

# MiDAS<sup>DA</sup>

User Guide  
Version 1.2



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# MiDAS DA User Guide

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# Chapter 1. Overview

## Introducing MiDAS DA

MiDAS DA is the fifth generation of MiDAS data collection software and takes advantage of Xcitex's knowledge learned from more than ten years of experience. Through our long partnership with National Instruments, we have developed MiDAS DA to take advantage of the newest data acquisition technology. MiDAS DA supports the largest selection of data acquisition hardware that Xcitex has offered to date.

With MiDAS DA we have also chosen to support a larger range of cameras by changing our approach to synchronization of video and data. With MiDAS DA we rely upon each camera manufacturer's own native software for video collection, controlling frame acquisition through the camera's external sync line input. MiDAS DA operates alongside the camera software, collecting data and managing the synchronization of video frame acquisition. After the acquisition, simply drag-and-drop saved video files onto the MiDAS DA window, and MiDAS DA will merge the video and data, automatically and precisely aligning it.

MiDAS DA also allows for easy re-creation of the same particular test setup, as well as saving test configurations for later use. Most importantly, MiDAS DA has full compatibility with our ProAnalyst line of analysis software, and full support for exporting data sets into formats that are easily readable by third party data analysis packages, as well as Microsoft Excel.

## New in MiDAS DA

MiDAS DA provides the kind of data and video synchronization we have always delivered in MiDAS, but now for newly available National Instruments hardware. At the same time, we have reduced the learning curve of using a new software package by utilizing your camera's native software. New features include:

- Full Support of National Instruments M-Series data acquisition systems, in addition to the E-Series architecture
- Support for the newer DAQmx driver set from National Instruments
- Support for a larger range of cameras
- Full ProAnalyst integration

## Updates and Support

As MiDAS DA is continually upgraded and improved, be sure to download the most current version of MiDAS DA from the Xcitex website at <http://www.xcitex.com/html/downloads.php>. You can check to see if there is a new update available by selecting **Check For Updates...** from the **Help** menu, and clicking **Check**. We at Xcitex encourage you to regularly check for updates to your software. The MiDAS DA installer available on the updates page will automatically update all the files on your computer to the most current versions. You can always

find current technical support answers for MiDAS DA and other Xcitex products at <http://www.xcitex.com/techsupport.html> or call us at 617-225-0080 and speak to one of our engineers.

## The MiDAS DA Manual on Your Computer

This manual is automatically loaded onto your computer in CHM (help file) format when you install MiDAS DA. You can access it at any time by clicking on the Windows **Start** button, selecting **MiDAS DA**, and then **MiDAS DA Documentation** from the menu that appears. For additional printed manuals, send an e-mail to Xcitex at <[info@xcitex.com](mailto:info@xcitex.com)> and request a hard copy of our manual.



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# Chapter 2. Installing MiDAS DA

Before you start using MiDAS DA, first check that you have received all of the hardware and software components you ordered. After unwrapping and checking the contents, follow the enclosed instructions for installing and setting up your hardware and software.

*Note: For a more detailed guide for your software installation, please consult your MiDAS DA Installation Guide.*

## What is Included

Depending on the package you have purchased, you should have received the following:

All MiDAS DA users should have received:

- MiDAS DA Installation CD
- Security key
- Installation guide
- User guide
- License agreement
- Registration card

If you purchased a MiDAS DA Data Acquisition Kit you will also receive:

### **For PCI based kits:**

- A PCI data acquisition board from National Instruments
- An 8-channel BNC breakout box, with jumpers pre-installed for use with MiDAS DA
- A 68-pin cable for connecting the DAQ board to the BNC breakout box
- A BNC female-to-female barrel connector
- A 1-meter coaxial cable with a BNC connector at each end
- A MiDAS DA Installation Disk

### **For PCMCIA based kits:**

- A data acquisition PCMCIA card from National Instruments

- An 8-connector BNC breakout box, with jumpers pre-installed for use with MiDAS DA
- A 68-pin cable for connecting the DAQ board to the BNC breakout box
- A BNC female-to-female barrel connector
- A 1-meter coaxial cable with a BNC connector at each end
- A MiDAS DA Installation Disk

**For USB based kits:**

- A data acquisition USB breakout box from National Instruments, with jumpers pre-installed for use with MiDAS DA
- A USB cable to connect the USB breakout box to your computer
- A power supply line for powering the USB breakout box
- A BNC female-to-female barrel connector
- A 1-meter coaxial cable with a BNC connector at each end
- A MiDAS DA Installation Disk

*Note: In addition, expansion breakout boxes are available with some PCI and PCMCIA cards that have extended input channels. If you ordered one of these, you will receive a second breakout box and a second cable.*

## Installing the (optional) Data Acquisition Hardware (PCI based)

*Note: If you did not purchase a MiDAS DA PCI DAQ hardware kit, you may skip this section.*

### **Warning**

Make sure your computer is off and that you are properly grounded to avoid harming your computer before installing any hardware.

### **Warning**

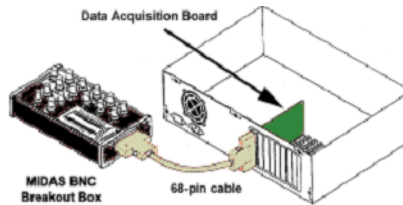
Do not attach your security key prior to installing software and hardware. You will be instructed to attach your USB security key at the proper time.

### **Warning**

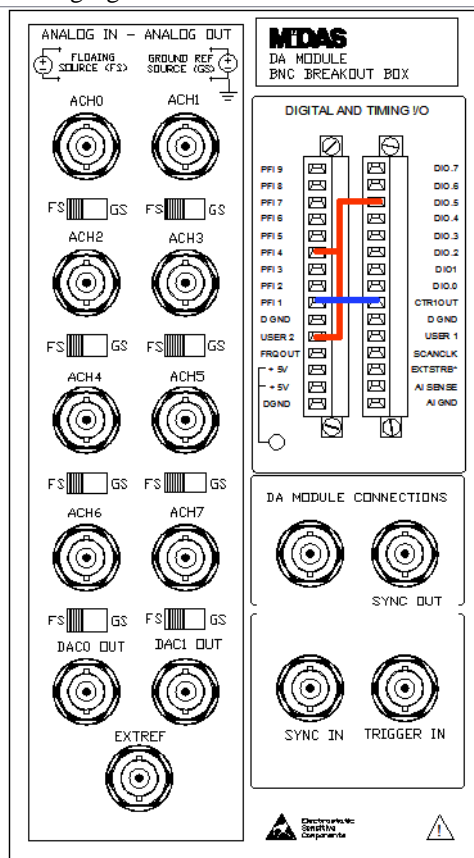
Depending on your DAQ hardware type, you will be instructed to install your hardware at different times during the installation process.

Note: If you are using a USB or PCMCIA Data Acquisition Kit, do not connect it at this time.

1. In an open PCI slot, install the data acquisition board.
2. Connect one end of the 68-pin shielded cable to the back panel connector of your data acquisition board. Then connect the other end of the cable to your BNC breakout box as shown in the following figure:



3. Your MiDAS BNC breakout box comes pre-configured with three jumper cables in place, as shown in the following figure:



Confirm that the first jumper is securely affixed to both the **PFI4** and **User2** terminals with a second jumper going from **PFI4** to **PO.5**. Confirm that the third jumper is securely affixed to both the **PFI1** and **CTR1OUT** terminals.

4. Restart your computer. Upon restart, Windows should detect your new hardware and install the appropriate drivers.

## Installing the Microsoft .NET 2.0 Framework

1. Insert the MiDAS DA Installation CD. The MiDAS DA Software Installer should start. If it doesn't, click **Run...** in your Windows Start Menu and enter **F:\SETUP** where "F" is the letter of your CD Drive. The Installation Setup Screen will appear. Click **Next**.
2. The .NET 2.0 Framework Software Requirement screen will appear. Click **Next**.
3. A screen will appear prompting you to install the .NET 2.0 Framework. Click **Next**.
4. A screen will appear showing the .NET 2.0 Framework End-User License Agreement. Read the agreement carefully. If you agree to the terms, click **I accept...** Click **Next**.
5. The Installing Components screen will appear as .NET 2.0 Framework is installed on your computer.
6. After .NET 2.0 Framework installs, the Setup Complete screen will appear. Click **Finish**.

*Note: The .NET 2.0 Framework is now successfully installed on your computer.*

## Installing the National Instruments Drivers and Components

1. The National Instruments Software Requirement screen will appear. When you're finished reading, click **Next**.
2. The Production Information screen will appear. When you're finished reading, click **Next**.
3. Choose a Destination Directory. Click **Next**.
4. The National Instruments Features screen will appear. Click **Next**.
5. The National Instruments Software License Agreement screen will appear. Read the agreement carefully. If you agree to the License terms, click **I accept...** Click **Next**.
6. The Start Installation screen will appear. Click **Next** to continue.
7. The National Instruments Installation screen will appear as your National Instruments Drivers and Components are installed on your computer.
8. When installation is complete click **Next**.

*Note: Installation of the National Instruments Drivers and Components is now complete. You will now have the Measurements & Automation icon on your desktop.*

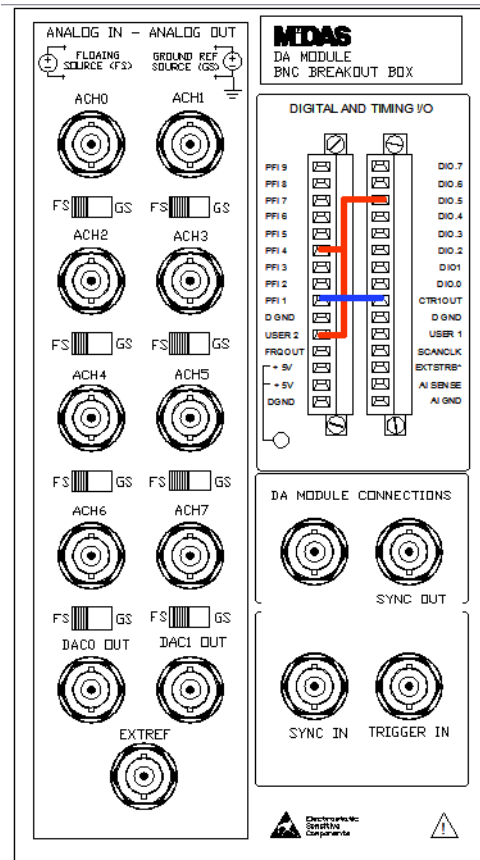
# Installing MiDAS DA and the HASP SRM Run-time

1. The MiDAS DA License Agreement will appear. Read the agreement carefully. If you agree to the License terms, click **I accept...** Click **Next**.
2. Choose a Destination Directory. Click **Next**.
3. Select a Start Menu Folder for the MiDAS DA icons. Click **Next**.
4. You are now ready to install MiDAS DA. Click **Install**.
5. The MiDAS DA Installation screen will appear as your MiDAS DA Drivers and Components are installed on your computer.
6. The HASP SRM Run-time Setup will appear. Click **Next**.
7. HASP SRM Run-time is now ready to be installed. Click **Next**.
8. The HASP SRM Run-time Updating System screen will appear while HASP SRM Run-time Drivers and Components are installed on your computer.
9. HASP SRM Run-time has now been successfully installed on your computer. Click **Finish**.
10. MiDAS DA is now successfully installed on your computer. You must restart in order to use MiDAS DA. Click, **Yes, restart** the computer now. Click **Finish**.

## Installing the (optional) Data Acquisition Hardware (PCMCIA based)

*Note: If you did not purchase a MiDAS DA PCMCIA DAQ hardware kit, you may skip this section. The following instructions are for PCMCIA-based DAQ hardware kits only.*

1. Insert the PCMCIA card in any open PCMCIA slot in your laptop.
2. Once you have inserted the card, Windows should detect your new hardware and install the appropriate drivers.
3. Connect one end of the 68-pin shielded cable to the connector of your PCMCIA data acquisition card. Then connect the other end of the cable to your BNC breakout box.
4. Your MiDAS BNC breakout box comes pre-configured with three jumpers in place, as shown in the following figure:



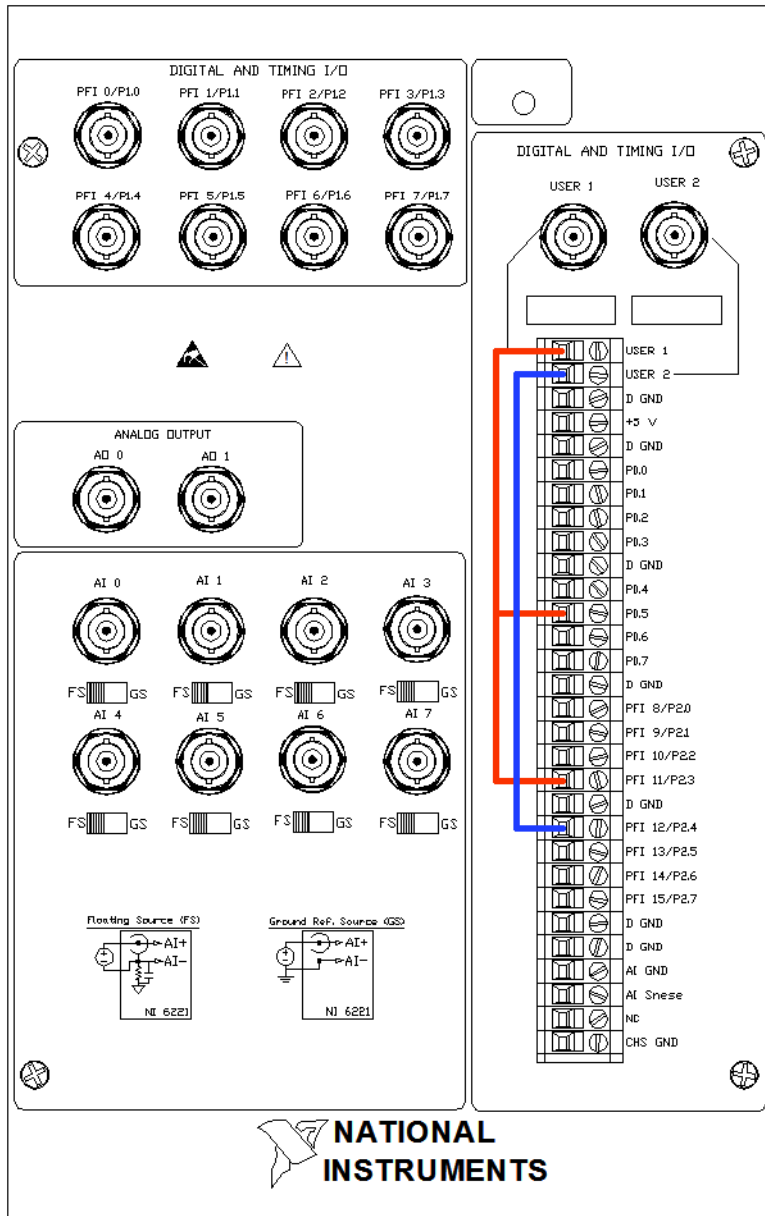
Confirm that the first jumper is securely affixed to both the **PFI4** and **User2** terminals with a second jumper going from **PFI4** to **PO.5**. Confirm that the third jumper is securely affixed to both the **PFI1** and **CTR1OUT** terminals.

## Installing the (optional) Data Acquisition Hardware (USB based)

*Note: If you did not purchase a MiDAS DA USB DAQ hardware kit, you may skip this section. The following instructions are for USB based DAQ hardware kits only.*

1. Insert the USB cable in any open USB slot in your computer.
2. Plug the supplied power adapter into a power socket and insert the lead into the USB breakout box power connection.
3. Connect the other end of the USB cable into the corresponding receptacle on your USB BNC breakout box.
4. Turn on the USB breakout box using the power switch located near the box's power connection. Once the box is on, Windows should detect your new hardware and install the appropriate drivers.

5. Your MiDAS BNC breakout box comes pre-configured with three jumpers in place, as shown in the following figure:

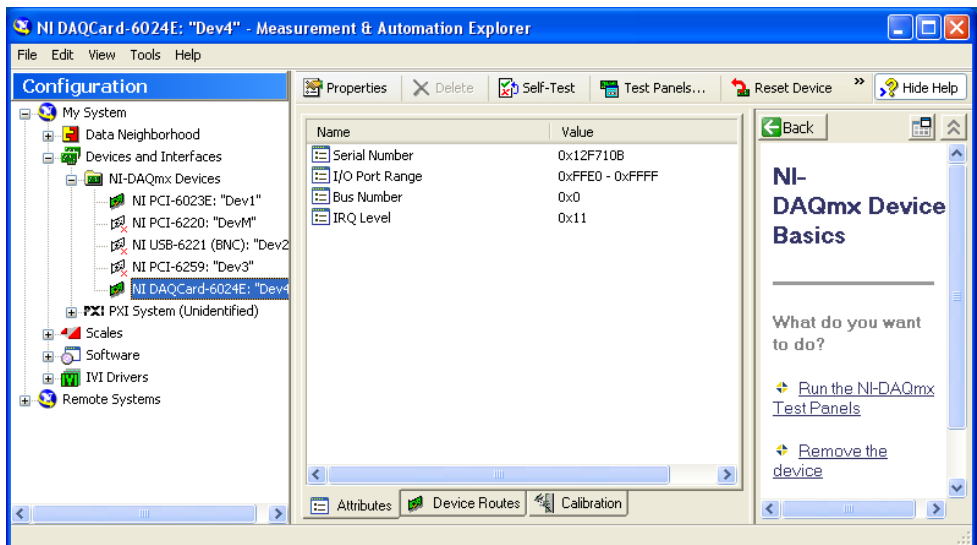


Confirm that the first jumper is securely affixed to both the **User 1** and **PFI 11** terminals with a second jumper going from **User 1** to **PO.5**. Confirm that the third jumper is securely affixed to both the **PFI 12** and **User 2** terminals.

# Confirm that your National Instruments Hardware is Properly Installed

*Note: If you did not purchase a MiDAS DA DAQ hardware kit, you may skip this section.*

1. From the Start menu, choose: **Programs/National Instruments/M Measurement & Automation**
2. Under **Configuration** expand **Devices and Interfaces** then **NI-DAQmx Devices**
3. Select your device in the device subtree.



4. Along the top of the Measurement & Automation Explorer is a button labeled **Test Panels...** click on this, it will open the National Instruments test panel.
5. Click **Start**.
6. Without any sensors attached, you will see a *Null Signal Line* (a line across the graph that varies or simply drifts up and down in voltage over time) and no error messages. If you receive an error message, insert the MiDAS DA disk again and run the repair process within the setup program.



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# Chapter 3. Fundamentals

## Understanding How MiDAS DA Works

MiDAS DA is a sensor data collection program. It is designed to work in conjunction with video acquisition hardware using Xcitex's patented *Wave per Frame Technology* to synchronize your data and video together. MiDAS DA has been designed to work with any high speed video camera and camera control package, allowing maximum flexibility in hardware and software solutions for high speed event capture.

MiDAS DA is designed to work side by side with your camera's native software; synchronization of video and data capture is done through each camera's external sync input and external trigger lines. To properly configure the camera hardware of your test setup, please refer to your camera's manual. The camera must be in *Slave Mode* or *External Sync Mode*, or configured as a secondary camera to sync data. In terms of hardware, installation involves connecting the *Sync Out* from your data acquisition hardware to the *Sync In* on your camera. You must also create a *Trigger Bus* by connecting all of your trigger lines (cables) to a common point.

