Trigger Output Module (Wireless)

User's Guide

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PM-U03

Specifications and procedures outlined in this document are subject to change without notice.

MAN-007-1-0

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Important Information

Intended Use

The Trigger Output Module is designed for research, investigational and scholarship purposes only. This device is designed to be used only with approved Delsys® systems. Delsys® products are not intended for measurement purposes or for use in the treatment and diagnosis of humans.

Technical Service and Support

For information and assistance visit our web site at:

www.delsys.com

Contact us at:

E-mail: support@delsys.com
tel: (617) 236 0599

Warnings and Precautions

Consult all accompanying documents for precautionary statements and other important information.

Consult accompanying user's guide for detailed instructions.

Keep the device dry. The presence of liquids may compromise the safety features of the device.

Handle with care.

Sensitive electronic device. Avoid static discharges. Do not operate or store near strong electrostatic, electromagnetic, magnetic or radioactive fields. Interference from external sources may decrease the signal-to-noise ratio or result in corrupted data.

This device may cause electrical disturbances in sensitive equipment within its operating environment.

Connect only to Delsys-approved devices.

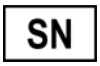
Immediately discontinue device use if a change in the device's performance is noted. Contact Delsys technical support for assistance.

Delsys Inc. guarantees the safety, reliability, and performance of the equipment only if assembly, modifications and repairs are carried out by authorized technicians; the electrical installation complies with the appropriate requirements; and the equipment is used in accordance with the instructions for use.

Device Information

Do not dispose this product with house waste. Contact Delsys Inc. for instructions on responsibly disposing this device. This product should not be mixed with other commercial wastes.

Date of Manufacturing (appears on device)



Serial Number (appears on device)

DELSYS INC.
650 Beacon St.
Boston MA 02215
USA

Manufacturer

Disclaimer

DELSYS INC. makes no warranties, express or implied, as to the quality and performance of this product including but not limited to, any implied warranty of applicability for other than research uses by qualified individuals. DELSYS INC. shall not be liable to any person for any medical expenses or any direct or consequential damages resulting from any defect, failure or malfunction, whether a claim for such damages is based upon theory of warranty, contract, tort or otherwise. No representative, agent, or licensed practitioner is authorized to waive this disclaimer. DELSYS INC. makes no diagnosis or prescription by virtue of anything about this product.

Limited Warranty

The Trigger Output Module is warranted against failure of materials and workmanship for a period of 1 year from the date of delivery, provided that the product is given proper care and has not been subject to abuse during this period. This warranty is in lieu of all other warranties expressed or implied. Operation of this device outside specifications determined by DELSYS INC. or use with any other input devices other than DELSYS INC. sensors constitute an invalidation of this limited warranty. This warranty is not transferable.

Trigger Output Module (Wireless)

The Trigger Output Module allows the Myomonitor to control the start and stop of Secondary Data Acquisition Systems while maintaining its wireless freedom. Please consult the **Appendix - Synchronization and Triggering** for important information if you are new to these subjects.

Figure 1. Trigger Output Module (NI USB-6501)

The Trigger Output Module is a National Instrument USB-6501 Digital I/O device that plugs into the Host Computer. It outputs Start and Stop Trigger Output signals. The communication scheme is portrayed below.

