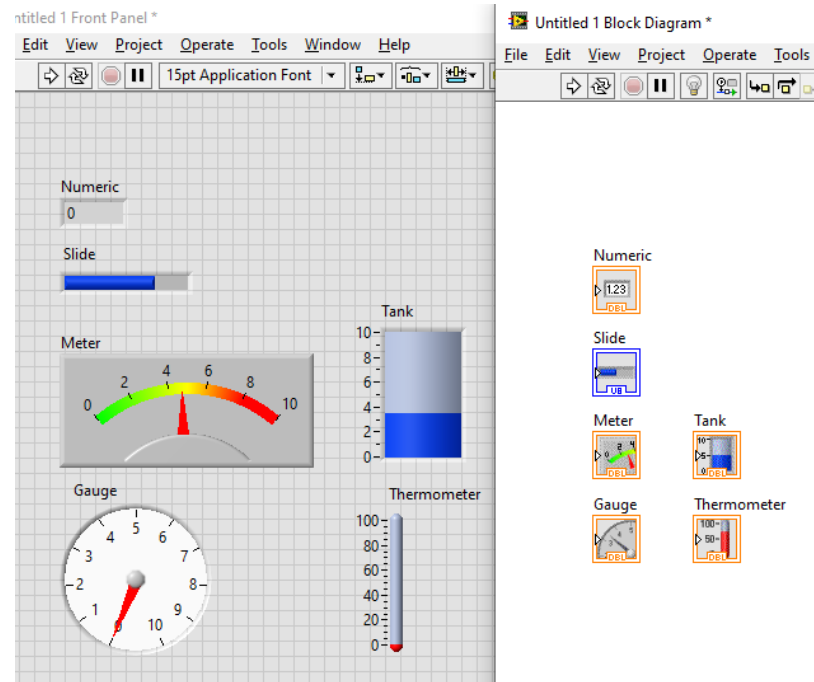
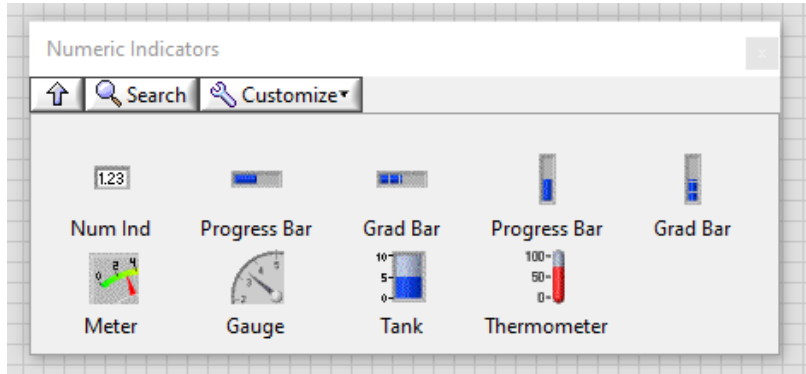


## Behavior Explanation

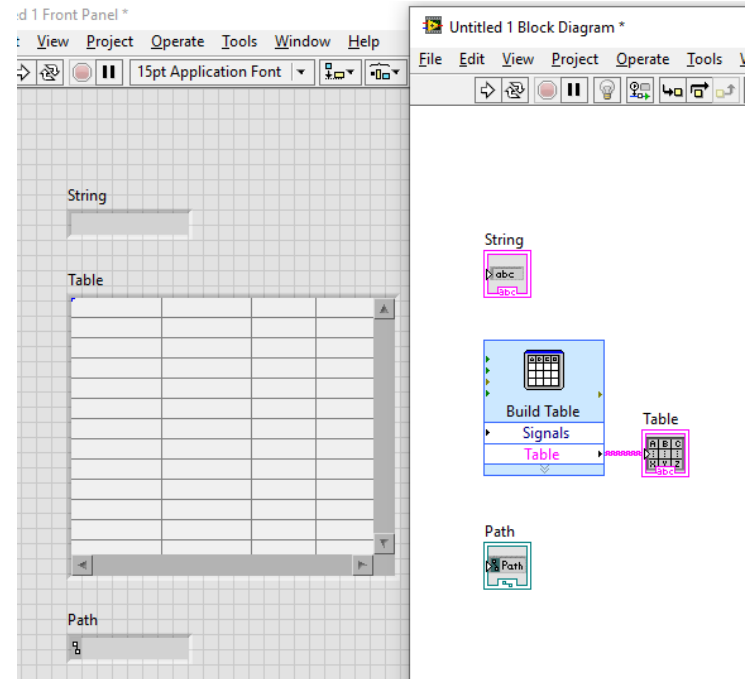
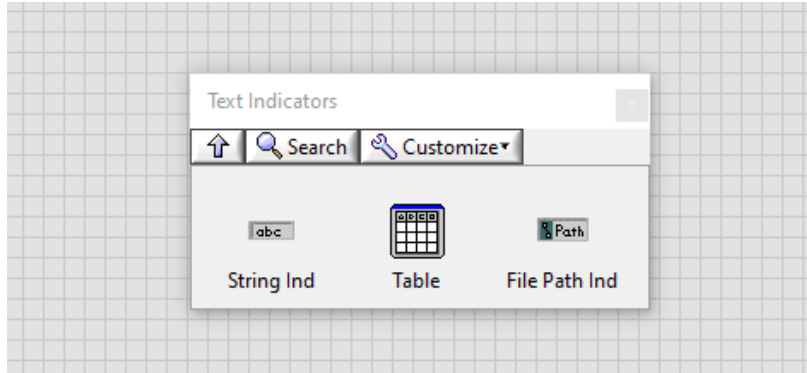


Change state on a button press. Change back when released and read by LabVIEW.

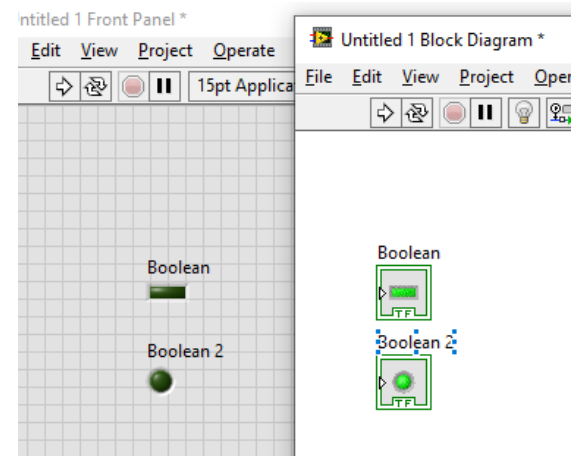
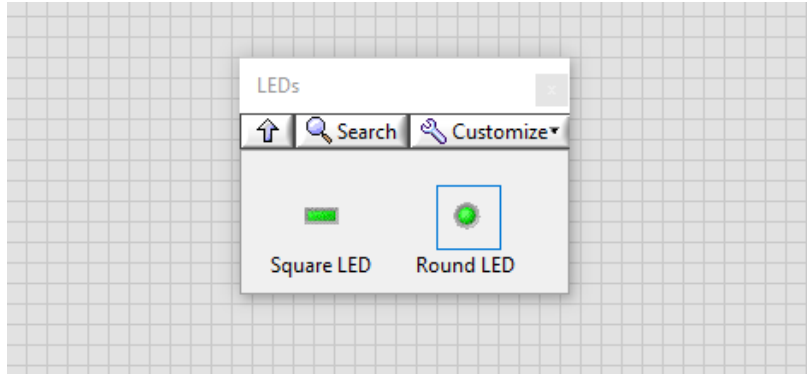
# NUMERIC INDICATORS



