UNIVERSITÀ DEGLI STUDI DI PAVIA

Dept. of Electrical, Computer and Biomedical Engineering

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Instrumentation for the data acquisition laboratory: The New NI MyDAQ System

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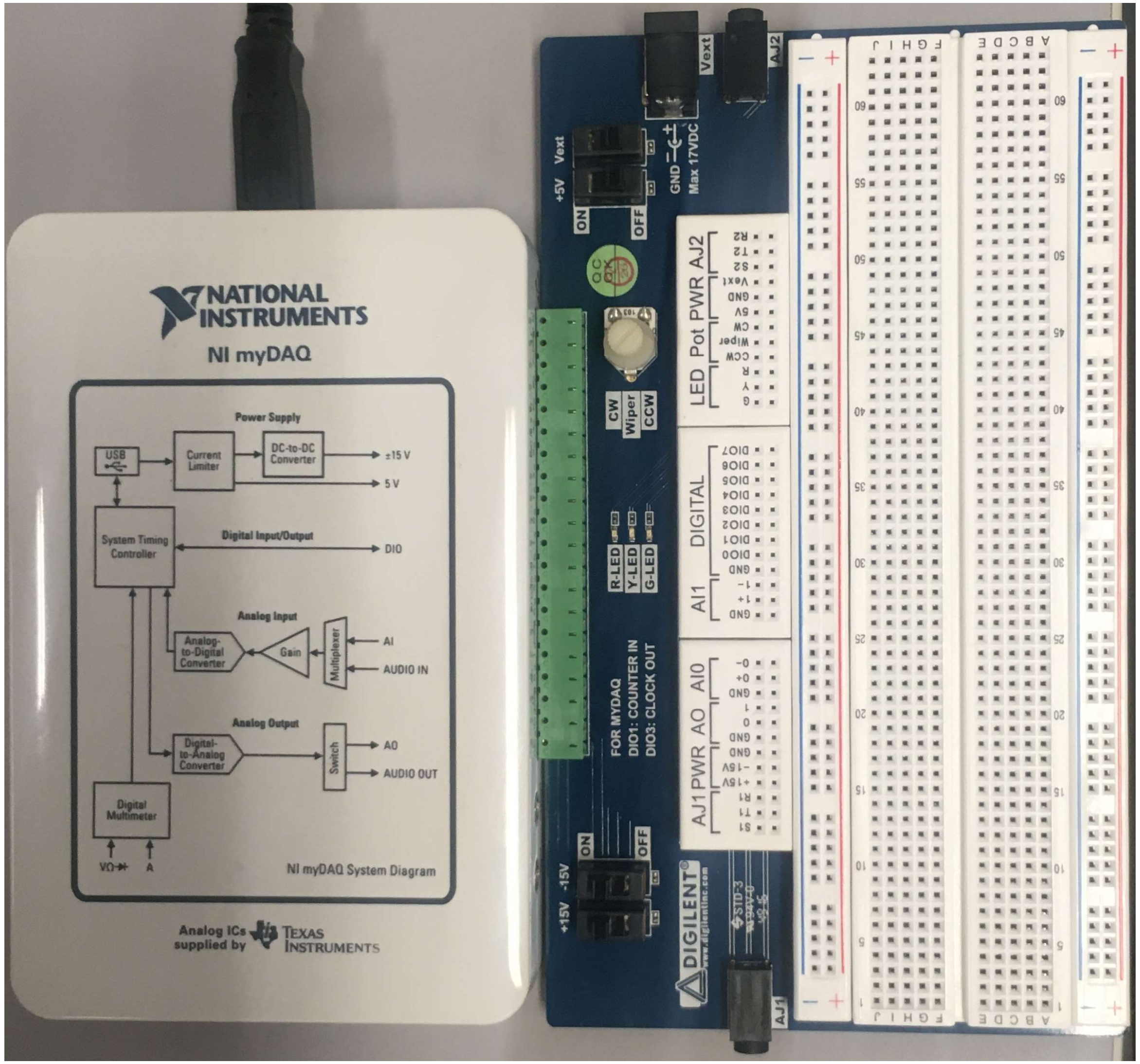
Purpose of each lab activity

- Design and make simple systems for data acquisition from detectors, systems for the remote control and programming of circuits and measurement equipment
- Each experiment will consist of two main parts
  - design and construction of a circuit (e.g., for conditioning the signal from a transducer) on a breadboard suitable for interfacing with an acquisition board installed on the PC
  - implementation of a virtual instrument (VI) in the LabVIEW programming environment serving as an interface between the measurement system and the user