The system is flexible and simple: configure MiDAS DA with your record settings and start it recording. Open the control software that came with your camera and configure it the same way. Begin recording video. Generally, this involves setting the camera to use a rising edge *External Sync Pulse* to synchronize its frame capture. Many cameras have some form of indication that they are receiving and using the incoming sync pulse. Often, the live window will not update when set to slave mode unless it is receiving an external sync pulse. You can start MiDAS DA recording while configuring the camera so that the camera will see sync pulses. Both the data and video will trigger together if everything is setup correctly, and MiDAS DA will switch directly to *Playback Mode*. Simply save the video from the camera software, and drag and drop the file onto MiDAS DA where it will be automatically synchronized. Take advantage of MiDAS DA's playback features to examine your data and video, or save your project and open it in ProAnalyst also from Xcitex, to perform advanced measurement and analysis.

## MiDAS DA Display Settings

The MiDAS DA window colors and resolution can only be changed by modifying Windows display settings.

*Note: While MiDAS DA is designed to operate with a resolution as low as 1024 x 768 pixels, the optimal viewing resolutions is at least 1280 x 1024 pixels (or equivalent, depending upon aspect ratio). We recommend using the highest resolution that you are comfortable with. We also recommend a minimum color depth of 24-bit.*

MiDAS DA and any of the windows within it, can be resized. In video windows, the display size of the video will actively update during resizing, maintaining the aspect ratio. To resize a window, move the mouse to the edge of the window where the mouse icon changes, click and hold down the mouse button down, and drag the window border to the size you prefer. Grab one side of the window border to change only the horizontal or vertical dimension. Grab the corner of the window to change the horizontal and vertical dimensions simultaneously.

*Note: If your windows do not show their adjusted contents in real time during resizing, you must make the following changes in your Windows settings:*

1. Click on the Windows **Start** button.
2. Click on **Control Panel**.
3. Double Click on **Display**.
4. Click on the **Appearance** tab.
5. Click on the **Effects...** button. A dialog box will appear.
6. Make sure the **Show Window Contents While Dragging** check box is selected.

## The MiDAS DA Interface

The MiDAS DA interface is similar to many other Windows based programs, and an average user should be able to navigate the program with ease. However, this chapter covers the functions of the program in detail.

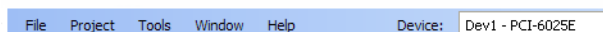
### The Title Bar

The MiDAS DA *Title Bar* is similar to that of most standard Windows programs and allows for control of the MiDAS DA window. When a project is open, the name of the project is displayed in the Title Bar. Use the controls on the Title Bar to let MiDAS DA run in the background (minimize it), to close the program, or to move the window or change its size.



### The Menu Bar

The MiDAS DA *Menu Bar* spans the top of the program window, immediately below the Title Bar. The Menu Bar allows you to access the universal program controls and common actions such as choosing a data device, opening files, and saving files. The following are the MiDAS DA Menu Bar options:



## File Menu

### File

**New Recording** - Set the *Record Panel* to default settings: four channels at 1000 samples per second for ten seconds with 250 video frames per second.

**Open MiDAS DA Project File...** - Open a *.DAP File* (MiDAS DA project file) and switch to Playback Mode to view the project's data and videos.

**Save MiDAS DA Project File...** - Save a *.DAP* (MiDAS DA project file) file with your current project's data, trigger alignment information, and video locations.

**Close Project** - Close all data and video windows and return to Record Mode.

**Open recording Configuration...** - Open a *.DRC* (MiDAS DA record configuration) file to apply previously saved settings to the Record Panel.

**Save Recording Configuration...** - Save a *.DRC* (MiDAS DA record configuration) file with all the settings in the Record Panel for easy application later.

**Export ProAnalyst Project...** - Create a project for Xcitex's ProAnalyst analysis software, from the videos and data in your current MiDAS DA project. ProAnalyst also opens *MiDAS DA Project (.DAP) File*.

**Exit** - Exit MiDAS DA.

## Project Menu

### Project

**Add Video...** - Launch a file opening window and add the selected video file to a MiDAS DA project, aligning it either by associated configuration file, or based on the current record configuration trigger percentage.

**Remove Window** - Close the current video or data window and remove it from the MiDAS DA project file.

**Recreate Recording** - Close the current project and return to *Record Mode*. The Record Panel will be configured based on the settings of the current MiDAS DA project.

*Note: This feature makes it easy to repeat a test several times in a row, saving the project after each run with all your data and aligned videos intact.*

## Tools

### Tools

**Refresh Device List** - Check for newly installed National Instruments data-collection hardware. The updated list appears in the pull-down menu of available devices. Use this feature if adding USB or PCMCIA cards while MiDAS DA is already running.

**Test Trigger...** - Launch the **Test Trigger Window**, which gives controls for an output digital and an analog signal, used for demonstration purposes.

**Clone Data Window** - Create another data window exactly like the currently active data window (or the original data window if none is active). The new data window has its own channel selection controls, so using multiple data windows makes breaking data into several sets for viewing simple.

**Export Data** > to Text, to Excel or Excel Template (if Excel is installed on your computer) - Depending on which menu sub item, write the data in the graph and its meta information to either a comma and tab delimited text file, a new MS Excel spreadsheet in a live Excel window, or into a selected Excel spreadsheet in a live Excel window.

## Window

Window

**Arrange Icons** - Move any minimized video or data windows to the lower left corner of the main MiDAS DA window and sort them.

**Title Horizontal** - Fit all non-minimized video and data windows into the main MiDAS DA window as horizontal bands.

**Title Vertical** - Fit all non-minimized video and data windows into the main MiDAS DA window as vertical bands.

**Cascade** - Make all non-minimized video and data windows the same size and stack them so all their title bars are visible.

**Show Alignment Legend** - Toggle showing the **Alignment Legend**, which makes it easy to see how videos line up with data and what portion of the data different data windows show.

## Help

Help

**Contents...** - Display the MiDAS DA manual with the **Contents** interface.

**Index...** - Display the MiDAS DA manual with the **Index** interface.

**Search...** - Display the MiDAS DA manual with the **Search** interface.

**Demo Mode** - Enable Demo Mode, which makes showcasing the functionality of MiDAS DA easy, even without hardware available. (This is for dealers only).

**Check for Updates...** - Opens a dialog that connects to Xcitex to find out if you have the latest version of MiDAS DA. If the update command locates a newer version, it will provide links to a new installer and accompanying release notes.

**About...** - Display a window with information about your version of MiDAS DA.

## Device

Device: Dev1 - PCI-6025E

**Device** - Provides a drop-down menu of all available DAQ hardware. Whichever device is shown in the selection box is the device that will be used during recording.

# The Record Panel

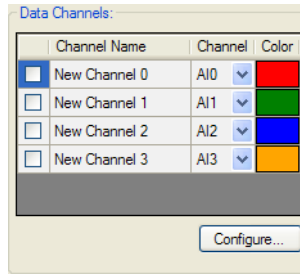
The Record Panel is the panel on the left side of the main window of MiDAS DA when in Record Mode. It shows all the choices to be made for a given recording session and is divided into subsections.

## Configuring Channels

The DAQ hardware can record data from several sources during a data recording. The channels in MiDAS DA represent the different incoming streams of data. Use the **Data Channels Panel** on the Record Panel to configure channels for your data capture event.

## Channel Selection List

The *Channel Selection List* is the list of configured analog input data channels. Each line represents a different configured channel and shows some of the configurable information about that channel.

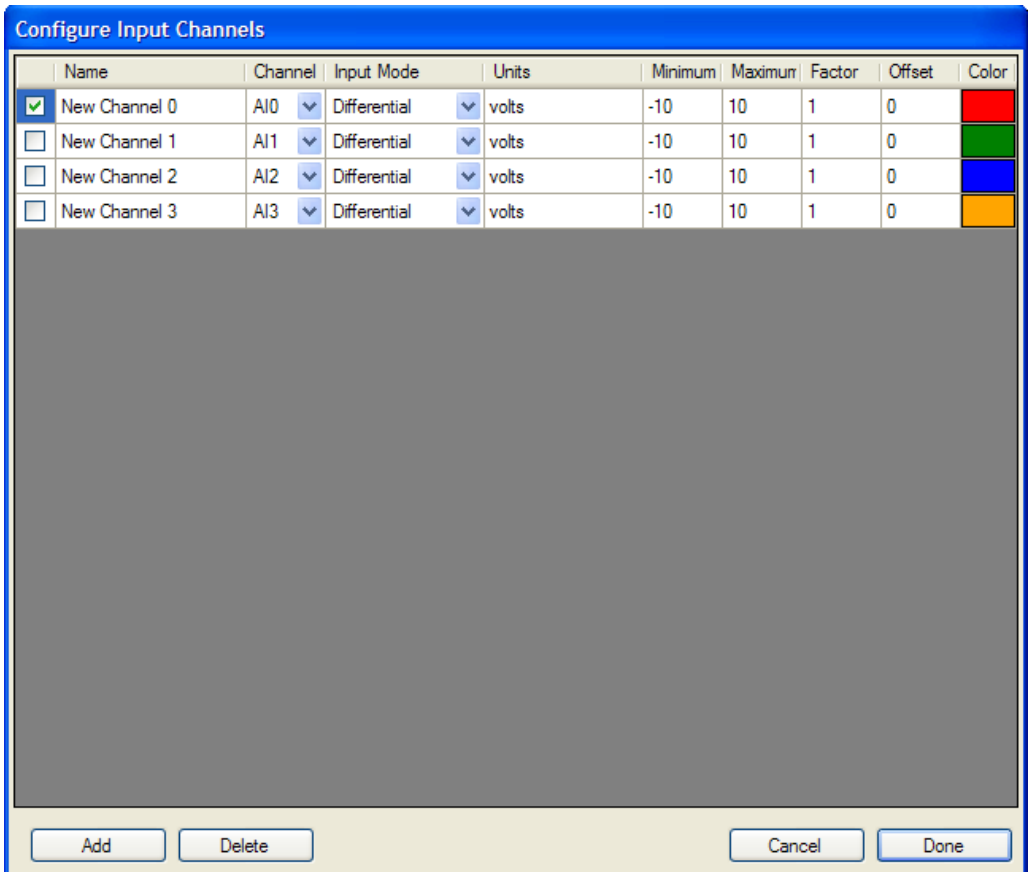


The check box at the left of each entry indicates whether or not that channel will be used during the recording. A checked box means the channel will be enabled.

The *Channel Name* field allows you to name each channel. Providing a descriptive name (e.g. left wall, or strain) at this stage makes reviewing data easier. The *Channel Field* specifies the hardware channel that is associated with that named channel. Finally, the color that will represent the channel in graphs can be changed by clicking on the current color and using the provided color chooser window.

## Configure Input Channels Window

To access more channel configuration options, open the *Configure Input Channels Window* by clicking **Configure...** just below the Channel Selection List.



As in the Channel Selection List on the Record Panel, each line represents a configured channel. This window shows all the attributes of the channels. From this window, add more channels if needed by clicking the **Add** button. Remove excess channels by clicking the **Delete** button which removes the active line. Click in the appropriate box to change the attributes of any channel and then fill in the new value or select it from a drop-down menu, if appropriate.

Name	Channel	Input Mode	Units	Minimum	Maximum	Factor	Offset	Color
New Channel 0	AIO	Differential	volts	-10	10	1	0	

In addition to the fields available on the main panel, the Channel Configuration Window allows the user to edit:

**Input Mode:** Differential or single-ended channel.

**Units:** Engineering units after scaling (inches, psi, etc.).

**Minimum:** Minimum expected input voltage.

**Maximum:** Maximum expected input voltage.

**Factor:** A scale factor to multiply with the input voltage.

**Offset:** An offset to add to the factor-multiplied input voltage.

The maximum and minimum field values can range from -10 to 10. These specify the range of volts expected of the input. The closer this range is to the actual values, the better the digitalization will be.

The *Factor* and *Offset* values provide the parameters for a linear scale that is applied to input voltages on each channel. Each voltage value in the input data is multiplied by the factor, and then the offset value is added. Use the appropriate scale factor and offset for the sensor attached to the channel so that incoming raw values will be automatically scaled to engineering units.

## DAQ Configuration

### DAQ Configuration Panel

The *DAQ Configuration Panel* controls the synchronization pulse (sync pulse) sent to the camera(s) through the Sync Out line, as well as the data collection rate, *Samples/Frame* and record time.

The screenshot shows the 'DAQ Configuration' dialog box with the following settings:

- Buffer Size (sec): 10.00
- Sync. Out Rate (Hz): 250 (selected with a radio button)
- samples/frame: 4 (selected with an 'X' in a box)
- Data Rate (Hz): 1000 (unselected with a radio button)
- An 'Advanced' button is located at the bottom right.

The *Buffer Size* defines the length of the data recording in seconds. MiDAS DA allows you to adjust the recording time of your data down to a hundredth of a second resolution.

*Note: The duration of recording is also the duration during which MiDAS DA will output a sync signal.*

Cameras accepting external sync pulses often use the number of received pulses to determine when to stop recording. Since MiDAS DA stops sending sync pulses after the data recording is complete, make sure the Buffer Size is longer than your video recording length, as configured

in your camera software. The camera may sit and wait for further pulses if the data recording is shorter, meaning the video recording will not properly complete.

The remaining fields of the panel set the rates of data and video collection. The interface emphasizes the relationship between the two (2) rates - the *Sync Out Rate* (video rate) times the number of data samples desired per frame of video (samples/frame) equals the *Data Rate*. The rates specify the data sample clock and sync out pulse train signal in Hertz (Hz). This means the number shown is the number of samples, or frames, collected per second. The Sync Out Rate is the rate of the video. It is the rate of the signal sent to each camera through its Sync In input. If the camera is properly set to slave mode, this signal will control the rate of frame acquisition. MiDAS DA assumes the camera will begin its exposure of consecutive video frames on consecutive rising edges of this sync signal. Using that assumption, and sending a signal to the standard Sync In interface of the camera, MiDAS DA can precisely correlate video frame capture with data sample capture.

There are two (2) approaches available for setting these rates:

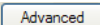
1. Set the Sync Out Rate (video rate) and samples/frame, and let MiDAS DA fill in the Data Rate.
2. Set the Data Rate and samples/frame, and let MiDAS DA fill in the Sync Out Rate.

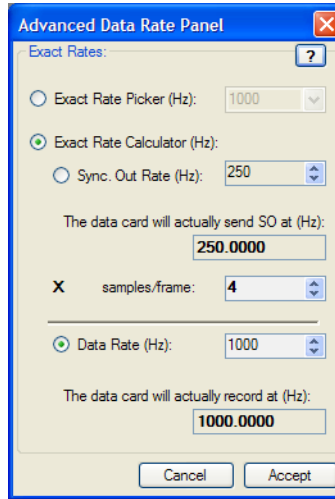
These choices provide flexibility, so you can think in terms of video or data. If you think in terms of video rates, select the radio button next to Sync Out Rate by clicking the circle so that a green dot appears inside as in the image above. Next, fill in the corresponding box with the desired video rate, and the box below it with the number of data samples to collect per video frame. The Data Rate box is automatically filled in with the product of the above two (2) numbers.

If you think in terms of data rates, select the radio button next to Data Rate by clicking the circle so that a green dot appears within it. Next, fill in the corresponding box with the desired data rate, and the box above it with the number of data samples you want per video frame. The Sync Out Rate is automatically filled in. For your convenience, using the up and down arrows on the Data Rate box adds or subtracts the samples/frame number with each click .

Because of the calculations between the two (2) rates, it is possible to configure the panel to an invalid state. There is a hardware requirement that the Sync Out Rate be an integer divisor of the data rate. For your convenience, the samples/frame box text is bold when the configuration of the panel is valid, signifying that the number of samples per frame divides evenly into the data rate to get an applicable video rate.

## Advanced Rate Window

National Instruments hardware generates the sync pulse by dividing a stable clock signal by an integer divisor. Because of the way the signal is generated, samples/frame must be at least four (4). Also, as is the case with any signal generator, there are only certain sync rates that can be generated exactly. Most inputted integer rates will not result in a signal at precisely the requested rate. If it is important to you to either know the precise rate, or to rigidly control this rate, you may do so through the advanced panel by clicking the  button.



The *Advanced Rate Window* will show the exact rates that your hardware can generate, as well as showing the precise generated rate corresponding to any integer input.

There are three (3) ways to use the panel for selecting rates.

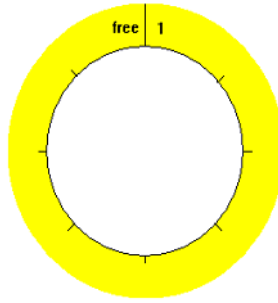
1. By choosing the option button for the *Exact Rate Calculator*, this enables an interface just like the DAQ Configuration Panel on the main Record Panel. Choose the radio button next to Sync Out Rate to choose the rate of the sync out pulse (video rate) and the number of data samples/frame and have the data rate calculated.
2. By choosing the *Exact Rate Picker*, this enables a drop down menu. Choose from all the available precise integer data rates for your card.
3. By choosing the radio button next to the Data Rate, the rate of data acquisition and the number of data samples/frame can be examined. Next, calculate the rate of the sync out pulse (video rate).

The difference between this panel and the main panel is determining extra precision information. There is another box below each of the rates, giving the rate the data card will actually produce to several decimal places. Because the number of decimal places in some cases is not enough to show the imprecision, the text in each of these boxes appears bold if the value shown is exact. The samples/frame box text is bold when the rates selected are valid (when the integer rates satisfy the divisibility condition) allowing for proper data acquisition.

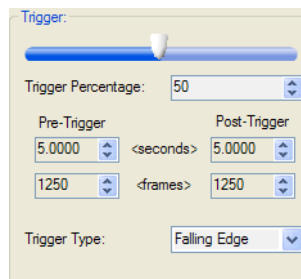
## Trigger Settings

The *Trigger Panel* allows you to allocate the total data buffer into "before trigger time" and "after trigger time." MiDAS DA uses the *Circular Buffer Concept*, also known as the *First-In-First-Out Principal*, to manage event-based triggering. Data is read from the sensors into your computer's memory. Only enough memory to hold the total buffer length of data is reserved, so as data is collected beyond the buffer length, the older data, now irrelevant, is overwritten with incoming data. Once your system is triggered, the pre-trigger portion is marked, and the system continues to collect data until the post-trigger buffer is filled. For a more detailed description of triggering see the *Event Triggering* section.





Adjusting the *Trigger Percentage* allows you to adjust the amount of time before the trigger and after the trigger you will capture your information. If the trigger will occur after the event, leave more pre-trigger time. If the trigger will precede the event, make sure there is enough post-trigger time to capture the event. You can adjust your Trigger Percentage (the percentage of samples occurring before the trigger) with the slider, or with the numeric chooser. The boxes for *Pre-Trigger* and *Post-Trigger* frames and seconds are calculated and displayed for convenience. These fields cannot be edited.

