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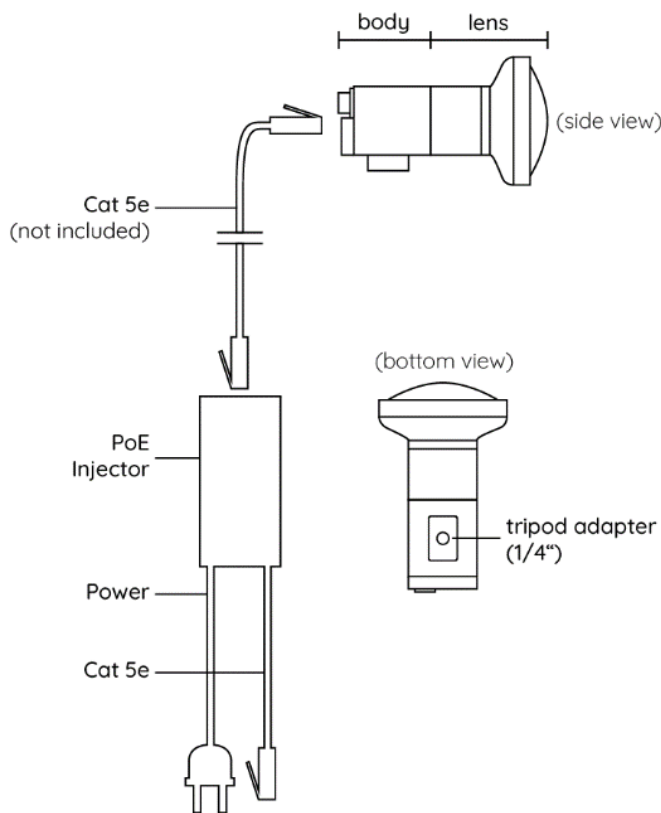
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Camera calibration kit overview

Calibration Kit	Description	Sensor size	Resolution	Lens
MS-CK-W(xx)	Wide-angle calibration kit	1/1.8"	3072 x 2048	89,0° x 73,8° 76,0° x 60,8° 56,8° x 44,0°
MS-CK-WU (xx)	Ultra-Wide-angle calibration kit	1/1.8"	3072 x 2048	135,0° x 119,0° 110,0° x 94,0°
MS-CK-T(xx)	Tele calibration kit	1/1.8"	3072 x 2048	44,7° x 33,9° 28,9° x 21,9°
MS-CK-FDN	Full-dome calibration kit	1"	2592 x 2048	365,00° x 185,00°

Calibration Kits are based on a HiK Robotics IP cameras. They come with the camera body, a suitable lens, and a PoE-Injector for running the camera on any switch or directly from the PC/server.

All the camera kits use 1 GbE interface and HiK CA Series Camera body.



All the camera kits come with one year warranty.

MS-CK-QXX Super HQ Calibration Kits



6.5 mm 8.5 mm 12 mm 16 mm 25 mm 35 mm 50 mm

Range of Use	
Main Characteristics	12 MPix high performance camera with 6.5mm low distortion lens
Application	Choose from a selection of fixed focus lenses
Multicam-ready	Simulation and large-scale scenarios with highest quality requirements

Physical Data	
Camera	
Class	Computer vision camera with interchangeable lens
Lens Mount	C-Mount
Interface	GigE RJ45 (1GB/s)
Measures (H × W × D)	34mm × 44mm × 47mm / approx. 110g
Sensor	
Type	CMOS, global shutter, monochrome
Sensor Size	1.1"
Pixel Size	3.45 μm × 3.45 μm
Resolution class / max. resolution (HxV)	12 MPix / 4104 × 3006 Pixel
Max. frame rate	9 fps @12 MPix

Available 12 MPix lenses				
Focal length	Field of view (H × V)	Aperture range (F)	Distortion (TV)	Measures (H×W×D mm)
8.5mm	79.2° × 63.8°	2.5~16.0	0.55 %	64 × 64 × 73.3mm / 230g
12mm	60.0° × 49.9°	1.8~16.0	0.26 %	51 × 51 × 73.8mm / 260g
16mm	48.0° × 36.7°	1.8~16.0	-0.4 %	43 × 43 × 65.7mm / 200g
25mm	31.5° × 23.9°	1.8~16.0	-0.3 %	45 × 45 × 69.4mm / 220g
35mm	22.1° × 16.7°	1.8~16.0	-0.01 %	41 × 41 × 66.0mm / 205g
50mm	16.1° × 12.1°	1.8~16.0	-0.03 %	41 × 41 × 74.5mm / 205g
6.5mm	See MS-CK-WQ95 HQ Wideangle Calibration Kit			

MS-CK-FDN-3 Fisheye Calibration Kit



Range of Use	
Main Characteristics	High performance 4 MPix 2/3" sensor camera with 1.8mm fisheye lens
Application	For domes, panadomes and panoramas of all kinds
Multicam-ready	No