A preliminary activity (this lab): *getting familiar with New NI MyDAQ System*

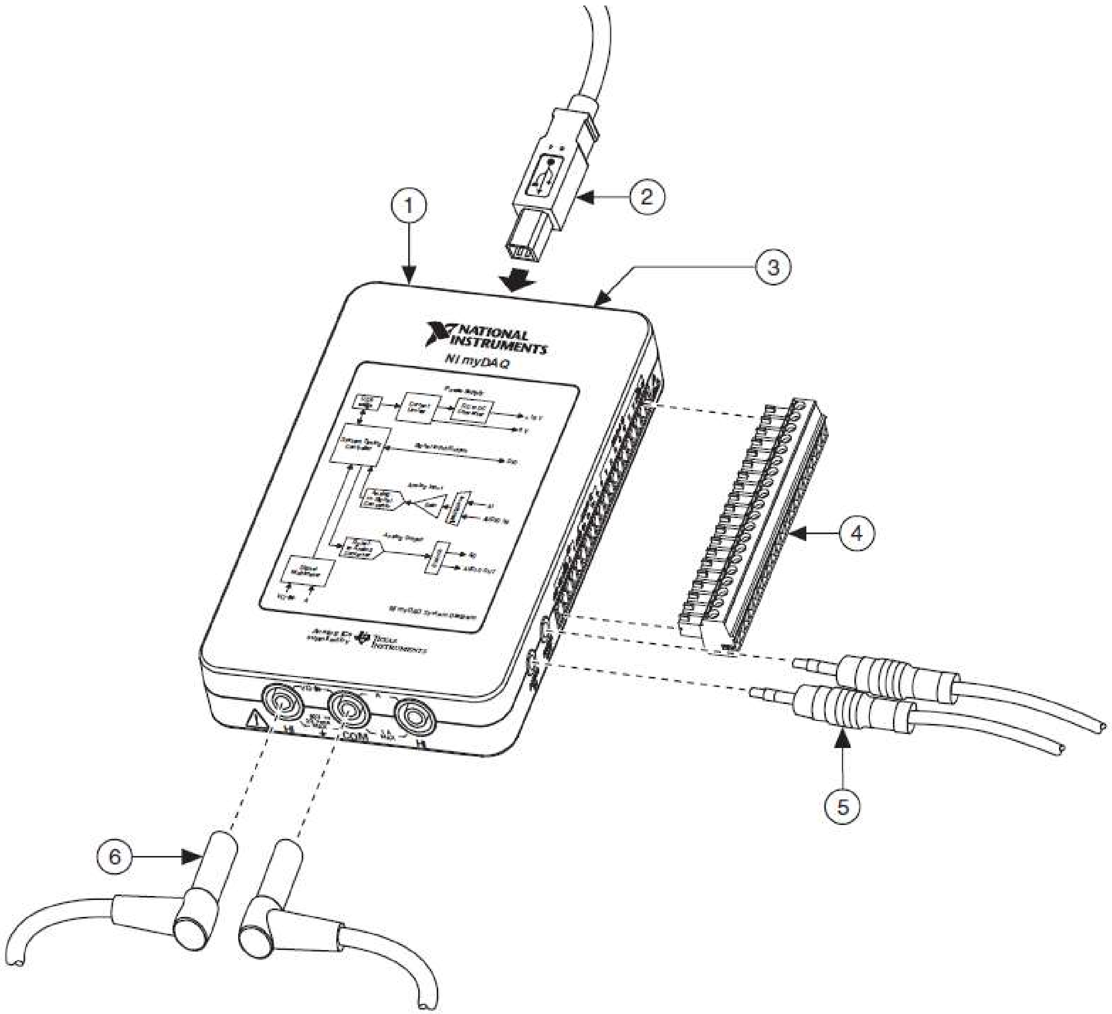
-> *Voltage Acquisition (Elvis and LabView)*

The New NI MyDAQ System and Breadboard



- Digilent-TI Breadboard suitable for a direct connection to data acquisition (DAQ). In particular to new NI MyDAQ System.
- Makes it possible to send and acquire analog and digital signals to and from circuits built on the breadboard
- Can be powered directly by the DAQ board to which the breadboard is connected (±15 V and an additional supply of 5 V) or by an external power supply

The New NI MyDAQ System



1	NI myDAQ	4	20-Position Screw Terminal Connector
2	USB Cable	5	Audio Cable
3	LED	6	DMM Banana Cable

- The breadboard is connected to the NI MyDAQ System through a 2x20 pin connector
- The NI MyDAQ System is connected to the PC via standard USB cable

