

# MIDAS2.0



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## User Guide



# MIDAS2.0

## User Guide

Version 2.1.7



## MIDAS DOCUMENTATION AND LEGAL NOTICES

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# MIDAS2.0

## Getting Started

Getting Started







# Overview of MiDAS2.0

## What is MiDAS?

MiDAS2.0 is the second generation, fully integrated system for controlling and adding functionality to industrial and high-speed video cameras to allow sophisticated event capture and analysis. MiDAS2.0 represents a significant step forward over previous versions of MiDAS. It adds numerous new features and 12 new or fully revised optional modules. As you will find by reading this manual, MiDAS is comprised of a Base Software and Optional Modules. The Base Software provides all the functions needed to control and manage numerous video cameras – conventional rate or high-speed – and the features to allow you, the user, to record, play, view, save and load image sequences.

MiDAS works with numerous brands of cameras. Contact Xcitex or visit the Xcitex web site at <http://www.xcitex.com> for more information on camera compatibility.

MiDAS is actually a singular, extensive piece of software. The entire software package is supplied to you with the purchase. You may also download free upgrades from the Xcitex web site. With your software, you are supplied two additional items:

- (1) a keytag (also known as a dongle or Hardlock)
- (2) a license key code.

The keytag is a physical device that attaches to the printer port of your computer. MiDAS frequently seeks out the existence of the keytag to confirm that you are a licensed user of MiDAS. The keytag also provides a method for MiDAS to keep track of which optional modules or features of MiDAS you have licensed.

The License Key Code is a 16-digit number supplied by Xcitex. This number unlocks the various components of MiDAS that you have licensed (e.g. purchased). You can always add features by contacting Xcitex – we will simply supply you with a new License Key Code (unlock code).

The optional modules are unlocked using the License Manager. Chapter3 discusses the License Manager and how to use it.

MiDAS is continually upgraded and improved. You may always download the most current version of MiDAS from the Xcitex web site downloads page at <http://www.xcitex.com/downloads.html>. The engineers at Xcitex encourage you to visit this page frequently and update your software regularly. The MiDAS installer software built into MiDAS will automatically update all the files on your computer to the most current versions.

*Note: Hardware features of your specific camera are not included in this MiDAS manual (e.g. strobe trigger, data lines, power connections, etc.). We strongly advise that you read the manual supplied with your specific camera(s) in addition to this manual!*

This MiDAS manual is also automatically loaded onto your computer with MiDAS software in Adobe PDF format. You can access it at any time from MiDAS by clicking on the Windows Start button, then selecting MiDAS, then MiDAS Manual. Updates to the manual are available from Xcitex directly by email at [sales@xcitex.com](mailto:sales@xcitex.com).

Finally, you can always find the most current technical support at <http://www.xcitex.com/techsupport.html>. This page contains a database of common and rare support problems.

## **New in MiDAS 2.0**

If you are already a MiDAS user running version 1.0, 1.1, 1.2 or 1.3, you will find many new features and changes to MiDAS in version 2.0. The standard MiDAS look and feel has been preserved with the MiDAS Control Panel, but significant improvements have been made to the underlying organization of MiDAS and the features that are available to the user. The new “products”, modules and features are contained within MiDAS2.0. The following is a summary list of new features of MiDAS2.0. Refer to the Xcitex web site (<http://www.xcitex.com>) for a complete listing of the new features in MiDAS2.0.

- Expanded camera support
- 2 new Synchronized Video and Data Acquisition Modules.
- 6 completely renovated Synchronized Video and Data Acquisition Modules.
- 3 new External Time Sync Modules.

- New "Easy-Sync" multiple camera system
- New MiDAS Notes
- 2 New Automatic Capture/Download Modules
- New Lens Calculator
- Better, easier 64-point Auto-Tracking Module
- New Tab Manager
- New Secure Data Encryption
- Playback rate override
- Background threading
- Image sharpening algorithms
- Image Contrast Palette
- Improved Spreadsheet Analysis with Manual Tracking module
- Stand-alone Play Module for low-cost remote analysis
- Windows 2000 compatibility
- Higher accuracy timing alignment
- Auto graph scaling
- Extended Record' mode
- Split Screen' mode
- Simultaneous Internal and/or External Triggering
- Double the data input capacity to 32 differential (DI) or 64 single ended (SE) inputs
- Detachable control panels

### **Upgrading DA Hardware for MiDAS2.0**

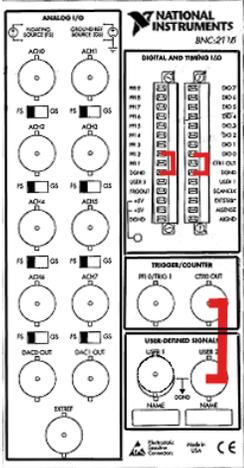
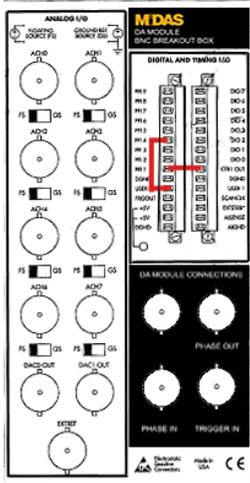
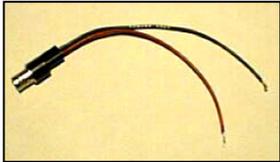
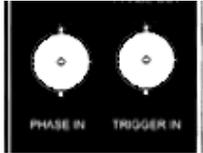
The DA data acquisition hardware has been simplified in version 2.0. There are two hardware changes to the MiDAS DA modules for new MiDAS2.0. First, the jumper pattern on the BNC Breakout Box has been changed to eliminate the need for the BNC jumper cable. Second, in MiDAS2.0, the external event trigger connects directly into the BNC Breakout Box to eliminate the MiDAS DA Trigger Adapter.

If you are a user of one of the following MiDAS DA modules:

DA-123M	DA-132M	DA-160M
DA-161M	DA-170M	DA-171M

you must upgrade your BNC Breakout Box to use MiDAS2.0. If you are using a DA Terminal Block or MiDAS 5B+ Rack instead of the BNC Breakout Box, refer to Chapter 12 for upgrade instructions.

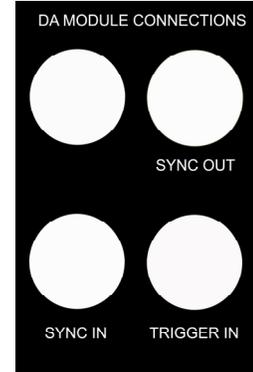
A summary of the changes between versions is as follows:

	Previous MiDAS version 1..x	New MiDAS version 2.0
BNC Breakout Box Jumper Configuration:		
Connecting to an External Trigger with BNC Breakout Box:	<p>MiDAS DA Trigger Adapter</p>  <p>Red to PFI9            Black to DGND</p>	<p>No Trigger Adapter Required!</p> <p>In MiDAS2.0, the event trigger connects directly to the lower right connector on the BNC Breakout Box.</p> 
DA Terminal Block Jumper Configuration	<p>Jumper: Terminals 10 to 2            Jumper: Terminals 52 to 3            Sync Out: Terminals 40 to 35            Trigger: Terminals 3 to 35</p>	<p>Jumper: Terminals 10 to 40            Sync Out: Terminals 2 to 35            Trigger: Terminals 41 to 39</p>
Connecting to a 5B+ Signal Conditioner Rack	Not Available	Direct Connection



To modify your MiDAS DA hardware, Xcitex has created a small “MiDAS2.0 DA Upgrade Kit”. This kit contains the following items:

1. New MiDAS DA label
2. New DA Connections label
3. Large Jumper (not shown)
4. Small Jumper (not shown)



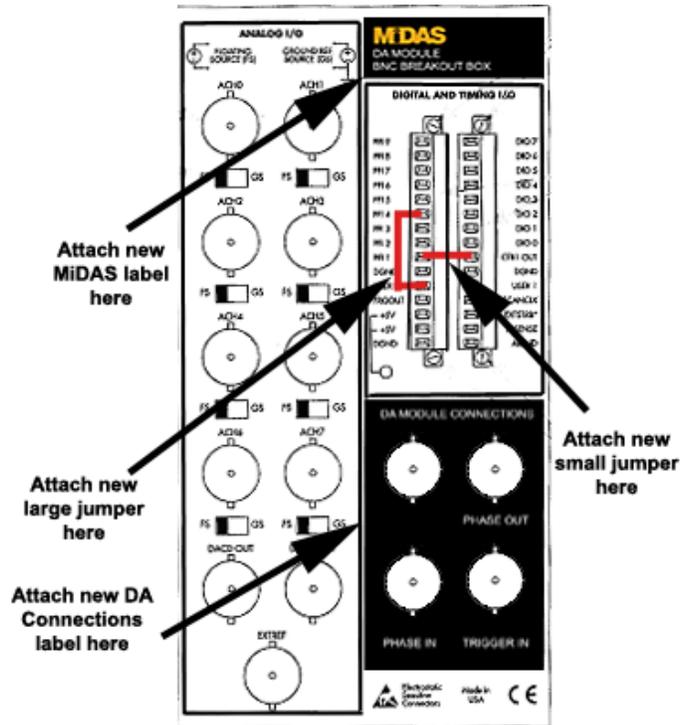
To convert your MiDAS DA Breakout Box for use with MiDAS 2.0, follow the following instructions:

1. Remove all the jumpers from your DA Breakout Box.
2. Attach the labels as illustrated in the following figure:
3. Connect the new jumpers as follows:

Large jumper  
PF14 to User 2

Small jumper  
PF11 to CTRL Out

4. The 1-meter connection cable connects to the BNC labeled “Sync Out” and to the camera Phase In or Sync In connection.



## **Available Modules for MiDAS**

MiDAS Base Software provides the foundation for adding any of the optional MiDAS modules. The following optional modules are available for MiDAS 2.0:

### Software Modules:

- AD1 – standard Auto-Download/Auto-Capture
- AD2 – enhanced Auto-Download/Auto-Capture/Auto-Trigger
- SA1 – Spreadsheet Analysis with manual tracking
- SA2 – Spreadsheet Analysis with automatic tracking
- EC1 – Video/Data encryption
- AU1 – Synchronized Audio
- MiDAS Notes – Annotation and documentation

### Software and Hardware Modules

- DA-123M/B/P -- Standard Synchronized Data Acquisition
- DA-132M – 16 Bit Synchronized Data Acquisition
- DA-160/161M – ISA architecture Synchronized Data Acquisition
- DA-170/171M – Enhanced Synchronized Data Acquisition
- TS-01M – IRIG Time Synchronization
- TS-02M – IRIG/GPS/NASA Time Synchronization
- TS-02M – IRIG/GPS/NASA Time Synchronization with Tracker Reader

### Other MiDAS Hardware

- MiDAS PC – Portable Computer for use with MiDAS
- MiDAS Motion Trigger – detects motion, triggers MiDAS
- MiDAS CB-68 Screw Terminal Block
- MiDAS Sensors

### Other MiDAS Software

MiDAS Player – free software that opens, plays and allows manipulation of MiDAS-acquired video, data, Notes, and timing information.

MiDAS Lens Calculator – free version (with advertisements) of the Lens Calculator feature that appears in MiDAS.

## **How this Manual is Organized**

This Manual is organized into 4 sections:

Section 1 contains the overview and installation information.

Section 2 contains the basic information on how to use MiDAS Base Software.

Section 3 contains all the instructions for how to use all of the MiDAS optional modules.

Section 4 contains the following informational appendices:

Appendix A provides the specifications for MiDAS.

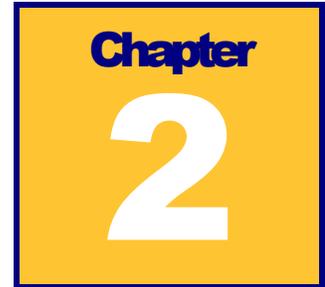
Appendix B contains the pin-outs for MiDAS DA module terminal blocks.

Appendix C details of how to install the ISA-based MiDAS DA modules

Appendix D provides troubleshooting tips and lists of common error messages.

Appendix E provides sources of technical support.





## Installing MiDAS

To start using MiDAS, first check that you have received the components required. After unwrapping and checking inventory, follow the enclosed instructions for installing and setting up your hardware and software. Please read and understand how to use the MiDAS License Manager – this is very important.

### What is Included

Before installing your hardware and software, verify that you have everything you purchased and understand the purpose of your hardware components. First, check which modules you purchased.

For all MiDAS, you should have received:

- The MiDAS software CD
- A keytag
- Registration Card

If you purchased a MIDAS Data Acquisition module DA-123M, -132M, -160M, -170M, you should also have:

- A Data Acquisition Board from National Instruments
- An 8-cconnector BNC Breakout Box
- A 68-pin cable for connecting the DAQ board to the BNC Breakout Box
- A 1-meter long coax cable with BNC connectors at each end
- A NIDAQ driver diskette from National Instruments

If you purchased a MIDAS Data Acquisition module DA-160M, -161M, you should also have:

- A Data Acquisition Board from National Instruments
- An 8-connector BNC Breakout Box
- A 16-connector BNC Extension Breakout Box
- A 100 pin Y-cable for connecting the DAQ board to the two BNC Breakout Boxes
- A 1-meter long coax cable with BNC connectors at each end
- A NIDAQ driver diskette from National Instruments

If you purchased a MIDAS Time Sync module TS-01M you should also have:

- An IRIG board from Datum, Inc.
- A short multi-pin breakout cable
- A 1-meter long coax cable with BNC connectors at each end

If you purchased a MIDAS Time Sync module TS-02M or -03M you should also have:

- An IRIG board from Datum, Inc.
- A GPS antenna
- A 25-foot long antenna cable
- A short multi-pin breakout cable
- A 1-meter long coax cable with BNC connectors at each end

## **Install the Camera Hardware and Drivers**

*Note: If you wish to just install the MiDAS Player, skip to step 32.*

1. Remove the cover from your computer.

*WARNING: Prior to installing boards in your computer, disconnect the power to the computer. Make sure you are properly grounded using a wrist ground strap.*

2. In an open PCI slot, install the video camera board in your computer, and attach the cable and camera head in accordance with the manufacturer's instructions.
3. Turn on the computer and install the camera driver software in accordance with the manufacturer's instructions.

4. Re-boot the computer when instructed.
5. Test your camera in accordance with the instructions of the manufacturer. Make sure you open a camera and successfully get an image on the screen before continuing.
6. Repeat Steps 1-5 for each camera type in the computer.

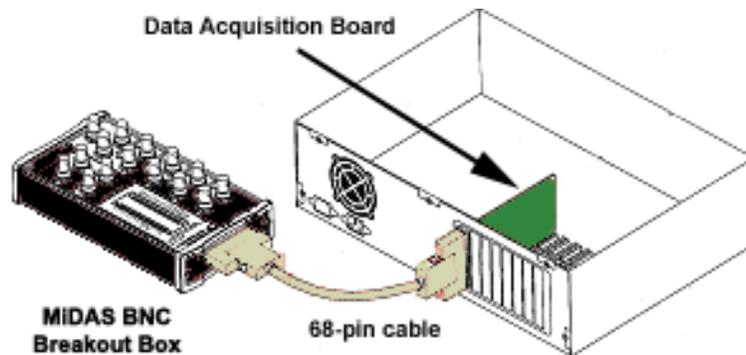
### **Install the Data Acquisition Module (DA) Hardware**

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

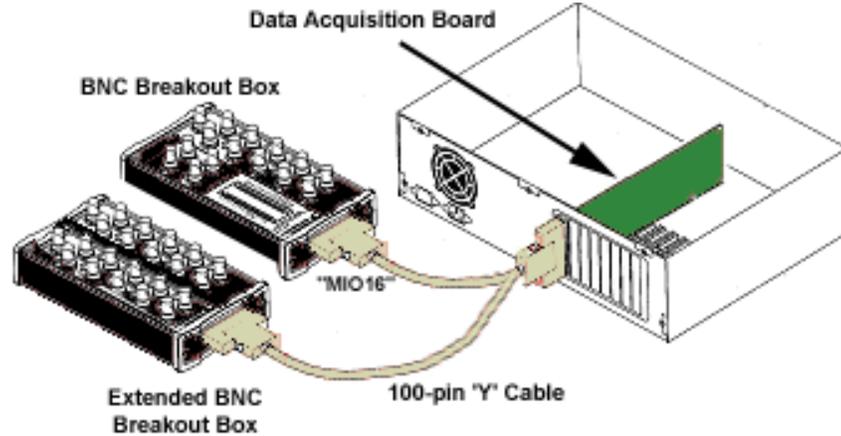
*Note: If you purchased a model MiDAS DA-160M or a model MiDAS DA-161M DA module, skip directly to Appendix D – “Installing ISA MiDAS Modules”. The following instructions are for PCI-based DA modules only. The procedure for installing an ISA based system is very different.*

*Note: All MiDAS DA modules include a data acquisition board, a BNC Breakout Box (or multiple BNC Breakout Boxes), a MiDAS 5B+ Rack. If you also purchased an optional MiDAS Terminal Block, connect the BNC Breakout Box as described below, then follow the instructions listed in Chapter 12.*

7. In another open PCI slot, install the MiDAS data acquisition board.
8. If you purchased a DA-123M, -132M, -160M or -170M module, 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:



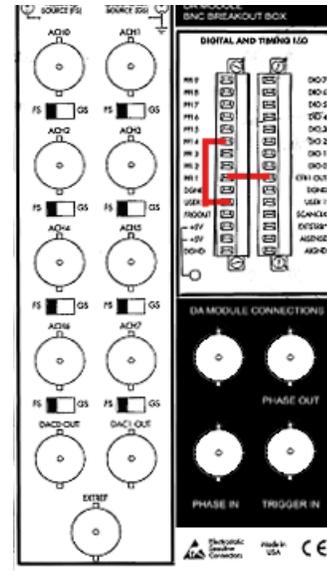
9. If you purchased a DA-161M, or -171M module, connect the large end of the -100-pin shielded 'Y' cable to the back panel connector of your data acquisition board. Then connect the other end of the cable labeled "MIO16" to your MiDAS BNC Breakout Box and the other end of the cable labeled "Extended I/O MIO64" to the MiDAS Extended Breakout Box, as shown in the following figure:



10. If you purchased a DA-123B module, connect one end of the 68-pin 'Y' Ribbon Cable to the back panel connector of your data acquisition board. Then connect the other ends (2) of the cable to the associated connectors on the MiDAS 5B+ Rack. Skip to Step 12.

11. Your MiDAS BNC Breakout Box comes pre-configured with two jumpers in place, as shown in the following figure:

Confirm that the first jumper is securely affixed to both **PF14** and **User2** terminals. Confirm that the second jumper is securely affixed to both **PF11** and **CTR1Out** terminals.



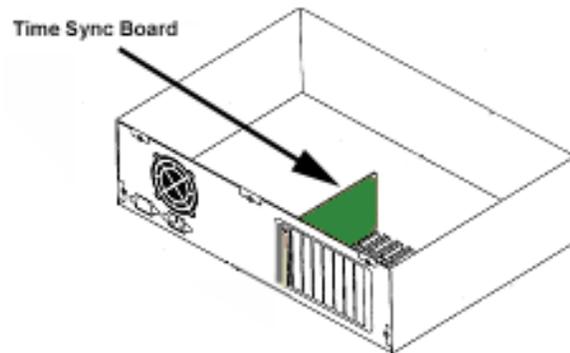


## Install the Time Sync (TS) Module Hardware

*Note: If you did not purchase a MiDAS TS module, you may skip this section.*

*Note: All MiDAS TS modules include a time synchronization board and a breakout cable. If you have purchased a TS-02M or -03M module, you will also find a GPS antenna and 25' cable.*

12. Turn off your computer.
13. In another open PCI slot, install the MiDAS TS board.
14. Connect the TS multi-pin breakout cable (not shown) and the GPS antenna (not shown).



*Note: If you are using a TS module with a DA module, you must also place a jumper on the MiDAS BNC Breakout Box between the PFI5 and User1 terminals, in addition to the two jumpers described in step 11. MiDAS DA BNC Breakout Boxes are NOT shipped with this jumper in place.*

## Install the Data Acquisition Drivers (Software)

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

15. Turn on your computer.
16. Insert the “NI-DAQ” driver CD from National Instruments (Disk 1). The driver installation program should start automatically. If it does not, from the Run prompt, the letter of your CD-ROM drive.

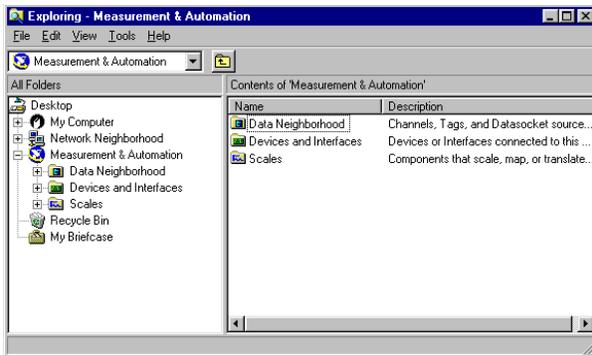
*Note: You MUST be logged in as the Windows Administrator to properly install MiDAS. Failure to have Administrative privileges not install key MiDAS drivers.*

17. Click on **INSTALL NIDAQ** at the first screen.
18. Follow the instructions on the screens to load the NI-PAL, MS Runtime and the NIDAQ drivers for your model DAQ board.

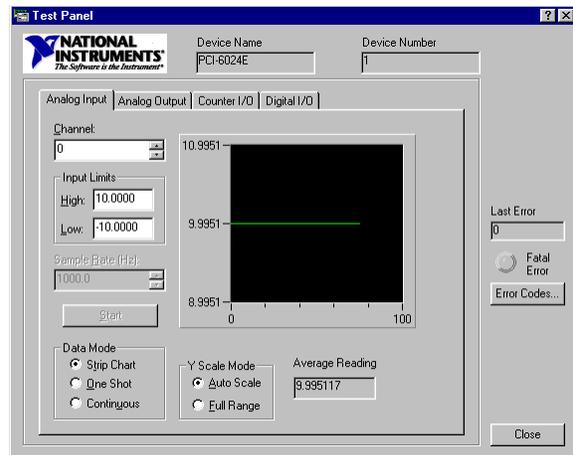
*Note: The model DAQ board is automatically sensed and determined by the software and the appropriate driver(s) will be automatically installed.*

19. Re-boot the computer when instructed.
20. After the re-boot, the NIDAQ Setup Routine will continue. Follow the instructions in the program.
21. At the NIDAQ Setup screen, it is not necessary to choose any additional documentation. Check the checkbox on the screen to decline installing further documents. Click on the **NEXT** button.
22. At the Select Development Platform screen, it is again not necessary to choose any development platforms at this time – the development libraries are automatically loaded with the MiDAS disk. Click on the **NEXT** button.
23. Select the Configure Measurement and Automation checkbox and click the **FINISH** button.

24. If the Measurement and Automation Explorer does not automatically appear, double click on the National Instruments “Measurement and Automation” icon on your desktop. The following screen will appear:



25. Click on the + sign next to the “Devices and Interfaces” folder. You should see the internal model number of your data acquisition board listed below. If you do not see the board number, the system does not recognize the existence of your hardware. You must quit, turn your computer off and re-seat the board in the PCI slot, then repeat step 20.



26. Right click on the board number and select **TEST PANEL**. The following screen will appear:

Without any signal hooked up,

you should see a noisy waveform (a line across the screen that varies or simply drifts up and down in time) and no error messages listed on the right side of the Test Panel. If you receive an error message, remove and reinstall the drivers starting at step 15.

27. Remove the disk at this time. Re-boot your computer.

### **Install the MiDAS Software**

32. Turn on your computer.
33. Insert the CD-ROM that contains the MiDAS software. The MiDAS software installer should automatically start. If it does not, from the **RUN** prompt, type **F:/SETUP**, where “**F**” is the letter of your CD drive.
34. Follow the instructions on the screens to install the MiDAS drivers, application software, and documentation.
35. When asked, install the MiDAS components that you desire. We suggest installing MiDAS, the MiDAS Player, the MiDAS Lens Calculator and the MiDAS documentation.
36. Enter your Registration Number – the number provided on your Registration Card. Your Registration Number is a 9-digit number in the format 00000-0000. Type the dash (-) when typing in your number.

*Note: To install just the MiDAS Player (not the full version of MiDAS), use the special Registration Number of 99999-9999.*

37. Continue to follow the on-screen installation procedures. When instructed by the software, remove the CD-ROM from your CD drive.
38. Re-boot your computer.

Before starting MiDAS, you must first attach your MiDAS keytag and enter your License Key Code into the MiDAS License Manager.

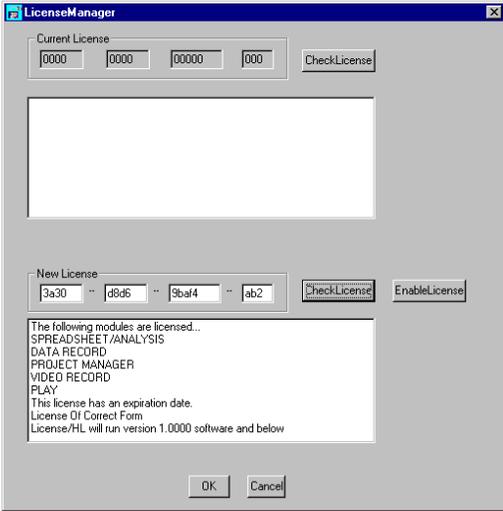


# Chapter 3

## The MiDAS License Manager

The MiDAS software is protected by a hardware keytag (also known as a keylock, Hardlock or dongle). You must run the MiDAS License Manager to inform the software that you are a registered user and what options you have purchased.

1. Remove any printers attached to your computer.
2. Attach your MiDAS keytag to your computer parallel (printer) port. Reconnect any printers to the keytag.
3. To run the MiDAS License Manager, click on the Windows **START** button, then **PROGRAMS**, then **MIDAS**, and then **LICENSE MANAGER**.
4. The current license is displayed at the top of the screen. Enter the License Key Code in the New License section. You can find the License Key Code on your Registration Card with your Registration Number. The License Key Code is a 16 digit code that is segmented as follows: 0000 – 0000 – 00000 – 000.
5. After you have entered your license code, click on **CHECK LICENSE**. If you have entered the license correctly, information about the keytag and the License Key Code will appear in the lower text box.



6. The features of MiDAS and/or MiDAS LC that you have purchased will be listed, along with an indication that this License Key Code is either Time Limited or Time Unlimited. The **ENABLE LICENSE** button will also become highlighted after a valid License Key Code has been entered.
7. Press the **ENABLE LICENSE** button. Information about your software will be listed in the lower text box, along with an indication that the License has been enabled.
8. Click **OK** to exit the MiDAS License Manager.

*Note: You will require a new License Key Code from Xcitex when you add new modules or features to MiDAS.*

*Note: If you are upgrading from an older version of MiDAS, you must re-insert your License Key Code into the License Manager. License Key Codes generated for MiDAS 2.0 are not backward compatible with previous versions of MiDAS.*

**MiDAS2.0**



**MiDAS  
Fundamentals**

**MiDAS Fundamentals**



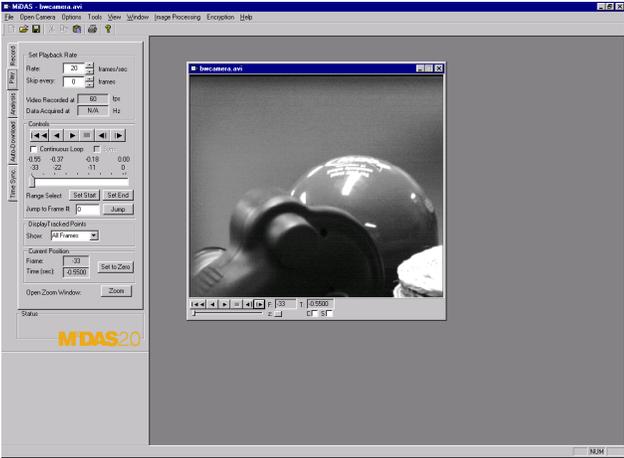


# Chapter 4

## Interacting with MiDAS2.0

### The MiDAS Desktop

The MiDAS desktop window is comprised of various elements and sections, as shown below. MiDAS is based on conventional Windows applications, with a menu bar across the top and a series of sizing icons across the bottom. Standard Windows messages appear across the bottom row as well. The MiDAS window colors can only be changed by modifying the Windows display settings.



The left section of the MiDAS window is termed the “Control Panel”, which contains the “Tab Controls” or just “Tabs”. The area to the right, where document windows are displayed, is termed the “Console”.

## MIDAS2.0

### Chapter 4: Interacting with MiDAS

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At the bottom of the desktop is the “Status Bar”. The MiDAS status bar contains information about the video file you are recording or viewing and about where you are pointing with your mouse cursor. The information is displayed in four boxes along the bar, as shown below:



The boxes in the status bar display the following information, stating on the left, which is described later in this chapter in the subsections titled “Working with Windows” and “Reticle”:

- Reticle position
- Zoom Region size
- Actual Image size
- Window Frame size

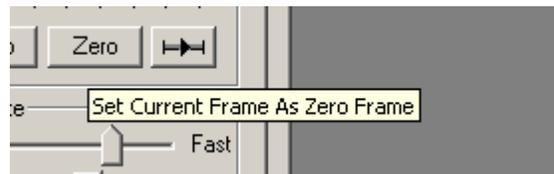
*Note: For optimum viewing area and to view images at their highest resolution, set your display to SXVGA mode – 1180x768 pixels -- with a minimum of 24-bits of color. MiDAS is designed to operate on displays as low as 800x600 pixels and will generate an error message if your color depth is not set to High Color (16-bits) or above.*

The display resolution will actively update during resizing. To resize a display window, grab any corner of the window by clicking down on the mouse, and, while holding the mouse down, drag it. MiDAS will maintain the correct aspect ratio.

*Note: If your display resolution does not update in real time during resizing, you must set your Microsoft Windows as follows:*

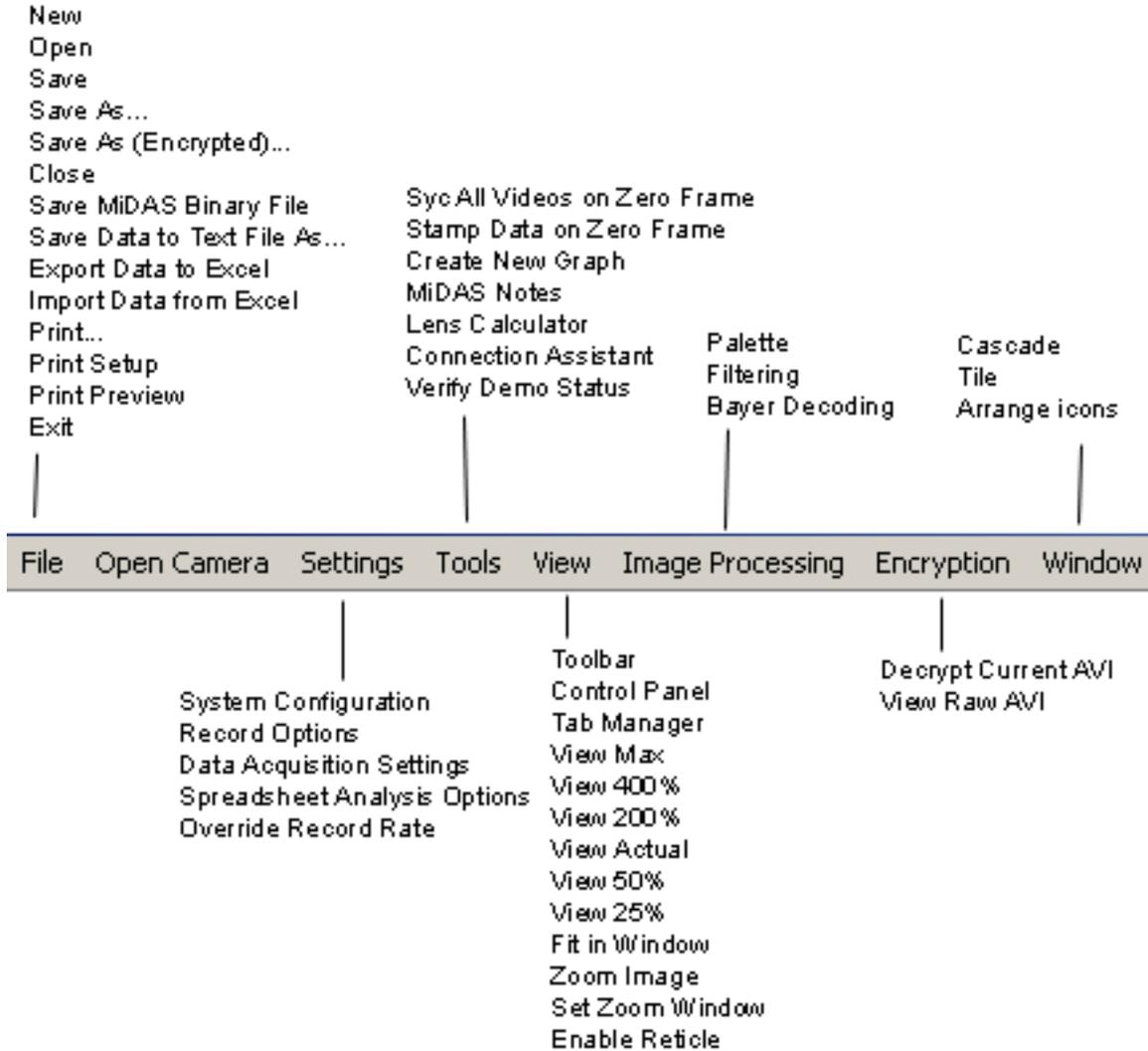
1. Click on the Windows **START** button
2. Click on **SETTINGS**, then **CONTROL PANEL**
3. Click on the **DISPLAY** icon
4. Click on the **Effects** tab
5. Make sure that the “Show Window Contents while Dragging” checkbox is selected.

Throughout the MiDAS desktop, you will also find ScreenTips. These helpful messages or phrases describe the various functions within MiDAS. To view a ScreenTip, simply slide the mouse cursor over the function without clicking. For example, when the mouse cursor is placed over the **ZERO** button on the Play tab, the ScreenTip shown at right appears.



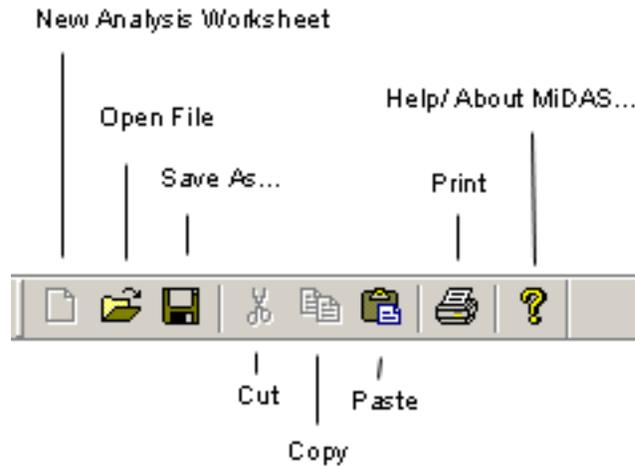
## The Menu Bar

The MiDAS menu bar spans the top of the desktop. The menu bar is the primary method of interacting with MiDAS. Depending on which mode you are in (e.g. Record, Playback, Analysis, etc.), the contents of the menu items changes. The following shows the MiDAS menu bar options:



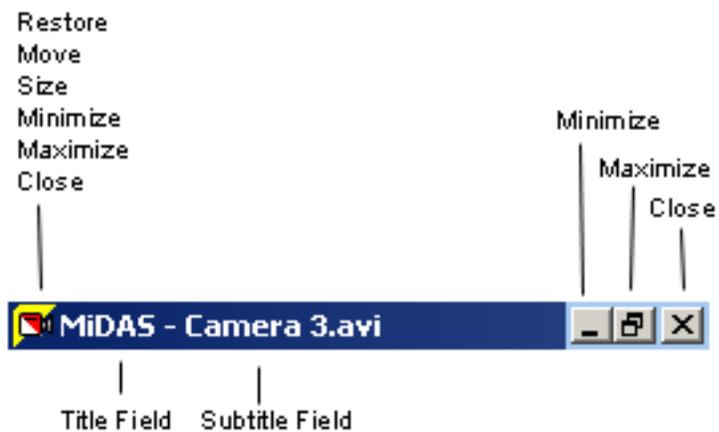
### The Tool Bar

The MiDAS tool bar is directly below the menu bar. It provides shortcuts to frequently used commands and features, as shown below:



### The Title Bar

The MiDAS title bar is directly above the menu bar. The components of the title bar are as shown below.



## Window Types

Images and data appear in Windows on the MiDAS desktop. Each window has a border. Windows that are ‘active’ have a blue title bar while windows that are ‘inactive’ have a gray title bar.

The various types of windows you will find within MiDAS are as follows:

<p><b>Camera View Window</b></p>	<p>This window shows a live view from the camera. The Camera View Window is controlled by the camera – if the camera displays live while recording (and this option is enabled from the Record Options menu), the image will be shown in this window.</p> <p>Magnifying, zooming and panning are available for the Camera View window.</p> <p><i>Note: The Video Display Window automatically minimizes to an icon when the recording is complete and a Playback window is active.</i></p>
<p><b>Playback Window</b></p>	<p>This window displays recorded images. You may interact with the Playback window using the Playback controls on the Play tab or by using the shortcut bar under the window or by using contextual (right-click) commands. Multiple Playback windows can be displayed and synchronized.</p> <p>Magnifying, zooming and panning are available for the Playback window.</p>
<p><b>Data Window</b></p>	<p>This window contains synchronized data graphs. See Chapter 12 for more details on this type of window and how to manipulate its contents..</p>
<p><b>Zoom Window</b></p>	<p>This is another Playback Window of only the selected zoom region. Zoom windows are created by click-dragging a box around the region of zoom interest. Zoom windows have all the same properties and characteristics of Playback windows.</p>

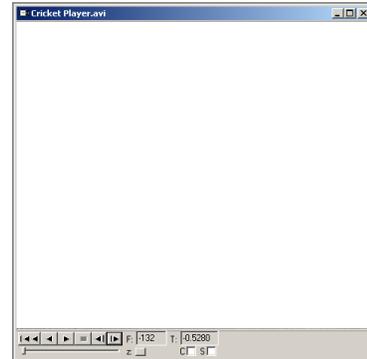
The title bar will inform you of the type of window that is present. Camera view windows show the camera name and “Live” or “Recording” plus a chain number. Playback windows have a camera icon and show either the camera name or, if containing a previously saved file, the type of file (e.g. .avi, .bmp, etc.). Zoom windows show the concentric box zoom icon.

## Working with Window Sizes

There are three components to MiDAS Camera View and Playback windows – the window frame, the actual image size and the zoom region size.

The ‘frame’ is the outside container of the window, much like a picture frame. The frame size is measured in display pixels.

The ‘Actual Image’ is the complete image, at full resolution. This is also termed the image or camera resolution. The image may be larger than the frame or larger than the desktop itself.



The “Zoom Region” is the portion of the actual image that is actually displayed within the window frame, measured in actual image pixels.

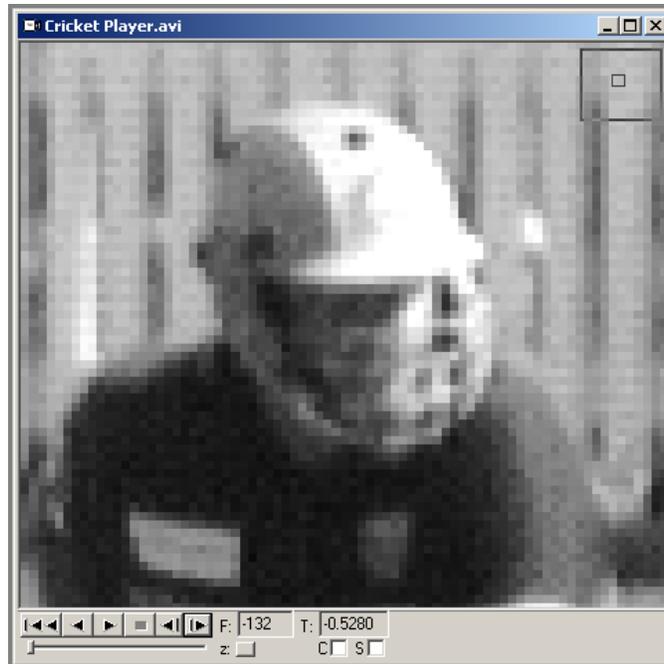
For example, the following image of a cricket player was recorded at 480x420 pixels: The zoom region -- the player’s head, as shown at upper right -- is 80x70 pixels.



When the zoom region is placed in a window frame of 640x560 pixels, the final displayed image looks as shown below.

In this example, the MiDAS status bar will report the following numbers (pixels)

Actual Image size: 480x420  
Zoom region size: 80x70  
View Window size: 640x560.



In this example, the image is magnified 8x (8 times) the actual image size, based on pixel numbers (640x560 divided by 80x70 equals 8).

Magnification of the image can be achieved in any of the following ways:

- Increase the size of the window frame by clicking on one side and dragging it larger;
- Increase the size of the view by zooming in on the zoom region. This can be achieved by either changing the View percentage from the menu bar, increasing the View percentage using a contextual (right-click) command, or by using the click-drag zoom feature.

*Note: A zoom ratio of 1 means that the image and the frame are the same size. A zoom ratio of greater than 1 means the image is larger than the window frame and that only a portion of the image (i.e. the zoom region) is displayed within the window frame.*

The following zoom and magnification commands are very useful. These can be accessed via either the menu under View or by right clicking within a View window:

**View Actual Pixels**

When selected, this command sets the zoom region and the window frame to be equal to the actual image size. That is, everything is displayed within a frame at 1:1.

<b>View x %</b>	<p>When selected, this command sets the window frame to be a multiplier times the actual image size. For example, if 200% is selected in the above example, the frame is set to 960x840 pixels.</p> <p>If the new frame size is larger than the desktop area permits, then the image is zoom magnified to the correct value and the window frame limited to the maximum size permitted by the desktop. For example, if 400% is selected in the above example, the image is magnified 4x to 1920x1680, but only the available number image is displayed (for example 969x848). In this case, the status bar will display the number of image pixels contained within the frame in the zoom region size box and the View window size will be the available display dimensions.</p>
<b>View Max</b>	<p>When selected, this command determines the largest window frame of the correct aspect ratio that will fit within the desktop area. It then fits the entire image within a frame of this size. In this case, the status bar will display a zoom region equal to the View window size.</p>
<b>Fit in Window</b>	<p>When selected, this command fits the entire image into the window frame. This command does not change the window frame size, just the image size. In this case, the status bar will display a zoom region equal to the window frame.</p>
<b>Zoom Image</b>	<p>This command allows you to use your mouse or trackball to easily zoom the magnification up or down of the image. When selected, the mouse cursor turns to a 4-pringed star on the view window. Simply roll the mouse or trackball up the image to zoom up (magnify) or roll downward to zoom down (minify).</p> <p><i>Note: During zooming, the geometric center of the image remains the same.</i></p> <p>The zoom box appears in the upper right corner of the window showing you the zoom ratio – the size of the zoom region relative to the actual image size.</p> <p>The status bar indicates the size of the zoom region, in pixels.</p>



**Pan Image**

This command allows you to use your mouse or trackball to easily pan the image – move the image in any direction to optimize its location.. When selected, the mouse cursor turns to a 4-pringed star on the view window. Simply roll the mouse or trackball in any direction to scroll the image in that direction..

The location box appears in the upper right corner of the window showing you the relative size and location of the window on the actual image size.

The status bar indicates the size of the zoom region, in pixels.

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**Set Zoom Window**

This command lets you draw a box around any portion of the image and create a separate Zoom Window. A zoom window behaves exactly like a Playback Window, and can be further interacted with as described above (pan, zoom, change view size, etc..)

To magnify the image to the largest possible size permissible by your video display, click on the Magnify button within the window toolbar. Click on the restore button to restore it to the previous size.

If the visible resolution exceeds the view resolution (e.g. the image is magnified), a small zoom map will be displayed that illustrates the current visible size and position relative to the overall view size and location. The zoom map position may be moved to any corner of the screen by right clicking within the window and selecting **ZOOM MAP LOCATION**.

## **The MiDAS Control Panel**

The tabs contained within the Control Panel are the primary means of interacting with the MiDAS program. By clicking on the various left-hand tabs, such as “Play” or “Record”, specialized controls for that particular tab are presented.

The Control Panel contents automatically change depending on what mode MiDAS is in currently. The Record tab is visible during camera control. The Play tab is automatically moved to the front when the recording is complete.

The Control Panel is typically docked on the left or right side of the MiDAS window. It can also be undocked and repositioned anywhere on the screen. To undock the Control Panel, double-click near the top of the docked region of the Control Panel.

To dock the Control Panel, drag the window to the left or the right side of the Console area. If you would like to move the Control Panel near the edges of the Console window without allowing it to dock, press and hold the **CTRL** button while dragging the Control Panel window.

*Note: If you have dragged the Control Panel window off the lower portion of the screen and you cannot get it to reappear, it is likely that the window is hidden beneath the Windows Taskbar. In order to uncover the window, click and drag the Windows Taskbar to the right, left, or top of the screen temporarily. This should reveal the Control Panel window, which you can then drag back towards the center of the screen.*

At the bottom of the Control Panel is the Status Box. This box is used only by MiDAS to indicate the current status of the MiDAS software or to advise users of triggering or usage conditions. Typical Status Box messages might be “Trigger Activated”, “Recording”, and “Saving data”.

*Note: The MiDAS convention is to show those parameters that are set by the operator in white. Items in gray are not accessible.*

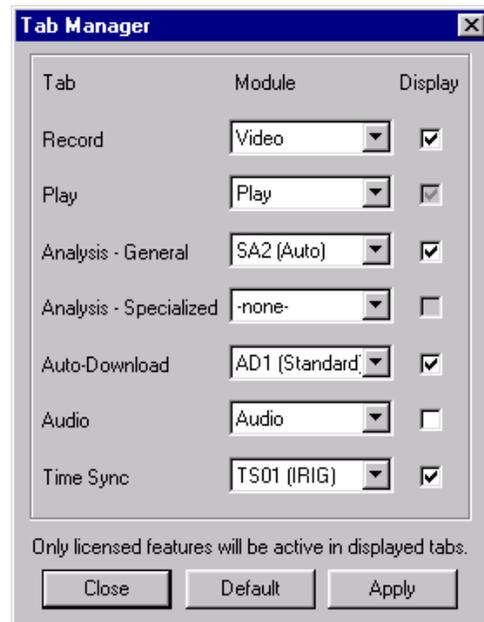
## **The MiDAS Tab Manager**

The choice of which tabs to display in the Control Panel can be set using the Tab Manager.

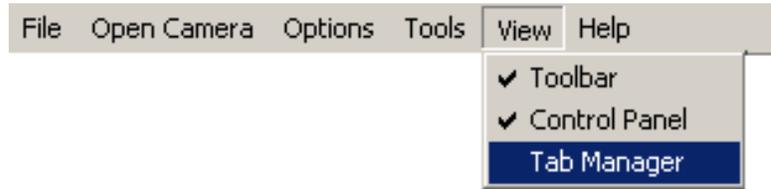
The Tab Manager lists all the possible tabs that could be displayed. The “Play” tab is always displayed by default. The other tabs can be selectively displayed or hidden by clicking on the checkboxes on the right and then clicking on **APPLY**.

Each of the tabs may have different modes of operation. For instance, the Record tab can be set to record just Video, or it can record Video & Data.

Non-licensed tabs can be displayed, however, the features within those Tabs will not be active. This allows individuals to view the possible functionality within the various other



tabs. The **DEFAULT** button will automatically set the display settings to the tabs that have been licensed.



The Tab Manager can be displayed by selecting **VIEW** and then **TAB MANAGER** from the top menu bar.

In addition to previewing the functionality in unlicensed tabs, the Tab Manager can also be used to reduce clutter in the Control Panel by selecting only those most frequently used tabs. This can also be beneficial when systems are deployed in areas where users are less familiar with the more advanced functionality of the system, and a reduced set of options should be presented by default.

## The Playback Shortcut Bar

Under each video display, you will find shortcuts to buttons and features also found in the “Play” tab in the Control Panel.



These controls include the following:

<b>Playback Controls</b>	These provide the standard play, reverse, rewind, stop, and step controls. The slider beneath the buttons allows for quick scanning through the video and indicates the current position within the video.
<b>Frame and Time</b>	The frame number and time stamp relative to the trigger event are displayed next to the playback controls.
<b>Zoom</b>	The Zoom button allows you to zoom in on a region of interest in the video during playback. When the button is pressed, you can draw a box within the video display and a new zoomed window will appear. The box you have drawn within the video display can also be dragged around to other regions of the display. In order to resize the box, simply

**Extended Play Options**

press the zoom button once again and draw a new box or the correct size.

The “C” checkbox selects a continuous playback mode. When this option is selected, the video will automatically loop around to the beginning whenever the end of the video is reached.

The “S” checkbox selects synchronized playback. This option allows for synchronized playback of multiple video files. When synchronized, the frame position of each of the video files is incremented (or decremented) by the same amount relative to some starting position for each file.

To enable synchronized playback, do the following:

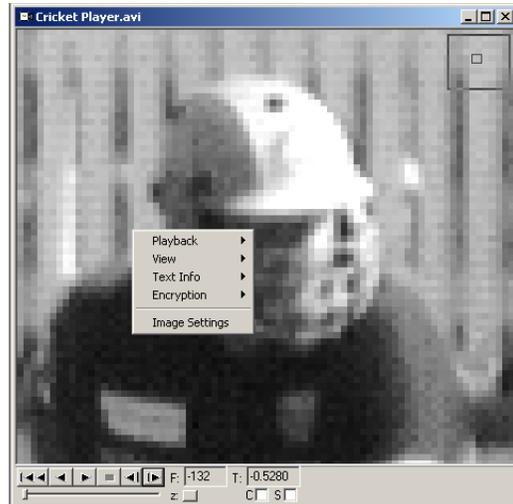
1. Position each video at the desired first frame for synchronized playback.
2. Select the “S” checkbox in each video display window. This sets the starting position to the current frame for each video display.
3. Press the “Play” button in any one of the synchronized video display windows and all the synchronized windows will play simultaneously.

*Note: When using BOTH continuous playback and synchronized playback, only select the “C” checkbox in the window in which you press the “Play” button.*

**Contextual Commands**

In addition to the controls in the menu bar, tool bar, control panel and playback shortcut bar, there are context menus that can be accessed by right-clicking within the video display itself.

When you click the right mouse button



inside of an open view window (e.g. a camera view windows, a playback window or a zoom window), a menu of options is shown.

**Playback Commands (Playback and Zoom Windows only)**

From the right-click menu, you can control the images directly, including forward and reverse single stepping.

*Note: This is a very valuable menu for maximizing the usable area of the screen. For example, hide the Control Panel from the Tools menu. Maximize the image size on the screen and control the image directly using these contextual*



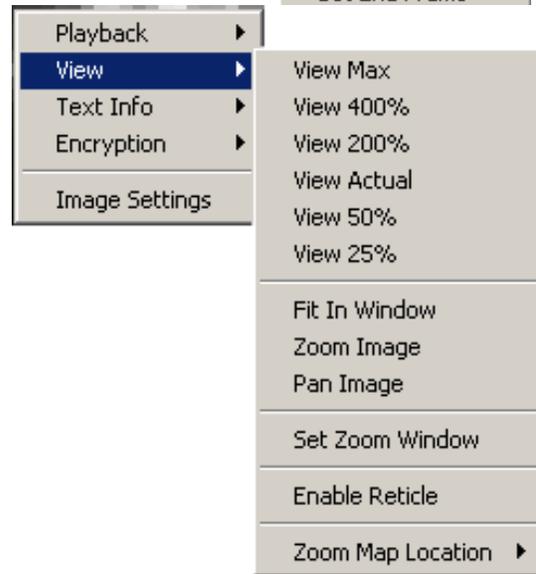
commands.

The Playback controls are discussed in Chapter 7.

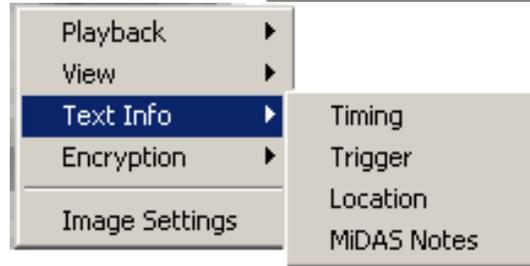
**View**

The contextual view commands include all the window manipulation and sizing function described in the above section (View, View Actual, Fit in Window, Zoom Image, Pan Image, Set Zoom Window).

In addition, it allows you to enable the display of a reticle crosshair on the window. When displayed, the coordinates of the crosshair centerline are shown in the bottom status bar.

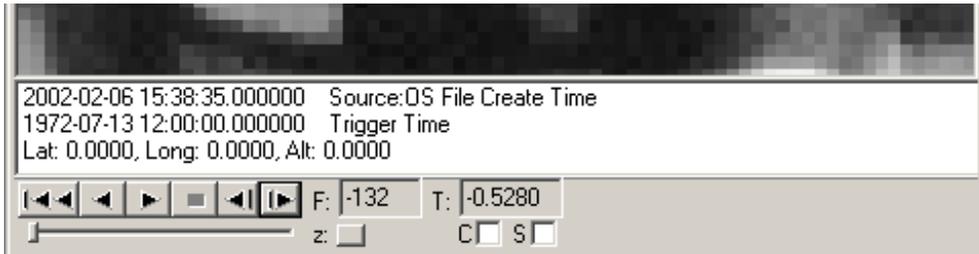


In addition, you may select where you desire the Zoom map – the locator map that shows the location and size of the zoom region relative to the actual image size – to be located. The options are upper right, upper left, lower right and lower left. In addition, you may hide the map.



### Text Info

The **TEXT INFO** menu allows you to display associated frame-by-frame text or data information directly below the video display. Examples of typical information include the trigger time from when the video was acquired, frame time stamping, GPS location, and camera orientation information. When selected, the information is displayed directly beneath the video display as shown.



The top line –Timing – shows the actual time as recorded either from the Operating System clock or an external clock source such as an IRIG generator or GPS satellite (see Chapter 15 – Time Synchronization Modules – for more details).

The second line – Trigger – shows the actual time that an external trigger or Trigger Stop button selection was received.

The third line – Location – shows the physical location, as recorded from a GPS satellite and external camera tracker, in latitude, longitude, altitude, azimuth and elevation. (see Chapter 15 for more details on these items).

The fourth line – Pointing – shows the azimuth and elevation of a camera tracker (see Chapter 15 for more details on these items).