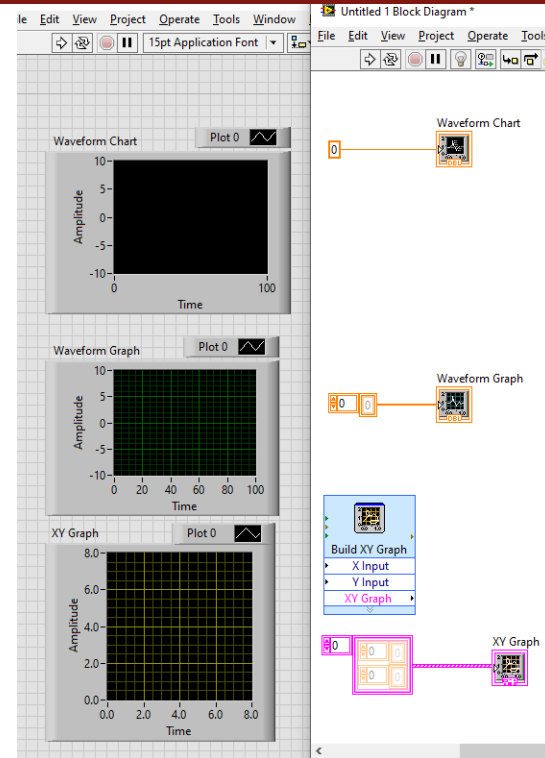
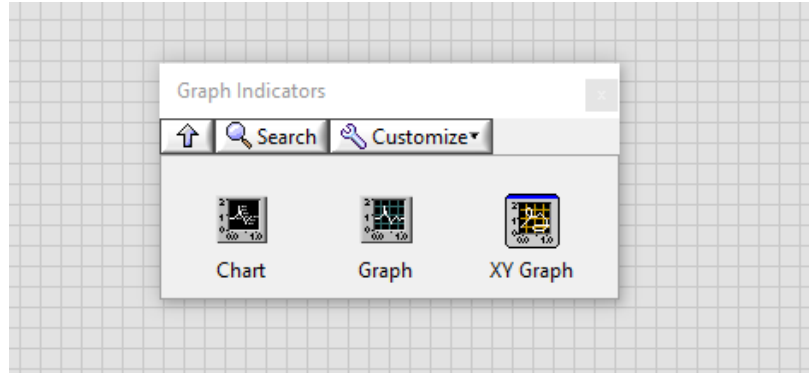
# STRING INDICATORS



# BOOLEAN INDICATORS

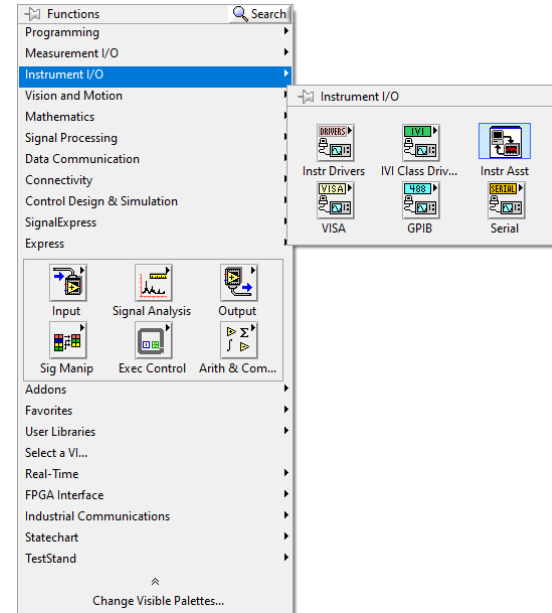
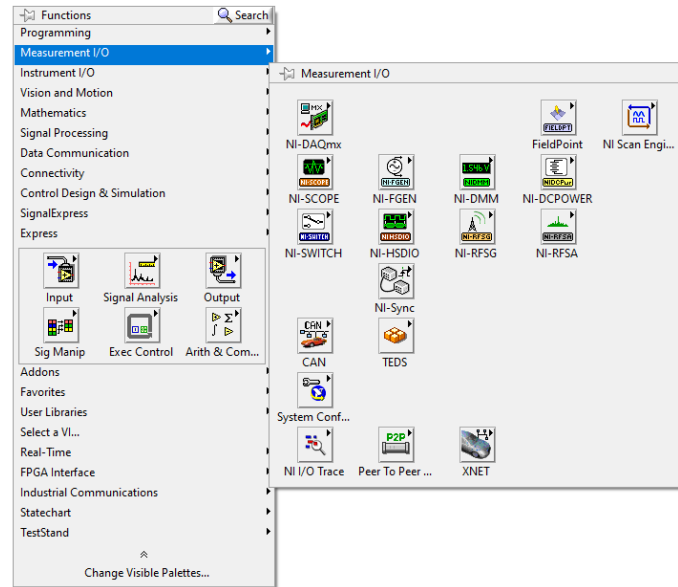
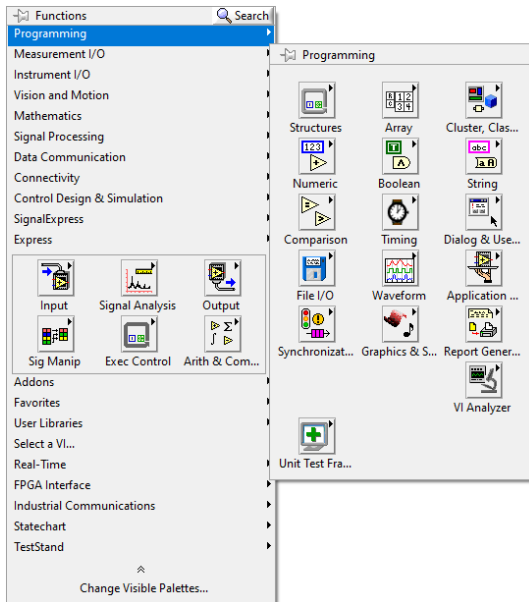


# GRAPH INDICATORS

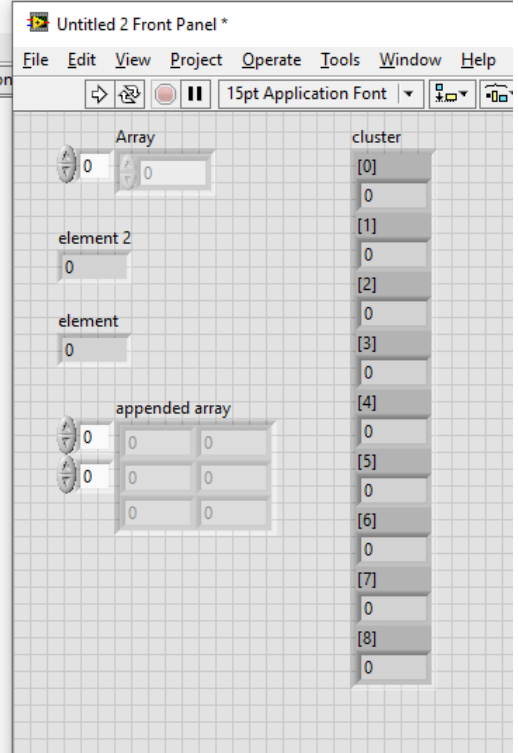
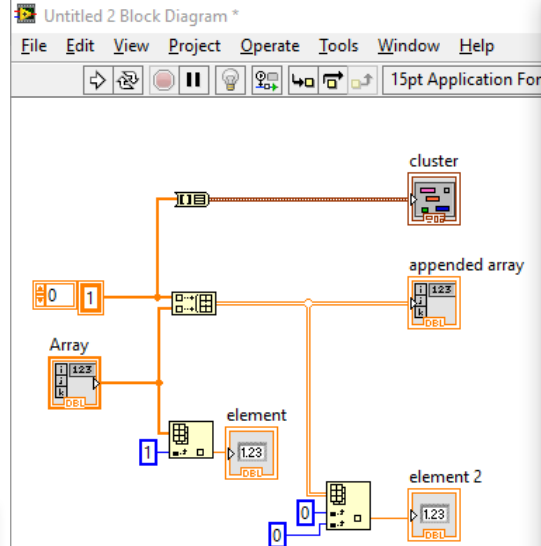
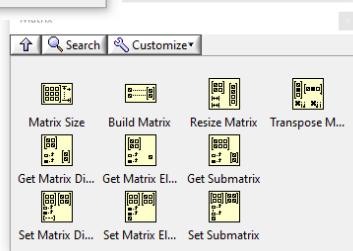
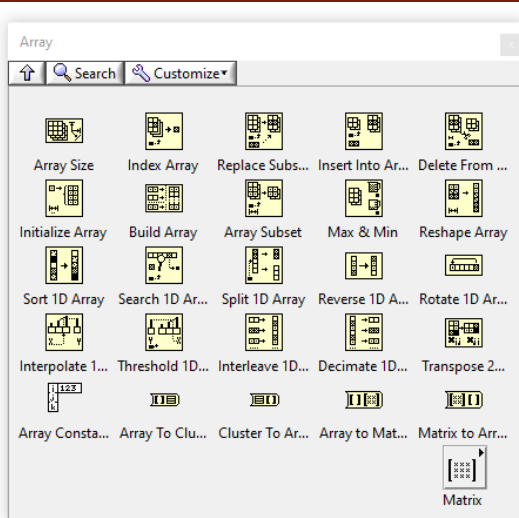