Physical Data	
Camera	
Class	Computer vision camera with interchangeable lens
Lens Mount	C-Mount
Interface	GigE RJ45 (1GB/s)
Measures (H × W × D)	29mm × 29mm × 42mm / approx. 70g
Sensor	
Type	CMOS, global shutter, monochrome
Sensor Size	1"
Pixel Size	3.45 μm × 3.45 μm
Resolution class / max. resolution (HxV)	5 MPix / 2448 × 2048 Pixel
Max. frame rate	42 fps (full resolution)
Lens	
Focal length	1.8mm (fixed focus)
Field of view (H × V)	185° × 185° (on 1" sensor)
Resolution class / minimal pixel pitch	5 MPix
Aperture range (F)	1.8~16
Distortion	Linear fisheye distortion
Measures (H × W × D)	56.5mm × 56.5mm × 52.2mm / approx. 160g

MS-CK-T29-H Tele Calibration Kit

Range of Use	
Main Characteristics	6 MPix camera with 12mm tele lens
Application	Flexible, for small- and large-scale scenarios and large distances
Multicam-ready	No

Physical Data	
Camera	
Class	Computer vision camera with interchangeable lens
Lens Mount	C-Mount
Interface	GigE RJ45 (1GB/s)
Measures (H × W × D)	29mm × 29mm × 42mm / approx. 70g
Sensor	
Type	CMOS, rolling shutter, monochrome
Sensor Size	1/1.18"
Pixel Size	2.4 μm × 2.4 μm
Resolution class / max. resolution (HxV)	6 MPix / 3072 × 2048 Pixel
Max. frame rate	17 fps @6 MPix
Lens	
Focal length	12.0mm (fixed focus)
Field of view (H × V)	28.9° × 21.9° (on 1/2" sensor)
Resolution class / minimal pixel pitch	2 MPix
Aperture range (F)	1.4~16
Distortion	n/a
Measures (H × W × D)	29.5mm × 29.5mm × 28.8mm / approx. 55g

MS-CK-T44-H Tele Calibration Kit

Range of Use	
Main Characteristics	6 MPix camera with 8mm tele lens
Application	Flexible, for small- and large-scale scenarios and large distances
Multicam-ready	No

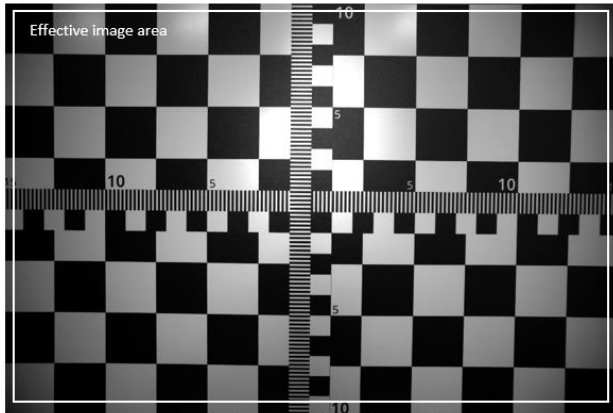
Physical Data	
Camera	
Class	Computer vision camera with interchangeable lens
Lens Mount	C-Mount
Interface	GigE RJ45 (1GB/s)
Measures (H × W × D)	29mm × 29mm × 42mm / approx. 70g
Sensor	
Type	CMOS, rolling shutter, monochrome
Sensor Size	1/1.18"
Pixel Size	2.4 μm × 2.4 μm
Resolution class / max. resolution (HxV)	6 MPix / 3072 × 2048 Pixel
Max. frame rate	17 fps @6 MPix
Lens	
Focal length	8.0mm (fixed focus)
Field of view (H × V)	44.7° × 33.9° (on 1/2" sensor)
Resolution class / minimal pixel pitch	6 MPix / 2.2 μm
Aperture range (F)	1.8~11.0
Distortion	<4.70% (on 1/2.5" sensor)
Measures (H × W × D)	34mm × 34mm × 41mm / approx. 78g

MS-CK-W56-H Wide-Angle Calibration Kit

Range of Use	
Main Characteristics	6 MPix camera with 6mm wide-angle low distortion lens
Application	Flexible, for small- and large-scale scenarios
Multicam-ready	Yes

Physical Data	
Camera	
Class	Computer vision camera with interchangeable lens
Lens Mount	C-Mount
Interface	GigE RJ45 (1GB/s)
Measures (H × W × D)	29mm × 29mm × 42mm / approx. 70g
Sensor	
Type	CMOS, rolling shutter, monochrome
Sensor Size	1/1.18"
Pixel Size	2.4 μm × 2.4 μm
Resolution class / max. resolution (HxV)	6 MPix / 3072 × 2048 Pixel
Max. frame rate	17 fps @6 MPix
Lens	
Focal length	6.0mm (fixed focus)
Field of view (H × V)	56.6° × 44°
Resolution class / minimal pixel pitch	6 MPix / 2.4 μm
Aperture range (F)	2.0~16
Distortion	<1.05%
Measures (H × W × D)	37mm × 37mm × 42mm / approx. 136g

