



SmartCow[®]

An AI Engineering Company

SmartCam

User's Manual

October 2022

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This manual provides an overview of SmartCam as well as instructions for anyone involved in SmartCam installation and operation. The document is intended to ensure the safe and efficient operation of the device by the operating personnel.

Topics:

- [Features and key benefits](#)
- [SmartCam specifications](#)
- [Mechanical and input/output connections](#)

SmartCam is an AI camera with high-resolution sensors suitable for smart retail, smart factories, and smart cities.


2.1 Features and key benefits


The following are the key benefits of SmartCam.

- Compact camera design with high computing power, up to 1.33 TFLOPs AI performance
- IP66-rated enclosure that can withstand harsh conditions
- Flexible power sources that support both PoE+ and DC power
- 5MP CMOS camera sensor with wide-angle lens, suitable for a variety of AI recognition applications
- Powered by NVIDIA Jetson platform
- ONVIF compliant
- mSATA 128G storage

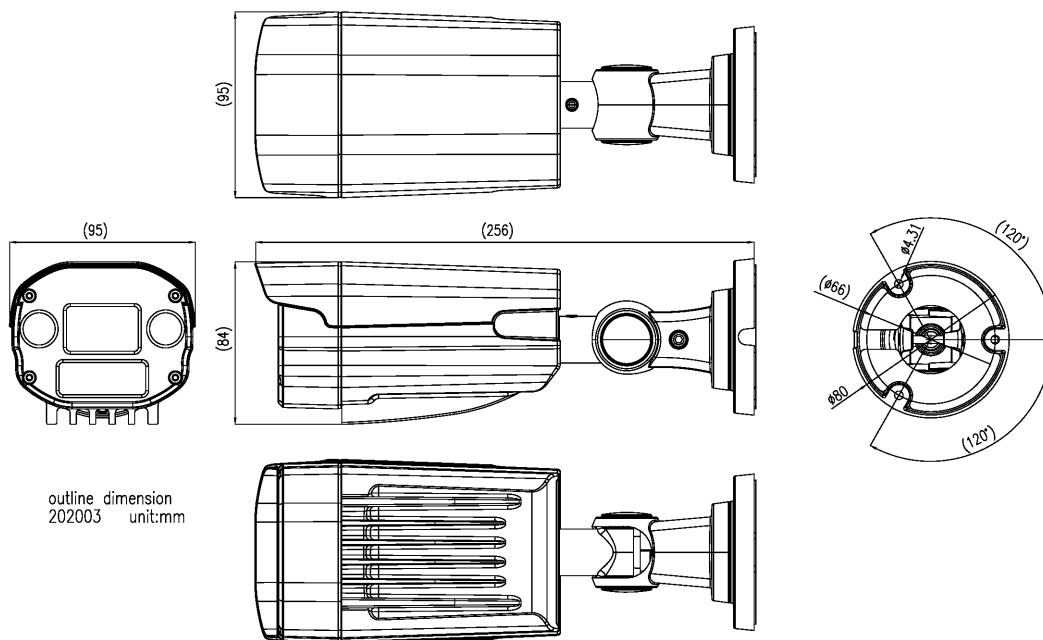
2.2 SmartCam specifications

Table 1: SmartCam specifications

Video	Max. Image Resolution	2592H x 1944V	
	Video Stream Codec	H.264 / H.265 supported	
	Bit Rate Control	CBR / VBR	
Camera	Image Sensor	AR0521(1/2.5") from ON Semiconductor	
	 Tip: Pixel size and sensor active area parameters are useful when dewarping an image to remove lens distortion.	Type/ Optical Size	1/2.5" Optical format CMOS image sensor
		Resolution	5MP
		Image Format	UYVY
		Pixel Size	2.2μm x 2.2μm
		Sensor Active Area	2592 (H) x 1944 (V)
		Responsivity	18.8 ke—/lux-sec
		SNR	40dB
		Dynamic Range	74.3dB
	WDR	Digital WDR	
	Day/Night Mode	N.A.	
Lens	S/N Ratio	40dB	
	Focal Length	3mm	
	Field of View	140.5°(D) x 110°(H) x 82°(V)	
	Focus Control	Fixed	
	Aperture	F2.8	

