

EE3810

Instructor: Won

Department of Electrical and Computer Engineering
California State University, Los Angeles

1 Concepts

Engineering

1. instrumentation
2. virtual instruments
3. black box structure
4. input/output channels
5. indicators, controls
6. data acquisition
7. data structures
8. data types

2 Objectives

In this experiment, you will learn to program a LabView VI which

1. learn to create your own VI
2. add controls for user input
3. perform a calculation in the block diagram
4. add indicators

and you will

5. understand boolean based controls and indicators
6. understand loop structures
7. learn to create graphs and charts

3 Background

3.1 Instruments

The world of biomedical technology is full of instrumentation - including more common instruments, such as an ECG monitor, an EEG monitor, and a drip IV to more novel technologies such as the cardiac pacemaker, deep brain stimulator, and retinal prosthesis.

What do each of these have in common? LabView is a graphical programming language which allows you to create instruments in software - they are not real hardware, but rather "virtual instruments", or VIs. LabView has all the building blocks that are commonly found in real instruments. You will explore several of those today.

3.2 Analog vs. digital

Analog signals are continuous in time and continuous in amplitude. Digital signals can only take on a finite number of values and the values are sampled at discrete points in time. Real signals in nature are analog, such as sound, electromagnetic waves, etc. In order to store them in digital memory, the analog signals must be digitized. This means that at fixed intervals of time, the signal is sampled - i.e., the value at that given point in time is measured. The reciprocal of that sampling time interval is called the sampling rate or sampling frequency.

3.3 Data Acquisition

Measurements taken directly from a sensor are analog signals. How do you get these signals to be displayed on the computer monitor or to be saved to a file? Below is a block diagram representing the hardware interface to do this.

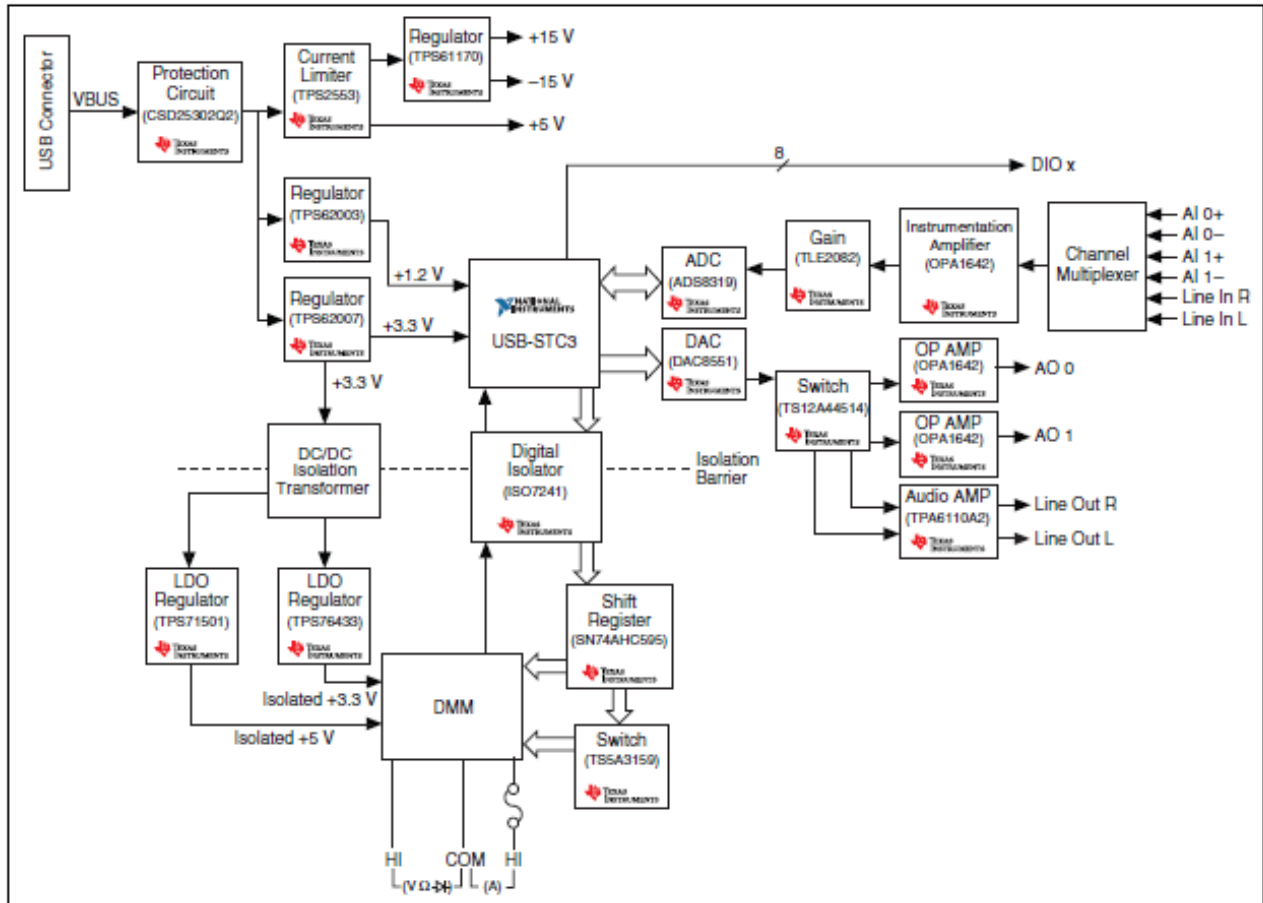


Figure 1: Block diagram of the NI myDAQ device.

4 Procedure

4.1 Measuring electrode impedance

Based on Exercise 1-3 from Essick

Suppose you want to measure the impedance of a microelectrode that will be implanted in the brain for a neural prosthesis. Create a virtual instrument which has a way for a user to enter the reading from an ohmmeter you use to try to estimate the electrode impedance.

1. The ohmmeter used to measure the impedance has a resistance of $500\text{K}\Omega$ (this is unrealistically low, but let's pretend for a moment). Now, based on the measurement of the ohmmeter, calculate the estimated electrode impedance and display that to the user.

4.2 Pseudo EEG monitor

Based on Exercise 2-3 from Essick Let's build a virtual EEG monitor which is supposed to acquire and display an EEG waveform continuously. We are not going to truly acquire EEG signals but we will just use a sine wave to simulate an acquired EEG signal.

1. Create a sine function that has a fixed frequency of 20Hz.
2. Show the waveform continuously using the Waveform Chart. Plot the pseudo EEG signal vs. time in ms, and show 500ms worth of data.
3. Modify the VI to allow the signal frequency to be adjusted by the user, but instead of showing the signal continuously, just show the first 500ms of data (Hint: What kind of waveform display should you use?)
4. Try to create a continuous EEG signal but with the correct time scale.

5 Questions

1. Think about a retinal prosthesis, and imagine you need to design a LabView controller for the retinal prosthesis.
 - (a) What indicators would it need?
 - (b) What controls would it need?
2. Let's suppose you are writing a LabView program to control an IV drip counter.
 - (a) What sensor would you use?
 - (b) Sketch a very basic block diagram to show how you would design this IV drip counter.