The New NI MyDAQ System

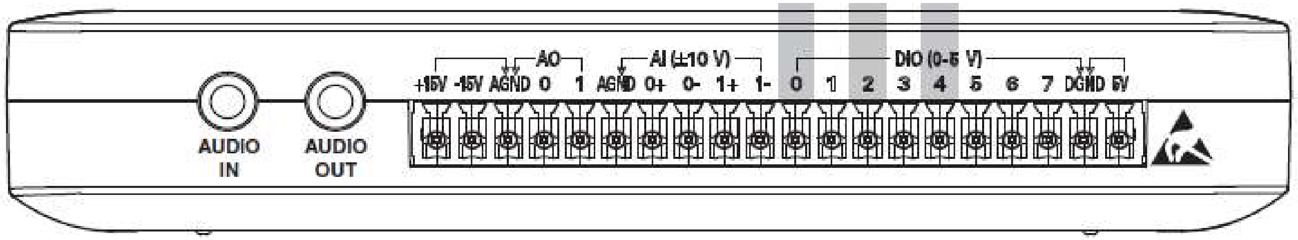
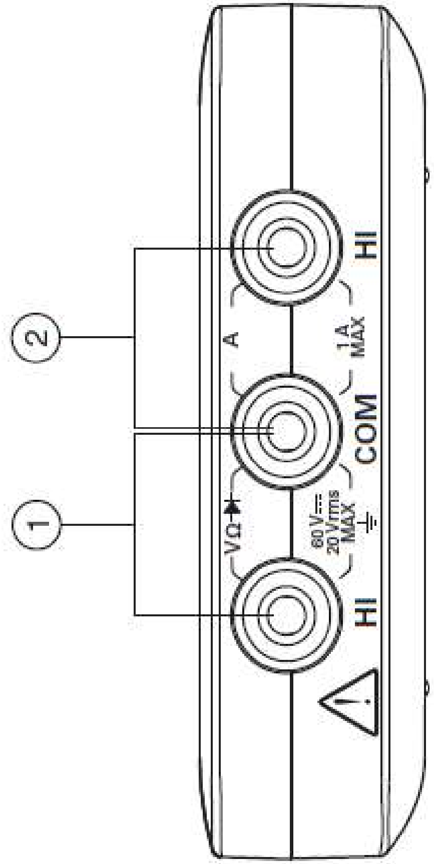


Table 1. Screw Terminal Signal Descriptions

Signal Name	Reference	Direction	Description
AUDIO IN	—	Input	**Audio Input**—Left and right audio inputs on a stereo connector
AUDIO OUT	—	Output	**Audio Output**—Left and right audio outputs on a stereo connector
+15V/-15V	AGND	Output	+15 V/-15 V power supplies
AGND	—	—	**Analog Ground**—Reference terminal for AI, AO, +15 V, and -15 V
AO 0/AO 1	AGND	Output	Analog Output Channels 0 and 1*
AI 0+/AI 0-; AI 1+/AI 1-	AGND	Input	Analog Input Channels 0 and 1



