

Perkin Elmer Ultraview Vox: Hamamatsu C9100-13 EMCCD Camera Controls

The following camera controls appear in the Velocity Video Preview unless they have been de-selected in the 'Devices' pane under Edit>Preferences.

Important Controls

Exposure



The exposure sets the time that the signal integrates on the camera chip before being read out. It can be set by using the slider; entering a value in the field; or using the up and down *spin*

buttons next to the fields. The clock icon changes the slider range from milliseconds to seconds and tens of seconds.

The *Auto Exposure* (AE) button will automatically adjust the exposure to the optimal value for the camera depth. This will take some time and the final value may harm living samples or be unsuitable for the required speed of acquisition. For these reasons I generally do not use Auto Exposure.

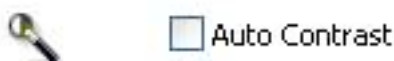
Binning



Binning integrates the signal from adjacent pixels, which lowers the resolution but increases the sensitivity.

For example, switching the C9100-13 camera to 2x binning will add 4 adjacent pixels together to increase the sensitivity up to 4x, but the resolution will drop from 512 x 512 to 256 x 256. Binning values greater than 1x are not usually necessary with the C9100-13 camera.

Auto Contrast



Auto Contrast adjusts the video preview display settings so that images occupying the lower levels of the 16-bit

range do not appear dark. Applying Auto Contrast does not affect the underlying data.

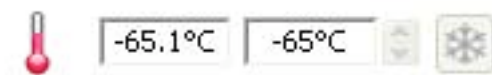
Gain and Sensitivity



The settings for *gain* and *sensitivity* both have the same 'sun' icon.

Increasing the gain multiplies the voltage generated by the readout amplifier in response to the charge from the chip. Sensitivity (also called *EM Gain*) is specific to EMCCD cameras. It controls the degree to which the charge is amplified on the chip before it reaches the readout amplifier. This is used in low light level imaging to increase the weak signal so it is above the level of noise caused by the readout amplifier (*readout noise*).

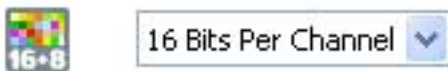
Temperature



CCD cameras, and especially EMCCD cameras, must be cooled in order to reduce *dark current* noise. The C9100-

13 camera is automatically air-cooled to a minimum of -65°C, but this can take a few minutes after the system is switched on.

Depth

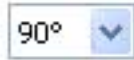


The camera produces a digital image in which the intensity levels are represented by ranges of discrete bits.

The maximum number of intensity levels possible is 16-bit (65,536 intensity levels) but the images can also be acquired at a depth of 8-bit (256 intensity levels). A wider range of processing software packages handle 8-bit images but it is harder to measure small differences in intensity when you only have 256 levels. I would recommend acquiring at 16-bit and converting images to 8-bit later if necessary.

Less Critical Controls

Rotation



This option rotates the view of the image on the screen relative to the fixed camera position. You can use it to match up what you see down the microscope to what you see on the computer, since some image flipping occurs in the optics. A rotation of 90° should do the trick.

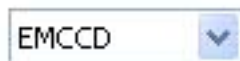
Readout Speed



The camera's readout speed can be set to 11 MHz (High Speed), 2.75 MHz or 0.69 MHz. Using a high readout speed increases the potential rate of image capture (which also depends on Exposure) but at the cost of increasing the readout noise. The latter should not be a problem if Sensitivity is set to >50, so most capture can be done in High Speed mode.

	Readout Speed	Minimum Exposure Time	Readout Noise
EM-CCD with Sensitivity Off	11 MHz	30.52 ms	25 electrons
	2.75 MHz	122.11 ms	20 electrons
	0.69 MHz	488.44 ms	8 electrons

Readout Mode



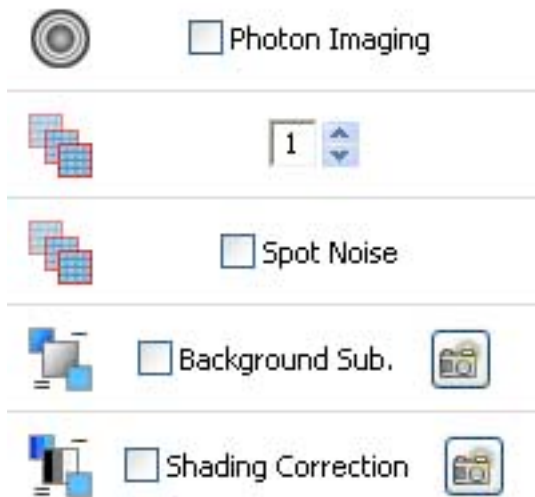
The C9100-13 camera can be set to EMCCD or Conventional mode. In the latter the EM Gain register (Sensitivity) is turned off and the charge is routed through a conventional amplifier, so the camera has a similar response to a regular Orca AG, albeit with a lower resolution. Conventional mode would be used at high light levels, when EMCCD cameras have worse signal to noise ratios than conventional CCD cameras. Conditions like this are unlikely to arise when using a spinning disc confocal. Conventional mode can only be used at readout speeds 2.75 MHz and 0.69 MHz.

EM Protection



The EM Gain degrades over time and with over-illumination of the camera chip. EM Protection alerts the user if the illumination level is too high and shuts down the gain register so the camera stops working when in EMCCD mode.

Disabled Controls



These modes cannot be used when serial commands and TTL pulses are triggering the camera, as is the case with the Ultraview Vox as well as most other microscope acquisition systems.

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