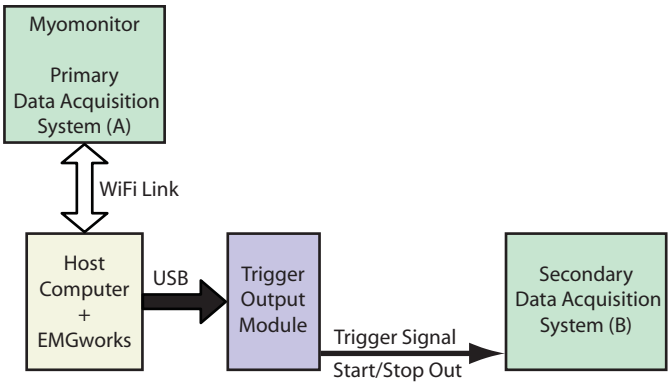


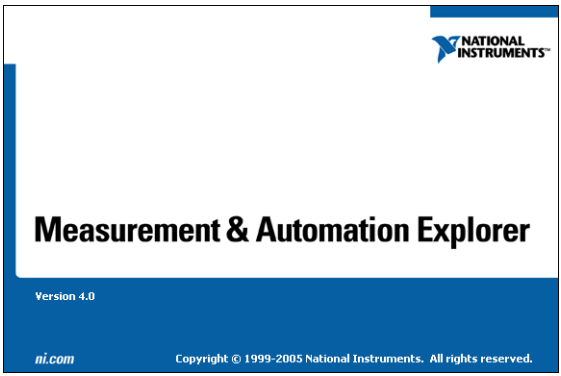
Figure 2. Trigger Output Module Communication Scheme. The Myomonitor communicates with the Host Computer through a wireless network link. The Start/Stop Trigger Output signals are sent from the Myomonitor to EMGworks via this link. EMGworks then issues Start/ Stop Trigger Output signals through the USB port to the Trigger Output Module. These signals are then used to control the start/stop of a Secondary Data Acquisition System.

Setting Up the Trigger Output Module

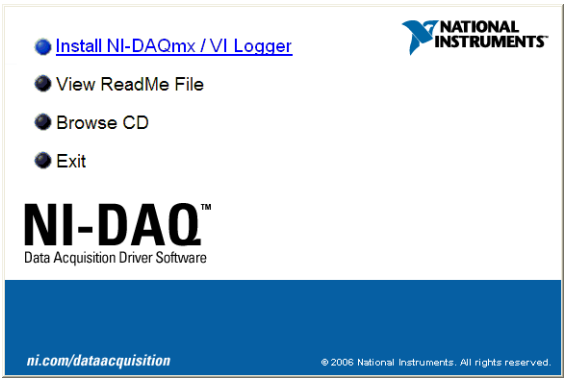
It is necessary to follow these instructions in the proper order to successfully set up the Trigger Output Module.

1. Installing the National Instruments DAQmx Drivers

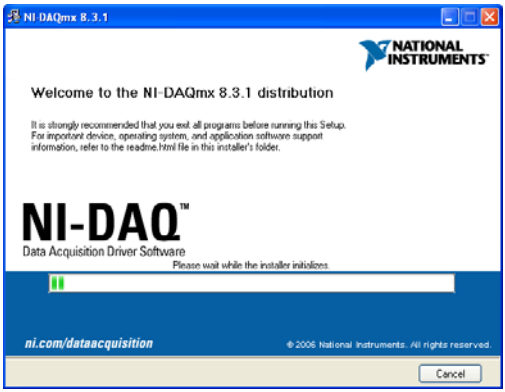
Insert the National Instruments CD to install the DAQmx drivers (version 8.3.1) supplied with the USB-6501. If you do not have the CD, the drivers can be downloaded from the National Instruments website at www.ni.com.



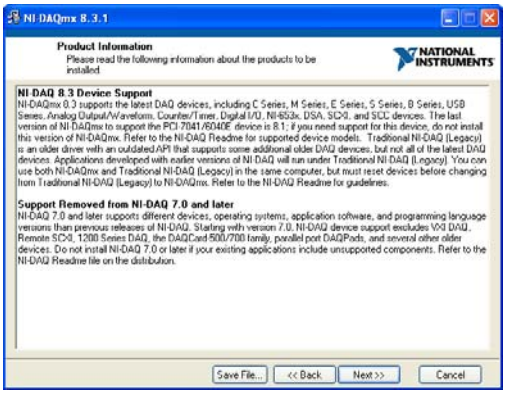
1. The **Measurement and Automation Explorer** splash screen will appear after inserting the CD or starting the downloaded installation.