	Iris Control	Fixed
Network	Ethernet	1x GBE through RJ45 connector
	ONVIF	Profile S
	Protocol	IPv4, IPv6, TCP, UDP, ARP, HTTP, HTTPS, DNS, RTP/RTCP, RTSP
General	Operating Temperature	-20 ~ +60°C
	Operating Humidity	10% ~ 90%
	Power Input	DC Jack 12V / POE+ (IEEE 802.3at)  Important: Does not support IEEE 802.3af.
	Power Consumption	30W Max
	Expansion	Optionally support GNSS feature. (33 channels support GPS L1 C/A, GLONASS L1 C/A, Beidou B1 C/A, QZSS)
Mechanical	Dimensions	95mm x 84mm x 256mm
	Housing Material	Aluminum
	Weight	850g
Certification	CE / FCC / RoHS / NEMA / IP66	

2.3 Mechanical and input/output connections



Topics:

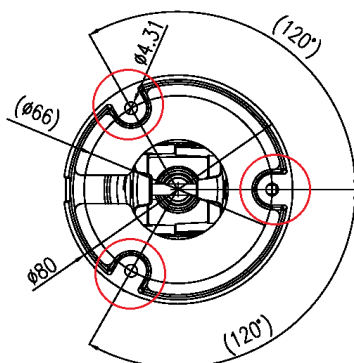
- [Prerequisites](#)
- [General steps to use your SmartCam](#)
- [Running the SmartCam Discovery Tool](#)
- [Running Web Preview App on SmartCam](#)
- [Changing the camera's sensor configuration](#)
- [Adjusting the exposure compensation for low-light conditions](#)

3.1 Prerequisites

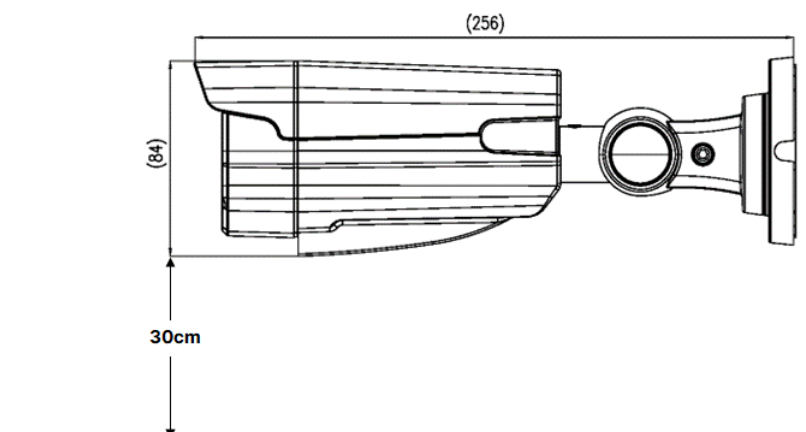
Mounting

Ensure that you meet the following requirements when mounting SmartCam.

- Always mount SmartCam using the mounting screw holes on the camera's base.



- To ensure heat dissipation, keep a minimum distance of 12" (30cm) between the base of the mounted SmartCam fin and the nearest obstacle.



- Do not install SmartCam in direct sunlight.

Electrical requirements

Use *one* of the following power supplies to turn on the SmartCam.

- DC 12V 5A power supply using an adapter with a 2.1 x 5.5 x 11 mm output connector.


- POE+ switch (IEEE 802.3at standard) using a CAT5e cable or above.



Note: When choosing to power SmartCam through POE, ensure that the power supply of the POE+ switch selected is at least 30W and in compliance with IEEE 802.3at (POE+) standard.

