



Ninox Video Camera

User Manual

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1 General Warnings and Cautions

1.1 Risks and Benefits

There is **no identified risk of physical harm or injury** with use of the Ninox product. The benefit provided by use of the device is to provide reference video of activities and to measure movement patterns in 2D space.

1.2 Safety Information Summary



Warnings

- Do not immerse the Ninox camera in any water or liquid
- Do not drop
- Do not use in conditions where the temperature can exceed 55 °C (130 °F)

2 Introduction

2.1 Brief Description:

The Ninox cameras are high-speed video cameras capable of sampling up to 300 frames per second (fps) depending on the model.

The cameras stream, in real-time, uncompressed video via a USB3 connection to the host computer. All video is captured on the host computer, in color, and compressed to m-jpeg or mpeg4 format. The cameras can be synchronized with other hardware by using a MyoSync device.

The Ninox camera includes an on-board LED light that is intended to be used with reflective motion tracking markers.

2.2 Intended Use

The Noraxon Ninox cameras are intended to be used for reference video and optical marker tracking in two dimensions (2D).

3 Definitions

3.1 Glossary of Terms

Angle of View (AOV) – The angular extent of the scene viewed by the camera

Aperture – The opening in the camera lens which allows light to pass through. The Ninox 300C recommended lenses have a manually adjustable ring to control the aperture.

Field of View (FOV) – The horizontal dimension (TOP view) of the scene that is viewable through the camera at a specific working distance.

FPS – The number of frames per second captured by the camera. As the FPS selected increase to faster speeds, the number of pixels each frame contains must be reduced to ensure complete data transmission. FPS is selected through the device settings.

Gain – The value which adjusts the apparent brightness of an entire image, this is a digital control that can be accessed through the device settings.

Gamma – The value which adjusts the luminance of an image. Increasing gamma will make dark areas darker and light areas lighter. The Gamma level is a digital control that can be accessed through the device settings.

Resolution – Describes the number of pixel columns and rows that are contained within each captured image frame. An image with NxM describes the width of the image as 'N' and the height of the image as 'M'.

Working Distance (WD) – The distance between the camera and the object of interest which is in focus.

4 Product Information

4.1 Product Versions and Configuration

The Ninox cameras are available in two different models.

- Ninox 125 (part #140): The Ninox 125 camera has a max frame rate capability of 125 fps and uses a fixed focal length, internal wide-angle lens.
- Ninox 300C (part #143): The Ninox 300C camera has a max useable frame rate of 300 fps and uses a C-mount fixed focal length lens with a manual focus. Four different lens options are available.
 - Navitar 3.5 mm
 - Navitar 4.5 mm
 - Navitar 6 mm
 - Navitar 12mm

4.2 Software Requirements

The Ninox camera requires software to perform its function, the equipment is offered in combination with the following computer program packages:

Noraxon myoRESEARCH® (MR3.12 or newer) and Noraxon myoVIDEO® (MR3.14) Software Module

5 Setting up the Hardware

5.1 System Unboxing and Component Identification

The Ninox camera system is packed within a reinforced padded box for storage and protection during transport. Upon arrival, carefully remove all contents and verify the following components are present. *Contents will vary depending on the purchased package.*



Figure 1 - Ninox camera
Ninox 125 (part #140)
Ninox 300C (part #143) – depicted above



Figure 2 - USB3.0 cable with sync (part #CBL31)



Figure 3 - MyoSync station (part #262)

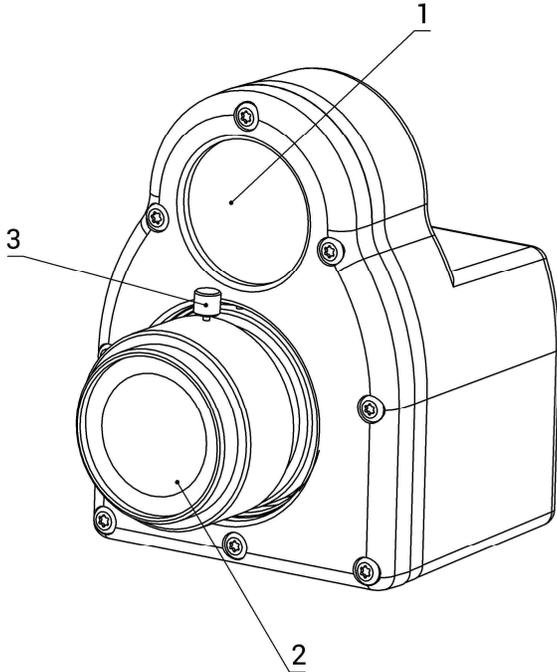


Figure 4 - USB cable for MyoSync station (CBL2)

Optional contents not illustrated:
Accessory lens (Ninox 300c only)
15m USB3.0 extension
Tripod

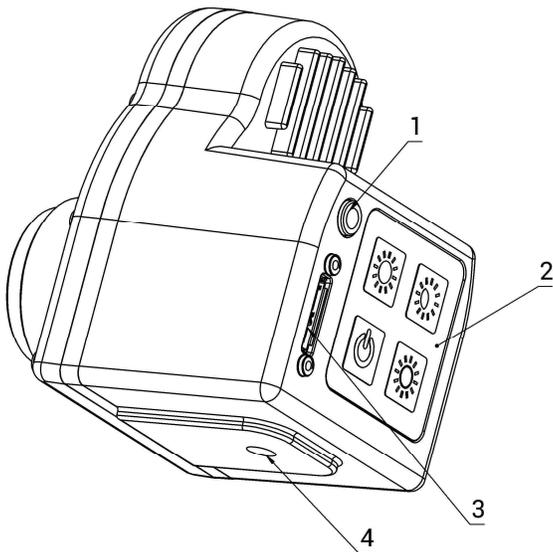
5.2 Camera Overview

The below section will cover the key components of the Ninox camera. Additional information can be found around the indicators and operation of the system in the following sections.