### Encryption

The **ENCRYPTION** menu allows you to decrypt the current video if it is encrypted. Selecting the **DECRYPT** option prompts for a pass-phrase, and if it is correct, the decrypted video frames will be displayed. The decryption is done on the fly in memory, so that the video file on the hard drive remains encrypted. Encryption is discussed in more detail in Chapter 17, “Video/Data Encryption Modules”.

### Image Processing or Palette

The Palette contextual menu allows you to change the palette for display and processing. Palette changes do not affect the original video file or any subsequent Save commands.

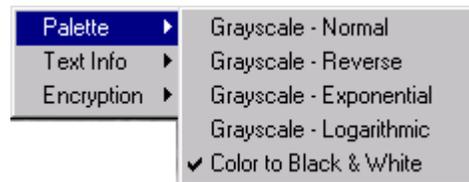
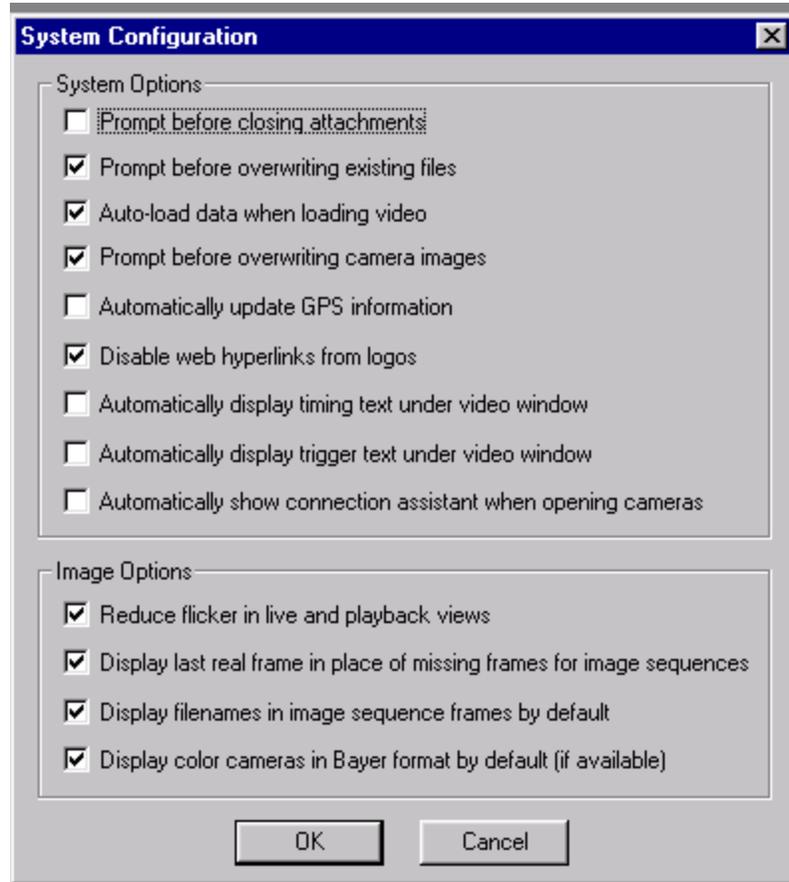


Image processing commands and controls are discussed in Chapter 9 of this Users Manual.

## Configuration Options

The following are options available with all MiDAS Base software. Standard input and output functions (**SAVE**, **LOAD**, **IMPORT**, **EXPORT**, etc.) are described in Chapter 10 "Saving and Loading". The **VIEW** option (toolbar) is self-explanatory.



Under the **OPTIONS** menu item, the **SYSTEM CONFIGURATION** window can be accessed. Within this window are various options for personalizing your version of MiDAS. The options are as follows:

**Prompt before closing attachments**

When enabled, this option instructs MiDAS to prompt the user before closing any window on the console (e.g. data window, video window, or spreadsheet window)

<b>Prompt before overwriting existing files</b>	When enabled, this option instructs MiDAS to warn the user that an overwrite is requested and to ask confirmation before proceeding.
<b>Auto-load Data when loading Video</b>	When enabled, this option instructs MiDAS to look for a data file that is associated with the requested video file. If such a data file is located, MiDAS opens both the video and data file. If no such file is found, MiDAS only opens the requested video file.
<b>Prompt before overwriting camera images</b>	When enabled, this option instructs MiDAS to prompt the user when an existing image in the camera is about to be lost. Typically, this message appears when the LIVE button is pressed after a playback.
<b>Display last real frame in place of missing frames for image sequences</b>	When playing a video comprised of a sequence of image files (BMP, TIF), if there is a missing frame in the sequence of images, MiDAS will by default skip the missing frame and continue the playback with the next available frame in the sequence. When this option is selected, MiDAS will display the last real frame in place of the missing frame, and in the upper left hand corner of the video, it will display “Missing” to indicate that this frame is a repeated frame.
<b>Automatically update GPS information</b>	When enabled, MiDAS automatically synchronizes video recording timing to the network of GPS satellites. See Chapter 15 for more information. When not selected, MiDAS uses the OS clock for time synchronization
<b>Disable web hyperlinks from logos</b>	When enabled, the MiDAS logo does not open the default system browser.
<b>Automatically display timing text under video window</b>	When enabled, the timing text is automatically displayed below each Playback window.
<b>Automatically display trigger text under video window</b>	When enabled, the trigger time is automatically displayed below each Playback window.
<b>Reduce flicker in live and playback views</b>	When selected, this feature reduces the amount of flicker in the live and playback views, for a higher-quality image appearance. If not selected, screen flicker will be more prevalent, but the software will update the images faster.



**Display color images in Bayer format by default**

When selected, MiDAS displays color images in native monochrome Bayer pattern for faster operation.

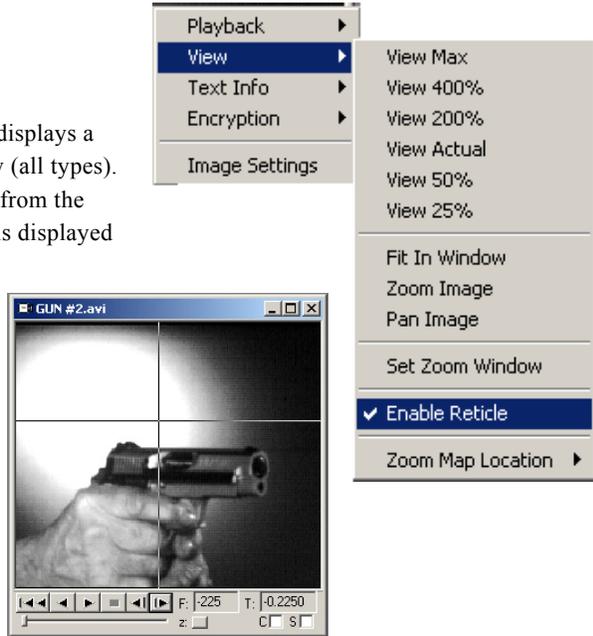
**Automatically show Connection Assistant when opening cameras**

When selected, MiDAS automatically displays the Connection Assistant when a second camera or when an external master component is present.

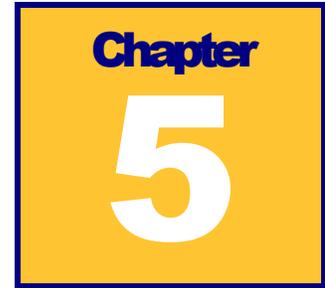
**The Reticle**

When enabled, the Reticle function displays a crosshair reticle on the view window (all types). The location of the reticle, in pixels from the upper left corner of the image (0,0) is displayed in the furthest left box on the status bar.

To enable and disable the reticle function, right click within any view window, then select/unselect Enable Reticle. The position of the reticle, in pixels from the upper right corner of the window is displayed in the Status Bar.







# Interconnecting Cameras and Other MiDAS Hardware

## MiDAS Synchronization

One of the key benefits of MiDAS is the ability to synchronize multiple cameras with each other and with external hardware such as sensors, lab equipment, timing generators and transducers.

MiDAS synchronizes cameras and hardware in a daisy-chain manner. The first component of the chain is termed the “master” and all the subsequent components are “slaves”. If external hardware is present (e.g. a camera, data acquisition card, timing card or timing generator), such hardware will always be the master timing source for the cameras. If only cameras are present, then the camera occupying the first position in the chain is considered the master camera and the subsequent cameras are synchronized to the master camera clock source. In other words, subsequent cameras only capture a frame when the master camera or master external hardware sends a synchronization pulse to the other cameras. In MiDAS, there are no master/slave settings required.

MiDAS actually controls the internal oscillator clocks of all the systems interconnected within the current system.

MiDAS knows which hardware is being used and actively configures the system accordingly. The MiDAS Connection Assistant explains how to interconnect the hardware. The process for interconnecting cameras and other hardware is as follows:

1. Open the cameras in sequence
2. Run the MiDAS Connection Assistant
3. Interconnect the hardware per the Connection Assistant diagram.

This process can be reversed. Advanced users may interconnect the hardware first, then open the cameras in the order to match the interconnection.

### **Open Camera Command**

MiDAS knows which camera(s) are properly installed in the computer. It will label the cameras correctly for your selection. To address a specific camera, you must first open it as follows:

1. Click on **OPEN CAMERA**.
2. Click on the camera of choice from the list.

*Note: The first camera that is opened is termed to be in “chain position 1” – the camera in chain position 1 is the only camera connected to external hardware.*

Open subsequent cameras in the same manner. After you open each camera, the title bar above the live camera frame will display the camera label and the position on the daisy chain.

*Note: If you are using multiple cameras, MiDAS will add the Chain Position to the camera view window title bar.*

*Note: You may change the name of the camera for multiple cameras to help with differentiation. For example, name one camera “Bottom View” and one camera “Top View”.*

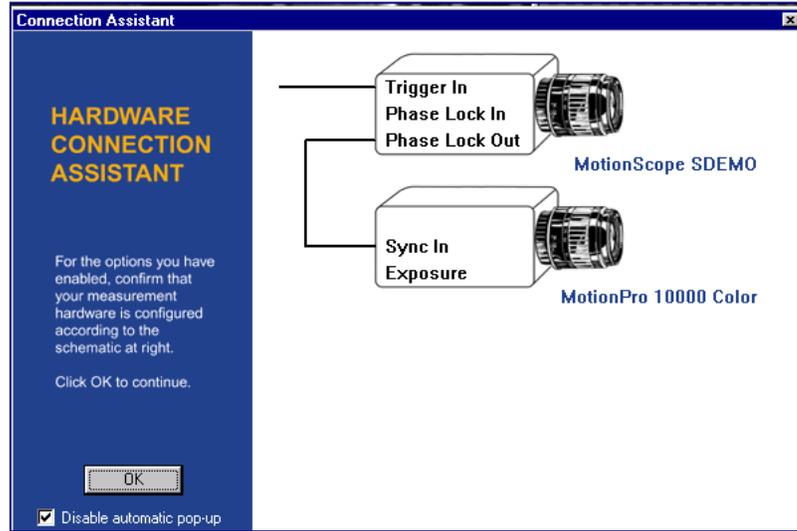
### **The MiDAS Connection Assistant**

The MiDAS Connection Assistant dynamically graphically depicts how to interconnect the hardware. This feature helps you confirm and, if necessary, set up the cabling and interconnection between cameras, data acquisition systems and external timing boards.

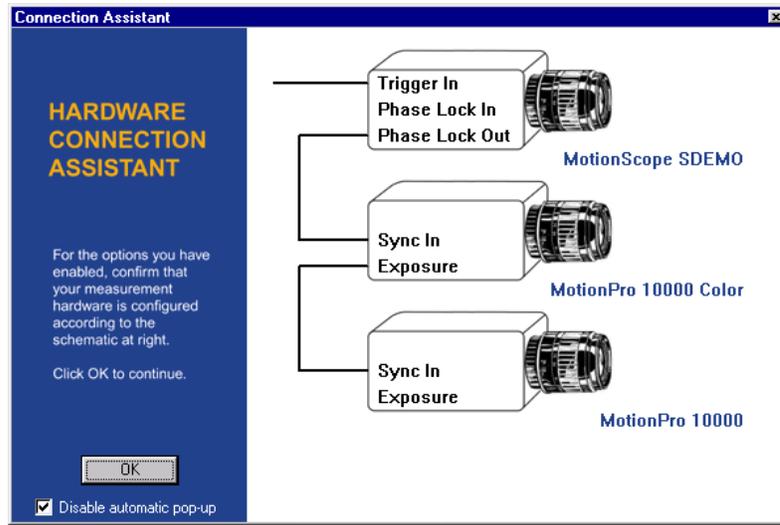
The MiDAS Hardware Connection Assistant will automatically launch whenever a slave camera is opened. It can be also be opened from the **TOOLS** menu item:

Depending on what hardware is installed, enabled and opened, the MiDAS Connection Assistant will show the interconnection diagram. The following is an example of the

Connection Assistant that would open for two video cameras only (e.g. a MotionScope PCI and a MotionPro).



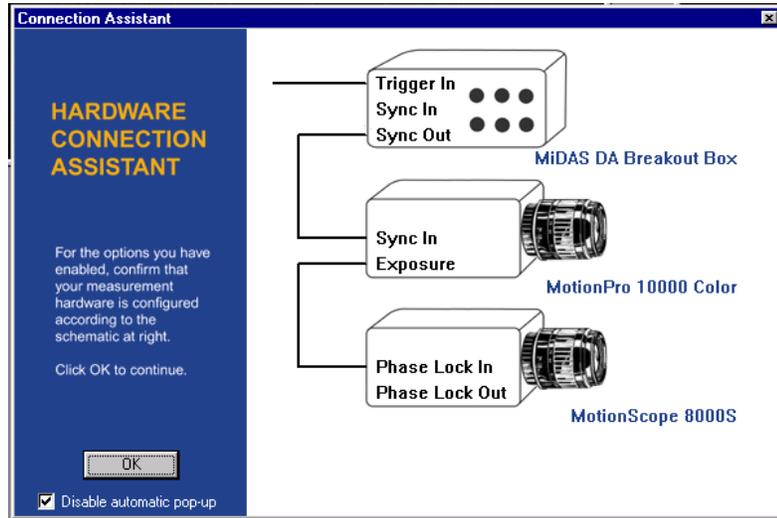
The Connection Assistant indicates that the user must connect the Phase Lock Out connection on the first camera to the Sync In connector on the second camera. When a third camera is opened, the Connection Assistant depicts the following:



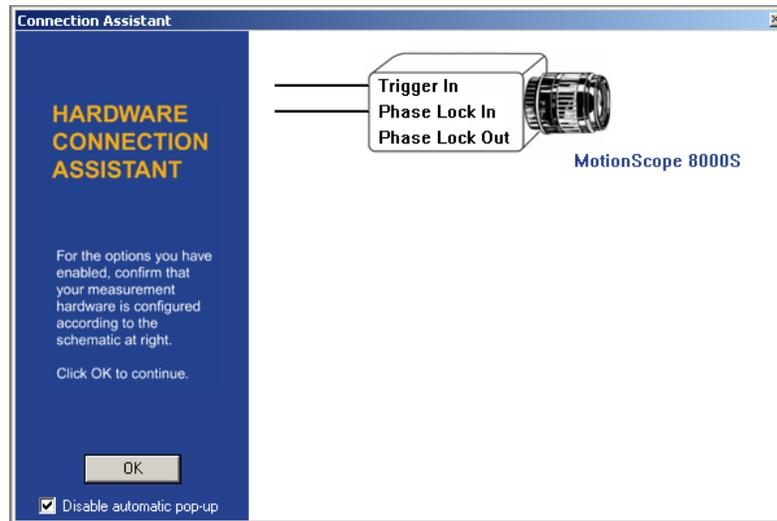
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If a Data Acquisition (DA) module is also added, the Connection Assistant will show the following:



If the First Camera Slave option has been selected under the Record Options (see chapter 7), the Connection Assistant will show the following:



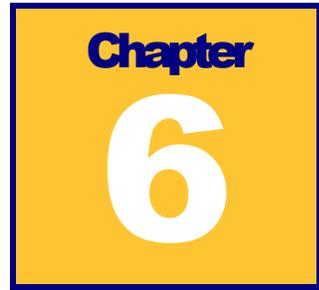
## **Interconnecting the Hardware**

Using the BNC coaxial cables provided with your MiDAS hardware, connect your system as follows:

1. If you have a TS-01M, -TS-02M or TS-03M module, connect one end of a BNC cable to the “Heartbeat Out” connector on the multi-pin breakout cable. If you are not using a TS module, skip to step 5.
2. If you have a MiDAS DA module installed, connect the other end of the BNC cable to either the BNC connector on the BNC Breakout Box labeled “Sync In” (or to the screw terminals labeled “Sync In” on the CB-68LP screw terminal block). If you are not using a MiDAS DA module, skip to step 5.
3. If you have a MiDAS DA module, connect one end of a BNC cable to the “Sync Out” connector on the BNC Breakout Box (or to terminal 40 of the MiDAS DA screw terminal block, ground to terminal 35).
4. Connect the other end of the cable to the input connector shown on the Connection Assistant for first camera in the chain.
5. Interconnect all the cameras as depicted in the Connection Assistant.







## Event Triggering

MiDAS provides numerous triggering options to ensure that all the components of the measurement event are captured properly. MiDAS can be triggered from an external source such as a hand trigger or a machine pulse. Clicking on the **STOP** or **TRIGGERSTOP** buttons on the Record tab can also trigger MiDAS. **STOP** and **TRIGGERSTOP** are collectively termed software triggers.

### MiDAS Triggering Overview

When MiDAS is in record mode, video from the cameras and data sensors controlled by MiDAS are streamed directly to the camera board RAM and/or the computer RAM. MiDAS controls the acquisition process precisely, keeping track of time and location of frames and data from the external sensors. MiDAS also keeps track of time from external phase lock devices such as GPS and IRIG generators.

The video and data is collected into synchronized revolving memory buffers in a first-in-first-out basis. Therefore, the most recently streamed information is always available in the memory buffer. If one were to encode and unwrap a 10-frame buffer, the record sequence would repeat through the frames as follows:

1-2-3-4-5-6-7-8-9-10-1-2-3-4-5-6-7-8-9-10-1-2-3-4-5-6-7-8-9-10-1-...

MiDAS will continue to infinitely record into the revolving memory buffers until a trigger event is received. A trigger event is either a software trigger or a hardware trigger. When MiDAS is in record mode, the remaining two software trigger buttons on the Record tab become active.

Triggering causes two events to happen:

1. Stop the recording at the desired time.
2. Isolate the exact point in time that the trigger impulse was received by MiDAS hardware.

The user sets the Trigger Percent (on the Record tab) to tell MiDAS when to stop the recording and where to put the Reference Frame 0 (video) and the Reference Datum 0 (data). The trigger percentage is the pre-trigger percentage of the total acquisition. For example, a trigger percentage of "0%" instructs the MiDAS software to (1) continue to acquire one full buffer of images (acquire 0% before the trigger and 100% after the trigger) and (2) to put the Reference Frame 0 at the beginning of the sequence. Alternatively, a trigger percentage of "100%" instructs the MiDAS software to (1) stop acquisition immediately upon receipt of a trigger input (acquire 100% before the trigger and 0% after the trigger) and (2) to put the Reference Frame 0 at the end of the sequence.

In the resulting captured sequence, frames with negative numbers are BEFORE the trigger pulse was received and frames with positive numbers are AFTER the trigger pulse was received.

There are three methods for stopping a recording:

- Sending a hardware pulse to the camera or other MiDAS hardware
- Clicking on the **TRIGGERSTOP** button
- Clicking on the **STOP** button.

*Note: Not all optional modules support both types of software triggers. Only those modes available to you are highlighted or displayed.*

## **Trigger Stop Command**

MiDAS treats pressing the **TRIGGERSTOP** button and an external hardware trigger the same. Upon receipt of a trigger stop (software or hardware) command, MiDAS executes the stop record function per the trigger settings (pre-record time and post-record time). The **TRIGGERSTOP** button places the Reference Frame 0 at the trigger point of the video sequence and the Reference Datum 0 at the trigger point of the data.

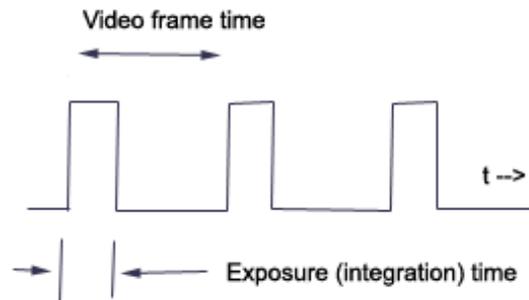
## STOP Command

Pressing the **STOP** button immediately stops the recording function and places the Reference Frame 0 at the end of the sequence. In other words, the **STOP** button behaves like the trigger percent is set for 100%, regardless of its actual setting

## Defining a Frame, Exposure Time, and Buffer

Most often, the time that a video camera is actually acquiring images of the scene is only a small fraction of the total time. The actual acquisition time is termed the Exposure Time or integration time, and is most often measured in microseconds.

A video frame is defined to be the total time between exposures. A buffer is a sequential collection of video frames. The following time line drawing shows this relationship:



For example, if the video acquisition rate is 1000 fps, the video frame duration is 1 ms. The exposure time might only be 20 microseconds in duration. Therefore, the camera is only acquiring scene information (e.g. light) for 2% of its operation time.

In MiDAS, frame counting is done at the leading edge of the frame. In this example, the exposure time (the time the camera shutter is open) is at the beginning of the frame. Some cameras integrate at the end of the frame. Consult your camera manual for information about your specific camera.

The Reference Frame is the frame in which the external event trigger is received. Whether a trigger is received during the exposure period or during the dark period has no impact on labeling the Reference Frame.

This subtle definition is very important. In the above example, if a trigger pulse is received after an exposure period is complete, then the first post-trigger image is on frame 1, not frame 0. Consequently, the image of frame 0 was acquired prior to the event trigger.

## The Reference Frame and Reference Datum

MIDAS places the Reference Frame 0 and the Reference Datum 0 per the following rules. The term “buffer” refers to a single memory buffer, “Trigger Stop” refers to either clicking on the **TRIGGERSTOP** button or executing an external trigger, and “Stop” refers to clicking on the **STOP** button.

If...	What is returned...	Reference Frame is ...
Buffer has been filled prior to Trigger Stop	A full buffer of video/data	On the frame corresponding to when the trigger was received.
Buffer has been filled prior to Stop	A full buffer of video/data	On the last frame and on the last data point.
Buffer has not been filled prior to Trigger Stop	All frames acquired prior to Trigger Stop and the desired number of post-trigger frames.	On the frame corresponding to when the trigger was received.
Buffer has not been filled prior to Stop	All frames acquired prior to Stop.	On the last frame and on the last data point.
Buffer has not been filled, Trigger Stop executed, then Stop	All frames acquired prior to the Stop	On the frame corresponding to when the trigger was received.

*Note: Some cameras do not add a frame after receiving an external trigger. That is, if the MIDAS trigger percent is set to 100% and an external event trigger is received in the middle of a video frame, the camera immediately stops and only returns all the frames prior to the trigger frame. In this case, there is no Reference Frame 0 and the last frame is frame number -1. Most cameras continue recording for one or two frames after receipt of an external trigger to provide a trigger frame.*

## Connecting an External Event Trigger

To trigger MIDAS using an external trigger pulse from a sensor or machine output, you must connect that sensor to a physical MIDAS component. You must always connect the event trigger to the first component on the synchronization chain (see Chapter 5 for more details on chains).

The location of the master component depends on what combination of MiDAS modules you have installed and determines where you should connect your external trigger, as follows:

If you have installed and enabled...	Connect the trigger to...
MiDAS with data acquisition (DA)	MiDAS DA BNC Breakout Box, Terminal Block or 5B+ Rack
MiDAS with data acquisition (DA) and IRIG/GPS time code monitoring (TS)	MiDAS-TS IRIG/GPS board
MiDAS with IRIG/GPS time code monitoring (TS), but without data acquisition (DA)	MiDAS-TS IRIG/GPS board
MiDAS without both IRIG/GPS time code monitoring and data acquisition (DA)	Trigger input on camera in chain position 1

**WARNING:** *If a MiDAS DA or TS module is present and enabled, the MiDAS system will not trigger if the external trigger is connected to a camera directly!*

*Note: When chaining multiple cameras together, make sure to connect the external trigger to the "Trigger In" connector on the first camera in the chain. For more information on externally triggering your camera, consult your camera User Manual and Chapter 12 of this manual.*

*Note: When chaining multiple cameras together, make sure to connect the "Trigger In" to the first camera in the chain.*

The easiest method of determining where to connect your external trigger is to use the MiDAS Connection Assistant. The MiDAS Connection Assistant, in addition to helping you confirm and the cabling and interconnection between multiple cameras, data acquisition systems and external timing boards, also explains where to connect the external trigger input.

The MiDAS Hardware Connection Assistant can be opened from the **TOOLS** menu item:

Depending on what hardware is installed and enabled, the MiDAS Hardware Assistant will show the interconnection diagram. The following Connection Assistant screen depicts 2 cameras and a TS module:

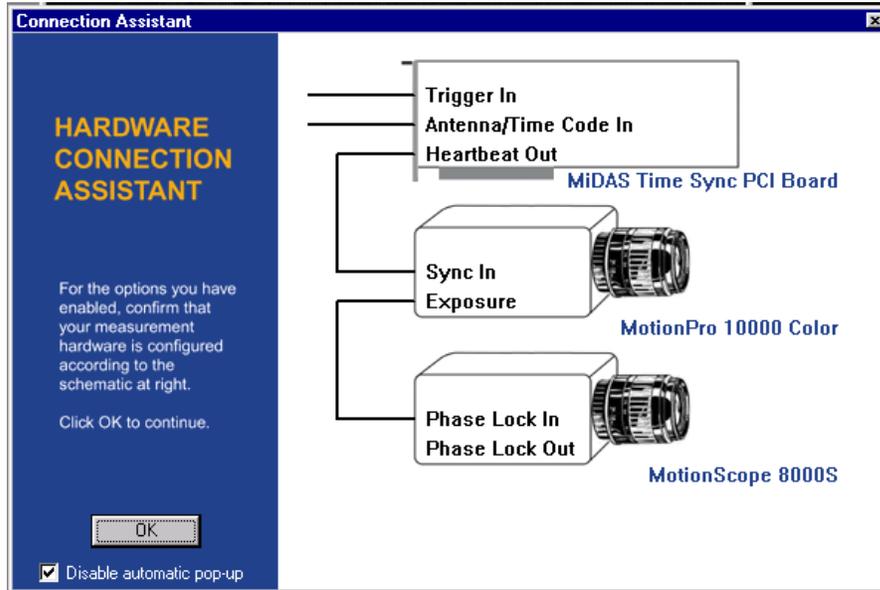
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In this example, the external event trigger is connected to the Trigger In connector on the Time Sync PCI board, as shown.

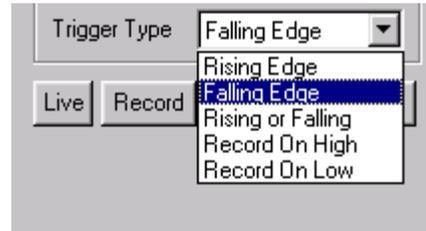
*Note: Consult with your camera manufacturer to find the input trigger location and labeling. Camera manufacturers often change label conventions.*

*Warning: Do not connect your event trigger to more than one location – it will confuse the clocks and potentially ruin your measurement. Connect the trigger to one place only.*



## Trigger Input Type

MIDAS2.0 allows 5 different types of external triggers, as shown in the box at right. The trigger type is set from the Record Tab. The types of triggers, the input voltage ranges, the triggering thresholds, and the connection types are determined by your camera and frame grabber architecture. In addition, many cameras and/or frame grabbers allow a contact closure to be interpreted as a trigger event. Consult the users Manual of your specific camera system to determine which trigger types and characteristics are available.



If your camera does not support a certain trigger type, that option is grayed on the menu.

See Chapter 2 for information on connecting an external trigger to MiDAS hardware.

*Note: Select **FALLING EDGE** when using MiDAS Motion Trigger.*

The types of external event triggers are as follows:

<b>Rising Edge</b>	Select Rising Edge if your event trigger generates a positive going pulse.  Select Rising Edge if your camera hardware interprets a contact closure as a trigger event.
<b>Falling Edge</b>	Select Falling Edge if your event trigger generates a negative going pulse.
<b>Rising or Falling</b>	Select Rising or Falling if you wish to trigger upon either type. For example, if you have a latching trigger or a flip-flop or a logic device that sends out a pulse, use this option.
<b>Record on High</b>	Set Record on High if you desire to place your camera in Record on Command (ROC) mode and record video only when an input pulse exceeds a threshold. In this mode, the MiDAS records video and data for as long as the trigger pulse is high. When the trigger line goes low, MiDAS stops recording. You may repeat the recording until the memory buffer is full. A full description of this mode of recording is described below.

**Record on Low**

Set Record on Low if you desire to place your camera in Record on Command (ROC) mode and record video only when an input pulse falls below a threshold. In this mode, the MiDAS records video and data for as long as the trigger pulse is low. When the trigger line goes high again, MiDAS stops recording. You may repeat the recording until the memory buffer is full. A full description of this mode of recording is described below.



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**Base  
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## Recording Video

This section describes the basic features of MiDAS for recording video. The term “video” in this section is interchangeably defined as either (a) a single file that contains all the frames and the playback header information, or (b) sequences of individual images, each contained within its own file and sequentially numbered for playback in the correct order. The most common video format is .AVI. The most common formats for image sequences are .BMP and .TIF.

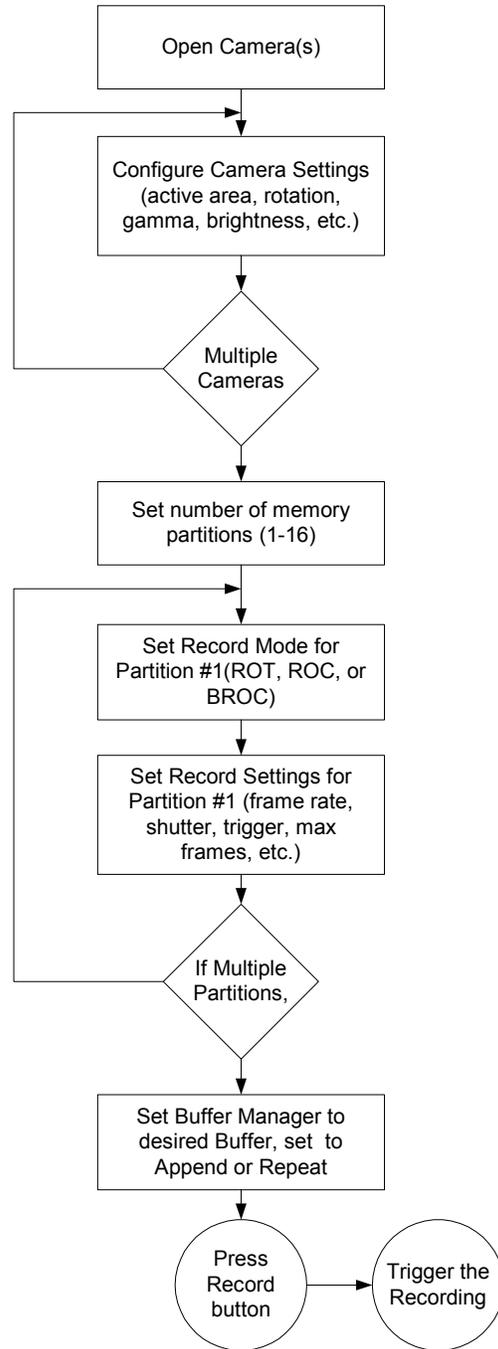
Acquiring video is the fundamental component of MiDAS. Video can be automatically acquired (Auto-Download, Chapter 14), synchronized with external data (Data Acquisition, Chapter 12) and acquired on external events (Triggering, Chapter 6). This section contains the basic video acquisition theory and the instructions for acquiring video in stand-alone mode. You are referred to the above chapters for more information on advance recording modes.

In a simplistic form, MiDAS controls video cameras, instructing them how and when to acquire pictures and what to do with the acquired information. In most cases, the information from the sensor is passed to memory contained on the frame grabber or to computer memory.

### The Record Sequence

To Record a video (and synchronized data, if enabled – see Chapter 12), follow these simple steps:

1. Open and configure your camera. Repeat for each camera in your chain.
2. Configure (partition) your memory buffers.
3. For each memory buffer, set the Record Mode and the Record Settings from the Control Panel.
4. Go to the memory buffer of interest and set MiDAS to either Append or Repeat.
5. Press the Record button
6. Trigger your recording.



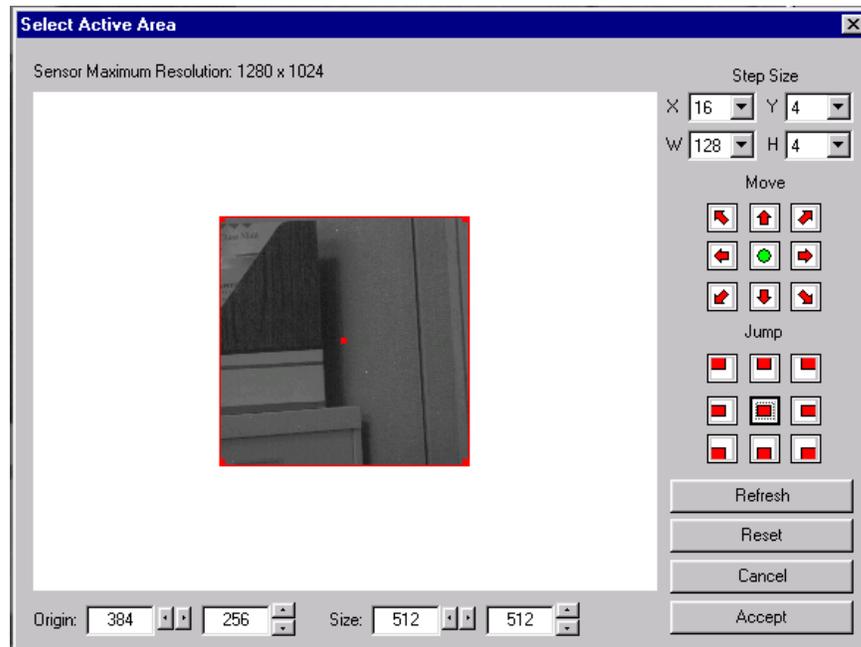
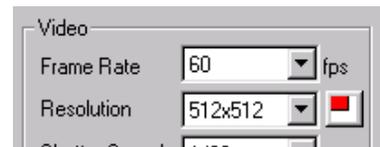
## Opening Camera(s)

Connect your camera(s) per the instructions in Chapter 5. If you have multiple cameras in your system, interconnect the hardware per the instructions in the MiDAS Connection Assistant. Connect the external event trigger (if used) per the instructions in Chapter 6. MiDAS will automatically check and display a live image for each camera opened.

*Note: You may change the name of the camera for multiple cameras to help with differentiation. For example, name one camera "Bottom View" and one camera "Top View".*

## Setting the Camera Active Area

For cameras that support the variable placement and sizing of the active area, the button to the right of the resolution setting will be enabled. Click on this button to bring up the Select Active Area dialog window, as shown below:



There are multiple ways to modify the active area. The most straightforward method is to “drag-and-drop” by clicking on the small red square markers on the image. Clicking and dragging corner marker will reposition that corner of the active area, adjusting the width and height as necessary. Clicking and dragging the center marker will shift the active area, while maintaining the same width and height.

Additional controls are provided for more precise selection. Each of these are described below.

<b>Move</b>	The Move buttons allow you to move the active area in the directions indicated by the arrows. Click on any of these to reposition the desired active area. When you are satisfied with the new location, click on the green circle button in the center to apply the changes.
<b>Jump</b>	The Jump buttons are provided for quick placement of the active area in common locations. These buttons will place the active area in the upper-left, top-center, upper-right, middle-left, center, middle-right, lower-left, bottom-center, and lower right respectively.
<b>Origin and Size</b>	Finally, you can directly edit the origin and the size of the active area in the Origin and Size controls located beneath the sensor image. Values can be entered in directly or you can push the left-right, up-down buttons adjacent to each entry to increment or decrement the respective values. Note that values entered into the Origin and Size controls may be rounded to the nearest allowable value based upon the constraints of the hardware.
<b>Step Size</b>	The impact of each of these additional controls described here is governed by the Step Size selections in the upper right corner. The X and Y step size selections will dictate how much the X and Y coordinates of the origin are shifted when the Move arrow buttons are pushed or the “Origin” left-right, up-down buttons are pushed. The W and H step size selections will dictate how much the width and height of the active area are changed when the Size left-right, up-down buttons are pushed. The choices for the X, Y, W, and H increments are dictated by the hardware and cannot be arbitrarily set.

While adjusting the active area, the camera image is automatically refreshed whenever the selection is changed. However, there may be instances when you wish to force the update of the image. You can push the **REFRESH** button and this will retrieve the live image from the camera and update the dialog.

If you have modified the active area, but wish to go back to the original settings when the dialog was opened, push the **RESET** button.

To close the dialog, you can either select **CANCEL** or **ACCEPT**. **CANCEL** will undo any changes that you have made and restore the settings prior to opening the active area dialog. **ACCEPT** will commit the changes you have made.

After you have closed the dialog, the new resolution that you have selected will be shown in the resolution settings of the Record tab. However, in order to view the origin settings, you must re-open the Select Active Area dialog.

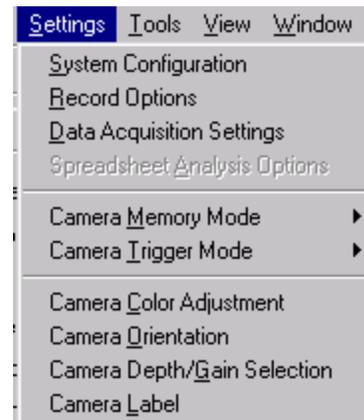
*Note: When moving the active area away from the mechanical center of your camera, you may require higher performance and larger format lenses.*

## Additional Camera Settings

Additional camera features can also be accessed by clicking on the **SETTINGS** button on the Record tab.

*Note: The Additional Settings window may be appear slightly different for your camera, depending on which features are supported by your camera and frame grabber hardware. Unsupported features are grayed out on the screen.*

These features can also be accessed through context menus with a live camera window highlighted.

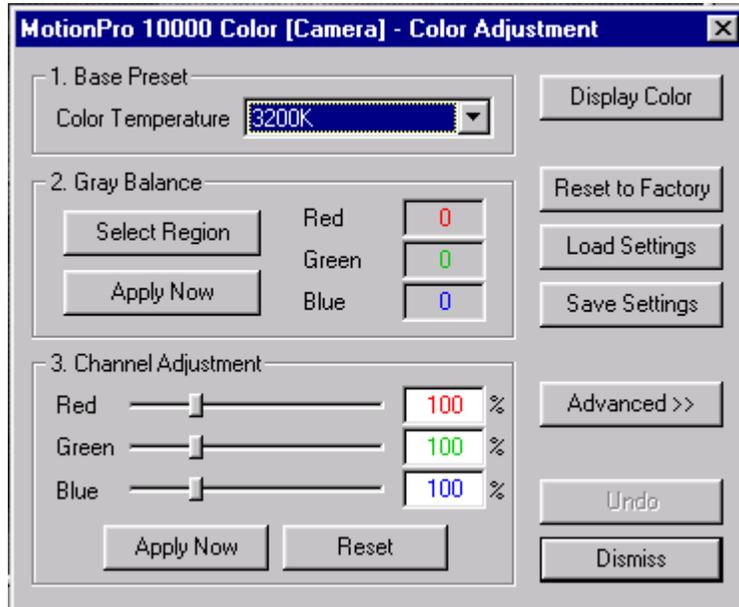


## Setting up Color Cameras

Many cameras generate images in a Bayer format (which appear like patterned grayscale images). These Bayer images are converted to color images using a set of nine color coefficients. These color coefficients can be modified to account for color temperature, gray balance, and color balance.

The coefficients for a given camera are set using the Color Adjustment window shown here. This window can be accessed either through the main menu, under Settings, or by right-clicking in each live camera display window and selecting Camera Color Adjustment.

The buttons along the right side of the Color Adjustment window perform the following operations:



<b>Display Color / Display Bayer</b>	This button switches between displaying the images in raw Bayer format or in color. When displaying in color, the update rate will be slower due to the added computation required for the color conversion. The only effect of this selection is the refresh and display speed.
<b>Reset to Factory</b>	The cameras have a set of default coefficients which were set at the factory. This button resets the color coefficients to the default factory values.
<b>Load Settings</b>	Sets of coefficients can be stored to file using the Save Settings button and later restored using this load button.
<b>Save Settings</b>	Once you have found a good set of coefficients for a given lighting situation, you can store these coefficients to a file which can be later be loaded using the Load Settings button.
<b>Advanced / Basic</b>	The Color Adjustment window can be displayed in two formats, either Basic or Advanced. The Advanced version allows for direct modification of the nine color coefficients.



<b>Undo</b>	This button will undo the last change which was made to the set of color coefficients.
<b>Dismiss</b>	This button closes the window.

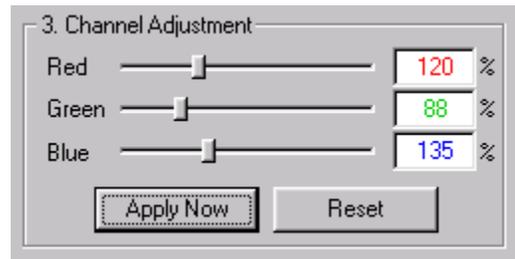
Along the left side of the window, there are three numbered sections. These have been numbered to indicate the order in which a typical user might adjust the color settings for the camera.

The first section allows you to choose from a number of preset coefficients that can be thought of as color temperature settings. The first two items in the drop down box are “Manual Settings” and “Factory Preset”. If you select Factory Preset, then the default coefficients that are stored in the camera are loaded. Manual Settings is a special selection that represents any set of coefficients that do not match one of the other presets. For instance, if you load a set of coefficients from a file that do not match any of the other color temperature settings, the drop down box will display “Manual Settings”. Other selections in the drop down box represent suggested sets of coefficients for a given lighting situation.

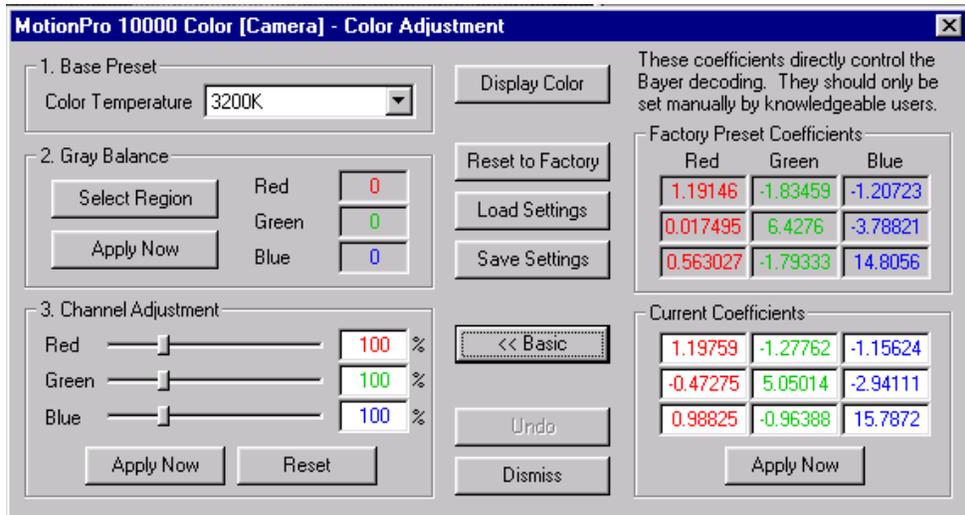
Once you have selected a base preset setting, you must decide if the color appears satisfactory. If you wish to do additional adjustment, you can use the automatic gray balance tool or do color balancing. The gray balance tool is a simplified interface to the color balance sliders. The gray balance tool allows you to select a region in your image that should be gray by pressing the “Select Region” button. After you have selected your region, then press “Apply Now”. The average of the red, green, and blue values of the pixels within the region you selected are computed and the color balance sliders are adjusted so that the red, green, and blue values would all become equal, attempting to make the region in the image appear gray (red = green = blue).



If after gray balancing, you wish to do some additional adjustment to the color, you can modify the color balance sliders directly. Settings of 100% for each of the three sliders represent the same amount of red, green, and blue as specified using the base preset from Section 1. A setting of 150% represents 1.5 times more of that particular channel. A setting of 0% represents none of that channel. The **RESET** button resets the sliders to the results from the last gray balance application.

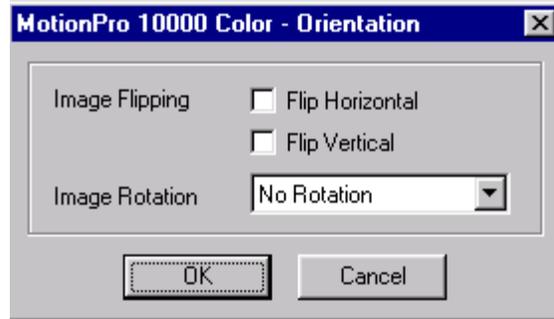


If you wish to do additional fine tune adjustment of the color coefficients, you can modify the coefficients directly using the Advanced version of the Color Adjustments window. The advanced version displays the factory present coefficients and the current color coefficients. There are nine total coefficients, three coefficients for each channel (red, green, and blue). The coefficients form a 3x3 matrix used for Bayer decoding. The color balance sliders from Section 3 represent multipliers for the red, green, and blue columns of the coefficients from the current base preset from Section 1. The Advanced version of the dialog allows you to change the coefficients individually rather than scaling all three values in a column simultaneously.



## Setting Camera Orientation

To set the camera orientation, select **Camera Orientation**. The following options are available:



### Flip Horizontal

Select the Flip Horizontal checkbox to flip the image along a vertical axis (e.g. left to right). Images are flipped both in live view mode and as saved images.

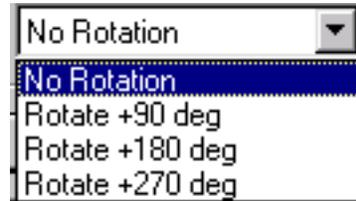
### Flip Vertical

Select the Flip Vertical checkbox to flip the image along a

horizontal axis (e.g. top to bottom). Images are flipped both in live view mode and as saved images.

**Image Rotation**

Select +90° to rotate the image clockwise 90°. Select 270° to rotate the image counter-clockwise 90°. Select No Rotation to restore correct image rotation.

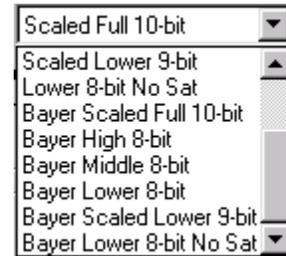
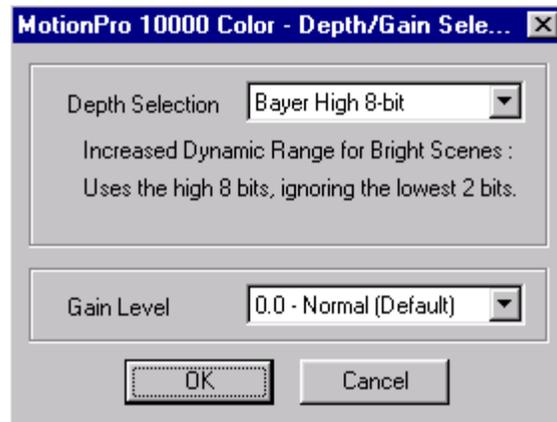


**Setting Depth and Gain**

To set the camera pixel depth and/or the camera amplifier gain level, select **Camera Gain/Depth Selection**.

To set the pixel depth, click on the upper drop-down box. A list of the depth options will appear based on your specific camera capabilities, along with a brief description that explains the purpose and benefit of each selection. The following are a common subset of 10-bit camera depth selections.

- For example, Red Only – displays the red pixels only
- Green Only – displays the green pixels only
- Blue Only – displays the blue pixels only
- High 8-bit – displays the top 8 bits of a 10+ bit camera
- Middle 8-bit – displays the middle 8 bits of a 10+ bit camera
- Bottom 8-bit – displays the bottom 8 bits of a 10+ bit camera
- Bayer x-bit – displays a Bayer pattern in the desired bit format.
- Scaled full 10-bit – shows the full 10-bit dynamic range.



Scaled 9-bit – compresses a 10-bit depth into a fully scaled 9-bit pattern.

The Gain setting applies an amplification factor to the camera, boosting the signal and noise levels. Gain is primarily used to compensate for low light or bright light levels. Your specific camera type determines the default gain. Not all cameras have the same gain scales – some express gain as a multiplier and others as a dB gain level.



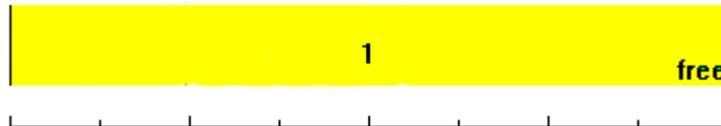
## **Understanding Memory Buffers**

When MiDAS is in any record mode, video from the cameras and data sensors controlled by MiDAS are streamed directly to the camera board RAM and/or the computer RAM. MiDAS controls the acquisition process precisely, keeping track of time and location of frames.

This memory is often called a “buffer” or sometimes a “memory buffer”.

### **The Revolving Buffer Concept**

Consider the following bar to represent a memory buffer (for example, 128 MB).



MiDAS collects video and data into the buffer on a first-in-first-out basis. Once the buffer is full, it starts overwriting the buffer, starting at the beginning. Therefore, the most recently streamed video is always available in the memory buffer. This process of continuously writing in a loop is called a “revolving buffer”.

For example, if the above memory buffer contains 128 video frames, MiDAS will record video in the following sequence:

1,2,3 ... 126, 127, 128, 1, 2, 3 ... 126, 127, 128, 1, 2, 3 ... etc.

MiDAS will continue to record in this revolving sequence until the user stops the recording. When a recording is stopped, MiDAS returns a full buffer of video and data to the Playback window. MiDAS then rennumbers the video and data to place the Reference Frame 0 in the correct position per the trigger instructions (see Chapter 10 for more details).

### Multiple Memory Buffers (Partitions)

In many advanced cameras and frame grabbers supported by MiDAS, the physical memory of the system may be partitioned into smaller memory buffers. Often this capability is termed “Segmented Memory” or “Multiple Memory Buffers”. In most cases, the memory partition sizes are user-configurable.

For example, a user may partition the above single memory buffer into a series of smaller memory buffers.



*Note: Separating physical memory into memory buffers is analogous to partitioning a computer hard drive into smaller partitions. The same amount of total storage memory is present, but it is partitioned differently.*

In the above example, the memory is partitioned into 5 smaller memory buffers, as follows:

Memory Buffer 1 ... 20 frames  
 Memory Buffer 2 ... 20 frames  
 Memory Buffer 3 ... 20 frames  
 Memory Buffer 4 ... 20 frames  
 Memory Buffer 5 ... 48 frames  
 Total Frames:        128 frames

Each memory buffer becomes its own separate storage partition independent of the other partitions. For example, if you are working in Memory Buffer 1, then MiDAS will record in the following sequence:

1, 2, 3 ... 18, 19, 20, 1, 2, 3 ... 18, 19, 20, 1, 2, 3 ... etc.

MiDAS will continue to record in this revolving sequence until the user stops the recording.

### Configuring Multiple Buffers

In MiDAS, the user can set each memory buffer to be different than the other buffers. Parameters that can be set for each memory buffer:

- Record Mode (ROT, ROC, BROc)
- Number of Frames (buffer partition size)
- Trigger Type

- Trigger Percent
- Frame Rate
- Shutter Speed
- Resolution

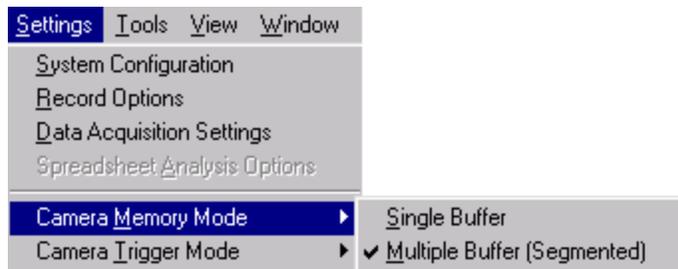
Users set the parameters from the Record tab of the Control Panel, as described in the below sections.

## Recording with Multiple Buffers

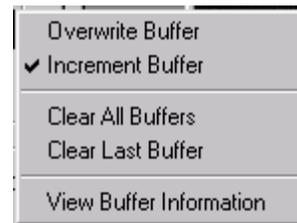
When using multiple buffers, you set the size of each buffer prior to recording into it. The buffer sizes can be changed or you can use the standard MiDAS defaults.

To record in MiDAS with multiple memory buffers:

1. Open a camera that has multiple memory buffer capability.
2. From the **SETTINGS** menu, select **CAMERA MEMORY MODE** and select **MULTIPLE BUFFER (SEGMENTED)**.

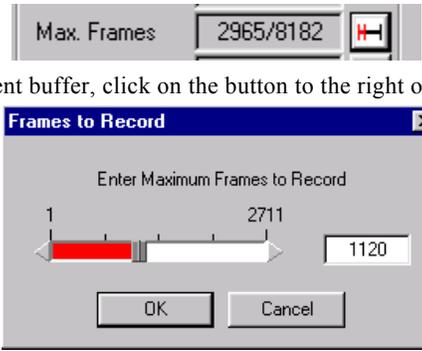


3. The current buffer box in the Record tab will present the number of available buffers.
4. Click the little white box next to the Current Buffer Box. The current memory buffer (e.g. buffer 2 of 16) is displayed. If only one buffer is selected or multiple buffers is not a feature of your camera, the word SINGLE appears.
5. The options at right appear. Select either **OVERWRITE BUFFER** or **INCREMENT BUFFER**.



