

PHOTO TRAFFIC ENFORCEMENT

APPLICATION NOTE **#4** EXPOSURE

For image capture in a traffic enforcement application right image exposure is a major key:

- the issue is the image readability, compatible with legal action,
- hence the need for an illumination suitable in quality and quantity, even at night or in back-light situation.

In this document, we will detail what exposure actually is, and what factors affect it.

What is exposure



In photography, exposure **is the amount of light** per unit area **reaching an image sensor** [...] Wikipedia

IN PRACTICE, EXPOSURE TRANSLATES INTO THE LIGHTNESS LEVEL ON AN IMAGE: LIGHTER OR DARKER.



F-Stop and dB are relative measurements. They refer respectively to aperture and sensor's sensitivity (see next page).

Exposure is a compromise

It is sometimes difficult to expose correctly all the details of an image, particularly in case of objects with strong contrast:

- licence plate (particularly with retro-reflective materials),
- car body,
- driver's head behind the windshield,
- surroundings, or distant cars in the background on the same road.

Readable images can be obtained by fine camera settings adjustments

Four factors do affect image lighteness

Factor #1: Shutter time	Factor #2: Aperture
 Exposure increases with shutter time, all else being equal. for image capture of a moving vehicle, short shutter time is mandatory to avoid blur, a shorter shutter time necessitates a more powerfull light on the scene. 	 Exposure increases with aperture, all else being equal. A wide aperture (small f-stop figure) lets more light pass through the lens than a narrow aperture (big f-stop figure). - a narrow aperture brings more depth of field: a larger portion of the image is sharp but more light is needed on the scene to balance a narrow aperture!
Factor #3: Sensor's sensitivity	Factor #4: Light intensity on the scene
 Exposure increases with sensor's sensitivity / gain, all else being equal. Or, more precisely, less light is needed when sensitivity, or gain, is high. But noise on the image - i.e. "bad" pixels - increases with sensor's sensitivity / gain, which impedes image readability and licence plate reading. 	 Exposure increases with the amount of light available on the scene, all else being equal. More light available means a higher image quality overall: a correct exposure of the subject - i.e. not underexposed, less motion blur, because the shutter time can be shorter, more depth of field, because the aperture can be smaller (big f-stop figure), better pixels, and noise reduction, because the camera sensitivity (or gain) can be lowered.

PRACTICAL EXAMPLE: 5 WAYS TO DOUBLE THE EXPOSURE

Factors	Exposure X 2
Shutter time	x2 ms
Aperture	+1 f. stop
Sensitivity	x2 IS0
Gain	+3 dB
Light on the scene	x2

Whatever the subject, and whatever the distance to the camera, more light available on the scene means more latitude in the image management, as well as better image readability