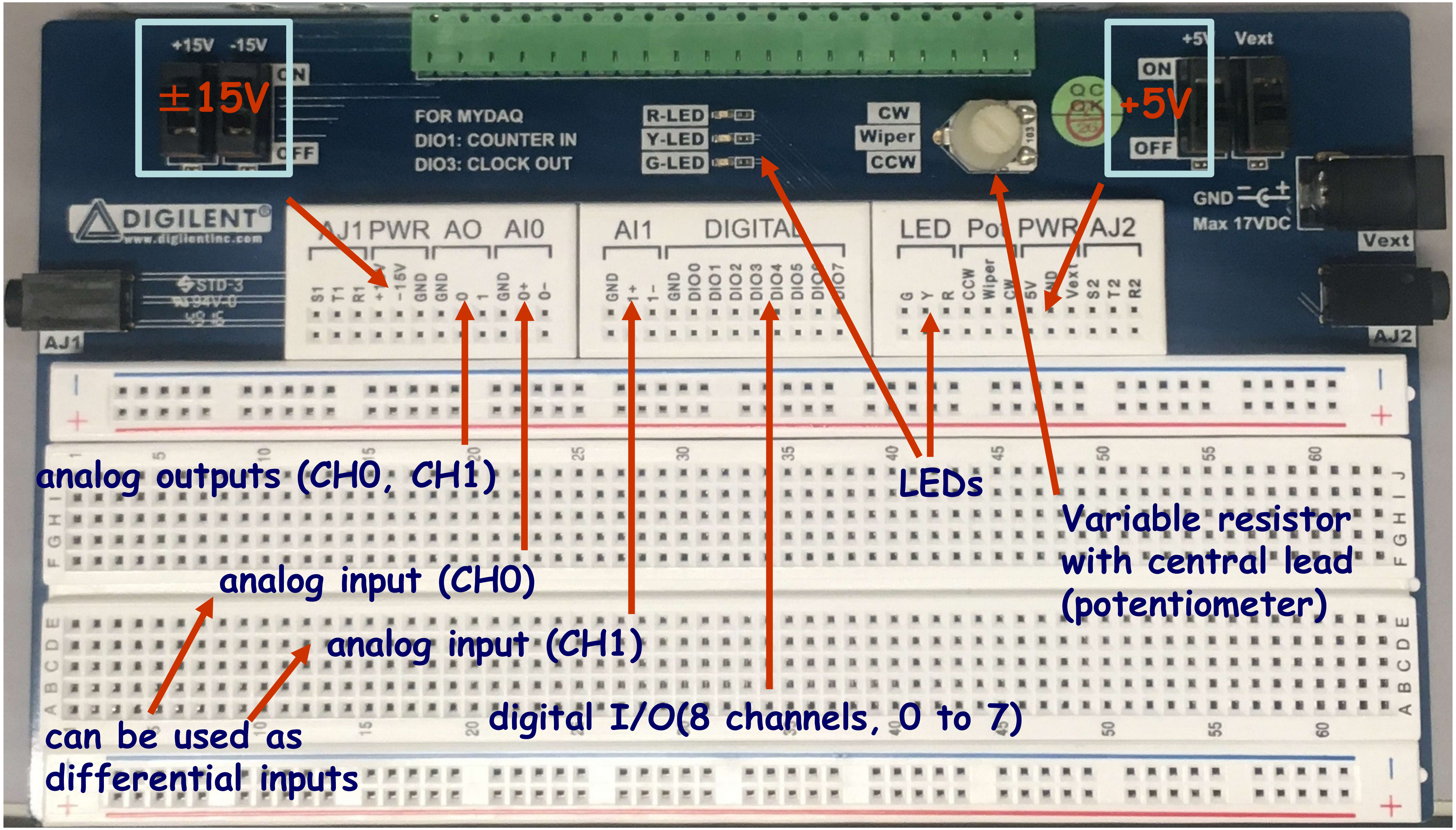
- *A multimeter is also included*

The New NI MyDAQ System: Voltage Supply

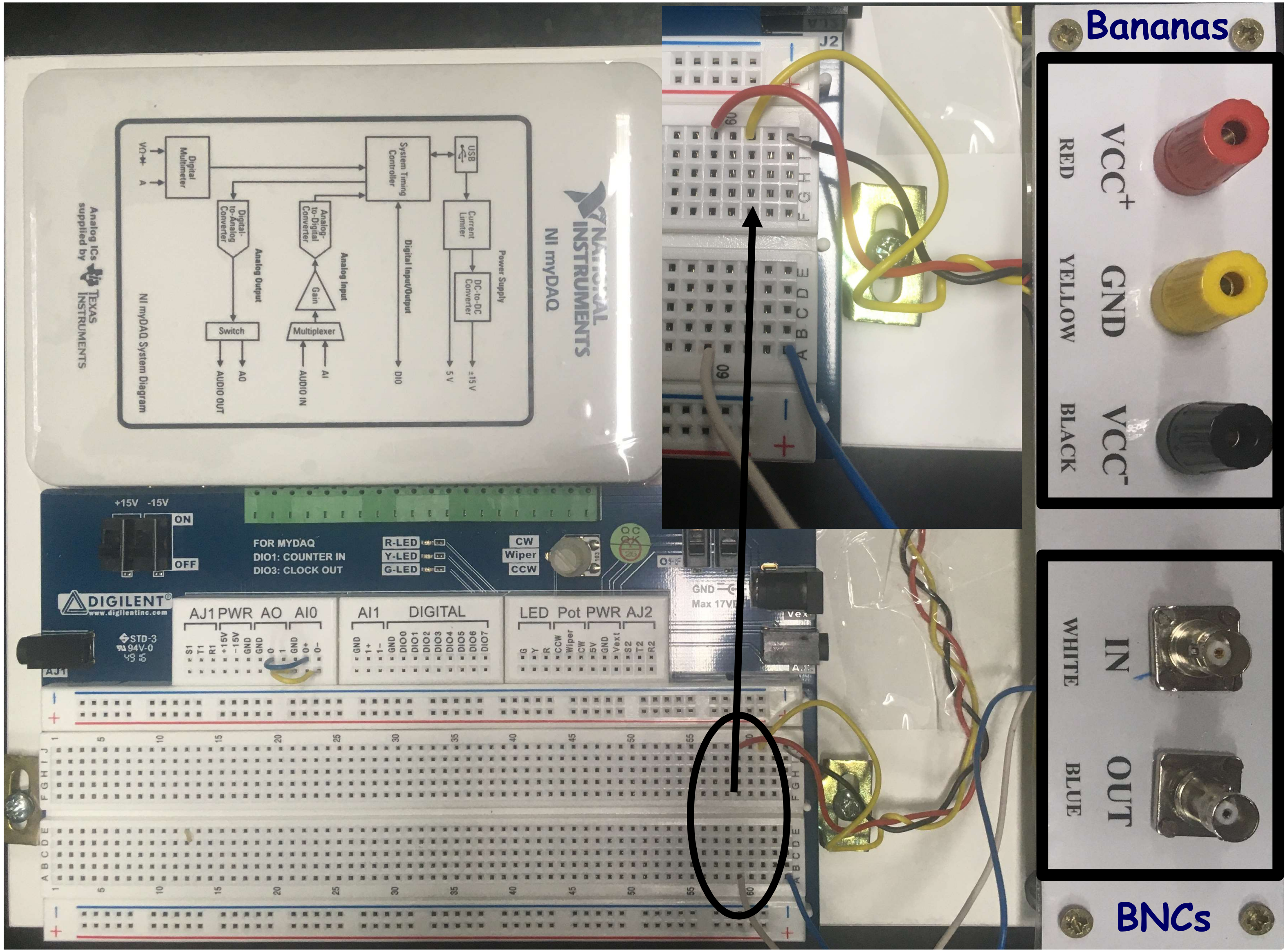
- The **New NI MyDAQ System+TI-Digilent Breadboard** may easily replace DAQ boards and systems of the previous series (Like E series and 12000 series).