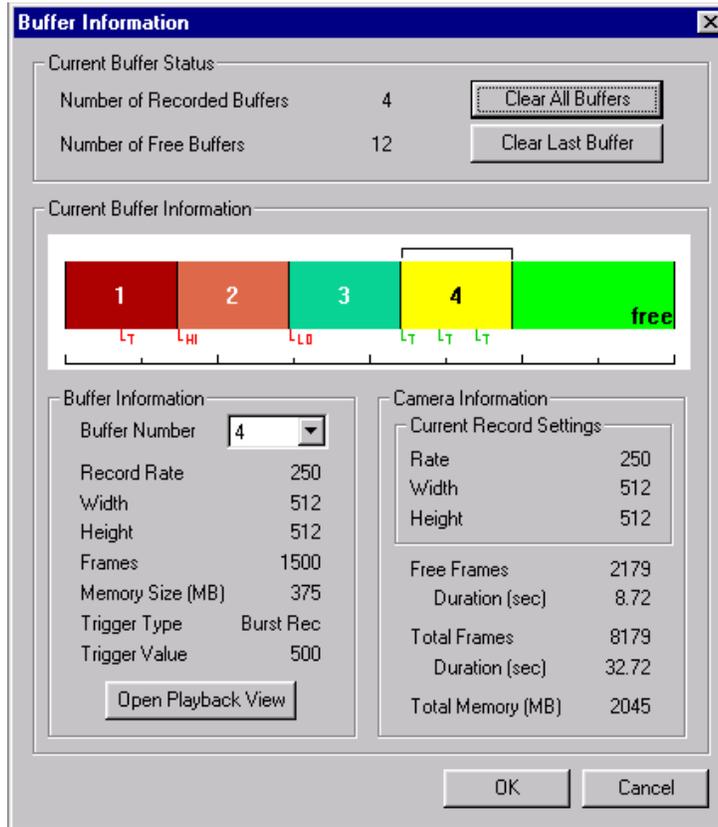
<b>Overwrite Buffer</b>	Each recording overwrites the previous recording within the same buffer. For example, if the current buffer is buffer 4 and another recording is made, it overwrites buffer 4.
<b>Increment Buffer</b>	Each recording is automatically placed into the next sequential buffer. For example, if the previous recording was made into buffer 4, the next recording is made automatically into buffer 5
<b>Clear All Buffers</b>	Erases the contents of all buffers and returns to buffer 1
<b>Clear Last Buffer</b>	Erases the previous buffer
<b>View Buffer Information</b>	Shows all the information about the current and previously recorded buffers, including size, number of frames and recording parameters. Also shows the amount of free memory and number of available (free) buffers.

6. The size of the current buffer, in frames, will, by default, be equal to the previous buffer size. To modify the size of the current buffer, click on the button to the right of the Max Frames box on the Record tab. The Frames to Record window appears. Either use the slider bar or type the number of frames to record. Click **OK** to continue.



7. Make a recording.

To review your multiple buffer status, change the buffer number and reset buffers, select **VIEW BUFFER PROPERTIES**. The Buffer Information window (shown below) contains all the information about your buffer structure.



*Note: The maximum number of memory buffers is determined by your camera and frame grabber manufacturer.*

To set MiDAS to .one continuous buffer (e.g. exit multiple memory buffer mode):

1. From the **SETTINGS** menu, select **CAMERA MEMORY MODE** and select **SINGLE BUFFER**
2. The current buffer box in the Record tab will reflect this change.

## Camera Trigger Options

MiDAS2.0 has three Camera Trigger modes. Each mode acquires video (and data and time information) according to specific rules, as described in the following three sections.

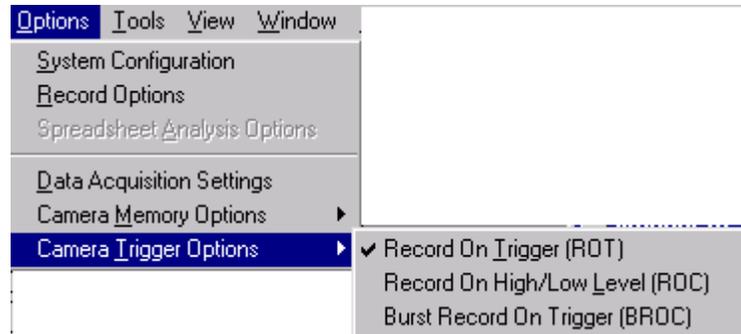


*Note: Not all Record modes are available with all cameras – consult with your camera manufacturer to determine which record modes your camera supports.*

To set the MiDAS Camera Trigger mode, click on **Options**, then **Camera Trigger Options**

In summary, the three record modes are:

1. Record on Trigger (ROT) mode. In this mode, MiDAS records video in accordance with the trigger percent setting on a one-time basis when a valid trigger is received.
2. Record on Command (ROC) mode. In this mode, MiDAS records video whenever a valid external trigger input is received. When a valid external trigger input stops, MiDAS stops recording. MiDAS will continue in Record on Command mode until either the STOP button is pressed or the memory buffer fills.
3. Burst Record on Command (BROC) mode. In this mode, MiDAS records preset bursts of



video frames every time a valid trigger is received. MiDAS continues recording until either the STOP button is pressed or the memory buffer fills.

After a recording is stopped, MiDAS automatically returns the valid video frames and sets itself into Playback mode (see Chapter 7).

MIDAS2.0 defaults to Record on Trigger Mode for all camera types.

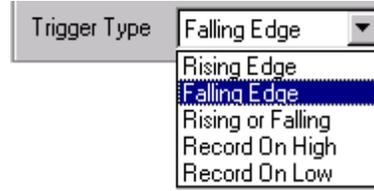
## Record on Trigger Mode

In this mode of operation, when a trigger event occurs (either an external trigger pulse is received or the user presses the TRIGGERSTOP or STOP buttons on the Record Tab), the desired number of pre-trigger and post-trigger frames are acquired and displayed.

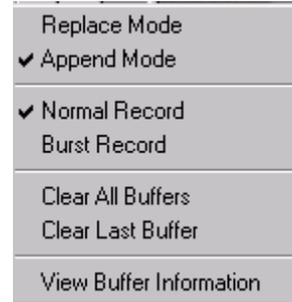
To set MiDAS into Record on Trigger mode:

**MIDAS2.0**  
**Chapter 7: Recording Video**

1. Set the Trigger Type to either RISING EDGE, FALLING EDGE or RISING OR FALLING EDGE (see Chapter 10 for details on these).
2. Click on the button next to the Current Buffer box
3. Select NORMAL RECORD.



*Note: In Record on Trigger mode, TriggerStop and an external event trigger input have the same effect.*



In Record on Trigger mode, MiDAS2.0 will return the following frames, depending on when the trigger event is received relative to the record buffer size

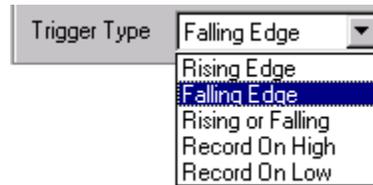
If the trigger % is...	and you have recorded...	and the event is...	then MiDAS....
100%	a full buffer	TriggerStop or Stop	stops and returns a full buffer, as recorded
100%	a partial buffer	TriggerStop or Stop	stops and returns only those frames that were recorded
0%	a full or partial buffer	TriggerStop	continues recording one full buffer more and stops
0%	a full buffer	Stop	stops and returns a full buffer, as recorded
0%	a partial buffer	Stop	stops and returns only those frames that were recorded
0% < t < 100%	a full buffer	TriggerStop	continues recording the prescribed number of post-trigger frames, then stops and returns a full buffer
0% < t < 100%	a partial buffer	TriggerStop	continues recording the

			prescribed number of post-trigger frames, then stops and returns all the post-trigger frames and the available pre-trigger frames.
$0% < t < 100%$	a full buffer	Stop	stops and returns a full buffer, as recorded
$0% < t < 100%$	a partial buffer	Stop	stops and returns only those frames that were recorded

### Record on Command (ROC) Mode

In this mode of operation – also called Record on High/Low Level Mode, MiDAS will record video only when a valid external trigger input is received. A valid trigger is defined as either (a) a voltage that exceeds a threshold determined by your camera hardware (Record on High) or (b) a voltage that falls below a threshold determined by your camera (Record on Low).

MiDAS will continue to concatenate (append) video every time a valid trigger input is received until either (a) the memory buffer fills or (b) the user presses the STOP button.



*Note: In Record on Command mode, the TRIGGERSTOP button is disabled.*

*Note: Record on Command mode is not available in systems with multiple cameras or with DA and TS modules.*

To set MiDAS into Record on Command mode:

1. In the Trigger Type box, select either Record on High if you desire to record when receiving a valid high pulse or Record on Low if you desire to trigger on a low pulse.
2. Press the RECORD button.

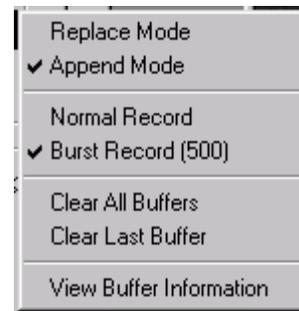
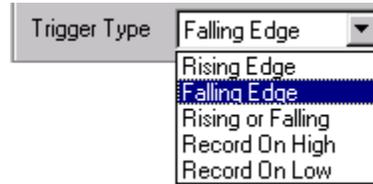
## Burst Record on Command (BROC) Mode

In this mode of operation, MiDAS will record video in user-defined bursts every time a valid trigger is received. A valid trigger is either a TRIGGERSTOP button or an external trigger input. Video is recorded after the trigger is received.

MiDAS will continue to concatenate (append) video every time a valid trigger input is received until either (a) the memory buffer fills or (b) the user presses the STOP button.

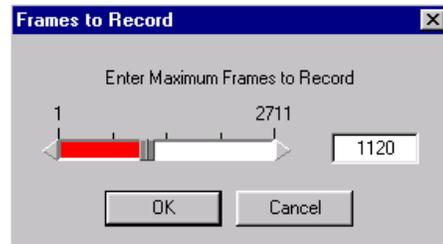
To set MiDAS into Burst Record on Command mode:

1. Set the Trigger Type to either RISING EDGE, FALLING EDGE or RISING OR FALLING EDGE (see Chapter 10 for details on these).
2. Click on the button next to the Current Buffer box
3. Select BURST RECORD.
4. The Frames to Record window appears. Select the number of Burst Frames to record on trigger.
5. Press OK. The number of burst frames appears in parenthesis adjacent to the checked Burst menu.



*Note: In Burst Record on Command mode, TriggerStop and an external event trigger input have the same effect.*

*Note: In Burst Record on Command mode, the Trigger Percent function is disabled. MiDAS will only post-trigger in this mode (record frames AFTER receiving a trigger).*



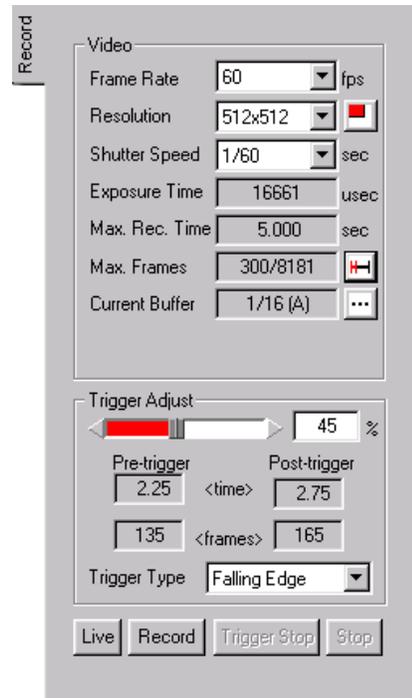
*Note: Burst Record on Command mode is not available in systems with multiple cameras or with DA and TS modules.*

## Setting Record Parameters

In the Control Panel, the Record tab contains the information to set up a recording.

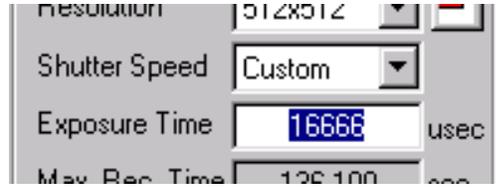
*Note: The MiDAS Record tab may change slightly depending on which camera you have installed.*

To record a video image, you must configure the camera from within MiDAS. The software settings for the Record tab are as follows:



<b>Frame Rate</b>	The frame rate drag-down box displays the available video frame rates. The rates are determined by the camera hardware in the computer. The default is set to 60 fps.
<b>Resolution</b>	The available resolution settings for the camera. For each frame rate chosen, only certain resolutions are available. Choose the desired resolution from the list shown. Note that lower resolutions typically result in longer recording times and more video frame. If resolution is the most important parameter, you can also set the resolution and then set the frame rate from the list..
<b>Shutter Speed Exposure Time</b>	The shutter speed and the exposure time denote the amount of time that the electronic shutter of the shutter remains "open" during each frame. Shorter exposure times reduce blur within each frame, but at the expense of light collecting ability. The shutter speeds and exposure times are determined by the camera hardware in the computer. The default is set to the inverse frame rate (open shutter).  Shutter speeds are displayed in inverse seconds. Exposure times are displayed in microseconds ( $10^{-6}$ seconds).

Select the shutter speed from the drag down box. The corresponding exposure time will be displayed in the gray box below the selected shutter speed.



Some cameras allow the user to set custom exposure times.



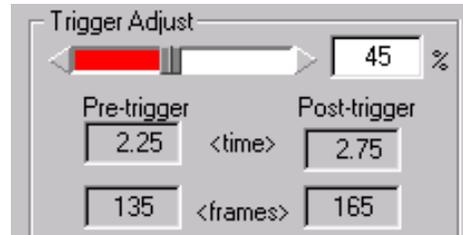
To set an exposure time not included in the drag down list, select Custom in the drag down list. Then type the custom exposure time, in microseconds, in the box to the right of the exposure time label:

---

### Trigger Percent

Trigger Percent is only enabled when MiDAS is in Record on Trigger mode.

*Note: Trigger percent has no effect when MiDAS is in Record on Command or Burst Record on Command modes.*



The percentage trigger puts the Reference Frame 0 at the desired position and dictates the amount of time prior to the

trigger and after the trigger is received. The listed number is the pre-trigger percentage of the total acquisition. For example, a trigger percentage of "0%" instructs the MiDAS software to (1) continue to acquire one full buffer of images (acquire 0% before the trigger and 100% after the trigger) and (2) to put the Reference Frame 0 at the beginning of the sequence. Alternatively, a trigger percentage of "100%" instructs the MiDAS software to (1) stop acquisition immediately upon receipt of a trigger input (acquire 100% before the trigger and 0% after the trigger) and (2) to put the Reference Frame 0 at the end of the sequence.

The Reference Frame 0 is placed at the exact frame when the trigger input is received. To see frames before and after the trigger input time, use trigger percentages in the range of 10% to 90%. In the resulting captured sequence, frames with negative numbers are BEFORE the trigger pulse was received and frames with positive numbers are AFTER the trigger pulse was received.

Trigger percentages are selectable from 0% to 100% in 1% increments. The default is 100%.

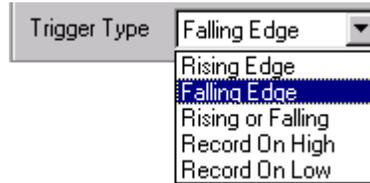
See Chapter 10 on Triggering your Measurement for more information on Trigger Percent.

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**Trigger Type**

The external trigger input is always enabled in MiDAS.

The Trigger Type box is used to instruct MiDAS as to which type of external and internal (software button) triggers to accept.



Consult Chapter 2 for information on connecting an external trigger to MiDAS hardware and Chapter 10 for more details on the different types of triggers.

Select Rising Edge if your event trigger generates a positive going pulse.

Select Falling Edge if your event trigger generates a negative going pulse.

Select Rising or Falling Edge if your trigger latches or is a fast pulse.

Select Record on High or Record on Low to put MiDAS into Record on Command mode.

*Note: Select **FALLING EDGE** when using MiDAS Motion Trigger.*

The following information is also displayed on the Record tab:

<b>Max Rec Time</b>	the maximum amount of time that can be recorded during a video sequence, in seconds.
<b>Max Frames / Total Frames</b>	the maximum number of frames that will be acquired during the next record sequence / the total frames in all buffers.
<b>Current Buffer / All Buffers (A,R, B)</b>	the current buffer number / the total number of buffers available per the architecture of your camera (Append buffers or Replace buffer or Burst Record Mode).
<b>Pre-Trigger Time</b>	the amount of record time to be acquired prior to the trigger input.
<b>Post-Trigger Time</b>	the amount of record time to be acquired after the trigger input.
<b>Pre-Trigger Frames</b>	the number of frames to be acquired prior to the trigger input.
<b>Post-Trigger Frames</b>	the number of frames to be acquire after the trigger input.

In addition to the configuration information listed above, the Record tab has two mode buttons on the bottom.

<b>LIVE button</b>	The <b>LIVE</b> button puts the camera board into live video mode. While in this mode, video is streamed directly to the display and refreshed at approximately 25 frames/second.
<b>RECORD button</b>	The <b>RECORD</b> button puts the camera board into record mode. MiDAS displays a flashing box with the words "MiDAS RECORDING" to notify the operator that MiDAS is recording.



When MiDAS is in any record mode, video from the cameras and data sensors controlled by MiDAS are streamed directly to the camera board RAM and/or the computer RAM. MiDAS controls the acquisition process precisely, keeping track of time and location of frames.

The video is collected into a revolving memory buffer in a first-in-first-out basis. Therefore, the most recently streamed video is always available in the memory buffer. MiDAS will continue to record into the revolving buffer until a trigger event is received. A trigger event is either a software trigger or a hardware trigger.

When MiDAS is in record mode, the remaining two software trigger buttons become active on the bottom of the tab. These two buttons are used to stop a recording, as follows:

**TRIGGERSTOP Button**

The **TRIGGERSTOP** button executes the stop record function per the trigger settings (pre-record time and post-record time). The **TRIGGERSTOP** button places the Reference Frame 0 at the trigger point of the sequence. For more information on using **TRIGGERSTOP** to stop a recording, see Chapter 10..

*Note: an external trigger pulse is treated like a **TRIGGERSTOP** event.*

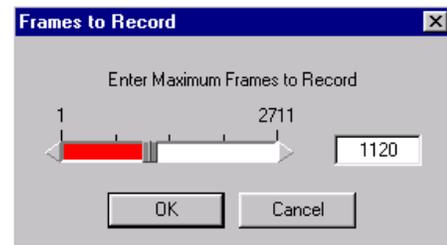
**STOP button**

The **STOP** button immediately stops the recording function and places the Reference Frame 0 at the end of the sequence. Also called a ‘Panic Stop’ button, the **STOP** button behaves like the trigger percent is set for 100%. regardless of its actual setting . For more information on using **STOP** to stop a recording, see Chapter 10.

### Setting the Max Record Time and Frames

For cameras that support the variable setting of recording time and number of frames, the button to the right of the Max Frames setting will be enabled. Click on this button to bring up the Frames to Record window. Either use the slider bar or type the number of frames to record. Click **OK** to continue.

To reset to the maximum number of frames permissible by your camera and MiDAS hardware, drag the slider bar to the right.



## Persistence of Settings

The guiding principle for the persistence of camera settings when any one of the parameters is changed is to maintain whatever can be maintained and only change those values which must be changed in order to be compatible with the new setting.

The table below outlines what may happen to the parameters listed across the top when the parameters listed down the left side are changed.

<b>Then...</b>	<b>Resolution + Active Area</b>	<b>Shutter Speed</b>	<b>Max. Frames</b>
<b>If you change...</b> <b>Frame Rate</b> Sets the frame rate to the new setting.	<b>Resolution + Active Area</b> Resolution is maintained if it is compatible with the new frame rate. If the resolution must be changed, the center of the active area is maintained unless it reaches the border of the sensor area, in which case, it is shifted to remain fully in the sensor area.	<b>Shutter Speed</b> The shutter speed multiplier (1x, 2x, etc.) is maintained as the frame rate changes. If the shutter speed was a custom setting, the custom setting (in msec) is maintained instead if it is less than 1x at the new frame rate in msec.	<b>Max. Frames</b> The number of frames to record is maintained if it is less than the total number of available frames. If the previous setting is greater than the new total, the max. frames is set to the new total. The total number of frames may have changed if the resolution was forced to change.
<b>Resolution + Active Area</b> Changes of resolution and active area do not affect the frame rate setting. The set of selectable resolutions presented in the control panel are	<b>Resolution + Active Area</b> Changes to resolution will attempt to maintain the center of the active area. If the border of the sensor is reached, the active area is shifted to remain fully in	<b>Shutter Speed</b> Changes of resolution and active area do not affect the shutter speed setting. These settings are completely independent.	<b>Max. Frames</b> The number of frames to record is maintained if it is less than the total number of available frames at the new resolution. If the previous setting is greater than the new total, the

	dictated by the current frame rate, thus only compatible resolution selections are possible.	the sensor area.		max. frames is set to the new total.
<b>Shutter Speed</b>	Changing the shutter speed does not affect any of the other camera settings.			
<b>Max. Frames</b>	Changing the number of frames to record does not affect any of the other camera settings.			

### Adjusting Camera View Window Sizes

The following zoom and magnification commands are very useful in the camera view. These can be accessed via either the menu under View or by right clicking within a View window:

**View Actual Pixels**

When selected, this command sets the zoom region and the window frame to be equal to the actual image size. That is, everything is displayed within a frame at 1:1.

**View x %**

When selected, this command sets the window frame to be a multiplier times the actual image size. For example, if 200% is selected in the above example, the frame is set to 960x840 pixels.

If the new frame size is larger than the desktop area permits, then the image is zoom magnified to the correct value and the window frame limited to the maximum size permitted by the desktop. For example, if 400% is selected in the above example, the image is magnified 4x to 1920x1680, but only the available number image is displayed (for example 969x848). In this case, the status bar will display the

	<p>number of image pixels contained within the frame in the zoom region size box and the View window size will be the available display dimensions.</p>
<b>View Max</b>	<p>When selected, this command determines the largest window frame of the correct aspect ratio that will fit within the desktop area. It then fits the entire image within a frame of this size. In this case, the status bar will display a zoom region equal to the View window size.</p>
<b>Fit in Window</b>	<p>When selected, this command fits the entire image into the window frame. This command does not change the window frame size, just the image size. In this case, the status bar will display a zoom region equal to the window frame.</p>
<b>Zoom Image</b>	<p>This command allows you to use your mouse or trackball to easily zoom the magnification up or down of the image. When selected, the mouse cursor turns to a 4-pringed star on the view window. Simply roll the mouse or trackball up the image to zoom up (magnify) or roll downward to zoom down (minify).</p> <p><i>Note: During zooming, the geometric center of the image remains the same.</i></p> <p>The zoom box appears in the upper right corner of the window showing you the zoom ratio – the size of the zoom region relative to the actual image size.</p> <p>The status bar indicates the size of the zoom region, in pixels.</p>
<b>Pan Image</b>	<p>This command allows you to use your mouse or trackball to easily pan the image – move the image in any direction to optimize its location.. When selected, the mouse cursor turns to a 4-pringed star on the view window. Simply roll the mouse or trackball in any direction to scroll the image in that direction..</p> <p>The location box appears in the upper right corner of the window showing you the relative size and location of the window on the actual image size.</p> <p>The status bar indicates the size of the zoom region, in pixels.</p>

**Set Zoom Window**

This command lets you draw a box around any portion of the image and create a separate Zoom Window. A zoom window behaves exactly like a Playback Window, and can be further interacted with as described above (pan, zoom, change view size, etc..)

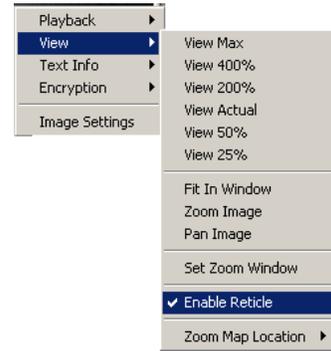
For more information on setting window sizes, zooming and magnifying, see Chapter 4.

**The Reticle**

When enabled, the Reticle function displays a crosshair reticle on the view window (all types). The location of the reticle, in pixels from the upper left corner of the image (0,0) is displayed in the furthest left box on the status bar.

To enable and disable the reticle function, right click within any view window, then select/unselect Enable Reticle.

The reticle is useful when setting up the camera.

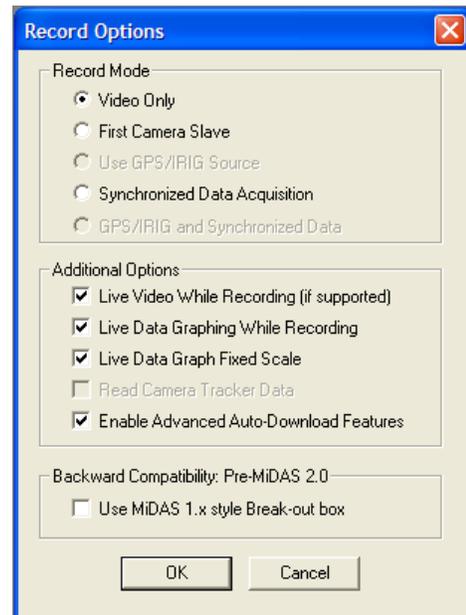


**Record Options**

Standard options for recording video with other hardware and software modules are contained in the Record Options window.

To access this window, select **RECORD OPTIONS** window under the **OPTIONS** menu. The window at right appears. This window allows you to enable and disable certain features of MiDAS recording to customize your interface or application. Only licensed features are displayed. Features not currently licensed are grayed out. Selecting or unselecting a feature does not affect the licensing.

The options of this window are as follows:



Video Only	Enables recording of high-speed video only from a single or multiple cameras.
First Camera Slave	<p>By selecting this option, the first camera in the chain is <b>NOT</b> the master, and will instead act as a slave to the external timing source. In other words, the first camera, as well as all subsequent cameras, will only capture frames when the master external hardware transmits a synchronization pulse.</p> <p>MiDAS knows which hardware is being used and actively configures the system accordingly. The MiDAS Connection Assistant explains how to interconnect the hardware.</p> <p><i>NOTE: Make sure that the master timing source is configured to provide enough sync pulses to capture all pre-trigger and post-trigger frames. If the external sync pulses cease before MiDAS has captured all frames, it will remain in Record mode and wait indefinitely for the next sync pulse. If this happens, click the STOP record button.</i></p> <p><i>NOTE: Make sure that the master timing source is sending sync pulses at or below the chosen frame rate in the Record tab.</i></p> <p><i>NOTE: When recording with First Camera Slave, all timing information is displayed during playback as NA because MiDAS does not know the time at which each sync pulse was transmitted.</i></p> <p><i>NOTE: First Camera Slave only works with video cameras recording video only. GPS/IRIG and synchronized data acquisition functions are disabled when this is selected.</i></p>
Synchronized Data Acquisition	Enables recording of synchronized data with video, as described in Chapter 12. This option is grayed if you do not have a licensed and enabled DA module present.
Use GPS/IRIG source	If you have a TS module installed, you can enable or disable the phase lock to the external time generator using this feature. If the checkbox is selected, MiDAS will phase lock

	<p>the cameras to the external source. If the checkbox is not selected, the primary clock source will be either the DA module hardware or the first camera in the chain, as described in Chapter 2.</p>
<p><b>GPS/IRIG and Synchronized Data</b></p>	<p>If you have a TS and a DA module installed, you can enable or disable the phase lock to the external time generator using this feature. If the checkbox is selected, MiDAS will phase lock the cameras and data acquisition hardware to the external source. If the checkbox is not selected, the primary clock source will be the first camera in the chain, as described in Chapter 2.</p>
<p><b>Live data graphing while recording</b></p>	<p>Selecting this option allows the user to watch the data graph update continuously while recording both video and external data (requires DA module). Note that the process of updating a live data graph is very processor intensive and can typically require all the processor power available from the computer. If the CPU usage reaches 100% because of enabling the Live Data Graphing, certain other functions will be disabled. For example, you may not be able to stop the recording or re-size a window. Enable this feature only if you have a very powerful and fast computer such as a Pentium PIII/550 or better.</p> <p>To determine if your computer has enough computing power, enable the CPU monitor during a test recording (via <b>CTRL-ALT-DEL</b>) and note the amount of CPU usage during a MiDAS recording. Optimally, the CPU usage should be &lt;40%..</p>
<p><b>Live video while recording</b></p>	<p>Enables live display of the video image while recording, if your camera supports this function.</p>
<p><b>Read camera tracker data</b></p>	<p>If you have module TS-03M licensed and enabled, then select this checkbox to read the azimuth and elevation from the tracker, as described in Chapter 14.</p>
<p><b>Enable advanced auto-download features</b></p>	<p>You can enable or disable the “Auto-Trigger” and “Delayed Reset” features of module AD2, as described in Chapter 13. If the checkbox is selected, these two features are available. If the checkbox is not selected, these two features are grayed on the MiDAS AD2 tab and not available for selection.</p>

**Use MiDAS 1.x style  
Breakout Box**

This checkbox should only be checked if you were a user of MiDAS prior to version 2.0 and you do not elect to modify your BNC Breakout Box per the instructions in Chapter 2 of this Users Guide.

*Note: If possible, you should upgrade your BNC Breakout Box to the MiDAS2.0 configuration.*

If you are unable to upgrade (for example, the BNC Breakout Box is physically not accessible or in a hazardous environment), select this check box and MiDAS will use the jumper settings as defined in past versions of MiDAS. Consult with Xcitex engineers for more information on legacy hardware.

### **About the Camera**

MiDAS also displays pertinent information about the specific camera, as retrieved from the firmware and camera hardware.

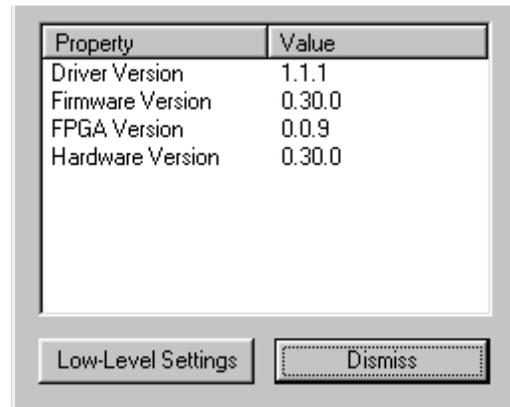
To access the information about the camera, click on the camera icon in the upper left corner of the Video Display window (on the title bar) containing your camera.

The camera manufacturer determines the specific information in the About the Camera window.

The information is not editable.

Possible information in this window might include:

- Camera serial number
- Camera model number
- Firmware revision level
- Camera address
- Maximum frame rate and resolution



Property	Value
Driver Version	1.1.1
Firmware Version	0.30.0
FPGA Version	0.0.9
Hardware Version	0.30.0

Low-Level Settings      Dismiss



- Security code
- FPGA revision level
- Hardware serialization
- Maximum frame rate allowed.

Some cameras also have low-level software commands that affect the camera architecture and board-level properties. To access this information, click on **LOW-LEVEL SETTINGS**. Consult with your specific camera manual for information on how to change these low-level settings.

*Warning: Changing low-level settings on a camera may significantly degrade camera performance and potentially damage the camera. Change this information only under the supervision of your camera manufacturer.*



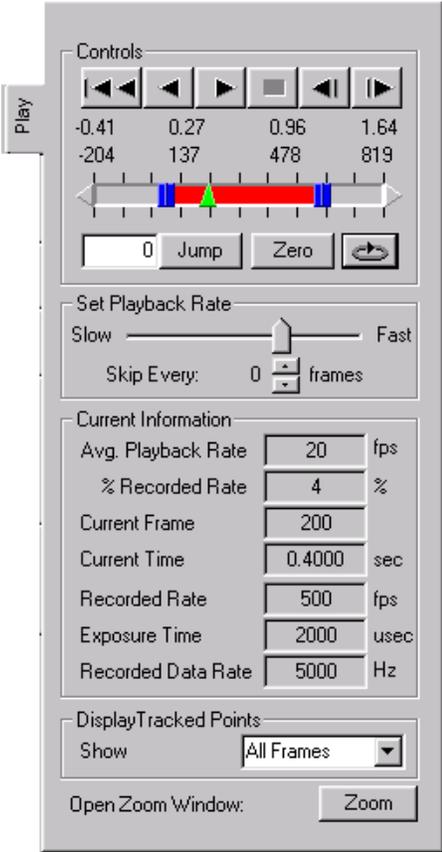
# Chapter 8

## Playing Recorded Videos

When the recording is complete, the Play tab (shown at right) and a second Video Playback window will automatically appear. The Live Video display window is minimized for later use.

### The Play Tab

The MiDAS Play tab is the only tab that does not change or cannot be removed from the MiDAS Control Panel. The MiDAS Player also uses the exact same Play tab. This tab controls all the playback functions from within MiDAS, whether they include stored images residing in the memory of the frame grabber boards for single or multiple cameras, saved video sequences on hard drives, saved sequences of images on hard drive, or synchronized data located on the hard drive. MiDAS Play tab synchronizes multiple images and allows users to seamlessly interface with all the data in one simple format.



Playback control is established using the following features of the Play tab:

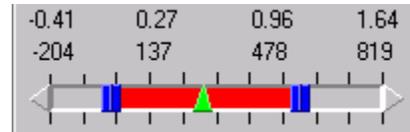
**Controls**

The following controls are available by clicking on the control buttons:

- Skip to beginning of the entire recording or the Reference Frame (ROT mode, single buffer) or to the beginning of the current memory buffer or burst recording. 
- Skip to the end of the entire recording or the Reference Frame (ROT mode, single buffer) or to the beginning of the next memory buffer or burst recording. 
- Play Backward 
- Play Forward 
- Step Backward 
- Step Forward 
- Stop (square box) 

**Slide Bar**

The slide bar allows the operator to quickly move to a specific part of the playback cycle. Just click on the center triangle (green) of the slider and, holding down the left



mouse button, drag the slider to the desired position. The time and the frame numbers are displayed directly above the slide bar. The active area is displayed in red. The inactive area is displayed in gray.

**Slide Bar Range Brackets**

The slide bar range brackets are used to establish the beginning and end of the playback range. The range brackets are two squares (blue) with a red interior. To approximately select the beginning of the playback range, click on the left square and, holding down the left mouse button, drag the slider to the desired position. To fine-tune your range, click on the arrows (as shown above) at the end

	of the slide bar.
<p><b>Jump to Frame Number</b></p>	<p>This feature allows the operator to immediately and repeatedly jump to a specific place in the video clip. This is a valuable feature for returning to a specific event. The frame number is placed in the edit box. Type the frame number in the edit box.</p> <div data-bbox="964 443 1149 499" data-label="Image"> </div> <p>Then click on the <b>JUMP</b> button to immediately jump to that frame. If the frame you have selected is outside the range selected above, MiDAS will jump to the minimum or maximum selected frame respectively.</p>
<p><b>Set Current Frame to Zero</b></p>	<p>By clicking the <b>ZERO</b> button, the current frame of the video playback is reset to become the Reference Frame 0 and the current datum is reset to become the Reference Datum 0. Set Current Frame to Zero cannot be undone from within MiDAS. If you make a mistake, close the video display window and load the file directly again.</p> <div data-bbox="1252 663 1354 716" data-label="Image"> </div>
<p><b>Continuous Loop Playback</b></p>	<p>By clicking on this button, the playback is continuously looped between the brackets described above. When this button is not selected, the playback stops at the end of the selected range.</p> <div data-bbox="1260 909 1357 1062" data-label="Image"> </div>
<p><b>ZOOM button</b></p>	<p>By clicking this button, you can select a portion of the image to magnify. Click within a video image with the left mouse button and, holding down the left mouse button, drag within the image until a square frame is visible and of the desired size. When the mouse button is released, a separate window appears of the magnified image. Only one video zoom window can be displayed within MiDAS at a time. The image zoom window uses the same image processing features as the main video display window (reverse, contrast enhancement, etc.)</p>
<p><b>Display Tracked Points</b></p>	<p>Select whether you desire to display points on the video image from a previous or current image analysis.</p>

The following displays are found on the Play tab:

<b>Frame Number</b>	The current frame number
<b>Time</b>	The time associated with the current frame
<b>Recorded Rate</b>	The rate at which the video was recorded
<b>Exposure Time</b>	The exposure setting during that recording
<b>Recorded Data Rate</b>	The rate at which the synchronized data was recorded.

### Setting the Playback Rate

<b>Set Playback Rate</b>	The actual playback rate on the computer screen is determined by many factors, including the number of synchronized images, the video RAM and the speed of the computer processor. Therefore, MiDAS provides a slider between “slow” and “fast”. Set the relative speed of playback by clicking on the center post of the slider and, holding down the left mouse button, drag the slider to the desired position. Read the actual playback rate in the box below.
<b>Skip Every N Frames</b>	This feature allows the operator to speed up the display update rate by skipping frames. Default is 0 frames.
<b>Average Playback Rate</b>	The rate at which the video is actually being played on your display, in frames per second. MiDAS will sample a few frames and determine the average playback rate for your configuration and settings. This number is updated every few seconds.
<b>% Recorded Rate</b>	The average playback rate divided by the original recording rate of that video image, expressed in percent. For example, if a video was recorded at 250 fps and if you are playing back at 20 fps, MiDAS will display 8%.

## Playback Shortcut Bar

Under each video display, you will find shortcuts to buttons and features also found in the “Play” tab in the Control Panel.



These controls include the following:

<b>Playback Controls</b>	These provide the standard play, reverse, rewind, stop, and step controls. The slider beneath the buttons allows for quick scanning through the video and indicates the current position within the video.
<b>Frame and Time</b>	The frame number and time stamp relative to the trigger event are displayed next to the playback controls.
<b>Zoom</b>	The Zoom button allows you to zoom in on a region of interest in the video during playback. When the button is pressed, you can draw a box within the video display and a new zoomed window will appear. The box you have drawn within the video display can also be dragged around to other regions of the display. In order to resize the box, simply press the zoom button once again and draw a new box or the correct size.
<b>Extended Play Options</b>	<p>The “C” checkbox selects a continuous playback mode. When this option is selected, the video will automatically loop around to the beginning whenever the end of the video is reached.</p> <p>The “S” checkbox selects synchronized playback. This option allows for synchronized playback of multiple video files. When synchronized, the frame position of each of the video files is incremented (or decremented) by the same amount relative to some starting position for each file.</p>

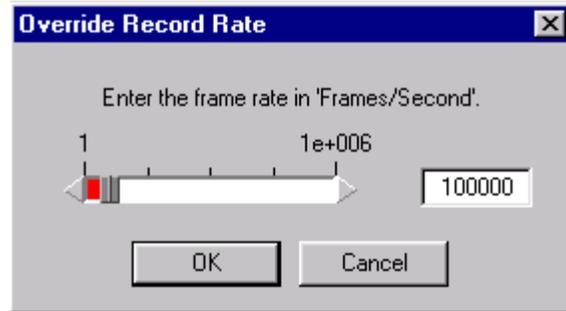
The following displays are found on the Shortcut bar:

<b>Frame Number</b>	The current frame number
<b>Time</b>	The time associated with the current frame

## Overriding the Default Record Rate

MiDAS knows the rate at which the video was recorded for all MiDAS-generated images. If you are importing a file from another acquisition program, MiDAS may not recognize the configuration file format. If MiDAS is unable to determine the rate at which the video was recorded, it will default to 30 fps. In such a case, you may override the default MiDAS rate, as follows:

1. Click on the Options menu.
2. Click on Override Record Rate. The window shown at right appears:
3. Either use the slider bar to select or directly type the correct frame rate in the edit box.
4. Click OK.



## Playing Multiple Synchronized Videos

If multiple windows are in the MiDAS console, then the video display window with the active blue stripe across the top is addressed by the Play tab. You may synchronize multiple video images in playback by using the sync button in the Play tab on the Control Panel or by using the “s” button on the Playback shortcut bar. This option allows for synchronized playback of multiple video files. When synchronized, the frame position of each of the video files is incremented (or decremented) by the same amount relative to some starting position for each file. Associated data is automatically synchronized as well.

To enable synchronized playback:

1. Click on the first video display window.
2. Position the video at the desired first frame for synchronized playback. This sets the starting position to the current frame for that video display.
3. Select the “s” checkbox in the playback shortcut bar under the video image.
4. Repeat steps 1 to 3 for each video you desire to synchronize.
5. Press the “Play” button on the Play tab or on any one of the synchronized video display shortcut bars and all the synchronized windows will play simultaneously.



To remove a video image from synchronization:

1. Stop the playback.
2. Deselect the “s” checkbox of that video image.
3. Resume playback.

*Note: When using BOTH continuous playback and synchronized playback, only select the “C” checkbox in the window in which you press the “Play” button*

To quickly synchronize multiple images, click on **TOOLS**, then SYNC ALL TO ZERO FRAME.

## Zooming and Panning

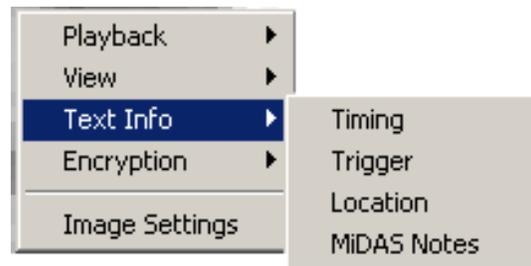
MiDAS provides four methods for magnifying an image or a portion of an image.

1. Resize the window. Click on the window frame and drag the window open. The window size, in pixels, is displayed in the status bar.
2. Zoom region. Either right click within a window and select **SET ZOOM REGION** or click on the **ZOOM** button in the Play tab. Draw a box around the zoom feature using the mouse.
3. Zoom in. To zoom the image, right click within a window and select **ZOOM**. Move the cursor up and down the screen to magnify and minify the image. Alternatively, hold down the shift key and move the cursor.
4. View size. Set the magnification using the view settings under the **VIEW** menu.

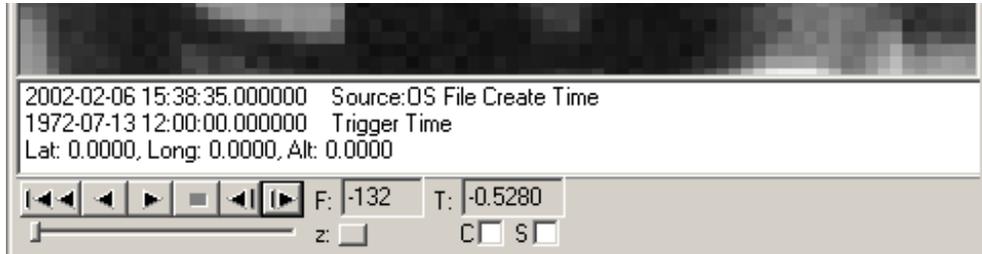
To pan a magnified image, right click within a window and select **PAN**. Move the cursor within the screen to move the image. Alternatively, hold down the ctrl-shift keys and move the cursor.

## Displaying Synchronized Time

To display associated frame-by-frame time information directly below the video display, right click within the image and select **TEXT INFO**.



Examples of typical information include the trigger time from when the video was acquired, frame time stamping, GPS location, and camera orientation information. When selected, the information is displayed directly beneath the video display as shown.



The information that is displayed is summarized as follows: .

<p><b>Timing</b></p>	<p>The top line –Timing – shows the actual time as recorded either from the Operating System clock or an external clock source such as an IRIG generator or GPS satellite (see Chapter 15 – Time Synchronization Modules – for more details).</p> <p>Text information will appear below the video sequence, in the following format:</p> <p><b>“Year-Month-Day-Hour-Minute-Second-Fraction of Second – Source: “Source Text”</b></p>
<p><b>Trigger</b></p>	<p>The second line – Trigger – shows the actual time that an external trigger or Trigger Stop button selection was received. Text information will appear below the video sequence, in the following format.:</p> <p><b>“Year-Month-Day-Hour-Minute-Second-Fraction of Second” Trigger Time</b></p>
<p><b>Location</b></p>	<p>The third line – Location – shows the physical location, as recorded from a GPS satellite and external camera tracker, in latitude, longitude, altitude, azimuth and elevation. (see Chapter 15 for more details on these items.</p> <p>Text information will appear below the video sequence, in the following format:</p>

<p><b>Camera Pointing</b></p>	<p><b>“Lat ###.####, Long ###.####, Alt ###.####”</b></p> <p>The fourth line – Pointing – shows the azimuth and elevation of a camera tracker (see Chapter 15 for more details on these items.</p> <p>If you have a camera tracker, then text information will appear below the video sequence in the following format.</p> <p><b>“Azimuth ###.####, Elevation ###.#### “</b></p>
-------------------------------	---

To maintain compatibility across all recording options, you have the option to display the time and position information even if you don’t have the TS module. MiDAS will either display un-initialized numbers as is the case for latitude, longitude, and altitude, or it will display information taken from another source as is the case for Timing.

“Source Text” for Timing will be one of the following text descriptions:

<p><b>Source: Synch from External Source</b></p>	<p>This text is displayed next to the Frame Time, when the sequence that you are viewing was recorded with a MiDAS TS module enabled. It means that the information was fundamentally obtained, as described above, from the external time source (GPS, IRIG-B, etc.). It also means that this was the first camera in a multi-camera chain.</p>
<p><b>Source: OS System Clock at Acquisition</b></p>	<p>This text is displayed next to the Frame Time, when the sequence that you are viewing was recorded with MiDAS but did not use the MiDAS TS module. This means that the frame time is derived from the system clock time at the end of the recording. It also means that this was the first camera in a multi-camera chain.</p>
<p><b>Source: Derived from Master</b></p>	<p>This text is displayed next to the Frame Time, when the sequence that you are viewing was recorded with a MiDAS. It means that the information was fundamentally obtained, as described above, from the external time source or the OS system clock. It also means that this camera was “down the chain” (i.e. not the first camera) in a multi-camera chain.</p>
<p><b>Source: OS File Create Time</b></p>	<p>This text is displayed next to the Frame Time, when the sequence that you are viewing was recorded with MiDAS before the TS module was available, or you</p>

used another system to acquire the sequence. It means that time is derived from the time of file creation. The last frame is treated as if it were created at file creation time.

### **Verifying Demo Status**

MiDAS and the MiDAS Player allow you to download and analyze various demo files supplied by Xcitex. These files are specially watermarked to unlock certain features within MiDAS and the MiDAS Player. Typically, these files are supplied for technical support purposes, for sales support purposes or for confidential exchange of data between Xcitex and customers. To verify the demo status of a file supplied by Xcitex:

1. Open the file using the **FILE → OPEN** commands.
2. Click on **TOOLS → VERIFY DEMO STATUS**.
3. Check the message box that appears to confirm status of the file.

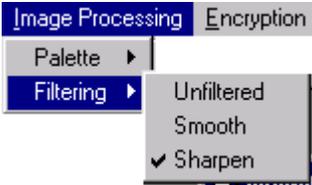
# Chapter 9

## Image Processing

MiDAS includes various techniques for improving image quality and image contrast. Such image manipulation is termed image processing. While image processing tools are very useful for general viewing, they are typically used to improve accuracy of tracking features for the purposes of analyzing motion.

### Improving a recorded video image

To improve the appearance of the video image, you can apply either a sharpen or smoothing filter.

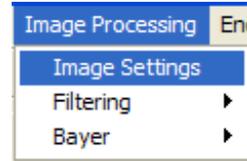


Under the **IMAGE PROCESSING** menu item, select **FILTERING**. You can also reach these options through the **SYSTEM CONFIGURATION** window. Select one of the following three options for viewing your video images:

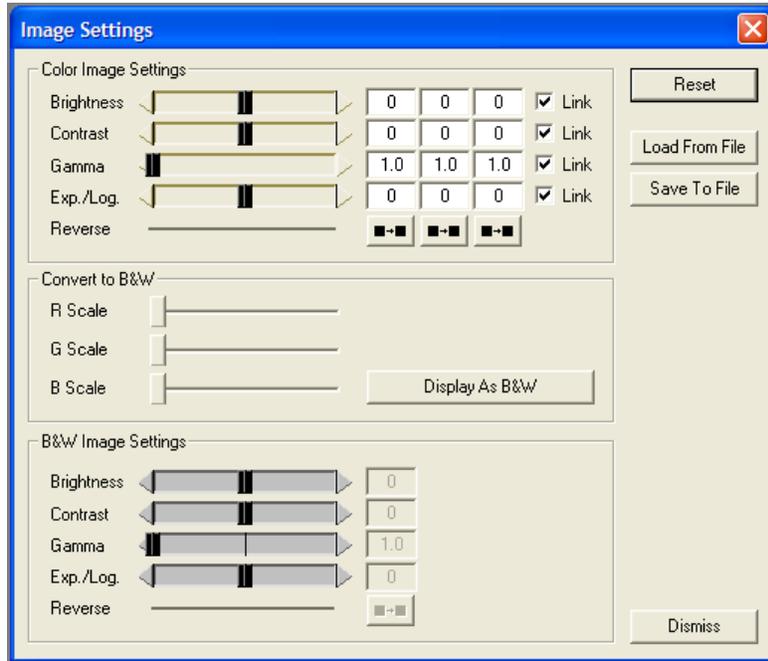
<b>Sharpen</b>	When enabled, the video is passed through an image sharpening algorithm that enhances the edges and removes some of the pixelization effects that occur during low resolution recordings.
<b>Smooth</b>	When enabled, the video is passed through an image smoothing algorithm that reduces the edge contrast and improves appearance of the image
<b>Unfiltered</b>	When selected, the image is unprocessed.

## Image Enhancement

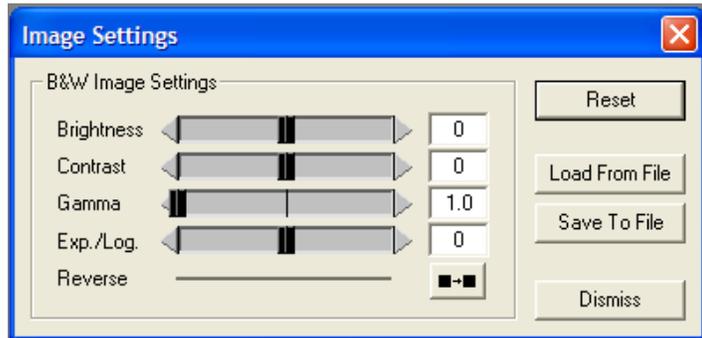
To access the image settings screen, under the **IMAGE PROCESSING** menu item, select **IMAGE SETTINGS**.



If you are viewing a color video image, the following dialog window appears:



If you are viewing a monochrome (black and white) video image, a smaller window which only contains the bottom portion of the above window appears :



This image processing windows allow you to set all the parameters about the image, save your settings and restore them for later use. Note that there are the same sets of sliders for color and monochrome (black and white) images. For the color settings, the individual red, green and blue channels of the color images can be independently adjusted or, if linked, adjusted as a group. The channel sliders for red, green, and blue can be hidden or kept fixed by clicking on the R, G, and B buttons above each column.

The various image settings are:

<b>Brightness</b>	Adjusts the brightness of the image. The brightness of the image is the maximum white level.
<b>Contrast</b>	Adjusts the contrast of the image. The contrast of the image is the normalized ratio of whites minus blacks.
<b>Gamma</b>	Adjusts the gamma of the image. The gamma of the image affects the brightness of the displayed result on your monitor.
<b>Exp./Log.</b>	Adjusts the exponential/logarithmic palette function. With a normal palette, '0' is black and '255' is white and the ratio of the input to output is linear. That is, input 134 maps to output 134. By adjusting this value, you can change the slope of the input/output curve to be either exponential (more blacks) or logarithmic (more whites). A more detailed explanation is provided below.
<b>Reverse</b>	Changes the color palette such that whites and blacks are reversed.
<b>Link</b>	Links the Red, Green and Blue channel sliders together.
<b>Display as B&amp;W</b>	Converts color images to monochrome images using the conversion factors indicated by the R, G, and B sliders.
<b>R Scale</b>	Amount of red channel to include when converting from color to monochrome.
<b>G Scale</b>	Amount of green channel to include when converting from color to monochrome
<b>B Scale</b>	Amount of blue channel to include when converting from color to monochrome.
<b>Reset</b>	Sets all the functions to their default levels.
<b>Load from File</b>	Allows previously stored image settings to be loaded for this image.

**Save to File**

this image.

Allows you to save certain image settings into an LUT (Look Up Table) format for later retrieval.

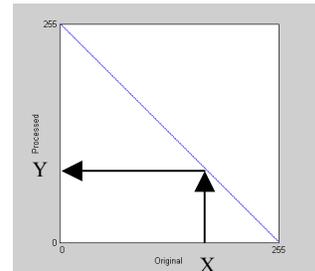
**Dismiss**

Closes the window with the current settings.

The Exp./Log, and Reverse features allow you to improve the image contrast to enhance the tracking success. Understanding that MiDAS looks for objects that have some “color” or, more specifically, a “level of grayscale”, changing these values adjusts the “palette” to improve the white-on-black image contrast. A level of grayscale is best described as the level between black (a value of ‘0’ on an 8-bit gray scale) and white (a value of ‘255’ on an 8-bit gray scale).

A description of these image processing palette options is given below. The images on the left are examples of the effects of each of the palette options. The plots on the right show the mapping of pixel intensity values from the original (horizontal axis) to the processed (vertical axis) image after applying the new palette.

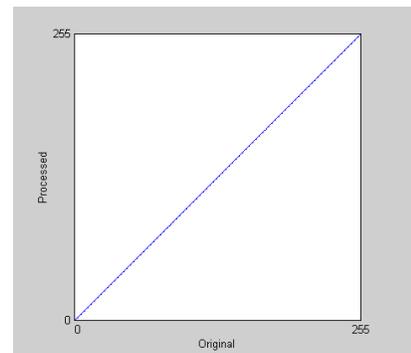
To help in understanding the palette mapping plots, here is an example using the reverse palette. For a given pixel intensity of  $X$  in the original image, we move upward at coordinate  $X$  until we intersect with the blue line, then we move horizontally to find the new pixel value in the processed image, in this case it would be  $Y$ . This is done for every pixel in the image, producing the final processed image as shown in the figures on the left.



**Normal**



This option uses a normal palette, where ‘0’ is black and ‘255’ is white. This is the default and standard palette with no processing occurring. In other words, the processed pixels are identical to the original pixels.

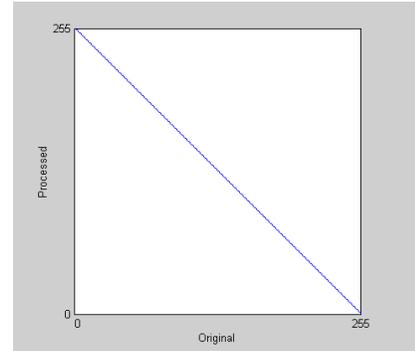




### Reverse



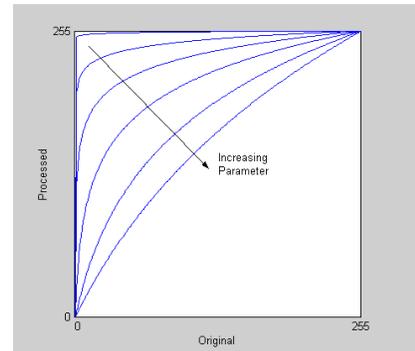
This option uses a reverse palette, where '255' is black and '0' is white. This will invert the image so that light regions are dark and dark regions are light. Contrast is not affected.