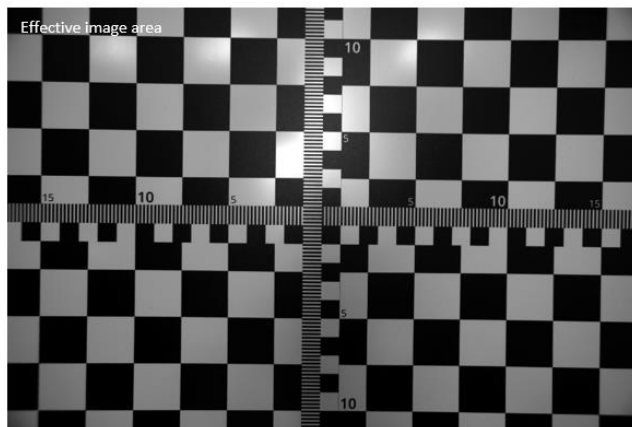
MS-CK-W76-H Wide-Angle Calibration Kit



Range of Use	
Main Characteristics	6 MPix camera with 4mm wide-angle low distortion lens
Application	Flexible usage for many applications, single- and multicam use
Multicam-ready	Yes

Physical Data	
Camera	
Class	Computer vision camera with interchangeable lens
Lens Mount	C-Mount
Interface	GigE RJ45 (1GB/s)
Measures (H × W × D)	29mm × 29mm × 42mm / approx. 70g
Sensor	
Type	CMOS, rolling shutter, monochrome
Sensor Size	1/1.18"
Pixel Size	2.4 μm × 2.4 μm
Resolution class / max. resolution (HxV)	6 MPix / 3072 x 2048 Pixel
Max. frame rate	17 fps @6 MPix
Lens	
Focal length	4.0mm (fixed focus)
Field of view (H × V)	76° × 60.06° (on 1/2" sensor)
Resolution class / minimal pixel pitch	5 MPix / 3.45μm
Aperture range (F)	2.0~16
Distortion	<0.9%
Measures (H × W × D)	37mm × 37mm × 53.5mm

MS-CK-W89-H Wide-Angle Calibration Kit



reference image taken from distance = 25

Range of Use	
Main Characteristics	6 MPix camera with 3.5mm wide-angle very low distortion lens
Application	Perfect for very precise calibrations in close quarters
Multicam-ready	Yes

Physical Data	
Camera	
Class	Computer vision camera with interchangeable lens
Lens Mount	C-Mount
Interface	GigE RJ45 (1GB/s)
Measures (H × W × D)	29mm × 29mm × 42mm / approx. 70g
Sensor	
Type	CMOS, rolling shutter, monochrome
Sensor Size	1/1.18"
Pixel Size	2.4 μm × 2.4 μm
Resolution class / max. resolution (HxV)	6 MPix / 3072 x 2048 Pixel
Max. frame rate	17 fps @6 MPix
Lens	
Focal length	3.5mm (fixed focus)
Field of view (H × V)	89° × 73.8° (on 1/1.8" sensor)
Resolution class / minimal pixel pitch	2 MPix / 1.5μm
Aperture range (F)	2.4~14
Distortion	<0.46%
Measures (H × W × D)	42mm × 42mm × 37.2mm / approx. 85g

MS-CK-WQ95 HQ Wide-angle Calibration Kit

Range of Use	
Main Characteristics	12 MPix high performance camera with 6.5mm low distortion lens
Application	Simulation and large scale scenarios with highest quality requirements
Multicam-ready	Yes

Physical Data	
Camera	
Class	Computer vision camera with interchangeable lens
Lens Mount	C-Mount
Interface	GigE RJ45 (1GB/s)
Measures (H × W × D)	34mm × 44mm × 47mm / approx. 110g
Sensor	
Type	CMOS, global shutter, monochrome
Sensor Size	1.1"
Pixel Size	3.45 μm × 3.45 μm
Resolution class / max. resolution (HxV)	12 MPix / 4104 × 3006 Pixel
Max. frame rate	9 fps @12 MPix
Lens	
Focal length	6.5mm (fixed focus)
Field of view (H × V)	95.7° × 89.9° (on 1.1" sensor)
Resolution class / minimal pixel pitch	6 MPix / 2.2 μm
Aperture range (F)	2.5~16.0
Distortion	-1.51% (on 1.1" sensor)
Measures (H × W × D)	84mm × 84mm × 79.1mm / approx. 300g