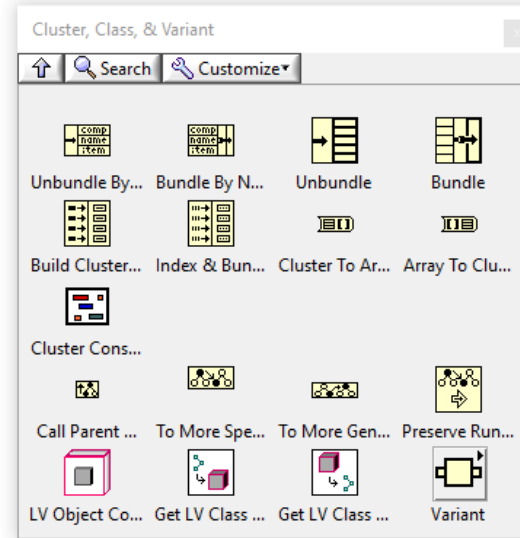
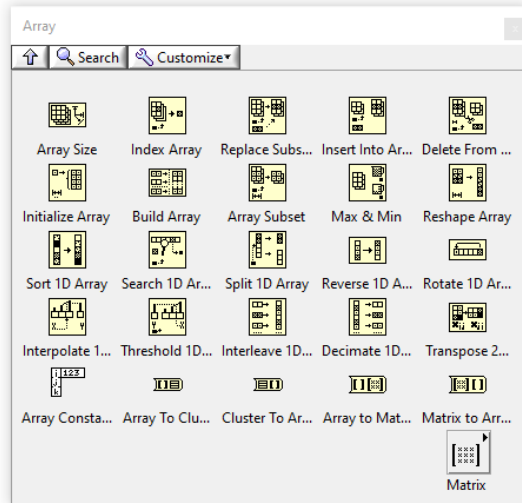
# MAIN ELEMENTS FROM THE FUNCTION PALETTE



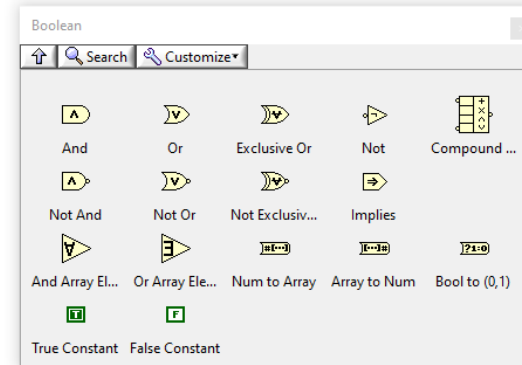
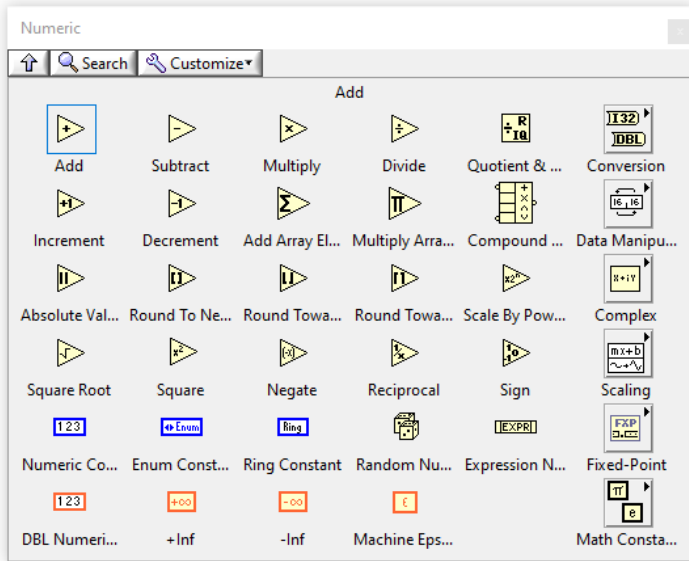
# ARRAYS



# ARRAYS AND CLUSTERS



# OPERATIONS



# OPERATIONS

Comparison

↑ Search Customize

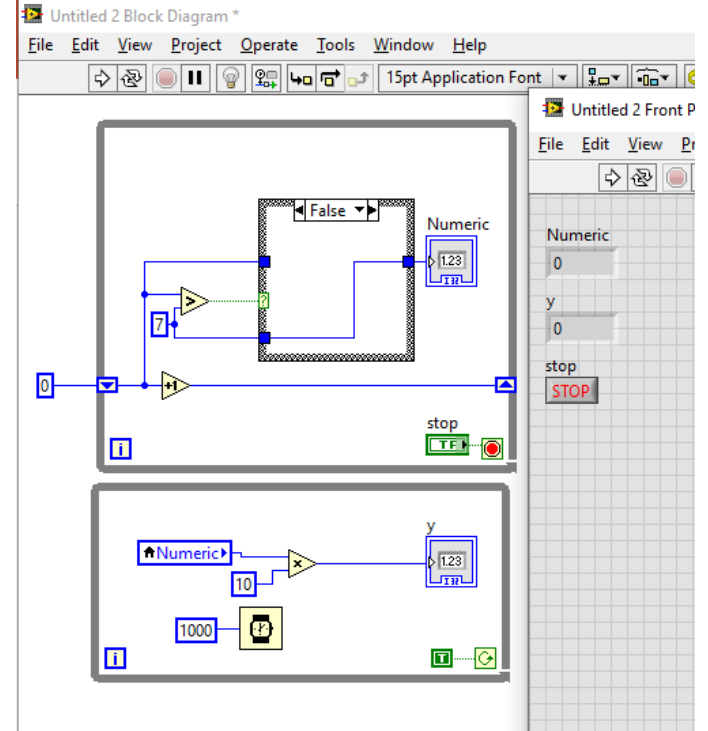
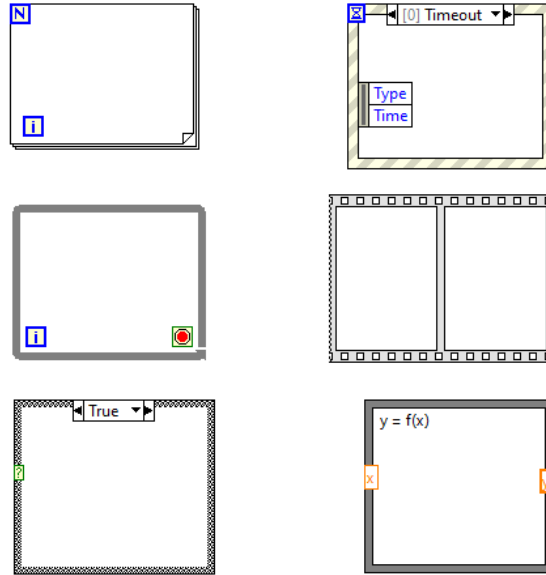
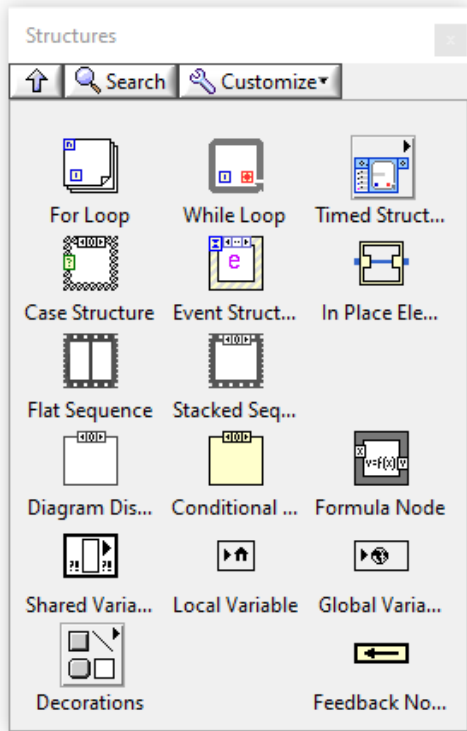
Equal?	Not Equal?	Greater?	Less?	Greater Or E...	Less Or Equal?
Equal To 0?	Not Equal To...	Greater Than...	Less Than 0?	Greater Or E...	Less Or Equal...
Select	Max & Min	In Range and...	Not A Num...	Empty Array?	Empty String...
Decimal Digit?	Hex Digit?	Octal Digit?	Printable?	White Space?	Lexical Class
Comparison					Fixed-Point ...