### Logarithmic



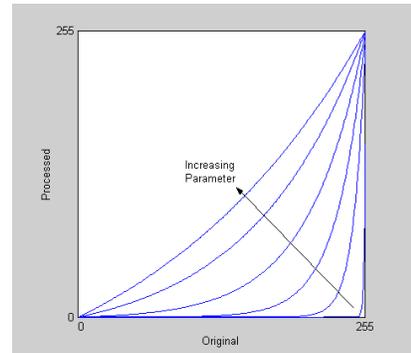
Slide the Exp./Log. slider towards the left. The plot on the right shows multiple mappings for different parameter values. As the parameter is decreased to lower numbers (e.g. -150 to -250), the mapping approaches a straight line (i.e. no processing). This palette increases the contrast in dark regions and decreases the contrast in light regions. This has the effect of bring out more detail in the dark regions and making light regions very light.



**Exponential**



Sliding the Exp./Log. slider towards the right produces an exponential palette, the opposite of the logarithmic palette. This palette increases the contrast in light regions and decreases the contrast in dark regions. This has the effect of making dark regions darker and bringing out more detail in lighter regions. Typical values are positive numbers (e.g. 150 to 250).



**Bayer Decoding Settings**

When you have completed a recording, or if you have loaded a Bayer formatted file, you can view and modify the color coefficients that are used to decode the Bayer images in the video. The Bayer Decoding Settings window can be accessed through the main menu, under Image Processing – Bayer – Decoding Settings, or by right clicking on the playback window and selecting Bayer Decoding Settings.

**MotionPro 10000 Color [Playback] - Bayer Decoding Settings**

1. Base Preset  
Color Temperature: From CLR File [v]

2. Gray Balance  
Select Region [v]    Red: 0    Green: 0    Blue: 0  
Apply Now

3. Channel Adjustment  
Red: 100%    Green: 100%    Blue: 100%  
Apply Now    Reset

Display Color  
Reset to CLR File  
Load Settings  
Save Settings

These coefficients directly control the Bayer decoding. They should only be set manually by knowledgeable users.

Coefficients from CLR File

Red	Green	Blue
1.43711	-1.12431	-1.56092
-0.56729	4.44412	-3.9705
1.1859	-0.84821	21.3127

Current Coefficients

Red	Green	Blue
1.43711	-1.12431	-1.56092
-0.56729	4.44412	-3.9705
1.1859	-0.84821	21.3127

<< Basic  
Undo  
Dismiss  
Apply Now

The Bayer Decoding Settings window is identical to the Camera Color Adjustments window, with only one minor difference. Instead of having factory presets, playback views have default CLR files, or color coefficient files. These files store the last stored color coefficients used to decode the particular video.

The previous page contains a typical Bayer Decoding Settings window for a MotionPro 10000 Color camera, showing all the advanced coefficients as well as basic functions.



# Chapter 10

## Saving and Loading

### Saving Video and Data

You can save your video and data in a few formats. Video can be saved in Windows video (AVI) format or as a series of JPEG, Bitmap (BMP) or TIFF images. Data can be saved either in a tab-delimited text format (TXT) or in Microsoft Excel (XLS) format.

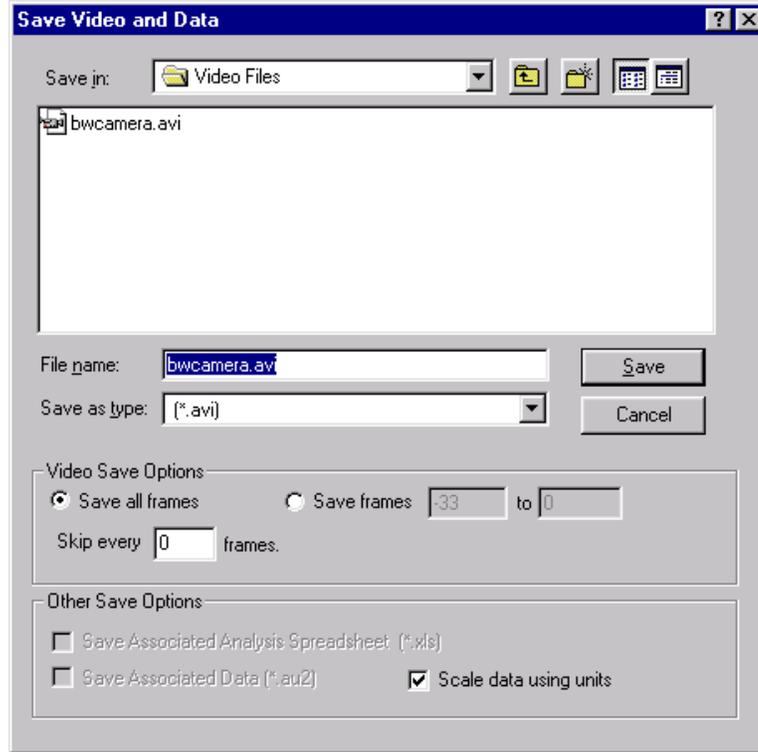
Depending on which window is live (e.g. the title bar across the top is highlighted), the save options change under the FILE menu column. I

1. If the Data Playback Window is selected (active), then both **SAVE DATA AS TEXT** and **EXPORT DATA** options are visible under the File menu column.

<b>Save Data as Text</b>	Saves the data into a file of type *.AU2, where AU2 is a proprietary suffix to MiDAS. This file type is designed as a tab delimited text file. MiDAS associates the AU2 suffix with Wordpad (a Microsoft Windows native text editing software package) during the installation process.
<b>Export Data to Excel</b>	Opens an Excel spreadsheet on the MiDAS console and places the data from all channels being exported directly into the spreadsheet. Note that Excel has a limitation of 65,536 lines – do not try to export data to Excel if more than 65,536 data points have been acquired.

2. If a Video Playback window is selected (active), the **SAVE AS...** is the only visible option under the FILE menu.

The **SAVE AS...** window has various options for saving video, data and spreadsheet files.



The user must configure the save using the following information:

<b>File Name</b>	The Microsoft Windows compatible file name and associated folder location on the hard drive or network.
<b>File Type</b>	Select the desired file type from the drag down list.
<b>Save all Frames</b>	Save all Frames from the current video clip. Note that typical high-speed monochrome video images require approximately 45 MB/second of recording time, while color images require approximately 135 MB/second of recording time.
<b>Save Frames M to N</b>	Save a range of the frames, designated by frame numbers. A

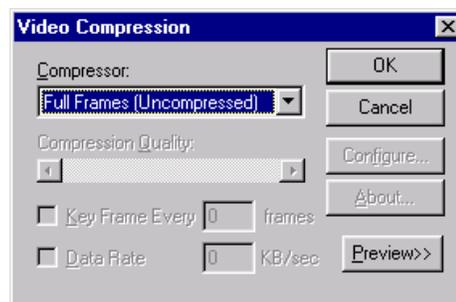
	shortcut to creating M and N is to use the playback slide bar located on both the Play tab and the Play shortcut bar under each video display window. By sliding the bar from one location to another, a blue bar appears on the Play tab. The blue bar defines the range of saving.
<b>Skip every N frames</b>	Skips frames during saving – this is a valuable way to save hard drive space. A value of 1 skips every other frame.
<b>Save Associated Spreadsheet Analysis</b>	Saves the associated spreadsheet as <i>Filename.XLS</i> . To save an associated Spreadsheet with the video, select the <b>SAVE ASSOCIATED SPREADSHEET</b> checkbox on the bottom of the Save As screen prior to saving.
<b>Save Associated Data</b>	Saves the associated data as <i>Filename.AU2</i> . To save associated data with the video, select the <b>SAVE ASSOCIATED DATA</b> checkbox on the bottom of the Save As screen prior to saving.
<b>Scale data using Units</b>	When selected, data is saved in scaled units as entered in the configuration window. When not selected, data is saved in measured voltages.

3. If an Excel Spreadsheet window is selected (active), the **SAVE SPREADSHEET AS...** options are visible under the FILE menu column. All spreadsheets are saved in their native Excel form as *Filename.XLS*.

## Standard Windows AVI Codecs

If you have selected to save a video to an AVI file, MiDAS will present you with the Video Compression Dialog window. The various codecs listed in this dialog are provided by your operating system.

It is highly recommended that you save using the “Full Frames (Uncompressed)” option. The other common codecs are lossy. Using a lossy codec will result in degradation of your video data. MiDAS provides these alternatives for your convenience when storage space is limited.



To use video compression:

1. Save your video sequence. The screen at right appears:
2. Under the menu item labeled Compression, select one of the AVI codecs that is listed.

*Note: The displayed list is derived from the codecs on your operating system.*

3. Press **OK**.

## **Saving to a Sequence of Image Files**

If you have selected to save a video as a sequence of image files, MiDAS will append an underscore and frame numbers to the file name entered. MiDAS will attempt to intelligently handle cases when you have entered a file name which ends with a number or contains underscores and numbers. Prior to executing the final save, MiDAS will display a confirmation dialog containing the pattern of image file names which will be saved. Please check the resulting pattern to see if it matches your desired naming/numbering scheme.

It is also possible to over-write a sequence of image files. In the Save Dialog window, if you select an image file that is already a part of a sequence, MiDAS will prompt you asking if you wish to overwrite the existing sequence. If you select **OK**, MiDAS will delete the entire selected sequence of image files, and then save the new sequence of images.

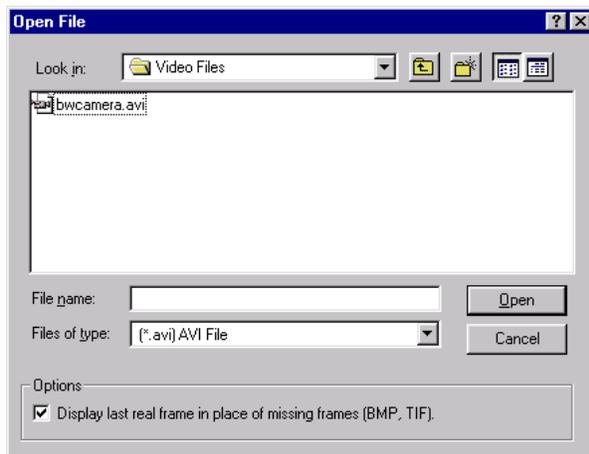
*WARNING: Use caution when over-writing a sequence of image files, ALL image files matching the pattern selected will be deleted. Pay close attention to the pattern displayed in the confirmation dialog when over-writing an existing sequence.*

## **Loading and Importing Files**

Using the **OPEN** command under the FILE menu brings up the following screen.

In this dialog window, you may type in the file name to load, or you can click on the specific AVI file.

For loading a sequence of image files, you can click on any image in





the sequence and MiDAS will load the complete sequence of image files that match the same pattern. For example, if you select *Image\_009.BMP*, MiDAS will load all files that match the pattern *Image\_\*.BMP*, where “\*” is replaced by a frame number only.

The option “Display last real frame...” determines how to handle missing frames in a sequence of image files. If this option is checked, whenever a missing frame (missing file in a sequence) is encountered, the last real frame is displayed instead. If this option is not selected, then missing frames will be ignored and skipped during playback. The default behavior for this option can be set within **SYSTEM CONFIGURATION**, under the **OPTIONS** menu item, as discussed in Chapter 6.

If video (in an AVI or an image sequence) and associated data were saved together, then they will share the same filename. For example, associated video and data files would be saved as *Filename.AVI* and *Filename.AU2* respectively. In the case of an image sequence, the data file would be saved using the image sequence prefix (the filename without the underscore or frame number). For example, when saving to a BMP sequence, the frames would be numbered *Image\_\*.BMP* and the data file would be saved as *Image.AU2*.

If the Auto Load Data when Loading Video option has been enabled in the **SYSTEM CONFIGURATION** window under the **OPTIONS** menu item, then MiDAS will search for a file of *Filename.AU2*. If one is found, it will be opened in a Data Playback window at the same time as the *Filename.AVI* file.

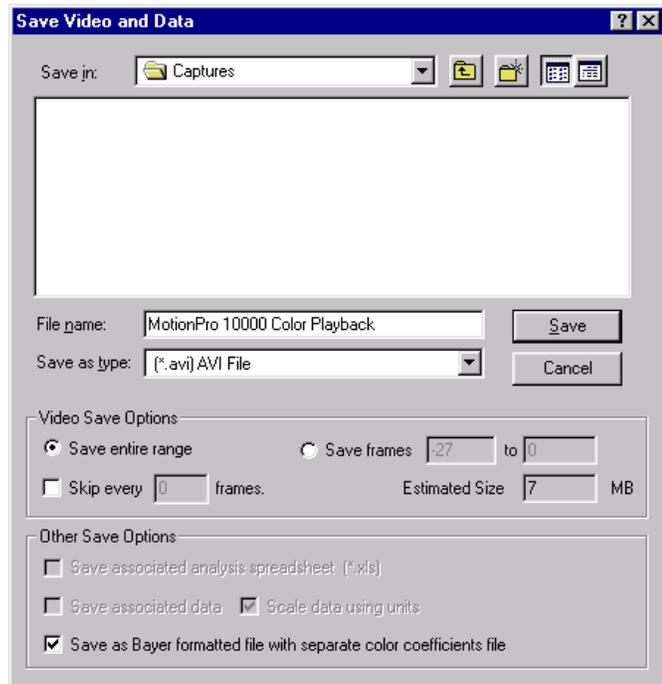
Data files can be opened in any text editor (e.g. Notepad, Wordpad, Microsoft Word, etc.). The AU2 file extension is associated automatically with Wordpad.

## **Playback Decoding and Saving**

The Bayer decoding color coefficients can also be modified after you have completed a recording. You can access the Bayer Decoding Settings window from the main menu, under Image Processing – Bayer – Decoding Settings, or by right clicking on the playback window and selecting Bayer Decoding Settings. The Bayer Decoding Settings window appears and functions exactly like the Color Adjustments window.

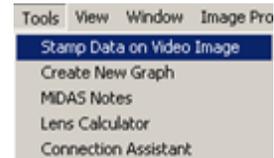
When you save a recording from the playback view, you have the option to save the video as a color video or as a Bayer formatted file. If you save the video as color, the current color coefficients will be applied to do the conversion and the resulting output will be a true color file. If you save the video as a Bayer formatted file, then the raw Bayer frames will be stored to the file and an associated color coefficients file (.clr) will be stored to hold the color coefficients that are used for decoding.

There are two immediate benefits to storing as a Bayer formatted file. If you store in Bayer format, the resulting file will be three times smaller than if you stored as color. Also, if you store in Bayer format, you can modify the Bayer Decoding Settings at any time to adjust the color of the displayed video.



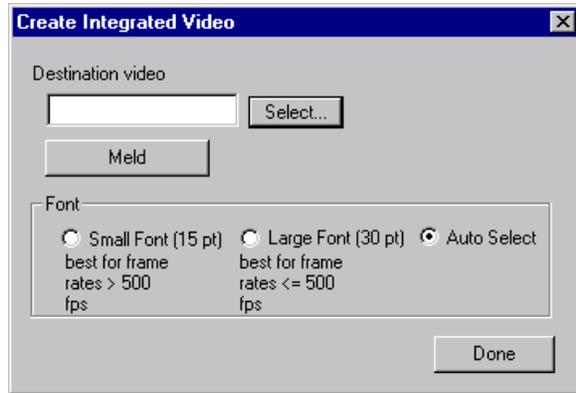
## Creating Melded Video and Data Files

The Create Integrated Video Feature of MiDAS can be used to stamp video frames with correspondingly acquired data points. This feature permanently modifies the AVI file to include the data. MiDAS screens the information onto each frame as a bitmap image. The following steps should be taken to use the feature:

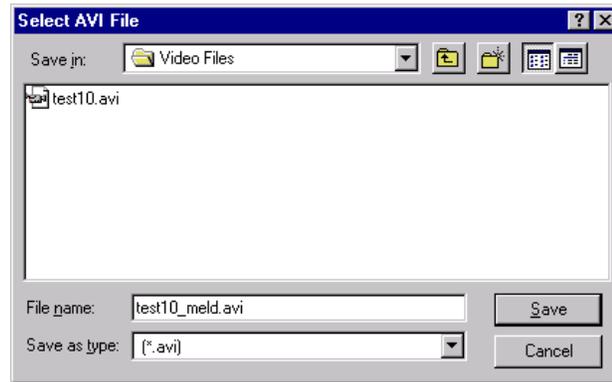


1. Have open an AVI and its associated data (from a current or previous recording). These can be unsaved images, although we encourage you to save the image prior to Melding.
2. From the Tools Menu select the **STAMP DATA ON VIDEO IMAGE**:

3. The following screen appears:
4. Click on **SELECT...** Do not directly type in the 'Destination Video' text box. MiDAS only uses this field to display the chosen filename. It was not intended to be editable. The following screen appears:
5. Choose the directory and name of a new AVI file. In this example, the name of the new file is *Test10\_meld.AVI* and it is located in the folder *D:\Video Files*.



*Note: Do not use the name of the source AVI or any other currently opened AVI. MiDAS will not successfully meld the video and data under these circumstances and will generate an error.*



6. Click **SAVE**
7. Click the **MELD** button. If the operation successfully completes, a new stamped AVI will get opened and displayed within MiDAS, as shown in the figure shown at right:

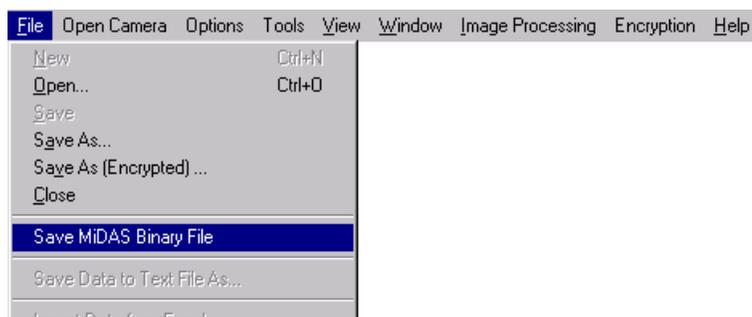
*Note: If more than one data point per frame was acquired during the acquisition, then MiDAS will only use the first data point per frame for the stamping.*



## **The MiDAS File Formats**

With each MiDAS measurement you make and save, MiDAS creates numerous files on your hard drive. It is important to copy all the MiDAS files when archiving or moving the information. The files are as follows:

<b>AVI</b>	Standard Microsoft Windows Video format. MiDAS can save video into AVI file format.
<b>BMP</b>	Standard bitmap file format. MiDAS can save video as a series of sequential BMP images.
<b>TIF</b>	Standard tag image file format. MiDAS can save video as a series of sequential TIFF images.
<b>JPG</b>	Standard jpeg compressed file format. MiDAS can save video as a series of sequential JPG images.
<b>CFG</b>	MiDAS configuration file. Contains all the configuration information about your measurement so that when you open a measurement back up, MiDAS or the MiDAS Player knows the frame rate, shutter speed, etc. of the original recording
<b>AU1</b>	Reserved for MiDAS-LC data files
<b>AU2</b>	MiDAS data files. Tab-delimited text files that contain all the data from a measurement.
<b>AU3</b>	MiDAS binary file. See the next chapter for more details.
<b>XLS</b>	Standard Microsoft Excel file format. MiDAS SA analysis is saved in this format.
<b>CAM</b>	MiDAS camera file for the Lens Calculator. This file contains the information about each camera (resolution, frame rates, etc.) for each camera. CAM files are editable in a text editor.
<b>LUT</b>	MiDAS image processing look-up table values. Contains settings for modifying an image using MiDAS image processing tools.
<b>CLR</b>	MiDAS color balancing file. Contains the Bayer decoding coefficients for color files, plus any color temperature settings and gray balance settings.



## The MiDAS Binary File

The MiDAS Binary File (\*.AU3) is a vital companion file to a MiDAS measurement and a subsequent MiDAS analysis. It is structured with a format that will accommodate the growth of MiDAS recording options. It also contains information regarding any analysis that you perform. As additional processing and record options become available, the content of the MiDAS Binary File will grow. It will always be backward and forward compatible.

The MiDAS Binary File contains the following information in a structured fast access format.

- MiDAS Notes <sup>TM</sup>
- IRIG Timing Information
- Trigger Timing Information
- GPS Timing Information
- GPS Position Information
- Camera Tracker Orientation Information
- Manually Tracked Points and Regions
- Automatically Tracked Points and Regions

The MiDAS Binary File (\*.AU3) is created and saved along with your Video Sequence (typically an \*.AVI file) and your data file (.AU2). A MiDAS Binary File is saved any time that you save your video sequence, in its entirety, or as a reduced number of frames.

It is convenient to save the MiDAS Binary File without being forced to resave the video. This is useful if you have made additions to MiDAS Notes, or performed an analysis on the video sequence with either Manual or Automatic Tracking. You can save the file, from the File Menu, by selecting “Save MiDAS Binary File”.

All of the information that is stored in the MiDAS Binary File is loaded when you load a video sequence. All of the information associated with a MiDAS Measurement can be viewed from MiDAS and MiDAS Player. After you have completed recording, analyzing, and adding commentary to your measurement, you have the freedom to freely distribute the results to your colleagues and managers.

*Note: The MiDAS .AU3 binary file cannot be edited.*



# The MiDAS Lens Calculator

## Overview

The MiDAS Lens Calculator is both a stand-alone application and a component of MiDAS2.0. The Lens Calculator is designed to help the novice videographer select the appropriate optics for a measurement and to configure the test conditions. It is designed using conventional photographic equations and rules for photography, as applied to video usage. The user can select which camera they wish to use, and, since the format of video cameras very often changes depending on frame rate, it recalculates the information for each frame rate.

The Lens Calculator provides a collection of information on selecting depth of field, field angle, format size, hyperfocal distance, and other parameters. It also helps you determine how much blur your image will have when capturing high-speed events.

## Theory and Formulas

The common video lens follows conventional optical imaging theory. The image on the video sensor inside the camera is taken to be the apparent reproduction of an object formed by an optical system. The object, in most cases, is an illuminated combination of finite elements. The "field" is the area that the object occupies, and, in virtually all video systems, the size of the field is defined by the physical dimensions of the sensor projected into "object space". The sensor is therefore the "field stop" of the optical system.

The size of the field is typically termed the "field of view", and can be described as either a physical size (e.g. a "field width") or an angular subtense (e.g. the "field angle"). Both descriptions are common in optical theory calculations.

Although the lens creates a reproduction of the object onto the sensor, it also creates a field of view based on the sensor size and the focal length of the lens. Shorter focal length lenses result in larger fields of view (commonly referred to as wide angle optics), while longer focal length lenses result in smaller fields of view (commonly referred to as telephoto optics). Commonly, the ratio of the field width to the sensor size is the optical "magnification", or optionally the "magnifying power". For example, if the field width is 10 meters and the sensor size is 10 mm, the magnification is  $10 * 1000 / 10 = 1000:1$ . Another common definition is the "overall system magnification" -- the ratio of the field of view to the final projection size on a monitor or display device. For example, if the field width is 10 meters and the display size is 300 mm, the overall system magnification is only  $10 * 1000 / 300 = 33:1$ . One can envision that the object is presented on the display at  $1/33^{\text{rd}}$  its original size.

Conventional macro photographic scientists tend to consider positive magnification as objects larger than the sensor, whereas micro photographic scientists -- those that work with optical systems designed for microscopic analysis -- have the opposite definition. The engineers designing the MiDAS Lens Calculator follow the photographic convention; all the formulas in the MiDAS lens calculator are designed for magnification to be greater than unity when the object is larger than the sensor size. Therefore, a 50 mm lens produces a 10x magnification. The confusion may occur with some markings on microscopic lenses, where the magnification is stamped 0.5x to define an object that is twice as large as the sensor. In the MiDAS lens calculator, a 0.5x magnification describes an object that is 1/2 the size of the sensor.

The concept of "minimum resolution" is also important. In video systems, the minimum resolution in sensor space is (in the absence of special signal processing algorithms) defined as 1 pixel width. Perceived image sharpness is therefore a quantity based on the minimum resolution and other factors such as the zoom magnification on the monitor, the position of the viewer relative to the display and optical properties of the lens.

The "depth of field" is a quantification of perceived image sharpness using formulas honed over years of empirical data and intermixed theory. The near-focus point and far-focus point bracket the physical distances from the lens that a standard viewer using standard viewing practices will perceive an object to be sharp. The MiDAS Lens Calculator follows the theory outlined in [Applied Photographic Optics](#) (1999) by Sidney Ray, modified for conventions used herein. The "circle of confusion diameters are between 0.015 (1/2" video format" and 0.040 (1.25" format), for those accustomed to making their own calculations.

Finally, the use of photographic attachments is common with videographers. Close-up lenses (also called Diopter lenses), tube extenders, and tele-converters are common ways of "cheating" when setting up the test conditions. The engineers at Xcitex always advise users to use the

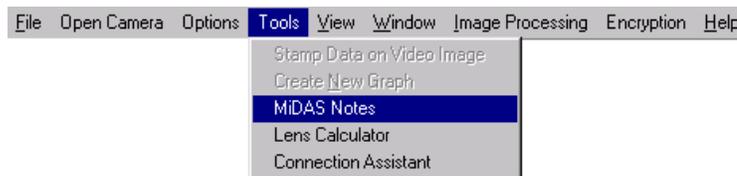


proper lens at the proper settings, but acknowledge the prevalent use of photographic attachments. Therefore, the MiDAS Lens Calculator lets users calculate what impact such attachments will have on an optical system. The formulas in the calculator are again taken from conventional optical engineering textbooks, though modified to encapsulate both macro and micro photography. Specialty lenses such as macro, anamorphic and soft focus lenses will not follow the conventions exactly.

It is important to recognize that the formulas used in the optics calculator are generalized for common video applications -- specialty cases will require special modifications to these formulas.

## Using the Lens Calculator

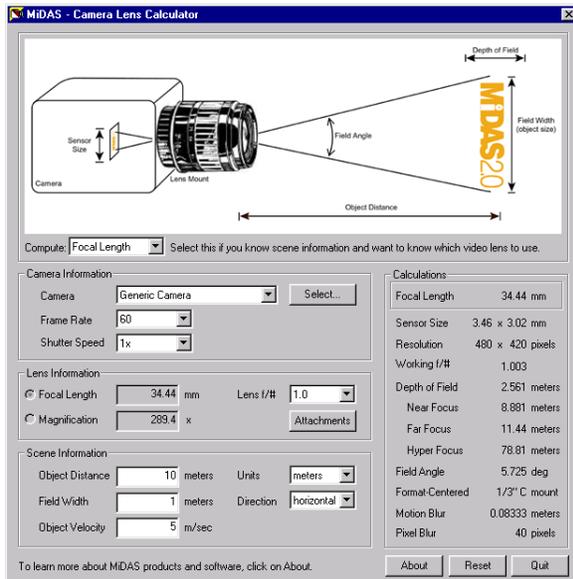
To launch the MiDAS Lens Calculator, select **LENS CALCULATOR** from the **TOOLS** menu drag down.



The main Lens Calculator screen appears, as shown at right.

There are four modes of primary operation for the Lens Calculator. These modes are selected via the drop down box directly underneath the top graphic. The four choices are to compute for:

1. Focal Length
2. Magnification
3. Object Distance
4. Field Width



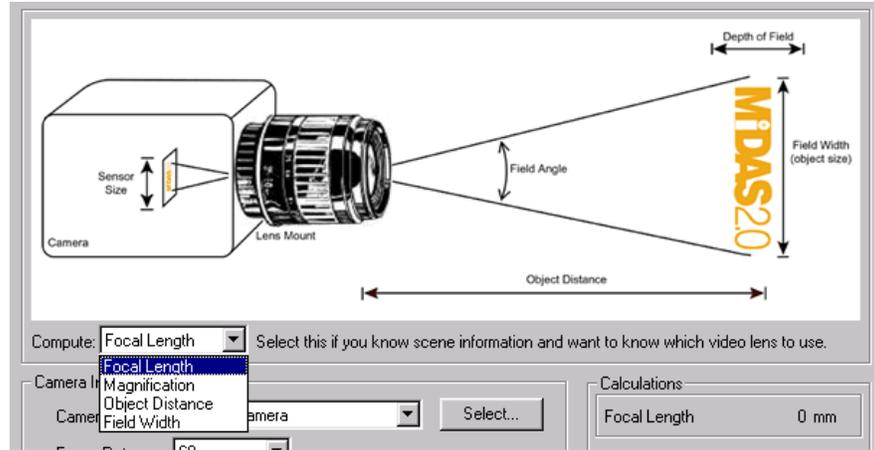
## MIDAS2.0

### Chapter 11: Lens Calculator

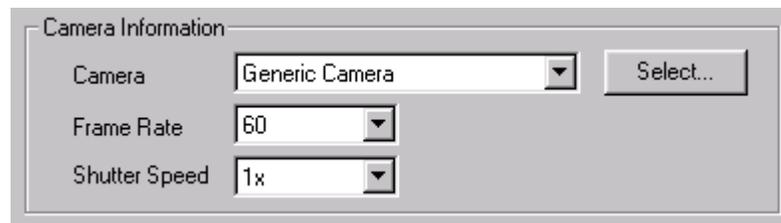
---

Depending on which of these options you select, various entry fields will become active or disabled. (white or gray). You are only allowed to change the active (white areas).

A quick note to the right of the computation drag-down menu explains what each is used option is used for.



After selecting the particular quantity to solve for, you must next set the camera information. If you have a specific camera in mind, click on the **SELECT...** button and locate the information file for that camera. . When you click on the **SELECT...** button, a standard **OPEN** dialog window will appear. Inside of this dialog, you can select multiple camera files and they will all be loaded and placed inside of the drop-down Camera selection control for your use.



If a camera file does not exist for your particular camera, you can create your own using the format given in the section titled “Creating Your Own Camera File”. If you do not have a specific camera in mind, you can use the built-in “Generic Camera” which has general values.

After you have selected your camera, select the Frame Rate and Shutter Speed using the drop down boxes. The Frame Rate will affect the resolution, which in turn affects the sensor size

used in computations. The Frame Rate will also affect the motion blur calculations. The Shutter Speed affects only the motion blur calculations.

There are three basic parameters to any lens that are controlled by the video engineer -- focal length, aperture and focus point. Most over-the-counter optics are designed for maximum performance with the focus ring set to infinity. The f# is, to the first order, the ratio of the focal length to internal aperture of the lens.

Now we are ready to enter specific information about your measurement. Each of the four different compute modes will require different inputs. The following table lists the combinations of inputs required for each of the modes

Compute Mode	Required Inputs
Focal Length	Object Distance –AND– Field Width.
Magnification	Field Width
Object Distance	Focal Length –AND– Field Width
Field Width	Magnification -OR– Focal Length –AND– Object Distance

As each mode is selected, the appropriate input regions will become active in the Lens Information and the Scene Information regions. You can only input the Focal Length (in mm) or the Magnification; you cannot input both, since they depend directly on one another. Therefore in the case of compute mode set to Field Width, you can use the selection buttons to the left of Focal Length and Magnification to select which one you would like to input.

The screenshot shows a software interface with two main sections: 'Lens Information' and 'Scene Information'.  
 In the 'Lens Information' section, there are two radio buttons: 'Focal Length' (which is selected) and 'Magnification'. Next to 'Focal Length' is a text input field containing '0' followed by 'mm'. Next to 'Magnification' is a text input field containing '0' followed by 'x'. To the right of these is a 'Lens f/#' dropdown menu set to '1.0' and an 'Attachments' button.  
 In the 'Scene Information' section, there are three text input fields: 'Object Distance' (0 meters), 'Field Width' (0 meters), and 'Object Velocity' (0 m/sec). To the right of these are two dropdown menus: 'Units' set to 'meters' and 'Direction' set to 'horizontal'.

Select the appropriate Lens f/# using the drop-down box. The **ATTACHMENTS** button is described in the subsequent section titled “Lens Attachments”.

In the Scene Information region, in addition to the Object Distance and Field Width, you can also select the preferred units for input and display, the direction of motion, and the Object Velocity. Selection of the units is self-explanatory. All values in the input boxes will be scaled appropriately to reflect the newly selected units, with the exception of Focal Length, which is always given in mm. The direction of motion is given with respect to the axes of the camera sensor.

A selection of **HORIZONTAL** implies that the object of interest will be oriented/moving along the horizontal axis of the camera. This selection is used to control the sensor size since the horizontal and vertical resolution for cameras are often different. The final input is the Object Velocity. This quantity is used for the motion blur calculations and is described in the next section titled “Motion and Pixel Blur”.

After all the relevant parameters have been entered, the calculations region on the right is updated automatically with the corresponding results. The item selected in the first “Compute” drop-down control is displayed in the first line. In the following lines, additional supplemental calculation results are presented.

Calculations	
Focal Length	34.44 mm
Sensor Size	3.46 x 3.02 mm
Resolution	480 x 420 pixels
Working f/#	1.003
Depth of Field	2.561 meters
Near Focus	8.881 meters
Far Focus	11.44 meters
Hyper Focus	78.81 meters
Field Angle	5.725 deg
Format-Centered	1/3" C mount
Motion Blur	0.08333 meters
Pixel Blur	40 pixels

The MiDAS Lens Calculator calculates the following results:

**Focal length**

the distance from the rear principle plane to the focal point. A focal length equal to the diagonal of a sensor is generally considered to be "standard" -- providing a perspective (viewpoint) consistent with the human eye. Focal lengths larger than the diagonal of the sensor are generally considered to be "telephoto", providing narrow perspective. Focal lengths smaller than the diagonal of the sensor are generally considered to be "wide angle" or "retrofocus". To compare formats (e.g. video to 35 mm photography), compare the standard focal length ratio. Focal lengths are always expressed in mm.

<b>Magnification</b>	the ratio of sensor size to field width. Magnifications less than unity have larger field widths. Magnifications are unitless.
<b>Field width</b>	the physical dimension, in chosen units, of the object field. If <b>HORIZONTAL</b> is chosen, the field width describes the long dimension of the field. If <b>VERTICAL</b> is chosen, the field width is the other dimension.
<b>Object Distance</b>	the physical dimension, in chosen units, that will yield the sharpest image for a lens of specific focal length and field width. The object distance is theoretically computed from the front principle plane of the lens, not necessarily from the physical front of the lens, though this approximation is usually sufficient. The object distance is not dependent on the focus setting of the lens, though most lens designers will set the infinity (best) focus of the lens to be at the correct object distance.
<b>Sensor resolution</b>	the number of horizontal and vertical pixels in use.
<b>Sensor size</b>	the size of the sensor in use for a chosen frame rate, calculated by multiplying the center-to-center pixel size by the number of pixels.
<b>Format</b>	<p>The convention attached to the diagonal dimension of the sensor active area and the corresponding lens mount. The numerical component is based on the diagonal size of the sensor, as follows:</p> <p>1/3"    6 mm  1/2"    8 mm  2/3"    11 mm  1"      16 mm</p> <p>The alphabetic component is a convention based on the register of flange focal distance and the mount type that produces no noticeable vignetting, as follows:</p> <p>C      standard c-thread video mount  B      46 mm flange, also commonly known as F, AI, E, AI-S and D mount</p>

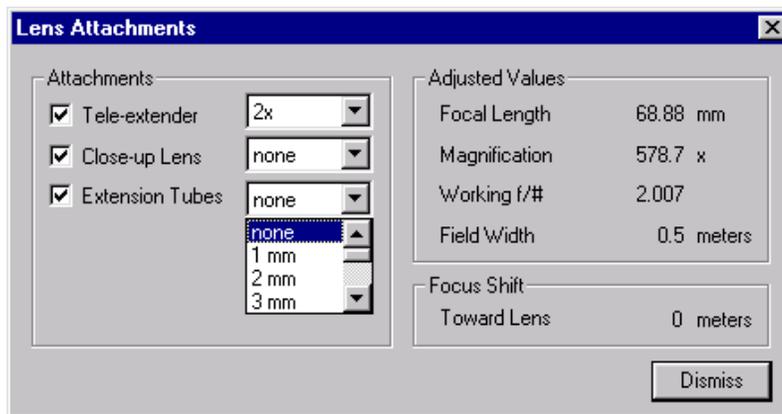
	<p>Note that some cameras allow users to select the active area within a sensor. The MiDAS Lens Calculator shows the format for an active area centered on the sensor. If the area is not centered, the user must re-calculate the format required.</p>
<b>Working f#</b>	<p>The actual cone of light created by the lens aperture and the sensor plane. The f# stamped on the lens describes the cone of light (as a ratio) when the lens is used at its infinite object distance. The working, or actual f#, describes the ratio as the lens is actually used. The Working f# may be larger (less light) depending on the actual position of the object.</p>
<b>Depth of field</b>	<p>The overall distance between near focus and far focus that an image will be perceptibly sharp to the average user.</p>
<b>Near focus</b>	<p>The distance from the lens to the closest point in object space that will be perceptibly sharp when the lens is focused at the optimum object distance.</p>
<b>Far focus</b>	<p>The distance from the lens to the farthest point in object space that will be perceptibly sharp when the lens is focused at the optimum object distance. A far focus of "infinity" indicates that all points farther than the optimum object distance will be perceptibly sharp.</p>
<b>Hyper focus</b>	<p>Also called the "hyperfocal distance". The distance from the lens to a point in object space whereby all objects from 1/2 the hyperfocal distance to infinity will be perceptibly sharp. An approximation for macro-photography that is not appropriate for close-up photography or photomicrography.</p>
<b>Field Angle</b>	<p>The full angle subtended by the field width to the lens, based on the object distance.</p>
<b>Motion Blur</b>	<p>The amount of blur that will be evident in the image, in units of measure in object space.</p>
<b>Pixel Blur</b>	<p>The number of pixels that will show blur of the motion. (See below)</p>

## Motion and Pixel Blur

Motion blur and pixel blur calculations are made using the various camera, lens, and scene information. The motion blur quantity depends only upon the Object Velocity, Frame Rate, and Shutter Speed. The result is given in terms of distance the object has traveled during the exposure time. The pixel blur depends on the same values as the motion blur, and in addition, also depends on the sensor size in pixels, the direction of motion (horizontal/vertical), and the Magnification. The pixel blur is given as the number of pixels that the object has “blurred” through during the exposure time.

## Lens Attachments

After you have solved for a base scenario as described above, you can also examine the effects of standard lens attachments on the computed results. Click on **ATTACHMENTS** in the Lens Information region and the following dialog will appear.



Using this dialog, you can select various settings for Tele-extenders, Close-up Lens Attachments, and Extension Tubes. The adjusted values are computed on the right.

The adjusted values from the lens attachments are dependent upon the solution from the base scenario in the main MiDAS Lens Calculator window. In order for the attachment results to be computed, the base scenario must first be solved. If, in the main MiDAS Lens Calculator window, the calculations still show ‘0’ for some of the results, it is likely that you have not input sufficient information for the base scenario to be solved. Input additional information into the entry boxes in the main window until valid solutions appear in the Calculations area. Once the base scenario is solved, the adjusted values as a result of the lens attachments will also update.

The following are information used in the attachments screen:

<b>Close-up lenses</b>	Supplemental lenses normally screwed onto the front of a photographic lens for close up work. Also called Diopter lenses and typically sold in +1, +2 and +4 diopter sets. These lenses have the effect of changing the focal length without changing the effective aperture of the lens, and cause some degradation of image quality (astigmatism and field curvature).
<b>Tele-extenders</b>	Also known as a tele-extender, range extender, matched multiplier or Barlow lens. These screw mount optics go between the prime lens and the video camera. Since they are pupil matched, they allow the close focus of the prime lens to be retained, but with twice the effective focal length and 1/2 the aperture. The effect is the conversion of a standard lens into a telephoto macro lens. Some slight image degradation is visible.
<b>Extension tubes</b>	These screw in tubes extend the distance from the video camera body to the lens. The result is use of the lens at image space conjugates not intended by the lens designers, causing a reduction of the object distance -- a close-up effect. Use of these tubes significantly impairs the performance of the prime lens and is not recommended.

The following are calculated in the attachments window:

<b>Focal length</b>	the distance from the rear principle plane to the focal point. Focal lengths are always expressed in mm.
<b>Magnification</b>	the ratio of field width to sensor size. Magnifications greater than unity have larger field widths.
<b>Field width</b>	the physical dimension, in chosen units, of the object field. If <b>HORIZONTAL</b> is chosen, the field width describes the long dimension of the field. If <b>VERTICAL</b> is chosen, the field width is the other dimension.
<b>Focus Shift</b>	The distance that the user must move the object towards the lens to be at the optimal focal position for that lens. The focal shift is not dependent on the focus point of the lens -- it is strictly a change in object distance.



## Creating your Own Camera File

The camera files (\*.cam) are text files, which contain basic information about camera frame rate and resolution capabilities. Below is a copy of a sample camera file.

```
#
# name of the camera
#
My 500fps Camera
#
# pixel size: horiz, vertical (in 1e-6 meters)
#
7.4, 7.4
#
# capabilities: fps, horiz res, vertical res
#
60,    480, 420
125,   480, 420
250,   480, 420
500,   320, 280
```

Empty lines and lines beginning with a '#' are ignored by MiDAS. They are used only to help organize the data file. The first non-empty, non-commented line in the file is used as the name of the camera. This string is displayed in the camera selection drop down box within MiDAS Lens Calculator.

The next non-empty, non-commented line should have the horizontal and vertical pixel size of the sensor. These values should be supplied in units of  $\mu\text{m}$  ( $1\text{e-}6$  meters).

Each of the subsequent lines should contain the various frame rate and corresponding horizontal and vertical resolution capabilities of the camera. For instance, the first line in the above file states that the camera can capture at 60 fps at a resolution of 480 pixels horizontal and 420 pixels vertical (lines).

There is no need for any —end—characters.

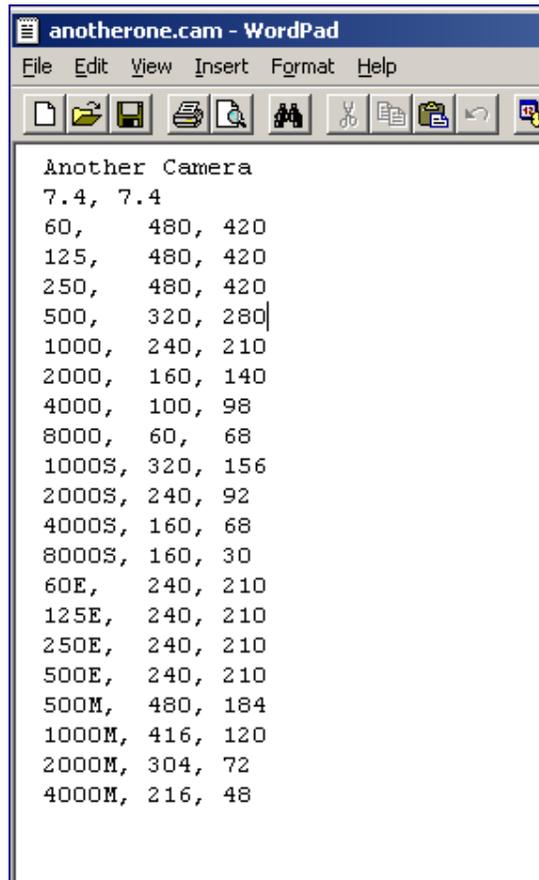
Use a general text editor like WordPad or NotePad to create the camera files. For example, the following camera file named "another.cam" was created in WordPad, a generic Windows text editing software application included with each Windows installation. "Another.cam" is

## MIDAS2.0

### Chapter 11: Lens Calculator

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included with each MiDAS installation. Simply edit and rename the file for a quick, shortcut method of adding cameras to the Lens Calculator.



**MIDAS2.0**

**Optional  
Modules**

Optional Modules





**Chapter**  
**12**

# DA

## Data Acquisition Modules

**Overview**

If you purchased a MiDAS Data Acquisition module, you can simultaneously capture high-speed video and data from a variety of sensors, including accelerometers, strain sensors, microphones, etc. MiDAS will accept up to sixty-four (64) analog inputs

There are eight available high-speed Data Acquisition modules for MiDAS, the specifications of which are listed in the following table:

Part Number	Differential Analog Inputs	Single Ended Analog Inputs	Total Sample Rate (kS/s)	Included Hardware
DA-123M	8	16	200	BNC Breakout Box
DA-123B	8	16	200	5B+ Rack
DA-132M	8	16	100	BNC Breakout Box
DA-160M	8	16	500	BNC Breakout Box
DA-161M	16	64	333	BNC Breakout Box & BNC Extended Breakout Box
DA-170M	8	16	1,250	BNC Breakout Box

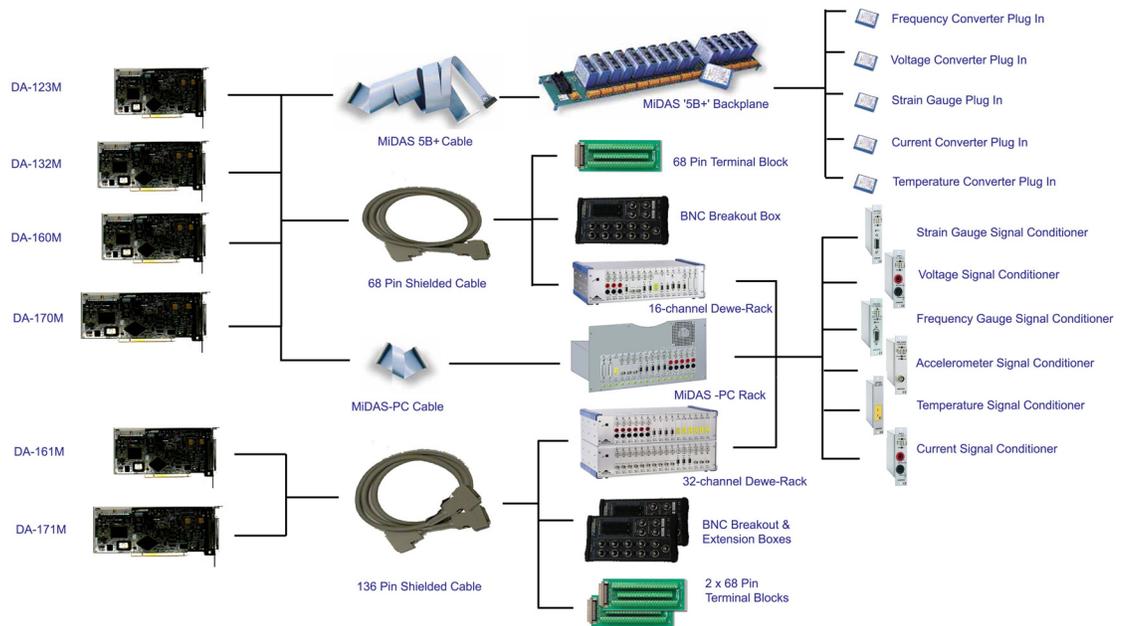
**MIDAS2.0**  
**Chapter 12: Data Acquisition Modules**

DA-171M	16	64	1,250	BNC Breakout Box BNC Extended Breakout Box
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MiDAS DA models DA-123x, -170M and -171M are all configured for PCI bus architecture with 12-bit resolution. MiDAS DA model DA-132M is configured for PCI bus architecture with 16-bit resolution. MiDAS DA models DA-160M and DA-161M are configured for ISA bus architecture with 12-bit resolution. Output lines and digital input lines are currently not used by MiDAS standard software but are available for use with specialty software and with the DAQ boards independent of MiDAS.

All MiDAS DA modules are supplied with a data acquisition board manufactured by National Instruments, a cable and a breakout box. The complete family tree of the MiDAS DA modules is shown in the following drawing:

Complete installation instructions are provided in Chapter 2.

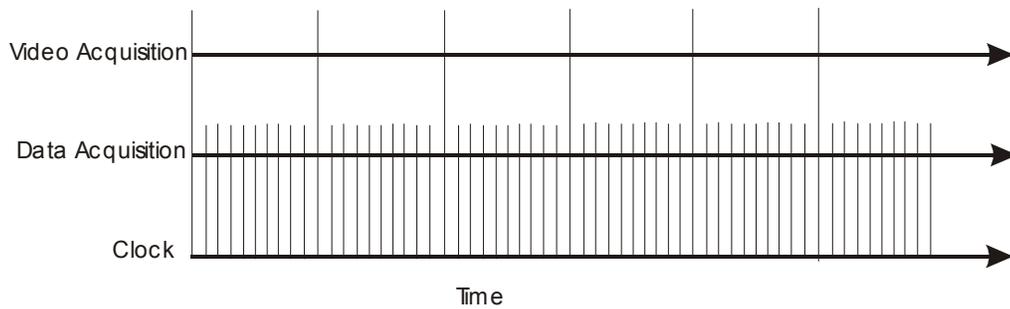


## How MiDAS DA Modules Work...

### The Master Clock

The master clock for the MiDAS DA system is on the DA board installed in the computer. The DA board sends pulses to both the data acquisition engine and the video acquisition engine at the precise times. Each pulse causes the acquisition of the corresponding information and the subsequent storage of the data or video in RAM. The MiDAS DA board and the camera board are connected via a synchronization cable – a physical BNC coaxial cable from the Phase Out connection on the BNC breakout box to the Phase In connection on the camera board. The camera becomes a slave to the MiDAS system – that is, a frame is acquired when a pulse is received across the phase in line. Similarly, the MiDAS DA engine is a slave to the MiDAS system – data is acquired only when the MiDAS software instructs the engine to sample each enabled analog input channel.

The ability to have synchronized yet different clock rates for video and data is the basis for the MiDAS "Waveform per Frame" technology. If, for example, the operator chooses to acquire 10 data points per single frame, the pulse sequence includes one pulse to the video camera for every 10 data pulses, as follows:



### Multiplexed Data Acquisition

If multiple analog channels are selected, the various inputs are "multiplexed" – sampled sequentially through a single analog input. The input is very quickly switched between the enabled channels. If your DA module can acquire 200,000 samples per second (e.g. model DA-123M), and if you enable two (2) analog input channels, then each channel can acquire 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.

Therefore, if in the above example, the operator chooses to acquire 10 data points per single frame and enables 8 analog channels, the pulse sequence includes one pulse to the video camera, and 10 slightly offset data pulses to each channel.

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**

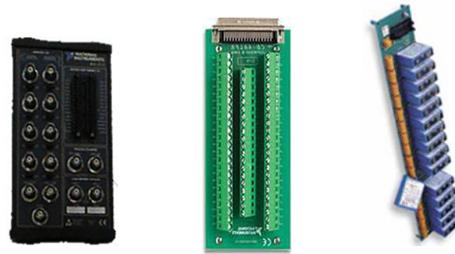
Most MiDAS DA modules include standard a BNC Breakout box. If you purchased an extended analog model (DA-161M, DA-171M), you also received an additional BNC Extension Breakout Box.

MiDAS module DA-123B includes a 5B+ Rack and ribbon cable. The 5B+ Rack is a modified version of the very common “5B” hardware from Analog Devices. This low-cost system for connecting sensors and signal conditioners in a simple rack is used extensively in R&D, laboratory and other development environments. The MiDAS 5B+ version accepts standard 5B signal conditioner modules.

Some high-end and laboratory applications warrant 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 use the MiDAS Terminal Blocks. Terminal Blocks are typically used for a large number of sensor inputs (MiDAS can support 64 sensor inputs) and for large numbers of Single Ended sensors (see description below) that only bring one wire back to the DA hardware. They are very common and very versatile.

The following table helps describe the advantages of each type of connection hardware. If you have questions for a particular application, contact Xcitex engineers for assistance.





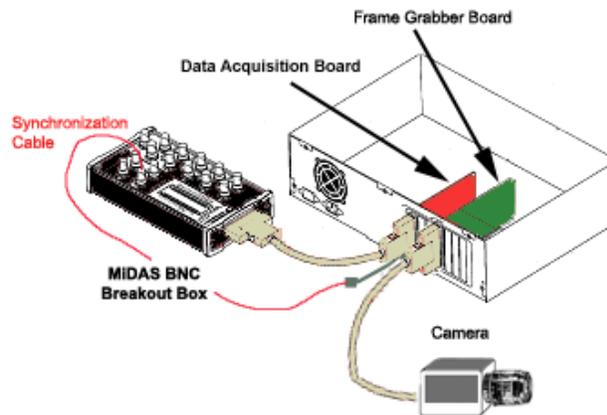
	BNC Breakout Box(es)	Terminal Block(s)	5B+ Rack
<b>Maximum number of analog inputs</b> Modules: DA-123M, -125M, -132M, -160M, -170M	8 any type	16 Single Ended or 8 Differential	16 any type
<b>Maximum number of analog inputs</b> Modules: DA-161M, DA-171M	8 any type	32 any type	Not Available
<b>Maximum number of extended inputs</b> Modules: DA-161M, DA-171M	24 any type	32 any type	Not Available
<b>Cable Type</b>	Shielded	Shielded	Ribbon
<b>Switching</b>	Internal	None	Internal
<b>Connection types</b>	BNC jacks	Screw terminals	Plug ins
<b>Internal Isolation/Shielding</b>	Yes	No	No
<b>Built-in Bias Resistors for Floating Sources</b>	Yes	No	Yes
<b>Accepts Signal Conditioner Modules</b>	No	No	Yes
<b>Powers Strain Gauge Sensors Directly</b>	No	No	Yes
<b>Accepts Voltages greater than +/-10V</b>	No	No	Yes (with SC)
<b>Accepts Single Ended signal inputs</b>	Yes	Yes	Yes
<b>Accepts Differential signal inputs</b>	Yes	Yes	No
<b>BNC Pigtail required for sync cable</b>	No	Yes	No
<b>BNC Pigtail required for ext. trigger</b>	No	Yes	No

## Hooking up your DA Module

Follow steps 7-37 of the installation procedure (Chapter 2 of this User Guide) to install the software and hardware for the DA module.