3.2 General steps to use your SmartCam

Table 2: General steps

Sl. No	Step	Additional Information
1.	Connect SmartCam to the power supply.	Electrical requirements
2.	If you are using DC 12V 5A power supply, connect the Ethernet cable to the RJ45 jack.	
3.	Find your SmartCam's IP address using the SmartCam Discovery Tool.	Running the SmartCam Discovery Tool  Tip: You can identify the SmartCam by its hostname, tegra-ubuntu.local. Alternatively, you can scan your network with IP scanners such as zenmap or angry ip scanner to find your SmartCam's IP address.
4.	SSH into the SmartCam.	To ssh into your SmartCam, use the IP address discovered using SmartCam Discovery Tool and then run the following command. <pre>ssh nvidia@192.168.xxx.xxx default password: nvidia</pre>
5.	Run the Web Preview App on SmartCam and then view the live video stream on any compatible web browser.	Running Web Preview App on SmartCam on page 9
6.	<i>(Optional)</i> Change the camera's sensor configuration.	Changing the camera's sensor configuration on page 10
7.	<i>(Optional)</i> Adjust the exposure compensation for low-light conditions.	Adjusting the exposure compensation for low-light conditions on page 11

3.3 Running the SmartCam Discovery Tool

Use the SmartCam Discovery Tool to scan and discover all cameras within the network's local IP range.

On Windows

1. Download the SmartCam Discovery Tool.

https://smartcow-smartcam-discovery-tool.s3.us-east-2.amazonaws.com/windows/SmartCamDiscoveryInstaller_0.0.1.zip

2. Install and configure SmartCam Discovery tool.

- a. Extract SmartCamDiscoveryInstaller.exe from the downloaded ZIP file.
- b. Run the installer.

By default, a desktop shortcut is created, and the system prompts you for firewall access during the first time you launch the tool. You can use the tool for discovery after allowing firewall access.



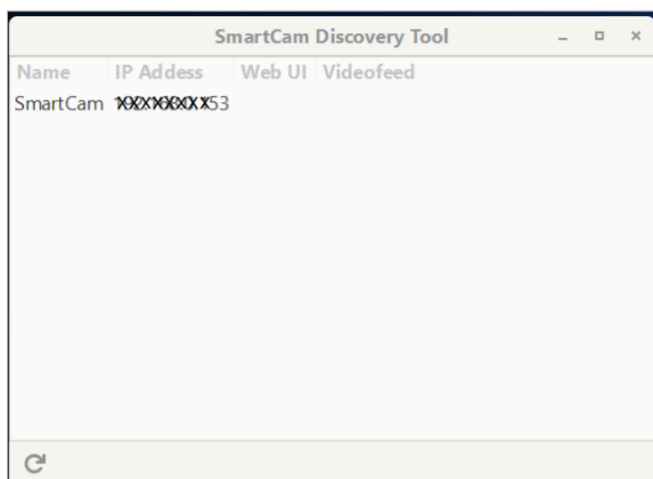
Note: If you are prompted with a warning window, select **More Info** and click on **Run Anyway**, and then proceed with the rest of the installation steps.

3. Run the SmartCam Discovery tool on your computer to get a list of cameras on your local network.

To run the SmartCam Discovery Tool, double-click the shortcut icon pointing to the executable file that is available at the default installation folder:

C:\Program Files\SmartCow Discovery Tool

You can view the camera's name and IP address as shown in the following figure.



On Ubuntu

1. Download the SmartCam Discovery Tool.

https://smartcow-smartcam-discovery-tool.s3.us-east-2.amazonaws.com/linux/smartcam-discovery_0.0.1-bionic_amd64.deb

2. Install and configure SmartCam Discovery tool.

To install the smartcam-discovery package, run the following command.

```
sudo apt install [path/to/.deb file]
```

For example:

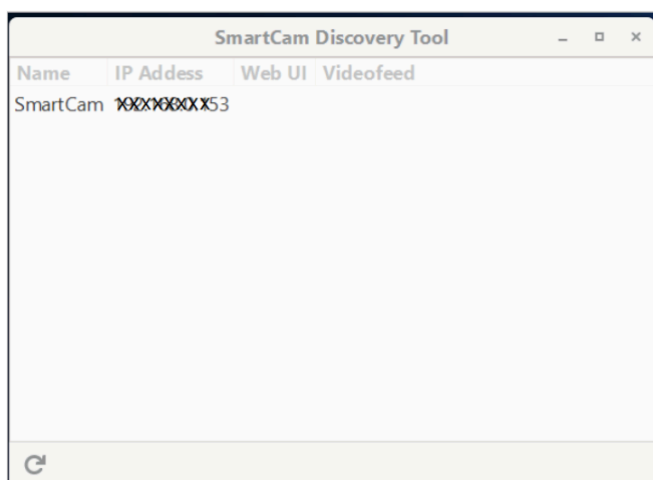
```
sudo apt install smartcam-discovery_0.0.1-bionic_amd64.deb
```