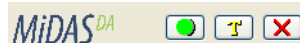


*Trigger Type* allows you to configure MiDAS DA based on the type of trigger you will be using. Specifically, this is the type of analog signal that MiDAS DA will recognize as the trigger. Use a *Rising Edge* if the trigger line will go from low to high, and *Falling Edge* if the line will go from high to low. If you use an unpowered switch connected to the line, select *Switch Closure*. The software trigger takes this setting into account and sends an appropriate signal out on the line to trigger data and video simultaneously.

Often, camera manufacturers require either a rising or falling edge trigger. To be safe, check your camera's manual to get the correct trigger. Make sure to configure MiDAS DA to use the same type of trigger or the data and video will trigger at different times, distorting the synchronization.

## Record Controls

The record controls are used to **Start**, **Trigger** or **Stop** recordings. These three buttons, respectively, are on the bottom of the panel.



The **Record Button** begins recording data based on the Record Panel settings with the chosen device from the **Device Menu**. A data window provides a real time view of the data as it comes in. The recording is then waiting for a trigger on the *Trigger Line* (cable), which can be sent by

pushing the **Trigger Button**. To abort a recording use the **Stop Button**.

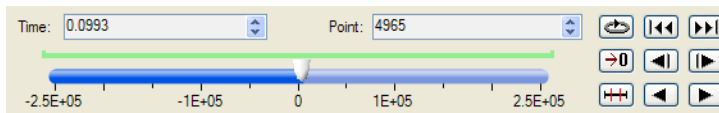
*Note: After a successful recording, MiDAS DA automatically switches to Playback Mode where data can be reviewed and video can be added to the project.*

## Playback Panel

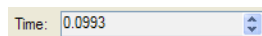
In Playback Mode, the Playback Panel is a toolbar across the top of the main MiDAS DA window. There are three (3) components, the **Playback Controls and Tools** section, the **Playback Rates** section and the *Information Section*.

### Playback Controls and Tools Section

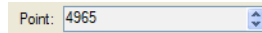
The Playback Controls and Tools section contains the standard playback controls with a playback position slider and position indicators with tools for adjusting data.



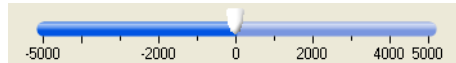
The various functions of the playback controls are detailed below.



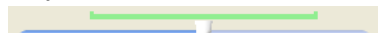
**Playback Time:** Displays the time position of playback. You can also jump to a specific playback time by editing this value. The up/down arrows will skip in one (1) second increments.



**Playback Point:** Displays the playback positions by data point. You can also jump to a specific data point by editing this value. The arrows will skip in one (1) data point increments.



**Playback Slider:** Provides a convenient means of visually picking points in the playback.



**Bounds (Boundaries):** Shows the beginning and end bounds of playback when bounds are set from a zoom window.



**Loop Button:** Toggles *Loop Mode*. If the loop icon is showing, playback will follow through from one end of the data buffer to the other, continuously looping through the data. If the straight arrow icon is showing, playback stops at the end points. When using playback bounds, the bounds are treated as the endpoints for playback.



**Set Zero:** Sets the current cursor position as the zero frame.



**Trim:** Trims the data set to the limits of the associated video(s).



**To Start and Move Playback Point:** Moves the playback point to the next stopping point in the appropriate direction. Stopping points include endpoints, playback bound limits, and the zero frame.



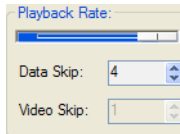
**Step Backwards and Step Forwards:** Moves the playback point backward or forward by the number of points specified in the Playback Rate section.



**Play Backwards** and **Play Forwards**: Play backward or play forward at the rate set in the Playback Rate section.

## Playback Rate Section

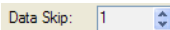
The Playback Rate section contains the controls that change the rate at which MiDAS DA plays the data and video. The controls allow skipping several data points or video frames at a time and inserting a pause between advancing the playback counter.



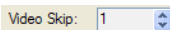
The specific functions of the playback rate controls are detailed below.



**Playback Rate Slider:** Controls the rate of video and data playback. Fastest playback is specified by the slider fully to the right, and slowest, fully to the left. This slider controls the pause between advancing the playback counter. With the slider at the right there is no pause between advances. With the slider at the left there is a one (1) second pause between each advancement of the playback counter.



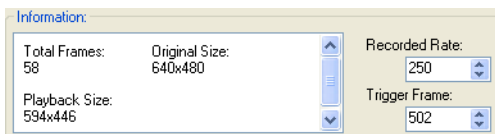
**Data Skip:** Determines how many data points are skipped at each advance of the playback counter. Raise this number to have MiDAS DA skip through data quicker, or lower it to see more points of data during playback. Playback is affected only by this number when a data window is active.



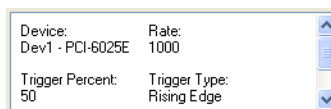
**Video Skip:** Determines how many video frames are skipped at each advance of the playback counter. Raise this number to have MiDAS DA skip over video frames for faster playback, or lower it to see more frames. Playback is only affected by this number when a video window is active.

## Information Section

The Information section displays information about the active data or video window and includes adjustment controls for videos.



The various functions of the Information window are detailed below.



**Information Box:** Information about the active data or video window. Data window information includes the device used, the recorded rate, the Trigger Percentage, the Trigger Type, and the exact video and data rates from the data card. Video window information includes the total number of frames, the original size of the video and the current playback size.

Recorded Rate:

**Recorded Rate:** Displays the rate at which the video was recorded. Change this value to affect the number of samples/frame in playback.

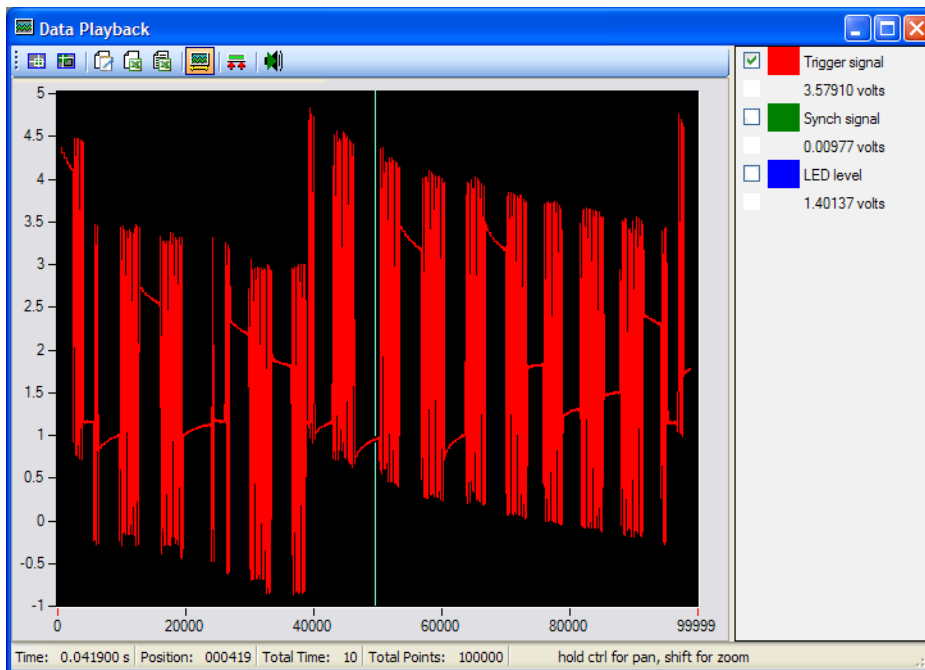
Trigger Frame:

**Trigger Frame:** Displays the index of the video frame that is aligned with the trigger. Change this value to adjust the alignment of the video against the data.

## Data Playback Windows

There are four (4) components to a MiDAS DA data playback window. The **Toolbar**, **Channel Legend**, **Data Graph** and **Status Bar**.


Each data playback window has the ability to display all recorded data, but channels can be turned "on" and "off." Each window has its own zoom and pan settings. To create several displays of the data, each with its own zoom, pan, and channel settings, use the data window cloning feature from the menu (see **Tools Menu**).




Since a MiDAS DA Project includes all the data windows that are open when the project is saved, closing a data window removes it from the project, and closing the last one, closes the project. Close data windows, or minimize or maximize them, from the Title Bar. Data playback windows can also be resized in the standard way with your mouse by dragging the edges.


## Toolbar


The toolbar has eleven (11) buttons, which control data views and export.


 **Zoom Mode** - Turn on zoom mode, which shows a magnifying glass mouse cursor over the


data graph. Click and drag the mouse over the area of interest, letting go once your area of interest is covered.


 **Pan Mode** - Turn on pan mode, which shows a hand mouse cursor over the data graph. Click in the data area and drag the data sets through the window until the appropriate part is shown.


 **Incremental Zoom (In)** - Zoom-in the graph by 10%.

 **Incremental Zoom (Out)** - Zoom-out the graph by 10%.


 **Export to Text** - Export all the data in the graph to a tab and comma delimited text file, including a header of recording information.


 **Export to Excel** - Open Microsoft Excel and export all the data in the graph to a new spreadsheet. The output is a header of recording information followed by columns of data.


 **Export to Excel Template** - A prompt will appear asking for a Microsoft Excel file. Open it with Excel, exporting all the data in the graph to the spreadsheet as above. Use this option to export data into a template that uses the data for calculations.

 **Oscilloscope Mode** - Toggle *Oscilloscope Mode* "on" and "off." When Oscilloscope Mode is turned on, the data in the graph moves behind a stationary cursor during playback. When Oscilloscope Mode is turned off, playback is a moving cursor on static data.

*Note: Oscilloscope Mode only works when you are zoomed into a portion of the data. When the full data set is shown in the window the data cannot be scrolled.*

 **Set Boundaries (Bounds)** - Set the **Playback Bounds** to the bounds of the data window. When playing or scrolling through data and video, the Playback Bounds determine the endpoints. You can see the bounds clearly even if the data window moves because they are marked by a green bracket above the playback position slider bar and on the alignment window. Use this feature to limit playback to a time period of interest in the data and video.

 **Un-Set Boundaries (Bounds)** - Set the Playback Bounds to the full range of data, effectively no longer using playback bounds. Use this button to undo playback bounding so the full data and video are displayed during playback.

 **Play Data Channel as Audio** - Open a dialog that can play a data track as sound.

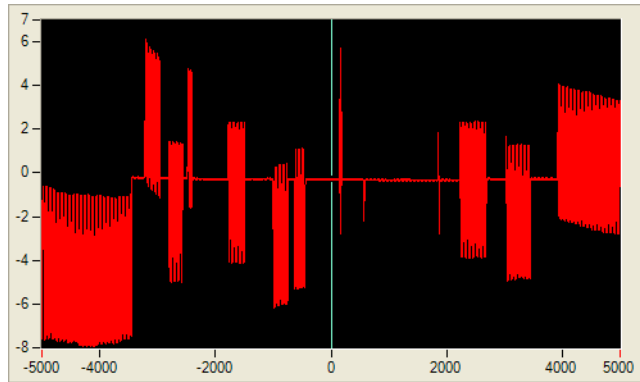
## Channel Legend

The Channel Legend lists all the recorded data channels as well as their display color and value at the current playback point.

 New Channel 0  
-0.77589 volts

Each data channel has one line in the legend. The box on the left is a checkbox for whether or not to display the channel within the graph. If the box has a check mark in it, the channel will be shown on the graph, and un-checking the box will make the channel temporarily invisible. To the right of that is a sample of the channel's identifying color (the color of its image on the graph). The first line of text is the channel's name, and the second shows the value, in specified units, of the channel at the current playback position. Use the legend to hide extraneous data channels to make examination of the important channels easier, and sample actual data values.

## Data Graph



The Data Graph shows the data in an x, y graph. Data values in specified scaled units are on the y-axis. Time, in the form of trigger-referenced sample numbers, is on the x-axis.

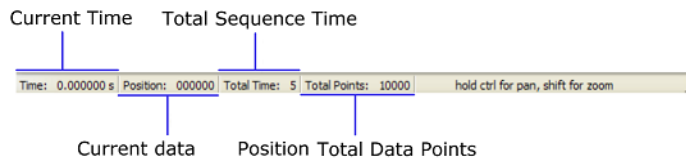
Use the **zoom** and **pan** commands to focus on a particular area of interest. Either select zoom or pan mode with the toolbar buttons, or in standard cursor mode, hold Ctrl (control) down to pan and Shift down to zoom. To move back through the zoom and pan history hold down Ctrl or Shift, and right click. Double-clicking the mouse resets the zoom and pan state to the original.

Using more than one copy of the data graph makes it easy to zoom into different points of interest. Clone multiple data windows using the command **Tools\Clone Data Window...** on the menu. Each window keeps track of its own zoom and pan state and visible channels, making examination of several pertinent points in time in the data easy.

While in cursor (normal) mode, moving the cursor moves the playback point and aligns all the data and video windows together. To move the cursor, either drag it with the mouse, or just click on the graph and the cursor snaps to the closest data point.

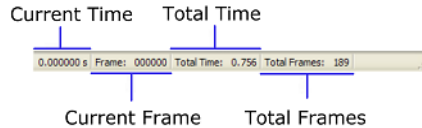
## Status Bar

The Status Bar shows information about the data recording and continually updates based on the playback point. On the very right of the status bar is a reminder of how to use the keyboard shortcuts for pan and zoom on the graph.



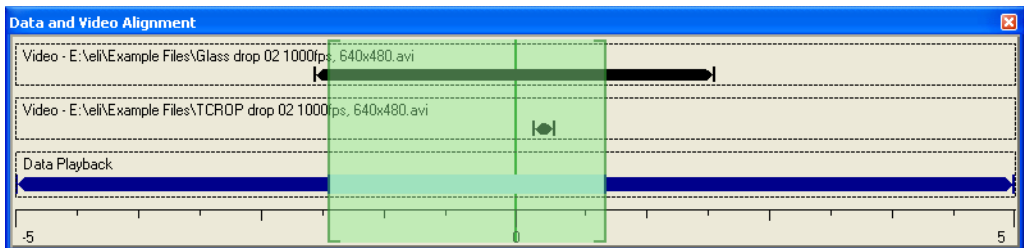
## Video Playback Windows

The *Video Playback Window* shows the frame of the video associated with the current playback point. The status bar across the bottom gives updated information on the video.



## Data and Video Alignment Window

The *Data and Video Alignment Window*, also called the *Alignment Legend*, allows you to see how your videos align with your data, represented in a timeline. Each video and data window is represented by a dashed-line rectangle with a label. Inside the rectangle is a bar representing the data or video. Along the bottom is a ruler similar to the one below the playback slider in the Playback Panel, except that it is labelled in time instead of data points. A green vertical line shows the position of the playback cursor.



Data windows are represented by a dark blue bar. There is a light blue section highlighted on the bar which shows what part of the data line the corresponding graph window has in view. During playback, if the data window is set to Oscilloscope Mode the light blue highlight line will move along the data bar. In this case, the cursor will stay in the middle of the highlighted section unless it hits one of the edges of the data stream. Testing this out is a simple way to see how useful the Data and Video Alignment Window is.

Video windows are represented by a black bar. Changing the alignment settings of the video from the Playback Panel will immediately change how the video is rendered in the Alignment Legend. Changing the *Record Rate* will change the length of the bar. Changing the *Trigger Frame* up and down will move the bar left and right respectively.

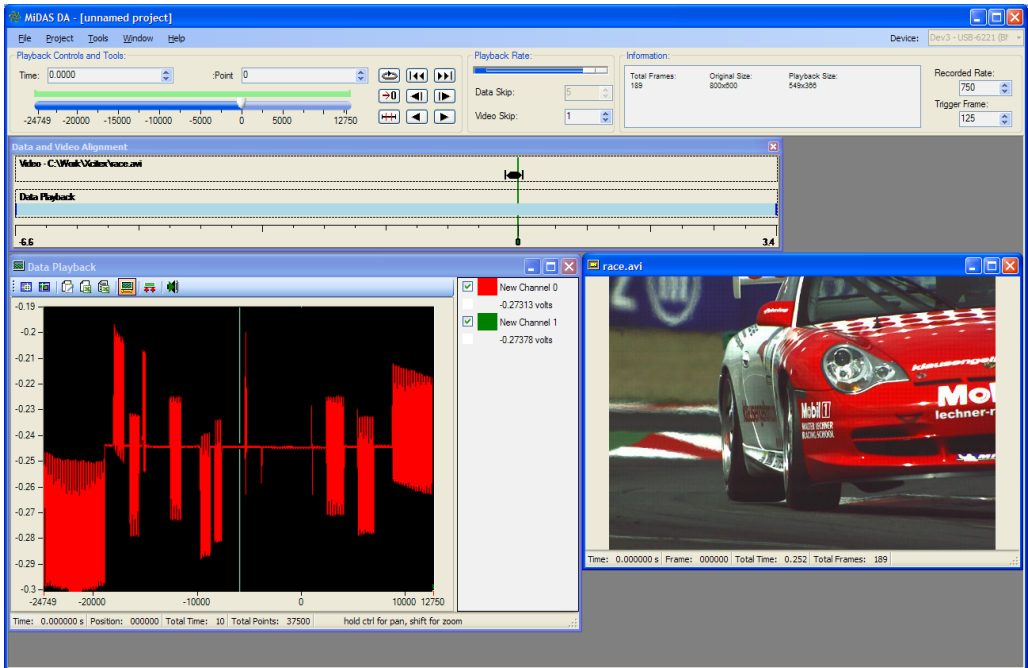
The Playback Bounds are shown on the Alignment Legend as a light green highlighted section enclosed in darker green brackets. During playback, the cursor will only move within this section. The Playback Bounds can be changed by using the *Set Bounds Button* on any of the data windows. You can see where the bounds will show up on the Alignment Legend before you set them because the data window's display region will be highlighted.

To toggle the Alignment Legend "on" and "off," use the menu option **Window\Show Alignment Legend**.

## Adding Videos

After completing a recording, save the video from camera software. There are two (2) options for importing the video into MiDAS DA.

1. Drag and drop the video file onto the MiDAS DA work space.
2. Choose **Project/Add Video...** and select the video file.



MiDAS will look for a recognized configuration file provided by the camera manufacturer's software. If one is found, the alignment information comes from that file. Otherwise, MiDAS DA will calculate an alignment automatically based on the Trigger Percentage, giving a warning message that a configuration file was not found. Once the video is imported into MiDAS DA, it is associated with the data as a MiDAS DA project. To remove the video from the project, close the video window.

MiDAS DA will not make any changes to video files, nor annotations to any configuration files. The alignment is only within the MiDAS DA project and is only saved to a MiDAS DA (.DAP) Files. To perform analysis in ProAnalyst, open the MiDAS DA project file in ProAnalyst, or open one of the videos in ProAnalyst. There is a special *.DAR File* associated with each video to tell ProAnalyst about the MiDAS DA Project (.DAP) File. It is important to keep the video placed in the same location relative to the project file. If the video is no longer where MiDAS DA expects to find it, it will open a File Open dialog to relocate it. Make sure to keep in mind where you save your MiDAS DA Project (.DAP) File for easy location.

## Saving and Loading

MiDAS DA has two (2) major file formats, *Record Configuration Files* and, the above mentioned MiDAS DA Project (.DAP) Files. Repeating data collection and reviewing data and video after they have been associated is simple with these two (2) file formats.

