

# Camera Control Reference

The Camera class includes controls for mechanical (or equivalent digital) features of a device such as controllable lenses or sensors.

## Camera Control IDs

V4L2\_CID\_CAMERA\_CLASS (class)

The Camera class descriptor. Calling [ref`VIDIOC\\_QUERYCTRL`](#) for this control will return a description of this control class.

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v4l\[linux-master] [Documentation] [userspace-api] [media] [v4l]ext-ctrls-camera.rst, line 19); [backlink](#)**

Unknown interpreted text role "ref".

V4L2\_CID\_EXPOSURE\_AUTO

(enum)

enum v4l2\_exposure\_auto\_type -

Enables automatic adjustments of the exposure time and/or iris aperture. The effect of manual changes of the exposure time or iris aperture while these features are enabled is undefined, drivers should ignore such requests. Possible values are:

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v4l\[linux-master] [Documentation] [userspace-api] [media] [v4l]ext-ctrls-camera.rst, line 35)**

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.. tabularcolumns:: |p{7.1cm}|p{10.4cm}|
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**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v4l\[linux-master] [Documentation] [userspace-api] [media] [v4l]ext-ctrls-camera.rst, line 37)**

Unknown directive type "flat-table".

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.. flat-table::
   :header-rows: 0
   :stub-columns: 0

   * - ``V4L2_EXPOSURE_AUTO``
     - Automatic exposure time, automatic iris aperture.
   * - ``V4L2_EXPOSURE_MANUAL``
     - Manual exposure time, manual iris.
   * - ``V4L2_EXPOSURE_SHUTTER_PRIORITY``
     - Manual exposure time, auto iris.
   * - ``V4L2_EXPOSURE_APERTURE_PRIORITY``
     - Auto exposure time, manual iris.
```

V4L2\_CID\_EXPOSURE\_ABSOLUTE (integer)

Determines the exposure time of the camera sensor. The exposure time is limited by the frame interval. Drivers should interpret the values as 100  $\mu$ s units, where the value 1 stands for 1/10000th of a second, 10000 for 1 second and 100000 for 10 seconds.

V4L2\_CID\_EXPOSURE\_AUTO\_PRIORITY (boolean)

When V4L2\_CID\_EXPOSURE\_AUTO is set to AUTO or APERTURE\_PRIORITY, this control determines if the device may dynamically vary the frame rate. By default this feature is disabled (0) and the frame rate must remain constant.

V4L2\_CID\_AUTO\_EXPOSURE\_BIAS (integer menu)

Determines the automatic exposure compensation, it is effective only when V4L2\_CID\_EXPOSURE\_AUTO control is set to AUTO, SHUTTER\_PRIORITY or APERTURE\_PRIORITY. It is expressed in terms of EV, drivers should interpret the values as 0.001 EV units, where the value 1000 stands for +1 EV.

Increasing the exposure compensation value is equivalent to decreasing the exposure value (EV) and will increase the

amount of light at the image sensor. The camera performs the exposure compensation by adjusting absolute exposure time and/or aperture.

V4L2\_CID\_EXPOSURE\_METERING

(enum)

enum v4l2\_exposure\_metering -

Determines how the camera measures the amount of light available for the frame exposure. Possible values are:

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v4l\linux-master\Documentation\userspace-api\media\v4l\ext-ctrls-camera.rst, line 85)**

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**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v4l\linux-master\Documentation\userspace-api\media\v4l\ext-ctrls-camera.rst, line 87)**

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.. flat-table::
   :header-rows: 0
   :stub-columns: 0

   * - ``V4L2_EXPOSURE_METERING_AVERAGE``
     - Use the light information coming from the entire frame and average
       giving no weighting to any particular portion of the metered area.
   * - ``V4L2_EXPOSURE_METERING_CENTER_WEIGHTED``
     - Average the light information coming from the entire frame giving
       priority to the center of the metered area.
   * - ``V4L2_EXPOSURE_METERING_SPOT``
     - Measure only very small area at the center of the frame.
   * - ``V4L2_EXPOSURE_METERING_MATRIX``
     - A multi-zone metering. The light intensity is measured in several
       points of the frame and the results are combined. The algorithm of
       the zones selection and their significance in calculating the
       final value is device dependent.
```

V4L2\_CID\_PAN\_RELATIVE (integer)

This control turns the camera horizontally by the specified amount. The unit is undefined. A positive value moves the camera to the right (clockwise when viewed from above), a negative value to the left. A value of zero does not cause motion. This is a write-only control.