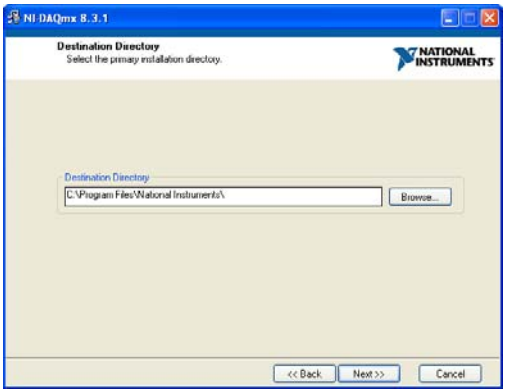
2. Left click **Install NI-DAQmx / VI Logger** when the menu appears.



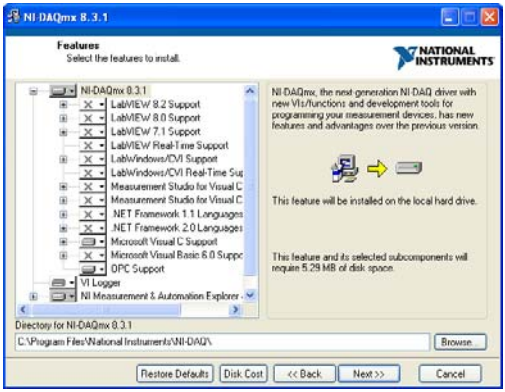
3. Wait while the installer initializes.



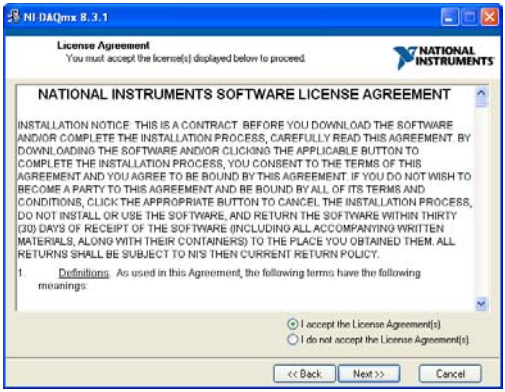
4. Click the **Next** button on the **Product Information** screen.



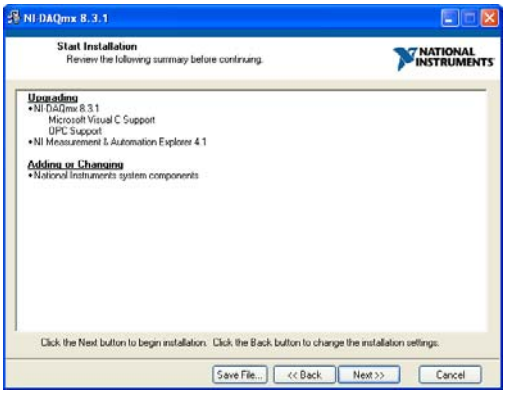
5. Click **Next** to install the program in the default directory. An alternative directory can be specified if desired.



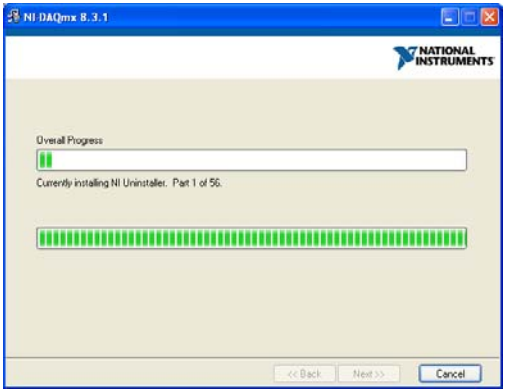
6. Click **Next** to install the program with the default features.



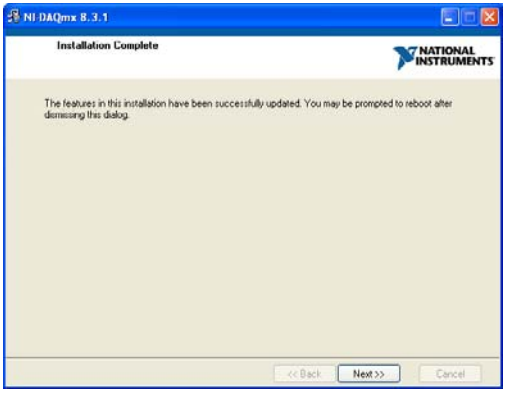
7. After reading the License Agreement, choose to accept and click **Next**.