Camera (Front)

1. **Marker tracking LED** – LED light for marker tracking
2. **Camera lens** –
 - a. 300C – Removable C-mount lens
 - b. 125 – Fixed lens, no user access
3. **Focus thumb screw** – Loosen thumb screw to manually focus the lens



Camera (Rear)

1. **Sync** – TTL (on-off) compatible 3.5 mm stereo jack connection to other devices.
2. **Keypad** – Control brightness and ON/OFF of the LED light
3. **USB Port** – USB connection between the camera and computer
4. **Tripod mount** – Threaded for standard tripod mounts

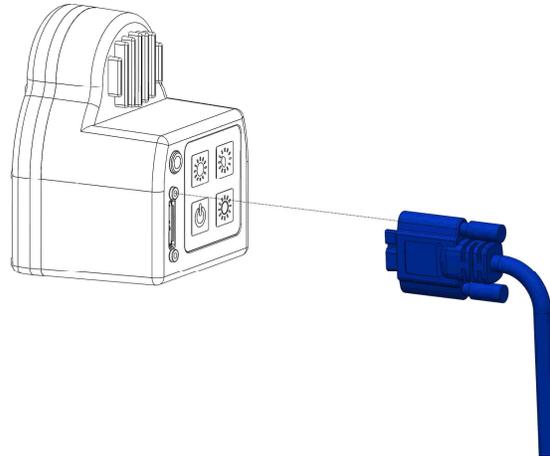
5.3 Hardware Setup Instructions

Step 1

Insert CBL31 USB connector (USB3.0 micro b) into the USB3.0 receptacle on the camera.

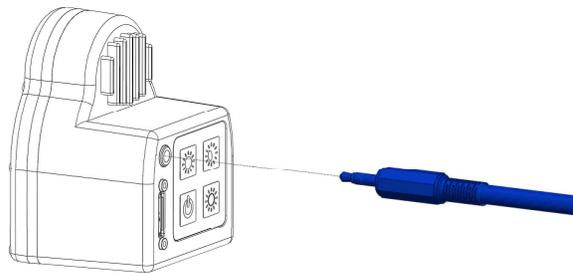
Tighten BOTH thumb screws to the secure CBL31 to the camera.

Note: Failure to connect CBL31 to the camera with BOTH thumb screws can result in damage to the USB3.0 receptacle on the camera.



Step 2

Insert the stereo jack portion of CLB31 into the receptacle on the camera.



Step 3

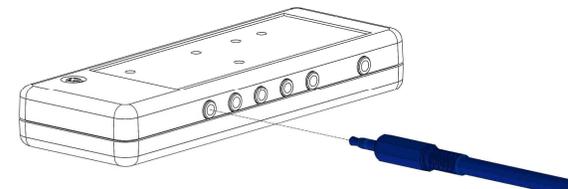
Insert the USB Type A end of CBL31 into a USB3.0 port on the host computer.

Note: ONLY two cameras per USB controller or USB hub are supported.



Step 4

Insert the stereo jack portion of CBL31 into any of the "Sync Out" ports of the MyoSync station.

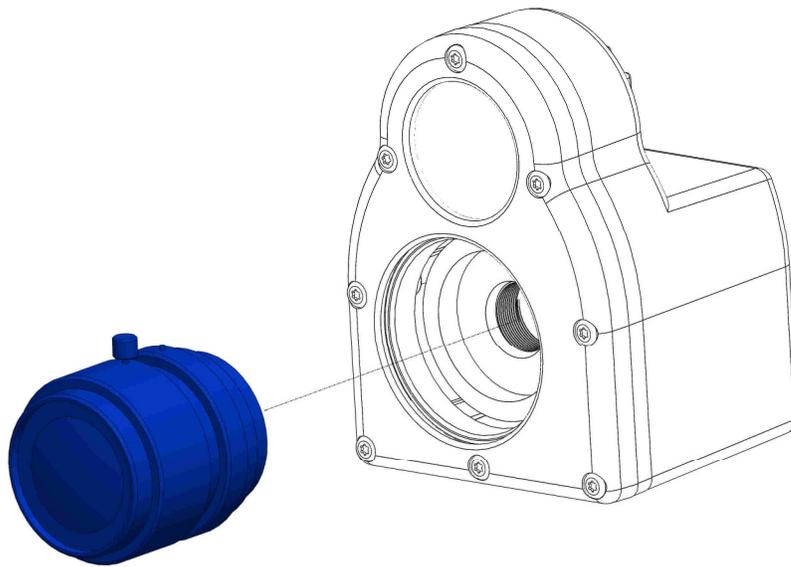


5.4 Select and attach your lens (300C only)

Select a lens based upon the field of view that is needed for your specific use-case. Refer to the Section 11.3 of the hardware manual for details on selecting the appropriate lens. The following fixed-focal length lenses are available for use with this camera:

- a. Navitar 3.5 mm
- b. Navitar 4.5 mm
- c. Navitar 6 mm
- d. Navitar 12 mm

Once selected, carefully screw on the lens to the Ninox camera.



5.4.1 Aperture and Focal Adjustment

The C-mount lens used with the Ninox 300C has a set aperture and an adjustable focus. By rotating the cylinder on the lens labeled 'Near ---- ∞', one can manually adjust the focus of the lens for each use case.

Note: For extreme cases of bright or dark conditions, the aperture can be manually adjusted. See Section 11.5 of this Manual for more information.