## Record Configurations

MiDAS DA can save sets of recording parameters to make it easy to repeat a test without manually reconfiguring each channel. A Record Configuration File includes information from all the panels of the Record Panel: **Data Channels**, **DAQ Configuration**, and **Trigger**. Saved record configurations are a fast and easy way to set MiDAS DA for a specific testing regime.



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To save a recording configuration, configure MiDAS DA for your recording, and choose **File/Save Recording Configuration...** on the menu. A standard **File Save** dialog box will open for choosing the target filename.

Open a recording configuration from the menu: **File/Open Recording Configuration....** When the file is opened, the Record Panel fills out all the appropriate record settings. All these settings can be modified.

## MiDAS DA Projects

*MiDAS DA Project (.DAP)* Files hold everything related to a collection of data and its associated videos. Use projects to review sets of video and data after they are aligned. A saved project includes the data itself, information on how it was recorded, the states of the data windows, playback bounds' range, the alignment specification, the relative paths to the videos, and the playback state.

To save a MiDAS DA Project choose **File/Save MiDAS DA Project File...** from the menu. A standard **File Save** dialog box opens for choosing the target filename.

Open projects from the menu at **File/Open MiDAS DA Project File....** When the file is opened, the data windows and video windows that were saved are recreated and the playback settings restored. If any video file could not be found, there is a prompt for relocating it with a **File Open** dialog.

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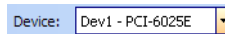
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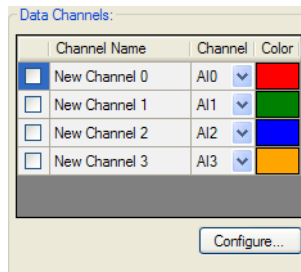
# Chapter 4. Quick Start Guide


Once you have installed MiDAS DA, your data acquisition hardware and National Instruments drivers, you are ready to start recording data. Below we will go through the typical process of recording, playing back data, and importing videos.

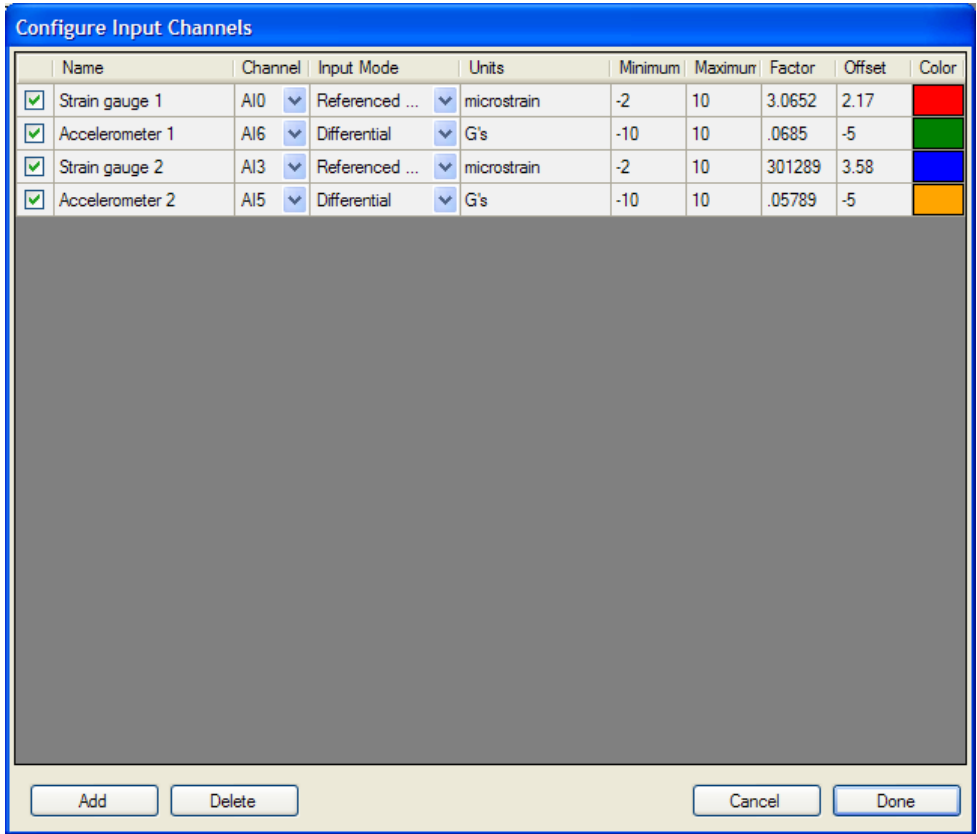
1. Start MiDAS DA.
2. In the upper right hand corner is a list of available data acquisition devices. Choose the device you want to use for acquiring data.



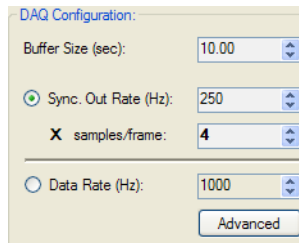
3. Choose on which channels to record data. Upon startup, MiDAS DA shows four (4) channels configured with default settings in the **Data Channels** panel. Click on the left-most box for any channel in order to enable that channel for recording.



4. To change the default settings open the **Channel Configuration Window** using the  button. From here, you can change all of the channel settings as well as add new channels.

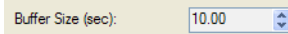


- After configuring the individual data channels, proceed to the **DAQ Configuration** panel on the **Record Panel**.

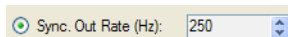


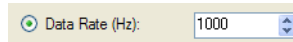
- To set the length of recording, adjust the **Buffer Size**.

*Note: Buffer Size must be slightly longer than your video recording. For example, if your camera will capture 8.2 seconds of video, round up to 9.0.*



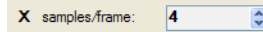
- Choose whether to set the rate of the sync pulse or data collection first by clicking the radio button next to either *Sync Out Rate* or *Data Rate*. The sync out rate is equivalent to the frame rate of your video camera. It is the rate of the pulse that is sent to the camera, telling it when to capture frames. Fill in the value next to the selected field.





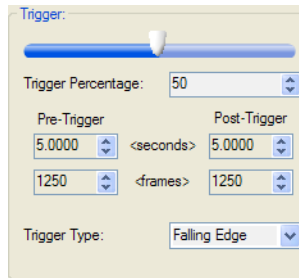
*Note: MiDAS DA will calculate whichever of these two (2) values you don't edit yourself so they are divisible, allowing for proper data acquisition.*

8. Fill in **Samples/Frame**. This is the number of data samples to take per frame of video.



9. The standard trigger settings use a 50% rising-edge trigger. To adjust the *Trigger Percentage* (the percentage of samples occurring before the trigger), either adjust the slider bar or edit the field labeled **Trigger Percentage**. The next series of values show how the Trigger Percentage translates into pre-trigger and post-trigger frames and seconds. At the bottom of the Trigger section, set the *Trigger Type* to the type of signal you will use for the trigger line, either rising edge, falling edge, or switch closure. For more information on trigger settings, refer to the chapter on *Event Triggering*.

*Note: Make sure to configure the Trigger Type the same way in your camera's software.*



10. MiDAS DA is now configured for recording. Setup the two (2) following hardware connections:
  1. Connect **Sync Out** on the data breakout box to the **Sync In** on your camera(s).
  2. Connect the trigger on the data breakout box to the trigger source (if not MiDAS DA software trigger) and to **Trigger In** on the camera(s) through as many BNC T connectors as required.
11. Once the hardware has been connected, put MiDAS DA into **Record Mode** by clicking the green circle button. This will start the sync out pulses to the camera(s).

*Note: Many cameras must be in slave or external sync mode to show a live image.*

12. Switch to the camera software and configure these four (4) software settings on your camera:
  1. Make the buffer length shorter than the one selected in MiDAS DA.
  2. Make the frame rate the same as the Sync Out Rate.
  3. Set your camera to receive the external sync pulse.
  4. Set the same trigger settings as MiDAS DA's.

13. Start the camera(s) recording.
14. Once the pre-trigger buffers for your camera(s) and for MiDAS DA are full, trigger at any time.

*Note: Once MiDAS DA has filled its post-trigger buffer, it will change to Playback Mode and display your data in a graph with sample number in the x-axis and scaled data values in the y-axis.*

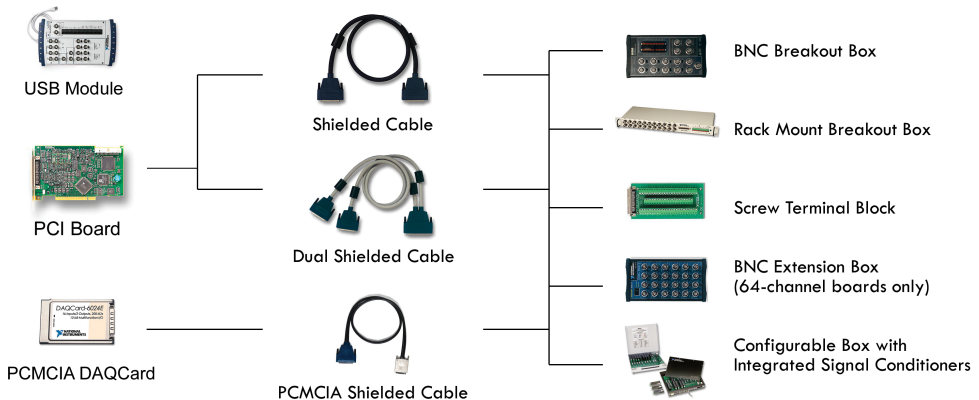
15. In your camera software, save the acquired video to the hard drive, making note of its location.
16. To synchronize your video and data, simply drag and drop your video file into the playback area of MiDAS DA. MiDAS DA will synchronize the video either through the configuration file of the video, or based on the trigger settings if there is no supported configuration file present. Repeat this process for multiple videos.
17. Now you can review your data and video fully synchronized. For more information about the settings available in **Record Mode**, or the features available in **Playback Mode**, see the *Fundamentals Section*.

# Chapter 5. Data Acquisition Theory

## Overview - MiDAS DA Data Acquisition Kits

This chapter provides explanations on data capture and synchronization with video. Before getting into details about theory, it is important to know about the main hardware components involved. In a data collection system there is hardware responsible for measuring and storing data. Called the *Data Card* it is installed in your computer. Attached to the data card through a cable, is a *Breakout Box*. On the breakout box are *Terminals*, which are connection points. There are terminals that connect signals from the data card to the camera(s) and terminals used to connect incoming data sources. The terminals can be *BNC Connectors* for attaching coaxial cable, or screw terminals into which wires are attached directly. There are even a rack of signal conditioners.

One important exception in terms of separating the data card and breakout box is, *USB Breakout Boxes* are now available from National Instruments. USB breakout boxes incorporate both the data card and breakout box in one device that attaches to the computer through a USB cable. For this manual, we will refer to the USB breakout box as a breakout box or terminal block depending on the terminals available. In either case, the functionality to the user is the same. The supported configurations of data hardware are shown in the following diagram:



MiDAS DA can interface with a wide range of National Instruments data collection hardware, but choosing hardware can still be a difficult task. The array of available cards can seem confusing, so Xcitex offers *Data Acquisition Kits* that pair MiDAS DA with appropriate hardware. We have selected a subset of the options National Instruments offers. Below, we provide a table of kits that include the most important characteristics, like number of available analog inputs, the maximum sample rate, the bit resolution of the incoming data, and the form factor.

All MiDAS DA data acquisition kits are supplied with a data acquisition board (data card) manufactured by National Instruments, a cable, and a breakout box. Xcitex can help you figure out what hardware meets your needs. Feel free to contact us at 617-225-0080, or your dealer. You can also contact us through email at <techsupport@xcitex.com>. Added to this, there are installation instructions provided in the Installation chapter.

There are ten (10) available high-speed data acquisition kits for MiDAS DA. The specifications of these kits are as follows:

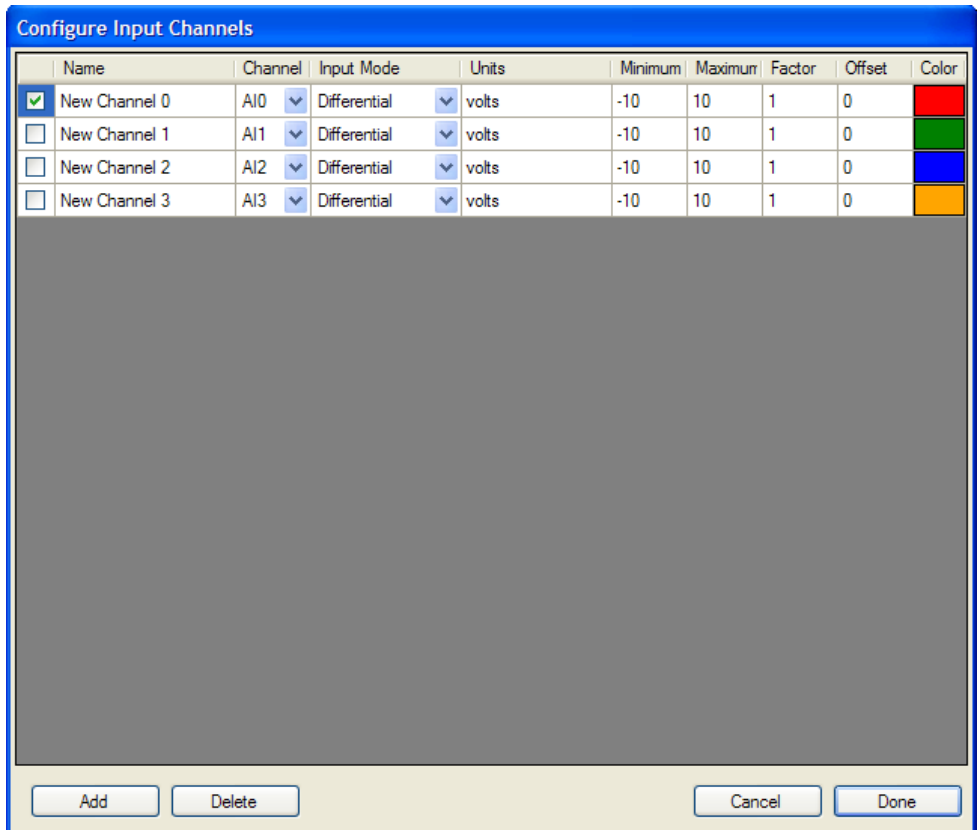
Kit Number	Part Number	Differential Analog Inputs	Single Ended Analog Inputs	Total Sample Rate	Resolution	Included Hardware
1	DAQ-221-PCI	8	16	250 kS/s	16 bit	BNC Breakout Box / PCI card
2	DAQ-251-PCI	8	16	1.25 MS/s or 1.0 MS/s multichannel	16 bit	BNC Breakout Box / PCI card
3	DAQ-259-PCI	16	32	1.25 MS/s or 1.0 MS/s multichannel	16 bit	BNC Breakout Box & BNC Extended Breakout Box / PCI card
4	DAQ-024-PCMCIA	8	16	200 kS/s	12 bit	BNC Breakout Box / PCMCIA card
5	DAQ-062-PCMCIA	8	16	500 kS/s	12 bit	BNC Breakout Box / PCMCIA card
6	DAQ-221-USB	8	16	250 kS/s	16 bit	USB BNC Breakout Box
7	DAQ-251-USB	8	16	1.25 MS/s or 1.0 MS/s multichannel	16 bit	BNC Breakout Box

## Connecting and Configuring Sensors in MiDAS DA (BNC Breakout Box)

The following instructions explain connecting and configuring sensors for use in MiDAS DA. Before configuring the data channels, follow the instructions in the Installation chapter. Turn on your computer, start MiDAS DA, and select the device you are using (see Fundamentals or Quick Start).

1. Click on the configure button located in the **DAQ Configuration** panel. The **Channel Configuration Window** will open.





2. Enable the appropriate channel (row) by enabling the checkbox at the left. If the box does not show a check mark, click inside it.
3. Determine the type of sensor that you are using (see the instruction manual or specification sheet that came with your sensor for more details).
4. Determine the parameters of the sensor (units of measurement, offset, voltage range, calibration factor). Make sure you factor in the signal conditioning amplification, if appropriate.
5. Configure MiDAS DA with the specific information about the sensor and (if applicable) signal conditioner. Set the information about each sensor on which you are acquiring data. The following list explains the options for configuring a sensor. Enter all the information requested.

Add Button

MiDAS DA automatically provides four channels. Use the **Add** button to add additional channels.

Delete Button

Use the **Delete** button to remove unneeded channels by removing the active line.

Cancel Button

Use the **Cancel** button to exit the window without saving changes.

Done Button	Click the <b>Done</b> button when you are finished to apply your configuration.
Name	A short label for the analog input channel. Use this to make a name for the channel that can help identify the data stream later.
Channel	The actual hardware channel that the configured channel will use as a data source. For a BNC breakout box, the AI0 BNC connector is AI0 for differential inputs, and for single-ended inputs, AI0 is paired as the sensor input with AI8, the outside of the BNC connector, as the ground.
Input Mode	The three options here are <b>DIFF</b> , <b>RSE</b> and <b>NRSE</b> . See the above description to determine which type of sensor you are using. If you do not know which type of sensor you have and the sensor was provided with a BNC connector select <i>DIFF Mode</i> .
Units	A short field for placing the name of engineering units in your data files.
Lower Limit/Minimum	The lower limit, in volts, that you expect to see from your sensor, after any hardware conditioning. Using the tightest range that includes all your sensor's values will improve your results. A small amount of over and under scan has been automatically provided. Typical <b>bi-polar</b> sensors have an input range of $-10V$ $+10V$ . Typical <b>uni-polar</b> sources have an input range of $0V$ to $+10V$ .
Upper Limit/Maximum	The upper limit, in volts, that you expect to see from your sensor, after any hardware conditioning. Using the tightest range that includes all your sensor's values will improve your results. A small amount of over and under scan has been automatically provided. Typical <b>bi-polar</b> sensors have an input range of $-10V$ $+10V$ . Typical <b>uni-polar</b> sources have an input range of $0V$ to $+10V$ .
Factor	The scale factor to be applied by MiDAS DA to convert the input volts to a meaningful number in engineering units. This number is applied immediately after the input voltage is registered.
Offset	In units, the offset to be applied by MiDAS DA to account for drifts or offsets in the input. This offset is applied after the scale factor multiplication.
Plot Color	The color of the line representing this channel in graphs. Click the colored box to bring up the color palette.

6. Physically connect your sensor to the BNC Breakout Box(es).
  - Terminate your sensor with a BNC plug connector. Connect the positive signal channel (+) from your sensor to the center post of the BNC.
  - If you are using a differential sensor, connect the negative to the outside of the BNC. Most differential sensors will already have BNC terminations.
  - If your sensor is a single-ended grounded (NRSE) sensor, connect the common wire from the sensor system to the screw terminal labeled *AISENSE* on the BNC Breakout Box.
  - If your sensor is single-ended floating (RSE) sensor, connect the common wire from the sensor system to the screw terminal labeled *AIGND* on the BNC Breakout Box with a bias resistor, as described in the above section.
  - Connect the BNC connector to the corresponding BNC input on the BNC breakout or the BNC extended breakout box.
7. Flip the switch on the bottom of the BNC input as follows:

If your sensor is differential and grounded, set the switch to **GS**.