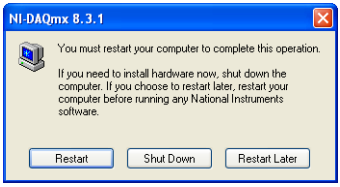
8. Click **Next** to start the installation.



9. The installation will start and the progress will be displayed.



10. Click **Next** when the installation is complete.



11. Click the **Restart** button to finalize the installation.

(a) 

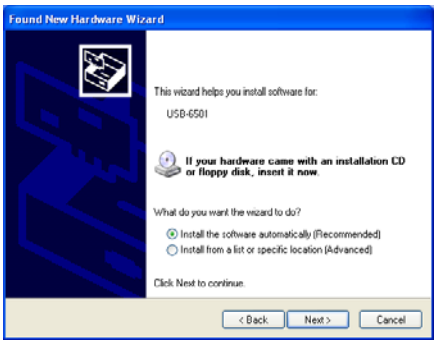
(b) 

12. A shortcut (a) for the software will be added to the Windows desktop and an icon (b) will be added to the taskbar.

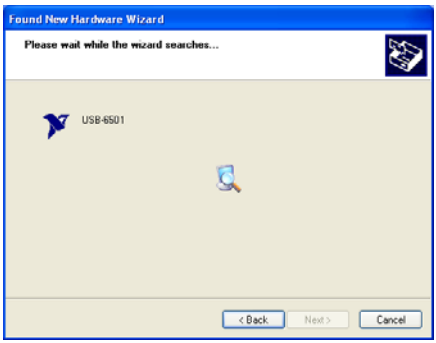
2. Connecting the USB-6501 to the Host Computer

Connect the USB-6501 Digital I/O device to an available USB port on the Host Computer.

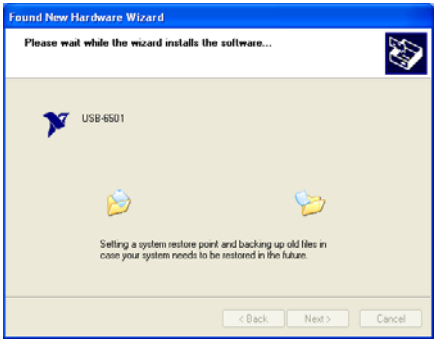
1. The **Found New Hardware Wizard** will appear. Leave "Yes, this time only" selected and click **Next**.



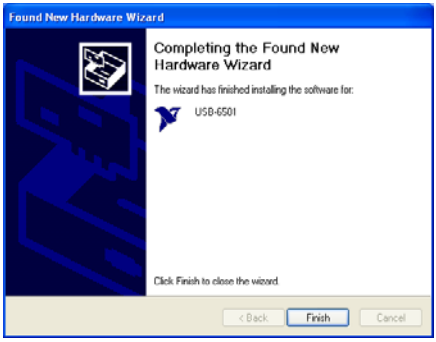
2. Leave "Install the software automatically (Recommended)" selected and click **Next**.



3. The wizard will automatically search for the software.



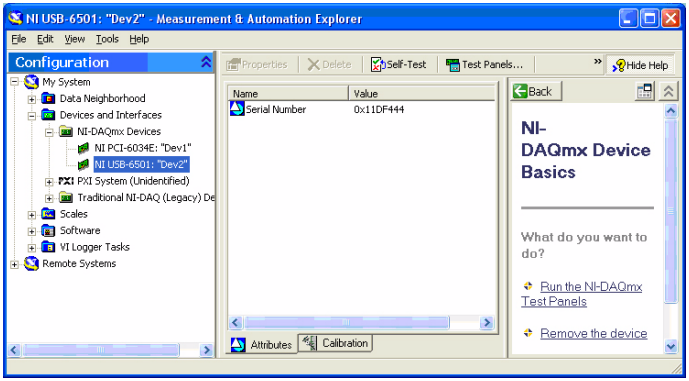
4. The wizard will automatically install the software.