5.5 Determining USB Hub needs:

Note: Ninox cameras **MUST** be plugged into a USB3.0 port

Note: **ONLY** two Ninox cameras per USB controller or USB hub

Depending on the configuration, a USB hub may be required due to either a lack of USB ports on the host computer or lack of sufficient power from the host computer. In either case, one of the following setup options is required:

5.5.1 Unpowered USB3.0 hub

The recommended and tested USB3.0 hub is an Anker 4-port slim hub.

For up to two cameras, most computers can supply the power requirements needed for the cameras and the USB hub directly through the USB port. Be sure to follow the guidelines for adjusting the computer power settings Section 11.2.

When using an Anker slim hub or any unpowered USB hub, the following restrictions must be met for proper function:

- **Maximum** of two cameras
- The unpowered hub **CANNOT** run an active extension cable
- The hub **must be** plugged into a USB3.0 port on the host computer

5.5.2 Powered USB3.0 Hub

The recommended and tested powered USB3.0 hub is an Anker 7 port, USB3.0 powered hub.

In some cases, the host computer is unable to provide the power necessary to run two Ninox cameras. In this a scenario, the user must upgrade to a powered hub.

When using a powered USB3.0 hub, the following restrictions must be met for proper function:

- A **Maximum** of 2 cameras at the recommended resolution and FPS.
- A powered hub **WILL** run two cameras with an active extension cable (15m cable is available)

5.6 Adjusting Computer Performance Settings

Important: The CPU, graphics card and power settings need to be adjusted on your computer for use with MR3.

Before using your Ninox camera, you must adjust your computer settings to handle the high speed video measurement and streaming within MR3. See Section **Error! Reference source not found.**1.2 for a step by step description of how to adjust your computer settings.

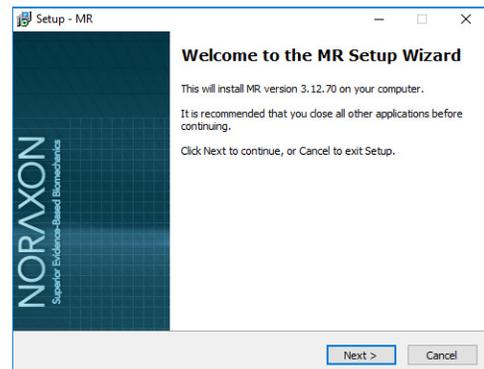
5.7 Installing the companion Software – myoResearch™ 3

To utilize the full functionality of the Ninox system, and ensure the system has updated drivers, Noraxon’s *myoResearch 3* needs to be installed on the computer.

Companion Software Installation

The Ninox Cameras are compatible with Noraxon MR3 software.

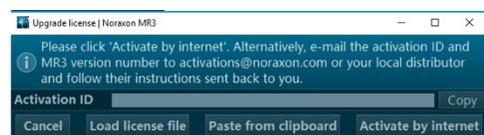
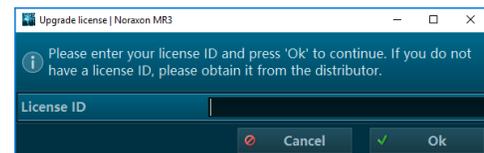
1. Insert the MR3 USB flash drive into the PC
2. A menu will automatically pop up
3. Click on the Noraxon installation file and follow the Wizard’s instructions



Companion Software Activation

The installed companion software must be *activated* before unrestricted use is possible.

1. Open MR3
2. A dialog box will indicate how many more times MR3 can be opened
3. Click on “Activate”
4. Enter the License ID provided on your USB flash drive and press “OK”
5. If you have an internet connection, click Activate by Internet for immediate activation
6. Alternatively, email the provided activation ID to activation@Noraxon.com Noraxon Support will



email or respond by phone with the Activation Code. Enter the provided Activation Code to remove any restrictions on use.

5.8 Device Communication (Driver) Software Installation

The Ninox camera requires the IDS uEYE device driver which is pre-installed by the MR3 software installation.

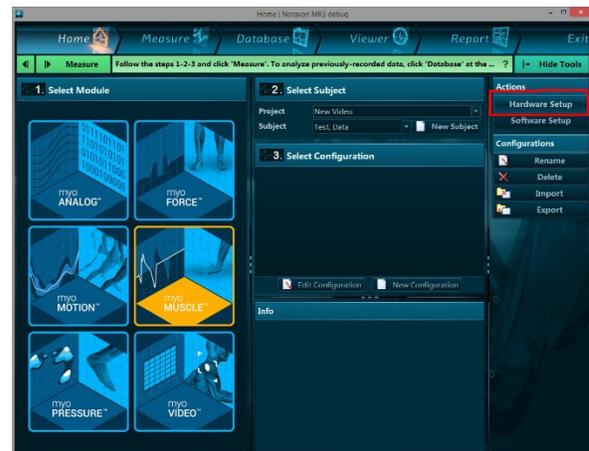
5.9 Configuring the Hardware

Before the Ninox can be used, the device software settings must be configured to adjust frame rate, resolution, and other camera settings.

Step 1

Open MR3, typically listed under *Noraxon* -> *MR3*

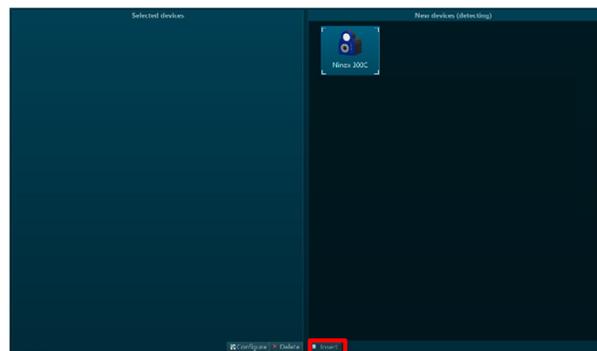
Click on the **Hardware Setup** button in the upper right-hand corner.