V4L2\_CID\_TILT\_RELATIVE (integer)

This control turns the camera vertically by the specified amount. The unit is undefined. A positive value moves the camera up, a negative value down. A value of zero does not cause motion. This is a write-only control.

V4L2\_CID\_PAN\_RESET (button)

When this control is set, the camera moves horizontally to the default position.

V4L2\_CID\_TILT\_RESET (button)

When this control is set, the camera moves vertically to the default position.

V4L2\_CID\_PAN\_ABSOLUTE (integer)

This control turns the camera horizontally to the specified position. Positive values move the camera to the right (clockwise when viewed from above), negative values to the left. Drivers should interpret the values as arc seconds, with valid values between  $-180 * 3600$  and  $+180 * 3600$  inclusive.

V4L2\_CID\_TILT\_ABSOLUTE (integer)

This control turns the camera vertically to the specified position. Positive values move the camera up, negative values down. Drivers should interpret the values as arc seconds, with valid values between  $-180 * 3600$  and  $+180 * 3600$  inclusive.

V4L2\_CID\_FOCUS\_ABSOLUTE (integer)

This control sets the focal point of the camera to the specified position. The unit is undefined. Positive values set the focus closer to the camera, negative values towards infinity.

V4L2\_CID\_FOCUS\_RELATIVE (integer)

This control moves the focal point of the camera by the specified amount. The unit is undefined. Positive values move the focus closer to the camera, negative values towards infinity. This is a write-only control.

V4L2\_CID\_FOCUS\_AUTO (boolean)

Enables continuous automatic focus adjustments. The effect of manual focus adjustments while this feature is enabled is undefined, drivers should ignore such requests.

V4L2\_CID\_AUTO\_FOCUS\_START (button)

Starts single auto focus process. The effect of setting this control when V4L2\_CID\_FOCUS\_AUTO is set to TRUE (1) is undefined, drivers should ignore such requests.

V4L2\_CID\_AUTO\_FOCUS\_STOP (button)

Aborts automatic focusing started with V4L2\_CID\_AUTO\_FOCUS\_START control. It is effective only when the continuous autofocus is disabled, that is when V4L2\_CID\_FOCUS\_AUTO control is set to FALSE (0).

V4L2\_CID\_AUTO\_FOCUS\_STATUS (bitmask)

The automatic focus status. This is a read-only control.

Setting V4L2\_LOCK\_FOCUS lock bit of the V4L2\_CID\_3A\_LOCK control may stop updates of the V4L2\_CID\_AUTO\_FOCUS\_STATUS control value.

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v41\[linux-master] [Documentation] [userspace-api] [media] [v41]ext-ctrls-camera.rst, line 177)**

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**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v41\[linux-master] [Documentation] [userspace-api] [media] [v41]ext-ctrls-camera.rst, line 179)**

Unknown directive type "flat-table".