String

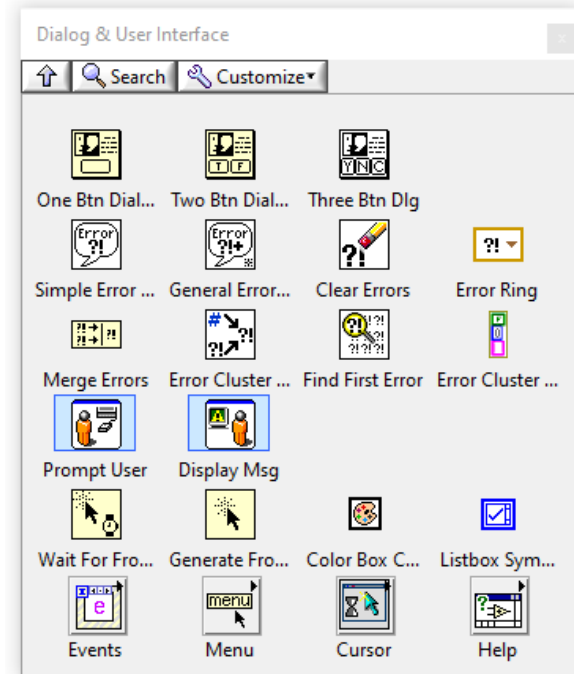
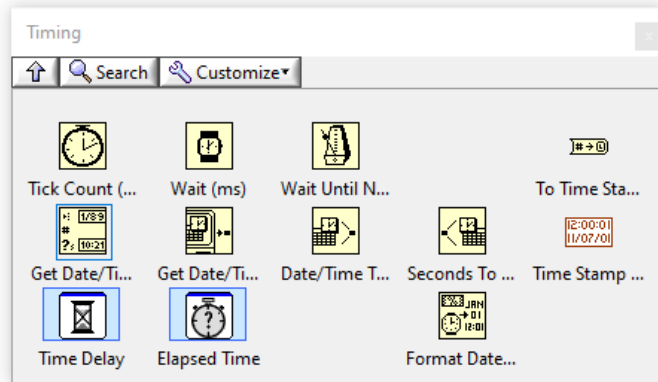
↑ Search Customize

String Length	Concatenate...	String Subset		Additional St...	
Replace Sub...	Search and R...	Match Pattern	Match Regul...	Format Date...	String/Num...
Scan From St...	Format Into ...	Spreadsheet ...	Array To Spr...		Conversion
Build Text	Trim Whites...	To Upper Case	To Lower Case	Space Const...	
String Const...	Empty String...	Carriage Ret...	Line Feed Co...	End of Line ...	Tab Constant

# STRUCTURES



# TIMING AND USER INTERFACE



# MATHEMATICS

Mathematics

↑ Search Customize

Numeric	Elementary	Linear Algebra
Fitting	Interp & Extr...	Integ & Diff
Prob & Stat	Optimization	Differential E...
Geometry	Polynomial	Script & For...

Elementary & Special Functions

↑ Search Customize

Trigonometric	Exponential	Hyperbolic
Gating Funct...	Discrete Math	Bessel Functi...
Gamma Fun...	Hypergeome...	Elliptic Integ...
Exponential l...	Error Functio...	Elliptic & Par...

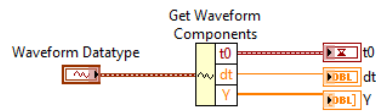
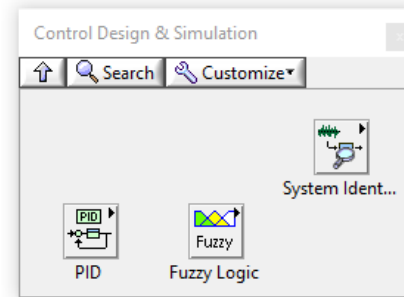
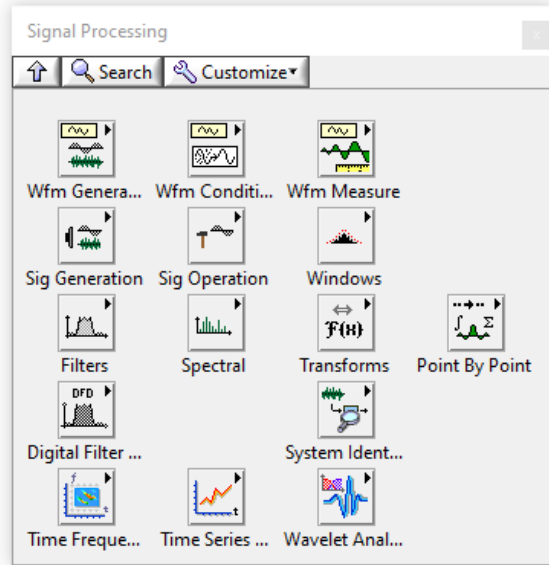
Linear Algebra

↑ Search Customize

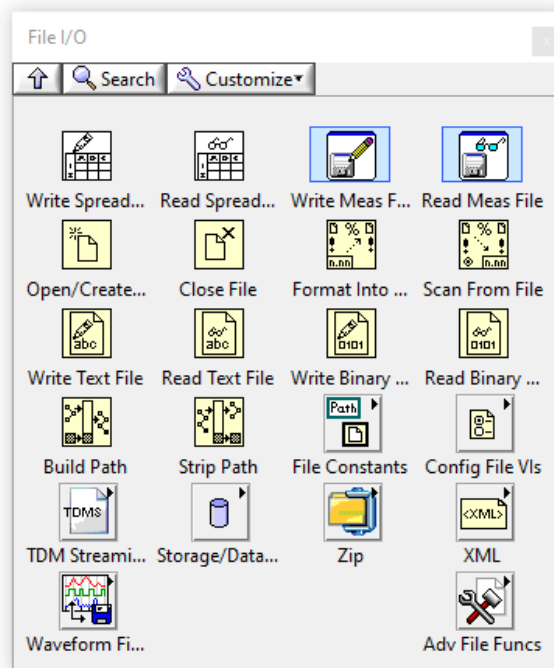
Create Speci...	Create Real ...	Matrix				
Solve Linear ...	Dot Product	Outer Product	A x B	Kronecker Pr...	Subspaces A...	
Determinant	Vector Norm	Matrix Norm	Matrix Rank	Trace	Test Matrix T...	Condition N...
Inverse Matrix	Pseudolnv	Transpose	Matrix Sqrt	Matrix Exp	Matrix Power	Matrix Log
LU	Cholesky	Cholesky Up...	QR	SVD	Generalized ...	
Schur	Hessenberg	QZ	Sylvester Eqs	Lyapunov Eqs		
Eigenvalues ...	Generalized ...	Matrix Balance	Back Transfo...	Matrix Chara...		BLAS



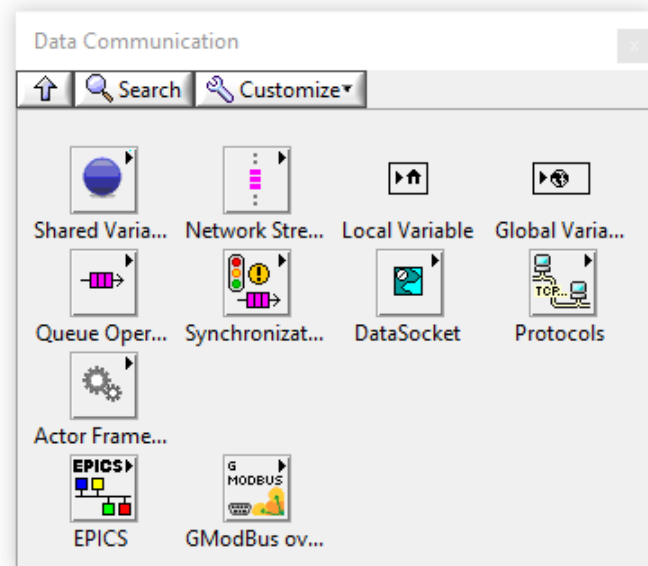
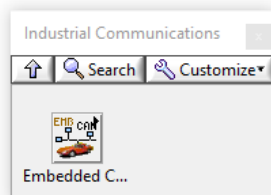
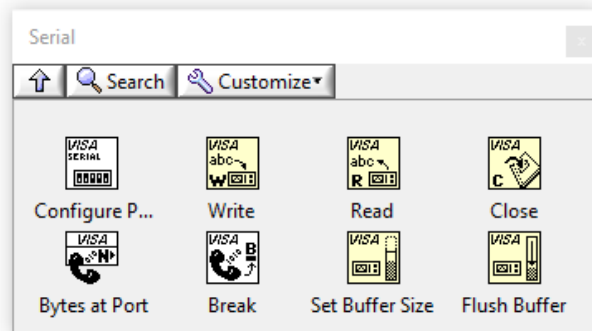
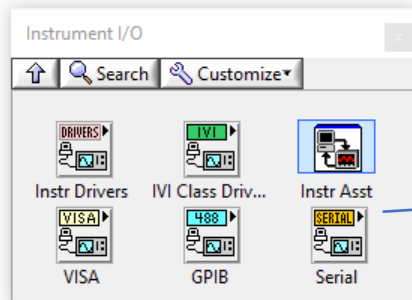
# SIGNAL PROCESSING



