

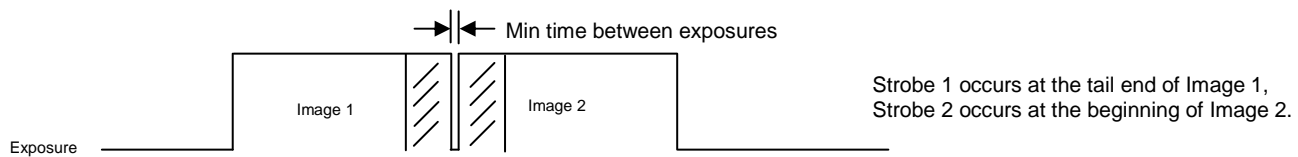
Technical Note:

PIV – Minimum Time Between Exposures for AVT GigE Cameras

Given the ability of CCD and some CMOS sensors to simultaneously readout an image while exposing the next image, this allows for a relatively short time between two images, given the camera's exposure time setting is equal to or greater than the sensor readout time. Sensor readout time can be approximated to $1/\text{max camera frame rate}$.

The minimum time between exposures value can be useful for particle image velocimetry (PIV) applications, where two images are taken in rapid succession to measure the speed of a moving object.

Because the exposure time setting must be greater than or equal to the sensor readout time, which is equal to $1/(\text{camera max frame rate})$ and in the millisecond range, PIV users will need to use precisely timed strobe(s) in an otherwise dark operating environment in order to achieve suitable results:



To set strobe(s), there are two possible options, as determined by the camera type. Both options use the camera SyncOut1/2/3 signal to trigger a strobe.

Option 1:

For cameras in table without an asterisk (*), a single strobe pulse may be used which spans both exposures.

`SyncOut1/2/3 = Strobel`

`StrobelMode = Exposing`

`StrobelDuration = Required Strobe Length * 2 + Min Time Between Exposures`

`StrobelDelay = ExposureValue - Required Strobe Length`

With `StrobelMode = Exposing`, the strobe pulse is tied to the rising edge of the camera's internal exposure signal. However, every second SyncOut1/2/3 strobe trigger from the camera must be ignored by the strobe. Otherwise two strobes are generated for each pair, with the second triggering off the rising edge of the second image, and firing at the tail end of the second image.

Option 2:

For cameras in table with an asterisk (*), two strobes are necessary. This is due to an existing limitation of the camera firmware, in which the minimum time between exposures varies between two discrete values, from image pair to

image pair. For example, the GB2450 has a min time of 15.2µs between the first image pair, and 20.8µs between the next image pair. All quoted values use the longer of the two measured values. The reason for this variation is unknown, but we are working towards resolving this.

Given the variation, a single strobe pulse cannot be used, as the second image will be brighter and contain motion blur in the case when the min exposure time between images is shorter than quoted. Two strobes are necessary.






Strobe1:

```
SyncOut1/2/3 = Strobe1
Strobe1Mode = Exposing
Strobe1Duration = Required Strobe Length
Strobe1Delay = ExposureValue - Required Strobe Length
```

Strobe2: Tied to Strobe 1 and triggered with external logic Minimum Time Between Exposures + Required Strobe Length after Strobe1.

As with Option 1, every second SyncOut1/2/3 strobe trigger from the camera must be ignored by the strobe.

Minimum Time Between Exposures

				
G-032 283 µs	GX1050 19.9 µs	GC640* 40.0 µs	GE640* 40.0 µs	GB650* 78.0 µs
G-033 93 µs	GX1660 19.6 µs	GC650* 121 µs	GE650* 121 µs	GB660* 75.0 µs
G-046 114 µs	GX1910 19.9 µs	GC655* 121 µs	GE680* 38.2 µs	GB1380* 80.0 µs
G-125 63 µs	GX1920 50.0 µs	GC660* 75.0 µs	GE1050* 134 µs	GB2450* 20.8 µs
G-145 106 µs	GX2300 21.4 µs	GC750 91.0 µs	GE1350* 107 µs	
G-145-30fps 35 µs	GX3300 22.2 µs	GC780* 113 µs	GE1380* 125 µs	
G-146 88 µs		GC1020* 123 µs	GE1600* 115 µs	
G-201 60 µs		GC1280* NA**	GE1650* 104 µs	
G-201-30fps 72 µs		GC1290* 89.8 µs	GE1660* 62.1 µs	
G-504 29 µs		GC1350* 107µs	GE1900* 113 µs	
		GC1380* 125 µs	GE1910* 71.0 µs	
		GC1380H* 84.0 µs	GE2040* 115 µs	
		GC1600* 115 µs	GE4000* 110 µs	
		GC1600H* 60.0 µs	GE4900* 110 µs	
		GC2450* 20.8 µs		

*Requires two strobes, as mentioned above.

**No simultaneous readout and exposure mode for this sensor.

GS series: same timing as corresponding GB camera.

Color sensors, and varying sensor classes within a model, use the timing values as listed above.

GC/GE/GB measured with firmware 1.36. GX measured with firmware 1.38. GC750 measured with firmware 1.30. Manta measured with firmware 1.44.00. Values unlikely to change with future firmware updates.

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