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   :stub-columns: 0

   * - ``V4L2_AUTO_FOCUS_STATUS_IDLE``
     - Automatic focus is not active.
   * - ``V4L2_AUTO_FOCUS_STATUS_BUSY``
     - Automatic focusing is in progress.
   * - ``V4L2_AUTO_FOCUS_STATUS_REACHED``
     - Focus has been reached.
   * - ``V4L2_AUTO_FOCUS_STATUS_FAILED``
     - Automatic focus has failed, the driver will not transition from
       this state until another action is performed by an application.
```

V4L2\_CID\_AUTO\_FOCUS\_RANGE  
(enum)

enum v4l2\_auto\_focus\_range -

Determines auto focus distance range for which lens may be adjusted.

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v41\[linux-master] [Documentation] [userspace-api] [media] [v41]ext-ctrls-camera.rst, line 203)**

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**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v41\[linux-master] [Documentation] [userspace-api] [media] [v41]ext-ctrls-camera.rst, line 205)**

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.. flat-table::
   :header-rows: 0
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   * - ``V4L2_AUTO_FOCUS_RANGE_AUTO``
     - The camera automatically selects the focus range.
   * - ``V4L2_AUTO_FOCUS_RANGE_NORMAL``
     - Normal distance range, limited for best automatic focus
       performance.
```

- \* - ``V4L2\_AUTO\_FOCUS\_RANGE\_MACRO``
  - Macro (close-up) auto focus. The camera will use its minimum possible distance for auto focus.
- \* - ``V4L2\_AUTO\_FOCUS\_RANGE\_INFINITY``
  - The lens is set to focus on an object at infinite distance.

V4L2\_CID\_ZOOM\_ABSOLUTE (integer)

Specify the objective lens focal length as an absolute value. The zoom unit is driver-specific and its value should be a positive integer.

V4L2\_CID\_ZOOM\_RELATIVE (integer)

Specify the objective lens focal length relatively to the current value. Positive values move the zoom lens group towards the telephoto direction, negative values towards the wide-angle direction. The zoom unit is driver-specific. This is a write-only control.

V4L2\_CID\_ZOOM\_CONTINUOUS (integer)

Move the objective lens group at the specified speed until it reaches physical device limits or until an explicit request to stop the movement. A positive value moves the zoom lens group towards the telephoto direction. A value of zero stops the zoom lens group movement. A negative value moves the zoom lens group towards the wide-angle direction. The zoom speed unit is driver-specific.

V4L2\_CID\_IRIS\_ABSOLUTE (integer)

This control sets the camera's aperture to the specified value. The unit is undefined. Larger values open the iris wider, smaller values close it.

V4L2\_CID\_IRIS\_RELATIVE (integer)

This control modifies the camera's aperture by the specified amount. The unit is undefined. Positive values open the iris one step further, negative values close it one step further. This is a write-only control.

V4L2\_CID\_PRIVACY (boolean)

Prevent video from being acquired by the camera. When this control is set to `TRUE` (1), no image can be captured by the camera. Common means to enforce privacy are mechanical obturation of the sensor and firmware image processing, but the device is not restricted to these methods. Devices that implement the privacy control must support read access and may support write access.

V4L2\_CID\_BAND\_STOP\_FILTER (integer)

Switch the band-stop filter of a camera sensor on or off, or specify its strength. Such band-stop filters can be used, for example, to filter out the fluorescent light component.

V4L2\_CID\_AUTO\_N\_PRESET\_WHITE\_BALANCE  
(enum)

enum v4l2\_auto\_n\_preset\_white\_balance -

Sets white balance to automatic, manual or a preset. The presets determine color temperature of the light as a hint to the camera for white balance adjustments resulting in most accurate color representation. The following white balance presets are listed in order of increasing color temperature.

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v4l\linux-master\Documentation\userspace-api\media\v4l\ext-ctrls-camera.rst, line 278)**

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**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v4l\linux-master\Documentation\userspace-api\media\v4l\ext-ctrls-camera.rst, line 280)**

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   :stub-columns: 0
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- \* - ``V4L2\_WHITE\_BALANCE\_MANUAL``
  - Manual white balance.
- \* - ``V4L2\_WHITE\_BALANCE\_AUTO``
  - Automatic white balance adjustments.
- \* - ``V4L2\_WHITE\_BALANCE\_INCANDESCENT``
  - White balance setting for incandescent (tungsten) lighting. It generally cools down the colors and corresponds approximately to 2500...3500 K color temperature range.
- \* - ``V4L2\_WHITE\_BALANCE\_FLUORESCENT``