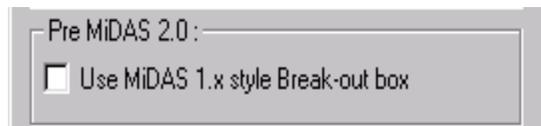
*Note: It is advisable to first install MiDAS with the standard BNC Breakout Box(es) supplied with your shipment. Once you have tested and learned how to use MiDAS with the standard hardware, then change to the optional 5B+ rack or terminal block, as required by your application.*

If you are using a MiDAS BNC Breakout Box, connect your synchronization cable(s) per the installation instructions in Chapter 2. The system should resemble the following diagram:



*Note: Many users have existing installations of BNC Breakout Boxes that cannot be upgraded to the new MiDAS 2.0 configuration per the instructions in Chapter 1. To accommodate these permanent hardware installations, MiDAS now includes a checkbox that instructs the software to use the old (MiDAS 1.x) jumper configurations. To access this checkbox,*

1. From the **OPTIONS** menu, select **RECORD OPTIONS**.
2. Select "Use MiDAS 1.x style Break-out box"

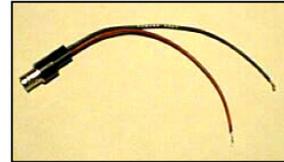


*The correct jumper settings for the Terminal Blocks when used with this checkbox checked are listed in Chapter 1.*

If you are using MiDAS Terminal Block (s), simply disconnect the standard BNC Breakout Boxes and replace them with the optional Terminal Blocks. On the primary Terminal Block (the one connected to the cable labeled “MIO-16”), you must also

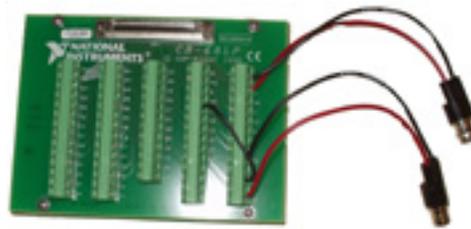
- Connect (with a wire) terminal 10 to terminal 40

You must also create the Sync Out synchronization cable. Using a BNC pigtail as such as shown in the figure at right,



- Connect the red (center post) wire to terminal 2
- Connect the black (outside ground) wire to terminal 35.

Label this pigtail “Sync Out”. From this connector, run the BNC sync cable to the camera “Sync-In” connector as shown in the above diagram.



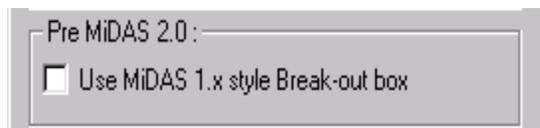
You must also create a BNC connector to accept the external event trigger. Using a BNC pigtail as such as shown in the figure above:

- Connect the red (center post) wire to terminal 41
- Connect the black (outside ground) wire to terminal 39.

Label this pigtail “Trigger In”.

*Note: Many users have existing installations of screw terminal blocks that cannot be upgraded to the new MiDAS 2.0 configuration per the instructions in Chapter 1. To accommodate these permanent hardware installations, MiDAS now includes a checkbox that instructs the software to use the old (MiDAS 1.x) jumper configurations. To access this checkbox,*

1. From the **OPTIONS** menu, select **RECORD OPTIONS**.
2. Select “Use MiDAS 1.x style Break-out box”

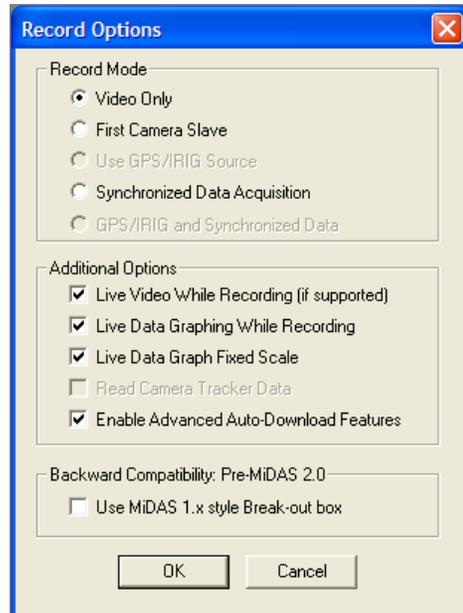


*The correct jumper settings for the Terminal Blocks when used with this checkbox checked are listed in Chapter 1.*

If you are using a MiDAS 5B+ Rack, simply connect the 5B+ ribbon cable and the 5B+ rack directly to the DA board as instructed in Chapter 2 of this manual. No jumpers are required for 5B+ hardware. The sync cable and the external trigger connect directly to the extension bracket on the 5B+ rack.

MiDAS software typically knows that you desire to acquire synchronized data with your video by your license key code. You can disable or enable MiDAS DA acquisition by respectively unselecting or selecting the “Synchronized data acquisition” checkbox in the **RECORD OPTIONS** window (shown at right) under the **OPTIONS** menu. See Chapter 6 for more information about the **RECORD OPTIONS** window.

Note that the process of updating a live data graph is very processor intensive and can require all the processor power available from the computer, leaving no computation ability for other MiDAS functions (for example, you may not be able to stop the recording or re-size a window). If your computer has a slower processor, unselect the “Live data graphing while recording” checkbox in the **RECORD OPTIONS** window under the **OPTIONS** menu.



*Note: Enable the “Live data graphing while recording” feature only if you have sufficient CPU power. To determine if your computer has enough power, enable the CPU monitor from the Performance tab of the Windows Task Manager during a test recording and note the amount of CPU usage during a recording. Optimally, the CPU usage should be <40%.*

## Data Acquisition Basics

MiDAS Data Acquisition modules have been designed to work with a multitude of analog sensors – also commonly termed “transducers”. These sensors convert force, rate of flow, pressure, temperature, etc. into a voltage 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 similar. Therefore, each sensor type typically uses a “Signal Conditioner” to produce signals (e.g. voltages) suitable for the MiDAS data acquisition hardware.

### Understanding what MiDAS DA measures...

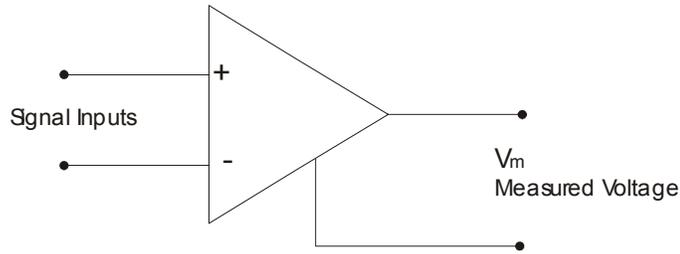
In the next few sections, you are introduced to the variety of sensor types that work with MiDAS. However, it is first important to understand what MiDAS Data Acquisition modules measure.

Your MiDAS DA computer board has an “instrumentation amplifier” on-board. Sensors are connected to the DAQ hardware (breakout box or terminal block) which in-turn pass these signals to this amplifier via the cable and board connector. Therefore, when you connect your sensor to the MiDAS hardware, you are essentially creating a connection with the computer board directly.

MiDAS measures the difference between the output of the instrumentation amplifier and some other voltage. Based on the information you give MiDAS when setting up your test, MiDAS measures the difference between the amplifier output and (1) computer ground, (2) the local ground at your sensor or signal conditioner, or (3) a floating ground source.

An instrumentation amplifier is a differential amplifier – it outputs the difference between two inputs. Therefore, two leads from a sensor can be brought to the amplifier and the difference between them will be determined and then compared to the chosen ground.

Diagrammatically, the differential instrumentation amplifier on the MiDAS data acquisition board is depicted as follows:

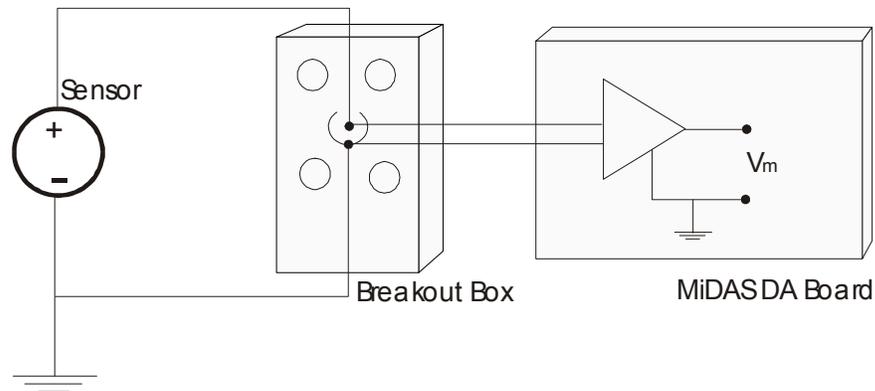


The signal inputs are connected to the sensor or to the transducer via the end connector on the board or via the BNC Breakout box provided with all MiDAS data acquisition systems.

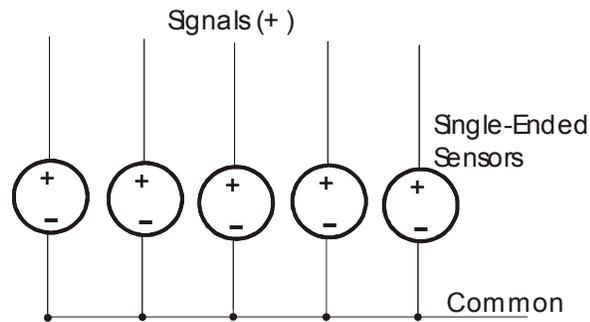
### **Understanding Different Types of Sensors**

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

Some sensors have two output wires and produce a signal that is the difference between the positive (+, or signal) lead and the negative (-) lead. These are named “Differential” sensors.



Some sensors have one signal wire and one common wire. These sensors are generally named “Single Ended” sensors. Typically, the common wires for an entire group of Single Ended sensors are all tied together. These 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 considered to be “Referenced” – that is, the sensor common is considered referenced or tied to the data acquisition board common. Contrarily, if the common wire from a sensor is connected to a common building or earth ground (and perhaps not physically connected to the data acquisition hardware), the system is considered to be “Non-Referenced”.

Combining these, sensor types can be Referenced Single Ended, Non-Referenced Single Ended, or Differential.

MiDAS is designed to work with all these sensor types. The operator must simply instruct MiDAS as to which sensor type is being connected and MiDAS automatically makes all the proper adjustments and switch settings. For example, if you are using a Referenced Single Ended sensor, MiDAS 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 knows which terminals to assign to the sensor and makes the appropriate switch changes to measure the difference between + and – leads.

*Note: If you are unfamiliar with sensor connections or the terms used in this manual, you are advised to consult the Xcitex website, where additional references that help reduce the confusions associated with all these terms and diagrams are published.*

Differential sensors are always recommended for better signal integrity. Single ended sensors are recommended only under controlled conditions, the most important of which is that you need more channels than are currently available. If your signal environment is the least bit noisy, your cable lengths exceed 3 meters (10 ft), or your signal level is less than 1V P-P, then it is highly recommended that you use Differential sensor types with two leads.

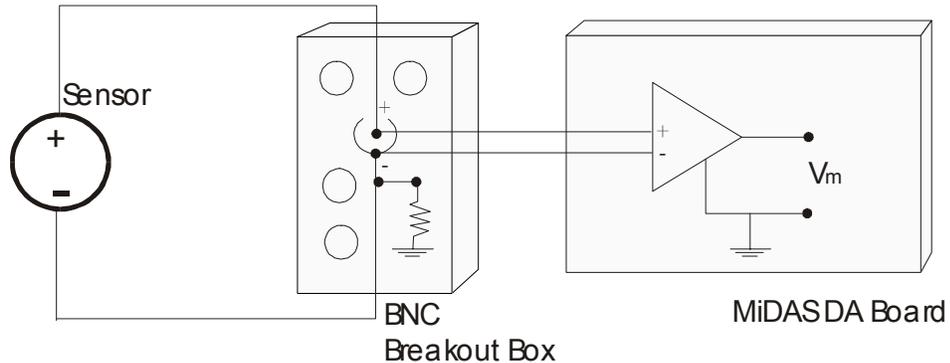
In the following sections, each type of sensor is summarized and diagrammatically depicted.

### “Differential Grounded” Sensors

In this configuration, the Differential sensor has two 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 (assuming that the computer is plugged into the same power system).

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.

Most commercial data acquisition systems are designed in a Differential Grounded configuration, especially if significant signal conditioning is required. In this configuration, the



little rocker switch under the BNC jack should be placed in the “GS” position.

### “Differential Floating” Sensors

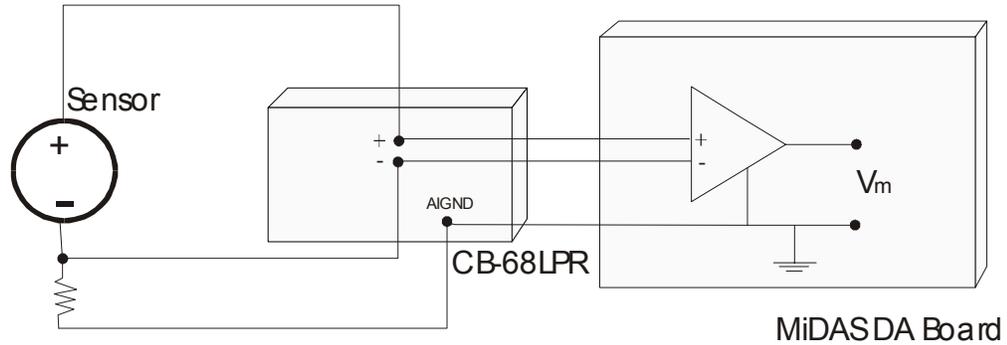
In this configuration, the Differential sensor has two leads – one positive (+) and one negative (-) and the negative lead of the sensor is NOT tied to earth or building ground and is therefore “floating” with respect to the amplifier. Therefore, to reduce the effects of signal drift relative to the board ground, you must tie the ground reference of the floating signal to your board's analog input ground through a bias resistor. In essence, you are “biasing” the drift toward ground. Technically, you should bias both the signal lead and the negative lead, but little improvement is gained by adding a bias resistor to the positive lead.

If you are using a BNC Breakout Box, a built-in 5k $\Omega$  bias resistor (and 0.1  $\mu$ F capacitor filter) is automatically engaged when the little rocker switch below the BNC jack is set to ‘FS’. The connections of the sensor are therefore simple, as shown in the following diagram:

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 large 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 and the AIGND pin as shown in the following diagram:



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

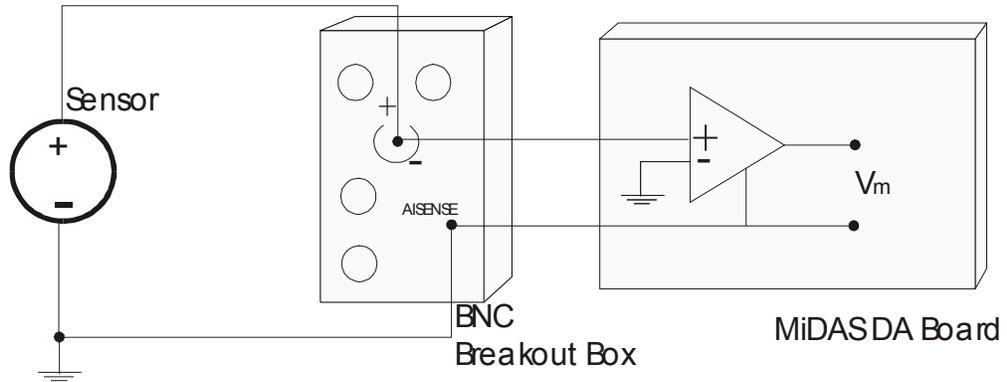
#### **“Single-Ended Grounded” Sensors (Non-Referenced or NRSE)**

Single-Ended sensors have one wire that carries the signal (+) and one common wire. Typically, single ended sensors are used in specialized applications such as crash testing where many additional sensors are required and the test environment is very well 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 also tied to earth or building ground and is therefore already connected to a common ground point with respect to the board (assuming that the computer is plugged into the same power system). 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” – 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 software.

If you are using a BNC Breakout Box, the positive signal lead gets 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:

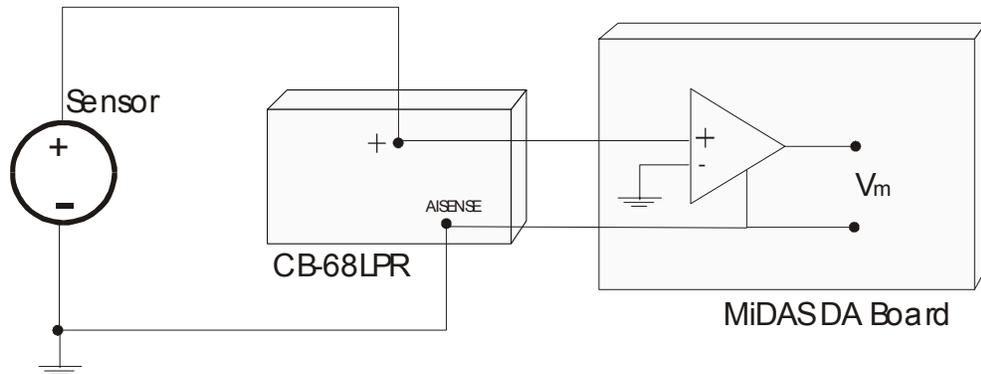
If you are using a Terminal Block, the connections are identical. The positive signal lead from the sensor gets connected to the appropriate screw terminal and the common lead(s) must be wired to the AISENSE terminal screw terminal as depicted in the following diagram:



In the NRSE (Single-Ended Grounded) mode, MiDAS 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)**

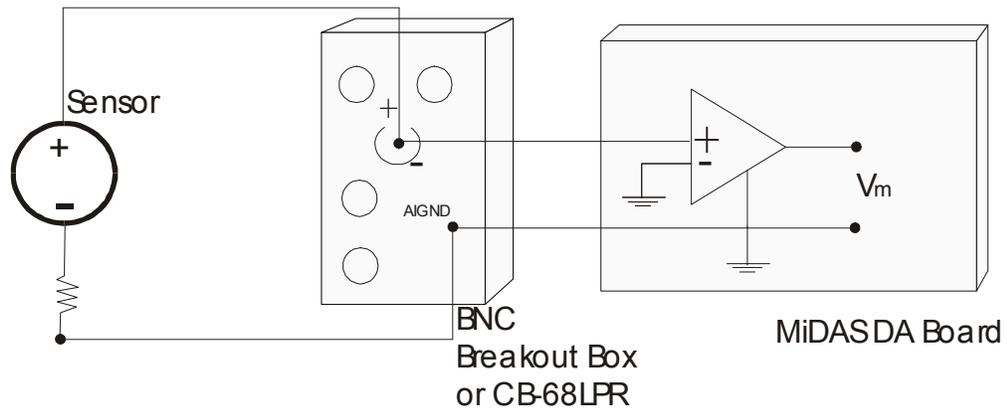
Single-Ended sensors have one wire that carries the signal (+) and one common wire. Typically, single ended sensors are used in specialized applications such as crash testing where many additional sensors are required and the test environment is very well controlled. If you are using single ended sensors, 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 is therefore 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. In essence, you are “biasing”

the drift toward ground. Technically, you should bias both the signal lead and the negative lead, but little improvement is gained by adding a bias resistor to the positive lead.

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 large 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 that this resistor must be placed regardless of whether you use the MiDAS Breakout Box or the Terminal Block. In the RSE (Single-Ended Floating) mode, MiDAS measures the difference between the output of the amplifier and AIGND. The switch on the BNC Breakout Box is not used.

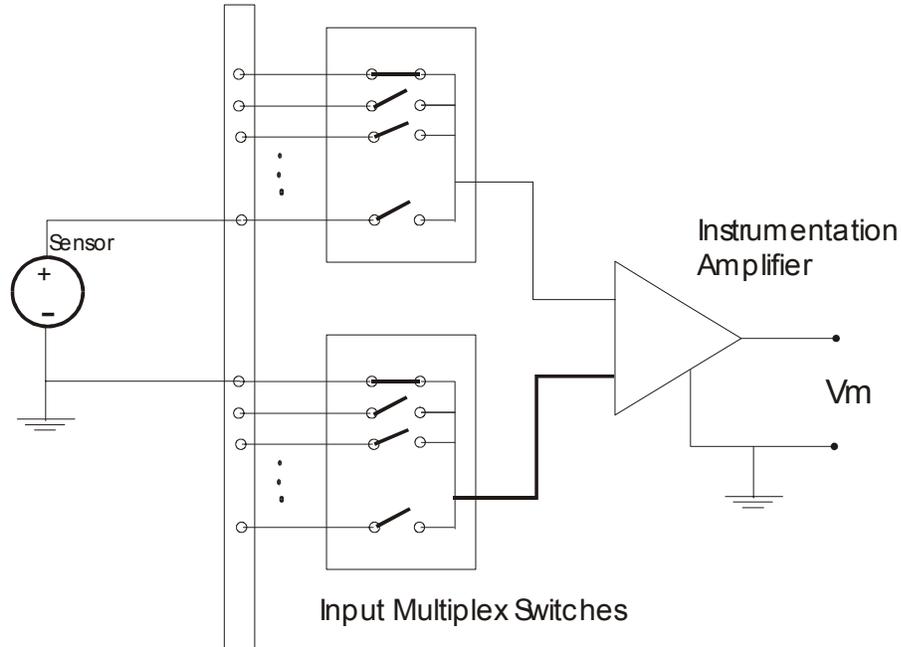
### How Multiplexing Works

MiDAS standard data acquisition modules work on the principal of multiplexing – the common technique for sampling multiple channels with one acquisition device. The incoming signals and lines are wired to a multiplex switch (“mux”) that switches the inputs rapidly to the instrumentation amplifier. MiDAS software automatically configures the data acquisition hardware to enable this ultra-fast switching and keeps track of which channel is configured for which type of connector.

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 in

inversely proportional to the number of channels and the total sample rate, but typically is a few microseconds.

Therefore, if multiple channels are selected, the true diagrams presented in the previous section would also include the front multiplex switch, as follows (example of differential grounded source):



### **Choosing the Data Sample Rate**

Since the inputs are switched via the multiplex switch described above, the total data sample rate is the product of the number of channels times the sample rate per channel. For example, if you have 4 channels active and wish to acquire 10,000 samples per second per channel, the total sample rate is  $4 \times 10,000 = 40,000$  samples/second. Likewise, if your data acquisition board is rated for 200,000 samples per second maximum rate and you have 8 channels active, the maximum rate per channel is  $200,000/8 = 12,500$  samples/second.

One important consideration when selecting the data rate is the processor usage. MiDAS draws each data point on the screen plus the cursor position for each graph. With many thousands of data points and multiple channels, the processor power required just to draw continuously will slow the system performance.

## Connecting Sensors to the BNC Breakout Box

1. Click on the **OPTIONS** menu item and select **DATA ACQUISITION SETTINGS**. The following configuration window appears.

**Data Acquisition Settings**

DAQ Configuration  
DAQ hardware being used: BNC Breakout Box(es)

Analog Inputs

On	Channel	Input Mode	Label	Units
<input checked="" type="checkbox"/>	2	NRSE	Speed	m/s

Lower Limit: 0    Upper Limit: 1    Factor (units/volt): 1    Offset (units): 3420    Plot Color: ■ Change

Chan	Input M...	Lowe...	Upe...	Label	Factor	Offset	Units
0	DIFF	0.00	10.00	Tach	1000.0...	0.00	rpm
1	DIFF	0.00	10.00	Load	500.0000	1000.00	psi
2	NRSE	0.00	1.00	Speed	1.0000	3420.00	m/s
3	RSE	0.00	1.00	Label	1.0000	0.00	v

Update    Set As Default    OK

2. Select **BNC BREAKOUT BOX(ES)** in the DAQ Configuration window.
3. Select the appropriate channel (e.g. "Channel 0") from the drag-down box. If that channel is available, click the **ON** checkbox. If that channel is unavailable, go to the next highest channel until you find an available channel. Start with Channel 0 always.
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 (gain, offset, voltage range, calibration). Make sure you factor in the signal conditioning amplification, if appropriate.
6. Configure MiDAS 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 chart shows the options for configuring a sensor. Enter all the information requested.

<b>DAQ hardware being used</b>	The options are BNC Breakout Box(es) or Terminal Block. If you are using the supplied BNC Breakout Boxes, select <b>BNC BREAKOUT BOX(ES)</b> See above.
<b>Channel</b>	MiDAS automatically determines and displays which channels are available based on which module you have purchased which type of DAQ hardware you have chosen and which type of sensors you have already configured. Starting with the next sequentially available channel (start with Channel 0) and check the box to enable that channel.
<b>Input Mode</b>	The three options here are DIFF, RSE and NRSE. 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, try DIFF mode.
<b>Label</b>	Provides a short (4 character) label for the analog input channel. This label is printed on the melded AVI file. We recommend using lower case letters only.
<b>Units</b>	A short (3 character) field for placing units in the graphs. We recommend using lower case letters only.
<b>Lower Limit</b>	The lower limit, in volts, that you expect to see from your sensor. MiDAS magnifies the dynamic range of the input from Lower Limit to Upper Limit. Voltages that exceed the lower limit in this field will appear as clipped or saturated. A small amount of over scan has been automatically provided. Typical “bi-polar” sensors have an input range of –10volts to +10volts. Typical “uni-polar” sources have an input range of 0V to +10V.
<b>Upper Limit</b>	The lower limit, in volts, that you expect to see from your sensor. MiDAS magnifies the dynamic range of the input from Lower Limit to Upper Limit. Voltages that exceed the lower limit in this field will appear as clipped or saturated. A small amount of over scan has been automatically provided. Typical “bi-polar” sensors have an input range of –10volts to +10volts. Typical “uni-polar” sources have an input range of 0V to +10V.

<b>Factor</b>	The scale factor to be applied by MiDAS to convert the input volts to a meaningful number, in units/volt. This number is applied immediately after the input voltage is registered.
<b>Offset</b>	The offset to be applied by MiDAS to account for drifts or offsets in the input, in units. This offset is applied after the scale factor multiplication.
<b>PLOT COLOR button</b>	The color of the line to be used in multiple-line graphs. Select this button to bring up the color palette.
<b>UPDATE button</b>	When clicked, this button causes the table to be updated with the new information.
<b>SET AS DEFAULT button</b>	When clicked, this button causes the current data configuration to be saved as the default for all future measurements. When MiDAS DA module is again opened, the default configuration will be present.
<b>OK button</b>	Exits the screen without further data saving.

7. Click on the **UPDATE** button
8. Physically connect your sensor to the BNC Breakout Box(es)
  - (a) 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. Note that most Differential sensors will already have BNC terminations.
    - If your sensor is “Single-Ended Grounded (Non-Reference Single Ended)”, 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 (Reference Single Ended)”, 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.
  - (b) Connect the BNC connector to the corresponding BNC input on the BNC Breakout Box and the BNC Extended Breakout Box. MiDAS will automatically enable the correct channels for you depending on which DA module you have purchased. DA models DA-123x, -132M, DA-160M and DA-170M, all enable 8 channels. DA model DA models DA-161 and -171 enable 32 channels.

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**Chapter 12: Data Acquisition Modules**

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When using the MiDAS BNC Breakout Box(es), connect your sensors as shown in the following chart:

<u>MiDAS Channel</u> (as selected in Settings window)	<u>Connect Sensor to BNC labeled...</u>
0	ACH 0
1	ACH 1
2	ACH 2
3	ACH 3
4	ACH 4
5	ACH 5
6	ACH 6
7	ACH 7
16	CH 16
17	CH 17
18	CH 18
19	CH 19
20	CH 20
21	CH 21
22	CH 22
23	CH 23
32	CH 32
33	CH 33
34	CH 34
35	CH 35
36	CH 36
37	CH 37
38	CH 38



39	CH 39
48	CH 48
49	CH 49
50	CH 50
51	CH 51
52	CH 52
53	CH 53
54	CH 54
55	CH 55

9. Flip the little rocker switch on the bottom of the BNC input as follows:

If your sensor is “Differential, Grounded” to “GS”

If your sensor is “Differential, Floating” to “FS”

If your sensor is “Single-Ended”, to “FS”

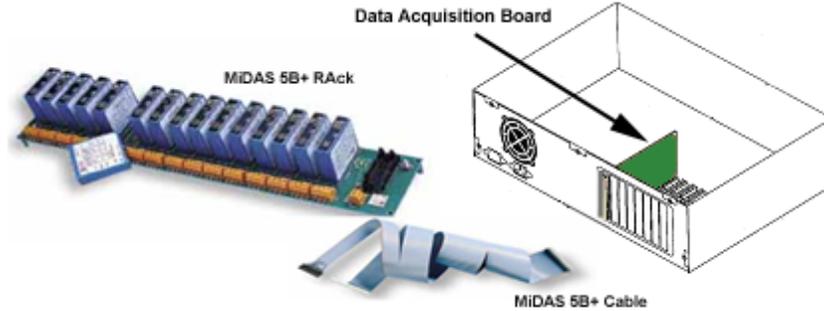
10. Repeat steps 3-9 for each sensor that you wish to hook up to MiDAS DA.

11. When done hooking up all your sensors, click on the **OK** button.

*Note: Consult with your sensor manufacturer for specific details regarding your sensor(s). MiDAS BNC Breakout Boxes accept –10V to 10V signals (the standard in the data acquisition Industry). If your sensors put out more than this amount, 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 modules.*

### **Connecting Sensors to the MiDAS 5B+ Rack**

The MiDAS DA-123B module includes a 16-channel 5B+ Rack and special cable. The MiDAS 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 in that it directly accepts a complete line of Signal Conditioner modules for modifying signals from sensors. The MiDAS 5B+ rack is depicted in the following diagram, completely populated with 16 signal conditioner modules:



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

### Frequency Measurement Modules

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

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 Modules

Voltage modules amplify or reduce DC input voltages to  $\pm 5$ VDC for MiDAS input.

Input Range	Output Range	Bandwidth	Part Number
$\pm 10$ mV	$\pm 5$ V	10kHz	M5B-VI40-01
$\pm 50$ mV	$\pm 5$ V	10kHz	M5B-VI40-02
$\pm 100$ mV	$\pm 5$ V	10kHz	M5B-VI40-03
$\pm 1$ V	$\pm 5$ V	10kHz	M5B-VI41-01
$\pm 5$ V	$\pm 5$ V	10kHz	M5B-VI41-02
$\pm 10$ V	$\pm 5$ V	10kHz	M5B-VI41-03
$\pm 20$ V	$\pm 5$ V	10kHz	M5B-VI41-07
$\pm 40$ V	$\pm 5$ V	10kHz	M5B-VI41-08

### Current Measurement Modules

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

Input Range	Output Range	Bandwidth	Part Number
-------------	--------------	-----------	-------------

0-20mA      0-5V      4Hz      M5B-CI32-02

### 5B Strain Measurement Modules

Strain Gauge modules both provide bias “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 Volts Excitation	±5V	Full bridge 300-10kΩ,	10 kHz	M5B-SG38-02
±30 mV @ 10 Volts Excitation	±5V	Half bridge 300-10kΩ,	10 kHz	M5B-SG38-04
±20 mV @ 10 Volts Excitation	±5V	Full bridge 300-10kΩ,	10 kHz	M5B-SG38-05

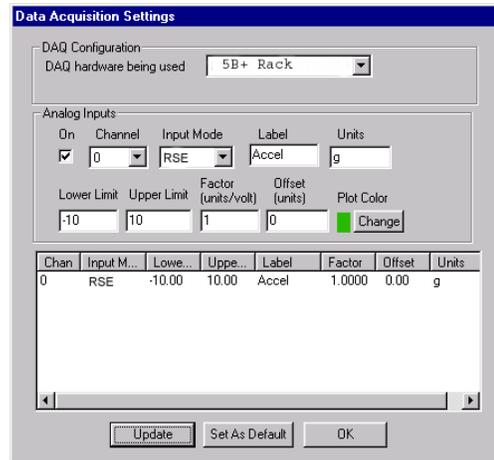
### 5B Temperature Measurement Modules

Temperature modules 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 connect sensors to your MiDAS DA-123B module:

1. Connect your MiDAS DA hardware per the instructions in Chapter 2.
2. Replace the BNC Breakout Box and shielded cable with the 5B+ Rack and ribbon cable.
3. Click on the **OPTIONS** menu item and select **DATA ACQUISITION SETTINGS**. The configuration window appears, as shown at right:



4. First, you must tell MiDAS which type of DAQ hardware you are using. Select “**5B+ RACK**” in the DAQ Configuration window.
5. Determine the type of sensor that you are using (see the instruction manual that came with your sensor for more details).
6. Starting with Channel 0, select a channel.
7. Click the **ON** checkbox next to the channel you selected.
8. Configure MiDAS with the specific information about the sensor. Note that all 5B signal conditioner modules are reference single ended (e.g. RSE )
9. Set the information about each channel on which you are acquiring analog data per the following instructions. Use the information coming out of the 5B+ modules (typically +/- 5V or 10V range). Set the scale factor as the product of the sensor and the signal conditioner amplification.

<b>DAQ hardware being used</b>	The options are BNC Breakout Box(es), Terminal Block or 5B+ Rack.
<b>Channel</b>	MiDAS automatically determines and displays which channels are available based on which module you have purchased which type of DAQ hardware you have chosen and which type of sensors you have already configured. Starting with the next sequentially available channel (start with Channel 0) and check the box to enable that channel.
<b>Input Mode</b>	Select RSE for most 5B+ applications. The ground is handled by the signal conditioner rack. If you are using a non-referenced ground system, select NRSE.
<b>Label</b>	Provides a short (4 character) label for the analog input channel. This label is printed on the Melded AVI file. We recommend using lower case letters only.
<b>Units</b>	A short (3 character) field for placing units in the graphs. We recommend using lower case letters only.
<b>Lower Limit</b>	The lower limit, in volts, that you expect to see from your sensor. MiDAS magnifies the dynamic range of the input from Lower Limit to Upper Limit. Voltages that exceed the lower limit in this field will appear as clipped or saturated. A small amount of over scan has been automatically provided. Typical “bi-polar” sensors have an input range of -10volts to +10volts. Typical “uni-polar” sources have an

	input range of 0V to +10V.
<b>Upper Limit</b>	The upper limit, in volts, that you expect to see from your sensor. MiDAS magnifies the dynamic range of the input from Lower Limit to Upper Limit. Voltages that exceed the upper limit in this field will appear as clipped or saturated. A small amount of over scan has been automatically provided. Typical “bi-polar” sensors have an input range of –10volts to +10volts. Typical “uni-polar” sources have an input range of 0V to +10V.
<b>Factor</b>	The scale factor to be applied by MiDAS to convert the input volts to a meaningful number, in units/volt. This number is applied immediately after the input voltage is registered.
<b>Offset</b>	The offset to be applied by MiDAS to account for drifts or offsets in the input, in units. This offset is applied after the scale factor multiplication.
<b>PLOT COLOR button</b>	The color of the line to be used in multiple-line graphs. Select this button to bring up the color palette.
<b>UPDATE button</b>	When clicked, this button causes the table to be updated with the new information.
<b>SET AS DEFAULT button</b>	When clicked, this button causes the current data configuration to be saved as the default for all future measurements. When MiDAS DA module is again opened, the default configuration will be present.
<b>OK button</b>	Exits the screen without further data saving.

10. Click on the **UPDATE** button
11. Insert your 5B Signal Conditioner Modules into the 5B+Rack. Make any adjustments to the modules (settings, voltage jumpers, etc.) at this time.
12. Connect your sensors directly to the 5B signal conditioner modules
13. Repeat steps 5-11 for each sensor you attach (up to 16).
14. Power up the 5B+ Rack with the power supply.
15. Adjust your offset values as necessary.

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

16. Configure your channels. When using the MiDAS 5B+ Rack, connect your sensors as shown in the following chart:

<b><u>MiDAS Channel</u></b> (as selected in Settings window)	<b><u>Connect Sensor to 5B Rack position</u></b>
0	1
1	2
2	3
3	4
4	5
5	6
6	7
7	8
8	9
9	10
10	11
11	12
12	13
13	14
14	15
15	16

*Note: Factor in any scaling or amplification caused by the 5B Signal Conditioner when setting channel information. For example, if the signal conditioner is a 2x voltage divider, the MiDAS Scale Factor must be multiplied by 2x for accurate acquisition.*

## Connecting Sensors to the Terminal Blocks

1. Replace the BNC Breakout Box and the BNC Extended Breakout Box if you have an extended analog module with Terminal Blocks.
2. Click on the **OPTIONS** menu item and select **DATA ACQUISITION SETTINGS**. The following configuration window appears.

On	Channel	Input Mode	Label	Units	Lower Limit	Upper Limit	Factor (units/volt)	Offset (units)	Plot Color
<input checked="" type="checkbox"/>	0	DIFF	Accel	g	-10	10	1	0	<span style="background-color: green; color: white; padding: 2px;">Change</span>

Chan	Input M...	Lowe...	Uppe...	Label	Factor	Offset	Units
0	DIFF	-10.00	10.00	Accel	1.0000	0.00	g

3. Select **CB/SCB TERMINAL BLOCK(S)** in the DAQ Configuration window.
4. Select the appropriate channel (e.g. 'Channel 0') from the drag-down box. If that channel is available, click the **ON** checkbox. Start with Channel 0 always. If Channel 0 is not available (already in use), then use Channel 1. If Channel 1 is already in use, then use Channel 2, and so on, until you find an available channel. Increment upwards as you proceed. MiDAS automatically knows which channels are available and which are in use. You cannot override this information.

5. Determine the type of sensor that you are using (see the instruction manual that came with your sensor for more details).
6. Determine the parameters of the sensor (gain, offset, voltage range, calibration). Make sure you factor in the signal conditioning amplification, if appropriate.
7. Configure MiDAS 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 chart shows the options for configuring a sensor. Enter all the information requested.

<b>DAQ hardware being used</b>	If you are using the optional CB-68LPR terminal blocks, select " <b>CB/SCB TERMINAL BLOCKS</b> ".
<b>Channel</b>	MiDAS automatically determines and displays which channels are available based on which module you have purchased which type of DAQ hardware you have chosen and which type of sensors you have already configured. Starting with the next sequentially available channel (start with Channel 0) and check the box to enable that channel.
<b>Input Mode</b>	The three options here are DIFF, RSE and NRSE. See the above description to determine which type of sensor you are using. See the above descriptions of sensor types.
<b>Label</b>	Provides a short (4 character) label for the analog input channel. This label is printed on the Melded AVI file. We recommend using lower case letters only.
<b>Units</b>	A short (3 character) field for placing units in the graphs. We recommend using lower case letters only.
<b>Lower Limit</b>	The expected lower limit, in volts, that you expect to see. MiDAS magnifies the dynamic range of the input from Lower Limit to Upper Limit. Voltages that exceed the lower limit in this field will appear as clipped or saturated. A small amount of over scan has been automatically provided. Typical "bi-polar" sensors have an input range of -10volts to +10volts. Typical "uni-polar" sources have an input range of 0V to +10V.
<b>Upper Limit</b>	The expected upper limit, in volts, that you expect to see. MiDAS magnifies the dynamic range of the input from Lower Limit to Upper Limit. Voltages that exceed the upperlimit in this field will appear as clipped or saturated. A



	small amount of over scan has been automatically provided. Typical “bi-polar” sensors have an input range of –10volts to +10volts. Typical “uni-polar” sources have an input range of 0V to +10V.
<b>Factor</b>	The scale factor to be applied by MiDAS to convert the input volts to a meaningful number, in units/volt. This number is applied immediately after the input voltage is registered.
<b>Offset</b>	The offset to be applied by MiDAS to account for drifts or offsets in the input, in units. This offset is applied after the scale factor multiplication.
<b>PLOT COLOR button</b>	The color of the line to be used in multiple-line graphs. Select this button to bring up the color palette.
<b>UPDATE button</b>	When clicked, this button causes the table to be updated with the new information.
<b>SET AS DEFAULT button</b>	When clicked, this button causes the current data configuration to be saved as the default for all future measurements. When MiDAS DA module is again opened, the default configuration will be present.
<b>OK button</b>	Exits the screen without further data saving.

8. Click on the **UPDATE** button
9. Physically connect your sensor to the CB-68LP Terminal Block(s)

*Note: MiDAS can accommodate both differential and single ended inputs. Mix and match them as required by your application.*

If your sensor is “Differential, Grounded” or “Differential, Floating”:

- (a) Connect the signal (+) lead and the negative (-) lead from your sensor to the screw terminals on the Terminal Block corresponding to the selected MiDAS channel you selected in Step 3 above. Use the following two charts to determine which terminals to use.

*Note: For example, if you selected Channel 5 in Step 3 above, then you connect the positive lead to terminal (pin) # 60 and the negative lead to terminal (pin) #26.*

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**Chapter 12: Data Acquisition Modules**

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If you have MiDAS DA models DA-123M, -125M, -132M, -160M, DA-170M, you can connect up to 8 Differential Input Sensors into the Terminal Block:

**Terminal Block**

<b>MiDAS Channel</b> (as selected in Settings Window)	<b>Connect DI Sensor Signal (+) to pin #...</b>	<b>Connect DI Sensor Negative (-) to pin #...</b>
0	68	34
1	33	66
2	65	31
3	30	63
4	28	61
5	60	26
6	25	58
7	57	23

If you have MiDAS DA models DA-161 or DA-171M, you can connect up to 32 Differential Inputs into your two Terminal Blocks. The first eight sensors are connected to the block connected to the cable labeled 'MIO-68' and the remaining 24 sensors are connected to the block connected to the cable labeled "MIO-68 Extended Analog Input", as follows:

**Terminal Block**

**Extended Terminal Block**

<b>MiDAS Channel</b> as selected in Settings Window)	<b>Connect DI Sensor Signal (+) to pin #...</b>	<b>Connect DI Sensor Negative (-) to pin #...</b>		<b>MiDAS Channel</b> as selected in Settings Window)	<b>Connect DI Sensor Signal (+) to pin # ...</b>	<b>Connect DI Sensor Negative (-) to pin #...</b>
0	68	34		16	68	34
1	33	66		17	33	67
2	65	31		18	32	66
3	30	63		19	65	31
4	28	61		20	30	64

5	60	26	21	29	63
6	25	58	22	62	28
7	57	23	23	27	61
			32	26	60
			33	59	25
			34	24	48
			35	23	57
			36	55	21
			37	20	54
			38	19	53
			39	52	18
			48	17	51
			49	16	50
			50	49	15
			51	14	48
			52	13	47
			53	46	12
			54	11	45
			55	10	44

(b) If your sensor is “Differential, Floating”, you must also connect a bias resistor to the common lead from your sensor. Connect the other side of this termination to any of the Analog Ground screw terminals pins 24, 27, 29, 32, 56, 59, 64, or 67. See the diagram in the previous section for details on this bias resistor.

If your sensor is “Single Ended”

- (a) Connect the signal (+) lead from your sensor to the screw terminals on the CB-68LPR Terminal Block corresponding to the selected MiDAS channel. MiDAS will automatically display only those channels that are available to you based on the DA module model you have.

If you have MiDAS DA models DA-123M, DA-125M, DA-132M, DA-160M, DA-170M, then you can connect up to 16 sensors to your CB-68LPR Terminal Block:

<b>MiDAS Channel</b> (as selected in Settings Window)	<b>Connect SE Sensor Signal (+) to Screw Terminal #...</b>
0	68
1	33
2	65
3	30
4	28
5	60
6	25
7	57
8	34
9	66
10	31
11	63
12	61
13	26
14	58
15	23

If you have MiDAS DA models DA-161M, DA-171M, you can connect up to 64 Single Ended sensors to the two Terminal Blocks (one on each end of the cable). You must connect the first 16 sensors to the terminal block connected to the cable labeled 'MIO-68' and the remaining 48 sensors on the second block (on the cable labeled 'MIO-68 Extended Analog Input'), as follows:

**Terminal Block**

<b>MiDAS Channel</b> (as selected in Settings Window)	<b>Connect SE Sensor Signal (+) to pin #...</b>
0	68
1	33

**Extended Terminal Block**

<b>MiDAS Channel</b> (as selected in Settings Window)	<b>Connect SE Sensor Signal (+) to pin #...</b>
16	68
17	33

---

2	65
3	30
4	28
5	60
6	25
7	57
8	34
9	66
10	31
11	63
12	61
13	26
14	58
15	23

18	32
19	65
20	30
21	29
22	62
23	27
24	34
25	67
26	66
27	31
28	64
29	63
30	28
31	61
32	26
33	59
34	24
35	23
36	55
37	20
38	19
39	52
40	60
41	25
42	58
43	57
44	21
45	54
46	53
47	18

48	17
49	16
50	49
51	14
52	13
53	46
54	11
55	10
56	51
57	50
58	15
59	48
60	47
61	12
62	45
63	44

- (b) If your sensor is Single Ended, Grounded (e.g. “Non-Referenced Single Ended” or “NRSE”), then connect the common lead from your sensor (or sensor system) to screw Terminal 62 (AISENSE) of either Terminal Block.

If your sensor is Single Ended, Floating, (e.g. “Referenced Single Ended” or “RSE”), then connect a bias resistor to the common lead from your sensor(s). Connect the other side of this termination to any of the Analog Ground screw terminals pins 24, 27, 29, 32, 56, 59, 64, or 67.

10. Repeat steps 3-8 for each sensor that you wish to connect to MiDAS.

*Note: Always start at Channel 0 and proceed upwards, using the above charts.*

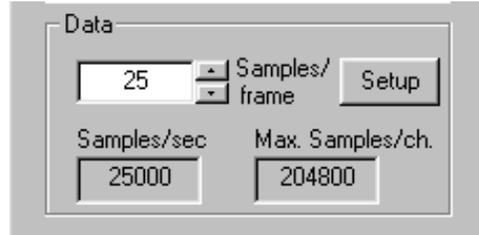
*Note: MiDAS will advise you of available and unavailable channels based on the type of hardware and sensor selection. MiDAS will accept mixed differential, RSE and NRSE sensors. Always set the sensor type in MiDAS prior to connecting the sensor and the signal conditioner to the Terminal Blocks.*

11. When done connecting all your sensors, click on the **OK** button.

## Recording Synchronized Video and Data

If you have licensed and enabled the data acquisition feature within MiDAS, a new Record Video/Data tab appears in place of the previous Record Video tab. Refer to Chapter 6 of this User Guide to understand how to use the Record tab.

You will notice two differences between the video only and the video/data tab. First, the name of the tab is changed to “Record Video/Data” (instead of “Record Video”). Second, a box is added to the tab that allows setting the number of data points to be acquired per frame using the MiDAS “waveform per frame” technology, as shown at right.



To record synchronized video and data, follow these steps:

1. Open a camera
2. Click on the Record Video/Data tab.
3. Set your video parameters as explained in Chapter 6, including frame rate, resolution, exposure time.
4. Set the Trigger Percent and trigger polarity.

### Trigger Percent

The percentage trigger puts the Reference Frame 0 and the Reference Datum 0 at the desired position and dictates the amount of time prior to the trigger and after the trigger is received. The listed number is the pre-trigger percentage of the total acquisition. For example, a trigger percentage of "0%" instructs the MiDAS software to (1) continue to acquire one full buffer of images (acquire 0% before the trigger and 100% after the trigger) and (2) to put the important Reference Frame 0 at the beginning of the sequence. Contrarily, a trigger percentage of "100%" instructs the MiDAS software to (1) stop acquisition immediately upon receipt of a trigger input (acquire 100% before the trigger and 0% after the trigger) and (2) to put the important Reference Frame 0 and Reference Datum 0 at the end of the sequence.

The Reference Frame 0 is placed at the exact frame when the trigger input is received. Therefore, frames with negative numbers are BEFORE the trigger pulse was received and frames with positive numbers are AFTER the

	<p>trigger pulse was received. Likewise, the Reference Datum 0 is placed at the exact data point when the trigger input is received. Therefore, data points with negative numbers are BEFORE the trigger pulse was received and data points with positive numbers are AFTER the trigger pulse was received</p> <p>Trigger percentages are 0% to 100% in 10% increments. The default is 100%.</p>
<b>Rising or Falling Edge</b>	<p>The external trigger input is always enabled. Select Rising Edge if your event trigger generates a negative a positive going pulse. Select Falling Edge if your event trigger generates a negative going pulse.</p> <p><i>Note: If using the MiDAS Motion Trigger, set to Falling Edge.</i></p>

5. Set the Number of Samples Per Frame.

<b>Samples per Frame</b>	<p>The number of data points per frame. Use the up-down arrow keys to select the desired number. The text box cannot be directly edited. The available number of data points per frame is determined by the data acquisition hardware in the computer. Refer to "How MiDAS Works" for more explanation.</p> <p><i>Note: Excessively high numbers of Samples per Frame will slow down computer drawing functions during live viewing or recording.</i></p>
<b>SETUP Button</b>	<p>Click this button to open the DA Setup Window, if you wish to adjust any information about your sensors or data gauges.</p>

The following information is displayed on the Record Video/Data tab:

<b>Pixel Resolution</b>	<p>the number of pixels that are used by the MiDAS video acquisition engine, in width by height.</p>
<b>Max Rec Time</b>	<p>the maximum amount of time that can be recorded during a video sequence, in seconds.</p>
<b>Max Frames</b>	<p>the maximum number of frames that can be acquired during a video sequence.</p>



<b>Exposure Time</b>	the amount of time, in seconds, that the electronic shutter is open for light exposure per frame
<b>Samples/Second</b>	the number of samples per second that will be acquired over all active channels. Calculated as the frame rate times the number of samples per frame times the number of active channels.
<b>Max Samples/Channel</b>	the maximum number of samples per analog input channel enabled, over the entire measurement duration. Calculated as the product of the Max Frames and the number of samples per frame.
<b>Pre-Trigger Time</b>	the amount of record time to be acquired prior to the trigger input.
<b>Post-Trigger Time</b>	the amount of record time to be acquired prior to the trigger input.
<b>Pre-Trigger Frames</b>	the number of frames to be acquired prior to the trigger input.
<b>Post-Trigger Frames</b>	the number of frames to be acquire prior to the trigger input.

6. Click on the **LIVE** button. The Live button puts the camera board into live video mode and the data acquisition hardware into live display mode, if enabled under the **OPTIONS** window. While in this mode, video is streamed directly to the display and displayed at 30 frames/second.
7. Click on the **RECORD** button. The video and data are recorded into various sections of RAM. A blinking MiDAS message box appears telling the operator that MiDAS is now recording.
8. Click on the **TRIGGERSTOP** or **STOP** buttons, or externally trigger the recording per the instructions in Chapter 6, or click on Active Auto-Download per the instructions in Chapter 13. The difference between **STOP** and **TRIGGERSTOP** is as follows:

<b>TRIGGERSTOP Button</b>	The <b>TRIGGERSTOP</b> button executes the stop record function per the trigger settings. Both video and data are stopped simultaneously. The <b>TRIGGERSTOP</b> button places both the Reference Frame 0 and the Reference Datum 0 at the trigger point of the sequence.
<b>STOP button</b>	The <b>STOP</b> button immediately stops the recording function and places both the Reference Frame 0 and the Reference Datum 0 at the end of the sequence. Also called a PANIC

STOP button.

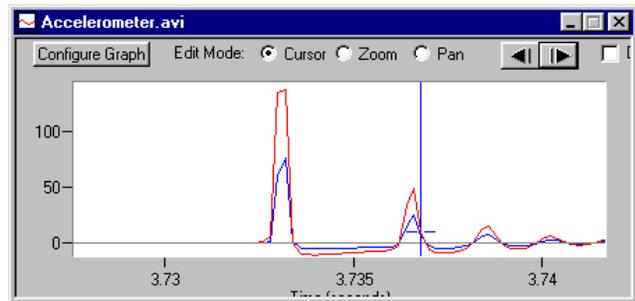
## Playing Video/Data Sequences

When the acquisition is completed, the Play tab is automatically brought forth and both Video Playback and Data Playback windows are opened. The Live Video display window is minimized for later use. If multiple windows are in the MiDAS console, then the window with the active blue stripe across the top is addressed by the Playback tab. Details of the Play tab are described in Chapter 7.

You can “play” the video/data using any of the following techniques:

1. The controls on the Play tab
2. The controls on the Video Playback window
3. The single step controls on the Data Playback window
4. Dragging the cursor in the Data Playback window

The first two options are described in detail in Chapter 7. The Data Playback window appears as shown at right:



The Data Playback window has a waveform display with some button features along the top and right side. A single blue cursor shows the location of the video/data counter, in data points. Along the bottom, the time position is displayed. The user settable features of the Data Playback window are as follows:

### Step Back



This button causes the data cursor to jump one single step backwards. Note that since there might be multiple data points per frame of video, the video frame might not advance every time this button is pressed. For example, if 10 data points per frame were selected, then this button would have to be pressed 10 times to advance the video one frame.

### Step Forward



This button causes the data cursor to jump one single step forwards. Note that since there might be multiple data points per frame of video, the video frame might not advance every

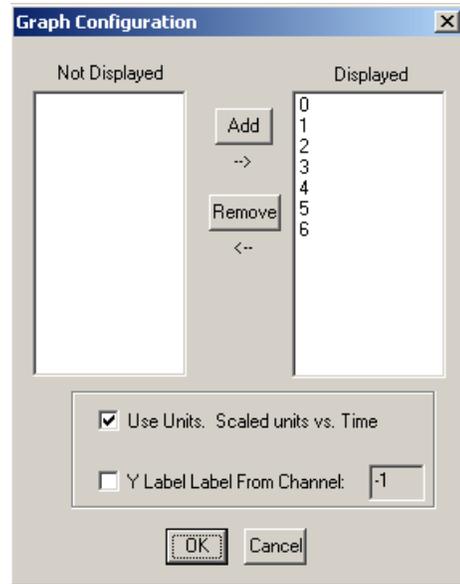
	<p>time this button is pressed.</p> <p>For example, if 10 data points per frame were selected, then this button would have to be pressed 10 times to advance the video one frame.</p>
<b>Edit Mode: Cursor</b>	<p>When the Cursor mode button is selected, the user has control of the cursor with the mouse. By clicking and dragging the cursor, both the video frames and data are advanced synchronously.</p> <p>A “jump advance” feature is also provided – just click anywhere within the waveform window and the cursor jumps to that position and the video is updated</p>
<b>Edit Mode: Zoom</b>	<p>When the Zoom mode button is selected, the user can change the zoom magnification of the waveform window. Simply click and drag within the waveform window to create a box around the feature that you desire to amplify. When the mouse is released, the waveform is zoomed.</p> <p>Double-click anywhere within the waveform window to de-zoom the window to the full range.</p>
<b>Edit Mode: Pan</b>	<p>When the Pan mode button is selected, the user can drag the graph up, down left or right.</p>
<b>Display Values</b>	<p>When enabled, the right side of the Data Playback window will display the cursor values for all the active channels.</p>
<b>Data Index</b>	<p>The current data point number of the current acquisition. Note that the data index is not the same as the frame number since multiple data points can be acquired per frame of video!</p>
<b>Time</b>	<p>The current time position of the cursor and the video.</p>

To modify the appearance of the Data Window, follow these steps.

1. Open a Data Graph Window, as shown above.
2. Click on the **CONFIGURE GRAPH** button. The window at right appears:

The top half of the window is displayed to selecting the active channels to display or to block from display.

The bottom half of the window contains the following selection information:



**Use Units**

When this option is selected, the Y-axis (vertical axis) is displayed in units rather than volts.