- **DC voltage supply**: the power supply for the circuits built on the breadboard are made directly available by the breadboard itself
  - **+5V**: achieved on the breadboard by means of DC-DC converters
  - **±15V**: achieved on the breadboard by means of DC-DC converters
  - **0V**: it is the common ground of the system, either for **+5V** and **±15V**
  - the power supply can be provided to the board also through an external source

The New NI MyDAQ System: Breadboard Connectors



The New NI MyDAQ System: Optional Connectors



Must be routed manually

Optional Positive Supply

Optional Ground Terminal

Optional Negative Supply

Optional Input Port

Optional Output Port

The New NI MyDAQ System: Prototyping Area

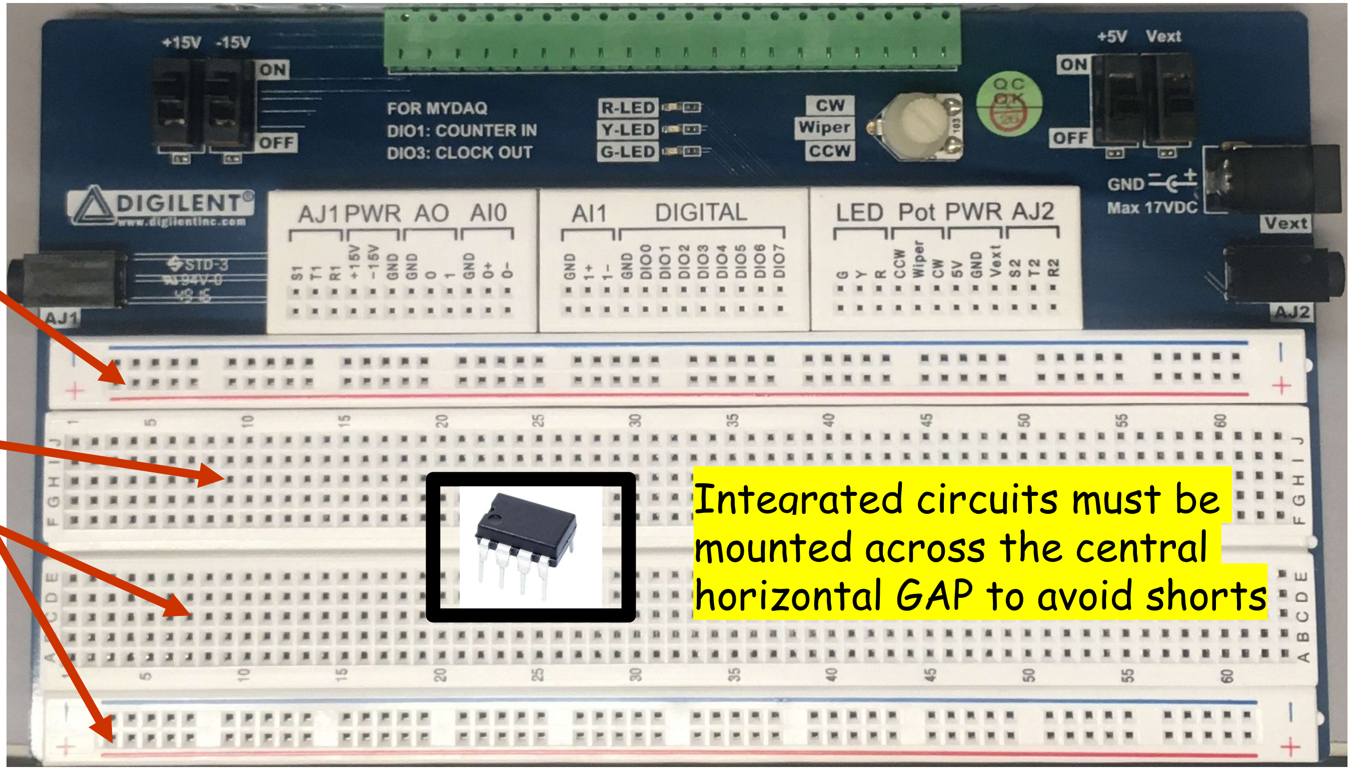
- **Prototyping area**: it includes
  - 2 arrays of 2x50 holes for component lead insertion: in each 50 hole column, the holes are short circuited. They are usually dedicated to supplies
  - 2 arrays of 5x63 holes for component lead insertion: in each 5 hole row, all the holes are short circuited. They are usually dedicated to basic connections