- White balance preset for fluorescent lighting. It corresponds approximately to 4000...5000 K color temperature.
- \* - ``V4L2\_WHITE\_BALANCE\_FLUORESCENT\_H``
- With this setting the camera will compensate for fluorescent H lighting.
- \* - ``V4L2\_WHITE\_BALANCE\_HORIZON``
- White balance setting for horizon daylight. It corresponds approximately to 5000 K color temperature.
- \* - ``V4L2\_WHITE\_BALANCE\_DAYLIGHT``
- White balance preset for daylight (with clear sky). It corresponds approximately to 5000...6500 K color temperature.
- \* - ``V4L2\_WHITE\_BALANCE\_FLASH``
- With this setting the camera will compensate for the flash light. It slightly warms up the colors and corresponds roughly to 5000...5500 K color temperature.
- \* - ``V4L2\_WHITE\_BALANCE\_CLOUDY``
- White balance preset for moderately overcast sky. This option corresponds approximately to 6500...8000 K color temperature range.
- \* - ``V4L2\_WHITE\_BALANCE\_SHADE``
- White balance preset for shade or heavily overcast sky. It corresponds approximately to 9000...10000 K color temperature.

V4L2\_CID\_WIDE\_DYNAMIC\_RANGE (boolean)

Enables or disables the camera's wide dynamic range feature. This feature allows to obtain clear images in situations where intensity of the illumination varies significantly throughout the scene, i.e. there are simultaneously very dark and very bright areas. It is most commonly realized in cameras by combining two subsequent frames with different exposure times. [1]

V4L2\_CID\_IMAGE\_STABILIZATION (boolean)

Enables or disables image stabilization.

V4L2\_CID\_ISO\_SENSITIVITY (integer menu)

Determines ISO equivalent of an image sensor indicating the sensor's sensitivity to light. The numbers are expressed in arithmetic scale, as per [ref: iso12232](#) standard, where doubling the sensor sensitivity is represented by doubling the numerical ISO value. Applications should interpret the values as standard ISO values multiplied by 1000, e.g. control value 800 stands for ISO 0.8. Drivers will usually support only a subset of standard ISO values. The effect of setting this control while the V4L2\_CID\_ISO\_SENSITIVITY\_AUTO control is set to a value other than V4L2\_CID\_ISO\_SENSITIVITY\_MANUAL is undefined, drivers should ignore such requests.

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v4l\[linux-master] [Documentation] [userspace-api] [media] [v4l]ext-ctrls-camera.rst, line 334); [backlink](#)**

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V4L2\_CID\_ISO\_SENSITIVITY\_AUTO  
(enum)

enum v4l2\_iso\_sensitivity\_type -

Enables or disables automatic ISO sensitivity adjustments.

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v4l\[linux-master] [Documentation] [userspace-api] [media] [v4l]ext-ctrls-camera.rst, line 356)**

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.. flat-table::
   :header-rows: 0
   :stub-columns: 0