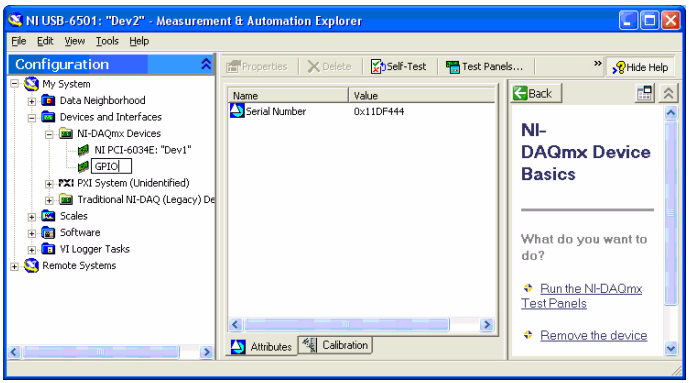
5. When the wizard is complete, click **Finish**.

3. Naming the USB-6501 in the National Instruments MAX

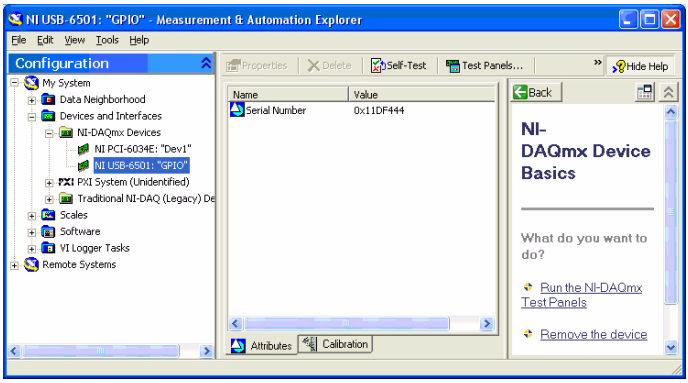
It is necessary to properly name the USB-6501 Digital I/O device so that EMGworks can establish communication with it. To do this, run the **Measurement & Automation Explorer (MAX)** by double clicking the shortcut that was placed on the Windows desktop during installation.



1. The **Measurement and Automation Explorer** will open. Locate the "NI USB-6501" in the **NI-DAQmx Devices** tree and select it.



2. Right click the selection and choose "Rename" from the menu. Rename the device to "GPIO".



3. The device name will appear as shown.

4. Installing EMGworks 3.5 on the Host Computer

Install or upgrade to EMGworks 3.5 Data Acquisition and Analysis Software if it is not currently installed on the Host Computer. This software can be downloaded from the Delsys web site at www.delsys.com if you do not have the original CD.

Please refer to the "EMGworks Installation Guide" for instructions concerning the installation of EMGworks.

Please refer to the "EMGworks User's Guide" for full details on the use of EMGworks.

5. Setting Up the Wireless Connection

The wireless connection between the Myomonitor and the Host Computer is enabled by the D-Link WUA-1340 Wireless G USB Adapter. Refer to the "Myomonitor IV Installation Guide for Wireless Operation" for instructions on how to set up the USB Adapter and how to establish the wireless connection.

Trigger Output Module Signals

The Start Trigger Output signal consists of a 5 Volt pulse that occurs on terminal 17 (“P0.0”) each time that the Myomonitor begins data acquisition. The Stop Trigger Output signal is a 5 Volt pulse that occurs on terminal 18 (“P0.1”) each time that the Myomonitor stops data acquisition. The ground is common for both signals and is available on terminals 25, 26, and 32.