If your sensor is differential and floating, set the switch to **FS**.

If your sensor is single-ended, set the switch to **FS**.
8. Repeat steps 2-7 for each sensor that you wish to hook up to MiDAS DA data acquisition. Use the **Add** button to add more channels to the list if needed.
9. When done connecting and configuring all your sensors you can proceed to the **Record Panel** to configure the sync. pulse and data rate, and begin recording.

*Note: Consult with your sensor manufacturer for specific details regarding your sensor(s). MiDAS DA BNC breakout boxes accept  $-10V$  to  $10V$  signals (the standard in the data acquisition industry). If your sensors put out more than this voltage, you should place a voltage divider in line between the sensor and the BNC breakout box, or consider using the MiDAS 5B+ Rack with voltage divider hardware.*

*Note: MiDAS DA will accept mixed differential, RSE and NRSE sensors. Always set the sensor type in MiDAS DA prior to connecting the sensor and the signal conditioner to the terminal blocks.*

*Note: Always start physically adding sensors using Channel "0" and proceed sequentially upwards.*

## Data Acquisition Basics

MiDAS DA data acquisition kits have been designed to work with a large number of different types of *Transducers*. These sensors convert force, rate of flow, pressure, temperature, etc. into a voltage (volts) that is proportional to the physical parameters being monitored. Typical sensors include:

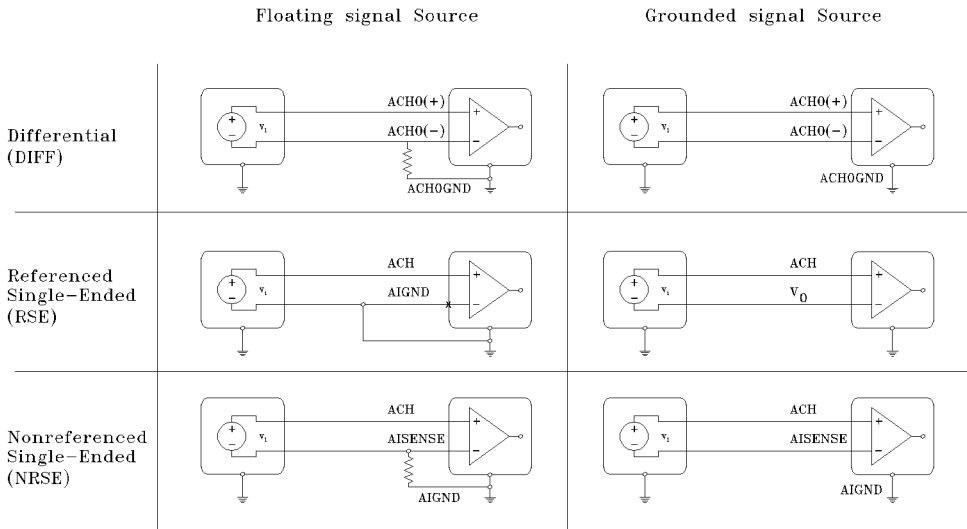
- Accelerometers
- Microphones
- Strain Gauges
- Flow Sensors
- Pressure Sensors
- Thermistors
- Hydrophones
- Dynamometers
- Speedometers
- Tachometers

Often, signals from these sensors must be amplified, filtered, biased, converted from current to voltage, or processed in other similar ways. Therefore, each sensor type typically uses a signal conditioner, designed specifically for that type of sensor, to produce signals recognized by the MiDAS DA data acquisition hardware. MiDAS DA uses voltage variations on the data lines to determine data values, so any signal conditioner that outputs a voltage can be used.

## Understanding What MiDAS DA Data Acquisition Measures

In the next few sections, you will be introduced to the variety of sensor types commonly used with MiDAS DA.

Below is a simple chart that demonstrates how all the different sensors attach:



*Note: Each sensor and its proper connection is described in detail in the following sections.*

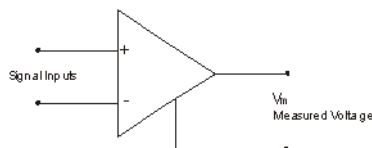
However, it is important to first understand what the various data acquisition kits measure.

Your MiDAS DA data acquisition board has an on-board instrumentation amplifier. Sensors are connected to the DAQ hardware (breakout box or terminal block), which passes these signals to the on-board amplifier via the cable and board connector. Therefore, when you connect your sensor to the MiDAS DA hardware, you are essentially connecting directly to the computer board circuitry. Unless you are using a USB data acquisition board, in which case your sensor is directly connected to the circuitry in the USB breakout box and then data is digitally encoded and passed on to the computer via the USB communication channel.

MiDAS DA measures the difference between the output of the instrumentation amplifier and another reference voltage. Based on the information you give MiDAS DA when setting up your test, the software measures the difference between the amplifier output and a ground, either the computer ground, the local ground at your sensor or signal conditioner, or a floating ground source.

An instrumentation amplifier is a differential amplifier - it outputs the difference between two (2) inputs. Two (2) leads from a sensor can be connected to the amplifier, and the amplifier will then compare the inputs and reference them to the chosen ground.

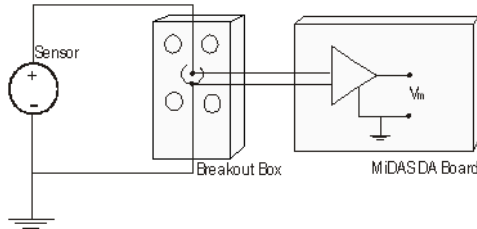
The differential instrumentation amplifier on the MiDAS DA data acquisition board is depicted as follows:



The signal inputs are connected to the sensor or to the transducer via the end connector on the board, or via the BNC breakout box provided with all MiDAS DA data acquisition systems.

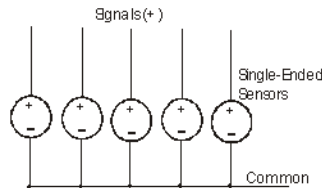
## Understanding Different Types of Sensors

Sensors have different characteristics that must be considered when connecting to MiDAS DA or any data acquisition system.



Some sensors have two (2) output wires and produce a signal that is the difference between the positive (+, or signal) lead and the negative (-) lead. These are known as *Differential Sensors*.

Some sensors have one (1) signal wire and one common wire (ground). These sensors are generally named *Single-Ended Sensors*. Typically, the common wires for an entire group of single-ended sensors are all tied together. Single ended sensors are very common in larger test facilities that use many sensors (crash testing, structural testing, etc.)



If the common wire from a sensor is physically connected to the data acquisition hardware, the system is called *Referenced*. The referenced is the sensor common. It is electrically connected to the data acquisition board common. On the other hand, if the common wire from a sensor is connected to a common building or Earth ground (and not necessarily physically connected to the data acquisition hardware), the system is considered to be *Non-Referenced*.

Sensors may also be configured as combinations of these types, such as referenced single-ended, non-referenced single-ended, or differential.

MiDAS DA is designed to work with all of these sensor designs. The operator must simply instruct MiDAS DA as to which sensor type is being connected, and the software automatically makes the proper adjustments and switch settings. For example, if you are using a Referenced Single Ended sensor, MiDAS DA knows to reference the signal to the common ground of the system (e.g. computer or building) and makes the appropriate internal switch changes. Likewise, if you are using differential sensors, MiDAS DA knows which terminals to assign to the sensor and makes the appropriate switch changes to measure the difference between positive and negative leads.

Differential sensors are always recommended for better signal integrity. Single-ended sensors are recommended only under controlled conditions. If your signal environment is the least bit noisy, electrically, your cable lengths exceed 3 meters (10 ft), or your signal level is less than 1V peak-to-peak, then it is highly recommended that you use differential sensor types with two (2) leads.

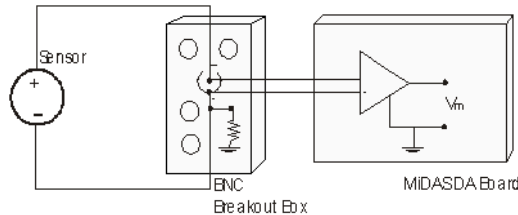
In the following sections, each type of sensor is summarized and depicted with a basic schematic.

## Differential Grounded Sensors

In this configuration, the differential sensor has two (2) leads—one positive (+) and one negative (-). The negative lead of the sensor is also tied to Earth or building ground and is therefore already connected to a common ground point with respect to the board. (This assumes that the computer is plugged into the same power system as the sensors).

If you have a differential grounded sensor and you are using either a BNC breakout box or a terminal block, wire the sensor positive and negative leads directly to the DAQ hardware, as shown in the following diagram:

*Note: Most commercial data acquisition systems are designed in a differential grounded configuration, especially if significant signal conditioning is required. In this configuration, the switch under the BNC jack should be placed in the **GS** position.*

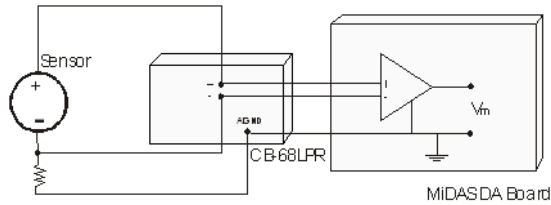


## Differential Floating Sensors

In this configuration, the differential sensor has two (2) leads: one positive (+) and one negative (-). The negative lead of the sensor is not tied to Earth or building ground and is therefore a *Floating Sensor* with respect to the amplifier. To reduce the effects of signal drift relative to the board ground, you must tie the ground reference of the floating signal to your board's analog input ground through a *Bias Resistor*.

If you are using a BNC breakout box, a built-in 5k $\Omega$  Bias Resistor (and 0.1 mF capacitor filter) is automatically engaged when the switch below the BNC jack is set to **FS**.

If you are using a terminal block, you must add the bias resistor yourself. For sources with low impedance, no bias resistor is needed and you may simply connect the negative lead to *AIGND* as well as the assigned screw terminal for the negative side of the amplifier. For sources with high impedance, you must put a bias resistor in-line to de-couple the noise from the amplifier. Place a bias resistor of minimum 100 times (100x) the equivalent source impedance between the negative terminal and the *AIGND* pin as shown in the following diagram:



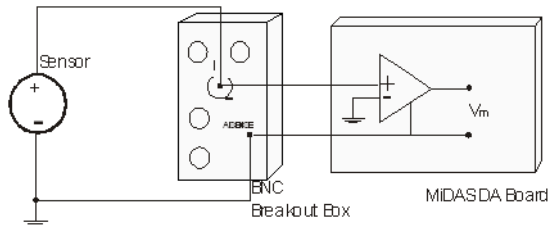
*Note: Some commercial data acquisition systems require an in-line resistor due to larger source impedance. Check the manual provided with your sensor for their recommendation. In this configuration, the switch under the BNC jack should be placed in the **FS** position.*

## Single-Ended Grounded Sensors (Non-Referenced or NRSE)

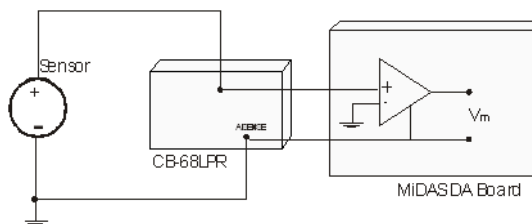
Single-ended sensors have one (1) wire that carries the signal (+) and one (1) common wire. Typically, single-ended sensors are used in specialized applications such as crash testing, where many sensors are required and the test environment is highly controlled. If you are using single-ended sensors, you may tie the common wires of the sensors together.

On a grounded single-ended sensor, the common lead of the sensor is tied to Earth or building ground and is already connected to a common ground point with respect to the board (assuming that the computer is plugged into the same power circuit). However, since the differential amplifier needs both a positive (+) and negative (-) input, the common lead must be tied to a point on the DAQ hardware called the *AISENSE*. *AISENSE* is an internal ground sensing point. When using single-ended grounded sensors, the common lead gets tied to *AISENSE* at the BNC breakout box or the terminal block hardware. All other connections and switches are handled automatically by MiDAS DA.

If you are using a BNC breakout box, the positive signal lead is connected to the center post of the BNC jack and the common lead(s) must be wired to the *AISENSE* terminal screw on the breakout box, as depicted in the following diagram:



If you are using a terminal block, the connections are identical. The positive signal lead from the sensor gets connected to the appropriate numbered analog input screw terminal and the common lead(s) must be wired to the *AISENSE* terminal as depicted in the following diagram:





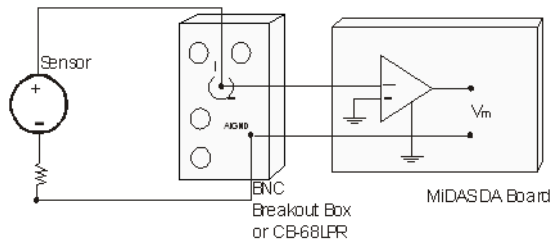
In the *NRSE Mode* (single-ended grounded), the MiDAS DA software measures the difference between the output of the amplifier and AISENSE. The switch on the BNC breakout box is not used.

## Single-Ended Floating Sensors (Referenced or RSE)

Single-ended sensors have one (1) wire that carries the signal (+) and one (1) common wire. Typically, single-ended sensors are used in specialized applications such as crash testing where many sensors are required and the test environment is highly controlled. If you are using single-ended sensors, you may tie the common wires of the sensors together.

On a floating single-ended sensor, the common lead of the sensor is not tied to Earth or building ground and as such is floating relative to the ground of the amplifier. Therefore, to reduce the effects of signal drift relative to the board ground, you must *reference* the floating signal to the amplifier analog input ground through a bias resistor.

You must add the bias resistor yourself, even if you are using the BNC breakout box. Single-ended sensors do not use the negative lead of the BNC jack. For sources with low impedance, no bias resistor is needed and you may simply connect the common lead(s) to AIGND directly. For sources with high impedance, however, you must put a bias resistor in-line to de-couple the noise from the amplifier. Place a bias resistor of minimum 100x the equivalent source impedance between the negative terminal (common) of the sensor and the AIGND pin of either the BNC breakout box or the terminal block (whichever you are using) as shown in the following diagram:



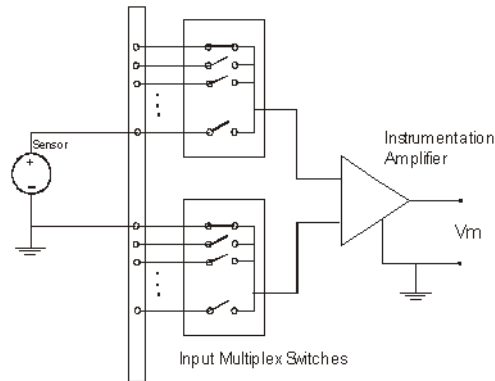
*Note: This resistor must be used regardless of whether you use the BNC breakout box or the terminal block. In the RSE Mode (single-ended floating), MiDAS DA measures the difference between the output of the amplifier and AIGND. The switch on the BNC breakout box is not used.*

## How Multiplexing Works

MiDAS DA Data Acquisition Kits gather their signals through *Multiplexing*, the common technique for sampling multiple channels with one acquisition device. The incoming signals are wired to a multiplexer switch (mux) that rapidly switches the inputs to the instrumentation amplifier. The MiDAS DA software automatically configures the data acquisition hardware to enable this switching and keeps track of which channel is configured on which connector.

When a single acquisition device deals with a multiplexed input, the incoming signals are staggered. For example, first channel "0" is sampled, then channel "1," then channel "2," etc. The increment of time between samples is proportional to the number of channels and the total sample rate. This is typically a few microseconds.

The diagrams in the previous section left out the channel switching component for clarity. Here is how the differential grounded source would look with multiplexing included:



*Note: This is a schematic for demonstration purposes. The switches are not mechanical, but high-speed semiconductor switches.*

## Choosing the Data Sample Rate

Since the inputs are switched via the multiplexer described above, the total data sampling rate is the product of the number of channels being sampled and the sample rate per channel. For example, if you have four (4) channels active and wish to acquire 10,000 samples per second per channel, the total sampling rate is  $4 \times 10,000 = 40,000$  samples/second. Your data card has a maximum sampling rate over all channels that restricts the number of channels you can record and at what rate. If your data acquisition board is rated for 200,000 samples per second maximum rate, and you have eight (8) channels active, the maximum rate per channel is  $200,000 / 8 = 25,000$  samples/second.

One consideration when selecting the data rate is processor usage. MiDAS DA draws a scrolling graph of incoming data points for all configured channels throughout recording. With many thousands of data points and multiple channels, the processor power required to draw continuously can slow the system performance.

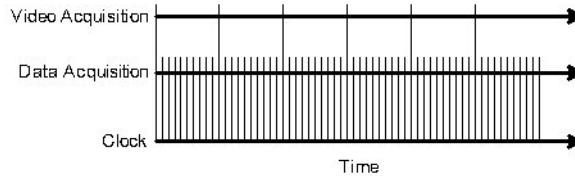
## How MiDAS DA Data Acquisition Works

### The Master Clock

The *Master Clock* used by the MiDAS DA data acquisition system comes from the data acquisition board installed in your computer, or from the USB data acquisition breakout box. The master clock controls pulses both for data acquisition and for video camera frame capture, so the two (2) pulses are coordinated with precise timing. The data acquisition hardware and the camera are connected via a synchronization cable, a BNC coaxial cable from the sync out terminal on the BNC breakout box to a sync in input on your camera. The camera operates as a slave device to the data hardware. Specifically, a frame is acquired by the camera when a pulse is received across the sync in line. The same master clock drives the data collection pulse, assuring the two (2) signals do not drift.

The ability to have synchronized yet different clock rates, and thus a different acquisition frequency for video and data, is the basis for the MiDAS DA. *Wave per Frame Technology*. For

example, if the operator chooses to acquire ten (10) data points per single frame of video, the pulse sequence includes one pulse to the video camera for every ten (10) data pulses, as follows:



## Multiplexed Data Acquisition

If multiple analog channels are selected, the various inputs are multiplexed, sampled sequentially through individual analog inputs. The input is switched between the enabled channels. The switching time between acquisition is dependent on the type of data acquisition card you are using. If your data acquisition hardware can acquire 200,000 samples per second (e.g. model DAQ-024-PCI), and if you enable two (2) analog input channels, then each channel can acquire a maximum of 100,000 samples/second. If four (4) channels are enabled, then each channel can acquire 50,000 samples/second. If eight (8) channels are enabled, then each channel can acquire 25,000 samples/second.

In the above figure demonstrating Waveform per Frame™ Technology, we left out the concept of multiplexed acquisition for simplicity. In fact, if the operator chooses to acquire ten (10) data points per frame and to enable eight (8) analog channels, the ten (10) data sample pulses shown per video frame pulse each represent eight (8) slightly offset pulses, one for each of the analog input channels.

*Note: Camera images are streamed directly to the local memory on the camera board. Data is streamed directly to the computer RAM.*




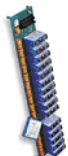
## BNC Breakout Box vs. Terminal Block vs. 5B+ Rack

Most MiDAS DA data acquisition kits include a standard BNC breakout box. If you purchased an extended analog model, you also received an additional BNC extension breakout box.

