

Lesson 4 More on Data Acquisition and Waveforms

You Will Review:

- A. About plug-in data acquisition (DAQ) boards
- B. About the organization of the DAQ VIs
- C. How to perform a single analog input
- D. About the DAQ Wizards
- E. About waveform analog input
- F. How to write waveforms to file
- G. How to output an analog signal
- I. How to use counter/timers

Overview

The fundamental task of all measurement systems is the measurement and/or generation of real-world physical signals. Measurement devices help you acquire, analyze, and present the measurements you take.

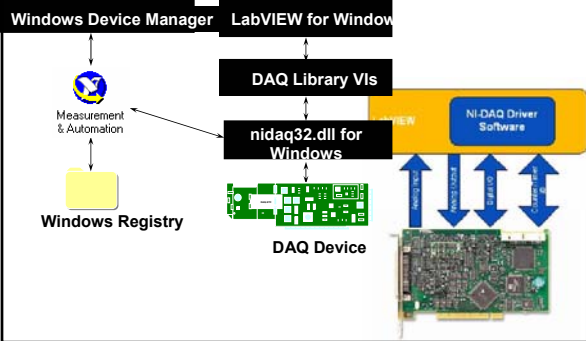
We acquire and convert physical signals, such as voltage, current, pressure, and temperature, into digital formats and transfer them into the computer.

Popular methods for acquiring data: plug-in DAQ and instrument devices, GPIB instruments, PXI (PCI eXtensions for Instrumentation) instruments, and RS-232 instruments.

- Data acquisition (DAQ) library supports all DAQ boards
- LabVIEW uses the NI-DAQ driver-level software
- DAQ boards for
 - Analog I/O
 - Digital I/O
 - Counter/timer I/O
- Data acquisition system components



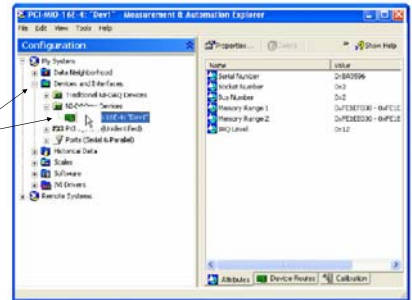
DAQ Software Architecture – Windows



DAQ Hardware Configuration

- Measurement & Automation Explorer (MAX) by selecting Tools>>Measurement & Automation Explorer...in LabVIEW

View Configure and Test



Hardware Connections

BNC-2120



SC-2075



SCB-68



Hardware Connections

Note:
The channels available depends on the DAQ card we use.

For instance, DAQCard-AI-16E-4 NI lent to us, there is no output channels available

Let's configure the Card with Measurement & Automation Explorer

AC00	16	AI	AI0	AI0
AC01	16	AI	AI1	AI1
AS00	16	AO	AO0	AO0
AS01	16	AO	AO1	AO1
AC02	16	AI	AI2	AI2
AC03	16	AI	AI3	AI3
AS02	16	AO	AO2	AO2
AS03	16	AO	AO3	AO3
AC04	16	AI	AI4	AI4
AC05	16	AI	AI5	AI5
AS04	16	AO	AO4	AO4
AS05	16	AO	AO5	AO5
AC06	16	AI	AI6	AI6
AC07	16	AI	AI7	AI7
AS06	16	AO	AO6	AO6
AS07	16	AO	AO7	AO7
AC08	16	AI	AI8	AI8
AC09	16	AI	AI9	AI9
AS08	16	AO	AO8	AO8
AS09	16	AO	AO9	AO9
AC10	16	AI	AI10	AI10
AC11	16	AI	AI11	AI11
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AS11	16	AO	AO11	AO11
AC12	16	AI	AI12	AI12
AC13	16	AI	AI13	AI13
AS12	16	AO	AO12	AO12
AS13	16	AO	AO13	AO13
AC14	16	AI	AI14	AI14
AC15	16	AI	AI15	AI15
AS14	16	AO	AO14	AO14
AS15	16	AO	AO15	AO15
AC16	16	AI	AI16	AI16
AC17	16	AI	AI17	AI17
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AC98	16	AI	AI98	AI98
AC99	16	AI	AI99	AI99
AS98	16	AO	AO98	AO98
AS99	16	AO	AO99	AO99

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Measurement Fundamentals

In Analytical Instrumentation, we convert **physical phenomena** into data, using a **transducer** to convert a physical phenomenon into an electrical

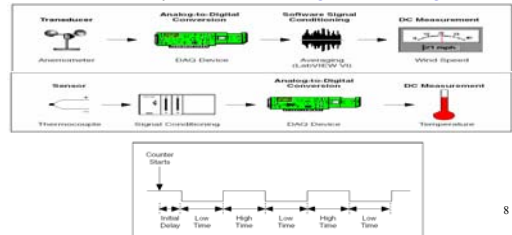
Summary of signal sources and measurement systems