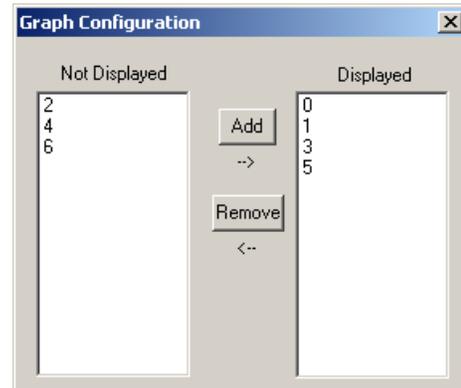
**Y Label from Channel x**

When selected, this option calculates the maximum of the Y-axis label with the data from the selected channel (must be an active channel). If only one channel is active, or if this checkbox is unselected, the Y-axis maximum value will be calculated as the maximum of the first active channel (e.g. channel 0).

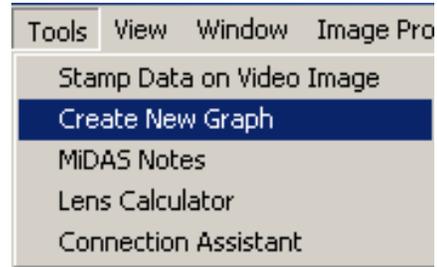
**OK**

Saves the settings and returns to the main Data Playback window.

To activate or deactivate any channels, use the **ADD** and **REMOVE** buttons. The “Displayed” channels are shown on the right side of the ledger. The “Not Displayed” channels are shown on the left side. To move, simply highlight the channel of interest and press the **ADD** or **REMOVE** buttons.

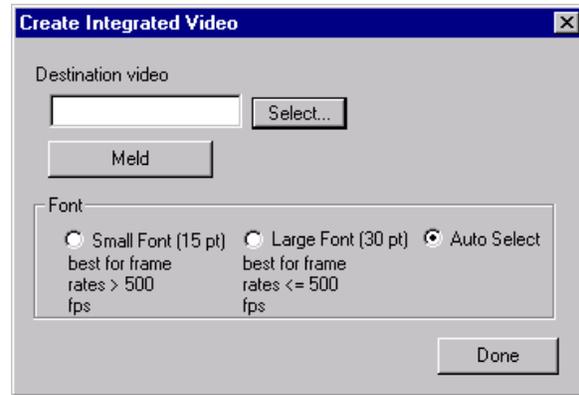


New graphs can be created by clicking on **TOOLS**, then **CREATE NEW GRAPH**. A single screen appears asking for the name of the new graph. Once the new graph appears on the MiDAS console, use the **CONFIGURE GRAPH** button to customize its appearance.



## Melding Video and Data

The process of creating an integrated video and data file in AVI file format is termed "Melding". During the melding process, MiDAS reads in the first frame of video and the first data point acquired during that frame period then stamps the data information on to the bottom of the frame. This new Melded frame – one that contains the original video frame and the stamped data on the bottom – is placed onto the hard drive in a new file. This process is repeated, frame by frame, until the entire video acquisition is completed. Depending on the options selected in software, the original AVI file is either saved alongside the Melded file or deleted for more hard drive space.



There are two limitations on Melding: first, only the first data point acquired during each video frame is stamped. If multiple data points per frame are selected (as in the previous example), the remaining data is discarded. Second, only data from the first four (4) channels is stamped due to size limitations.

For great presentation effects, use the Melding feature of MiDAS as follows:

1. Make sure that you have an open video playback window and an open data playback window with synchronized data.
2. Click on the **STAMP DATA ON VIDEO IMAGE** feature under the **TOOLS** menu item. The following screen appears:
3. Click on **SELECT...**, then choose the directory and name of a new AVI file that you wish to create.

4. Click **SAVE**.
5. Click the **MELD** button. If the operation successfully completes, a new stamped AVI will be opened and displayed within MiDAS.

# SA

## Spreadsheet Analysis Modules

### Overview

MIDAS contains two versions of the Spreadsheet Analysis module. SA1 supports manual tracking of features and SA2 supports automatic tracking of features. These analysis modules allow you to analyze your video files using Microsoft Excel (you must purchase and load Excel on your computer before using this feature).

The SA1 module allows you to manually click on features with your mouse within each video frame. The X-Y position of each click is recorded into Excel with the frame number and time position. By clicking throughout a video clip, you can populate an Excel spreadsheet with data, then use standard Excel formulas and graphing utilities. Create fancy analyses and graphs with ease – use wizards for pie charts, line charts, and PowerPoint presentations. The Spreadsheet Analysis module takes full advantage of the power of Excel.

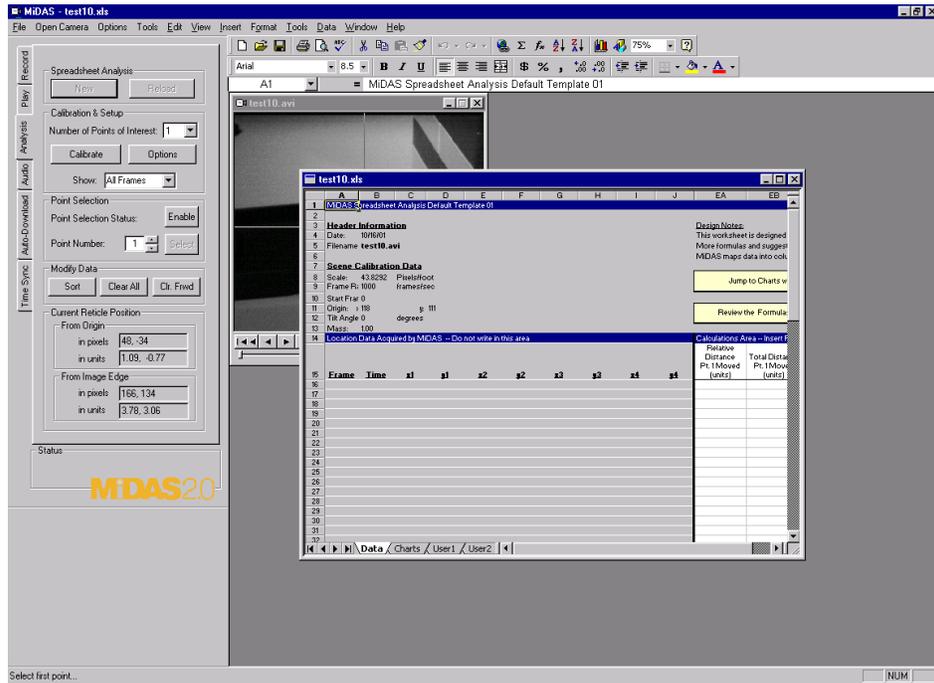
The SA2 module allows automatic tracking of features using “template matching” algorithms. Regions of an image are selected as a tracking template to search for in subsequent frames. The tracking template is matched and found automatically and the resulting coordinates are used to populate an Excel spreadsheet in the same fashion as with the manual tracking.

## MIDAS2.0

### Chapter 13: Spreadsheet Analysis Modules

To use the Spreadsheet Analysis module, record a video image normally (See Chapter 4 for details). Then click on the Analysis Tab and click on the **NEW** button inside the Spreadsheet Analysis region at the top of the Tab.

The Excel spreadsheet appears. The Excel toolbar appears at the top of the screen. A crosshair appears in the Video Playback window, as shown below:



An Excel Spreadsheet is “associated” with a video playback. When the Spreadsheet is saved, it can be linked to the video such that when the video is opened, the Spreadsheet also opens automatically.

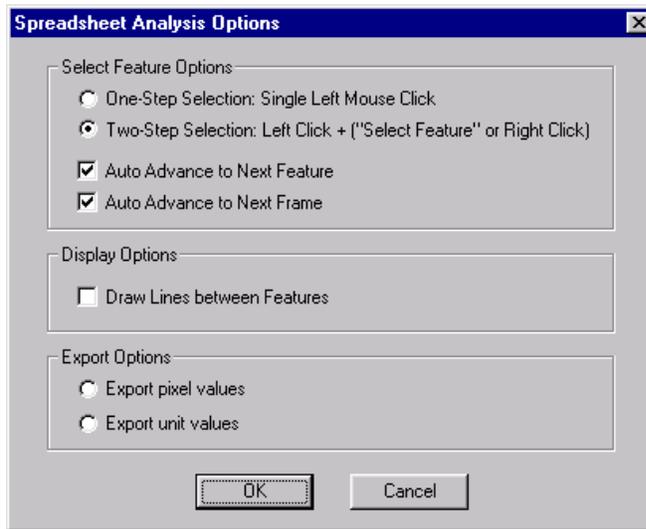
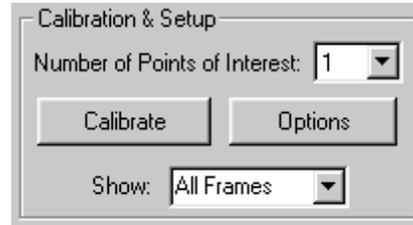
### Spreadsheet Analysis Options

There are a number of options that define the mode of user interaction and the behavior of the Spreadsheet Analysis modules. These options need only be set once, or whenever any of the options need to be changed.



In order to set or view the current option settings, click on the **OPTIONS** button (at right) in the Calibration & Setup region in the Analysis Tab.

The Spreadsheet Analysis Options window opens, as shown below:



This window allows you to customize your selection and display settings, as follows: The individual commands within this window are explained in the following table:

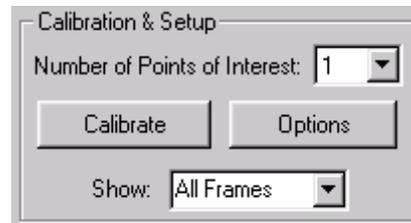
<b>One-Step Selection: Single Left Mouse Click</b>	This option allows the operator to identify points or features with a single left mouse click on the video image. This option provides for fast editing and tracking.
<b>Two-Step Selection: Left Click + (“Select” or Right Click)</b>	This option allows the operator to identify points or features with a two-step process – a left mouse click on the video image will place the reticle in the desired position. Use this option for precise placement of the point – it works well with the zoom window to exactly find the feature of interest (e.g. to a pixel). Then right click anywhere in the image or push the “ <b>SELECT</b> ” button in the Analysis Tab to select the feature.

<b>Auto Advance to Next Feature</b>	When selected, this option automatically advances to the next feature when the object(s) are tracked in the video image. When disabled, the operator must manually advance the feature counter, then select the feature of interest.
<b>Auto Advance to Next Frame</b>	When selected, this option automatically advances to the next frame in the video when all features are selected in the current frame. This option is useful for manual tracking, allowing uninterrupted selection of features frame by frame. If this option is disabled, then the operator must manually advance the video to the next frame in order to continue manual feature selection tracking in the next frame.
<b>Draw Lines between Features</b>	When selected, this option draws a line between features on the same video image. This feature is useful when trying to track a spinning or bouncing object such as a ball or disk. For instance, tracking two points on a rotating object with a line between them will result in the line rotating with the tracked object. Note that more than one feature must be selected.
<b>Export pixel values</b>	When an Excel spreadsheet is saved, the data is saved in pixel locations instead of unit distances.
<b>Export unit values</b>	When an Excel spreadsheet is saved, the data is saved in unit positions instead of pixel locations.

### Calibrating the Scene

The first step in analyzing a video is to calibrate the scene – to convert an image consisting of pixels to an image with real dimensions such as inches or meters or whatever units of interest. This process, termed “calibrating” the image, also includes setting some reference points and removing any tilt introduced by the camera head. Calibration is a simple process that needs to be performed only when the field of view of the camera is changed.

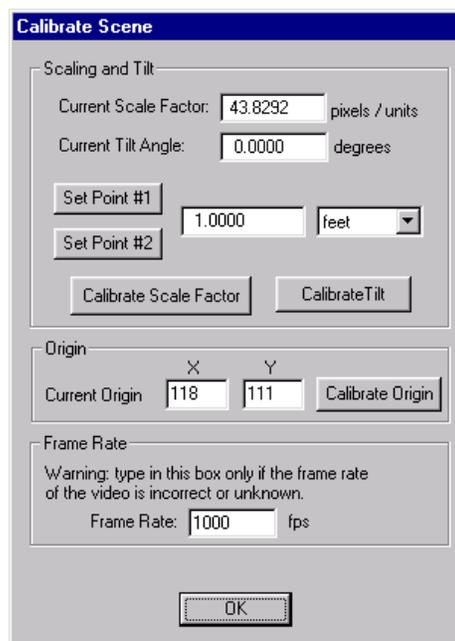
To calibrate the image, you must educate MiDAS about some feature in the field. We suggest that



you include a horizontal ruler in the picture or some equivalent fiducial that has both distance scale and horizon scale.

The calibration process is as follows:

1. Click on **CALIBRATE** button inside of the Calibration & Setup region in the Analysis Tab. The Calibrate Scene window appears.
2. In the playback window, using the mouse, left-click on one side of a known object like a ruler or block. Click on **SET POINT #1**.
3. Click on the other side of the known object. Click on **SET POINT #2**. Type the known unit size of this object in the edit box next to the two Set Point buttons. Next, select the units of measure from the drag down list (inches, feet, etc.)
4. Click on **CALIBRATE SCALE FACTOR** button to set the scale factor. The number in the Current Scale Factor display box should change to show the new calibration scale factor, in pixels/unit. Note that you can also type directly into the Current Scale Factor box, although we do not recommend calibrating in this manner.
5. Next, you should remove any residual tilt in the camera relative to the field of view. In the playback window, using the mouse, left-click on one side of a known horizontal object like a ruler or level or scale. Click on **SET POINT #1**.
6. Click on the other side of the known object. Click on **SET POINT #2**.
7. Click on **CALIBRATE TILT** button to calculate the image rotation amount. The number in the Tilt Angle display box should change to show the amount that the camera is tilted relative to the field level, in degrees. Note that you can also type directly into the Tilt Angle box, although we do not recommend calibrating in this manner.
8. Optionally, you can select an origin (0,0) point of reference to shift the coordinates for graphing or calculation of absolute movements or displacements relative to the origin. In the Video Playback window, using the mouse, left-click on the location that you would



like to denote as the origin. Then click on **SET ORIGIN**. The new coordinates of the origin should then be displayed.

9. Click **OK** to finish the calibration sequence and return to the spreadsheet

The calibration information for each scene/spreadsheet is stored in the upper left corner of the first sheet in the Excel document, under the “Scene Calibration Data” heading.

### **Additional Setup Options**

In addition to the **CALIBRATE** and **OPTIONS** buttons in the Calibration & Setup region of the Analysis Tab, there are two other controls.

The first is a selection for the number of points of interest (SA1) or the number of features to track (SA2). This option will be discussed in the following detailed sections on SA1 and SA2.

The other control is a drop down box for the selection of features to show. This “Show” selection determines which features are drawn in the video display window during and after tracking. The choices are as follows:

<b>Show All Frames</b>	Displays all tracking points from previous frames in red and displays all points from the current frame in blue.
<b>Show Current Frame Only</b>	Displays only the tracking points from the current frame. All other tracking points are not shown. Use this option when you are tracking an object that moves very small distances where previous points would clutter the image.
<b>Show None</b>	No tracked points are displayed.

The “Show” selection can be changed at any time during tracking and the display will update appropriately.

### **Manually Tracking Features (Module SA1)**

The process of following a feature from frame to frame through a video image and identifying the position of this feature is termed “tracking”. When an operator must manually select and identify the feature within each frame of the image, the process is termed “Manual Tracking”. Comparably, when the software automatically finds the feature of interest based on prior information in each frame, the process is termed “Auto Tracking”.

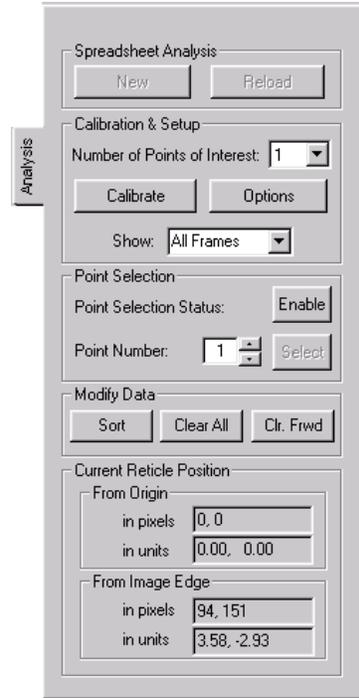
The Spreadsheet Analysis SA1 module allows Manual Tracking of points or features.

Before you enable tracking, you must instruct MiDAS as to the number of features of interest to track. Select the Number of Features of Interest using the drag-down box in the Calibration & Setup region in the Analysis Tab.

The MiDAS Spreadsheet Analysis SA1 module allows up to 64 points to be tracked per frame.

*Note: Although MiDAS can track 64 points per frame, more than 64 points per frame can be tracked by tracking the first 64 points during one tracking session and then repeating the same process for another 64 points, and so on. You can then sew the Excel Spreadsheets together into one large tracking document.*

The features of the Spreadsheet Analysis SA1 tab are as follows:



<b>Number of Points of Interest</b>	Select the Number of Features of Interest using the drag-down box. The MiDAS SA1 module allows up to 64 points to be tracked per frame.
<b>Point Selection Status: Enable/Disable</b>	Click on <b>ENABLE</b> after you have selected the number of points of interest.
<b>Point Number</b>	Using the up/down arrow keys you can instruct MiDAS which feature you are currently tracking. For example, if you have chosen to track 4 features per frame, then every time you click within a frame the Frame Counter advances once (1, 2, 3, 4). If you wish to skip a feature (e.g. the second feature is not present in this frame) or if you wish to repeat a feature (e.g. you wish to re-set the third feature), then you can advance the Frame Counter to read '3' and click on the feature of interest. If an X-Y mapping has already been placed in Excel, it will be overwritten with the new value. If you skip a feature, no value will be placed in the associated map location in Excel.

	This feature is also invaluable for overwriting erroneous tracking points or for “filling in the gaps” of a spreadsheet. If you feel that you have made a mistake and wish to overwrite a previous erroneous data point, you can back up to the desired frame with the mistaken data point, select the feature with the Feature Counter, and re-click the point(s). The new points will be mapped over the original data points.
<b>SORT button</b>	This sequentially arranges the tracked points according to frame number. This button will also rescale the data points if you have changed your calibration or export unit settings.
<b>CLEAR ALL button</b>	This button erases all Spreadsheet Analysis data acquired since tracking was enabled. When this button is clicked, the associated spreadsheet is opened and all data erased.
<b>CLR. FRWD button</b>	This button erases all Spreadsheet Analysis data for the current feature from the current frame forward, including the current frame.

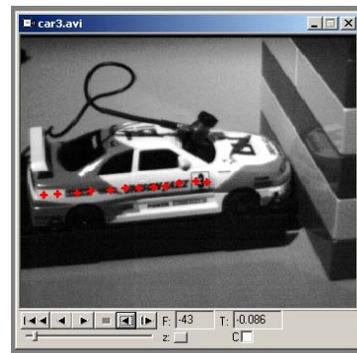
To run manual tracking, use the following steps:

1. Click on **NEW** in the Analysis Tab. Excel will load a default tracking template into a MiDAS window.
2. Calibrate the scene using the **CALIBRATE** button as previously described. You may perform calibration using any frame in the video by advancing forwards or backwards to find the appropriate image.
3. Select the number of points of interest in the Calibration & Setup region.
4. Click on **ENABLE** button in the Analysis Tab to begin tracking. The spreadsheet window becomes minimized and the Microsoft Excel toolbar disappears from across the top of MiDAS.
5. Select features in the video image by left clicking in the image (if you have selected one-step feature selection in the **CONFIGURATION OPTIONS**), or by left clicking followed by pressing the **SELECT** button –or- right clicking (if you have selected two-step feature selection in the Configuration Options).



- Repeat step 5 for every feature and frame you wish to track.
- Click on **DISABLE** to finish your tracking session and maximize the populated Excel spreadsheet.

When running manual tracking, every time a point is selected within the video display window (e.g. a point is “tracked”), the corresponding Frame Number, Time, X position (in units or pixels) and Y position (in units or pixels) is written into Excel. All tracked points from the same frame are placed in one Excel row – therefore each row within the Excel Spreadsheet corresponds to a specific frame of the video. MiDAS keeps track of the mapping process of rows and columns in Excel to video frames and features.



Spreadsheet rows need not be sequential. If for example, Row 8 corresponds to Frame 1015 and Row 9 corresponds to Frame 1026, and you decide that you wish to add some tracking between the two frames, MiDAS will add Excel row 10 to correspond to Frame 1020. The **SORT** button can be pressed to rearrange the rows sequentially.

After you have completed the tracking procedure, the resulting tracked data is not automatically saved. You can save the tracked points by either selecting **SAVE AS...** from the **FILE** menu which will save both the video and the associated MiDAS AU3 file. To simply save the binary file associated with the current video, select **SAVE MIDAS BINARY FILE** from the **FILE** menu.

*Note: Tracked points are not saved automatically. Saving the resulting spreadsheet template does not save the associated tracked points in the video. In order to save the tracked points with the video, you must select **SAVE AS...** or **SAVE MIDAS BINARY FILE** from the **FILE** menu.*

## Automatically Tracking Features (Module SA2)

MiDAS Spreadsheet Analysis module SA2 allows users to both automatically track and manually select specific features within the video sequence and export their locations directly to Excel. This module produces the tab shown on the right. The process of instructing MiDAS to automatically find a specific feature within a frame, determine the location of the feature and export that location to Excel is termed “Auto-Tracking”.

MiDAS Auto-Tracking works on the principle of template matching. The user selects a tracking template – a group of pixels within the image. Tracking templates are also referred to as “regions” of an image, not to confuse them with Excel Worksheets that are also called “templates”. Once the user has selected a “region”, MiDAS advances the video image to

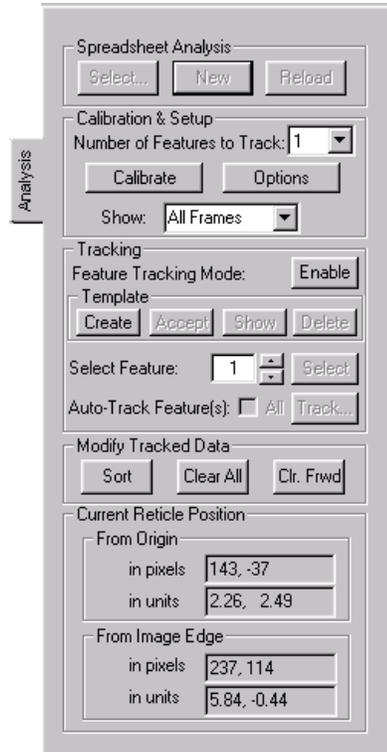
subsequent frames and executes a sophisticated correlation algorithm to find a match for the region. If a tracking template match is found in subsequent frames, MiDAS continues to advance. If no tracking template match is found, MiDAS discontinues tracking for that feature. Tracking can be continued from the frame in which the template was lost by setting a new template in that frame and continuing tracking. See the later section titled “Restarting Auto-Tracking After Stop” for more details.

This process of locating templates in each frame of the video is repeated until either MiDAS cannot find a tracking template match, the video is finished, or the user aborts the process.

***Note:** To understand tracking, practice a few times using the Manual Tracking mode first, as described in the previous section. This will familiarize you with the process of tracking points and with the interface, which is very similar to the Auto-Tracking Interface.*

The process for auto-tracking a series of features is as follows:

1. (Optional) Click on **SELECT...** in the Spreadsheet Analysis region of the Tab if you wish to use a different Excel spreadsheet template to store and process your tracking results (rather than the default template). See the later sections titled “The Spreadsheet Template” and “Creating and Using Your Own Excel Template” for more details.
2. Start Spreadsheet Analysis. Click on **NEW** to load Excel into a MiDAS window.
3. Calibrate the scene. Advance the video to frame that has fiduciary information in it. A ruler or other marker will provide a length calibration. A level or tabletop will provide a tilt calibration. Click on **CALIBRATE** and follow the instructions in the previous section on calibration.
4. Select the number of features per frame that you will be tracking. MiDAS allows users to track up to 64 features per frame.
5. Click on **OPTIONS**. The Spreadsheet Analysis Options window allows you to customize your selection and display settings as previously described. Users are strongly advised to





use the **Two-Step Selection: Left Click + (“Select Feature” or Right Click)** setting when using Automatic Tracking.

6. Click on the **IMAGE PROCESSING** menu item. Select **PALETTE**. You can also reach this palette by right clicking within an image and the context menu will appear as shown. This feature allows you to improve the image contrast to enhance the tracking success. The various palette options are described in more detail in the later section titled “Using Image Processing to Improve Contrast”.



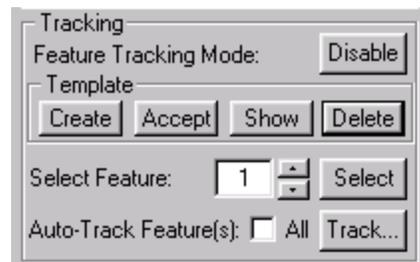
MiDAS looks for objects that have some “color” or, more specifically, a “level of grayscale”, adjust the palette to improve the white-on-black image contrast. For color video, you need to select **COLOR TO BLACK & WHITE** first before accessing the Grayscale palette options. All tracking is done in grayscale, color video is converted to grayscale automatically during tracking, even if you have not explicitly selected the Color to Black & White option. By selecting this option, you gain access to the various grayscale palette options to be applied on the resulting color-to-grayscale video.

*Note: If your image predominately contains a bright object against a dark background, “reverse” the image to white-on-dark. You will have the highest correlation factor with this configuration.*

In the image at right, a black knife on a white background has been reversed to show a white knife blade on a dark background. The small image at right is a zoom view of the knife tip.



7. Click on **ENABLE**.
8. For the number of features that you have selected from Step 3., you need to define templates for the features to auto-track. The next steps describe how to create and add a template.
9. Set the feature counter to the desired feature number, for example, Feature Number 1.
10. Click on **CREATE** in the Template region of the tab.



11. Draw your “region” (e.g. the “tracking template”). Advance or rewind the video to the first frame that contains the feature(s) you desire to track. Draw a box on the image that circumscribes (surrounds) the first feature you wish to track.

*Note: Find features that have high contrast (blacks and whites) and sharp lines. Greater accuracy will be achieved when MiDAS can match very distinct and unique features.*

12. Click on **ACCEPT** to establish the template for Feature Number 1.

*Note: When you select a “region” or “tracking template”, MiDAS exports the location of the geometric center to the Excel spreadsheet.*

13. Repeat Steps 8-11 for any other features (up to 64 total) you wish to auto-track.

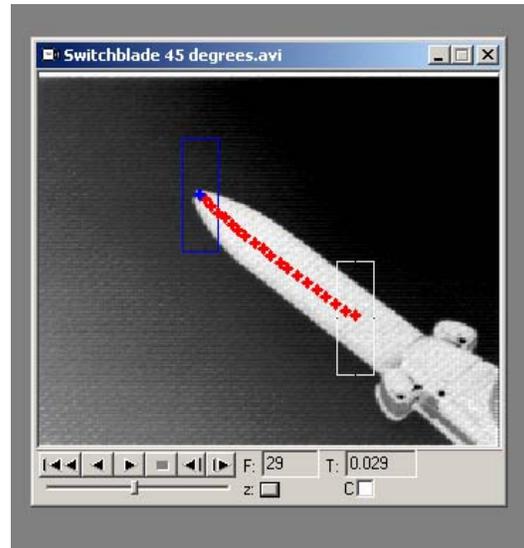
13. If you wish to edit any of the templates you have selected, you can use the buttons in the Template region of the Tab. Using these buttons, you can show the various templates you have selected, delete certain templates, and create new ones.

14. Once you are satisfied with the entire group of feature tracking templates, you are ready to track. If you have selected more than one feature to track, each feature can be tracked independently. This allows you to auto-track some features and manually track other features. If you would like to auto-track all features simultaneously, and you have created templates for each one, you can check the All checkbox next to Auto-Track Features(s).

15. Now, click on the **TRACK...** button. MiDAS will now track your feature(s) as shown above, and export the positions to Excel.

16. Clean up your exported data if necessary. Once the data has been exported to Excel, you can modify the data to replace any data that seems incorrect, add data manually, reset your template or eliminate any unwanted data points. The following features are available:

<b>CLEAR ALL button</b>	Clears all data points within the Excel spreadsheet
<b>CLR FRWD button</b>	Clears all data points forward of (and excluding) the current video frame



**SORT button**

This sequentially arranges the tracked points according to frame number. This button will also rescale the data points if you have changed your calibration or export unit settings.

If you have manually edited tracked points in the spreadsheet, or if you have manually corrected/added data points using manual tracking, you will find this feature useful. For more details on using manual tracking functionality to correct auto-tracked data, see the later section titled “Manually Repairing Data”.

17. If MiDAS loses any feature, it will stop tracking that feature. To continue tracking that feature again, you can re-select a new template for that feature (attempting to account for any changes to the template region which caused the loss of tracking) in the frame in which it was lost. Then re-run tracking for that feature from that frame onward. See the later section titled “Restarting Auto-Tracking After Stop” for more details.
18. Click on **DISABLE** to end your tracking session and display the populated Excel spreadsheet. You can now do processing or graphing of the resulting track data from within the Excel window.
19. To Save your Excel spreadsheet, select the spreadsheet window and click on **FILE**, then **SAVE SPREADSHEET AS....**

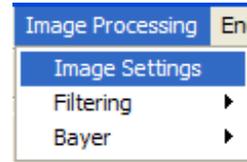
After you have completed the auto-tracking procedure, the resulting tracked data is not automatically saved. You can save the tracked points by either selecting **SAVE AS...** from the **FILE** menu which will save both the video and the associated MiDAS AU3 file. To simply save the binary file associated with the current video, select **SAVE MIDAS BINARY FILE** from the **FILE** menu.

*Note: Tracked points are not saved automatically. Saving the resulting spreadsheet template does not save the associated tracked points in the video. In order to save the tracked points with the video, you must select **Save As...** or **Save MiDAS Binary File** from the **File** menu.*

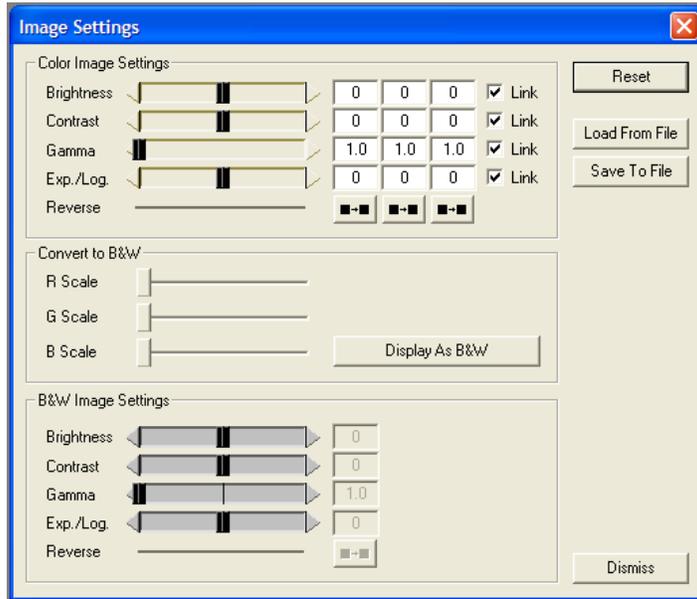
Once the tracked points are saved to the MiDAS Binary file, whenever you reopen the associated video, the tracked points will also be loaded. You can use these tracked points to populate an Analysis spreadsheet and do processing on the tracked point data. For more details, see the later section titled “Reloading Tracked Points Into A Spreadsheet”.

## Using Image Processing to Improve Contrast

MiDAS provides four image processing algorithms to help you improve image contrast. To access these, click on the **IMAGE PROCESSING** menu item. Select **IMAGE SETTINGS**. You can also reach this palette by right clicking within an image.



For color images, you may select **COLOR TO BLACK & WHITE** to improve contrast. By selecting this option, you gain access to the various grayscale palette options to be applied on the resulting color-to-grayscale video.



Understanding that MiDAS looks for objects that have some “color” or, more specifically, a “level of grayscale”,

adjust the palette to improve the white-on-black image contrast. A level of grayscale is best described as the level between black (a value of ‘0’ on an 8-bit grayscale) and white (a value of ‘255’ on an 8-bit grayscale). MiDAS uses these settings in the tracking algorithms.

A more detailed description of these image processing palette options is provided in Chapter 9, “Image Processing”. A summary of the image processing settings is as follows:

<b>Brightness</b>	Adjusts the brightness of the image. The brightness of the image is the maximum white level.
<b>Contrast</b>	Adjusts the contrast of the image. The contrast of the image is the normalized ratio of whites minus blacks.
<b>Gamma</b>	Adjusts the gamma of the image. The gamma of the image affects the brightness of the displayed result on your monitor.

<b>Exp./Log.</b>	Adjusts the exponential/logarithmic palette function. With a normal palette, '0' is black and '255' is white and the ratio of the input to output is linear. That is, input 134 maps to output 134. By adjusting this value, you can change the slope of the input/output curve to be either exponential (more blacks) or logarithmic (more whites). A more detailed explanation is provided below.
<b>Reverse</b>	Changes the color palette such that whites and blacks are reversed.
<b>Link</b>	Links the Red, Green and Blue channel sliders together.
<b>Display as B&amp;W</b>	Converts color images to monochrome images using the conversion factors indicated by the R, G, and B sliders.
<b>R Scale</b>	Amount of red channel to include when converting from color to monochrome.
<b>G Scale</b>	Amount of green channel to include when converting from color to monochrome
<b>B Scale</b>	Amount of blue channel to include when converting from color to monochrome.
<b>Reset</b>	Sets all the functions to their default levels.
<b>Load from File</b>	Allows previously stored image settings to be loaded for this image.
<b>Save to File</b>	Allows you to save certain image settings into an LUT (Look Up Table) format for later retrieval.
<b>Dismiss</b>	Closes the window with the current settings.

## Manually Repairing Data

MiDAS creates one row in the SA template for each frame. This is an important concept because it shows that individual points can be edited or re-tracked. If you wish to manually re-track a specific point, follow these steps:

1. Click on **ENABLE** in the Analysis Tab to begin re-tracking.

2. Move to the video frame of interest.
3. Select the feature number that you wish to replace using the “Selected Feature” arrow buttons.
4. Manually re-track the specific feature in the video image by left clicking in the image (if you have selected one-step feature selection in the Configuration Options), or by left clicking followed by pressing the **SELECT** button –or- right clicking (if you have selected two-step feature selection in the Configuration Options).
5. Repeat step 4 for every feature and frame you wish to re-track.
6. Click on **DISABLE** to finish your tracking session and maximize the populated Excel spreadsheet with the corrected data.



### **Restarting Auto-Tracking after Stop**

It is very common for all auto-tracking algorithms to eventually lose the object that they are tracking. Typically, the object changes shape, color or size or it moves into a different background region. In this case, the MiDAS SA2 auto-tracking system will simply stop and the **ABORT** button will change back to **TRACK...**

If MiDAS fails to locate one of several auto-tracking points, it will discontinue tracking of that particular feature, but continue tracking all other features until all features are lost.

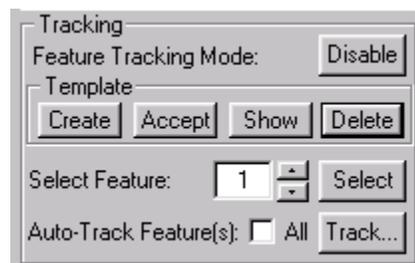
You can also manually abort an auto-tracking sequence by clicking, at any time, on the **ABORT** button.

If MiDAS discontinues tracking for a given feature, you can simply start it back up again by re-creating a new template at the frame in which the feature was lost (or from any other frame):

1. Move to the desired frame using the Play functions (forward, backward, etc.) Advance or rewind the video to the first frame from which you would like to restart tracking of the feature(s).

*Note: Because MiDAS maps one row of the spreadsheet to one frame, you can overwrite any existing data for particular frames with newly tracked data without affecting other frame data. So, in addition to continuing tracking for lost features, you can also use this to fine tune existing tracking results by using a new template from a given frame.*

2. Set the feature counter to the desired feature number, for example, Feature Number 1.
3. Push the **CREATE** button in the Template region of the tab.
4. Draw your new “region”. Draw a box on the image that circumscribes (surrounds) the feature you wish to track. Use the image processing features to help improve the contrast.



*Note: For better tracking accuracy, find features that have high contrast (blacks and whites) and sharp lines. The highest accuracy will be achieved when MiDAS can match very distinct and unique features. Experiment with different palette options as well.*

5. Click on **ACCEPT** to establish the revised template for Feature Number 1, starting at the current frame onward.
6. De-select the All checkbox next to Auto-Track Feature(s) since we only wish to update the track results for this particular feature.
7. Click on the **TRACK...** button. MiDAS will now track your feature(s) as shown below, and export the positions to Excel.
8. Click on **SORT**. MiDAS will resort any data by frame number in the Excel template that may be out of order.
9. Repeat this process for each feature you wish to re-track from a given frame.

## The Spreadsheet Template

MiDAS is shipped with a standard MiDAS default workbook. This default Excel Workbook has 5 worksheets built into it. You can access the different worksheets by clicking on the tabs along the bottom of the Excel sheet. The tabs are labeled Data, Charts, User1, User2, and Formulas.

MiDAS always maps the data to the first worksheet in the workbook, allowing you to create elaborate multi-layer analysis projects.

The workbook, also called the MiDAS Spreadsheet Template, is named “**SATemplate.XLS**” in the base MiDAS installation directory, typically this is “**C:\Program Files\Xcitex\MiDAS**”. The default template is designed for general-purpose analysis of objects.

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## Chapter 13: Spreadsheet Analysis Modules

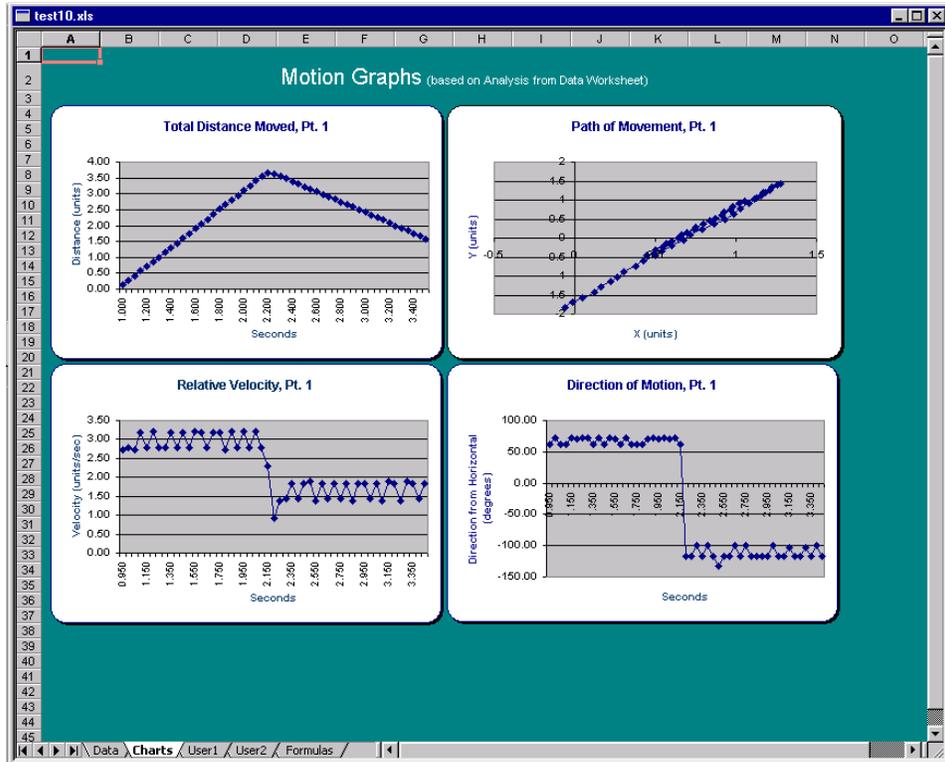
In this general-purpose spreadsheet template, the gray areas are those that are reserved by MiDAS mapping technologies. The blue areas are simple headers and the white cells are areas that can be used for calculations or graphing.

*Note: Columns K..DZ have been collapsed to show the calculations area in a smaller screen. If you have tracked additional features, simply expand the necessary columns to display the additional feature data.*

Frame	Time	x1	y1	x2	y2	x3	y3	x4	y4	Relative Distance Pt. 1 Moved (units)	Total Distance Pt. 1 Moved (units)	Direction of Motion, Pt. 1 (degrees)	Velocity, Pt. 1 (units/sec)
16	19	0.35	-0.1244	-1.9466									
17	20	1	-0.0605	-1.8255						0.14	0.14	62.18	2.74
18	21	1.05	-0.0168	-1.6938						0.14	0.27	71.64	2.78
19	22	1.1	0.0471	-1.5728						0.14	0.41	62.16	2.74
20	23	1.15	0.1217	-1.4395						0.16	0.57	62.17	3.20
21	24	1.2	0.1654	-1.2998						0.14	0.71	71.64	2.78
22	25	1.25	0.2197	-1.1479						0.16	0.87	70.33	3.23
23	26	1.3	0.2635	-1.0162						0.14	1.01	71.60	2.78
24	27	1.35	0.3072	-0.8845						0.14	1.15	71.64	2.78
25	28	1.4	0.3817	-0.7432						0.16	1.31	62.20	3.19
26	29	1.45	0.4254	-0.6116						0.14	1.44	71.64	2.78
27	30	1.5	0.5	-0.4702						0.16	1.60	62.17	3.20
28	31	1.55	0.5437	-0.3385						0.14	1.74	71.64	2.78
29	32	1.6	0.5981	-0.1866						0.16	1.90	70.30	3.23
30	33	1.65	0.6726	-0.0454						0.16	2.06	62.18	3.19
31	34	1.7	0.7163	0.0863						0.14	2.20	71.64	2.78
32	35	1.75	0.7909	0.2276						0.16	2.36	62.17	3.20
33	36	1.8	0.8654	0.3688						0.16	2.52	62.18	3.19
34	37	1.85	0.9293	0.4899						0.14	2.65	62.18	2.74
35	38	1.9	0.9927	0.6418						0.16	2.82	70.30	3.23
36	39	1.95	1.0274	0.7735						0.14	2.95	71.64	2.78
37	40	2	1.0817	0.9254						0.16	3.11	70.33	3.23
38	41	2.05	1.1255	1.0571						0.14	3.25	71.60	2.78
39	42	2.1	1.1798	1.209						0.16	3.41	70.33	3.23
40	43	2.15	1.2235	1.3407						0.14	3.55	71.64	2.78
41	44	2.2	1.2768	1.4416						0.11	3.67	62.15	2.28
42	45	2.25	1.2855	1.4013						0.05	3.62	-117.86	0.91
43	46	2.3	1.2235	1.3407						0.07	3.55	-117.84	1.37

On the second sheet of the default Excel Template, labeled “Charts”, you will find samples of various graphs of the resulting data and calculations. You can use these as examples for your own processing of tracked data.





The third and fourth sheets are left empty to use as your own workspace.

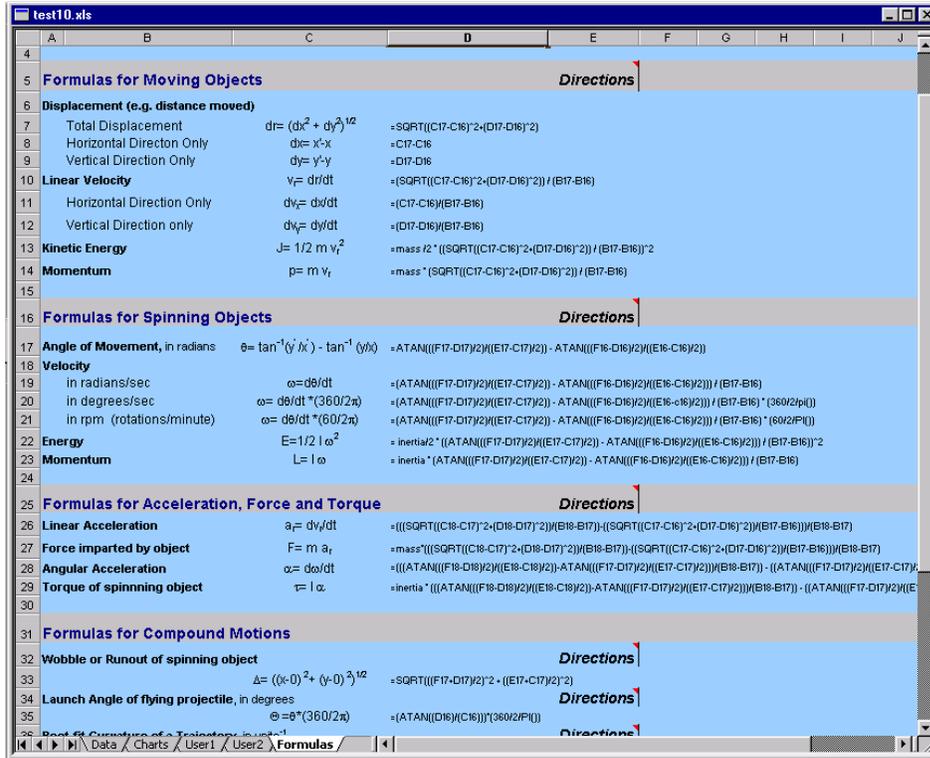
In the fifth sheet (shown on the opposite page for reference), labeled "Formulas", you will find various useful formulas for standard calculations pertaining to moving objects. These formulas are provided in general text format so you can copy the cell that contains the formula and paste it into the appropriate worksheet.

Informational call outs are also provided to aid you – move the mouse over the red flags to display helpful tips for acquiring and analyzing tracking data for various scenarios.

The following chart lists the sample formulas that are included in the Formulas sheet, for your reference.

Note: These formulas are designed to be general purpose. When applying a formula via cut/paste, check the cell references for accuracy.

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The following formulas work with linearly moving objects:

<b>Displacement</b>		
Total Displacement	$dr = (dx^2 + dy^2)^{1/2}$	$=\text{SQRT}((C17-C16)^2+(D17-D16)^2)$
Horizontal Direction	$dx = x'-x$	$=C17-C16$
Vertical Direction	$dy = y'-y$	$=D17-D16$
<b>Linear Velocity</b>		
Horizontal Direction	$dv_x = dx/dt$	$=(C17-C16)/(B17-B16)$
Vertical Direction	$dv_y = dy/dt$	$=(D17-D16)/(B17-B16)$
<b>Kinetic Energy</b>	$J = 1/2 m v_r^2$	$=\text{mass} / 2 * ((\text{SQRT}((C17-C16)^2+(D17-D16)^2)) / (B17-B16))^2$
<b>Momentum</b>	$p = m v_r$	$=\text{mass} * (\text{SQRT}((C17-C16)^2+(D17-D16)^2)) / (B17-B16)$

<b>Linear Acceleration</b>	$a_r = dv_r/dt$	$=(((\text{SQRT}((C18-C17)^2+(D18-D17)^2))/(B18-B17))-((\text{SQRT}((C17-C16)^2+(D17-D16)^2))/(B17-B16)))/(B18-B17)$
<b>Force imparted by object</b>	$F = m a_r$	$=\text{mass} * (((\text{SQRT}((C18-C17)^2+(D18-D17)^2))/(B18-B17))-((\text{SQRT}((C17-C16)^2+(D17-D16)^2))/(B17-B16)))/(B18-B17)$

The following formulas work with spinning objects:

<b>Angle of Movement, in radians</b>	$\theta = \tau \alpha v - 1 (\psi \vartheta / \xi \vartheta)$	$=\text{ATAN}(((F17-D17)/2)/((E17-C17)/2)) - \text{ATAN}(((F16-D16)/2)/((E16-C16)/2))$
<b>Velocity</b>	$-\tau \alpha v - 1 (\psi / \xi)$	
in radians/sec	$\omega = \delta \theta / \delta \tau$	$=(\text{ATAN}(((F17-D17)/2)/((E17-C17)/2)) - \text{ATAN}(((F16-D16)/2)/((E16-C16)/2))) / (B17-B16)$
in degrees/sec	$\omega = \delta \theta / \delta \tau * (360/2\pi)$	$=(\text{ATAN}(((F17-D17)/2)/((E17-C17)/2)) - \text{ATAN}(((F16-D16)/2)/((E16-C16)/2))) / (B17-B16) * (360/2/\text{PI}())$
in rpm (rotations/minute)	$\omega = \delta \theta / \delta \tau * (60/2\pi)$	$=(\text{ATAN}(((F17-D17)/2)/((E17-C17)/2)) - \text{ATAN}(((F16-D16)/2)/((E16-C16)/2))) / (B17-B16) * (60/2/\text{PI}())$
<b>Energy</b>	$E = 1/2 I \omega^2$	$= \text{inertia} / 2 * ((\text{ATAN}(((F17-D17)/2)/((E17-C17)/2)) - \text{ATAN}(((F16-D16)/2)/((E16-C16)/2))) / (B17-B16))^2$
<b>Momentum</b>	$L = I \omega$	$= \text{inertia} * (\text{ATAN}(((F17-D17)/2)/((E17-C17)/2)) - \text{ATAN}(((F16-D16)/2)/((E16-C16)/2))) / (B17-B16)$
<b>Angular Acceleration</b>	$\alpha = \delta \omega / \delta \tau$	$=(((\text{ATAN}(((F18-D18)/2)/((E18-C18)/2)) - \text{ATAN}(((F17-D17)/2)/((E17-C17)/2)))/(B18-B17)) - ((\text{ATAN}(((F17-D17)/2)/((E17-C17)/2)) - \text{ATAN}(((F16-D16)/2)/((E16-C16)/2)))/(B17-B16)) / (B18-B17)$
<b>Torque of spinning object</b>	$\tau = I \alpha$	$= \text{inertia} * (((\text{ATAN}(((F18-D18)/2)/((E18-C18)/2)) - \text{ATAN}(((F17-D17)/2)/((E17-C17)/2)))/(B18-B17)) - ((\text{ATAN}(((F17-D17)/2)/((E17-C17)/2)) - \text{ATAN}(((F16-D16)/2)/((E16-C16)/2)))/(B17-B16)) / (B18-B17)$

## Creating your own Excel Template

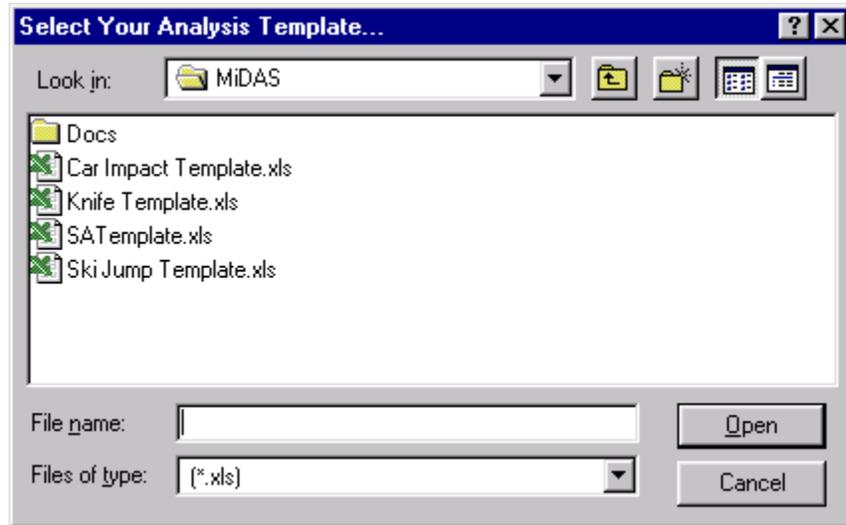
The Excel spreadsheet shown in the previous section is the default template for manual and auto-tracking. MiDAS also allows you to supply your own custom designed templates to be used in conjunction with the Analysis modules.

For the Manual Tracking (SA1) module, there is only one template that is loaded by default. This template is named "SA Template.XLS" in the base MiDAS installation directory, typically this is

"C:\Program Files\Xcitex\MiDAS". To replace the default template, simply replace this file with one of your own creation. We strongly suggest you backup the original in order to use it as a reference.



For the Auto-Tracking (SA2) module, in addition to replacing the default template as with the manual module, a different template can be selected for each tracking run. To select a particular template for tracking, click on **SELECT...** before clicking on **NEW**. This will bring up the template selection dialog.



This will load your desired template and use it for the tracking session when you click on **NEW**.

You can also change the template that you are using after you have already run tracking on a video sequence by selecting a new template and then reloading the tracked points into the new template using the **RELOAD** button. For more details on selecting templates after tracking has already been completed, see the next section titled "Reloading Tracked Points Into A Spreadsheet".

To create your own MiDAS template, simply design a worksheet in Excel outside of MiDAS. You can copy the supplied default "SATemplate.XLS" file as a starting point from which to make your modifications.

Here are the cells that MiDAS uses when mapping data into the spreadsheet. You should not place formulas into these cells – MiDAS will overwrite the information:

Cell	Mapped Information
B4	Record Date
B5	Filename of Video Image
B8	Calibration Scale Factor
C8	Calibration units (conversion)
B9	Record Frame Rate
C9	“frames/second”
B10	SA Reference Number (“Start Frame”)
B11	Origin X position (pixels)
D11	Origin Y position (pixels)
B12	Tilt Angle
C12	“degrees”
A{16...65536}	Frame Number
B{16...65536}	Time
C{16...65536}	Feature 1, X-coordinate (units)
D{16...65536}	Feature 1, Y-coordinate (units)
E{16...65536}	Feature 2, X-coordinate (units)
F{16...65536}	Feature 2, Y-coordinate (units)
G{16...65536}	Feature 3, X-coordinate (units)
H{16...65536}	Feature 3, Y-coordinate (units)
I{16...65536}	Feature 4, X-coordinate (units)
J{16...65536}	Feature 4, Y-coordinate (units)
... DZ{16...65536}	... Additional Feature Coordinates

We suggest that you also reserve A7:D12 for calibration information.

Create your workbook (multi-layers, multi-sheets) just as you would any other Excel document. You are now ready to unleash the power of Excel. Cut and paste formulae, create great graphs, and calculate everything about the motion of the features you tracked.

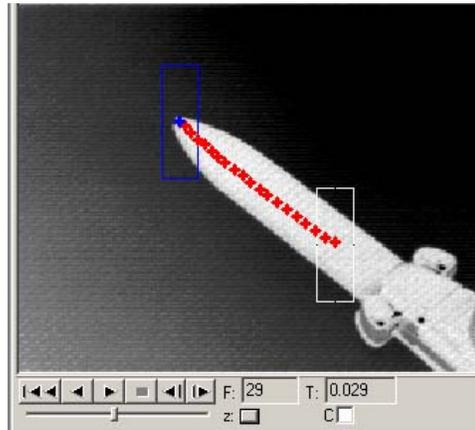
To customize the Excel toolbar (e.g. add a graph wizard icon, etc.), make the desired modifications in Excel as a stand-alone application, then save the changes. MiDAS automatically picks up these changes when starting the Spreadsheet Analysis module.