MS-CK-WU120-H Ultra Wide-Angle Calibration Kit



reference image (from lens provider)

Range of Use	
Main Characteristics	5 MPix camera with 1.67mm ultra wide-angle lens and quite noticeable pincushion distortion
Application	Close quarters with demand for maximum camera coverage
Multicam-ready	No

Physical Data	
Camera	
Class	Computer vision camera with interchangeable lens
Lens Mount	C-Mount
Interface	GigE RJ45 (1GB/s)
Measures (H × W × D)	29mm × 29mm × 42mm / approx. 70g
Sensor	
Type	CMOS, rolling shutter, monochrome
Sensor Size	1/2.5"
Pixel Size	2.2 μm × 2.2 μm
Resolution class / max. resolution (HxV)	5 MPix / 2592 x 1944 Pixel
Max. frame rate	24 fps @5 MPix
Lens	
Focal length	1.67mm (fixed focus)
Field of view (H × V)	120° × 104° (on 1/2.5" sensor)
Resolution class / minimal pixel pitch	3 MPix / n/a
Aperture range (F)	1.8~closed
Distortion	<1% barrel (for 1/3 sensor) + noticeable pincushion distortion
Measures (H × W × D)	36mm × 36mm × 56mm

MS-CK-WU135-H Ultra Wide-Angle Calibration Kit



reference image (from lens provider)

Range of Use	
Main Characteristics	5 MPix camera with 1.3mm ultra wide-angle lens and very noticeable pincushion distortion
Application	Close quarters with demand for maximum camera coverage
Multicam-ready	No

Physical Data	
Camera	
Class	Computer vision camera with interchangeable lens
Lens Mount	C-Mount
Interface	GigE RJ45 (1GB/s)
Measures (H × W × D)	29mm × 29mm × 42mm / approx. 70g
Sensor	
Type	CMOS, rolling shutter, monochrome
Sensor Size	1/2.5"
Pixel Size	2.2 μm × 2.2 μm
Resolution class / max. resolution (HxV)	5 MPix / 2592 x 1944 Pixel
Max. frame rate	24 fps @5 MPix
Lens	
Focal length	1.3mm (fixed focus)
Field of view (H × V)	135° × 119° (on 1/2.5" sensor)
Resolution class / minimal pixel pitch	5 MPix / n/a
Aperture range (F)	1.8~closed
Distortion	<3% barrel (for 1/3 sensor) + very noticable pincushion distortion
Measures (H × W × D)	36mm × 36mm × 54mm

Camera setup guide

1. Computer requirements

The system requirements of the computer running the calibration software depends on the calibration task: the more projectors needed to be calibrated, the more RAM will be required.

General guidelines:

- Operating system: Windows 10 (x64) recommended; Windows 11 (x64) supported
- System memory: 16 GB RAM as minimum, 64 GB RAM recommended for 8 x 4K projector calibration
- Admin access to install and register services

2. Connecting the camera

Mount the camera and connect camera to PoE injector and the PoE injector to the network and power.

a. PoE (Power Over Ethernet)/DATA- Connect the camera to this socket (this will power the camera and a small light will flicker).

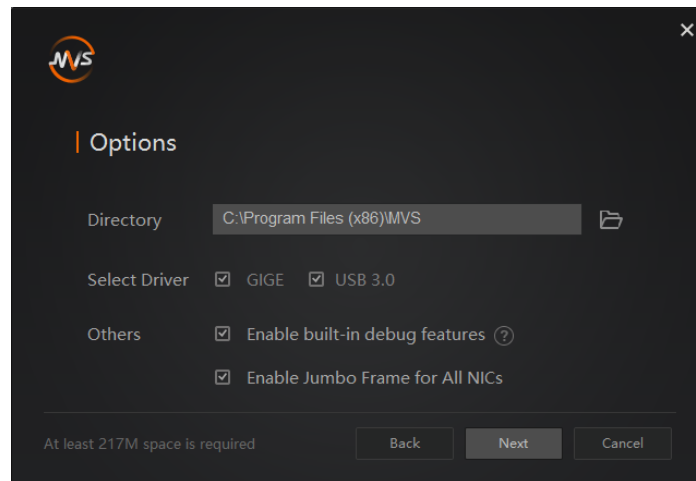
b. DATA- Connect the Ethernet cable to the PC/server or to a switch.