MiDAS DA is also capable of working with a *5B+ Rack System*. The 5B+ rack system is a common hardware interface from Analog Devices Inc. that allows for individual signal conditioner hardwares per channel. MiDAS DA accepts standard outputs from 5B+ signal conditioner hardwares.

Some high-end and laboratory applications necessitate replacing the BNC breakout boxes with optional screw terminal blocks. It is recommended that you are very familiar with data acquisition fundamentals and with your sensor performance if you are planning to use terminal blocks. Terminal blocks are typically used for a large number of sensor inputs and for large numbers of single-ended sensors that bring only one (1) wire back to the data acquisition hardware each.

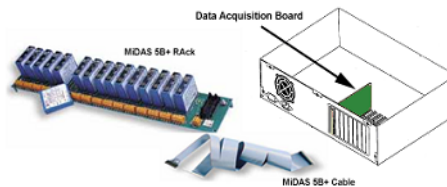
*Note: The following table helps describe the advantages of each type of connection hardware. It lists the available specs for the different types of connection hardware paired with our different kits. If you have questions for a particular application, contact Xcitex engineers for assistance at 617-225-0080 or email us at <techsupport@xcitex.com>.*

				
	<b>BNC breakout box(es)</b>	<b>USB Breakout Box</b>	<b>Terminal block(s)</b>	<b>5B+ rack</b>
<b>Standard number of analog inputs</b> kits: 1, 2, 4, 5, 6, 7	16 Single-Ended or 8 Differential	16 Single-Ended or 8 Differential	16 Single-Ended or 8 Differential	16 Single-Ended
<b>Extended number of analog inputs</b> kits: 3	32 Single-Ended or 16 Differential	Not Available	32 Single-Ended or 16 Differential	Not Available
<b>Cable type</b>	Shielded	USB	Shielded	Ribbon
<b>Switching</b>	Internal	Internal	None	Internal
<b>Connection types</b>	BNC jacks	BNC jacks	Screw terminals	Plug ins
<b>Internal isolation/shielding</b>	Yes	Yes	No	No
<b>Built-in bias resistors for floating sources</b>	Yes	Yes	No	Yes
<b>Accepts signal conditioner hardwares</b>	No	No	No	Yes
<b>Powers strain gauge sensors directly</b>	No	No	No	Yes
<b>Accepts Voltages greater than +/-10V</b>	No	No	No	Yes (with SC)
<b>Accepts single-ended signal inputs</b>	Yes	Yes	Yes	Yes
<b>Accepts differential signal inputs</b>	Yes	Yes	Yes	No
<b>BNC pigtail required for sync cable</b>	No	No	Yes	No
<b>BNC pigtail required for ext. trigger</b>	No	No	Yes	No

# Connecting and Configuring Sensors in MiDAS DA (5B+ Rack)

The following instructions explain connecting and configuring sensors for use in MiDAS DA. Before configuring the data channels, follow the instructions in Installation (using a 5B+ Rack and ribbon cable), turn on your computer, start MiDAS DA, and select the device you are using (see Fundamentals or Quick Start).

The MiDAS DA DA-123B hardware includes a 16-channel 5B+ Rack and special cable. The MiDAS DA 5B+ rack is a derivative of the series of 5B hardware manufactured by Analog Devices and sold through numerous worldwide distributors. The 5B+ hardware has a distinct advantage over the standard BNC breakout box. The 5B+ directly accepts a complete line of signal conditioner hardwares for modifying signals from sensors. The MiDAS DA 5B+ rack is depicted in the following diagram, completely populated with sixteen (16) signal conditioner hardwares:



A list of the available 5B+ signal conditioner hardwares is as follows:

## Frequency Measurement Hardware

Frequency hardwares convert input frequency from encoders, gauges, tachometers to output voltage (0-5CDC).

Input Range	Output Range	Bandwidth	Part Number
0-5kHz	0-5V	10Hz	M5B-FI45-04
0-10kHz	0-5V	10Hz	M5B-FI45-05
0-25kHz	0-5V	190Hz	M5B-FI46-01
0-50kHz	0-5V	190Hz	M5B-FI46-02
0-100kHz	0-5V	190Hz	M5B-FI46-03
0-250kHz	0-5V	190Hz	M5B-FI46-04

## Voltage Measurement Hardware

Voltage hardwares amplify or reduce DC input voltages to  $\pm 5\text{VDC}$  for MiDAS DA input.

Input Range	Output Range	Bandwidth	Part Number
$\pm 10\text{mV}$	$\pm 5\text{V}$	10kHz	M5B-VI40-01
$\pm 50\text{mV}$	$\pm 5\text{V}$	10kHz	M5B-VI40-02
$\pm 100\text{mV}$	$\pm 5\text{V}$	10kHz	M5B-VI40-03

±1V	±5V	10kHz	M5B-VI41-01
±5V	±5V	10kHz	M5B-VI41-02
±10V	±5V	10kHz	M5B-VI41-03
±20V	±5V	10kHz	M5B-VI41-07
±40V	±5V	10kHz	M5B-VI41-08

## Current Measurement Hardwares

Current hardwares convert sensor output currents to output voltage (0-5V).

Input Range	Output Range	Bandwidth	Part Number
0-20mA	0-5V	4Hz	

## 5B Strain Measurement Hardwares

Strain Gauge hardwares provide both *Excitation Voltage* to the sensors and convert isolated strain gauge inputs to output voltage (0-5V).

Input Range	Output Range	Sensitivity	Bandwidth	Part Number
±30 mV @ 10 V Excitation	±5V	Full bridge300-10kO	10 kHz	M5B-SG38-02
±30 mV @ 10 V Excitation	±5V	Half bridge300-10kO	10 kHz	M5B-SG38-04
±20 mV @ 10 V Excitation	±5V	Full bridge300-10kO	10 kHz	M5B-SG38-05

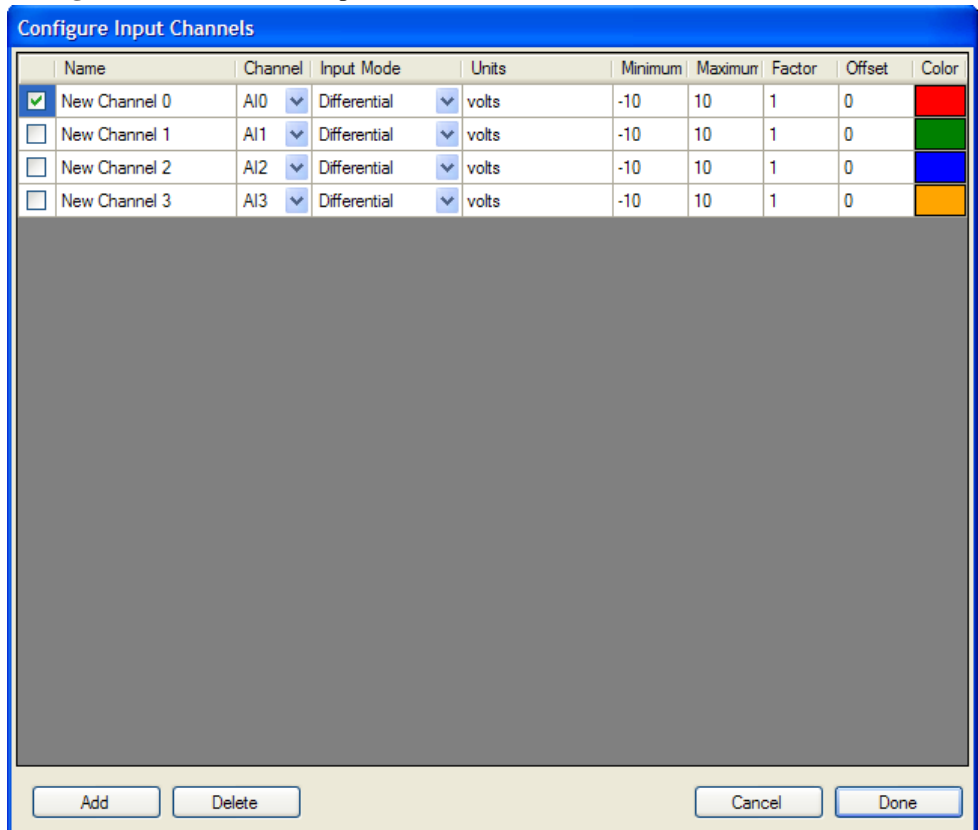
## 5B Temperature Measurement Hardwares

Temperature hardwares provide power to thermocouples and convert temperature from a thermocouple with cold-junction compensation (CJC) to voltage (0-5DC).

Type / Input Range	Output Range	Accuracy	Part Number
J type/0-760°C	0-5V	±.05%	M5B-TI37-J1
K type/-100-1350°C	0-5V	±.05%	M5B-TI37-K1
T type/-100-400°C	0-5V	±.05%	M5B-TI37-T1
E type/0-900°C	0-5V	±.05%	M5B-TI37-E1
R type/0-1750°C	0-5V	±.05%	M5B-TI37-R1
S type/0-1750°C	0-5V	±.05%	M5B-TI37-S1
B type/0-1800°C	0-5V	±.05%	M5B-TI37-B1
C type/-100-1300°C	0-5V	±.05%	M5B-TI37-C2

To configure and connect sensors to your MiDAS DA DA-123B hardware:

1. Click on the configure button located in the **DAQ Configuration** panel. The **Channel Configuration Window** will open.



2. 5B+ Channeling Numbering begins at one (1) and MiDAS DA channel numbering begins at zero (0). The data from the connector for channel one (1) on the 5B+ hardware comes into channel zero (0) in MiDAS DA, and so on.
3. Enable the appropriate channel (row) by enabling the checkbox at the left. If the box does not show a check mark, click inside it.
4. Determine the type of sensor that you are using (see the instruction manual or specification sheet that came with your sensor for more details). Note that all 5B+ signal conditioner hardwares are reference single ended (e.g. RSE).
5. Determine the parameters of the sensor (units of measurement, offset, voltage range, calibration factor). Make sure you factor in the signal conditioning amplification, if appropriate.
6. Set the information about each channel on which you are acquiring analog data. Use the information coming out of the 5B+ hardware (typically +/-5V or 10V range). Set the scale factor as the product of the sensor and the signal conditioner amplification. The following

list explains the options for configuring a sensor. Enter all the information requested.

Add Button	MiDAS DA automatically provides four channels. Use the <b>Add</b> button to add additional channels.
Delete Button	Use the <b>Delete</b> button to remove unneeded channels by removing the active line.
Cancel Button	Use the <b>Cancel</b> button to exit the window without saving changes.
Done Button	Click the <b>Done</b> button when you are finished to apply your configuration.
Name	A short label for the analog input channel. Use this to make a name for the channel that can help identify the data stream later.
Channel	The actual hardware channel that the configured channel will use as a data source. Note that numbering on the 5B+ hardware starts at one (1) while the MiDAS DA channel numbering starts at zero (0). The data coming from the connector labelled one (1) will be read as AI0 in MiDAS DA, and so on.
Input Mode	The three options here are <b>DIFF</b> , <b>RSE</b> , and <b>NRSE</b> . See the above description to determine which type of sensor you are using.
Units	A short field for placing the name of engineering units in your data files.
Lower Limit/Minimum	The lower limit, in volts, that you expect to see from your sensor, after conditioning. Using the tightest range that includes all your sensor's values will improve your results. A small amount of over and under scan has been automatically provided. Typical <b>bi-polar</b> sensors have an input range of -10V +10V. Typical <b>uni-polar</b> sources have an input range of 0V to +10V.
Upper Limit/Maximum	The upper limit, in volts, that you expect to see from your sensor, after conditioning. Using the tightest range that includes all your sensor's values will improve your results. A small amount of over and under scan has been automatically provided. Typical <b>bi-polar</b> sensors have an input range of -10V +10V. Typical <b>uni-polar</b> sources have an input range of 0V to +10V.
Factor	The scale factor to be applied by MiDAS DA to convert the input volts to a meaningful number in engineering units. This number is applied immediately after the input voltage is registered.



Offset	The offset to be applied by MiDAS DA to account for drifts or offsets in the input, in units. This offset is applied after the scale factor multiplication.
Plot Color	The color of the line representing this channel in graphs. Click the colored box to bring up the color palette.

7. Insert your 5B signal conditioner hardware into the 5B+ rack. Make any adjustments to the hardwares (settings, voltage jumpers, etc.) you require.
8. Connect your sensor directly to the 5B signal conditioner hardware.
9. Repeat steps 2-8 for each sensor that you wish to hook up to MiDAS DA data acquisition. Use the **Add** button to add more channels to the list if needed.
10. Power up the 5B+ Rack with the power supply.
11. Adjust offsets as necessary.
12. When done connecting and configuring all your sensors you can proceed to the **Record Panel** to configure the sync. pulse and data rate, and begin recording.

*Note: Consult both your sensor manufacturer and/or the instructions that came with your 5B signal conditioner hardwares for instructions on connecting your sensors to the signal conditioner hardwares. Some sensors require 3 wires, some require 2, and some require reverse bias. Most 5B hardwares accept both differential and single-ended sensor inputs.*

*Note: Always start physically adding sensors using Channel "0" and proceed sequentially upwards*

## Connecting and Configuring Sensors in MiDAS DA (Terminal Blocks)

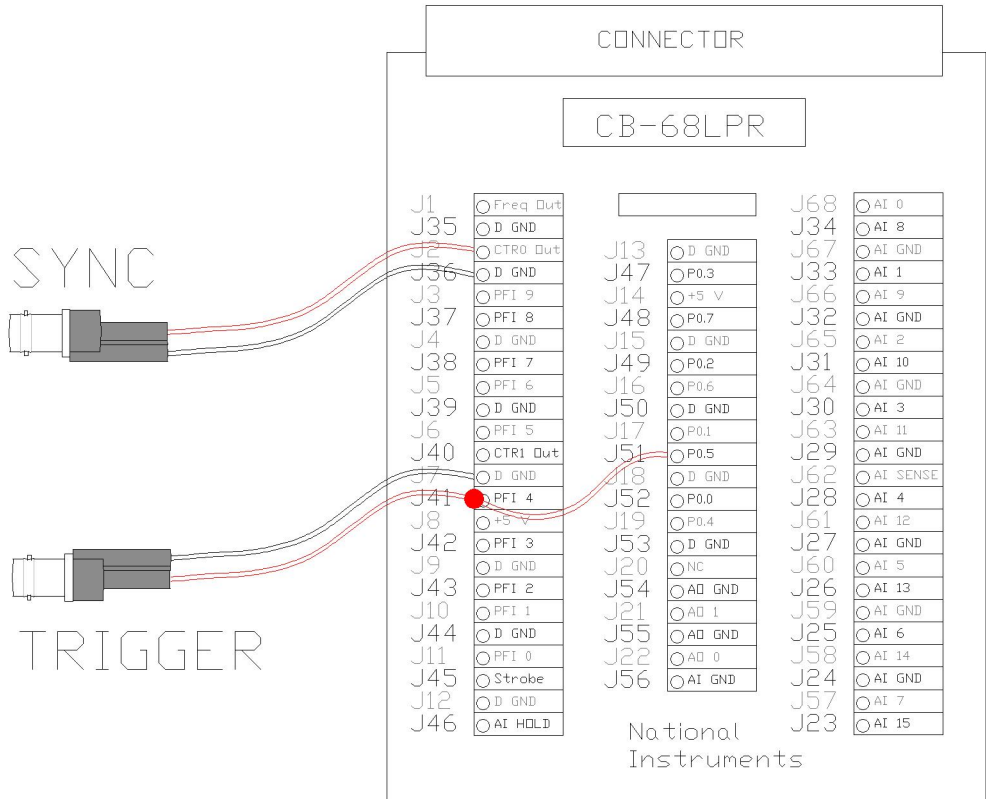
The following instructions explain connecting and configuring sensors for use in MiDAS DA. Before configuring the data channels, follow the instructions in Installation using terminal blocks, turn on your computer, start MiDAS DA, and select the device you are using (see Fundamentals or Quick Start).

When using a National Instruments terminal block you must perform some wiring modifications to access the sync out pulse and the trigger. You must use a *BNC Pigtail* to couple two terminals into a BNC connector for the sync out line, and another pigtail to couple two (2) terminals as the trigger line. Here is an example of a BNC pigtail:

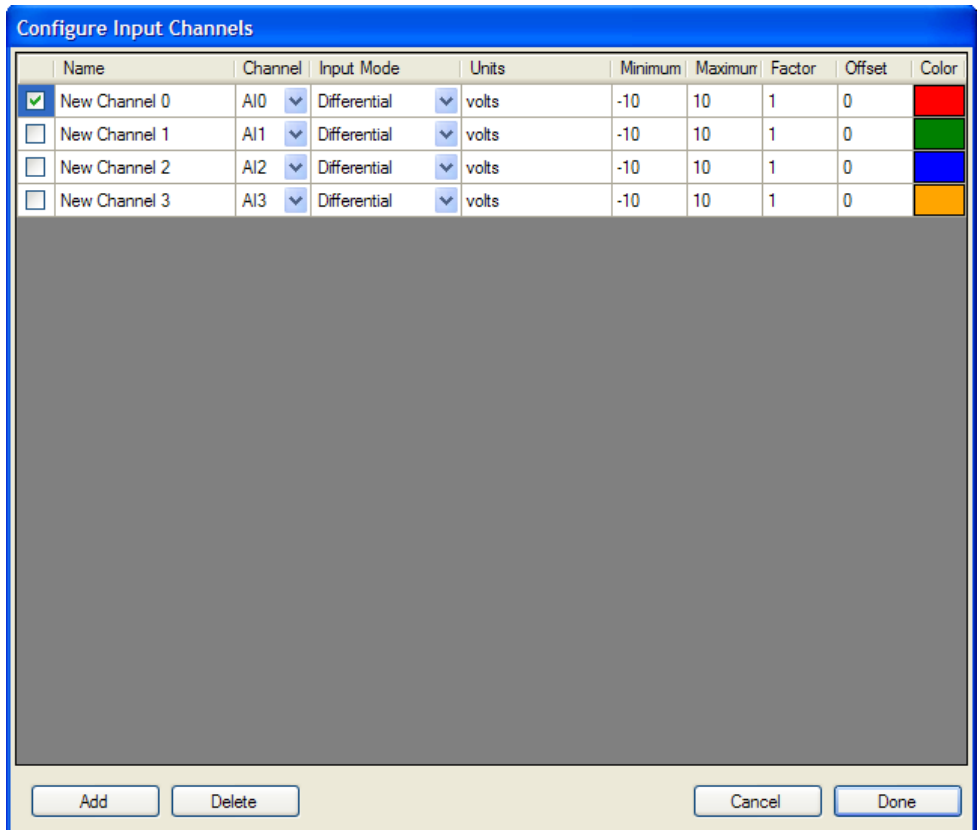


Follow the wiring diagram below to create the two required BNC connectors from the appropriate terminals on the terminal block:

*Note: Two (2) separate wires connect to **J41** since it must be connected to a pigtail and to **J51**, which ties the software trigger into the trigger system.*



1. Click on the configure button located in the **DAQ Configuration** panel. The **Channel Configuration Window** will open.



2. When configuring sensors with a terminal block, it is important to understand how to wire differential and single-ended sensors. Below is a table that explains the wiring of the different sensor types.