2 arrays of 2x5x10 holes - all the holes in each 50 hole column are short circuited

2 arrays of 5x63 holes - all the holes in each 5 hole row are short circuited

5 hole row (126 of them)

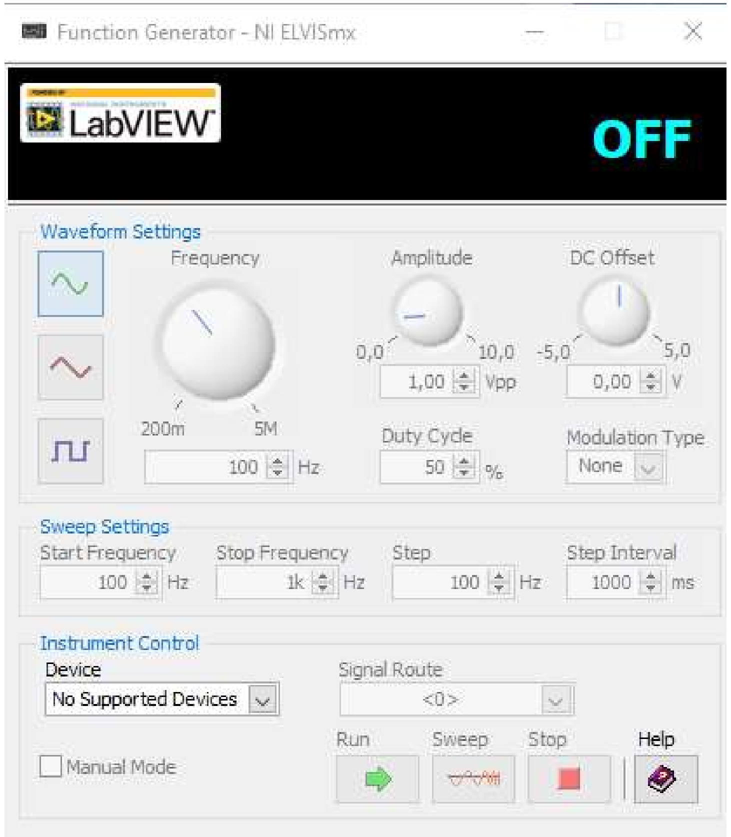
50 hole column (4 of them)