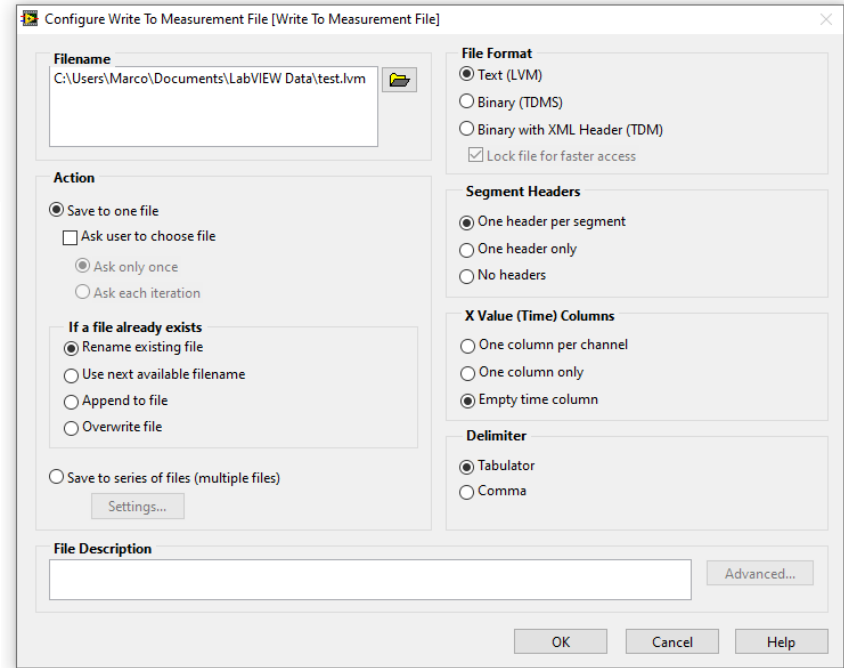
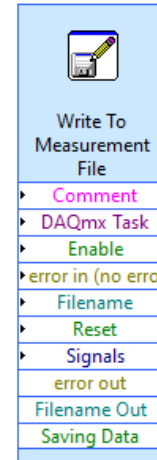
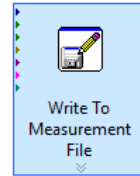
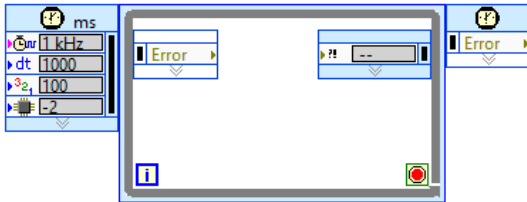
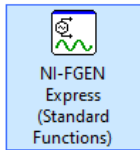
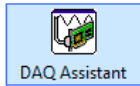
# FILE I/O