3. Run the SmartCam Discovery tool on your computer to get a list of cameras on your local network.

To run the SmartCam Discovery tool, run the following command.

```
smartcam-discovery-gtk
```

You can view the camera's name and IP address as shown in the following figure.



3.4 Running Web Preview App on SmartCam

SmartCam Web Preview is a web application that captures video feed from SmartCow cameras and displays the live video stream on any compatible web browser.

Before you begin

- Ensure that SmartCam has a discoverable public IP address and within the same network as the SmartCam Web Preview.
- Supported browsers: Google Chrome

About this task

The application is pre-installed on all SmartCow cameras and is available to all SmartCow users. You can use this application to preview the captured video feed and adjust the camera's position and angle as needed.

Procedure

1. To ssh into your SmartCam, use the discovered IP address and then run the following command.

```
ssh nvidia@192.168.xxx.xxx default
password: nvidia
```

2. To launch the Web Preview App on your SmartCam, run the following command.

```
smartcam-web-preview
```

3. If the application is not installed and the command above failed to run, reach out to the SmartCow team for the credentials to download the application from the `apt` repository.

```
user=xxxx
password=xxxxxxxxx
sudo apt update
sudo apt install -y curl ca-certificates
curl -sLf "https://$user:$password@smartcow.io/apt/gpg.key" | sudo apt-key add -
echo "deb https://smartcow.io/apt/repo/smartcam-web-preview-dev $(grep
'^DISTRIB_CODENAME=' /etc/lsb-release | cut -f2 -d=) multiverse" | sudo tee -a /etc/apt/sources.list.d/
smartcow-repo.list
echo "machine smartcow.io login $user password $password" | sudo tee -a
/etc/apt/auth.conf.d/smartcow-repo.conf>/dev/null
sudo apt update
sudo apt install -y smartcam-web-preview
```

4. When the application is running, type the IP address of your SmartCam with port number 8080 on your browser to check the camera feed preview.

For example, `https://<SmartCam_IP_address>:8080`

3.4.1 Updating Web Preview App to a new version

Procedure

To run a new version of Web Preview App, run the following command.

```
sudo apt-get install --only-upgrade smartcam-web-preview
```

3.5 Changing the camera's sensor configuration

You can install and use the `v4l2-ctl` utility to change the sensor configuration of the camera.

Procedure

1. Run the SmartCam Discovery Tool to get the SmartCam's IP address.
For more information, see [Running the SmartCam Discovery Tool](#).
2. Install the `v4l2-ctl` utility.

At the terminal, type the following command.

```
sudo apt install v4l-utils
```

3. To view a list of configuration parameters, type the following command.

```
v4l2-ctl --all
```

The configuration parameters that are most commonly used are listed in the following table.

Table 3: Configuration parameters

Controls	Minimum Value	Maximum Value	Default Value	Auto Control
Brightness	-15	15	0	NO
Contrast	0	30	10	NO
Saturation	0	60	16	NO
White Balance	1000	10000	4500	YES
Gamma	40	500	220	NO
Gain	1	100	1	NO
Horizontal Flip	0	1	0	NO
Vertical Flip	0	1	0	NO
Sharpness	0	127	16	NO
Exposure	1(100 μ s)	4300 (430ms)	312(31.2ms)	YES
Pan	-648000	648000	0	NO
Tilt	-648000	648000	0	NO
Zoom	100	800	100	NO
ROI Window Size	8	64	24	NO
Denoise	0	15	8	NO
Exposure Compensation	8000	430000	140000	NO

4. To change a parameter, use the `--set-ctrl` argument.

For example, to set the brightness level to 5, run the following command.

```
v4l2-ctl --set-ctrl=brightness=5
```

3.6 Adjusting the exposure compensation for low-light conditions

About this task

To achieve good low light quality, it is essential to adjust the exposure according to the change in lighting conditions. To support this feature, SmartCam has the full field of view (FoV) auto mode that changes SmartCam's exposure based on the lighting conditions to provide the best low light quality.