   * - ``V4L2_CID_ISO_SENSITIVITY_MANUAL``
     - Manual ISO sensitivity.
   * - ``V4L2_CID_ISO_SENSITIVITY_AUTO``
     - Automatic ISO sensitivity adjustments.
```

V4L2\_CID\_SCENE\_MODE

(enum)

enum v4l2\_scene\_mode -

This control allows to select scene programs as the camera automatic modes optimized for common shooting scenes. Within these modes the camera determines best exposure, aperture, focusing, light metering, white balance and equivalent sensitivity. The controls of those parameters are influenced by the scene mode control. An exact behavior in each mode is subject to the camera specification.

When the scene mode feature is not used, this control should be set to V4L2\_SCENE\_MODE\_NONE to make sure the other possibly related controls are accessible. The following scene programs are defined:

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v4l\linux-master [Documentation] [userspace-api] [media] [v4l]ext-ctrls-camera.rst, line 388)**

Unknown directive type "tabularcolumns".

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.. tabularcolumns:: |p{5.9cm}|p{11.6cm}|
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**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v4l\linux-master [Documentation] [userspace-api] [media] [v4l]ext-ctrls-camera.rst, line 390)**

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.. cssclass:: longtable
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**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v4l\linux-master [Documentation] [userspace-api] [media] [v4l]ext-ctrls-camera.rst, line 392)**

Unknown directive type "flat-table".

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.. flat-table::
   :header-rows: 0
   :stub-columns: 0

   * - ``V4L2_SCENE_MODE_NONE``
     - The scene mode feature is disabled.
   * - ``V4L2_SCENE_MODE_BACKLIGHT``
     - Backlight. Compensates for dark shadows when light is coming from
       behind a subject, also by automatically turning on the flash.
   * - ``V4L2_SCENE_MODE_BEACH_SNOW``
     - Beach and snow. This mode compensates for all-white or bright
       scenes, which tend to look gray and low contrast, when camera's
       automatic exposure is based on an average scene brightness. To
       compensate, this mode automatically slightly overexposes the
       frames. The white balance may also be adjusted to compensate for
       the fact that reflected snow looks bluish rather than white.
   * - ``V4L2_SCENE_MODE_CANDLELIGHT``
     - Candle light. The camera generally raises the ISO sensitivity and
       lowers the shutter speed. This mode compensates for relatively
       close subject in the scene. The flash is disabled in order to
       preserve the ambiance of the light.
   * - ``V4L2_SCENE_MODE_DAWN_DUSK``
     - Dawn and dusk. Preserves the colors seen in low natural light
       before dusk and after dawn. The camera may turn off the flash, and
       automatically focus at infinity. It will usually boost saturation
       and lower the shutter speed.
   * - ``V4L2_SCENE_MODE_FALL_COLORS``
     - Fall colors. Increases saturation and adjusts white balance for
       color enhancement. Pictures of autumn leaves get saturated reds
       and yellows.
   * - ``V4L2_SCENE_MODE_FIREWORKS``
     - Fireworks. Long exposure times are used to capture the expanding
       burst of light from a firework. The camera may invoke image
       stabilization.
   * - ``V4L2_SCENE_MODE_LANDSCAPE``
     - Landscape. The camera may choose a small aperture to provide deep
       depth of field and long exposure duration to help capture detail
       in dim light conditions. The focus is fixed at infinity. Suitable
       for distant and wide scenery.
   * - ``V4L2_SCENE_MODE_NIGHT``
     - Night, also known as Night Landscape. Designed for low light
       conditions, it preserves detail in the dark areas without blowing
       out bright objects. The camera generally sets itself to a
```

- medium-to-high ISO sensitivity, with a relatively long exposure time, and turns flash off. As such, there will be increased image noise and the possibility of blurred image.
- \* - ``V4L2\_SCENE\_MODE\_PARTY\_INDOOR``
    - Party and indoor. Designed to capture indoor scenes that are lit by indoor background lighting as well as the flash. The camera usually increases ISO sensitivity, and adjusts exposure for the low light conditions.
  - \* - ``V4L2\_SCENE\_MODE\_PORTRAIT``
    - Portrait. The camera adjusts the aperture so that the depth of field is reduced, which helps to isolate the subject against a smooth background. Most cameras recognize the presence of faces in the scene and focus on them. The color hue is adjusted to enhance skin tones. The intensity of the flash is often reduced.
  - \* - ``V4L2\_SCENE\_MODE\_SPORTS``
    - Sports. Significantly increases ISO and uses a fast shutter speed to freeze motion of rapidly-moving subjects. Increased image noise may be seen in this mode.
  - \* - ``V4L2\_SCENE\_MODE\_SUNSET``
    - Sunset. Preserves deep hues seen in sunsets and sunrises. It bumps up the saturation.
  - \* - ``V4L2\_SCENE\_MODE\_TEXT``
    - Text. It applies extra contrast and sharpness, it is typically a black-and-white mode optimized for readability. Automatic focus may be switched to close-up mode and this setting may also involve some lens-distortion correction.