Step 2

Select the Ninox icon, within the 'New Device' column, and click on the **Insert** button.

Note: Make sure the Ninox camera is attached to the USB port of the computer.



Step 3

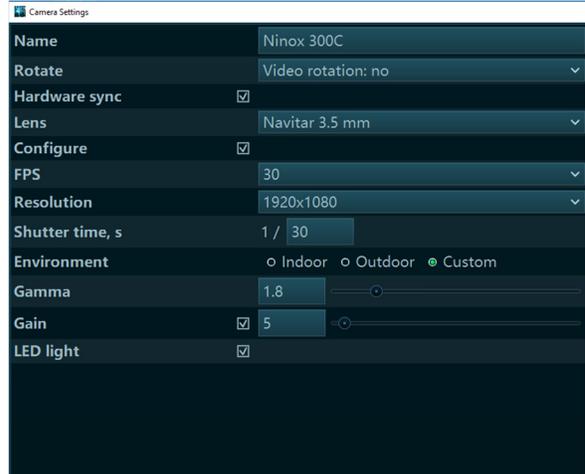
The Ninox Settings dialog will appear as shown. A preview of the image will also be shown here.

Within the “Settings” tab, select the desired collection frame rate (FPS).

Select a Resolution for recording. The recommended resolution will show up based on chosen FPS. See **Sections 11.3 and 11.4** for more information on camera frame rate and resolution options.

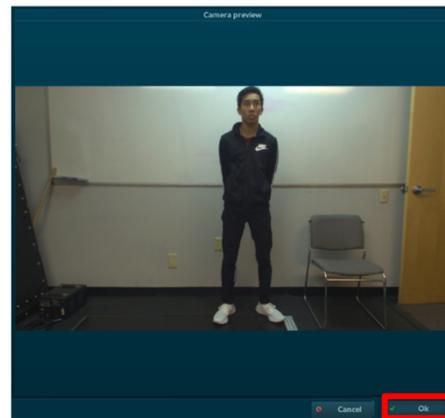
You may change the shutter time, environment, and settings such as gain and gamma here. Refer to **Section 7.1** to adjust these settings.

Note: If the camera image appears blurry (especially with a Ninox 300C), the focus on the lens may need to be adjusted. To do this, turn the lens in the camera until the image appears clear.



Step 4

Click on OK (in the bottom of the dialog box) when done.



6 Basic Operating Instructions

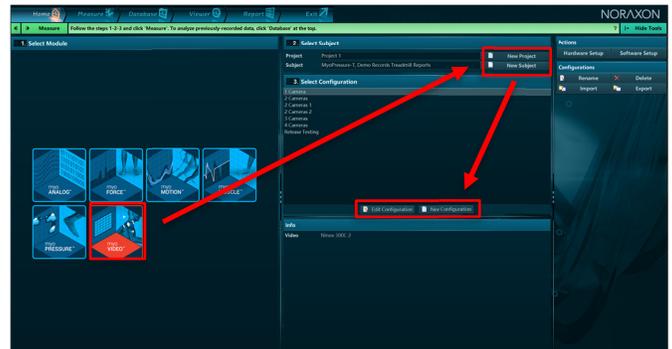
6.1 Recording a Measurement

Step 1

Within the Home screen, click on the myoVIDEO module icon.

Create a New Subject

Select **New Configuration**.



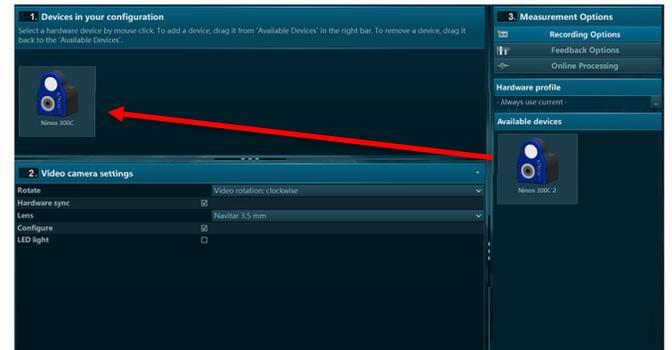
Step 2

Insert the devices to be used for the measurement into the configuration by dragging a device in from the list of **Available Devices**.

You may configure lens correction, image quality, resolution, video speed, and other settings here.

Refer to **Section 7.1** for information on these settings.

More details about the fps and resolution settings for the Ninox 300C can be found in **Section 11.3** and for the Ninox 125 can be found in **Section 11.4**.



Note: When working with the Ninox 300C, the various lens options make this camera robust to a wide variety of work settings. Carefully select a lens based upon the field of view that is needed for your specific use-case. Information on how to choose a lens can be found in **Section 11.3**.

6.2 Enter into the Measurement Screen

Continue to the next step by selecting **Measure**.

6.3 Record Signal as Desired

After checking the quality of your picture, you are ready to record a measurement. Select **Record** at the top left of the screen and begin your protocol. After completing your record, select **Stop** and **Save**. Save the record as the name of your configuration, or type in a new name. After this, save your record or **Discard & measure again**.

6.4 Storage and Protecting Between Use

For extended storage or when traveling:

- Unplug the camera from the USB on the computer
- Position all components (cameras and lenses) inside the travelling case according to their prepared cavities.

7 Additional Ninox Settings and Features

7.1 Camera Settings

Located under Hardware Setup, each individual camera has a General Settings menu. The options within this menu are detailed below:

Name: Allows the user to alter the name of each camera. This makes it easy to toggle between cameras from within each personalized configuration.