Save your new template with a standard *Filename.XLS* format.

### **Reloading Tracked Points into a Spreadsheet**

With the Auto-Tracking (SA2) module, you have the option of selecting different Excel spreadsheet templates to use for your analysis. You can select which template to use prior to running auto-tracking as described in the previous section, or you can also change the template which is being used after tracking is completed.

After you have finished a typical tracking procedure and have clicked on the **DISABLE** button, the populated Excel spreadsheet will appear. You can choose to work and save this spreadsheet or you can decide to try another template instead. In order to use the current tracked data to populate a different spreadsheet, do the following:



1. Close any current open spreadsheet. You will not lose your tracked data.
2. Select a different template to use by clicking on **SELECT...**
3. Click on **RELOAD** to populate the newly selected template with the previously tracked data.

In addition to changing the template during an analysis run, when you open a video which has been previously analyzed and saved, the associated tracked data will load along with the video. Tracked points will be displayed in the video image, similar to that shown on the right. Analysis need not be run again on this video. The existing tracked data can be reloaded into a spreadsheet template for additional analysis purposes. Simply follow Steps 2 and 3 above to reload the data into a new template of your choice.

## SA Helpful Hints

1. If you make a mistake during tracking, you can correct the mistake by using the video playback controls and Feature Counter buttons. Simply determine where the mistaken data point is (frame and feature), then back-up to this location and select the correct tracking point. The incorrect information will be overwritten.
2. If you incorrectly click on the screen and inadvertently select an incorrect manual track point, simply remember the frame number and then delete the associated row from within Excel after tracking is completed. Each row represents data for a single frame. Deleting a row deletes information for that frame only.
3. Spread out – do not try to jam a complicated formula into one cell. Let the formulas span many cells.
4. Shrink to invisible the unused columns to create workspace. If you are only tracking two points, shrink columns G-DZ associated with features 3 and higher. If you are tracking more features, expand the additional columns necessary to view the resulting data.
5. To track spinning objects, mark the object with a line (or with two distinguishable features) and use the two end points of the line as tracking points. Select the Configuration Option to draw lines between tracked features. This will result in a line which rotates with the object as the two end points are tracked.
6. Cut/paste from the default Excel template to save time when creating a new template.







# AD

## Automatic Download Modules

### Auto-Download Basics

The various MiDAS Auto-Download modules allow you to set your system to record data, video, and IRIG/GPS timing automatically. The basic operation is as follows.

1. Configure MiDAS' record parameters.
2. Start it recording in Auto-Download mode.
3. Then, every time that MiDAS receives a trigger (either externally or as explained later, internally) MiDAS will save the recording to any one of numerous destination locations that you defined.
4. MiDAS then 're-engages' itself and waits for the next trigger.

This feature is very useful for applications that require capture of information at a remote site (e.g. a test range or hazardous environment) or when the event happens intermittently (e.g. a production line failure or explosion).

If you purchased the MiDAS AD1 or MiDAS AD2 Auto-Download module, an additional tab appears in your MiDAS control panel. This tab describes the Download (or Save) settings for your MiDAS recording. The MiDAS recording (video, data, IRIG/GPS) is still performed as

described in previous chapters. The frame rate, the shutter speed, the number of data samples and the trigger percentage are all set per those instructions.

However, instead of pressing the **RECORD** button to make a recording, you now move over to the Auto-Download tab to describe how to save recordings and to set the options how MiDAS will reengage itself after every recording.

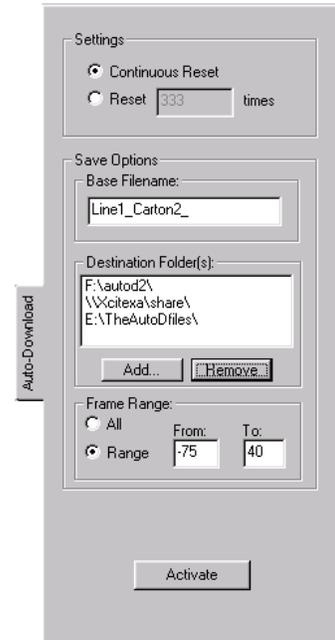
Once Auto-Download mode is activated, no changes to the recording settings are allowed until the Auto-Download mode is disabled and MiDAS is returned to “local record” mode.

### Using Standard Auto-Download (Module AD1)

If you purchased, (and enabled via the Tab Manager) the MiDAS Module AD1 using the Tab Manager, the tab shown at right will appear.

To set up MiDAS standard Auto-Download, follow these instructions:

1. Click on the Record Video/Data tab. Set up your video, data and time sync recording configuration as per the instructions in Chapter 5, Chapter 12 and Chapter 15 of this manual. Set the frame rate, exposure time, data record rate and trigger conditions.
2. Do not press **RECORD**. Instead, click on the Auto-Download tab.
3. Set the parameters of the AD1 Auto-Download tab are as follows:



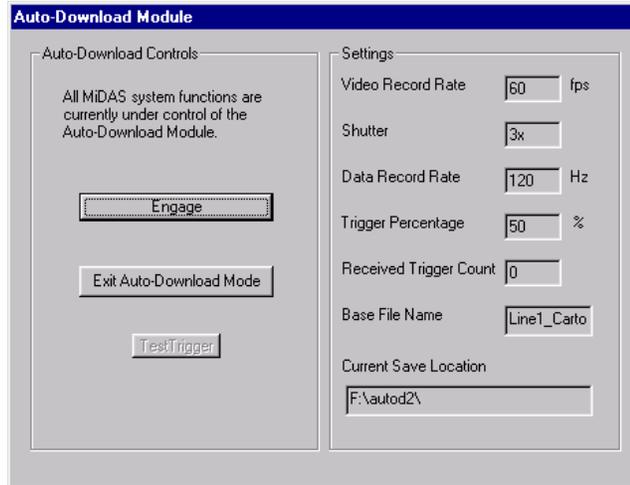
<b>Continuous Reset</b>	Will continuously save and re-arm MiDAS until the operator disables Auto-Download mode.
<b>Reset n times</b>	Will download only a finite number of recordings, then disable Auto-Download and return to local recording mode. This feature helps prevent unintentional filling of hard drives.

<b>Base File Name</b>	The filename that the downloaded (e.g. “saved”) video and data use. MiDAS adds the camera number ‘_cam#_’ and the number ‘1’ to the first download and increments this last digit every time a new file is downloaded. For example, if the filename is “Test”, then the first file saved from the master camera is “Test_cam0_1.AVI”, the second is “Test_cam0_2.AVI” and so on. The data file (*.AU2) and the MiDAS Binary File (*.AU3) is saved with the similar filenames.
<b>Destination Folder(s)</b>	<p>The folders to where the files are saved. The folders can be on the local computer (e.g. “C:\Tests\”) or on any computer that is networked to the computer (e.g. “\\Computer2\Tests\Tuesday”).</p> <p>MiDAS will walk through these directories every time that it tries to save. It will save in the first location that has enough room for the sequence that it is about to save.</p> <p>If for example you have filled the drives associated with the first and second destinations but that there is room in the third destination. MiDAS will save to the third. Each time MiDAS tries to save it will recheck the destinations from top to bottom to see if there is room. It will save in the first directory where there is space.</p> <p>This means, that as drives become full, you can remove the files (either copy them to another location or burn them to a disk) without stopping MiDAS and as MiDAS sees that the space is available, it will use it.</p>
<b>Frame Range</b>	The range of frames to be saved. For more information on saving a range of frames, see the section on Managing information.

4. Click on **CONTINUOUS RESET** or **RESET A NUMBER OF TIMES**.
5. Type in a Filename. [MiDAS saves video and data to this filename plus the camera number plus an incremented number.]
6. Select a folder on your computer (or on any other computer in the same Network Neighborhood) to which you wish the files be saved.
7. Select a range of video frames to be saved.

- Click on **ACTIVATE**. A large window warns that you are relinquishing control of the recording process to MiDAS.

After the **ACTIVATE AUTO-DOWNLOAD** button is pressed, the following “Technician Lock-out Window” appears:

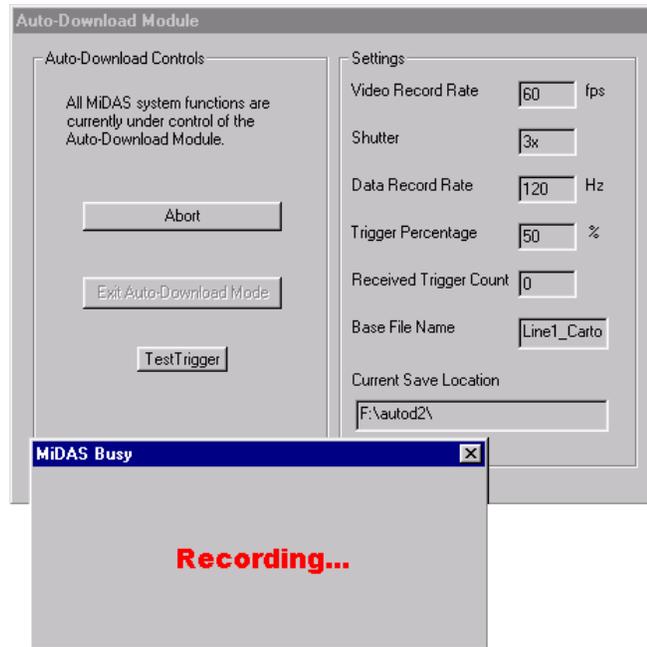


You will notice a change to MiDAS. The Control Panel becomes blank. It is “Locked Out”.

Within the Technician Lock Out Window, you will find the current record settings for MiDAS. In addition, you will see the following buttons:

<b>ENGAGE Button</b>	Engages full Auto-Download. At this point, the screen will not respond to any mouse clicks, keyboard entries or other commands. The MiDAS control panel is gray to alleviate confusion.
<b>EXIT AUTO-DOWNLOAD MODE button</b>	Press this button to disable Auto-Download and return MiDAS to local control mode.
<b>TEST TRIGGER button</b>	Sends a trigger pulse to MiDAS, simulating an external trigger event. Helps optimize the settings for Auto-Download (frame range, camera alignment, etc.). Note that a Test Trigger is treated like an external event trigger within MiDAS.

You will notice another change in Midas. A blinking box labeled “Recording” becomes visible, as shown in the above figure. MiDAS is now waiting for an external trigger (or you may hit the “Test Trigger” Button).



9. When Auto-Download is engaged, any external trigger will cause MiDAS to (1) record video, data and associated timing information, (2) download the information to the destination folder, and (3) re-arm itself into Record Ready mode awaiting the next external trigger.
10. Return to the MiDAS control panel by clicking **ABORT** and then **EXIT AUTO-DOWNLOAD MODE**.

*Note: Users can review recordings with the MiDAS Player while Auto-Download stays operating in the background. Simply double-click on the recording to launch the MiDAS Player (a separate program). MiDAS continues to record, waiting for a trigger pulse, in the background while you review the previously record file with the MiDAS Player. Therefore, you can always be recording while using the computer for other applications.*

*Note: The only time Auto-Download is unable to acquire a recording is when it is saving to the hard drive or network drive.*

## Using Advanced Auto-Download (Module AD2)

If you purchased MiDAS Module AD2, have selected the “Enable Advanced Auto-Download Feature” option from the Record Options, and didn’t hide the MiDAS Module AD2 using the Tab Manager, the tab shown at right will appear.

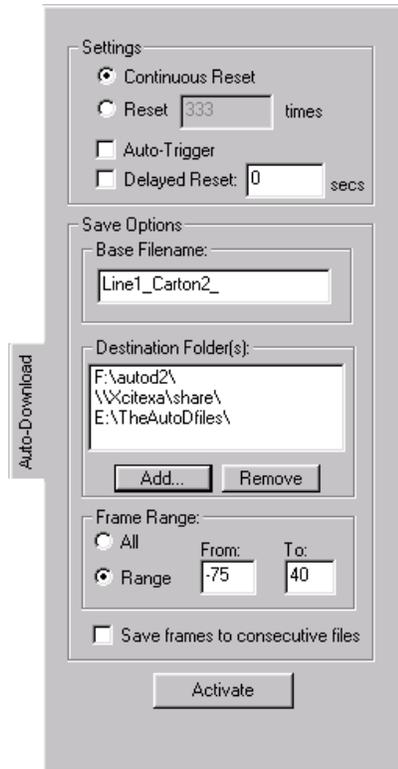
You will notice that there are three additional controls on the AD2 tab from the AD1 tab -- the “Auto-Trigger” checkbox, the “Delayed Reset, with # secs” checkbox, and the “Save frame to consecutive files” checkbox.

These three features used in various combinations enable a new suite of functionality such as Auto-Repeat and Time-Lapse, burst recording, audit recording and burst time lapse.

Using the AD2 functions follow the same general rules and principles as the AD1 tab described in the section above.

To set up MiDAS standard Auto-Download, follow these instructions:

11. Click on the **RECORD OPTIONS** under the **OPTIONS** menu item.
12. Make sure that the “Enable Advanced Auto-Download Feature” option is checked.
13. Press **OK**.
14. Click on the Record Video/Data tab. Set up your video, data and time sync recording configuration as per the instructions in Chapter 5, Chapter 12 and Chapter 14 of this manual. Set the frame rate, shutter speed, data record rate and trigger conditions.
15. Do not press **RECORD**. Instead, click on the Auto-Download tab.
16. Set the parameters of the AD2 Auto-Download tab are as follows:



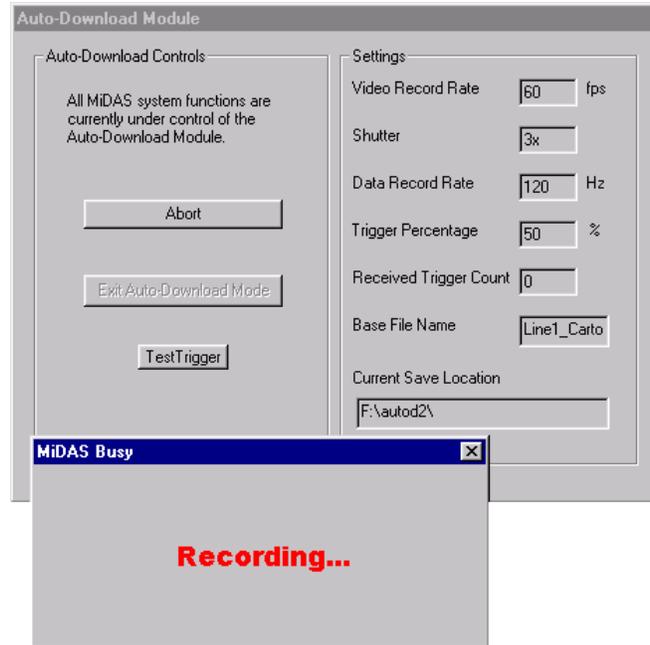
<b>Continuous Reset</b>	Will continuously save and re-arm MiDAS until the operator disables Auto-Download mode.
<b>Reset n times</b>	Will download only a finite number of recordings, then disable Auto-Download and return to local recording mode. This feature helps prevent unintentional filling of hard drives.
<b>Base File Name</b>	The filename that the downloaded (e.g. "saved") video and data use. MiDAS adds the camera number '_cam#_' and the number '1' to the first download and increments this last digit every time a new file is downloaded. For example, if the filename is "Test", then the first file saved from the master camera is "Test_cam0_1.AVI", the second is "Test_cam0_2.AVI" and so on. The data file (*.AU2) and the MiDAS Binary File (*.AU3) is saved with the similar filenames.
<b>Destination Folder</b>	<p>The folders to where the files are saved. The folders can be on the local computer (e.g. "C:\Tests\") or on any computer that is networked to the computer (e.g. "\\Computer2\Tests\Tuesday").</p> <p>MiDAS will walk through these directories every time that it tries to save. It will save in the first location that has enough room for the sequence that it is about to save.</p> <p>If for example you have filled the drives associated with the first and second destinations but that there is room in the third destination. MiDAS will save to the third. Each time MiDAS tries to save it will recheck the destinations from top to bottom to see if there is room. It will save in the first directory where there is space.</p> <p>This means, that as drives become full, you can remove the files (either copy them to another location or burn them to a disk) without stopping MiDAS and as MiDAS sees that the space is available, it will use it.</p>
<b>Frame Range</b>	The range of frames to be saved. For more information on saving a range of frames, see the section on Managing information.

<b>Auto-Trigger</b>	<p>If this option is selected, every time that MiDAS reengages it will automatically (internally) re-trigger. This means that it will only record for the amount of time set for Post Trigger from the Trigger slide control on the Record tab.</p> <p>This feature is great if you would like to get as continuous a recording as possible, the only gap, being the amount of time that it takes to save to disk.</p>
<b>Delayed Reset ___ secs</b>	<p>If this option is selected, after MiDAS finishes saving a recording, it will not reengage itself until after the indicated number of seconds.</p> <p>The delay period can be from 1 second to 86,400 seconds (24 hours).</p> <p>If, for example, your line stays down for 30 minutes, after it sends out the trigger signal to MiDAS, you would enter 1800. After MiDAS receives a trigger it saves to disk, and waits 30 minutes before it reengages into record mode waiting for the next trigger.</p>
<b>Save frames to consecutive files</b>	<p>If this option is selected your image sequence is saved as a series of bitmaps named BaseFileName_camX_Triggercount####.</p> <ul style="list-style-type: none"><li>• BaseFileName is the name that you selected.</li><li>• CamX is cam0 to indicate the master camera, or cam1 to indicate the next camera in the chain.</li><li>• Triggercount is the number of the received trigger. It starts at 1 and increments for every trigger</li><li>• #### is the number of the frame in the sequence.</li></ul> <p>This naming strategy allows you to load consecutive recordings as one continuous recording, so that you can view a Time Lapse sequence.</p>

*Note: If you are recording with cameras only and using Auto-Trigger, even though MiDAS will record for the post trigger time, the frame numbering will be from some negative number to zero (the last frame will be frame 0). A system timer is used in this configuration to call a delayed Panic Stop (see Chapter 4). Be certain to configure your save range accordingly!*



After the **ACTIVATE AUTO-DOWNLOAD** button is pressed, the following “Technician Lock-out Window” appears:



Within the Technician Lock Out Window, you will find the current record settings for MiDAS. In addition, you will see the following buttons:

<b>ENGAGE button</b>	Engages full Auto-Download. At this point, the screen will not respond to any mouse clicks, keyboard entries or other commands. The MiDAS control panel is gray to alleviate confusion.
<b>EXIT AUTO-DOWNLOAD MODE button</b>	Press this button to disable Auto-Download and return MiDAS to local control mode.
<b>TEST TRIGGER button</b>	Sends a trigger pulse to MiDAS, simulating an external trigger event. Helps optimize the settings for Auto-Download (frame range, camera alignment, etc.). Note that a Test Trigger is treated like an external event trigger within MiDAS.

You will notice another change in Midas. A blinking box labeled “Recording” becomes visible, as shown in the above figure. MiDAS is now waiting for an external trigger (or you may hit the “Test Trigger” Button).

17. When Auto-Download is engaged, any external trigger will cause MiDAS to (1) record video, data and associated timing information, (2) download the information to the destination folder, and (3) re-arm itself into Record Ready mode awaiting the next external trigger.

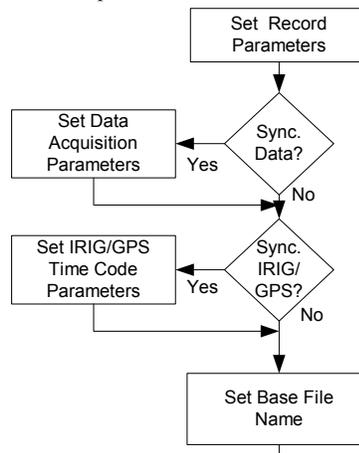
*Note: If you have selected Auto-trigger, the continuous reset process will not begin until after the first trigger pulse is received.*

18. Return to the MiDAS control panel by hitting **ABORT** and then **EXIT AUTO-DOWNLOAD MODE**.

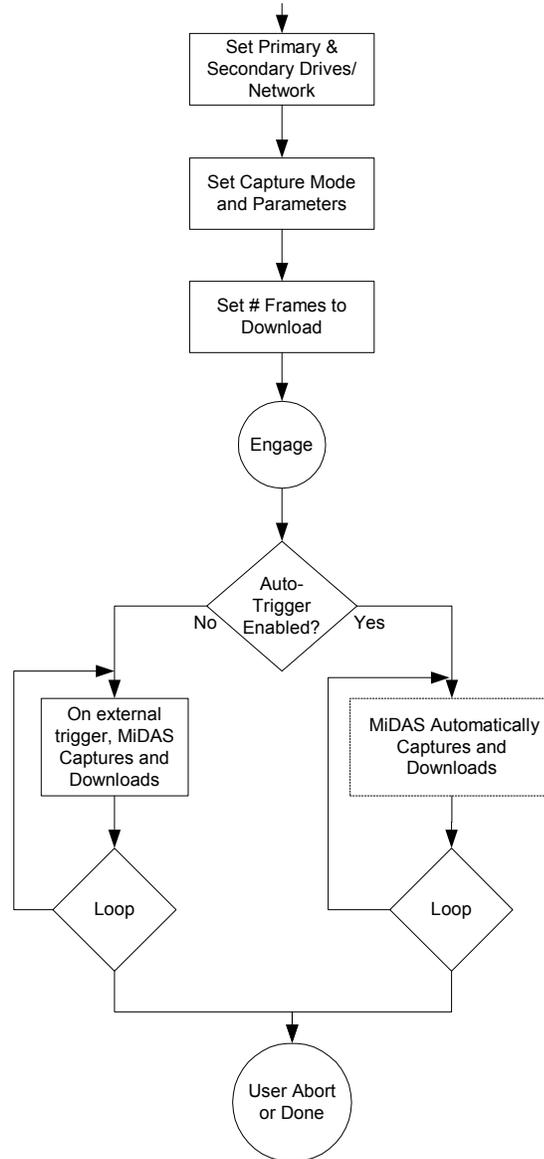
*Note: Users can review your recordings with the MiDAS Player while Auto-Download stays operating in the background. Simply double-click on the recording to launch the MiDAS Player (a separate program). MiDAS continues to record, waiting for a trigger pulse, in the background while you review the previously record file with the MiDAS Player. Therefore, you can always be recording while using the computer for other applications.*

*Note: The only time Auto-Download is unable to acquire a recording is when it is saving to the hard drive or network drive.*

The following flow chart helps explain the sequence of events used to set up MiDAS in Advanced Auto-Download mode:



[Advanced Auto-download procedure flow-chart – continued:)



## Specialty Modes with Advanced Auto-Download

The power of the Advanced Auto-Download features lies in the various specialty record modes that can be created with Auto-Trigger, Delayed Reset and Save as Continuous features. These are, for convenience, called “modes” of auto-capture/auto-download.

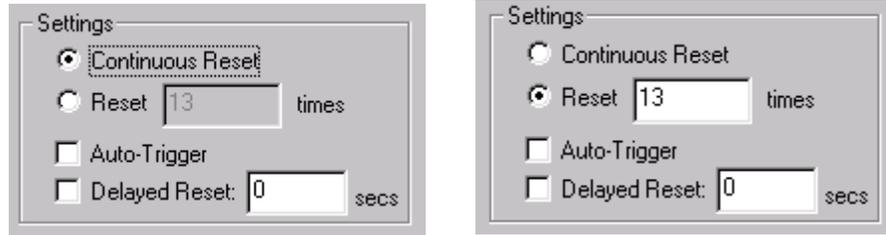
These modes are summarized in the following summary sections:

### Auto-Download Mode

The standard Auto-Download mode simply collects video and data onto a hard drive immediately upon receipt of an external trigger pulse. Immediately after downloading the information to the hard drive of choice, MiDAS resets itself waiting for the next trigger pulse.

If “Continuous Reset” is selected, then this process will continue until all the hard drives in the cue are full. Use the “Reset” button to select a finite number of recordings.

The pertinent tab settings for this mode are as shown in the following figures:



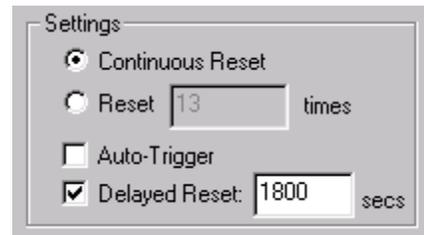
Use this mode for capturing human or animal motion, lightning strikes, environmental effects, surveillance, explosions, military applications and ballistics work.

### Auto-Download Mode with Delayed Reset

This mode allows the user to program in a delay between the time that MiDAS downloads the video and data to the hard drive and the reset time.

The pertinent tab settings for this mode are as shown in the following figure:

Use this mode for capturing failures on a production line or web inspection system in which a known delay is required. For example, when a web break occurs, MiDAS captures the event then waits 45 minutes for the technicians to reset the production line. During this 45 minutes, MiDAS



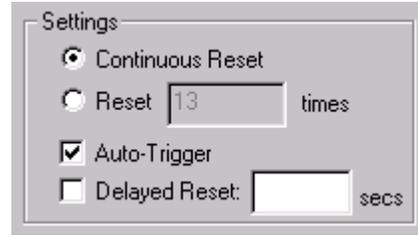
will not respond to a false event trigger. Other applications include drop testing (triggers on way down, not on way back up), oscillatory testing such as springs and valves, and horse or auto races (trigger each lap on lead car).

### Auto-Download/Auto-Repeat Mode

When the “Auto-Trigger” checkbox is checked, MiDAS will continuously record and download until the hard drive is full. There is no delay in the download reset. This mode is used when the user wants a low-cost alternative to “stream-to-disk” and wants to capture as much information as fast as possible about an event. The process will continue until the hard drives are full or the user presses the **ABORT** button.

The pertinent tab settings for this mode are as shown in the following figure:

Use this mode for capturing fast events like biomechanical motion of birds or fast animals. Other applications include mechanical part stressing and failure mode analysis, and component testing.



*Note: Auto-triggering will begin after the first trigger pulse is received.*

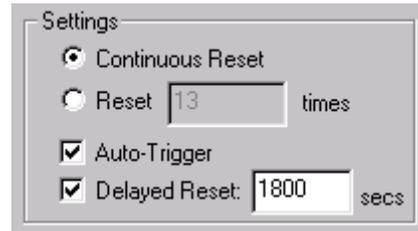
### Burst Record Mode

This mode is used to capture a full video recording (few seconds long) at some discrete period of time. It is an excellent audit tool and surveillance tool for slowly occurring, but fast events.

The pertinent tab settings for this mode are as shown in the following figure:

Use this mode to record a drug or crystal growing process, to check the work of a production facility every shift change or every hour, to see if a very fast process is starting to decay or change, or to automatically record periodic quality tests.

Using the remote network mode, you can have these audit measurements sent directly to your computer in your office – away from the production floor or laboratory. This mode is ideal for large production facilities in which a remote engineer wishes to monitor a process or production line, but does not wish to be present every hour or half hour.

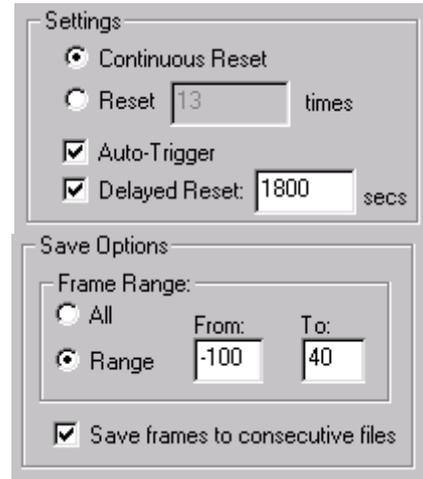


### Time-Lapse Burst Record Mode

This mode is similar to Burst Record Mode described above except that it allows you to string all your recordings together into one large video file. Therefore, you can create one very long video file that encapsulates periodic recordings.

To engage this mode, you simply check the Auto-Trigger checkbox, the Delayed Reset checkbox (enter a reset time), a range of frames, and check the “Save frames to consecutive files” checkbox.

In this mode, each frame of the video is saved as a separate bitmap file. The files are sequentially numbered, starting with 1. So, if the first recording was 2000 frames, the bitmaps would be labeled 1-2000. The second recording would start its numbering at 2001 (for example 2001-4000), etc. Then, MiDAS knows to play these files as though they were one very long, continuous video sequence.



The pertinent tab settings for this mode are as shown in the following figure:

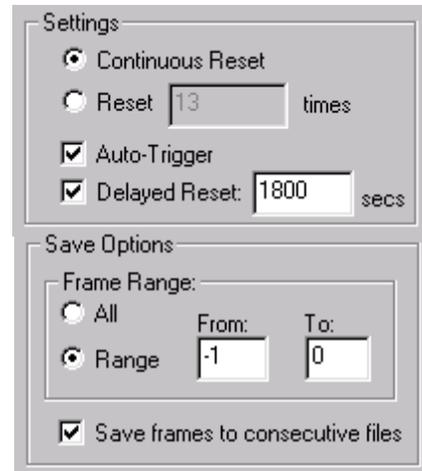
Use this mode for creating time lapse sequences of very fast events. For example, the motion of an insect or the motion of a baseball pitcher or swimmer throughout a long sporting event to look for degradation of performance. Other uses are for collections of failures (crashes or drops or lightning strikes) over a long period of time. Use it to monitor spray booths.

### Time-Lapse Snapshot Mode

This mode allows you to use a video camera like a snapshot time-lapse camera. By taking one video frame every period, then stringing these into one large video, you can create time-lapse with very fast shutter events, using your video camera. Time Lapse Snapshot Mode is similar to the above Burst Record Video Mode, but with only one frame captured per period.

The pertinent tab settings for this mode are as shown in the following figure:

Use this mode like you would use a conventional photography camera. Take one frame every hour

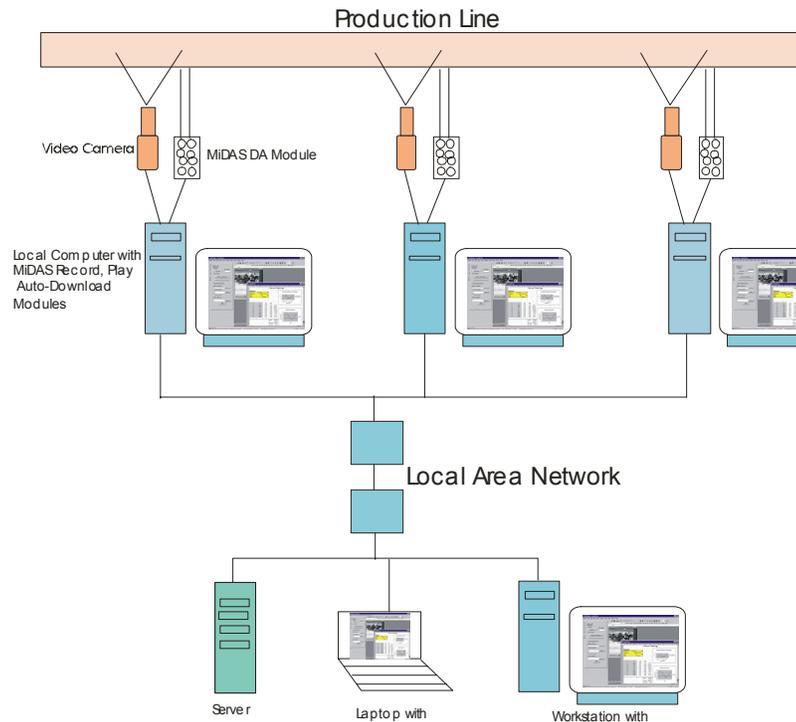


or 5 hours or day. Ideal applications are crystal growth, infrastructure motion, lava flow, building growth and aging. The advantage of this mode over conventional photography is that you get a video sequence at the end.

## Using Auto-Download in a Networked Environment

Advanced Auto-Download is ideal for the production and web break inspection businesses. In these, video and data are used to capture intermittent failure events.

1. Set up video cameras in computers along the production line or in the laboratory, as shown in the following diagram:



2. Connect these computers over a network (Ethernet, etc.)
3. Set up each computer with MiDAS (MiDAS will control multiple computers per computer)

4. Designate which computers on the network are archive computers, servers and review sites.
5. Configure MiDAS on each computer to, in the event of a trigger pulse, capture and automatically download the video and data to the computers designated in step 4 above. It is advised to use one very large RAID computer as the main archive computer as video files can get very large.

*Note: MiDAS has built-in network collision management algorithms. If a collision between two computers trying to download at the same time to a third computer, MiDAS controls the routing and flow to allow both to work congruently.*

6. If on a production line, configure in a delayed reset to account for technician reset and jam clear time.
7. Configure the triggers on each computer to trigger along a process. For example, if a process takes 30 seconds from start to finish, set the first camera bank to trigger at 5 seconds, the second to trigger at 10 seconds, and so on to fully capture a broken or failed part throughout the process.



# TS

## Time Synchronization Modules

The MiDAS TS modules provide the ability for MiDAS and the associated MiDAS components to accurately read time and location information. This information is provided from either a time generator that is centrally located to all the instruments participating in the measurement (e.g. an IRIG time generator) or from the network of Global Positioning Satellites (GPS), which broadcast master time as well as signals that enable MiDAS to calculate its exact position on earth. The MiDAS TS modules phase lock all the internal clocks within the MiDAS system to the external source and, in addition to the local frame time, display the universal time.

### **How MiDAS Active Phase-Locking Works**

The MiDAS TS modules provide precision time and frequency reference. Time is acquired from either GPS satellites using a supplied antenna/receiver (GPS) or from time code signals (IRIG, NASA, IEEE), most often IRIG B.

All MiDAS TS modules use a proprietary 'Active Phase Lock' technology. Central to the operation of the TS module board is a phase-locked (slaved, disciplined, rate synchronized) 10 MHz oscillator and 100 nanosecond clock. The TS board's 10 MHz oscillator is phase-locked to the external time generator. MiDAS in turn slaves the internal clocks for the video cameras, the DA data acquisition system, and the time code generator output circuitry to the clock on the TS module board.

Operation is as follows. The external generator controls the TS module's clock. The TS clock controls the acquisition clocks for the video camera and the DA data acquisition systems. If connection to the GPS satellites or the external time code generator is lost, the module will continue to maintain time and frequency stability (freewheel).

You will find that our competitors' systems read the external generator only once per recording or update the internal clock only once per generator cycle and then extrapolates the time. They assume that there is no drift between the acquisition clock and the external source clock even though they don't tie them together. They do not tend to actively synchronize all clock edges, but instead only synchronize a single clock edge of an acquisition sequence.

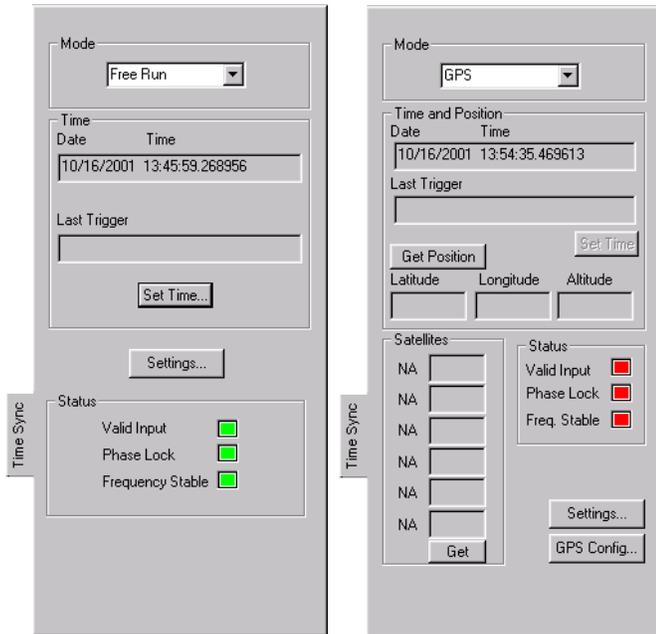
In MiDAS the clocks that run the acquisition are locked, physically and electronically tied, to the external time source.

### **MiDAS Time Sync Options**

MiDAS has three Time Sync (TS) optional Modules. Module TS-01 allows you to phase lock your system to a variety of ground-based time generators commonly used in military and space measurement ranges (IRIG, NASA, IEEE, etc.). Module TS-02 allows users to connect to all the above land-based time generators plus the broadcast GPS network.

Module TS-03M also adds the ability to read camera tracker pointing position (azimuth and elevation) along with the features of TS-02M.

MiDAS TS modules require no operator intervention after they are "set up". The MiDAS tabs, shown at right, allow some settings, but are mostly informational. The time, position, and pointing information appear with each video image on the MiDAS desktop.



Unlike other MiDAS modules, the TS tabs change their appearance to match the Mode that you have selected (e.g. NASA, IRIG, GPS, etc.). For example, if you have only purchased Module TS-01M then you do not have GPS functionality. You will only be able to view the GPS enabled version of the TS Tab from the Tab Manager but it will not be functional.

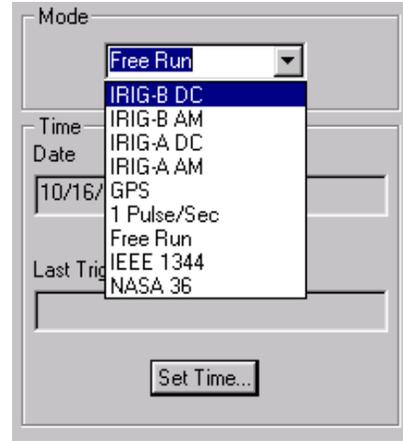
Each MiDAS TS module includes a board that fits within your computer and a multi-pin breakout cable. Modules TS-02M and TS-03M also include a GPS antenna and cable.

The following table shows the different Time Sync options within MiDAS

Feature	Module TS-01M	Module TS-02M	Module TS-03M
IRIG A, B (AM, DC) Sync	•	•	•
IEEE 1344 Sync	•	•	•
NASA 36 Sync	•	•	•
GPS Sync.		•	•
Free Run Mode	•	•	•
Time Generator Mode	•	•	•
External Trigger Input	•	•	•
Valid Input Verification	•	•	•
Phase Lock Verification	•	•	•
Frequency Stable Verification	•	•	•
Satellite Lock Verification		•	•
Satellite Strength Indicators		•	•
10 MHz Phase Lock Clock	•	•	•
Time	•	•	•
Location		•	•
Tracker Azimuth & Elevation			•
Trigger Time	•	•	•
Active Phase Lock System	•	•	•

## Synchronization Modes and Timing Sources

The primary function of the TS module board is to provide precise time and frequency to MiDAS. The TS board can derive time from any of the sources listed following. In all but the Free Running mode of operation, the board synchronizes it's on board 10 MHz oscillator to the timing source. The TS board achieves synchronization by extracting a signal from the timing source and using this signal to discipline the oscillator such that the locally generated signal is matched in phase and frequency to the reference. Once synchronization is achieved, the TS board is able to maintain time even if the timing source is lost (though some timing drift will occur); this is referred to as flywheeling. The TS board will also obtain time (as much as possible) from the timing source if it is available.



The following describes the various TS modes. These various modes are selected from the Mode dropdown menu on the TS tab. The selection of one of these modes configures MiDAS to receive its external synchronization from the indicated source.

### IRIG-B DC

The external source that you are connecting to the TS pigtail connection labeled “Time Code Input” is an *Inter Range Instrumentation Group Format-B DC Level Shift* device. The user must set the correct year.

### IRIG-B AM

The external source that you are connecting to the TS pigtail connection labeled “Time Code Input” is an *Inter Range Instrumentation Group Format-B Amplitude Modulation* device. The user must set the correct year.

### IRIG-A DC

The external source that you are connecting to the TS pigtail connection labeled “Time Code Input” is an *Inter Range Instrumentation Group Format-A DC Level*

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**IRIG-A AM**

*Shift* device. The user must set the correct year.

The external source that you are connecting to the TS pigtail connection labeled “Time Code Input” is an *Inter Range Instrumentation Group Format-A Amplitude Modulation* device. The user must set the correct year.

*Note: DC Level Shift is simply the envelope of the modulated time code signal and is a digital signal.*

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**GPS**

You do not use the connection to the TS pigtail connection labeled “Time Code Input”, instead you connect the *Global Positioning System (GPS)* antenna (included with Models TS-02M and TS-03M) to the “GPS Ant.” connector on the back plane of the TS Module Board.

In addition to time, other information is available from the GPS system such as accurate position. This mode requires the use of the GPS antenna mounted such that it has an unobstructed view of the sky.

An unobstructed view of the sky is important because the GPS sensor must initially track four satellites to obtain accurate time. If however the user’s position is accurately known, the GPS sensor can derive precise time from just one satellite

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**1 Pulse/Sec**

The external source that you are connecting to the TS pigtail connection labeled “Time Code Input” is a 1 pulse per second square wave. Note that it is important that you have verified the integrity (level and stability) of this signal. There is no way for MiDAS to verify that what you have connected is indeed a 1 pulse per second

	TTL square wave. The user must set the correct year, month, day, minute, and second.
<b>Free Run</b>	<p>This mode allows the user to perform measurements when an external timing source is unavailable.</p> <p>You are explicitly stating that you are not using an external source to synchronize the TS board and therefore not using the connection to the TS pigtail.</p> <p><i>Note: The TS board will behave as if it is in Free Run mode if it loses communication to the external source for which you have it configured.</i></p>
<b>IEEE 1344</b>	The external source that you are connecting to the TS pigtail connection labeled “Time Code Input” is an <i>IEEE 1344</i> device.
<b>NASA 36</b>	The external source that you are connecting to the TS pigtail connection labeled “Time Code Input” is an <i>NASA 36</i> device.

## The Global Positioning System

The GPS system consists of three segments:

The space segment consists of 18 satellites and three spares broadcasting the radio navigation signals.

The control segment tracks the satellites and uploads orbital information (ephemerides) and clock corrections. There are five monitor stations, three uplink stations, and one master control station. The user segment tracks and receives the radio navigation signals and computes user position and time.

The signals transmitted from the satellites consist of two modulated carriers: L1 at 1.575 GHz and L2 at 1.227 GHz. The L1 signal is modulated with both a C/A code and a P code. The L2 signal is modulated with a P code only. Civilian access to the system is provided through the

C/A code. The P code is intended for authorized military users only. The MiDAS system operates on the C/A code.

The MiDAS TS receiver board determines time and position by measuring the time of arrival of the satellite signals. If the user has no knowledge of time nor position, then four satellites are required to determine a solution for the four unknown quantities X, Y, Z and time. If position is known and static, then time can be determined by measuring the time of arrival of a single satellite signal. Each satellite broadcasts information that allows the user to calculate the position of the satellite. Knowledge of this position, the user position, and a model of the transmission path characteristics allow accurate time determination.

The structure and content of the satellite signals and the decoding and solution determination algorithms are beyond the scope of this manual. Further information may be obtained from the paperback overview [Guide to GPS Positioning](#), prepared by David Wells and published by the Canadian GPS Associates.

## Understanding Time and Position

The following text fields and controls are located within the group box labeled “Time” (or “Time and Position” if running in GPS mode)

The TS module’s current date and time is displayed in the top text field. This information is automatically obtained from the external time source when possible. In the various IRIG modes, IEEE 1344, and NASA 36 modes the user must set the year.

In 1 Pulse/sec and free run modes, the user must set the year, month, day, hour, minute, and second. MiDAS assists you in setting this information by obtaining the operating system clock when you press the “Set Time...” button.

The “Last Trigger” text field is populated with the date and time of the last trigger event that the TS board received. This field is not displayed until you have performed at least one recording.

In GPS mode only, the “Latitude”, “Longitude”, and “Altitude” text fields display their information

The screenshot shows a window titled "Time". It contains a text field with the date and time "10/16/2001 13:45:59.268956". Below this is a text field labeled "Last Trigger" which is currently empty. At the bottom of the window is a button labeled "Set Time...".

The screenshot shows a window titled "Time and Position". It contains a text field with the date and time "10/16/2001 13:54:35.469613". Below this is a text field labeled "Last Trigger" which is currently empty. At the bottom of the window are three buttons: "Get Position", "Set Time", and "Altitude". Below these buttons are three text fields labeled "Latitude", "Longitude", and "Altitude", which are currently empty.

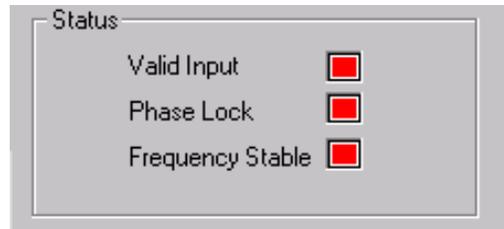
as labeled. The button “Get Position” will read this information from the TS board.

*Note: The “Automatically update GPS information” option accessed from the menu item “Options - System Configuration” will enable automatic updating of GPS satellite information. You may notice, a slight ‘blip’ in video playback about every 10 seconds if you automatically update the GPS information, as there is a little overhead associated with obtaining this information from the TS board.*

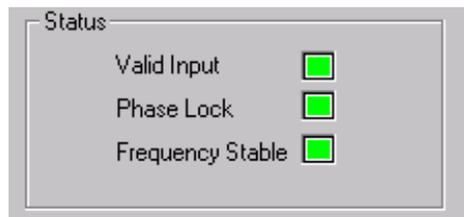
### **Status Indicators**

On every TS module (e.g. every tab type) , there are 3 status indicators in the “Status” group box to indicate the state of the TS board.

The “Valid Input” indicator is green when the TS board is tracking the indicated reference time source. If the light is red, it indicates that the TS board is not tracking the time source, usually because the time source has been lost or has become unstable. When this is the case, the board is flywheeling, and will keep time at the last known rate. When a timing Mode changes this light will go red until the TS board locks to the new timing source.



The “Phase Lock” indicator is green if the TS board oscillator is synchronized to better than 5 microseconds in IRIG, NASA, and IEEE modes; or to better than 2 microseconds in all other modes.



The “Frequency Stable” indicator is green if the on-board oscillator frequency offset relative to the timing source is better than  $5 \times 10^{-8}$ .

*Note: It is not necessary to wait for any of the lights to turn green before you do a recording with a MiDAS TS module. However, if you want the accuracy and stability as stated in the performance specifications you must wait until all lights are green.*

*Note: It takes time for electronic equipment to warm up and reach a steady state temperature. Electronic equipment, specifically equipment associated with timing and frequency generation, must be at a steady state temperature before it can output*



*stable signals. If you have just turned on your IRIG generator, and then hooked it up to the MiDAS TS board it would not be unusual to have to wait 20 minutes or longer, (depending on your generator) for all of the electronics to reach a steady state temperature with corresponding steady-state output behavior. The TS board could stop at telling you that it is locked to a source, but that is not really good enough. Instead MiDAS is making sure that the TS board is locked to the external source, and that the external source is stable. So, if you are operating in a cold climate, or have just turned on your equipment, please be patient.*

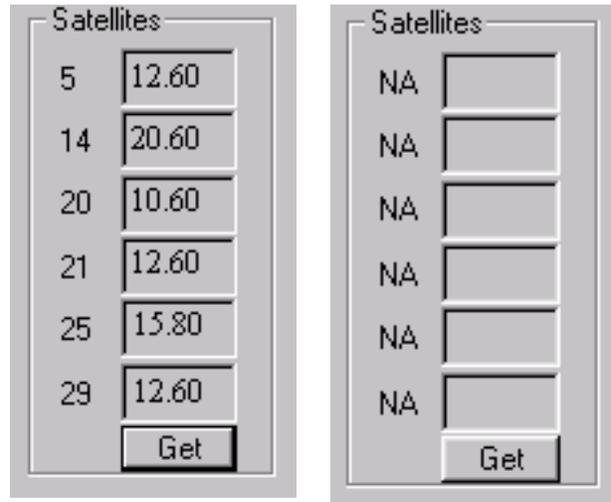
### Satellite Strength Indicators (GPS mode only)

On the GPS tab, you will find a box on the lower left labeled “Satellites”. This satellite group box contains information regarding the satellites that the GPS antenna can see. The text fields to the left of the edit boxes indicate the unique satellite identifier number. The number in the edit box indicates the received signal strength for the labeled satellite.

The “Get” button will read this information from the TS board.

If MiDAS is unable to read the satellite signals, it will display an NA (Not Available), as shown in the example at right.

*Note: The “Automatically update GPS information” option accessed from the menu item “OPTIONS- SYSTEM CONFIGURATION” will enable automatic updating of GPS satellite information. You may notice, a slight ‘blip’ in video playback about every 10 seconds if you automatically update the GPS information, as there is a little overhead associated with obtaining this information from the TS board.*



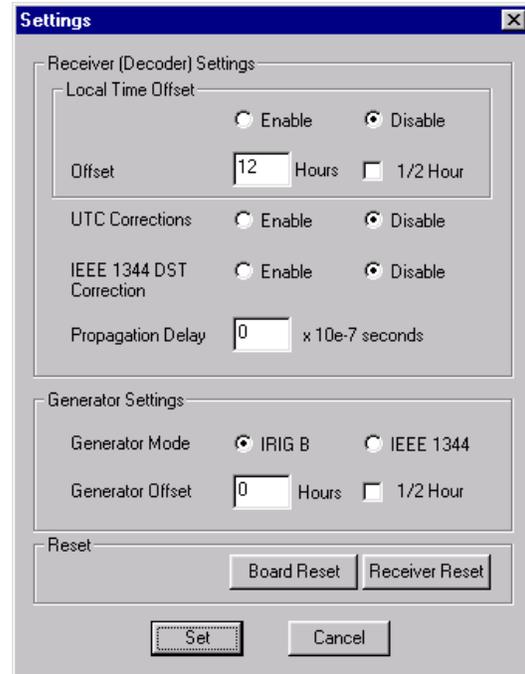
## Setting Local Time and Generator Mode

Clicking on the “Settings” button on the GPS or IRIG/NASA tab opens the settings dialog box shown at right.

In general you will not need to adjust the parameters that are accessed from this dialog box. They are typically set once (factory) and not touched.

The Settings box allows you to override certain time signals, to reset local time, or to add an offset to time to compensate for time zone changes. It also allows you to set your TS board as a “Generator”, where it sends pulses out instead of reading them in. This allows you to daisy chain many instruments off the MiDAS

TS hardware – a very valuable feature in the field. The following are the setting options you can change:



### Receiver (Decoder) Settings

<b>Local Time Offset</b>	Enable / disable the local time offset.
<b>Offset</b>	You can offset local time up to 16 hours from the receiver time in ½ hour increments.
<b>UTC Corrections</b>	The UTC Corrections may be enabled or disabled. Enabling UTC Corrections commands the device to include any leap second corrections provided by the reference source and act on any leap event data that is present.
<b>IEEE 1344 DST Correction</b>	The IEEE 1344 Daylight Savings Time Corrections may be enabled or disabled. Enabling IEEE 1344 DST Corrections commands the device to include the daylight savings time corrections provided by the reference.
<b>Propagation Delay</b>	It is sometimes desirable to program an offset into the basic

time keeping functions relative to the reference input. For example, if the reference input is an IRIG-B time code, there may be significant cable delay between the IRIG-B generator and the TS board. The delay setting allows this time difference to be removed by inserting the known amount of offset between the IRIG B reference and the TS board location; in this scenario, a positive offset would be used.

## Generator Settings

### Generator Mode

An IRIG B or IEEE 1344 time code output signal is available in both modulated and DCLS (DC Level Shift) forms. This signal will be present at the TS pigtail connector labeled “Time Code Output”.

### Generator Offset

The generator can output signal that is offset by up to 16 hours in ½ hour increments from its current time.

## Reset Settings

### Board Reset

You should never need to hit this button. Xcitex technical support will advise when you should use this control. This performs a board level reset of the MiDAS TS board.

### Receiver Reset

You should never need to hit this button. Xcitex technical support will advise when you should use this control. This performs time code (and GPS) receiver reset of the MiDAS TS board.

## Configuring the GPS Connection

Clicking on the **GPS CONFIG...** button on the GPS enabled tab opens the GPS configuration dialog box shown below.

In general, you will have no need to adjust the parameters in this dialog window. This information is provided for the “GPS Power User”. The default parameters are such that they should work for the majority of applications.

### Position Fix Mode

The options for this are Automatic, Manual 2D, and Manual 3D.

The preferable fix mode is 3D, where altitude is calculated along with the latitude, longitude and time. However, this requires four satellites with a PDOP below the PDOP mask set in order to obtain position. Normally, this would provide the most accurate solution. Thus, if only 3-D solutions are desired, then you should select 3D manual mode. Depending on how the PDOP mask is set, this may be restrictive when the receiver is subjected to frequent obscuration, or when the geometry is poor due to an incomplete constellation.

Alternatively, if you only want a 2D solution, then 2D manual should be requested. In this case, the sensor uses either the last altitude obtained in a 3D fix, or the altitude supplied by the user. However, any error in the assumed altitude will affect the accuracy of the latitude and longitude solutions. High accuracy users should avoid this mode and should expect fixes with accuracy's that are at best as accurate as the supplied altitude. If a marine user enters sea-level as the altitude, then small errors in the horizontal solution will occur when the sea is rough or there are high tidal variations. However, these errors may be smaller than the altitude errors induced by the supplied altitude, so 2D may be preferable for a marine user who does not want to observe "unusual" altitudes.

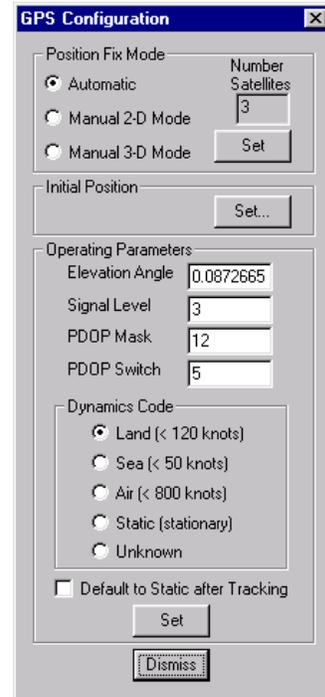
The default mode is Auto 2D/3D, where the receiver first attempts to obtain a 3D solution with a PDOP below the PDOP mask and PDOP switch. If this is not possible, then the receiver attempts to obtain a 2D solution with a PDOP less than the PDOP mask. This mode supplies fairly continuous position fixes even when there is frequent obscuration. This mode is preferable for most land or air applications, where altitude changes are occurring and there is occasional obscuration.

### Initial Position

By clicking on the "Set..." button in the Initial Position group box, the user can set the initial "guess" for the position of the receiver. This is also the location where you set the altitude, if in 2D mode.

### Operating Parameters

To understand the operation of the MIDAS TS hardware, one should first understand both "PDOP" and how it affects the quality of GPS data.