Differential sensor	Terminal Block Connection	Single-Ended Sensor	Terminal Block Connection
Diff 1 Positive	AI 0 (J68)	SE 1 Positive	AI 0 (J68)
Diff 1 Negative	AI 8 (J34)	SE 1 Negative	AI GND (J67)
Diff 2 Positive	AI 1 (J33)	SE 2 Positive	AI 1 (J33)
Diff 2 Negative	AI 9 (J66)	SE 2 Negative	AI GND (J67)
Diff 3 Positive	AI 2 (J65)	SE 3 Positive	AI 2 (J65)
Diff 3 Negative	AI 10 (J31)	SE 3 Negative	AI GND (J32)
Diff 4 Positive	AI 3 (J30)	SE 4 Positive	AI 3 (J30)
Diff 4 Negative	AI 11 (J63)	SE 4 Negative	AI GND (J64)
Diff 5 Positive	AI 4 (J28)	SE 5 Positive	AI 4 (J28)
Diff 5 Negative	AI 12 (J61)	SE 5 Negative	AI GND (J29)
Diff 6 Positive	AI 5 (J60)	SE 6 Positive	AI 5 (J60)
Diff 6 Negative	AI 13 (J26)	SE 6 Negative	AI GND (J27)

Diff 7 Positive	AI 6 (J25)	SE 7 Positive	AI 6 (J25)
Diff 7 Negative	AI 14 (J58)	SE 7 Negative	AI GND (J59)
Diff 8 Positive	AI 7 (J57)	SE 8 Positive	AI 7 (J57)
Diff 8 Negative	AI 15 (J23)	SE 8 Negative	AI GND (J24)
		SE 9 Positive	AI 8 (J34)
		SE 9 Negative	AI GND (J67)
		SE 10 Positive	AI 9 (J66)
		SE 10 Negative	AI GND (J32)
		SE 11 Positive	AI 10 (J31)
		SE 11 Negative	AI GND (J64)
		SE 12 Positive	AI 11 (J63)
		SE 12 Negative	AI GND (J29)
		SE 13 Positive	AI 12 (J61)
		SE 13 Negative	AI GND (J27)
		SE 14 Positive	AI 13 (J26)
		SE 14 Negative	AI GND (J59)
		SE 15 Positive	AI 14 (J58)
		SE 15 Negative	AI GND (J24)
		SE 16 Positive	AI 15 (J23)
		SE 16 Negative	AI GND (J24)

3. Enable the appropriate channel (row) by enabling the checkbox at the left. If the box does not show a check mark, click inside it.
4. Determine the type of sensor that you are using (see the instruction manual that came with your sensor for more details).
5. Determine the parameters of the sensor (units of measurement, offset, voltage range, calibration factor). Make sure you factor in the signal conditioning amplification, if appropriate.
6. Configure MiDAS DA with the specific information about the sensor and (if applicable) signal conditioner. Set the information about each channel on which you are acquiring data. The following list shows the options for configuring a sensor. Enter all the information requested.

Add Button

MiDAS DA automatically provides four channels. Use the **Add** button to add additional channels.

Delete Button

Use the **Delete** button to remove unneeded channels by removing the active line.

Cancel Button

Use the **Cancel** button to exit the window without saving changes.

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Done Button	Click the <b>Done</b> button when you are finished to apply your configuration.
Name	A short label for the analog input channel. Use this to make a name for the channel that can help identify the data stream later.
Channel	The actual hardware channel that the configured channel will use as a data source. Use the connection chart above to determine which terminal connects to which channel name in MiDAS DA.
Input Mode	The three options here are <b>DIFF</b> , <b>RSE</b> , and <b>NRSE</b> . See the above description to determine which type of sensor you are using.
Units	A short field for placing the name of engineering units in your data files.
Lower Limit/Minimum	The lower limit, in volts, that you expect to see from your sensor, after any hardware conditioning. Using the tightest range that includes all your sensor's values will improve your results. A small amount of over and under scan has been automatically provided. Typical <b>bi-polar</b> sensors have an input range of $-10V$ $+10V$ . Typical <b>uni-polar</b> sources have an input range of $0V$ to $+10V$ .
Upper Limit/Maximum	The upper limit, in volts, that you expect to see from your sensor, after any hardware conditioning. Using the tightest range that includes all your sensor's values will improve your results. A small amount of over and under scan has been automatically provided. Typical <b>bi-polar</b> sensors have an input range of $-10V$ $+10V$ . Typical <b>uni-polar</b> sources have an input range of $0V$ to $+10V$ .
Factor	The scale factor to be applied by MiDAS DA to convert the input volts to a meaningful number in engineering units. This number is applied immediately after the input voltage is registered.
Offset	The offset to be applied by MiDAS DA to account for drifts or offsets in the input, in units. This offset is applied after the scale factor multiplication.
Plot Color	The color of the line representing this channel in graphs. Click the colored box to bring up the color palette.

7. Physically connect your sensor to the terminal blocks:

*Note: MiDAS DA can accommodate both differential and single-ended inputs (RSE and NRSE). Mix and match them as required by your application. Always set the sensor type in MiDAS DA prior to connecting the sensor and the signal conditioner to the terminal blocks, and do not overlap terminals.*

If your sensor is **differential and grounded**, or **differential and floating**:

- Connect the signal (+) lead and the negative (-) lead from your sensor to the screw terminals on the terminal block corresponding to the selected MiDAS DA channel from step 2 above.
- If your sensor is differential floating, you must connect the common lead to a bias resistor and then the bias resistor to any of the analog ground screw terminals pins. See the diagram in the previous section for details on the bias resistor.

If your sensor is **single-ended**:

- Connect the signal (+) lead from your sensor to the screw terminals on the terminal block corresponding to the selected MiDAS DA channel from step 2 above.
- If your sensor is **single-ended grounded** (NRSE), connect the common lead from your sensor (or sensor system) to the screw terminal for AISENSE on the terminal block.

If your sensor is **single-ended floating** (RSE), connect a bias resistor to the common lead from your sensor(s). Connect the other side of the bias resistor to any of the analog ground screw terminals.

8. Repeat steps 2-7 for each sensor that you wish to hook up to MiDAS DA data acquisition. Use the **Add** button to add more channels to the list if needed.
9. Adjust offsets as necessary.
10. When done connecting and configuring all your sensors you can proceed to the **Record Panel** to configure the sync. pulse and data rate, and begin recording.

*Note: Always start physically adding sensors using Channel "0" and proceed sequentially upwards.*

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# Chapter 6. Event Triggering

## Understanding How MiDAS DA Records Events

In preparation for your recording projects, it is important you understand how MiDAS DA uses the *Circular Buffer Concept* while recording. This chapter explains how MiDAS DA uses circular buffers in conjunction with your video camera's software to record events, as well as how to configure your trigger settings in MiDAS DA and in your camera's software for optimal results.

## Understanding Memory Buffers

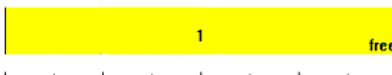
When your camera's software is recording video from the camera it controls, the video frames are streamed directly to either the camera's RAM, a *Frame Grabber Card*, or to the computer's memory, depending on the type of camera. Data is stored in the computer's memory. These combined memory sections are termed the *Buffer* and the buffer operates on the *First-In-First-Out Principal*. There is a limited amount of memory reserved for these operations. To keep the data current once the memory is full, the oldest data is discarded to make room for the most recent. This process helps save camera memory allowing for easier recording.

The way you configure your camera's software and MiDAS DA allows you to capture the event of interest within the buffer length. The quantity of information you can store is fixed by your camera's memory, or by the computer memory and/or data card limitations. You can configure the camera software or MiDAS DA to affect what gets recorded. For example, reducing your resolution will increase the number of frames you can capture with your camera. Similarly, decreasing the sampling frequency of data sensors will increase the amount of time during which you can buffer.

*Note: Make sure to adjust your camera's software and MiDAS DA so that the record durations are the same.*

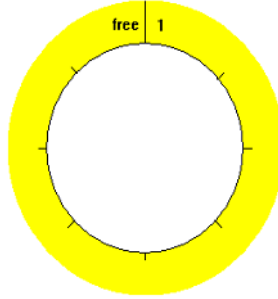
## The Circular Buffer Concept

Consider the following bar to represent a memory buffer, in this example: 128 MB:



MiDAS DA collects video and data into the buffer on a first-in-first-out principal. Once the buffer is full, the program starts to overwrite the oldest data, so that the most recently captured information is always available in the memory buffer.

This process of continuously writing in a loop is called a Circular Buffer. For that reason, it is useful to examine the buffer with this diagram:



Consider the example of recording a track runner. Obviously the race, start to finish, is the information set that you are interested in. Any video acquired before the start, or after the finish, is not of interest. Therefore, you want to configure the triggering to capture this specific event. 500 frames are needed to record the event, and the max frames based on the frame rate and resolution, is 525 frames. This margin means, without proper triggering you may miss important parts of the event.

If you were to trigger precisely at the starting gun, the data you want to record will all happen post trigger. Therefore, you want to set the trigger percentage to 0% which means all frames saved occurred after the trigger. The recorded video now starts immediately at the starting gun.

If instead you want to trigger with the runner crossing the finish line, the data you want is already in the buffer at the time of the trigger. Adjust the trigger to 100% and all the collected frames are from before the trigger. With a 100% trigger, all of the information has already been collected when the trigger is pressed.

If you were to trigger the recording when the runner passes the half way mark, you would want to trigger at 50%. Half the needed data will be in the buffer when the trigger is pressed, and the collection will continue until the other half has been collected. If you have extra frames you can adjust any of the above percentages by a few degrees to collect a few frames before or after the point of interest. Use the various reporting boxes in MiDAS DA and your camera's software to tell you how much time, and how many frames, will be collected pre- and post-trigger.

MiDAS DA will continue recording and collecting video and data into the Circular Buffer until a trigger is received and post-trigger frames collected, or until it receives a command to abort the recording.

## The Trigger Command and Settings

Triggering, regardless of type, does two (2) things:

1. Signals the camera and any data card on how to use the memory buffer.
2. Establishes the *Zero Frame* at the point in time during which the trigger event was received.

*Triggering* does not necessarily stop a recording immediately. The relationship between the time at which the trigger signal is received and the time at which the recording is stopped is governed by the *Trigger Percentage* setting on both MiDAS DA and your camera's software.



The Trigger Percentage indicates the pre-trigger portion of the total acquisition for a given collection of video images or data points. The remainder of information will be collected post-trigger.

For example, a trigger percentage of 0% means MiDAS DA will mark the current frame at the time of the trigger as zero (0), and then collect a full buffer of data. A trigger percentage of 100% means MiDAS DA will instruct the hardware to stop acquisition immediately upon receipt of a trigger input, acquiring 100% of the data before the trigger and 0% after the trigger. In this case, the final frame of the sequence is marked as the zero frame.

The zero frame, is always the frame that is concurrent with receipt of the trigger. Within any video or data sequence, any frames that occurred before the trigger was received are marked with a negative index. Frames with a positive index occurred following the trigger.

The following graph helps explain the Circular Buffer Concept:

If the trigger % is	and you have recorded	and the event is	then MiDAS DA will
100%	a full buffer	Trigger	Stop recording and return a full buffer, as recorded.
100%	a partial buffer	Trigger	Ignore the trigger, fill the buffer, and continue waiting for a trigger.
0%	a full or partial buffer	Trigger	Continue recording one full buffer more, returning it when complete.
$0% < t < 100%$	a full buffer	Trigger	Continue to record the prescribed number of post-trigger frames, then stop and return a full buffer.
$0% < t < 100%$	a partial buffer	Trigger	If prescribed number of pre-trigger frames are recorded, continue recording post-trigger frames then return a full buffer, otherwise ignore the trigger.

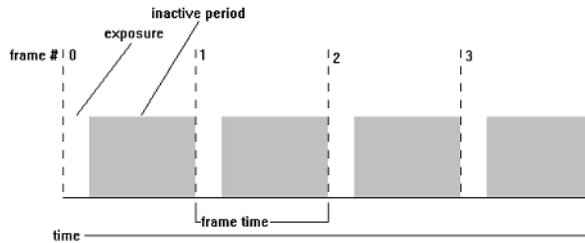
## Exposure Time and Frame Counting

Choosing a *Shutter Speed* greater than 1.0X (faster than the frame rate) results in a smaller exposure time than the frame capture time. The camera will not acquire an image during the entire frame duration. Depending on the frame rate you have chosen, there is a fixed length of time available for image acquisition. This period is a simple inverse ratio. If your *Frame Rate* is 500 frames per second, the available exposure time is 1/500th of a second. This is for a single

frame exposure, based on time, not related to any triggers you may be using. You can reduce this electronic shutter speed and decrease the amount of exposure time. Doing so can be useful for scenes that have a surplus of light.

When you use a shutter speed in excess of 1.0X, the time that the sensor is gathering light is less than full available exposure time. For the above example, if the frame rate is 500 frames per second (fps), and the shutter speed is 2.0X, the exposure time of the sensor array will be 1/1000 of a second (1000  $\mu$ sec). The mathematical representation of this is  $\frac{1}{n * \text{Frame Rate}} = \text{Exposure Time}$ , where "n" is the selected shutter speed.


A video frame is defined as the total time between exposures. The following drawing illustrates this relationship:



Depending on your type of camera, the exposure time will either be at the leading edge of the frame, or the trailing edge. Consult your camera's manual for information specific to your camera.

This has important implications for recording video. If a trigger pulse is received during the inactive period of a frame, that frame will still be defined as the zero frame and the next frame will be defined as the first post-trigger frame. The result is that the zero frame may be blank, and the first frame with an image will be frame one (1). This is because the electronic shutter was "closed" when the trigger was received, and the acquisition of the image for the next frame had not begun yet.

## Triggering vs. Stopping Recordings

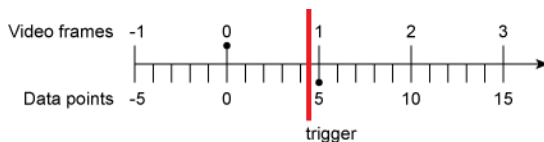
The normal mode of operation is to instruct MiDAS DA to stop and save a recording when it receives a trigger. You may also force MiDAS DA to stop a recording before receiving a trigger by clicking on the **Stop** button  to the far right of the record button. This immediately stops the recording function and returns you to the record panel, ready to record again.

## Data Buffer Lengths and Triggering

MiDAS DA handles both video and data at the completion of recording. Often, data is collected at a much higher rate than video. As a result, it is important to understand the implications of these two (2) different rates of collection and how the zero frame is incorporated.

The number of data points per frame of video is referred to as the *Samples/Frame*. When configuring MiDAS DA for recording, you set two (2) sample rates, the *Sync Out* and the *Sample Rate*. The first is the video frame rate and the second is the data sampling rate. To calculate samples/frame, divide the data rate by the video rate. To calculate the data rate from the video rate and the samples/frame, multiply the sync out rate by the samples/frame. You can also calculate sync out rate by dividing the data sample rate by samples/frame.

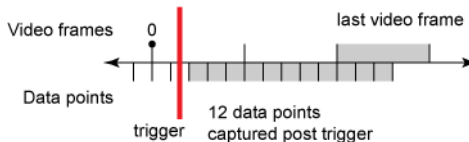
When your Trigger Percentage is between 0% and 100%, and the samples/frame are greater than one (1), the point of reference for your data "0" needs to be calculated by MiDAS DA. When you have just completed a recording, MiDAS DA automatically switches to Playback Mode. MiDAS DA displays the current playback frame within each video window so you can see the alignment of the video to the data. The data "0" will always be the data point corresponding to the last synchronization output pulse sent to the camera preceding the trigger, and the video "0" should always be the frame that the trigger was received in. Since the data is aware of when the last synchronization output pulse was sent out, the data "0" point is adjusted so that there is no misalignment of video and data resulting from the faster sampling rate of the data. In the following diagram, the red line marks where the trigger pulse arrived, the black dots indicate the video and data points where the trigger was received, and the zeros (0) show how the data and video frames and samples were numbered by MiDAS DA:



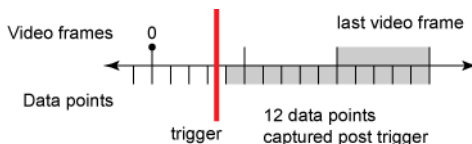
When you have completed a recording, MiDAS DA automatically switches to Playback Mode. After you have added videos, MiDAS DA will precisely align them so during playback, the video frame showing in each video window corresponds to the data point on the graph under the cursor. The data point labeled "0" is the data point corresponding to the last synchronization output pulse sent to the camera preceding the trigger. The video frame marked as "0" is the frame in which the trigger was received. Since the data is aware of when the last synchronization output pulse was sent, the data "0" point is adjusted so there is no misalignment of the video and data resulting from the faster sampling rate.

Because MiDAS DA labels as zero the data point taken alongside the synchronization pulse that started the video zero frame, there can be fewer than the expected number of samples/frame associated with the first and last frames of video. In the diagrams below, there is a video consisting of six (6) frames, with five (5) data samples/frame. The Trigger Percentage is 60% and we are looking at the few frames after the trigger. The Buffer Size is set to match the video, even though you should never set it that way for a recording. The equal buffer sizes make this demonstration clearer. The data buffer will consist of 30 samples. There will be twelve (12) post-trigger samples.

When the trigger is received between the 2nd and 3rd data point of the "0" video frame, the data card knows to collect the remaining twelve (12) data samples. However, with those data samples lined up appropriately, there are only four (4) data points corresponding to the final video frame.



If the trigger is received between the 4th and 5th data point of the "0" video frame, we will still have 12 post-trigger data points. However, the final video frame will have 5 data points.



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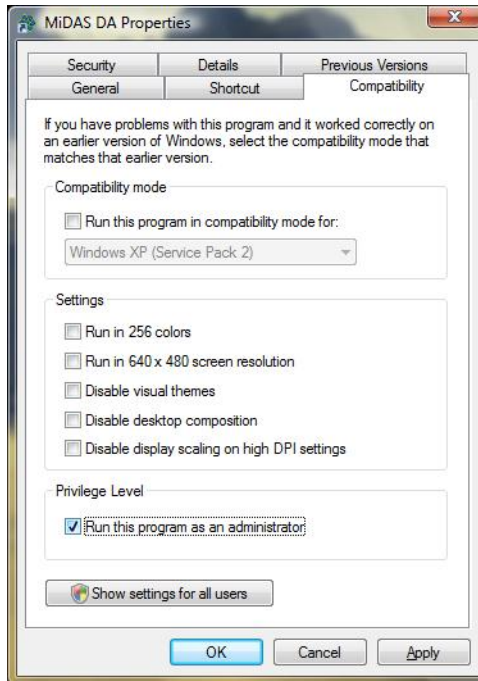
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# Appendix A. Troubleshooting

## Running MiDAS DA Under Microsoft Vista

MiDAS DA needs to be run in **Administrator Mode**. If you choose not to log into Microsoft Vista as an Administrator there are two options for running MiDAS DA in Administrator mode:

1. Right click on the MiDAS DA icon and choose **Run In Administrator Mode**. This will affect one execution only, and you will have to do this each time you run MiDAS DA.
2. Right click on the MiDAS DA icon and choose **Properties**. Under the **Compatibility** tab, choose **Run This Program as an Administrator**. This changes Windows' settings for running MiDAS DA so that it runs correctly every time.