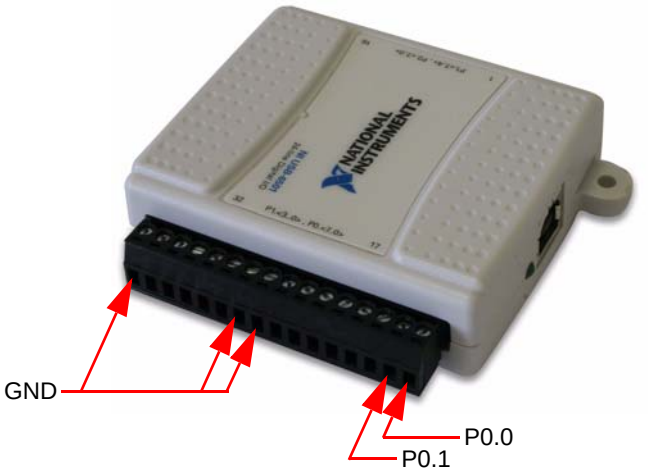


Figure 3. Terminals of the USB-6501 Digital I/O Device

Terminal Number	Terminal Name	Description
17	P0.0	Start Trigger Output
18	P0.1	Stop Trigger Output
25, 26, 32	GND	Common Ground

When the USB-6501 Digital I/O device is first turned on, the digital terminals are all configured to be high-impedance inputs and will register +5V if measured. This is normal.

When a Test using the Myomonitor is loaded in EMGworks, the Start Trigger Output and Stop Trigger Output terminals will be configured to the low state (i.e. ground potential).

Refer to *Configuring EMGworks on the Host PC* in the “Myomonitor IV Installation Guide for Wireless Operation” for details on loading a Test using the Myomonitor.

When data acquisition is started by the Myomonitor, the Start Trigger Output terminal will generate a positive pulse for approximately 1ms and will return back to the low (zero) state. There is a short delay (less than 5ms) between the start of data acquisition and the Start Trigger Output pulse.

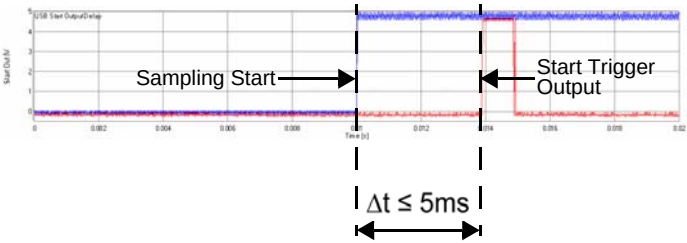


Figure 4. Start Trigger Output Delay

The Stop Trigger Output signal has a longer delay (less than 500ms), but is less critical for synchronization purposes than the Start Trigger Output.

Make sure that all connections are made to the proper side of the Trigger Output Module, which is labeled 17 - 32.

Make sure that all of the outputs from the Trigger Output Module are connected to high impedence inputs of other devices. Do not make low impedence connections to this device.

Appendix - Synchronization and Triggering

The Need for Synchronization

Physiological studies often utilize a variety of specialized measurement systems in experimental designs. The ideal case employs a single data acquisition system that records all necessary data types, inherently time-synchronizing all measurements. In many cases, however, it is necessary to have multiple data acquisition systems that are specifically designed for only one type of measurement. An example that is often encountered in the Biomechanics field is the need to record EMG data from the body's muscles as well as Motion Capture data from the body's movements. It is important to ensure that an EMG event detected by the EMG system is correlated to the corresponding biomechanical event detected by the Motion Capture system at the same point in time. In order to ensure this, the Motion Capture system must start at the same time that the EMG data acquisition system starts, so that no effective delay is observed between the two.

Acceptable Delays

The ability to discern the time delay between data acquisition systems is determined by the lowest sampling frequency. For example, the typical sampling rate for a surface EMG signal is 1000 samples/second, which constitutes a sampling period of 1 ms. A Motion Capture systems may sample at 100 frames/second, corresponding to a sampling period of 10 ms. In this case, a synchronization delay of 10 ms or less would be virtually undetectable, since the Motion Capture system is not able to resolve a time quantum smaller than this value. From a practical perspective, time delays up to several hundred milliseconds may be acceptable for physiological measurements, depending on the nature of the investigation.