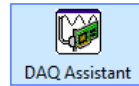
# COMMUNICATION



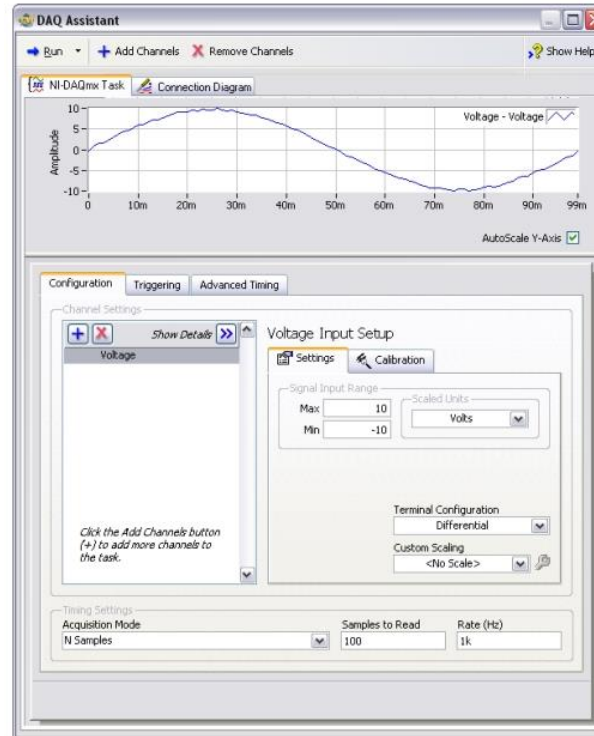
# GRAPHICAL INTERFACE BASED BLOCKS



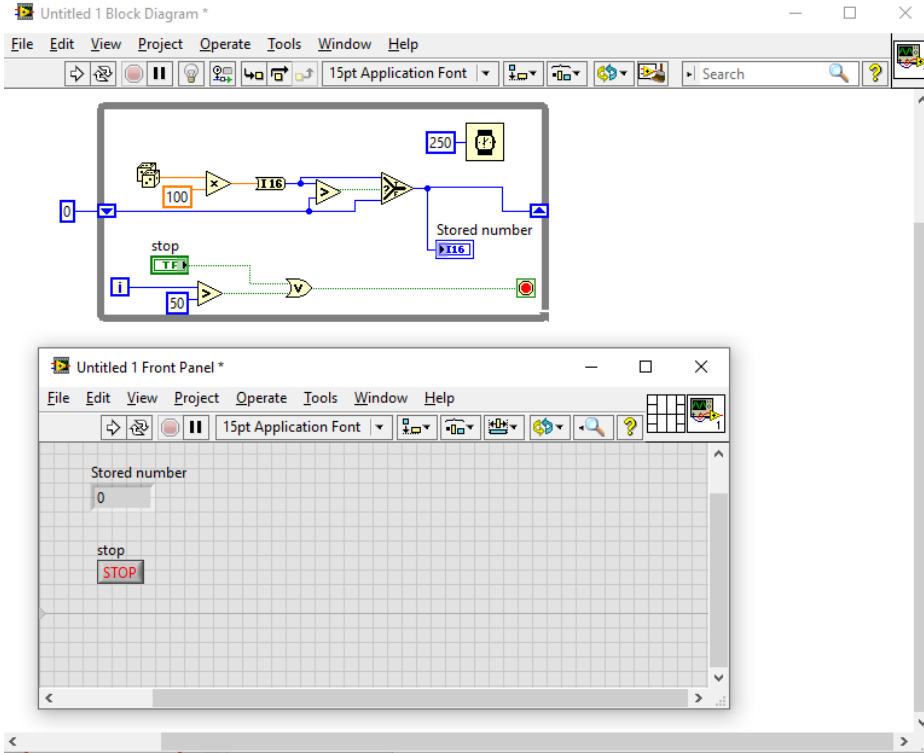
# GRAPHICAL INTERFACE BASED BLOCKS



DAQ Assistant

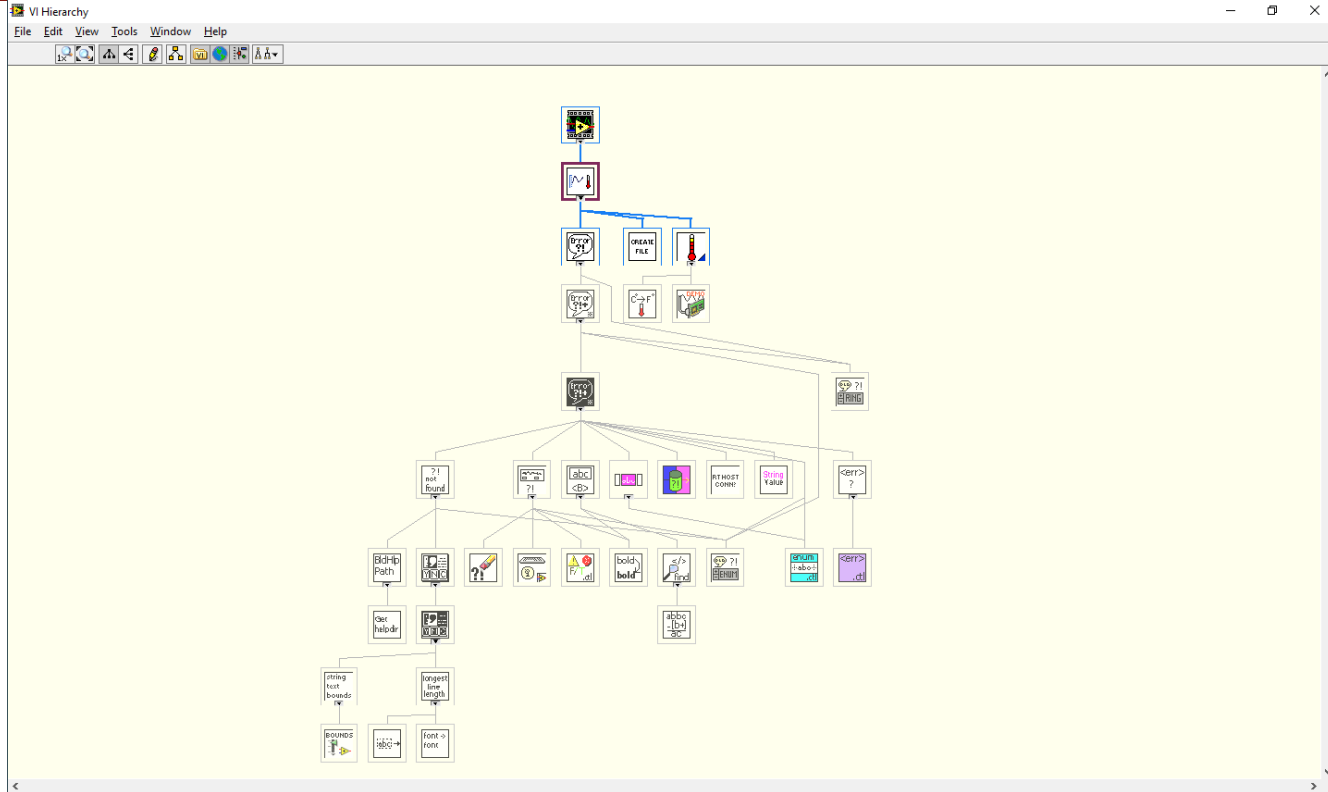


# NI/ LABVIEW / VI / SOME EXAMPLES

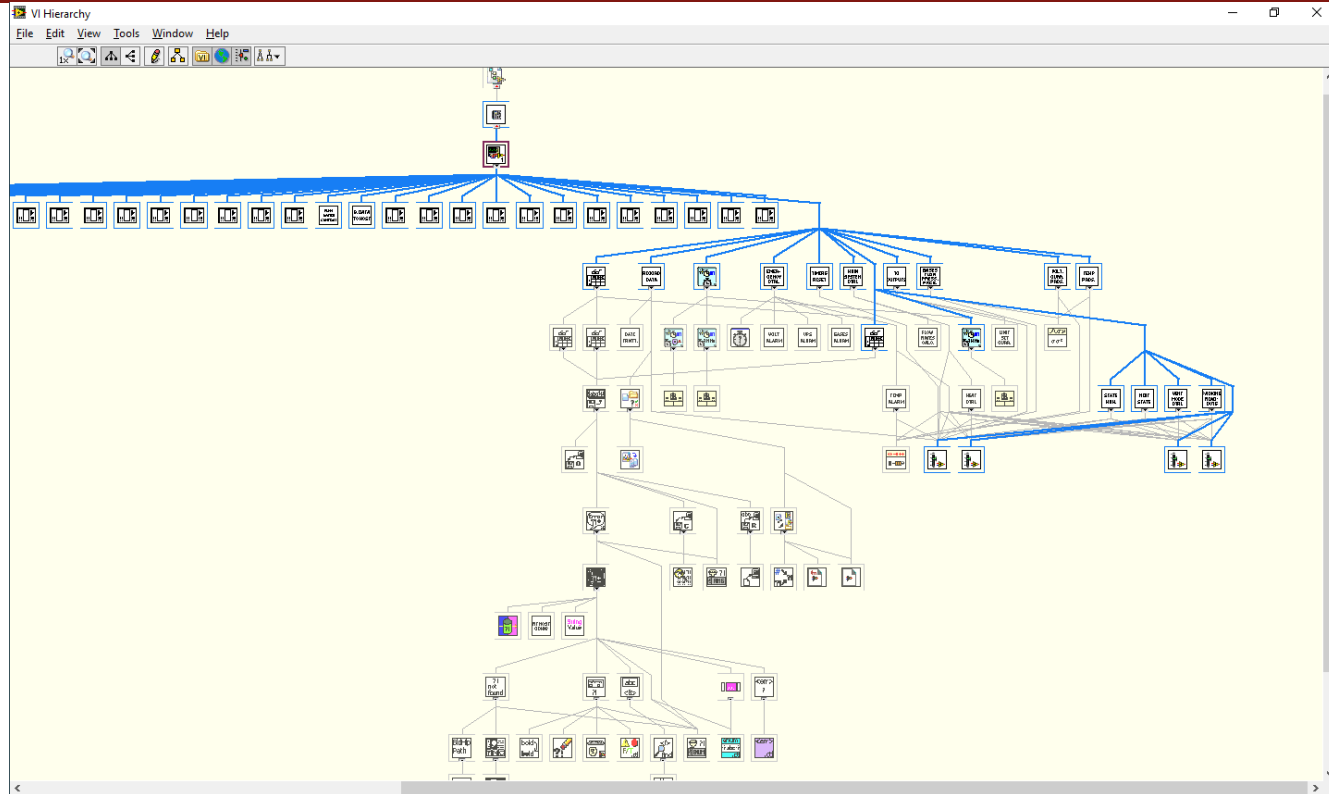


- NI Example finder / Signal Processing / Advanced Peak Detection
- NI Example finder / Level Measurement / Advanced DC-RMS Measurement

# VI HIERARCHY



# VI HIERARCHY





# NI-MAX (MEASUREMENT & AUTOMATION EXPLORER)

The screenshot displays the NI-MAX Measurement & Automation Explorer interface. The window title is "My System - Measurement & Automation Explorer". The menu bar includes "File", "Edit", "View", "Tools", and "Help".

**Left Panel (Navigation):**

- My System
  - Data Neighborhood
  - Devices and Interfaces
  - Scales
  - Software
  - IVI Drivers
  - Remote Systems

**Main Content Area:**

**System Settings**

Hostname	DESKTOP-KOJBKT6
DNS Name	DESKTOP-KOJBKT6
Vendor	Dell Inc.
Model	Latitude E5410
Serial Number	C3960N1
Firmware Version	A07
Hardware Revision	0001
Operating System	Microsoft Windows 10 Enterprise
System Start Time	02/12/2022 17:27
Description	
System Configuration Web Access	Local Only

**System Resources**

Total Physical Memory	3.80 GB
Free Physical Memory	627 MB
Total Virtual Memory	8.82 GB
Free Virtual Memory	1.61 GB
Primary Disk Capacity	232 GB
Primary Disk Free Space	57.7 GB
CPU Model	Intel(R) Core(TM) i7 CPU M 640 @ 2.80GHz
CPU Cores	2

**Right Panel (Help/Navigation):**

Back

### NI Measurement & Automation Explorer

Measurement & Automation Explorer (MAX) provides access to your NI products.

**What do you want to do?**

- [Manage my devices and interfaces](#)
- [Manage my installed NI software](#)
- [Manage virtual channels or tasks for my devices](#)
- [Create scales for my virtual instruments](#)
- [Configure my IVI instrument drivers](#)
- [Import/export my device configuration file.](#)

**Note** Some categories are device specific. For example, the IVI category appears only if you have IVI installed.

For more information about using MAX, select available help categories from the Help menu. If you need further assistance or want to know more about your device, visit the [NI Technical Support website](#).