## USB Security Key Error

If you receive the following error shown below, your USB Security Key is not installed, or not functioning properly. Make sure the drivers are installed and that the USB Security Key is plugged in.



## Live Video not Working in the Camera Software

Some cameras require a sync pulse to display a live video image once they have been set to external sync mode. If your camera does not display a live image once set into external sync mode, just start recording in MiDAS DA. Starting the recording will start the sync out pulse, which, if properly connected, will give your camera the signal it needs to show frames live. Because all the recording is done with a circular buffer, this will not cause any issues with the data recording.

## Trigger not Working

If you are having a problem with either the software or hardware trigger there are a variety of things to check:

1. Check your wiring connections. All trigger connections should be connected in parallel. Use as many *T Connections* as required. Also check for damaged cables.
2. Check the jumpers on your breakout box as explained in the Installation chapter.
3. Make sure you have chosen the correct trigger types. Often, your camera will dictate which kind of trigger you need to use. Also check for interference on the trigger line. MiDAS DA will hold the line high or low depending on which type of trigger is selected, and if the camera or another connected element is working against that, the resulting signal could be problematic. Check your camera's manual for further instructions.

## Incorrect Trigger Frame

If you feel that the trigger is in the wrong position there are two (2) possibilities. It could be a delay in the system, or an issue with importing the video's alignment.

To check for a delay in the system, perform a test to observe the alignment. You will need both a video and data representation of the trigger pulse to compare. The easiest way to do this is to use an *LED* (Light Emitting Diode). Wire an LED in parallel with the trigger line, and place it in the field of view of the camera. The LED becomes the visual representation of the trigger line. Use a BNC T adapter to run the trigger line into an available data channel, giving you a data channel representing the trigger line. The data line will have a sharp change when the trigger is fired, and the corresponding video frame will show the LED switching "on" or "off," depending on the active triggering edge (falling-edge or rising-edge).

*Note: Xcitex offers a Trigger Box that assists you in performing this test.*

Take video and data of the setup, making sure to record the channel to which the trigger line is attached, and import the video. Zoom in close to zero ("0") on the data. You should see the

transition of the trigger line soon after the zero ("0"). Specifically, the sample number where the trigger line transitions should be lower than the number of samples/frame. This means that the video was aligned properly because it shows the zero frame is the one during which the trigger occurred. In the video, when you play across 0 in the data, you should see the LED transition. If the output is incorrect, check that you have both the data and video set to the same type of triggering (rising edge, falling edge, or switch closure).

The second reason why you may have an incorrect trigger frame is a problem with the camera configuration file. Normally, MiDAS DA will tell you that it has a problem reading a configuration file and that it is using the configured trigger settings instead. If you suspect that MiDAS DA is incorrectly applying the trigger frame, please contact Xcitex at 617-225-0080, or through email at <techsupport@xcitex.com.> We can examine the files and determine the issue, if any.

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# Appendix B. Service and Support

You may receive support for MiDAS DA from the following sources:

1. **Internet Support:**

Sales Support: <http://www.xcitex.com>

Technical Support: <http://www.xcitex.com/html/techsupport.php>

Email: <[techsupport@xcitex.com](mailto:techsupport@xcitex.com)>

2. **Telephone Support and Customer Service:**

617-225-0080 (worldwide)

3. **Warranty Support:**

Email: <[techsupport@xcitex.com](mailto:techsupport@xcitex.com)>

Phone: 617-225-0080 (worldwide)

Fax: 617-225-2529

4. **Application Notes, User Guides, Calibration Instructions and other Product Materials:**

<http://www.xcitex.com/html/literature.php>

5. **Mailing Address:**

Xcitex, Inc.

25 First Street, Suite 105

Cambridge, MA 02141 USA

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# Glossary

## 5B+ Rack System

A signal conditioner interface standard.  
See Chapter 5: Data Acquisition Theory.

## AIGND

The label for the Sense (-) line when it is tied to the ground. (See: Referenced).  
See Chapter 5: Data Acquisition Theory.

## AISENSE

The label for the Sense (-) line when it is not tied to the ground. (See: Non-Referenced).  
See Chapter 5: Data Acquisition Theory.

## Advanced Rate Window

A window in MiDAS DA that mimicks the record panels interface for recording data rate and sync out rate. This allows access to your data cards exact available rates.  
See Chapter 3: Fundamentals.

## Alignment Legend (Data and Video Alignment Window)

A window in MiDAS DA that allows you to see how your videos align with your data, represented in a timeline  
See Chapter 3: Fundamentals.

## Bias Resistor

A resistor that is used to isolate the Sense (-) line from ground.  
See Chapter 5: Data Acquisition Theory.

## BNC Connectors

Standard connecting cables for breakout boxes, sensors, triggers and other data acquisition hardware.  
See Chapter 5: Data Acquisition Theory.

## **BNC Pigtail**

A device used to convert between the BNC connection to two bare wires for connecting to non-BNC devices.

See Chapter 5: Data Acquisition Theory.

## **Breakout Box**

A “box-shaped” electronic test equipment device in which a compound electrical connector is separated or “broken-out” into its component connectors. This device is essential in the collection and transference of data to your computer and singles to your camera(s).

See Chapter 5: Data Acquisition Theory.

## **Buffer**

The memory used for recording data or video.

See Chapter 6: Event Triggering.

## **Buffer Size**

Defines the length of the data recording in seconds.

See Chapter 6: Event Triggering.

## **Channel Configuration Window**

A menu in MiDAS DA that configures your data channels and sensors. Configures: units of measurement, voltage range, calibration factor, etc. (See: Advanced Configuration Window)

See Chapter 4: Quick Start Guide.

## **Channel Field**

Specifies the hardware channel that is associated with a named channel in the Channel Configuration Window and Data Channels Panel.

See Chapter 3: Fundamentals.

## **Channel Name**

The name given (by you or MiDAS DA defaults) to each channel in the Channel Configuration Window and Data Channels Panel.

See Chapter 3: Fundamentals.

## **Channel Selection List**

The list of configured analog input data channels. Each line represents a different configured channel and shows some of the configurable information about that channel. The check box at the left of each entry indicates whether or not that channel will be used during the recording. A checked box means the channel will be enabled. See Chapter 3: Fundamentals.

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## Circular Buffer Concept

The concept that a recording is not a static start/stop, that a buffer is constantly being recorded and discarded, allowing the operator to capture a point in time unknown at the beginning of the recording. (See: First-In-First-Out Principal)

See Chapter 6: Event Triggering.

## DAQ Configuration

The setup (configuration) of your data acquisition hardware. Also, the corresponding panel in record mode that allows for configuration of buffer size and data and video rates.

See Chapter 5: Data Acquisition Theory.

## .DAR File

A file that contains a link to a MiDAS DA Project (.dap) File. A .DAR files are created with every video file that is used in a MiDAS DA Project.

See Chapter 3: Fundamentals.

## Data Acquisition Kit

A set of hardware packaged together to work with data acquisition software. Includes: Data card, breakout box and cables.

See Chapter 5: Data Acquisition Theory.

## Data Card

In a data collection system, the hardware responsible for measuring and storing data.

See Chapter 5: Data Acquisition Theory.

## Data Channels

Individual data recording inputs, each of which correspond to a line in the data graph.

See Chapter 4: Quick Start Guide.

## Data Graph

Your data on an x, y graph. Data values in specified scaled units are on the y-axis. Time, in the form of trigger-referenced sample numbers, is on the x-axis.

See Chapter 3: Fundamentals.

## Data Rate

The rate at which data points will be acquired.

See Chapter 3: Fundamentals.

## **DIFF Mode**

A data channel mode used for differential sensors.  
See Chapter 5: Data Acquisition Theory.

## **Differential Sensors**

A type of sensor that utilizes two complimentary signal lines, with the signals combined at the receiver to reduce the effects of noise.  
See Chapter 5: Data Acquisition Theory.

## **Exact Rate Calculator**

In the Advanced Data Rate Panel, a tool for configuring data and video rates that mimicks the data recording panel, but that provides information about and control of exact available clock rates from the data card.  
See Chapter 3: Fundamentals.

## **Exact Rate Picker**

In the Advnaced Data Rate Panel, a tool that provides a choice of all data rates that are exactly available from the data card.  
See Chapter 3: Fundamentals.

## **Excitation Voltage**

Operating voltage of a transducer.  
See Chapter 5: Data Acquisition Theory.

## **External Sync Mode**

Putting hardware into a configuration that synchronizes acquisition to an external source.  
(See: Slave Mode)  
See Chapter 3: Fundamentals.

## **External Sync Pulse**

The pulse that is used as a reference for synchronization in your video acquisition.  
See Chapter 3: Fundamentals.

## **Falling Edge Trigger**

A trigger type setting in which the trigger line is held high, and then zero'ed to indicate the trigger point.  
See Chapter 3: Fundamentals.

## Factor

In MiDAS DA, a multiple applied to an input signal as part of converting to engineering units.  
See Chapter 3: Fundamentals.

## First-In-First-Out Principal

The principal behind circular buffering: As new frames are captured, older frames are discarded, giving a running collection of video.  
See 6: Event Triggering.

## Floating Sensor

A sensor that is not tied to ground.  
See Chapter 5: Data Acquisition Theory.

## Frame Grabber Card

A data card that includes memory and handles storing video frames.  
See Chapter 6: Event Triggering.

## Frame Rate

The rate (in Hz) at which video will be collected.  
See 6: Event Triggering.

## Ground(ed)

A reference voltage level of zero. When something is connected to the "ground" or "grounded," it is connected to the Earth, so in the event of a short circuit your computer will not be destroyed electrically.  
See Chapter 5: Data Acquisition Theory.

## Information Section

Information displays about the active data or video window which include adjustment controls for videos.  
See Chapter 3: Fundamentals.

## LED

Light Emitting Diode. Used as a visible (blinking) light source for testing data and video alignment.  
See Chapter 7: Troubleshooting.

## Loop Mode

Playback mode that will return to the beginning once the end is reached.  
See Chapter 3: Fundamentals.

## Master Clock

The base clock signal in the data acquisition hardware. Clock signals of lower rates are created by dividing the Master Clock.  
See Chapter 5: Data Acquisition Theory.

## Menu Bar

Spanning the top of the MiDAS DA program window, the Menu Bar allows you to access the universal program controls and common actions such as choosing a data device, opening and saving files, etc.  
See Chapter 3: Fundamentals.

## MiDAS DA Project (.DAP) Files

A file that contains an entire MiDAS DA Project, including: data settings and references to videos.  
See Chapter 3: Fundamentals.

## Multiplexing

The common technique for sampling multiple channels with one analog to digital converter.  
See Chapter 5: Data Acquisition Theory.

## National Instruments

A manufacturer of data acquisition hardware.  
See Chapter 2: Installation.

## .NET 2.0 Framework

A Microsoft application development framework that is included in MiDAS DA to provide common Windows interface components.  
See Chapter 2: Installation.

## NI Measurement & Automation Explorer

A software program offered by National instruments for interfacing with data acquisition hardware.  
See Chapter 2: Installation.



## Non-Referenced

Refers to a sensor that is not tied to ground. (See AISENSE).  
See Chapter 5: Data Acquisition Theory.

## NRSE Mode

A data channel mode used for Non-Referenced, Single-Ended sensors.  
See Chapter 5: Data Acquisition Theory.

## Null Signal Line

When no sensors are attached to your data acquisition hardware, the Null Signal Line is what shows up in the graph in place of real data. The signal varies or simply drifts up and down in voltage over time.  
See Chapter 2: Installation.

## Offset

In MiDAS DA, a number added to an input signal, after the Factor has been applied, as part of converting to engineering units.  
See Chapter 3: Fundamentals.

## Oscilloscope Mode

A toggle button in the data playback window toolbar. When enabled, the data in your data graph moves behind a stationary cursor during playback. When oscilloscope mode is turned off, playback is a moving cursor on static data.  
See Chapter 3: Fundamentals.

## PCI

A computer interface standard that involves add-on cards installed inside of a computer; usually a desktop computer.  
See Chapter 2: Installation.

## PCMCIA

A computer interface standard, similar to PCI, that involves add on cards installed in an expansion slot in many laptop computers.  
See Chapter 2: Installation.

## Playback Boundaries (Bounds)

When playing or scrolling through data and video, the playback bounds determine the

endpoints. You can see the bounds clearly because they are marked by a green bracket above the playback position slider bar and on the alignment window. Use this feature to limit playback to a time period of interest in the data and video.

See Chapter 3: Fundamentals.

## **Playback Controls and Tools Section**

A section of the Playback Panel that has the standard playback controls with a playback position slider and position indicators with tools for adjusting data.

See Chapter 3: Fundamentals.

## **Playback Mode**

In MiDAS DA, the mode that automatically appears after capturing an event, allowing you to view and alter your acquired video and data.

See Chapter 3: Fundamentals.

## **Playback Rate**

Rate at which video and/or data will be played back.

See Chapter 3: Fundamentals.

## **Pre-Trigger/Post-Trigger**

The amount of frames or time captured before and after the trigger.

See Chapter 3: Fundamentals.

## **Project Menu**

A menu in MiDAS DA on the Menu Bar that allows you to change your project by adding videos, removing data or video windows, or starting over with your data recording settings.

See Chapter 3: Fundamentals.

## **Record Panel**

The panel on the left side of the main window of MiDAS DA when in Record Mode. It shows all the choices to be made for a given recording session and is divided into subsections.

See Chapter 3: Fundamentals.

## **Recorded Rate**

A setting on the Playback Panel that changes the effective recorded rate of a video. This setting tells MiDAS DA the rate at which a video was captured. Changing this value affects playback of the video. The alignment legend will show changes to this field in the form of shortening or lengthening the bar representing the video.

See Chapter 3: Fundamentals.

## Rising Edge Trigger

A trigger type setting in which the trigger line is held at zero, and then driven high to indicate the trigger point.

See Chapter 3: Fundamentals.

## Record Configuration (.DRC) Files

A file that contains all the settings necessary to do a recording, including: channel configuration, data and video rates, and trigger settings.

See Chapter 3: Fundamentals.

## Referenced

Refers to a sensor that has the common line, or the Sense (-) line, and is tied to ground.

See Chapter 5: Data Acquisition Theory.

## RSE Mode

A data channel mode used for Referenced, Single-Ended sensors.

See Chapter 5: Data Acquisition Theory.

## Samples/Frame (Samples per Frame)

Number of data samples to be taken per video frame.

See Chapter 3: Fundamentals.

## Sample Rate

The rate at which data will be collected.

See Chapter 6: Event Triggering.

## Set Bounds Button

A button in the data playback window toolbar that sets the playback bounds to be the same as the bounds of the graph in the data window. (See: Playback Boundaries)

See Chapter 3: Fundamentals.

## Shutter Speed

The time duration for which a video frame will be captured, a subset of the entire frame duration; usually measured in milliseconds or microseconds.

See Chapter 6: Event Triggering.

## Single-Ended Sensors

A type of sensor that uses a single signal line and a common reference line.  
See Chapter 5: Data Acquisition Theory.

## Slave Mode

Putting hardware into a configuration that synchronizes acquisition to an external source.  
(See: External Sync Mode)  
See Chapter 3: Fundamentals.

## Status Bar

The information bar along the bottom of each data and video playback window. It shows information about the recording and continually updates based on the playback point. On the very right of the data window status bar is a reminder of how to use the keyboard shortcuts for pan and zoom on the graph.  
See Chapter 3: Fundamentals.

## Switch Closure Trigger

A trigger type setting in which the trigger line is held high, and an external user switch drives it to zero to indicate the trigger point.  
See Chapter 3: Fundamentals.

## Sync In

A connection point on a camera for inputting a synchronization signal.  
See Chapter 3: Fundamentals.

## Sync Out

A connection point on data acquisition hardware for outputting a synchronization signal. Also, the name of the signal itself.  
See Chapter 3: Fundamentals.

## Sync Out Rate

The rate of the sync pulse that the master device will output.  
See Chapter 3: Fundamentals.

## T Connectors

A type of electrical connector that joins through a conductor to another conductor at right (T) angles, effectively splitting a signal. See Chapter 7: Troubleshooting.

## Terminals

Connection points for wiring signals, i.e. screw-down points for attaching bare wires, or BNC connectors.

See Chapter 5: Data Acquisition Theory.

## Test Trigger Window

A window in MiDAS DA that gives you controls for an output digital and an analog signal; usually used for demonstration purposes.

See Chapter 3: Fundamentals.

## Title Bar

Similar to that of most standard Windows programs, the Title Bar allows for control of the MiDAS DA window. When a project is open, the name of the project is displayed in the Title Bar. Use the controls on the Title Bar to let MiDAS DA run in the background (minimize it), to close the program, or to move the window or change its size.

See Chapter 3: Fundamentals.

## Toolbar

The data playback window toolbar has eleven (11) buttons that control data views and exporting. Some of the commands are: zoom, pan, oscilloscope mode, export, set boundaries, etc.

See Chapter 3: Fundamentals.

## Tools Menu

A menu in MiDAS DA on the Menu Bar that allows you to refresh your device list, test your trigger, clone a data window and export data.

See Chapter 3: Fundamentals.

## Transducers

An electrical device that converts one form of energy into another.

See Chapter 5: Data Acquisition Theory.

## Trigger

Electronic signal used to mark the point of interest in a buffered recording.

See Chapter 3: Fundamentals.

## Trigger Box

A device used for testing MiDAS DA's alignment and precision. It responds to electrical signals, activating an LED.

See Chapter 7: Troubleshooting.

## Trigger Bus

Tying all trigger signal lines into one common point.

See Chapter 3: Fundamentals.

## Trigger Frame (ZeroFrame)

The frame marked "0", which is the frame during which the trigger was received.

See Chapter 3: Fundamentals.

## Trigger In

The input on your camera where you connect your trigger line.

See Chapter 3: Fundamentals.

## Trigger Panel

A window in MiDAS DA that allows you to allocate the total data buffer into "before trigger time" and "after trigger time."

See Chapter 3: Fundamentals.

## Trigger Percentage

The percentage of data or video that is marked pre-trigger.

See Chapter 3: Fundamentals.

## TTL

Transistor–Transistor Logic. A standard voltage threshold used to mark a transition, in most high speed video data acquisition instances, 3.5 Volts.

See Chapter 3: Fundamentals.

## USB

Universal Serial Bus. A standard for attaching external hardware to a computer.

See Chapter 2: Installation.

## **USB Breakout Box**

A combination breakout box and data card that interfaces with the host computer via the Universal Serial Bus (USB).

See Chapter 5: Data Acquisition Theory.

## **USB Security Key (Dongle)**

A USB device that contains the security key to operate the software. Commonly called a "dongle."

See Chapter 2: Installation.

## **Video Playback Window**

A window in MiDAS DA that shows the frame of the video associated with the current playback point with its own status bar across the bottom which gives updated information on your video.

See Chapter 3: Fundamentals.

## **Waveform per Frame Technology**

Proprietary technology that accurately and precisely aligns video and external data channels where the data is recorded at a rate much faster than the video; in essence, producing a waveform of data with each frame of video.

See Chapter 5: Data Acquisition Theory.

## **Zero Frame (Trigger Frame)**

The frame marked "0", which is the frame during which the trigger was received.

See Chapter 6: Event Triggering.

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