Phenomena	Transducer	Signal Source Type
Temperature	Thermocouples Resistance temperature detectors (RTDs) Thermistors Integrated circuit sensors	Fixed Signal Source (Not Connected to Building Ground) Examples: • Signal and Thermocouples • Signal Conditioning with Isolated Outputs • Battery Outputs
Light	Vacuum tube phototubes Photoconductive cells	Generated Signal Source Examples: • Piezo Instruments with Restricted Outputs
Sound	Microphones	Input See text for information on bias resistors.
Force and pressure	Strain gages Piezoelectric transducers Load cells	Generated Signal Source Examples: • Piezo Instruments with Restricted Outputs
Position (displacement)	Potentiometers Linear voltage differential transformers (LVDT) Optical encoders	Input See text for information on bias resistors.
Fluid flow	Head meters Rotational flowmeters Ultrasonic flowmeters	Generated Signal Source Examples: • Piezo Instruments with Restricted Outputs
pH	pH electrodes	Input See text for information on bias resistors.

Measurement Fundamentals

There are two types of voltage: direct current (DC) and alternating current (AC). DC signals are analog signals that slowly vary with time. Common DC signals include voltage, temperature, pressure, and strain. AC signals are alternating analog signals that continuously increase, decrease, and reverse polarity on a repetitive basis.

However, any physical signals will be converted into almost two types of measurement by transducers: **voltage and counting**.



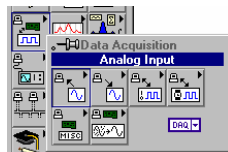
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DAQ VI Organization in LabVIEW software

- Analog Input
- Analog Output
- Digital I/O
- Counter
- Calibration and Configuration
- Signal Conditioning



A. labVIEW Traditional NI-DAQ

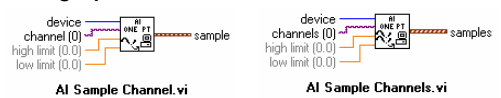


NI-DAQ
NI-DAQ contains two data acquisition drivers—Traditional NI-DAQ and NI-DAQmx—each with its own application programming interface (API), hardware configuration, and software configuration.

Analog Input VI Organization



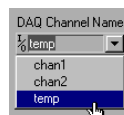
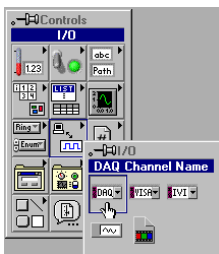
• Single-point VIs



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DAQ Channel Name Control

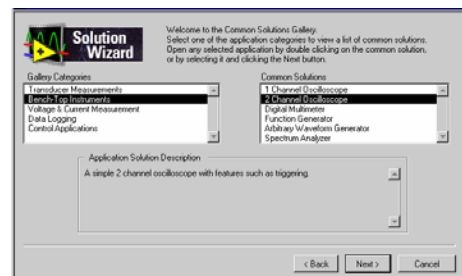
- Data type used to communicate with DAQ boards
- Enter channel names by number or by virtual channel name defined in MAX



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DAQ Wizards

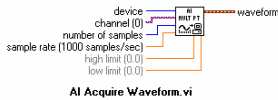
- DAQ Channel Wizard
- DAQ Solution Wizard



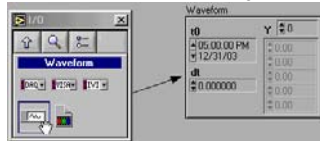
12

Waveform Analog Input

- AI Acquire Waveform
- VI displays a dialog box if an error occurs



- VI returns a waveform datatype



Analog- Pertaining to or being a device or signal having the property of continuously varying in strength or quantity, such as voltage or audio.

DAQ – Data Acquisition

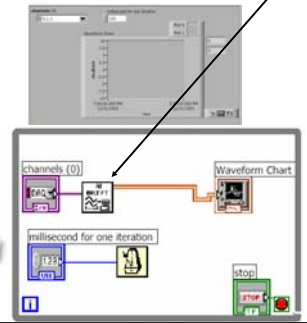
Let's do Simple Acquisition Example [Test.vi](#) Click to see

Two parameters

- Device = 1
- Channel = 0

with
SCB-68

connection board



Measurement Fundamentals

In Analytical Instrumentation, we convert physical phenomena into data, using a transducer to convert a physical phenomenon into an electrical

Summary of signal sources and measurement systems

Phenomena	Transducer
Temperature	Thermocouples Resistance temperature detectors (RTDs) Thermistors Integrated circuit sensors
Light	Vacuum tube phototubes Photoconductive cells
Sound	Microphones
Force and pressure	Strain gauges Piezoelectric transducers Load cells
Position (displacement)	Potentiometers Linear voltage differential transformers (LVDT) Optical encoders
Fluid flow	Head meters Rotational flowmeters Ultrasonic flowmeters
pH	pH electrodes