Important notes:

- The camera requires a stable at least 1Gb/s ethernet connection.
- It is strongly recommended to run the camera directly to the PC.
- Please note that during calibration the camera creates a large amount of data, occupying the whole network bandwidth and therefore should not be shared with other network-based applications (e.g., remote access).
-

3. Installing the driver package “MVS” and DirectShow interface

- Download link:
https://www.analogway.com/files/uploads/produit/download/mvs_std_3.3.1_201207.zip
- Install driver:



- Install DirectShow Interface:
Run as Admin:

```
C:\Program Files  
(x86)\MVS\Development\ThirdPartyPlatformAdapter\DirectShow\x64\Mv  
DSS2\InstallDSSvc_x64.bat
```

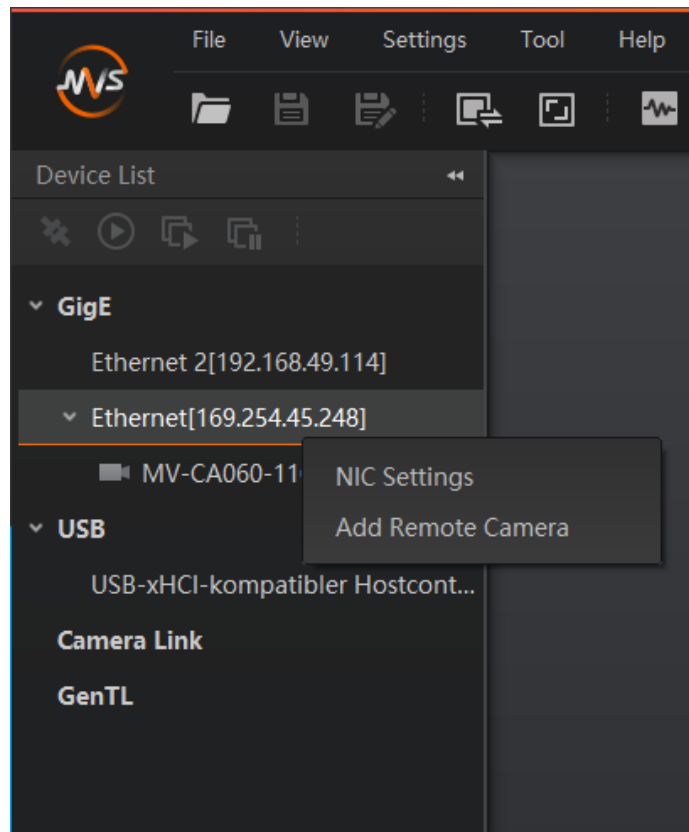
```
C:\Program Files  
(x86)\MVS\Development\ThirdPartyPlatformAdapter\DirectShow\x64\Mv  
DSS\register.bat
```

For x86 systems, run the same files from \x86 folder instead.

- Reboot the system.

4. Network configuration

- Make sure that the camera is connected and powered (PowerLED “blue”)
- Run the application “MVS”.
 - o If the camera is connected, it shows within the “GigE” tree under the network adapter.
 - o If the network adapter is set to DHCP, the camera gets an address starting with “169.254...”. In this case it is required to reconfigure the network interface to a static IP. Right-Click the network adaptor and select “NIC Settings”



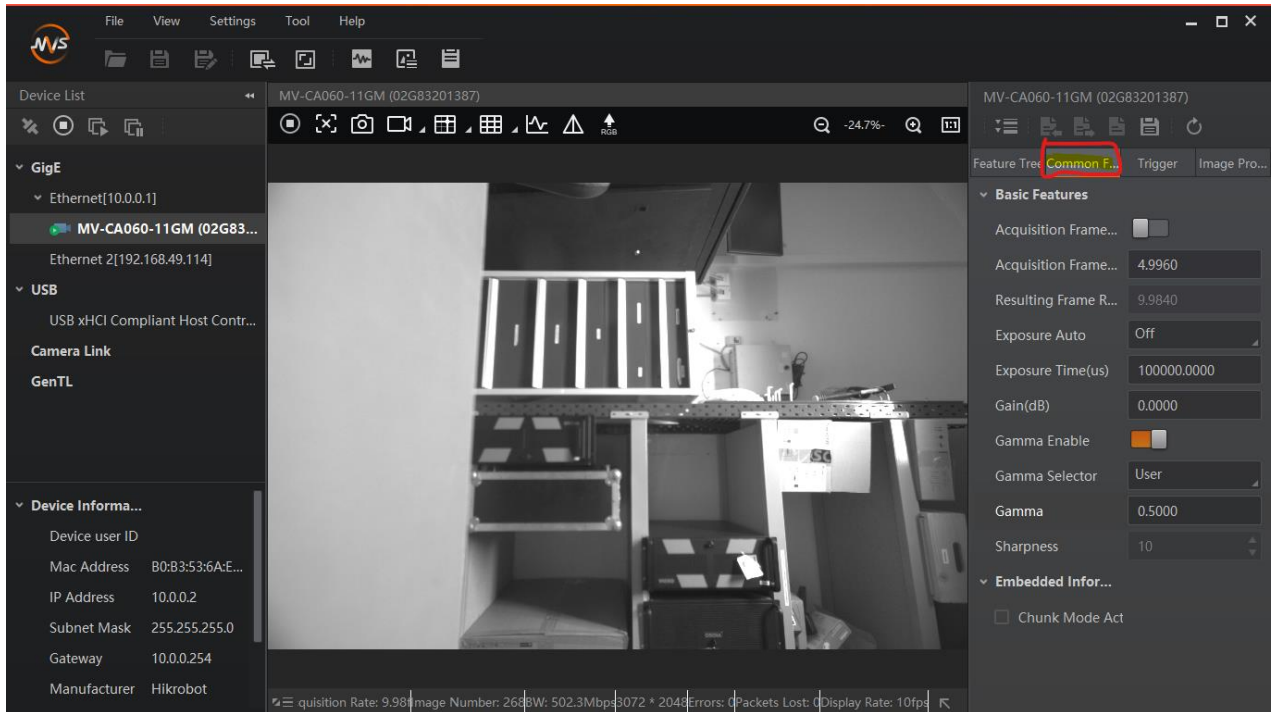
- In the window “NIC Configurator” click “Internet protocol properties” to access the Windows network settings. Change to static IP setting and enter an appropriate IP (e.g. 10.0.0.1 / 255.0.0.0 for a point-to-point connection). If the network already is set to a fixed IP, you can skip this step.
- Terminate everything with “OK” and “Apply”.
- Right-Click on the camera name and open the “Modify IP Address” dialog. Enter an IP that fits to the IP range entered for this ethernet connection (e.g. 10.0.0.2 according to the example above)
- This way the camera has a fixed IP, that will make all subsequent tasks for calibration more transparent.