Rotate: Allows the user to rotate the orientation of the image within the software.

Hardware Sync: Must be selected if you would like to synchronize the video, via MyoSync, with other cameras or other data streams

Note: This must be selected for each device that you would like synced.

Lens (Ninox 300C only): Select the lens that you are using for each camera to apply the appropriate lens correction algorithm (removes any lens distortion).

Configure: Must be selected to modify all the following settings (fps, resolution, etc.).

FPS: Select how many frames per second you would like to obtain throughout the measurement. Higher frame rates are useful when using 2D marker tracking of high speed movements: running, throwing, etc.. Lower frame rates may be suitable for those using the camera purely for reference.

Note: Increasing the fps will decrease the maximum obtainable resolution

Resolution: Select the number of pixels that you would like to receive from the camera.

Shutter Time: This setting alters the length of time that the camera's image sensor is exposed to light. Decreasing this value (increasing the denominator of the fraction) will expose the camera's image sensor to incoming light for a shorter period (useful when in very bright conditions – outdoors). Increasing this value (decreasing the denominator of the fraction) will expose the sensor to incoming light for a longer period and will thereby cause the image to be brighter and add a blur to very high speed movements. MR3 will recommend a shutter time based on the user selection of an indoor or outdoor environment.

Environment (Ninox 300C only): Select whether you are collecting data in an indoor or outdoor environment. This will alter the shutter time, gain, and gamma settings to a generic recommended setting.

Note: Lighting slightly differs in every laboratory space, therefore minor adjustments to these recommended values may be needed to optimize image quality.

Gain: This setting amplifies the brightness of the entire image. Increasing this value may be useful in low-light environments. Be sure to always adjust the ambient lighting and the shutter time before altering the gain.

Gamma: Gamma is an image correction value that will adjust the luminance of an image. Adjusting gamma will make dark areas of the image darker and light areas lighter. A gamma value equal to 1 will have no effect on the image, a gamma value <1 will shift the image towards the darker spectrum, and a gamma value >1 will shift the image towards a lighter image spectrum. Be sure to always adjust the ambient lighting and the shutter time before altering the gamma.

LED Light: Select this option to turn the camera's LED light on. This is useful when for 2D marker tracking.

7.2 On-board LED light

The on-board LED light is meant specifically for improving reflective marker tracking. The light is NOT meant to provide ambient lighting in low-light conditions. The keypad on the rear of the Ninox camera provides three different brightness levels (low, medium, high). The brightness can be adjusted to provide reflection from motion markers depending on ambient light conditions. However, to automatically have the LED light turn on at the start of the measurement, one must select the LED light option within the configuration (See Step 2 of Section 6.1)

7.3 Video Compression

All video files for the Ninox cameras are saved in a compressed format. The video compression occurs at two different levels, real-time and post-process.

Real-time compression - occurs as the video is streamed to the host computer. The video is compressed real-time into m-jpeg format.

Post-process compression - can be executed after a record has been saved. The video will be further compressed into an mpeg4 format to reduce file size. The post-process compression will reduce the initial file size approximately 5-10X.

7.4 File Size

Due to the high frame rate and resolution capabilities of the Ninox cameras, large file sizes will be created when recording. The following numbers are approximations of the file size per minute that can be expected. The values listed are for a single camera.

Ninox 300C: 0.5 to 1 MB per minute, depending on the frame rate and resolution

Ninox 125: 0.2 to 0.25 MB per minute, depending on the frame rate and resolution

8 Maintenance

8.1 Safety Precautions When Cleaning

**WARNING**

- Only use a damp cloth with mild soap and water or isopropyl alcohol to clean the camera housing.
- Do not immerse camera in any water or liquid.

8.2 Cleaning by Users

Clean the lens optical surface on a regular basis. The lens surface can be cleaned with isopropyl alcohol or any window/lens cleaner.

8.3 Safety Precautions When Performing Maintenance

No precautions required.

8.4 Maintenance by Users

No maintenance necessary.

8.5 Companion Software Updates

- Perform a backup of the data folders to a separate drive as a precaution.
- Click on the Patch/Update link provided in the email or as given on the [Noraxon website](#).
- Download the Patch/Update file.
- To install the Patch/Update, click “Run” on the dialog box. No password is required.

9 Troubleshooting, Fault Diagnosis

9.1 Optimize Shutter time, Gamma and Gain settings

9.1.1 Overexposed image

In the case of an overexposed image (bright spots/glare) the following procedure can be followed, in order, to optimize the video quality.

1. Begin by setting the gain to 0
2. Reduce the shutter time by increasing the shutter time divisor to further remove any bright/glaring spots in the video
3. Once the bright spots have been removed, the gamma value can be adjusted to correct the color representation and brighten dark areas in the video

Note: Best rule of thumb is to keep the gain value as low as possible while adjusting the shutter time to remove bright/glaring spots.

9.1.2 Motion Blurring

In the case of a blurred video during high speed movements, the shutter time of the camera needs to be reduced. This is assuming the lens has been fully focused in a static view.

Reducing the shutter time will reduce the amount of motion blur in the video. This is done by increasing the “Shutter Time” divisor value. Shutter time values will automatically change when a frame rate is selected. These values can be further increased to reduce any video motion blur.

9.2 Freezing or missed video frames

9.2.1 During real-time viewing

In the case where the video is freezing while viewing real-time, the likely issue is the USB communication.

Potential solutions:

- Check if USB suspend is disabled (Section 11.2)
- Make sure the camera is plugged into a USB3 port
- Do not use more than two cameras per USB3 controller or USB hub
- Reduce the frame rate or resolution

9.2.2 Post video capture (saved video file)

During video recording, the cameras can heavily stress a computer's CPU and GPU. If the computer CPU and GPU do not meet required specifications, video frames will be missed/lost in the recorded video file. In the case where video freezing is only seen after the video has been recorded, the most likely issues is poor computer performance.