For more information about this version of MAX, launch the [readme](#) or visit [ni.com/info](#) and enter the following Info Codes:

- [SysCfgFixList](#)—Improvements and bug fixes
- [SysCfgKnownIssues](#)—Known issues

System Settings | Network Settings

# LABVIEW INSTALLATION



## LabVIEW

LabVIEW is systems engineering software for applications that require test, measurement, and control with rapid access to hardware and data insights.

[+ Read More](#)

### DOWNLOADS

Supported OS

Windows

[View Release Notes](#)

Version

2023 Q3

Included Editions

Base, Full, Professional

Community

Runtime

Application Bitness

64-bit

**Note:** LabVIEW (64-bit) does not work with all toolkits supported by LabVIEW (32-bit). Select the application bitness for LabVIEW that is compatible with any toolkits you want to use. [Learn More](#)

Language

English

### LabVIEW 2023 Q3 and Drivers

Release Date

Jul/18/2023

Included Versions

2023 Q3

> Supported OS

> Language

> Checksum

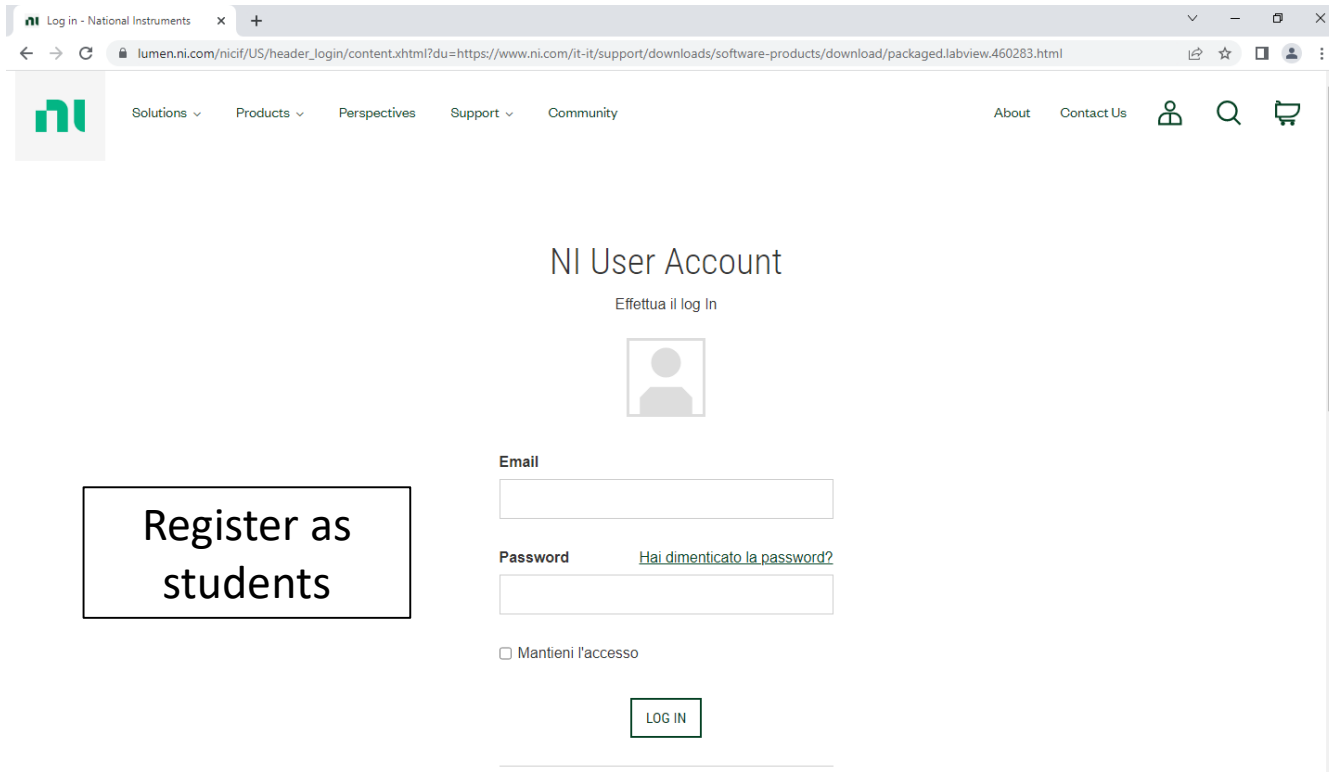
DOWNLOAD

INSTALL OFFLINE

File Size

4.67 MB

# LABVIEW INSTALLATION




ni Log in - National Instruments x +

lumen.ni.com/nicif/US/header\_login/content.xhtml?du=https://www.ni.com/it-it/support/downloads/software-products/download/packaged.labview.460283.html

ni Solutions Products Perspectives Support Community About Contact Us

## NI User Account

Effettua il log In



**Email**

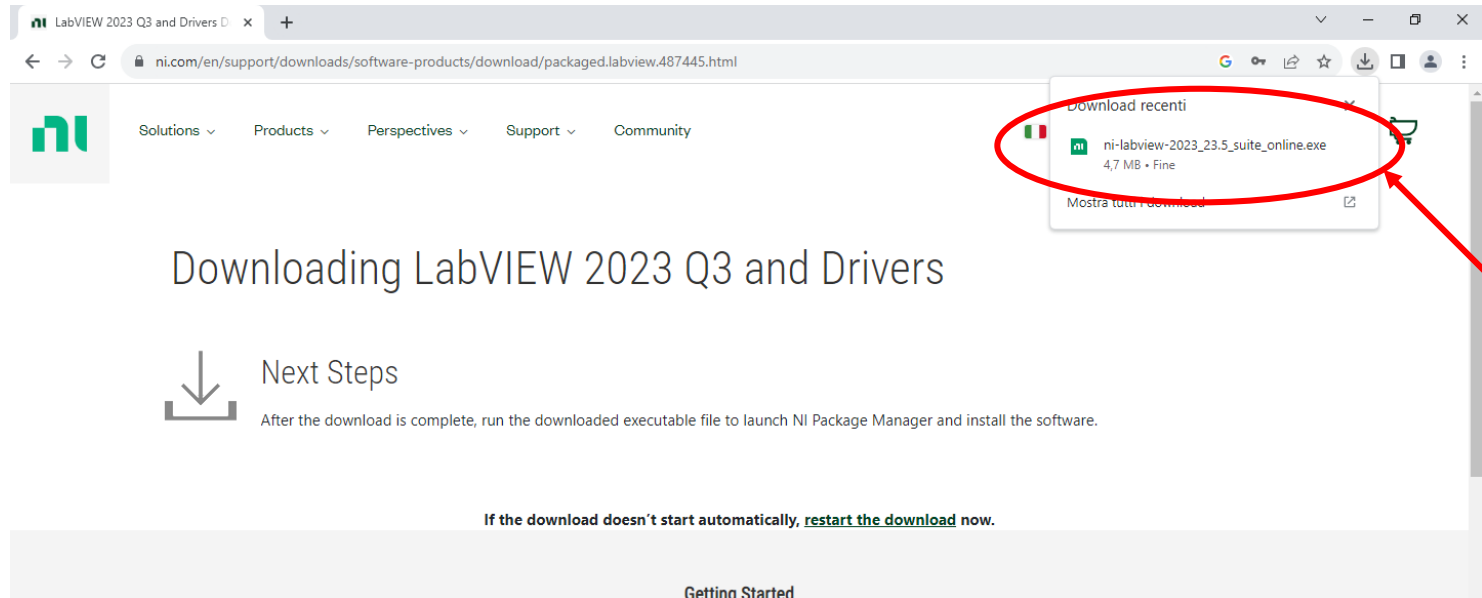
**Password** [Hai dimenticato la password?](#)