5. Basic configuration

All settings of the camera can be done in the “MVS” software. It is a complex tool, allowing a lot of settings to be made. But we recommend to stick to some very fundamental settings only, leaving as much as possible untreated. All settings that are done by the MVS software are persistent in the camera.

Once the camera network configuration is complete, the camera icon gets green, indicating that the camera is ready to be operated. Launch the preview by double clicking the camera and press the “Play” Button in the top button bar to display a live camera image.

Now it's time to switch off all ambient light sources and have the projectors powered on. Use the live view to position the cameras while filming the projection surface. The projectors should display a solid color (ideally white) so that the camera can be set to an appropriate sensitivity.



Common parameters

Switch to the tab “Common Functions” to handle the most important parameters of the camera sensor:

- **Acquisition Framerate:** Deactivate
- **Exposure Auto:** always set to OFF!

For the first time, you can set it to “once” to get an initial value of auto-exposure and start seeing a bright image, then turn it back off.

- **Exposure time:** Set to a value that matches with the brightness of the filmed scene. By setting the exposure, the framerate automatically adapts accordingly. Please evaluate the exposure when projectors are displaying bright content, filling all the projection area.
- **Gamma Enable:** OFF/ON – if the camera image is too dark, enable Gamma and use either of the selectors to change to an appropriate level. Try to maintain a high contrast when setting a user defined gamma value.