Potential solutions:

- Check if the CPU and GPU settings have been correctly set as defined in Section 11.2
- Do not use more than two cameras per USB3 controller or USB hub
- Reduce the frame rate or resolution

9.3 Troubleshooting Chart

Symptom: **Problem with the PC recognizing the Ninox camera**

Possible Reason

USB cable is disconnected or loose

USB Driver is not installed

Remedial Action

Check USB cable connection at both camera and computer

Check the Device Manager for USB driver errors and update the driver if needed

Symptom: **Only low resolutions are shown in the hardware or configuration menu**

Possible Reason

USB cable is plugged into a USB 2.0 port

Remedial Action

Move USB cable to USB3.0 port

Symptom: **Low computer CPU performance (power throttling)**

Possible Reason

Laptop will reduce CPU performance to increase battery life (running on battery power)

Remedial Action

Switch to high performance mode OR connect to power

Symptom: **Low computer CPU performance (thermal throttling)**

Possible Reason

Laptop will reduce CPU performance to reduce heat (running on battery power)

Remedial Action

Add a laptop cooling platform OR connect to power

9.4 Website Link to FAQ

Answers to frequent questions can be found at Noraxon's Frequently Asked Questions (FAQ) website page at this link:

<https://www.noraxon.com/support-learn/technical-support/faqs/>

10 Support, Service and Repair

10.1 Submitting Technical Support Requests

A Support Request can be submitted using the online form available at this link:

<https://www.noraxon.com/support-learn/support-request/>

Provide all information requested by the form including a **detailed** description of the problem being experienced and your telephone number or e-mail address.

10.2 Returning Equipment

Be sure to obtain an RMA Number (return material authorization) before returning any equipment. Completing the online service request form will assign an RMA Number. Otherwise contact Noraxon USA.

<https://www.noraxon.com/support-learn/rma-request/>

Send the equipment **postage prepaid** and **insured** to the address below. Include the RMA Number on the shipment label. Mark the package "Goods to be repaired – Made in USA" to avoid unnecessary customs charges. (Beware listing a Customs or Insurance value of \$5,000.00 USD or more will result in a delay at United States Customs.)

Noraxon USA
15770 N. Greenway-Hayden Loop
Suite 100
Scottsdale, AZ
85260, USA

If you are shipping from outside the USA please use UPS, FedEx, DHL, or EMS (US Postal Service) and **not a freight-forwarder**. Using a freight-forwarder incurs additional brokerage fees. If a package is shipped to Noraxon via a carrier other than the ones listed above, it may be refused.

11 Appendices

11.1 Appendix A – Product Specifications

Dimensions and Weight

- Ninox 125
 - 1.98" L x 2.14" W x 2.98" H (5.03 cm x 5.43 cm x 7.57 cm)
 - Weight: Less than 205 g.
- Ninox 300c
 - 2.77" L x 2.14" W x 2.98" H (7.36 cm x 5.43 cm x 7.57 cm)
 - Weight: Less than 205 g.

Performance Characteristics

Ninox 300C

- Max Resolution: 1920 x 1080 @ 30fps
- Max frame rate: 300 fps @ 480 x 320
- CMOS format: 1/2.8"
- Shutter: Rolling
- Interface: USB3

Ninox 125

- Max Resolution: 1280 x 960 @ 30fps
- Max frame rate: 125 fps @ 736 X 352
- CMOS format: 1/3"
- Shutter: Global
- Interface: USB3

Environmental Conditions for Normal Operation

- Ambient Temperature: 0C to +55C
- Relative Humidity: 20% to 80%

Environmental Conditions for Storage and Transport

- Ambient Temperature: -20C to +70C
- Relative Humidity: 20% to 80%

11.2 Appendix B – Computer Power Options and Graphics Card Driver Settings

All changes to the computer settings must be made by a user with **Administrator** privileges.

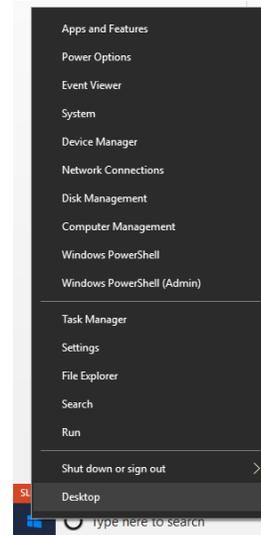
Power Options

Before using the Ninox camera, the host computer must have the correct power and performance options set. All computers may not have every **Power Option** listed below, but you can follow the steps to make the necessary changes to any option which is listed for your computer:

A note for laptop users: Be sure to change the settings for both **On Battery** and **Plugged In** modes. Be aware that the settings are all “High Performance” and will reduce the battery run-time.

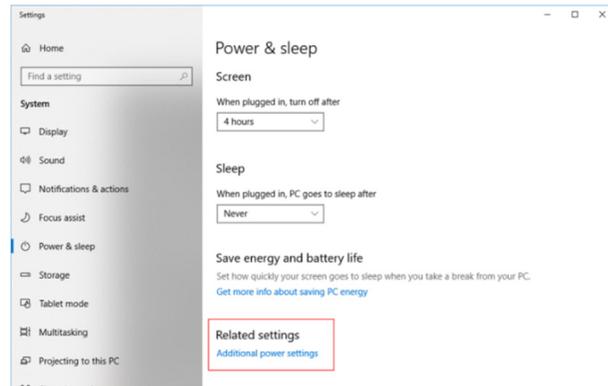
Step 1

Open the control panel by right clicking on the Start menu and clicking on **Power Options**.