V4L2\_CID\_3A\_LOCK (bitmask)

This control locks or unlocks the automatic focus, exposure and white balance. The automatic adjustments can be paused independently by setting the corresponding lock bit to 1. The camera then retains the settings until the lock bit is cleared. The following lock bits are defined:

When a given algorithm is not enabled, drivers should ignore requests to lock it and should return no error. An example might be an application setting bit V4L2\_LOCK\_WHITE\_BALANCE when the V4L2\_CID\_AUTO\_WHITE\_BALANCE control is set to FALSE. The value of this control may be changed by exposure, white balance or focus controls.

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v4l\[linux-master] [Documentation] [userspace-api] [media] [v4l]ext-ctrls-camera.rst, line 483)**

Unknown directive type "flat-table".

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.. flat-table::
   :header-rows: 0
   :stub-columns: 0

   * - ``V4L2_LOCK_EXPOSURE``
     - Automatic exposure adjustments lock.
   * - ``V4L2_LOCK_WHITE_BALANCE``
     - Automatic white balance adjustments lock.
   * - ``V4L2_LOCK_FOCUS``
     - Automatic focus lock.
```

V4L2\_CID\_PAN\_SPEED (integer)

This control turns the camera horizontally at the specific speed. The unit is undefined. A positive value moves the camera to the right (clockwise when viewed from above), a negative value to the left. A value of zero stops the motion if one is in progress and has no effect otherwise.

V4L2\_CID\_TILT\_SPEED (integer)

This control turns the camera vertically at the specified speed. The unit is undefined. A positive value moves the camera up, a negative value down. A value of zero stops the motion if one is in progress and has no effect otherwise.

V4L2\_CID\_CAMERA\_ORIENTATION (menu)

This read-only control describes the camera orientation by reporting its mounting position on the device where the camera is installed. The control value is constant and not modifiable by software. This control is particularly meaningful for devices which have a well defined orientation, such as phones, laptops and portable devices since the control is expressed as a position relative to the device's intended usage orientation. For example, a camera installed on the user-facing side of a phone, a tablet or a laptop device is said to be have V4L2\_CAMERA\_ORIENTATION\_FRONT orientation, while a camera installed on the opposite side of the front one is said to be have V4L2\_CAMERA\_ORIENTATION\_BACK orientation. Camera sensors not directly attached to the device, or attached in a way that allows them to move freely, such as webcams and digital cameras, are said to have the V4L2\_CAMERA\_ORIENTATION\_EXTERNAL orientation.



**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v4l\[linux-master] [Documentation] [userspace-api] [media] [v4l]ext-ctrls-camera.rst, line 525)**

Unknown directive type "tabularcolumns".

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**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v4l\[linux-master] [Documentation] [userspace-api] [media] [v4l]ext-ctrls-camera.rst, line 527)**

Unknown directive type "flat-table".

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.. flat-table::
   :header-rows: 0
   :stub-columns: 0

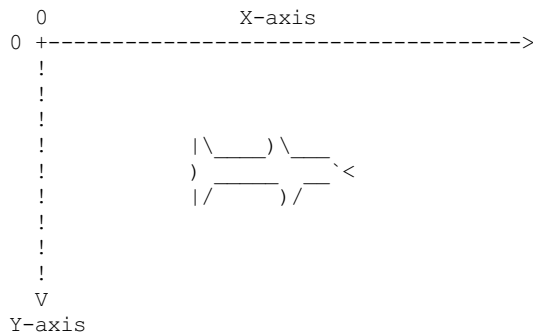
   * - ``V4L2_CAMERA_ORIENTATION_FRONT``
     - The camera is oriented towards the user facing side of the device.
   * - ``V4L2_CAMERA_ORIENTATION_BACK``
     - The camera is oriented towards the back facing side of the device.
   * - ``V4L2_CAMERA_ORIENTATION_EXTERNAL``
     - The camera is not directly attached to the device and is freely movable.
```

V4L2\_CID\_CAMERA\_SENSOR\_ROTATION (integer)

This read-only control describes the rotation correction in degrees in the counter-clockwise direction to be applied to the captured images once captured to memory to compensate for the camera sensor mounting rotation.