	Signal Source Type	
	Floating Signal Source (Not Connected to Building Ground)	Grounded Signal Source
Input	Examples • Signalized Thermocouples • Signal Conditioning with Isolated Outputs • Battery Devices	Examples • Plug-in Instruments with Nonisolated Outputs
Differential (DIFF)		
Single-Ended - Ground Referenced (SE)		
Single-Ended - Nonreferenced (SENR)		

DAQ – Data Acquisition

Simple Acquisition Example [Test.vi](#)

We can try different input modes

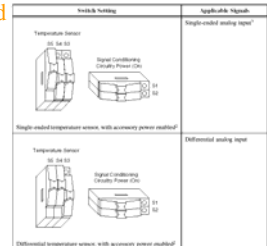
Two parameters

- Device = 1
- Channel = 0

with
SCB-68

connection board

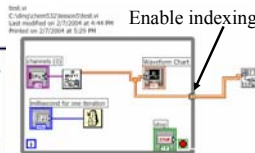
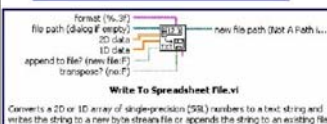
Single ended
Differential by configuring MAX and the board



Writing Waveform Data to File

...Not anymore

- Waveform File I/O subpalette of the Waveform palette
- Three VIs for writing waveform data to file but Write To Spreadsheet File.vi is the most important



Data Acquisition Terminology

- Resolution** - Determines How Many Different Voltage Changes Can Be Measured
 - Larger Resolution → More Precise Representation of Signal
- Range** - Minimum and Maximum Voltages
 - Smaller range → More Precise Representation of Signal
- Gain** - Amplifies or Attenuates Signal for Best Fit in Range
- Quiz** - what's the resolution with a 16 bits board in the range of ±12 V?

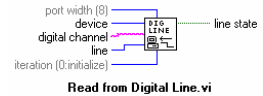
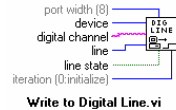
Analog Output VIs ...Not anymore

- **Single-point VI**

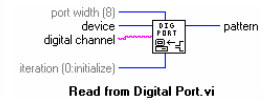
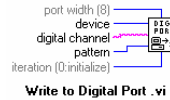


Digital Input and Output VIs

- **Line = single TTL signal**

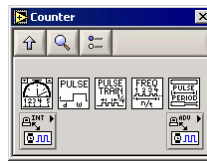


- **Port = collection of lines (4 or 8)**

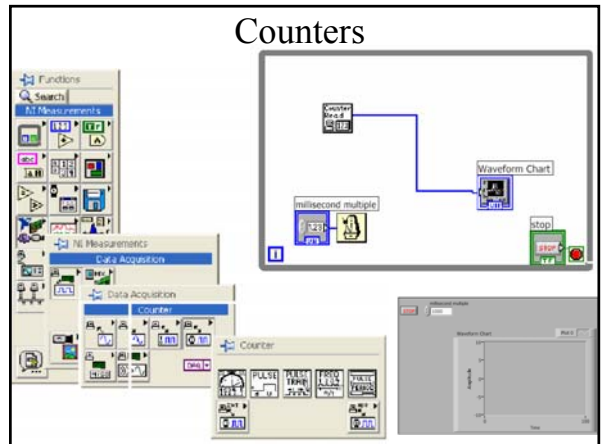


Counters

- A counter is a digital timing device.
- Typically used for:
 - event counting for PMT, EMT
 - frequency measurement
 - period measurement
 - position measurement
 - pulse generation

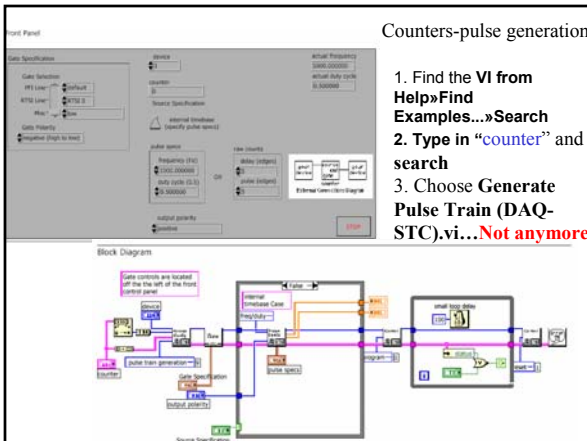


Counters



Counters-pulse generation

1. Find the VI from **Help>Find Examples...>Search**
2. Type in "counter" and search
3. Choose **Generate Pulse Train (DAQ-STC).vi...Not anymore**



DAQ VI Organization in LabVIEW software

B. LabVIEW NI-DAQmx

NI-DAQmx

Traditional NI-DAQ

NI-DAQmx

NI-DAQmx is the latest NI-DAQ driver with new VIs, functions and development tools for controlling measurement devices. The advantages of NI-DAQmx include the DAQ Assistant for configuring channels and measurement tasks for a device; increased performance, including faster single-point analog I/O and multitriggering; and a simpler API for creating DAQ applications using fewer functions and VIs than earlier versions of NI-DAQ.

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