Mantieni l'accesso

LOG IN

Register as  
students

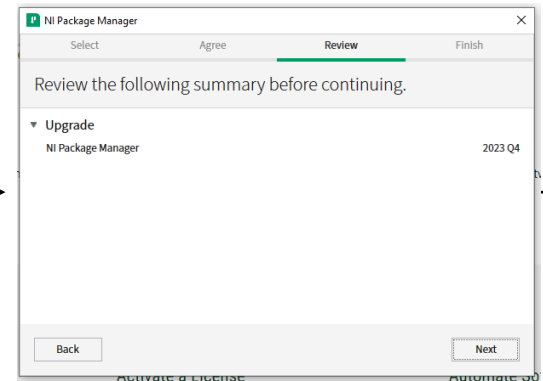
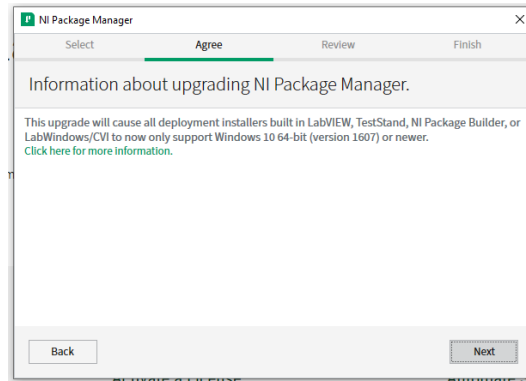
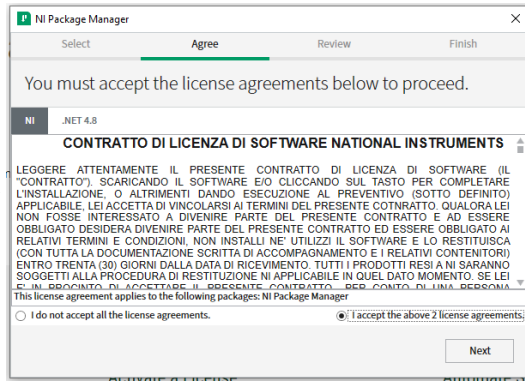
# LABVIEW INSTALLATION



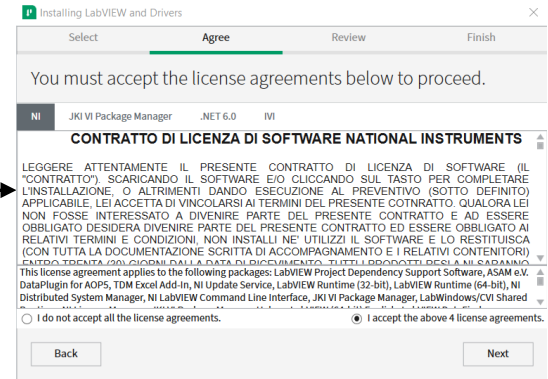
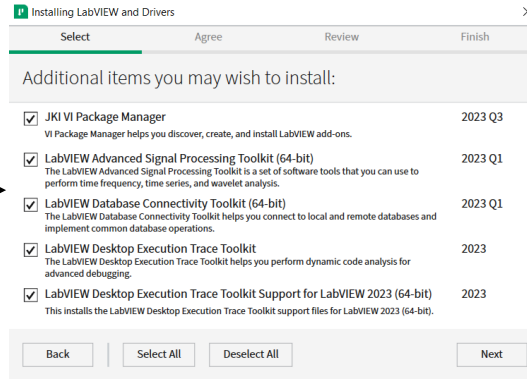
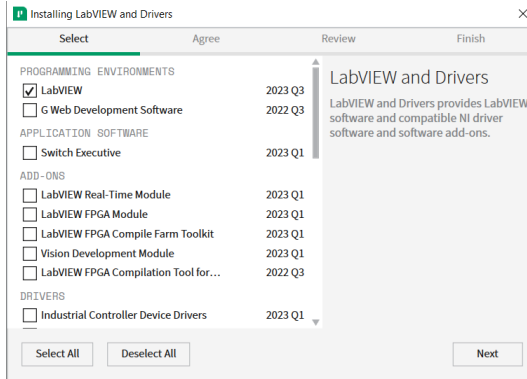
The screenshot shows a web browser window with the URL [ni.com/en/support/downloads/software-products/download/packaged.labview.487445.html](https://ni.com/en/support/downloads/software-products/download/packaged.labview.487445.html). The page content includes the NI logo, navigation menus for Solutions, Products, Perspectives, Support, and Community, and a main heading "Downloading LabVIEW 2023 Q3 and Drivers". Below this is a "Next Steps" section with a download icon and the text: "After the download is complete, run the downloaded executable file to launch NI Package Manager and install the software." A note states: "If the download doesn't start automatically, [restart the download](#) now." At the bottom of the page, it says "Getting Started".

A download notification popup is visible in the top right corner, titled "Download recenti". It lists a file: "ni-labview-2023\_23.5\_suite\_online.exe" with a size of "4,7 MB" and a status of "Fine". The notification is circled in red, and a red arrow points to it from the right side of the browser window.

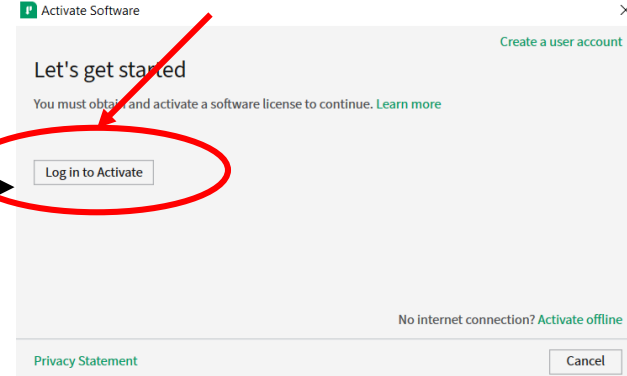
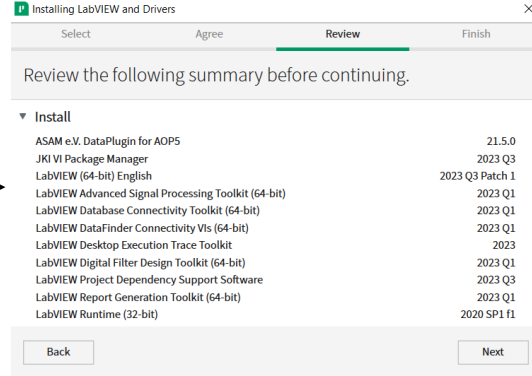
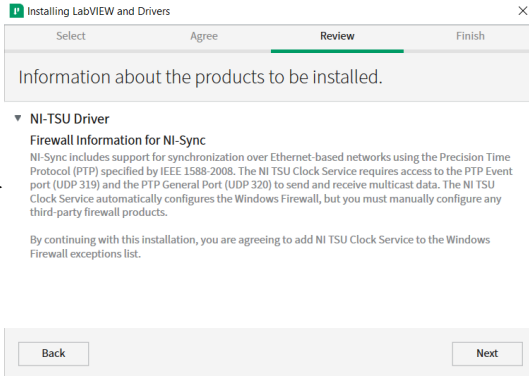
# LABVIEW INSTALLATION



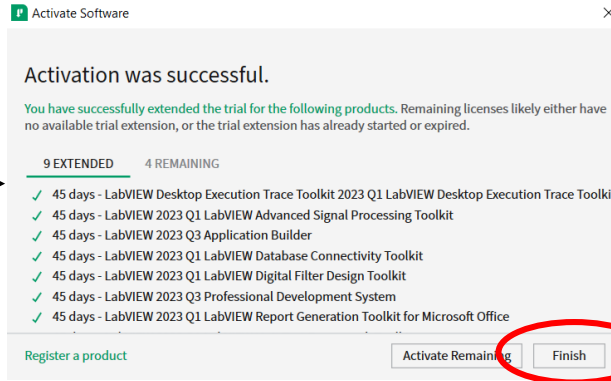
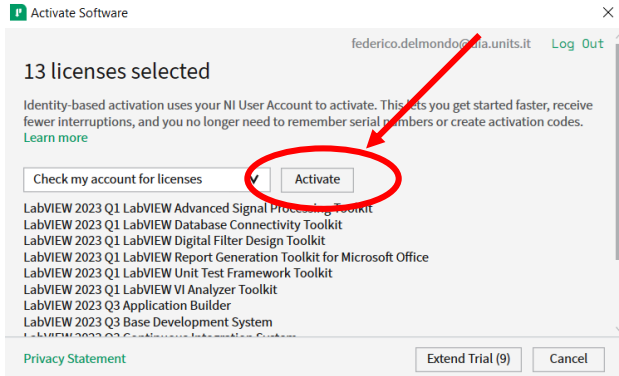
# LABVIEW INSTALLATION



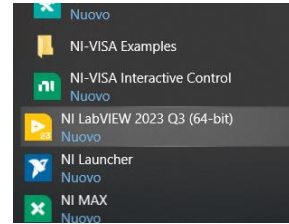
# LABVIEW INSTALLATION



# LABVIEW INSTALLATION



Reboot







UNIVERSITÀ  
DEGLI STUDI  
DI TRIESTE



Dipartimento di  
**Ingegneria  
e Architettura**