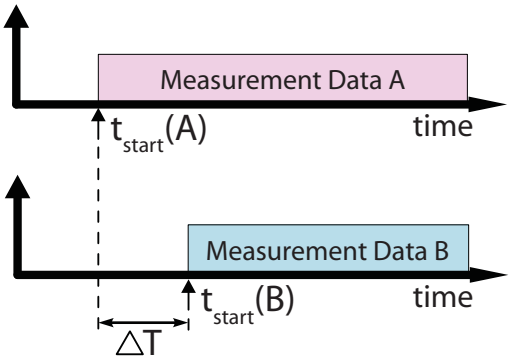


Figure 5. Time Delay Between the Start of Data Acquisition Systems. It is important to ensure that this time delay is minimized to an acceptable period.

Constant vs. Variable Time Delays

An important distinction between ***constant delays*** and ***variable delays*** must be understood. In some cases, the delay between data acquisition systems is a known, contant quantity, usually inherent in one of the measurement systems. A constant time delay is a benign inconvenience that can be corrected during data analysis. For example, if it is known that Motion Capture Data is always measured with a 100 ms delay with respect to the EMG data, then the data can be shifted in time by this same amount during analysis so that the information presented is time-synchronized.

Time delays that are variable in measurement systems are usually unknown to the investigator, and thus pose greater difficulty in their management. These types of delays are often introduced by software processes that are intrinsic to computer operation and cannot be controlled by data acquisition systems. In some cases an upper limit can be placed on these delays. These upper limits are usually a statistical average and must be treated as such. If this upper bound is smaller than the largest sampling period, or if it is otherwise an acceptable time period for the experimental design, then it can be effectively ignored. If, however, this upper bound is too large or unknown, then a synchronization strategy must be implemented to manage the delay. Fortunately, most data acquisition systems offer a variety of strategies for minimizing, and, in some cases, completely eliminating time delays.

The Concept of Triggering

The key to implementing a successful triggering strategy is to establish a control signal that is capable of immediately starting data acquisition on one or more systems. The ability for a data acquisition system to start with a digital control signal is usually described as a **Start Trigger Input**. The ability for a data acquisition system to start other systems with a digital control signal is usually described an a **Start Trigger Output**. In most cases, the specifications of these control signals are 5V digital pulses whose polarity and width will vary for different manufacturers.

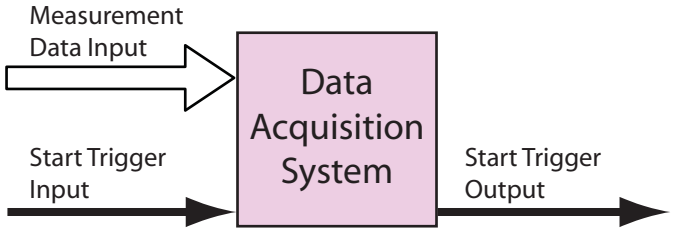


Figure 6. Important Signals in a Triggering Scheme. All data acquisition systems have an input for measurement data. Systems that have a Start Trigger Input can be started with a digital control signal. Those that have a Start Trigger Output can output a digital control signal when acquisition is started.

Primary/Secondary Triggering

A common strategy is to designate one data acquisition system as the primary device that controls all other data acquisition systems, the secondary devices. In this case, the **Primary Data Acquisition System** must have a **Start Trigger Output,** which is asserted the moment data sampling begins. This trigger signal is connected directly to the **Start Trigger Input** of the **Secondary System**, which initiates sampling on the second system. Note that it is possible to control more than one Secondary Data Acquisition System in this way. It may be necessary to condition the Start Trigger Output signal so that it can be interpreted correctly by the Secondary System, as dictated by the manufacturer's specifications.

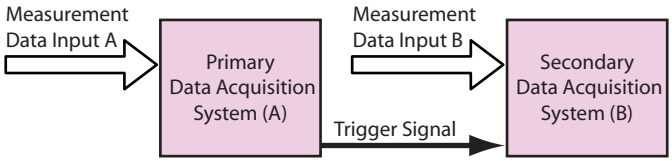


Figure 7. Triggering Scheme Using a Primary Data Acquisition System to Control a Secondary Data Acquisition System. The Start Trigger Output of the Primary System is directly input to the Start Trigger Input of the Secondary System so that when acquisition is started by the Primary System, it will signal the Secondary System to start.