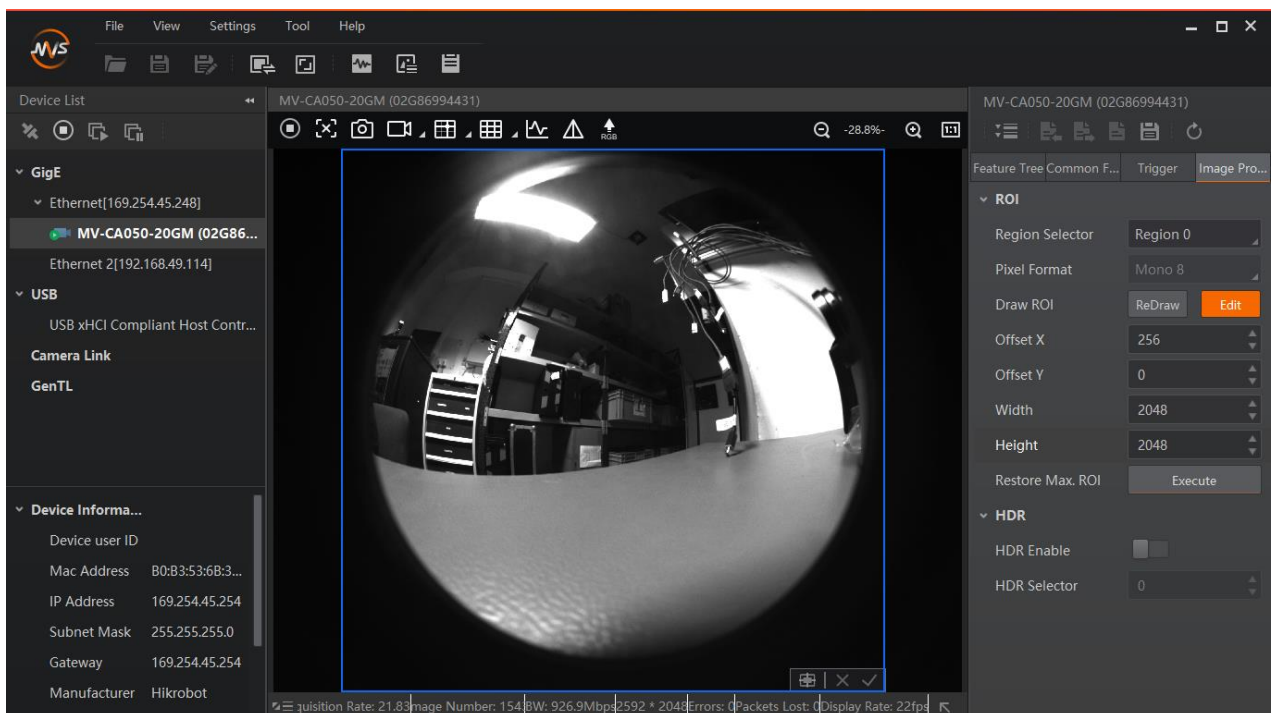
Region of Interest / Image cropping

Switch to the tab “Image Properties” to crop the image. By reducing the image size, e.g. cropping unnecessary parts of the image, the frame rate can be increased, this speeding up the scanning procedure.

- **Draw ROI [Edit]:** Starts an interactive drawing tool that helps positioning the region of interest onto the current camera image. By dragging and resizing, the values for Offset X/Y and size of the ROI are adjusted. Click the “confirm” icon at the bottom right corner of the rectangle to activate the region of interest, thus cropping the other parts of the image
- **Restore Max. ROI:** resets all settings so that the whole image is used

Example: To set the ROI of a fulldome calibration kit to match the fisheye lens, set...

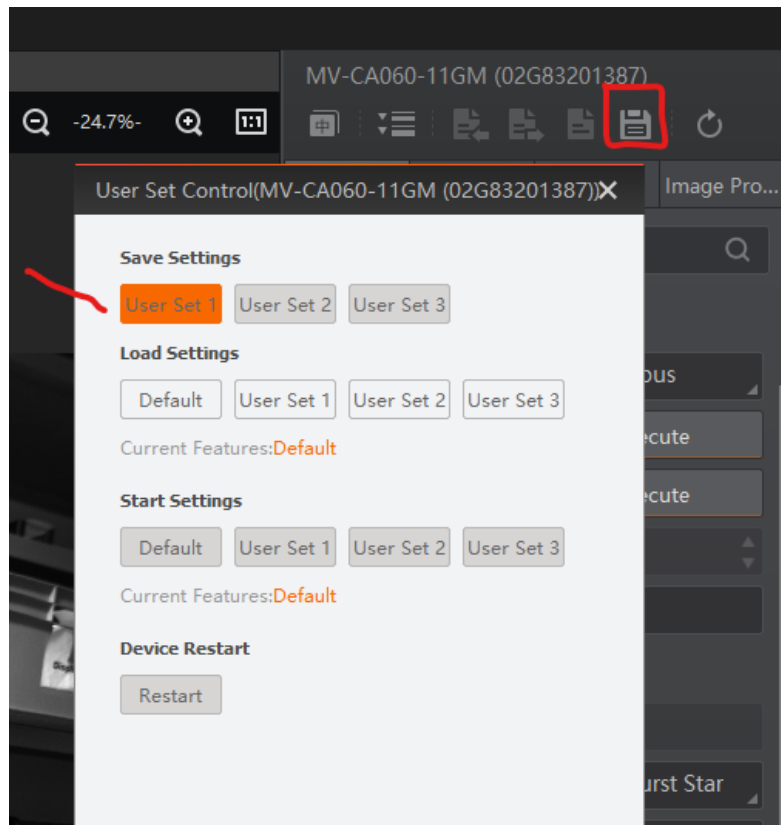
- Width = 2048
- Offset = 256



User Settings

Even though all settings made in the MVS software are immediately stored inside the camera, it is still possible to handle multiple sets of configurations. This “User Control sets” menu is accessible from the top right button bar. Usually it is not required to handle several parameter settings, but if there is a demanding situation the usage of several user sets can help to maintain a well-controlled workflow.

You can also set “Start Settings” to be your specified User Set if you experience problems of camera losing its setting on reboots or after unplug/replugs.



6. Using the camera in Analog Way calibrator

Once the camera is configured, MVS software must be closed.

Note: It is not possible to access the camera within Analog Way calibrator if the camera is opened in MVS.