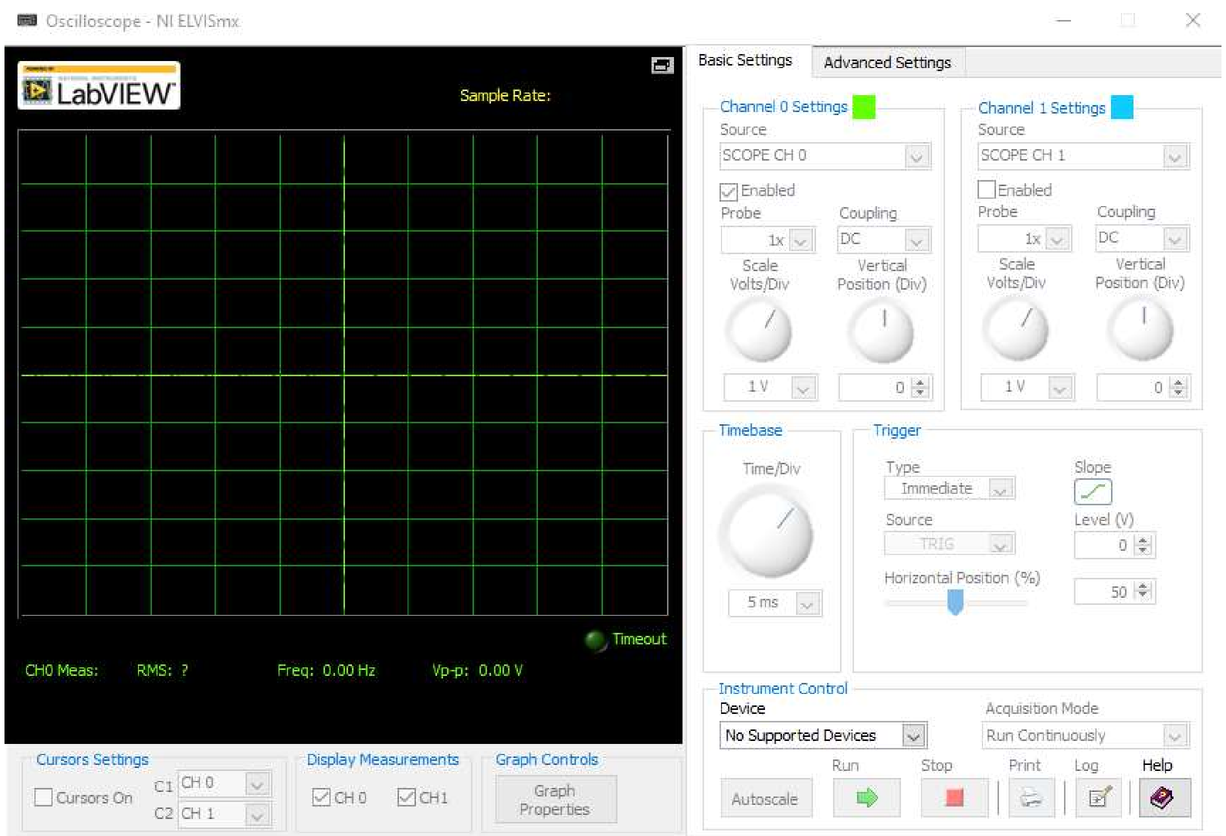


The New NI MyDAQ System: Specifications

- Some technical specifications
  - 2 differential analog inputs: **sampled at a 200 kSample/s rate with a 16 bit resolution**
  - 2 single-ended analog outputs: **sampled at a 200 kSample/s rate with a 16 bit resolution**
  - input dynamic range: **±10 V, ±2 V DC coupled**
  - output dynamic range: **±10 V, ±2 V DC coupled**
  - input impedance: **10 GΩ, 100 pF**
  - output impedance: **1 Ω**
  - maximum load current: **±2 mA**
  - 8 input/output digital channels: **TTL/CMOS compliant 0 V – 5 V (3.3 V)**
  - Digital input pull resistor: **DOWN, 75 kΩ**
  - **±15 V** supply maximum load current: **32 mA**
  - **+5 V** supply maximum load current: **100 mA**

The New NI MyDAQ System: ELVIS Interface





- Elvis Function Generator
- Elvis Oscilloscope

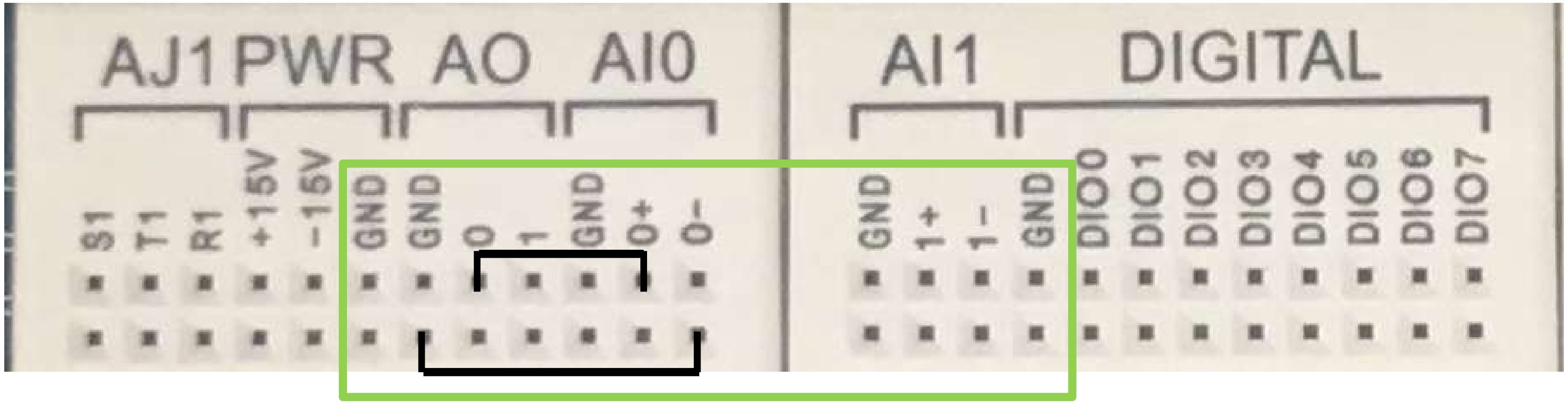
MyDAQ: Voltage Generation and Acquisition

- Quick overview on voltage generation and acquisition (ELVIS)
  - Open Elvis Function Generator
  - Select Analog Output (AO 0) as Elvis Function Generator Module
  - Open Elvis Oscilloscope
  - Select Analog Input 0 (AI0) as Elvis Oscilloscope Channel 0
  - Connect Analog Output (AO 0 on the BreadBoard to Positive Analog Input 0 (AI 0+)
  - Connect Negative Analog Input (AI 0-) 0 to Ground (Single-Ended mode)

- Quick overview on voltage generation and acquisition (ELVIS+LabView)
  - Open Elvis Function Generator
  - Open LabView
  - Select Analog Output (AO 0) as Elvis Function Generator Module
  - Connect Analog Output (AO 0) on the BreadBoard to Positive Analog Input 0 (AI 0+)
  - Connect Negative Analog Input (AI 0-) 0 to Ground (Single-Ended mode)
  - Develop a Voltage Acquisition Virtual Instrument
    - Two approaches: Physical channel and DAQ Assistant

- What about playing with a RC circuit (low pass and/or high pass) in frequency domain?