For a precise definition of the sensor mounting rotation refer to the extensive description of the 'rotation' properties in the device tree bindings file 'video-interfaces.txt'.

A few examples are below reported, using a shark swimming from left to right in front of the user as the example scene to capture.

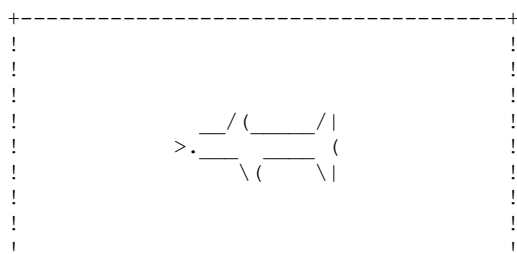


#### Example one - Webcam

Assuming you can bring your laptop with you while swimming with sharks, the camera module of the laptop is installed on the user facing part of a laptop screen casing, and is typically used for video calls. The captured images are meant to be displayed in landscape mode (width > height) on the laptop screen.

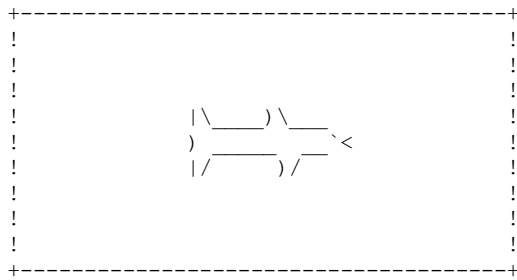
The camera is typically mounted upside-down to compensate the lens optical inversion effect. In this case the value of the V4L2\_CID\_CAMERA\_SENSOR\_ROTATION control is 0, no rotation is required to display images correctly to the user.

If the camera sensor is not mounted upside-down it is required to compensate the lens optical inversion effect and the value of the V4L2\_CID\_CAMERA\_SENSOR\_ROTATION control is 180 degrees, as images will result rotated when captured to memory.





A software rotation correction of 180 degrees has to be applied to correctly display the image on the user screen.

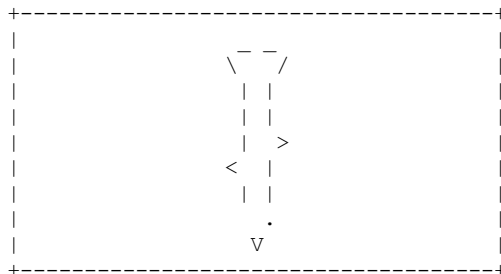


#### Example two - Phone camera

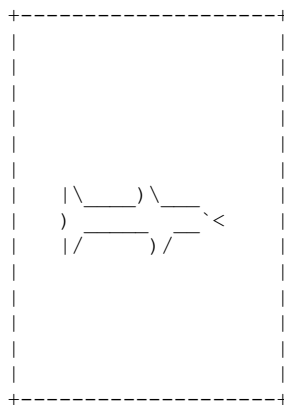
It is more handy to go and swim with sharks with only your mobile phone with you and take pictures with the camera that is installed on the back side of the device, facing away from the user. The captured images are meant to be displayed in portrait mode (height > width) to match the device screen orientation and the device usage orientation used when taking the picture.

The camera sensor is typically mounted with its pixel array longer side aligned to the device longer side, upside-down mounted to compensate for the lens optical inversion effect.

The images once captured to memory will be rotated and the value of the V4L2\_CID\_CAMERA\_SENSOR\_ROTATION will report a 90 degree rotation.



A correction of 90 degrees in counter-clockwise direction has to be applied to correctly display the image in portrait mode on the device screen.



[1] This control may be changed to a menu control in the future, if more options are required.