Note: Lower FPS can occur when the auto exposure algorithm increases the exposure to compensate for the lighting in the scene.

To maintain the frame rate under low-light conditions, you can use the `v4l2-ctl` utility to set the exposure compensation value.

Before you begin Ensure that you have installed the `v4l2-ctl` utility. For more information, see [Changing the camera's sensor configuration](#) on page 10.

Procedure

1. Calculate (estimate) the exposure compensation value.

You can calculate (estimate) the exposure compensation value using the following formula.

Exposure compensation = $1/(\text{frames per second (FPS)})$. For example, exposure compensation = $1/28\text{FPS} = 35\text{ms}$.



Note: Setting the exposure compensation value to a lower value can result in a decrease in image quality.

2. Run the `v4l2-ctl` utility.

For example, if you want to set the exposure compensation to 35ms, run the following command.

```
v4l2-ctl --set-ctrl=exposure_compensation=35000
```



Note: This calculation only applies to the maximum exposure time for slow moving targets. If you want to capture very fast moving objects, for example, lower the exposure value because the speed of the object must be considered in this calculation.

Topics:

- [Running a DeepStream application for viewing the RTSP stream](#)

This section provides some examples of applications and use cases.

Running a DeepStream application for viewing the RTSP stream

About this task

This example demonstrates how to use the SmartCam with DeepStream. It uses SmartCam's video stream as input, runs inference and streams output as an RTSP stream. This app uses `resnet10.caffemodel` for detection.



Note: This example optimizes the model for Int8 precision. Because SmartCam is built on the Jetson TX2 NX module, the default precision will be FP16 precision.

Procedure

1. Change the directory to the folder containing the DeepStream application.

```
cd /opt/nvidia/deepstream/deepstream/samples/configs/deepstream-app
```

2. Edit the `source1_usb_dec_infer_resnet_int8.txt` file.

```
sudo vim source1_usb_dec_infer_resnet_int8.txt
```

3. Change the following parameter values in the `source1_usb_dec_infer_resnet_int8.txt` file to match the following values.

```
#line 35 onwards
[source0]
enable=1
#Type - 1=CameraV4L2 2=URI 3=MultiURI type=1
camera-width=2592
camera-height=1944
camera-fps-n=28
camera-fps-d=1
camera-v4l2-dev-node=0
#line 46 Disable overlay sink
[sink0]
enable=0
#line 75 Enable RTSP stream
[sink2]
enable=1
```

4. Save the `source1_usb_dec_infer_resnet_int8.txt` file.
5. Run the application by running the following command.


```
deepstream-app -c ./source1_usb_dec_infer_resnet_int8.txt
```

After the pipeline starts playing, you can view the RTSP stream at:

```
rtsp://<SmartCam_IP_address>:8554/ds-test
```

This section describes the troubleshooting scenarios and frequently asked questions.

Table 4: Troubleshooting and FAQs

Problem	Solution
I am unable to discover any cameras after running the discovery tool.	Check that firewall access is enabled and that the cameras are installed on the same network as your computer.
When I use the Google Chrome browser, I am unable to view the preview or an invalid web page is displayed.	Run the Web Preview application in debug mode using the following commands and send the logs to the SmartCow personnel with whom you are liaising. <pre>export GST_DEBUG="*:3" smartcam-web-preview --verbose --debug</pre>
The SmartCam Discovery Tool is not running. How do I find SmartCam's IP address?	<ul style="list-style-type: none"> • Ensure that the power adapter jack is not loose. • You can scan your network with IP scanners such as zenmap or angry ip scanner to find your SmartCam's IP address. <p>You can identify the SmartCam by its hostname, <code>tegra-ubuntu.local</code>.</p>
How do I reset SmartCam?	<p>When SmartCam is powered on, press and hold the reset button for three seconds.</p> 

Document control

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