Dilution of precision (DOP) is the mathematical representation of the quality of GPS data being received from satellites. The number of visible satellites and their relative positions in the sky control DOP. The most commonly used dilution of precision is position dilution of precision (PDOP), which is the combination of horizontal dilution of precision (HDOP) and vertical dilution of precision (VDOP). A PDOP value of 1 indicates an optimum satellite constellation and high-quality data. The quality of the data decreases as the PDOP value increases.

**Elevation Angle**

This is the minimum elevation angle for satellites to be used in a solution output by the receiver. Satellites that are near the horizon are typically more difficult to track due to signal attenuation and are also generally less accurate due to higher variability in the ionospheric and tropospheric corruption of the signal. When there are no obstructions, the receiver can generally track a satellite down to near the horizon.

However, when this mask is set to low, the receiver may experience frequent constellation switching due to low elevation satellites being obscured. Frequent constellation switching is undesirable because small position jumps may be experienced when selective availability (SA) is present.

The benefit of a low elevation mask is that more satellites are available for use in a solution and a better PDOP may be yielded. The current mask is set to five degrees and provides a reasonable tradeoff of the benefits and drawbacks. High accuracy users may prefer a mask angle around ten degrees, where the ionosphere and troposphere begin to be more predictable.

**Signal Level**

This mask defines the minimum signal strength for a satellite to be used in a solution. There is some internal hysteresis on this threshold that allows brief excursions below the threshold if lock is maintained and the signal was previously above the mask. The mask has been set to 4.0 in V1.14 and higher versions due to increased tracking capability now included. The mask should only be lowered cautiously since this mask is also used to minimize the effects of jammers on the receiver. High accuracy users may use a slightly higher mask of 5.0-6.0 since weaker measurements may be slightly noisier. However, good performance is available with the default setting.

<b>PDOP Mask and Switch</b>	The PDOP mask is the maximum PDOP for which any 2-D or 3-D solution will be made. The switch is the level at which the receiver stops attempting a 3-D solution, and tries for a 2-D solution when in automatic 2-D, 3-D mode. The switch level has no affect on either manual mode. Raising the PDOP mask will generally increase the fix density during obscuration, but the fixes with the higher PDOP will be less accurate (especially with SA present). Lowering the mask will improve the average accuracy at the risk of lowering the fix density.
<b>Dynamics Code</b>	In AIR mode the receiver assumes a high dynamic environment. In this case, the satellite search and reacquisition routines are optimized to tolerate high accelerations. A user, which is subject to only benign accelerations (less than 1 g) may benefit by selection of LAND or SEA mode where the search and reacquisition routines assume a low acceleration environment. In this case, satellite loss-of-lock is due more often to obscuration rather than extreme dynamics.
<b>Default to Static</b>	If the checkbox “Default to Static After Tracking” is set. The receiver will switch to Static Mode after satellite acquisition and lock.

## Recording with MiDAS TS Modules

When you use the MiDAS TS Module to do a recording you make connection to the TS multi-channel breakout cable that consists of 5 BNC barrels. The various connectors are labeled, “Time Code Input”, “Time Code Output”, “Event Input”, “Heartbeat Out”, and “1 PPS Output”. The connections are outlined in Chapter 2 on installation, but are described here again.

- Your trigger source is connected to the “Event Input” line.
- The “Heartbeat Out” line is connected to either the Phase In on the first camera in your video chain or the Phase In on the MiDAS DAQ Breakout Box.
- Your external time code generator is connected to the “Time Code Input” line. If you are using GPS, your antenna is connected to the small connector on the TS board back-panel and not the MiDAS TS 5-barrel pigtail.

- If you are using the MiDAS TS module as a generator, the generated signal is present at the “Time Code Output” line.

*Note: The line “1 PPS Output” is not used with MiDAS.*

Once you have all of the correct hardware connections, and you have configured the video and data correctly you may hit the **RECORD** button on the Record tab. Then at some point you will either receive a hardware trigger, or hit the **TRIGGERSTOP** button.

*Note: MiDAS was designed to ensure that you always have very accurate registration between the TS hardware and the video and the data acquisition hardware. Therefore, when recording with the TS module you don't have the option for panic stop. The internal hardware connections have already been configured for a trigger stop. If you trigger the system with an external trigger, or hit the (Trigger) Stop button, the system will behave in its trigger stop configured fashion. That is, after the receipt of a trigger it will continue to record for the post trigger amount of time and then stop.*

## Displaying Synchronized Time

After you have completed a recording using the TS modules, in addition to the video or video/data you will have some or all of the following information:

- The time for every frame.
- The time of the trigger. The trigger time will occur at any time not just at a frame edge. The zero frame, is the frame that was in the process of being recorded when the trigger was received.
- The position of the GPS antenna (GPS mode only – Models TS-02M,TS-03M)
- The orientation of the camera (Model TS-03M)

You can access this information by using a Contextual Command (See Chapter 4 for details). Right click within the image window. A menu will appear that will allow you to display the TS generated information.



A window will appear below the image window. The selected information will appear within this window. The information is retrieved from the MiDAS Binary File (see Chapter 9 for more information on the MiDAS Binary File contents). The raw video and the stored information are not modified in any way with MiDAS.

The information that is displayed is summarized as follows for each of the display options shown in the figure at right. .



<p><b>Timing</b></p>	<p>text information will appear below the video sequence, in the following format:</p> <p><b>“Year-Month-Day-Hour-Minute-Second-Fraction of Second – Source: “Source Text”</b></p>
<p><b>Trigger</b></p>	<p>text information will appear below the video sequence, in the following format.:</p> <p><b>“Year-Month-Day-Hour-Minute-Second-Fraction of Second” Trigger Time</b></p>
<p><b>Location</b></p>	<p>text information will appear below the video sequence, in the following format:</p> <p><b>“Lat ###.####, Long ###.####, Alt ###.####”</b></p>
<p><b>Camera Pointing</b></p>	<p>If you have a camera tracker, then text information will appear below the video sequence in the following format.</p> <p><b>“Azimuth ###.####, Elevation ###.#### “</b></p>

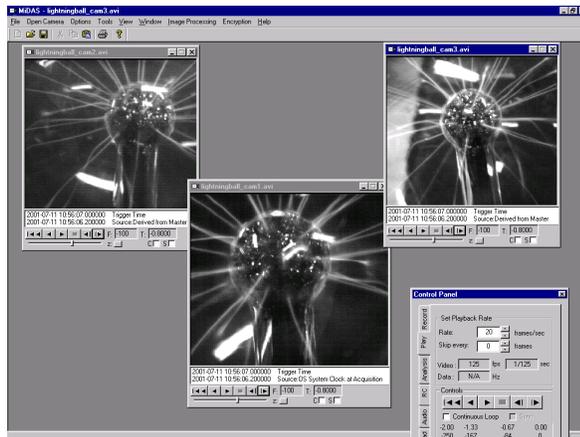


To maintain compatibility across all recording options, you have the option to display the time and position information even if you don't have the TS module. MiDAS will either display un-initialized numbers as is the case for latitude, longitude, and altitude, or it will display information taken from another source as is the case for Timing.

“Source Text” for Timing will be one of the following text descriptions:

<b>Source: Synch from External Source</b>	This text is displayed next to the Frame Time, when the sequence that you are viewing was recorded with a MiDAS TS module enabled. It means that the information was fundamentally obtained, as described above, from the external time source (GPS, IRIG-B, etc.). It also means that this was the first camera in a multi-camera chain.
<b>Source: OS System Clock at Acquisition</b>	This text is displayed next to the Frame Time, when the sequence that you are viewing was recorded with MiDAS but did not use the MiDAS TS module. This means that the frame time is derived from the system clock time at the end of the recording. It also means that this was the first camera in a multi-camera chain.
<b>Source: Derived from Master</b>	This text is displayed next to the Frame Time, when the sequence that you are viewing was recorded with a MiDAS. It means that the information was fundamentally obtained, as described above, from the external time source or the OS system clock. It also means that this camera was “down the chain” (i.e. not the first camera) in a multi-camera chain.
<b>Source: OS File Create Time</b>	This text is displayed next to the Frame Time, when the sequence that you are viewing was recorded with MiDAS before the TS module was available, or you used another system to acquire the sequence. It means that time is derived from the time of file creation. The last frame is treated as if it were created at file creation time.

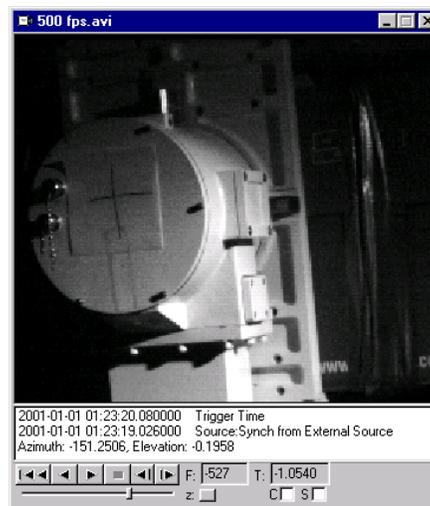
When using multiple cameras, all cameras in the chain are phase locked and synchronized through the hardware chain to the external time source. All cameras in the record sequence will have the correct timing, trigger, and location information if present, as shown in the following figure:



*Note: You will notice that your resulting recording does not have the exact number of pre and post frames that you would expect as dictated by the trigger percentage. This is due to small latencies in hardware setup times, and the overhead to make certain that everything is occurring on a synchronized edge. This does not affect your measurement. The time of the zero frame (the trigger frame) is correct, as is all of the time information for every single frame.*

## Reading an External Camera Tracker Data

If you have purchased Module TS-03, then you also own a camera tracker. You will connect your tracker control computer to the computer that contains your MiDAS system through COM port 2. As long as power is on and your tracker is functioning, MiDAS will continuously read the azimuth and elevation information from the tracker control computer during the record process.



The tracker control computer is not capable of supplying orientation information at the same rate as your MiDAS based high-speed camera. As data packets are read from the tracker, MiDAS time stamps them.

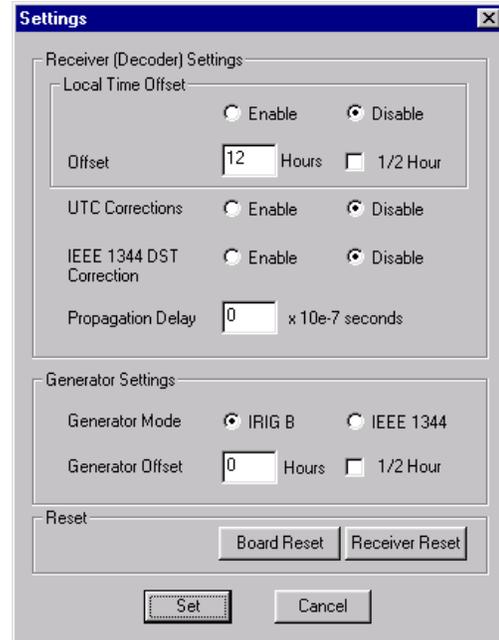
These time stamps are then used to supply every frame with the azimuth and elevation data from the data packet that was closest in time to when that frame was acquired. You will find that many consecutive frames will have the same azimuth and elevation data.

Post recoding, this information is accessed as described above, by right clicking on the video sequence and selecting “Camera Orientation” from the pop-up menu.

### Using your TS Board as a Time “Generator”

The TS board generates IRIG-B or IEEE 1344 time code synchronized to the reference source. Modulated and DC level shift format are produced simultaneously. The generator is available in any mode of operation. Simply connect the hardware that can read either IRIG-B or IEEE 1344 to the “Time Code Output” connector on the TS pigtail, and select which generator mode you would like to use.

The mode selection is made from the TS module Settings Dialog as shown at right. The options for using your TS board as a generator as follows:



**Generator Mode**

An IRIG B or IEEE 1344 time code output signal is available in both modulated and DCLS (DC Level Shift) forms. This signal will be present at the TS pigtail connector labeled “Time Code Output”.

**Generator Offset**

The generator can output signal that is offset by up to 16 hours in ½ hour increments from its current time.



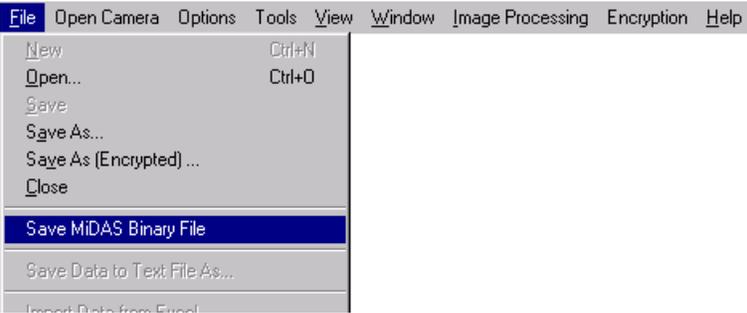
# Chapter 16

## MiDAS Notes

MiDAS Notes allows you to add custom text description and commentary to every video frame, every data point, and to the (global) measurement in its entirety. It allows you to tag frames that have relevant detail, so that when viewing your measurement at a later date, you can jump directly to the frames and data points of interest.

MiDAS Notes are saved in the MiDAS Binary File (\*.AU3) that is created along with your video sequence (typically an \*.AVI file) and your data file (.AU2). MiDAS Notes, are saved any time that you save your video to a new file, in its entirety, or as a reduced number of frames. You can also save MiDAS Notes without resaving the video sequence from the File Menu, by selecting “Save MiDAS Binary File”.

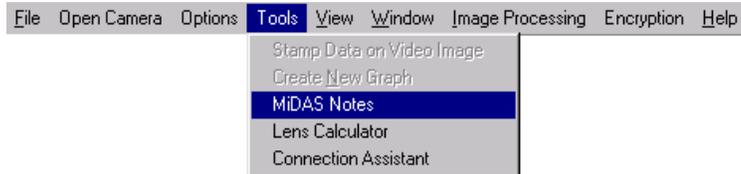
Note that the MiDAS Binary File stores information such as MiDAS Notes, tracked points, IRIG/GPS time and position, and other information.



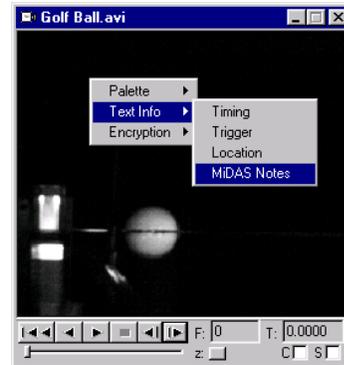
## Recording MiDAS Notes

To record a note or to review a note, you must open the MiDAS Notes window. To access the MiDAS Notes window:

1. Open a video or video/data sequence.
2. Open a MiDAS Notes window using one of the three following techniques:
  - a) Under **TOOLS**, select **MIDAS NOTES**



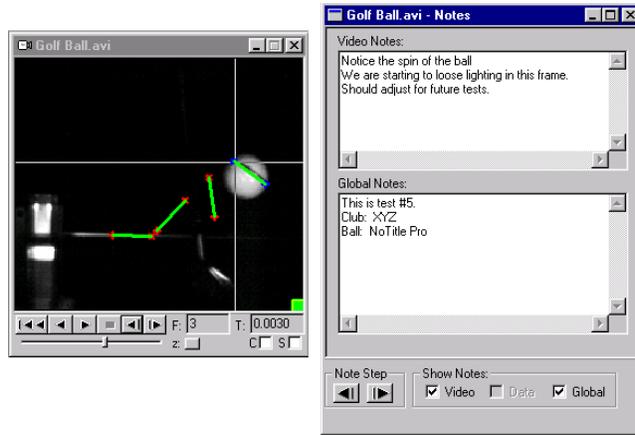
- b) Right click anywhere within the video window, then select **TEXT INFO**, then **MIDAS NOTES**, as shown at right.



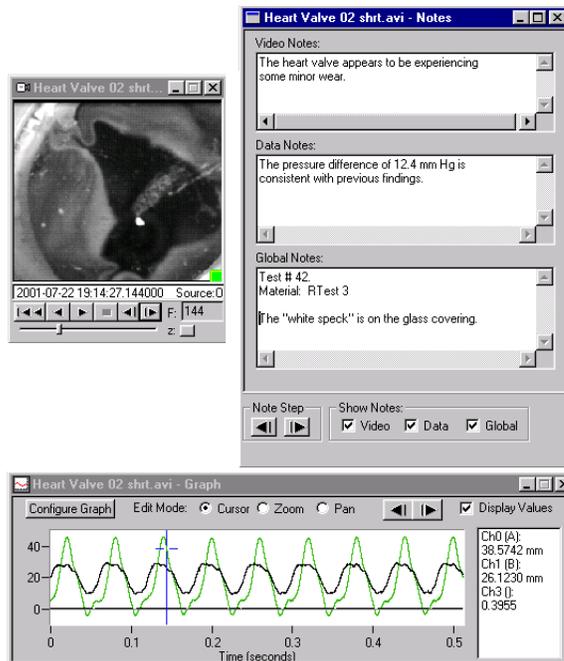
- c) If your video sequence already has notes recorded, a color button will appear in the lower right portion of the video window. Right click on this button and MiDAS Notes will appear.



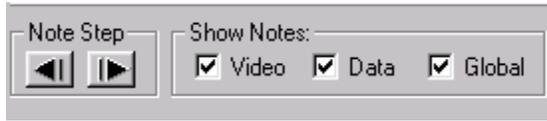
There are two forms of the MiDAS Notes window. A two-tiered window appears when you have recorded with video alone, as shown in the following figure



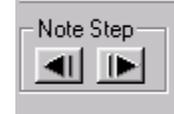
A three-tiered window appears when you have recorded with video and data, can be seen in the following figure.



- The “Show Notes” checkboxes allow you to select which notes you would like to actively display in the MiDAS Notes view window.



- Advance to any particular video frame or any particular data point using the Play features of MiDAS (Chapter 7).
- Type a note into either the top box (video) or the middle box (data) or the bottom box (common to all frames within the sequence).



### Playing Back MiDAS Notes

To review MiDAS notes saved with an image sequence or with a data sequence, simply click on **FORWARD NOTE STEP** button or **BACKWARD NOTE STEP** button. You will be automatically advanced to the next sequential note (video or data).

If your video sequence already has notes recorded, a color button will appear in the lower right portion of the video window. Right click on this button and MiDAS Notes will appear.



All MiDAS Notes are stored in the MiDAS Binary File. Therefore, the notes can be viewed with any free MiDAS Player. After you have completed recording, analyzing, and adding commentary to your measurement, you have the freedom to freely distribute the results to your colleagues and managers.





# AU

## Audio Module

### Overview

The MiDAS AU module is designed for applications that require correlation of video with audio. This module works in conjunction with the MiDAS DA modules to simultaneously acquire up to 64 channels of audio with video. Audio is acquired as a data stream, in the same fashion as other sensor inputs. The microphone is connected to one of the data channels of the DA hardware and MiDAS acquires video and data as described in Chapter 12.

Once the audio signal is acquired and contained within memory as data, users can review the audio signal using the DA module playback features or through the sound system of your computer as an audio signal.

Audio may be played back at the same or at different rates than the video images. For example, the video may be played back at 1 frame/second and audio played back at live rates of 44kHz. Likewise, the audio can be synchronized to the video to analyze every detail of the audio signal.

*Note: The MiDAS AU module requires a sound card and a set of external speakers for operation. MiDAS will not allow the user to playback an acquired signal if these components are not present.*

## Recording Audio with Video

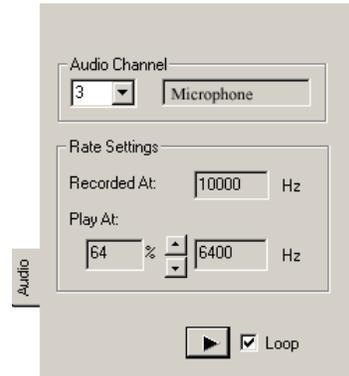
To acquire audio, place the microphone as desired. Follow these simple steps for each microphone in your measurement:

1. Connect the microphone output (through its amplifier or signal conditioner) to a channel on the DA hardware.
2. In the Data Acquisition Settings window (see Chapter 12), set the scale factor, minimum and maximum levels.
3. Acquire synchronized video and data (audio) as described in Chapter 12.

## Playing Back Audio

After the audio has been captured, click on the Audio tab, as shown at right. You may also load a previously recorded video.

1. Click on the Audio Channel drag down box. MiDAS will display all channels that have data.
2. Select the channel to which you wish to listen.
3. Set the Playback rate by using the up/down arrows. The Playback rate is shown at right in Hz.
4. Click on the Play button
5. If you wish to loop the playback, click on the Loop checkbox.



*Note: Only one channel of audio can be played at a time.*

# Chapter 18

## EC

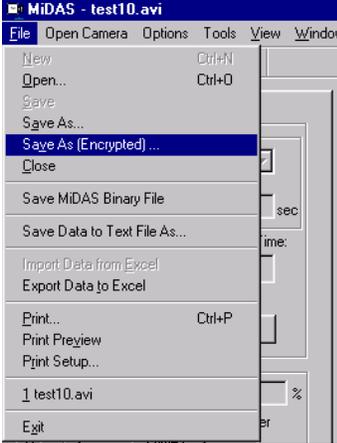
# Video/Data Encryption Module

### How to Encrypt Video and Data

To save encrypted video and data, first capture or open an existing video and data stream that you wish to encrypt. Then, under the **FILE** menu, select **SAVE AS (ENCRYPTED)...**

This will bring up the standard Save dialog as discussed in Chapter 5 “Managing Information”. Select the filename and path for the encrypted output using this dialog and then click on **SAVE**.

At this point you will be prompted to enter a pass-phrase. The pass-phrase can contain any string up to 64 characters in length. The pass-phrase is also case-sensitive. It is recommended that you use a phrase that is easy to remember. You must enter the pass-phrase twice, if the pass-phrases do not match, you will be prompted to re-enter the pass-phrase.





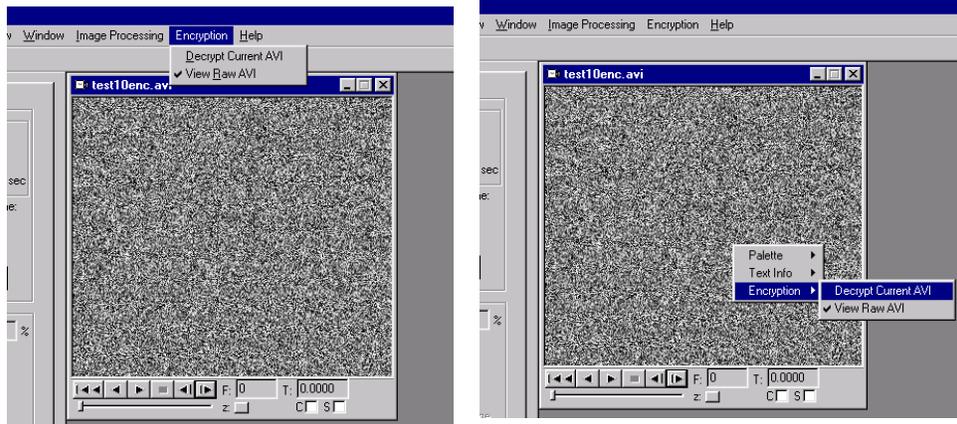
The rest of the procedure follows the standard Save process. While the save is in progress, the original video display will look like random noise. This is the correct behavior. The original video display will be restored after the save has completed.

*Note: MiDAS does not automatically over-write or delete the original un-encrypted video and data. When encrypting directly from a captured camera stream, there is no un-encrypted files residing on the hard drive. However, when encrypting existing video and data files, the original un-encrypted files will still remain on the hard drive. You must manually delete these files if you wish to retain only the encrypted copies.*

After every save operation, MiDAS automatically loads the saved file. When loaded back into MiDAS, the encrypted video will appear as random noise. In order to view the original video and data, you must first decrypt the video and data.

## How to Decrypt Video and Data

When MiDAS has opened encrypted video and data files, the video display will appear as random noise. There are two menu locations to decrypt the video and data. From the **ENCRYPTION** menu item, select **DECRYPT CURRENT AVI**, or you can right-click in the video display, and then select **ENCRYPTION** and **DECRYPT CURRENT AVI** from the context menu that appears.



You will be prompted to enter the pass-phrase with the same dialog window that was used for encryption. Remember, pass-phrases are case-sensitive.

If you have entered an incorrect pass-phrase, the video will still appear as random noise. You must select **DECRYPT CURRENT AVI** and enter the correct pass-phrase.

Once the correct pass-phrase has been entered, the video display should show the decrypted video frames. The resulting decrypted video and data can be treated just like any other normal video and data. For example, you can run manual or auto-tracking analysis on the video frames, or you can save the files as decrypted versions. The original encrypted files on the hard drive remain encrypted. The decryption occurs on-the-fly in memory.

If you wish to verify that the original file remains encrypted or if you wish to keep the file open, but want to require the re-entry of the pass-phrase for viewing, you can select the **VIEW RAW AVI** option from the menu. Whenever this option is selected, the video that is being played is the raw data directly from the hard drive with no decryption processing.

### **The MiDAS Encryption Algorithms**

MiDAS uses the widely used DES algorithm for encryption. DES is an acronym for the U.S. Government's Data Encryption Standard. It is identical to the ANSI standard Data Encryption Algorithm (DEA). The DES algorithm uses a 56-bit key and operates on 64-bit blocks of data. Inside MiDAS, video is encrypted on a frame-by-frame basis and data is encrypted on a per-file basis.



**MIDAS2.0**

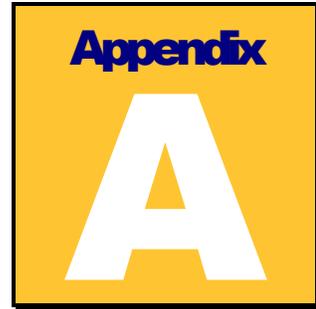


## **Appendices**

Appendices







# MiDAS Specifications

## Record:

---

Frame rates: ..... depends on camera model  
Multiple cameras: ..... 1 to 4 video cameras in a single computer  
Shutter: ..... depends on camera model  
Number of Analog Data Channels: ..... up to 64 (depending on module)  
Notes: ..... one per frame, one per data point, global cumulative note  
Analog Data Rate: ..... 200,000 to 1,250,000 data points/second (depending on module)

## Event Triggering:

---

Adjustable Trigger: ..... 0 to 100% adjustable pre- or -post trigger event  
Software Trigger: ..... Stop, Trigger Stop, specialty (camera based), automatic, time lapse, single frame, burst record mode.  
Automatic Reset: ..... Immediate, programmable automatic delay  
External Trigger Input: ..... 0-5V, 10 mV threshold, rising or falling edge, contact closure  
Trigger Accuracy: .....  $\pm 1$  frame (depending on camera model)

## Playback

---

Video Display: ..... Live(up to 4 channels), stored .AVI  
Image rotation: ..... 0, +/- 90°, 180°  
Image processing ..... Normal, reverse (negative), exponential, logarithmic.  
Data Display: ..... Full waveform with custom graph modes (max 16 curves per graph).  
Play Modes: ..... Asynchronized, Synchronized, Continuous Loop, Selected Range  
Buttons/Cursors: ..... Video forward and reverse, video single step, data single step, video cursor; data cursor click-and-drag, click advance, Jump, Zoom  
Play Rate: ..... 1 to 25 frames/second (depends on computer speed), frame rate override  
Skip Frames Rate: ..... 0 to 100 frames/second  
Zoom/pan: ..... Image zoom, data zoom, data pan  
Notes display: ..... 3-panel with data, 2-panel without data, green indicator on panel  
Contextual displays: ..... Trigger time, clock time or external sync time, latitude, longitude, altitude (TS module only), azimuth, elevation (TS03 module only), notes on/off.

## MIDAS2.0

### Appendix A: MiDAS Specifications

---

#### Data Acquisition Modules (optional)

---

Analog Input Modes: .....Differential, Single Ended (reference and non-reference)  
Sampling Resolution:.....12 bits (16 bits optional)  
Input voltage range: ..... $\pm 0.05$  to  $\pm 10$  volts  
Accuracy:.....0.0075%  
Offset, max: .....6.4 mV  
Input Modes:.....Ground source, floating source  
Trigger Accuracy:..... $\pm 1$  frame (depending on camera model)

#### Spreadsheet Analysis Modules (optional)

---

Number of Features, max: .....64  
Tracking: .....manual or automatic  
Calibrations: .....Linear scale, origin (0,0), units, camera tilt angle, frame rate override  
Display: .....reticle position in pixels, units, frame number, feature number  
Select options: .....single left click, click & select, draw line  
Modes: .....Manual select, auto-advance to next frame

#### Saving/Loading

---

Modes: .....Individual window save or project save, stamp acquired data onto acquired video ('meld' operation)  
Save Video Formats:.....Microsoft video (AVI) movie, series of, tiff, jpeg, bmp files (single or multiple frames), concatenated frames  
Save Data Formats:.....Save to tab-delimited text (MiDAS AU2 file), export to MS Excel  
Save Spreadsheet:.....Microsoft Excel (.XLS) native  
Tracked information: .....MiDAS binary file  
Measurement configuration: ..MiDAS CFG file  
Notes and annotation: .....MiDAS binary file  
Load:.....AVI video or series of frames, notes, tracked information, data (AU2) , and timing information (AU3).  
Import: .....data from Excel spreadsheet.  
Encryption (optional):.....56 bit full encryption, 64 letter case sensitive pass-phrase.

#### Recommended Computer

---

Pentium III, 500 MHz+, 1024x768 pixel graphics adapter with 16 MB video PCI RAM, 19"+ monitor size, 128 MB RAM. Data Acquisition (DA) module hardware requires 1 PCI or ISA slot. Time Sync (TS) module hardware requires 1 PCI slot.

*Note: Specifications subject to change without notice.*



## Pin Outs for MiDAS Terminal Blocks

The following table shows the screw terminal assignments for the MiDAS Terminal Block(s) when used with the correct MiDAS DA modules and the supplied shielded DA cables. For information on how to connect your MiDAS Terminal Block(s), review both Chapter 2 (Installation Procedures) and Chapter 12 (Data Acquisition Modules) of this User Guide.

For all Terminal Blocks used with DA-123M, DA-132M, DA-160M, DA-170M, and for the primary Terminal Blocks connected to the MIO16 cable of DA-161M and DA-171M modules, the following jumper must be made for proper execution of MiDAS:

- Terminal 10 connected to Terminal 40

In addition, the following two BNC's must be created:

- Terminal 2 (signal) and Terminal 35 (ground) combined to create Sync Out
- Terminal 41 (signal) and Terminal 39 (ground) combined for external Trigger In.

There are no jumpers on the extended I/O Terminal Block of DA-161M and DA-171M modules.

*Note: "CB Terminal Block(s)" must be selected from the DA Hardware Selection Box to properly use the MiDAS Terminal Blocks.*

*Note: The "Use MiDAS 1.x Style Breakout box" must be UNSELECTED when using the above jumper configuration. Refer to Chapter 1 and Chapter 12 for using old-style (MiDAS version 1.x) hardware with new (MiDAS2.0) software.*

**MIDAS2.0**  
**Appendix B: MiDAS Terminal Block Assignments**

---

**Terminal assignments for modules DA-123M, DA-132M**

ACH8	34	68	ACH0
ACH1	33	67	AIGND
AIGND	32	66	ACH9
ACH10	31	65	ACH2
ACH3	30	64	AIGND
AIGND	29	63	ACH11
ACH4	28	62	AISENSE
AIGND	27	61	ACH12
ACH13	26	60	ACH5
ACH6	25	59	AIGND
AIGND	24	58	ACH14
ACH15	23	57	ACH7
N/C	22	56	AIGND
N/C	21	55	AOGND
EXTREF	20	54	AOGND
DIO4	19	53	DGND
DGND	18	52	DIO0
DIO1	17	51	DIO5
DIO6	16	50	DGND
DGND	15	49	DIO2
+5V	14	48	DIO7
DGND	13	47	DIO3
DGND	12	46	SCANCLK
PFI0/TRIG1	11	45	EXTSTROBE
PFI1/TRIG2	10	44	DGND
DGND	9	43	PFI2/CONVERT
+5V	8	42	PFI3/GPCTR1_SOURCE
DGND	7	41	PFI4/GPCTR1_GATE
PFI5/UPDATE	6	40	GPCTR1_OUT
PFI6/WFTRIG	5	39	DGND
DGND	4	38	PFI7/STARTSCAN
PFI9/GPCTR0_GATE	3	37	PFI8/GPCTR0_SOURCE
GPCTR0_OUT	2	36	PFI8/GPCTR0_SOURCE
FREQ_OUT	1	35	DGND

Terminal assignments for modules DA-160M, DA-170M.

ACH8	34	68	ACH0
ACH1	33	67	AIGND
AIGND	32	66	ACH9
ACH10	31	65	ACH2
ACH3	30	64	AIGND
AIGND	29	63	ACH11
ACH4	28	62	AISENSE
AIGND	27	61	ACH12
ACH13	26	60	ACH5
ACH6	25	59	AIGND
AIGND	24	58	ACH14
ACH15	23	57	ACH7
DAC0OUT	22	56	AIGND
DAC1OUT	21	55	AOGND
EXTREF	20	54	AOGND
DIO4	19	53	DGND
DGND	18	52	DIO0
DIO1	17	51	DIO5
DIO6	16	50	DGND
DGND	15	49	DIO2
+5V	14	48	DIO7
DGND	13	47	DIO3
DGND	12	46	SCANCLK
PFI0/TRIG1	11	45	EXTSTROBE
PFI1/TRIG2	10	44	DGND
DGND	9	43	PFI2/CONVERT
+5V	8	42	PFI3/GPCTR1_SOURCE
DGND	7	41	PFI4/GPCTR1_GATE
PFI5/UPDATE	6	40	GPCTR1_OUT
PFI6/WFTRIG	5	39	DGND
DGND	4	38	PFI7/STARTSCAN
PFI9/GPCTR0_GATE	3	37	PFI8/GPCTR0_SOURCE
GPCTR0_OUT	2	36	PFI8/GPCTR0_SOURCE
FREQ_OUT	1	35	DGND

**MIDAS2.0**  
**Appendix B: MiDAS Terminal Block Assignments**

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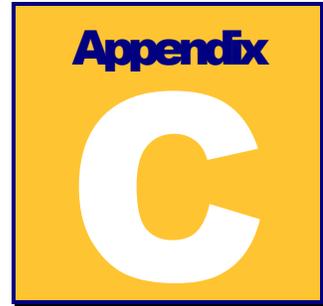
Terminal assignments for modules DA-161M, DA-171M.

**Terminal Block #1 (MIO16)**

ACH8	34	68	ACH0
ACH1	33	67	AIGND
AIGND	32	66	ACH9
ACH10	31	65	ACH2
ACH3	30	64	AIGND
AIGND	29	63	ACH11
ACH4	28	62	AISENSE
AIGND	27	61	ACH12
ACH13	26	60	ACH5
ACH6	25	59	AIGND
AIGND	24	58	ACH14
ACH15	23	57	ACH7
DAC0OUT	22	56	AIGND
DAC1OUT	21	55	AOGND
EXTREF	20	54	AOGND
DIO4	19	53	DGND
DGND	18	52	DIO0
DIO1	17	51	DIO5
DIO6	16	50	DGND
DGND	15	49	DIO2
+5V	14	48	DIO7
DGND	13	47	DIO3
DGND	12	46	SCANCLK
PFI0/TRIG1	11	45	EXTSTROBE
PFI1/TRIG2	10	44	DGND
DGND	9	43	PFI2/CONVERT
+5V	8	42	PFI3/GPCTR1_SOURCE
DGND	7	41	PFI4/GPCTR1_GATE
PFI5/UPDATE	6	40	GPCTR1_OUT
PFI6/WFTRIG	5	39	DGND
DGND	4	38	PFI7/STARTSCAN
PFI9/GPCTR0_GATE	3	37	PFI8/GPCTR0_SOURCE
GPCTR0_OUT	2	36	PFI8/GPCTR0_SOURCE
FREQ_OUT	1	35	DGND

**Terminal Block #2 (Extended I/O MIO64)**

ACH24	34	68	ACH16
ACH17	33	67	ACH25
ACH18	32	66	ACH26
ACH27	31	65	ACH19
ACH20	30	64	ACH28
ACH21	29	63	ACH29
ACH30	28	62	ACH22
ACH23	27	61	ACH31
ACH32	26	60	ACH40
ACH41	25	59	ACH33
ACH34	24	58	ACH42
ACH35	23	57	ACH43
AIGND	22	56	AISENSE
ACH44	21	55	ACH36
ACH37	20	54	ACH45
ACH38	19	53	ACH46
ACH47	18	52	ACH39
ACH48	17	51	ACH56
ACH49	16	50	ACH57
ACH58	15	49	ACH50
ACH51	14	48	ACH59
ACH52	13	47	ACH60
ACH61	12	46	ACH53
ACH54	11	45	ACH62
ACH55	10	44	ACH63
N/C	9	43	N/C
N/C	8	42	N/C
N/C	7	41	N/C
N/C	6	40	N/C
N/C	5	39	N/C
N/C	4	38	N/C
N/C	3	37	N/C
N/C	2	36	N/C
N/C	1	35	N/C



## Installing a DA-160M or DA-161M ISA-bus DA Module

If you purchased either the MiDAS DA-160M or the MiDAS DA-161M versions of the MiDAS Data Acquisition module, these special instructions must be followed to correctly install your boards.

The procedure for installing ISA hardware is different than the procedure for installing PCI hardware. First, ISA boards use Plug-and-Play installation process which is not native on Microsoft Windows NT4.0. Second, ISA hardware requires the operator to actively assign IRQ's (interrupt requests) and memory access locations. Some hardware have dip switches to set these operational parameters. The two data acquisition boards use software switches.

### Configure Windows to Accept Plug-and-Play Boards

1. Start your computer. To install devices for Windows NT, you must log into Windows NT as an administrator or as a user with administrator privileges.
2. Insert your Windows NT 4.0 CD
3. Browse to the **F:\Drvlib\Pnpisa\x86** directory, where "F": is the letter of your CD-ROM drive
4. Right click once on the file **PNPISA.INF**.
5. Select **INSTALL**. Follow the instructions on the screen.
6. Remove your Windows NT 4.0 CD.

7. Insert your Windows NT or Windows 2000 Service Pack CD (e.g. Service Pack 6). Reinstall the Service Pack. Reboot when instructed and remove the Service Pack CD.

### **Install the Data Acquisition Software Drivers**

*Note: With an ISA board, you must install the data acquisition driver software (NIDAQ from National Instruments) prior to installing your hardware.*

8. Insert the compact disk from National Instruments that has the “NIDAQ” drivers, version 6.5.0 or newer. These are the specific drivers for all National Instruments data acquisition boards. The installation program should auto-start shortly. If it does not, from the Run prompt, type **F:/SETUP**, where “**F**” is the letter of your CD-ROM.
9. Click on **INSTALL NIDAQ** at the first screen.
10. Follow the instructions on the screens to load the NIDAQ drivers for your model DAQ board. The model DAQ board is automatically determined by the software and the appropriate driver(s) installed.
11. Re-boot the computer when instructed.
12. After the re-boot, the computer will continue with the NIDAQ Setup Routine. Follow the instructions in the program.
13. At the “NIDAQ Setup” screen, it is not necessary to choose any additional documentation unless you so desire for other applications. Check the checkbox on the screen to decline installing further documents. Click on **NEXT**.
14. At the “Choose Development Platforms” screen, it is again not necessary to choose any development platforms at this time – the development libraries are automatically loaded with the MiDAS disk. Click on the **NEXT** button to continue.
15. Select the “Configure Measurement and Automation checkbox” and click the **FINISH INSTALLATION**.
16. Remove the disk at this time. You are now done installing the NIDAQ software.

### **Install the Data Acquisition Board**

17. Shut down your computer. Remove the cover from your computer. Unplug the computer from the wall before connecting any cables.

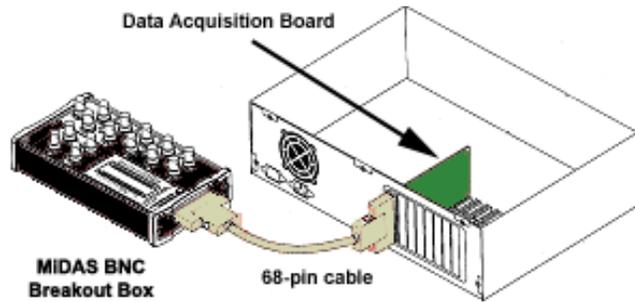


*WARNING: Prior to installing boards in your computer, disconnect the power to the computer. Make sure you are properly grounded using a wrist ground strap.*

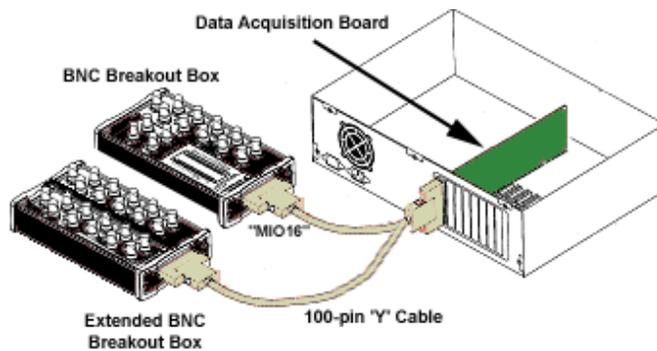
18. In an open ISA slot (black connector), install the Data Acquisition Board (either model DA-160M or DA-161M) supplied with your MiDAS system.

### Install the BNC Breakout Box

19. If you purchased a DA-160M module, 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:



20. If you purchased a DA-161M module, connect the large end of the 100-pin shielded 'Y' cable to the back panel connector of your data acquisition board. Then connect the other end of the cable labeled "MIO16" to your MiDAS BNC Breakout Box and the other end of the cable labeled "Extended I/O MIO64" to the MiDAS Extended Breakout Box, as shown in the following figure:



21. If you purchased a DA-123B module, connect one end of the 68-pin ‘Y’ Ribbon Cable to the back panel connector of your data acquisition board. Then connect the other ends (2) of the cable to the associated connectors on the MiDAS 5B+ Rack. Skip to Step 12.

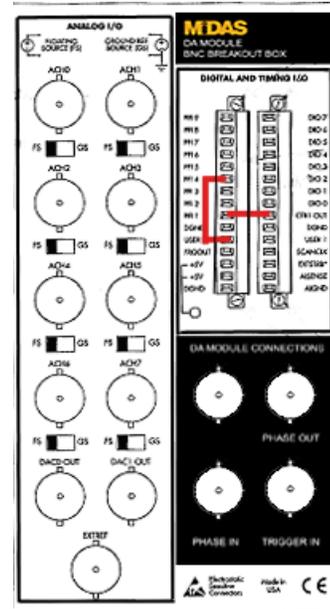
22. Your MiDAS BNC Breakout Box comes pre-configured with two jumpers in place, as shown in the following figure:

23. Confirm that the first jumper is securely affixed to both **PF14** and **User2** terminals. Confirm that the second jumper is securely affixed to both **PF11** and **CTR1Out** terminals.

24. Turn on the computer power after the hardware has been installed.

25. The computer should find a new PNP device, produce a message, and install the driver automatically.

26. Reboot the computer, again.



### Configure the DAQ Board

27. Double click on the Measurement and Acquisition icon on the desktop. This opens the National Instruments explorer. Click on the + sign next to the Devices and Interfaces folder on the left side of the screen. You should see your board number (AT-MIO-16E-2 or AT-MIO-64E-3). On the right side of the screen, double click on the device number or the serial number. The “Configuring Devices” dialogue box will appear.

28. For Device #1 (Do not change the device number – MiDAS is permanently configured to use Device #1), you must change the key parameters input/output range, interrupt request and direct memory access (DMA) according to what is available on your computer.

Inside the Configuring Devices box, you should see the following:

- IRQ
- Input/Output

- Direct Memory Access
  - Direct Memory Access
  - Direct Memory Access
29. To change the IRQ (interrupt request), double click on the IRQ line. Use the arrow spin control to select an IRQ not used by the system. To determine what is available on your computer, click on the Windows Start button (lower left), and select Programs, Administrative Tools, NT Diagnostics. Click on the Resources Tab. By selecting the IRQ, DMA and I/O buttons across the bottom, you can see what parameters are already assigned. The enclosed DAQ AT-E Series Manual from National Instruments – Chapter 2 (“Board Configuration”) – also provides some suggested guidelines.
30. Repeat step 26 for the Input/Output
31. Repeat step 26 for the first (top) Direct Memory Access. It is not necessary to configure the lower two Direct Memory Access listings.
32. Close the window and reboot the computer when requested.
33. Turn on the computer. You can test the DAQ board by running the test panel found in the Devices and Interfaces folder in the National Instruments folder. Double click on the Measurement and Acquisition icon on the desktop. This opens the National Instruments explorer. Click on the + sign next to the Devices and Interfaces folder on the left side of the screen. You should see your board number (AT-MIO-16E-2 or AT-MIO-64E-3). RIGHT click on the board label and select **TEST PANEL**. Without any signal hooked up, you should see a noisy, random waveform. This test panel is a great tool for diagnostics.

### **Install the Camera Drivers**

34. Install the camera driver software in accordance with the manufacturer’s instructions.
35. Re-boot and shut down the computer when instructed.

### **Install the Camera Board**

36. Remove the cover from your computer.

*WARNING: Prior to installing boards in your computer, disconnect the power to the computer. Make sure you are properly grounded using a wrist ground strap.*

37. In an open PCI slot (white connector), install the video camera board in your computer and the video camera in accordance with the manufacturer's instructions.
38. Turn on the computer when ready.
39. Open a camera and successfully get an image on the screen before continuing with the installation procedure. If you cannot get the **OPEN CAMERA** command to work, then you have an IRQ or other conflict within your computer. Repeat steps 24-30 and change the various parameters (IRQ, etc.). This may take numerous iterations – be patient, you will iterate to a stable configuration.

### **Interconnect all the Hardware**

In order for MiDAS to properly synchronize cameras and data acquisition hardware and time sync hardware, the physical internal clocks must be configured. Therefore, the physical components of the system must be interconnected.

MiDAS actually controls the internal oscillator clocks of all the systems interconnected within the current system. MiDAS does this by converting some hardware to become slaves to other hardware. In short, all the hardware controlled by MiDAS is slaved to the one piece of hardware that contains the “master clock”.

Using the BNC RG-58 or RG-59 coaxial cables provided with your MiDAS hardware, connect your system as follows:

40. If you have a TS-01M, -02M or -03M, connect one end of a BNC cable to the “Heartbeat Out “ connector on the multi-pin breakout cable. If you are not using a TS module, skip to step 36.
41. If you have a MiDAS DA module installed, connect the other end of the BNC cable to either the BNC connector on the BNC Breakout Box labeled “Phase In” (or to the screw terminals labeled Phase In on the CB-68LP screw terminal block). If you are not using a MiDAS DA module, skip to step 37.
42. If you have a MiDAS DA module, connect one end of a BNC cable to the “Phase Out” connector on the BNC Breakout Box (or the MiDAS screw terminal block).
43. Connect the other end of the BNC cable to the “Phase In” or “Sync In” connector on your video camera. Consult with your camera manufacturer or manual for details for using this connector.

*Note: If you are using multiple cameras with MiDAS, it is very important to connect these in daisy-chain sequence. The first camera to be connected is called the camera in “Chain Position 1”, the second camera is called the camera in “Chain Position 2” and*

*on down for all cameras. These are the titles given to the cameras by the software when running MiDAS. You must connect the Phase In/Phase Out connections properly. Consult Chapter 2 for information on interconnecting multiple cameras with DA modules.*

## **Install the MiDAS Software**

44. Turn on your computer.
45. Insert the CD-ROM that contains the MiDAS software. The MiDAS software installer should automatically start. If it does not, from the Run prompt, type **F:SETUP**, where “**F**” is the letter of your CD drive.
46. Follow the instructions on the screens to install the MiDAS drivers, application software, and documentation.
47. When asked, install the MiDAS components that you desire. We suggest installing MiDAS, the MiDAS Player, the MiDAS Lens Calculator and the MiDAS documentation.
48. Enter your Registration Number – the number provided on your Registration Card. Your Registration Number is a 9-digit number in the format 00000-0000. Type the dash (-) when typing in your number.
49. Continue to follow the on-screen installation procedures. When instructed by the software, remove the CD-ROM from your CD drive.
50. Re-boot your computer.

Before starting MiDAS, you must first attach your MiDAS keytag and enter your License Key Code into the MiDAS License Manager (Refer to Chapter 3 for this procedure).





## Troubleshooting

The following is a listing of the most common questions and technical support calls to Xcitex. Every technical support request and answer is posted at the Xcitex web site. Therefore, the user is encouraged to visit <http://www.xcitex.com> for an updated, searchable list of technical support questions and troubleshooting tips.

Error Condition	Description
<b>Error Message:</b> <i>"Unable to Launch MiDAS – Hardlock Violation"</i> (Windows NT), or <i>"Sorry, an Unexpected Error Occurred"</i> (Windows 2000)	MiDAS requires a valid keytag to operate. Check the connection of the keytag (see Chapter 3 for more details). If you are generating a time violation, contact Xcitex to confirm the validity of your keytag.
<b>Error Message:</b> <i>"Parameter is Incorrect"</i>	The sync cable is not connected properly between the MiDAS BNC Breakout Box and the camera connection. Start by verifying that all connections and jumpers are correct on the MiDAS hardware and camera hardware. See Chapter 2 for more information on these connections.
<b>Only records one frame</b>	This condition exists when the camera does not receive a sync pulse from the MiDAS system. This problem is usually attributed to a disconnected or missing sync cable between the

	<p>MiDAS BNC Breakout Box and the camera connection. Start by verifying that all connections and jumpers are correct on the MiDAS hardware and camera hardware. See Chapter 2 for more information on these connections.</p>
<p><b>Random triggering</b></p>	<p>Noise in the Data Acquisition system. Excessive noise in the DA system will cause the MiDAS DA board to trigger incorrectly. Typically, it executes a TriggerStop. Confirm that you are using a shielded cable from the DA board to the BNC Breakout Box and a shielded coaxial sync cable.</p>
<p><b>Unable to launch Excel – Generate error message “Unable to launch application: Switch or Retry”</b></p>	<p>MiDAS launches Excel by reading register locations. Often, the Windows NT registry fails to initialize Excel and this error message is generated. If you know that Excel is indeed installed on the computer (first, try launching Excel as a stand-alone application to confirm), continue to hit the RETRY button until Excel is launched.</p>
<p><b>Start Spreadsheet button is not highlighted</b></p>	<p>Click on the Video Playback window of interest (e.g. “make it active”).</p>
<p><b>Error Message: “Unable to close Excel”</b></p>	<p>On occasion, MiDAS is unable to shut down Excel when exiting. If this occurs and you get an error message to this effect, hit <b>CTRL-ALT-DEL</b>, then the <b>PROCESSES</b> tab. Find the process named “Excel” and kill the process. Shut down will proceed normally thereafter.</p>
<p><b>Unable to read GPS or IRIG time generator</b></p>	<p>Select the checkbox in the Record Options window enabling GPS/IRIG phase locking.</p>
<p><b>Auto-Download features are grayed</b></p>	<p>Select the checkbox in the Record Options window enabling advanced auto-download features.</p>
<p><b>Error message: “The specified device is not a National Instruments product. The driver does</b></p>	<p>The MiDAS DA drivers do not recognize the existence or the location of the MiDAS DAQ board -- probably because it was moved or</p>

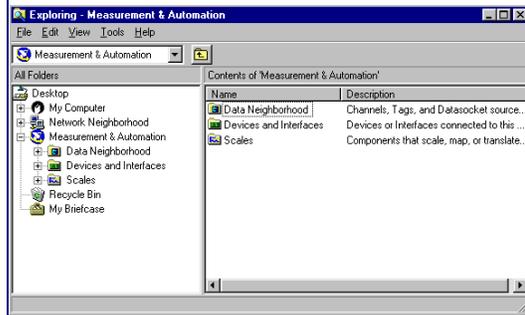


*not support the device or the device has not been configured using the NIDAQ Configuration Utility" or*

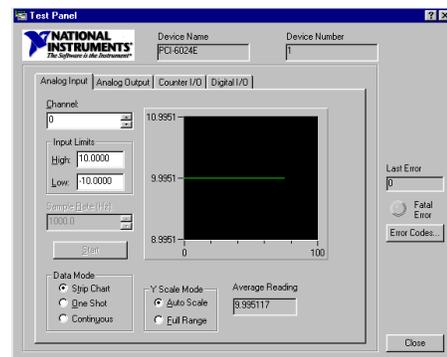
*"Have you moved your DA board? If so, then you must run the Measurement & Automation utility"*

replaced within the computer. The NIDAQ drivers need to be educated as to the location and type of board. To fix this problem, use the native National Instruments software on your computer, as follows:

1. Click on the "Measurement and Automation" icon on the desktop. The "Explorer" window shown below appears:



2. Left-Click to open the "Devices and Interfaces" folder. You should see the device "PCI-6023E (Device 1)" or your device name listed.
3. Click on the "Run Test Panels" button– you should see a panel like the one shown below. Without any sensor hooked up, you should see random noise or a scanning voltage in the waveform window, and no error messages.



	<ol style="list-style-type: none"><li>4. Close the Test Panel window.</li><li>5. Close the Exploring window. This should re-associate the board to the driver. If it does not, use the Control Panel to remove the NIDAQ drivers, then re-install per the instructions in Chapter 2.</li></ol>
<b>TRIGGERSTOP or STOP buttons disappear</b>	If you are using a DA module and you have selected Enable Live Data Graphing from the Record Options window, your processor is at full capacity and you must disable live data graphing. See Chapter 6 for details.
<b>Data Acquisition graph is saturated</b>	Increase the input voltage ranges on the Configuration Window.
<b>Only camera #1 triggers. The other cameras stay in Record mode</b>	You have not hooked your event trigger into the proper camera. See Chapter 2 for more details on how to interconnect multiple cameras and Chapter 10 on how to trigger multiple cameras.



## Service and Support

You may receive support for MiDAS from the following sources:

Internet support:

Sales support: <http://www.xcitex.com/salesfaq.html>

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

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

Telephone support and customer service:

+ 617-225-0080 (worldwide)

Warranty support:

email: [techsupport@xcitex.com](mailto:techsupport@xcitex.com)

Phone: + 617-225-0080 (worldwide)

Facsimile: +617-225-2529

Application Notes

<http://www.xcitex.com/appnotes.html>

Users Guides, Calibration Instructions and other Product Manuals

[http://www.xcitex.com/download\\_literature.html](http://www.xcitex.com/download_literature.html)

Mailing Address:

Xcitex, Inc.

432 Columbia Street, Suite B15

Cambridge, MA 02141 USA

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**Write your MIDAS License Key Codes here  
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# MIDAS2.0

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