Independent-Signal Triggering

For those systems that are **only** equipped with a **Start Trigger Input** feature, it is necessary to implement a control signal that is independent from the data acquisition systems in order to start them. In this scenario, all of the data acquisition systems are connected as Secondary Systems under the control of this independent device. This device could be a simple push-button switch or a digital control signal coming from a computer or other instrument.

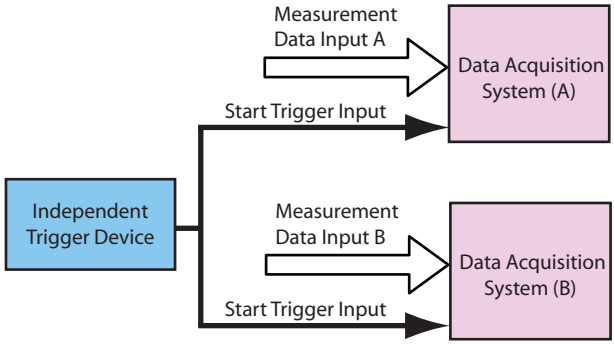


Figure 8. Triggering Scheme Using an Independent Trigger Signal to Start All Data Acquisition Systems. The same signal is input to the Start Trigger Input of all systems.

Common Signal Synchronization

In those cases where data acquisition systems do not support triggering functions, it may be possible to establish time synchronization of data by measuring a signal that is common to all systems. This is usually accomplished by sending an electrical pulse to one channel in each data acquisition system. All systems will record this electrical event on their respective channels, regardless of when the actual data sampling was started. A simple example of this technique might employ a 5V pulse that is activated by a push-button switch, which is sampled by all the active data acquisition systems. The time resolution of this technique is limited by the system that samples at the lowest rate, hence having the largest sampling period. Note that this approach may require each system to have a dedicated channel for observing the synchronization signal.

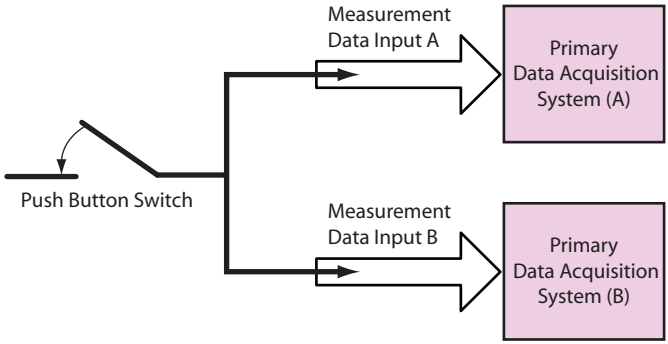


Figure 9. Synchronization Scheme for Data Acquisition Systems that Lack Start Trigger Inputs. A common signal, in this case a pulse from a push button, is input to one data channel in each data acquisition system. The data can then be synchronized during analysis using this common signal.

Stop Triggers

All of the triggering concepts discussed for synchronizing the start of data acquisition systems can be directly extended to situations requiring the synchronous stopping of data acquisition systems. Delays associated with Stop Triggers are not as critical as those affecting Start triggers, since they only dictate the length of the recorded data set and can be truncated as needed. Stop Trigger features can only be implement with those devices that offer Stop Trigger Inputs and Stop Trigger Outputs.

Specifications

Trigger Output Module

General	
Dimensions	85.1mm x 81.8mm x 23.1mm
Bus Type	USB
I/O Connectors	Screw Terminals

Electrical	
Logic	5 V
Max Current Load	5-10 mA
Start/Stop Output Pulse Duration	1 ms
Start Output Pulse Delay	< 5 ms
Stop Output Pulse Delay	< 500 ms

Component References

Part Description	Part Number
Trigger Output Module (Wireless) Package Trigger Output Module (Wireless) Trigger Output Module (Wireless) User's Guide	DS-U05 SC-A13 PM-U03
Myomonitor IV Installation Guide for Wireless Operation	PM-M06
EMGworks User's Guide	PM-E04
EMGworks Installation Guide	PM-E05