The camera will show up as “DirectShow” device with a device name like “HIKRobot MV...”. All parameters are available in a large parameter tree, that can be filtered by categories and complexity (“Guru”, “Beginner” ...). Though all parameters seem accessible, it is not recommended to do many changes here, because of a bad user experience:

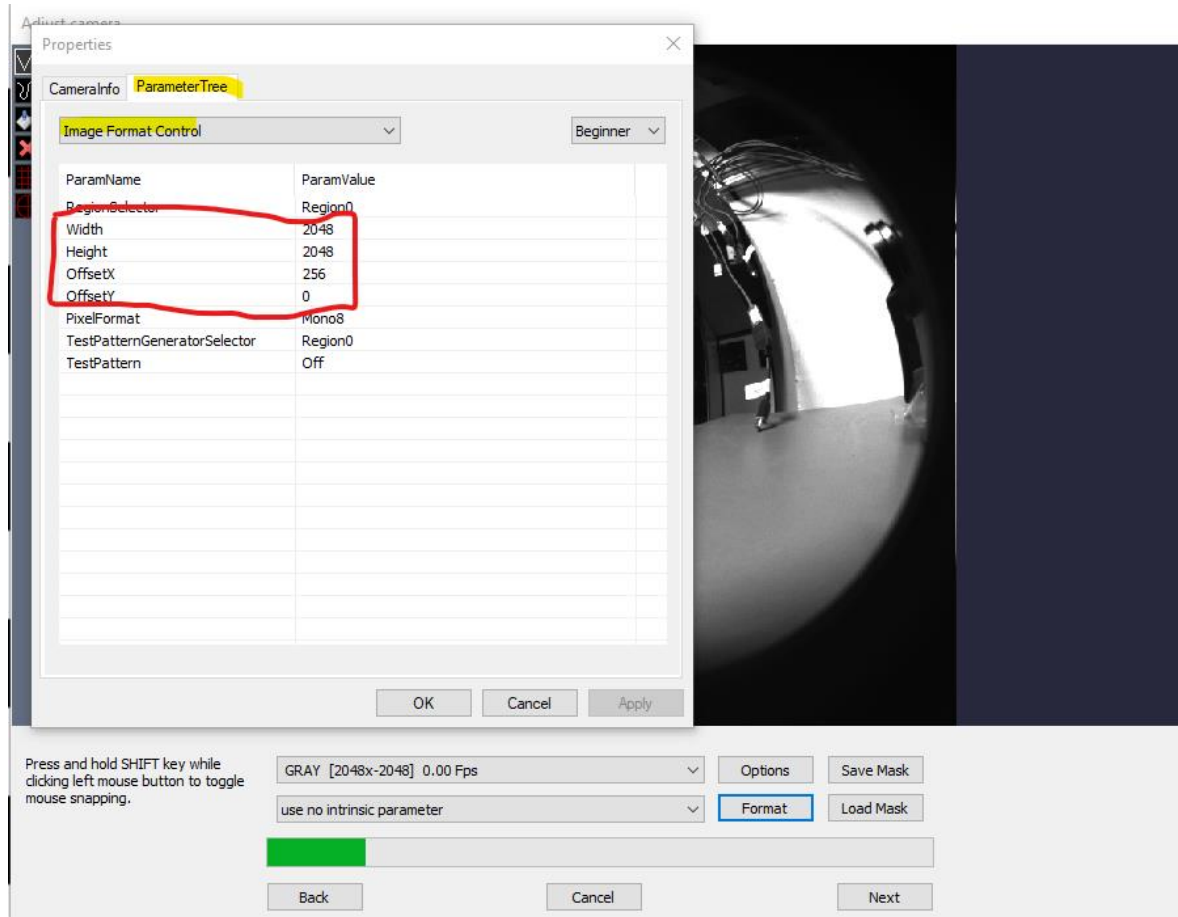
- It is hard to browse through the vast parameter tree
- After each parameter change, the dialog closes and must be re-opened and browsed through again

For “last minute” changes, though, we recommend concentrating on these parameters:

- Acquisition Control: Manipulate here the “Exposure time” to adjust the camera sensitivity to the test pattern displayed by the projectors
- Image Format Control: Use the values “Width/Height” as well as “OffsetX/Y” to enter a (well known) region of interest:

Example: crop the image of a full-dome calibration kit to fit the lens:

- set Width = 2048
- set OffsetX = 256



Since the usability of these dialogs is challenging, we recommend making these settings in the MVS application.

Notes about Multi-Camera usage:

- In MVS, when switching between cameras views, stop acquisition on the previous first or you will have bandwidth error warnings.
- In Calibrator MRD window (Model View Control) you might not see the camera full name in the dropdown menu. To check if it's the right camera assigned, open the MRD file you created in a text editor. It is in XML format where `defCamName` parameter refers to the camera that calibrated the selected compound.
- It can be helpful to fix camera custom names in MVS (Right Click the camera > Rename User ID). They will appear in Calibrator under "adjust camera > Options > Camera info"