MyDAQ: Voltage Generation and Acquisition



- Single-Ended Analog Outputs (AO 0,1)
- GND terminals are common to all inputs and outputs
- Differential Analog Inputs (AI0±, AI1±)
  - For Single Ended use connect negative inputs (AI0-, AI1-) to GND

This Lab →

- Connect AO 0 to AI 0+
- Connect AI 0- to GND

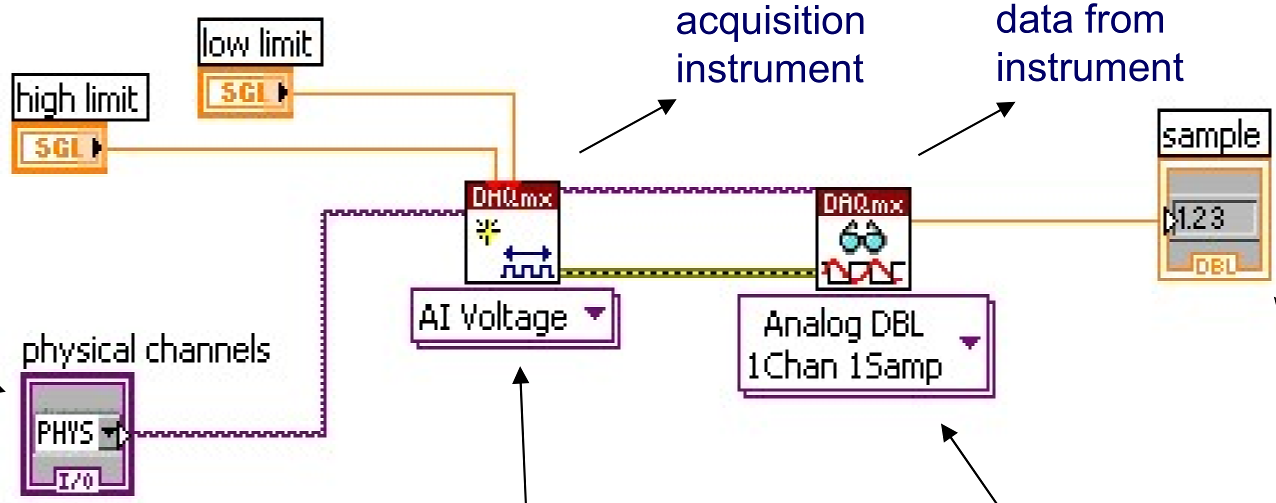
Voltage Acquisition VI: Physical Channel Approach

<u>Physical channel approach to implement a Virtual Instrument for acquisition</u>

expected limits for the signal to be acquired (like -10, +10)

sets up the acquisition instrument

samples data from instrument



input channel: myDAQ(AI0)

displays data

`Measurement I/O -> DAQmx Data Acquisition -> Advanced -> Constants -> physical channels.vi`

`Measurement I/O -> DAQmx Data Acquisition -> DAQmx Create Channel.vi`

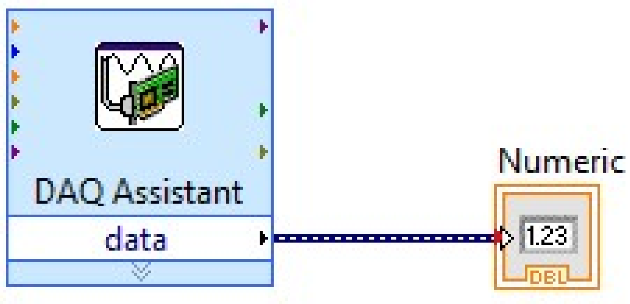
`Measurement I/O -> DAQmx Data Acquisition -> DAQmx Read.vi`

- You may want to use a loop
- You may want to play with signal generator

Voltage Acquisition VI: DAQ Assistant Approach

<u>DAQ Assistant approach to implement a Virtual Instrument for acquisition</u>

`Measurement I/O -> DAQmx Data Acquisition -> DAQ Assistant.vi`



- You may want to use a loop
- You may want to play with signal generator

- Click on the assistant icon to open the wizard guide
- Select: Acquire Signal -> Analog Input -> Voltage -> MyDAQ AI0
- Insert: Voltage limits (+10, -10), Differential Mode, Continuous ACQ
- Set: Number of samples and sample frequency (Default are 100, 1kHz)