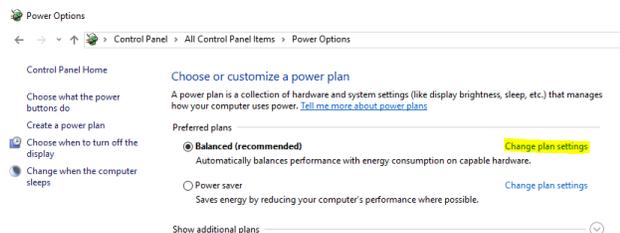
Step 2

Navigate to the **Additional power settings**



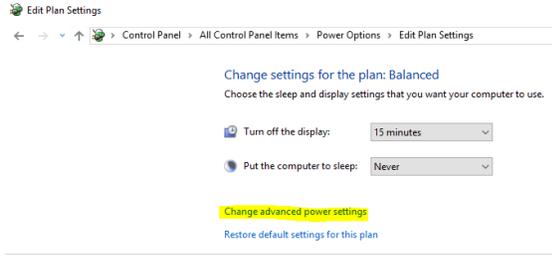
Step 3

Click on **Change Plan Settings** to make further changes



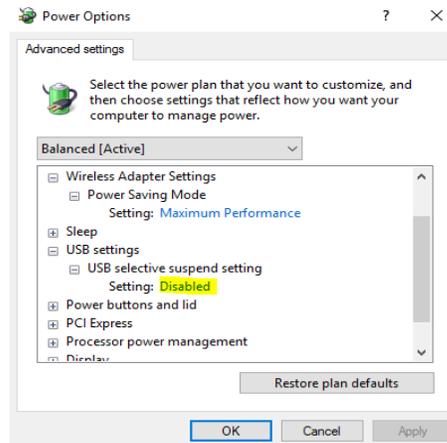
Step 4

Click on **Change Advanced Power Settings**



Step 5

Find the **USB Settings** -> **USB Selective Suspend** menu and select **Disabled**



Step 6

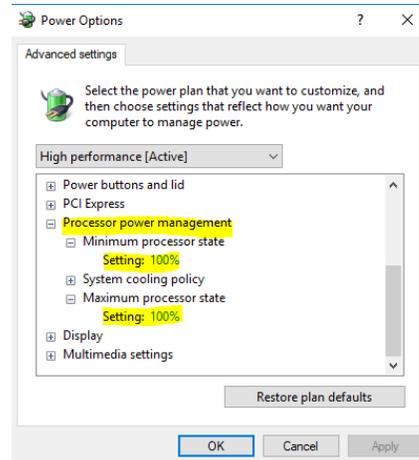
Find the **Intel (R) Graphics Settings**

Expand the **Intel (R) Graphics Power Plan** and change the setting to **Maximum Performance**

Step 7

Find the **Processor Power Management**

Change both the **Minimum** and **Maximum Processor State** to 100%

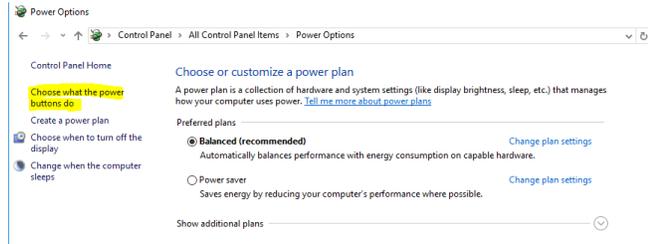


Step 8

Disable fast startup:

Open Control Panel\Power Options and click **Choose what the power buttons do** on the left-hand side.

If there is a checkbox labeled **Turn on fast startup**, uncheck this box. (If this option is gray or disabled, click the text at the top labeled “Change settings that are currently unavailable.”)

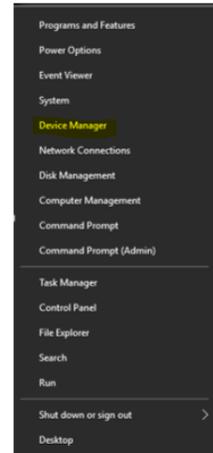


Graphics Card Driver

The latest graphics card drivers need to be installed on the host computer to ensure proper function with the 3D graphics and video in MR3.

Step 1

Open the Device Manager by right clicking the start menu and select **Device Manager**

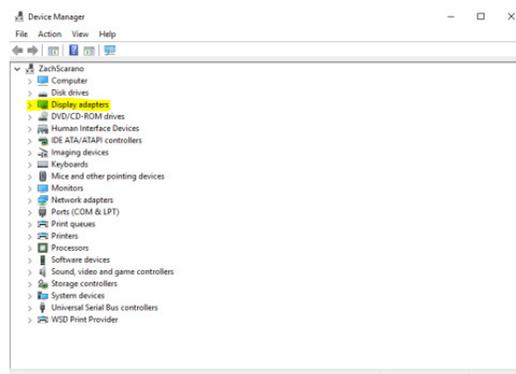


Step 2

In the Device Manager expand the tab labeled **Display Adapters**.

Force each display adapter (graphics card) that is listed the driver should be updated to the latest version available.

Right click on the display adapter and select **Update Driver Software**.



Step 3

Select the option to **Search automatically for updated driver software**.

Step 4

If the latest drive is already installed, you will receive the message “The best driver software for your device is already installed”.

← Update Driver Software - NVIDIA Quadro FX 570

How do you want to search for driver software?

→ **Search automatically for updated driver software**

Windows will search your computer and the Internet for the latest driver software for your device, unless you've disabled this feature in your device installation settings.

→ Browse my computer for driver software

Locate and install driver software manually.

← Update Driver Software - NVIDIA Quadro FX 570

The best driver software for your device is already installed

Windows has determined the driver software for your device is up to date.



NVIDIA Quadro FX 570

11.3 Appendix C – Ninox 300C Lens Selection, Frame Rate, and Resolution Options

The various lens options make this camera robust to a wide variety of work settings. Carefully select a lens based upon the field of view that is needed for your specific use-case.

Figure 1 provides an overview of the required working distance for a specific frame rate and lens with the camera in a landscape orientation. The scenario depicted is the recording of a walking gait stride of an individual 1.8m in height. At the given working distances and frame rates, the camera has a field of view wide enough to capture one full stride.

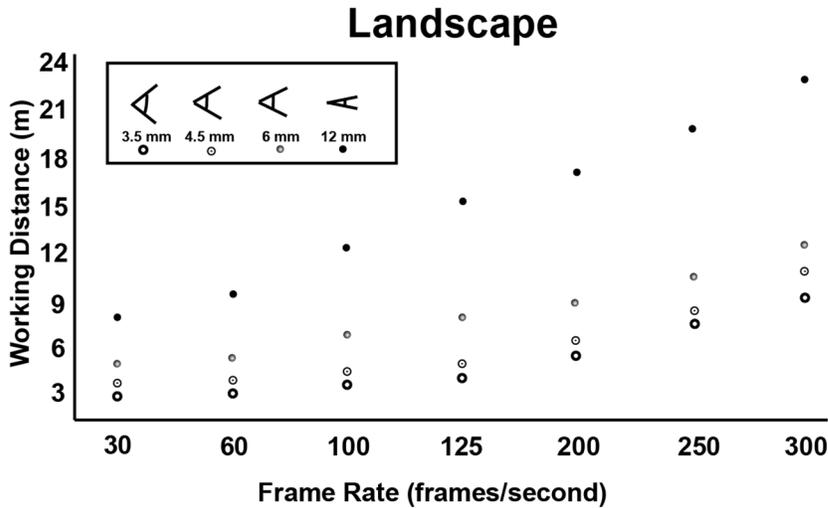


Figure 1: Ninox 300C Field of View (landscape)

For a less specific scenario, the WD, AOV, or FOV can be calculated from the information in Figure 2 and Table 1 using Equation 1. The diagram in Figure 2 shows the relationship between the WD, AOV, and FOV.

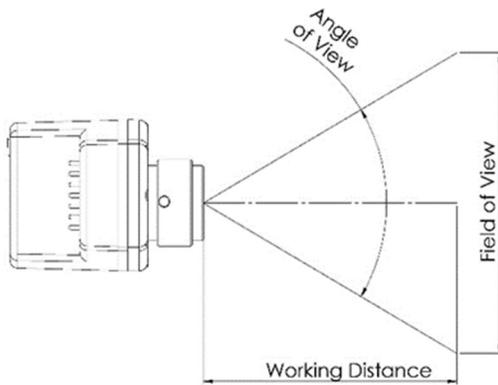


Figure 2: Ninox 300C Angle of View

$$\tan\left(\frac{AOV}{2}\right) = \frac{FOV/2}{WD}$$

Equation 1: AOV, WD, FOV relationship

Refer to Table 1 for a list of the AOV values for each available lens. The AOV is shown for the maximum available resolution at 30 fps and for the minimum resolution at 300 fps.

Table 1: Ninox 300C Angle of View

	Lens	H - Angle of View	V - Angle of View
1920 x 1080 30 fps	3.5 mm	75.5	46.6
	4.5 mm	67.9	38.1
	6 mm	50.0	28.4
	12 mm	26.6	14.6
480 x 340 300 fps	3.5 mm	20.9	15.0
	4.5 mm	17.4	11.9
	6 mm	13.1	8.3
	12 mm	6.8	2.1

The recommended resolutions for the Ninox 300C camera are presented in Table 2.

Table 2: Ninox 300C recommended resolution and fps

Frame Rate (fps)	Recommended Resolution (pixel)
30	1920 x 1080
60	1280 x 1080
100	960 x 720
125	960 x 680
200	720 x 560
250	640 x 480
300	480 x 340

Example: A user needs to record a broad jump (jump length approximately 3m) and has to have the camera 8m from the jump location with a sagittal view. What lens should be used?

- WD = 8m
- FOV = 3m
- AOV = ?

$$AOV = 2 * \text{atan}\left(\frac{FOV/2}{WD}\right)$$

$$AOV = 21 \text{ degrees}$$

There are two possible options based on Table 1.

1. If the user wants to use the highest frame rate possible to capture the high speed movement, the 3.5mm lens would be the best choice. The user can select a frame rate of 300fps to capture the full detail of the movement.
2. If the user is more concerned about image quality a 12mm lens would be the best choice. With a 12mm lens, the user could select a high definition resolution of 1920 X 1080 (1080p).

With either solution, the shutter speed of the camera can be reduced to remove any image blur regardless of the fps.

11.4 Appendix D – Ninox 125 Frame Rate and Resolution Options

The Ninox 125 camera uses a non-adjustable, wide-angle, fixed focal length lens. The lens does not require focus therefore all images should be in focus from 1m to infinity.

The recommended resolutions for the Ninox 125 camera are presented in Table 3..

Table 3: The recommended resolution for the Ninox 125 at each of the selectable frame rates

Frame Rate (fps)	Recommended Resolution (pixel)
30	1280 x 960
60	1088 x 704
100	736 x 352
125	736 x 352

11.5 Appendix E – Manual Lens Focal Adjustment (Ninox 300c)

For extreme cases of bright or dark conditions, the aperture can be manually adjusted by removing the lens and loosening the set screw located between “C” and “O”.

