



IMAGE QUALITY EVALUATION REPORT  
Ring Doorbell Pro 2



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This image quality evaluation report is generated from the tests performed using an exclusive protocol developed by DXOMARK IMAGE LABS. The test protocol is designed to benchmark the image quality performances of surveillance cameras. 3 analysis are available for both indoors, outdoors and doorbell cameras.

This report is based on a careful analysis of multiple user-case scenarios for each type of camera, DXOMARK provides scores for the most relevant image quality attributes to evaluate the performance of video surveillance cameras: exposure, color, details, noise and artifacts. Field of view (FOV) is also measured.

The cameras are tested under laboratory controlled and real-world conditions, using a wide variety of subjects and lighting conditions. The final scores are generated from objective measurements as well as perceptual evaluations. Sophisticated metrics are used in the perceptual evaluations, which allow a panel of experts to precisely compare and assess each attributes.



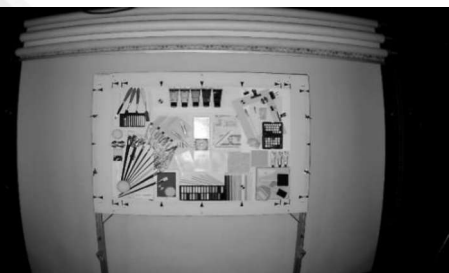
Lab test example: setup used for Texture, Color, Exposure and Timing measurements.



Real-world test scene example: Sunlight coming in from the window, as one person moves around in the room while camera records the scene (left); challenging outdoors HDR scene depicting a package delivery uses case.

To cover as many use cases as possible, we test:

- Various lighting conditions:
  - Controlled lab lighting systems with different illuminants: LED, A, H, D65
  - Natural illumination settings: daylight, sunset and night
  - Natural light sources: sunlight through windows, typical indoor ceiling lights, desktop lamp, dark room
- Various subjects, stationary and in motion:
  - Human subjects and life-like mannequins
  - Up to 2 moving subjects in test scenes
- Various distances between camera and subjects: from 1 meter up to 6 meters



Lab test example: Object under tungsten bright light (left) and under low light (right), which could trigger a camera's infrared mode.  
Test example: Intrusion scenario (below): the "stranger" moves back and forth in the room with a flashlight.



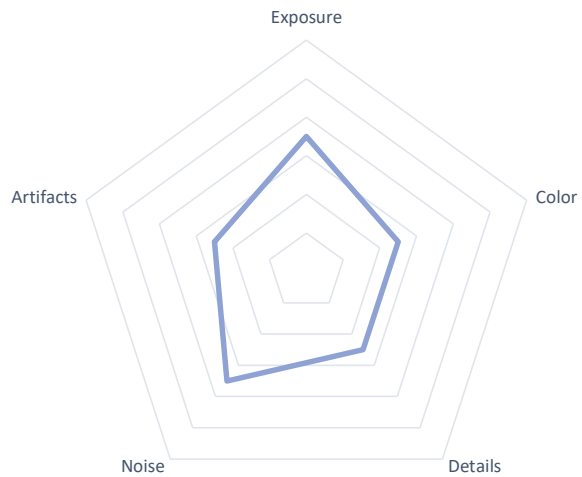
Please contact DXOMARK at [sales@dxomark.com](mailto:sales@dxomark.com) if you have any questions about this Image Quality Evaluation Report and/or this test protocol.

Specifications and Overall Image Quality Resolution



Camera	
Resolution	1536 x 1536
FOV diagonal	146°
FOV diagonal	140°
Night vision	YES
Infrared Light Source	
Available	YES
Wavelength	/
Storage	
Memory card	NO
Cloud service	YES
Power	
AC	YES
Battery power	NO

<b>Overall score</b>	<b>30.0</b>
Exposure	3.5
Color	2.5
Details	2.5
Noise	3.5
Artifacts	2.5



## Executive Summary

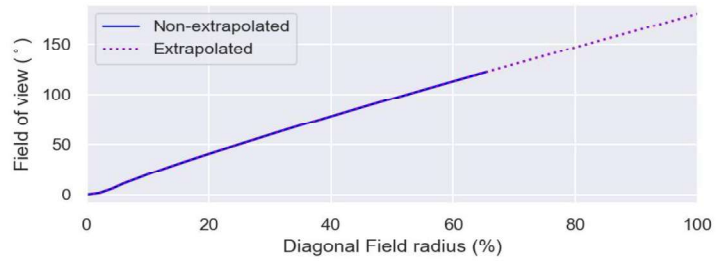
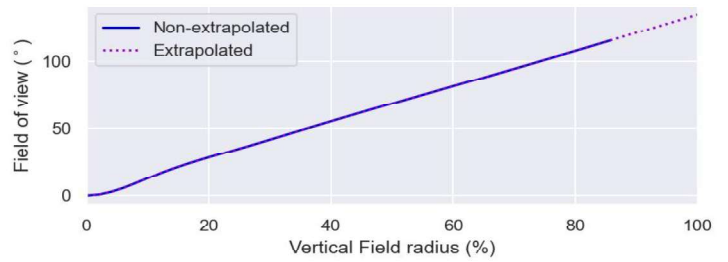
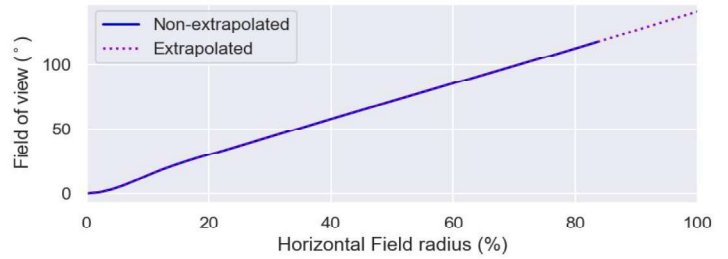
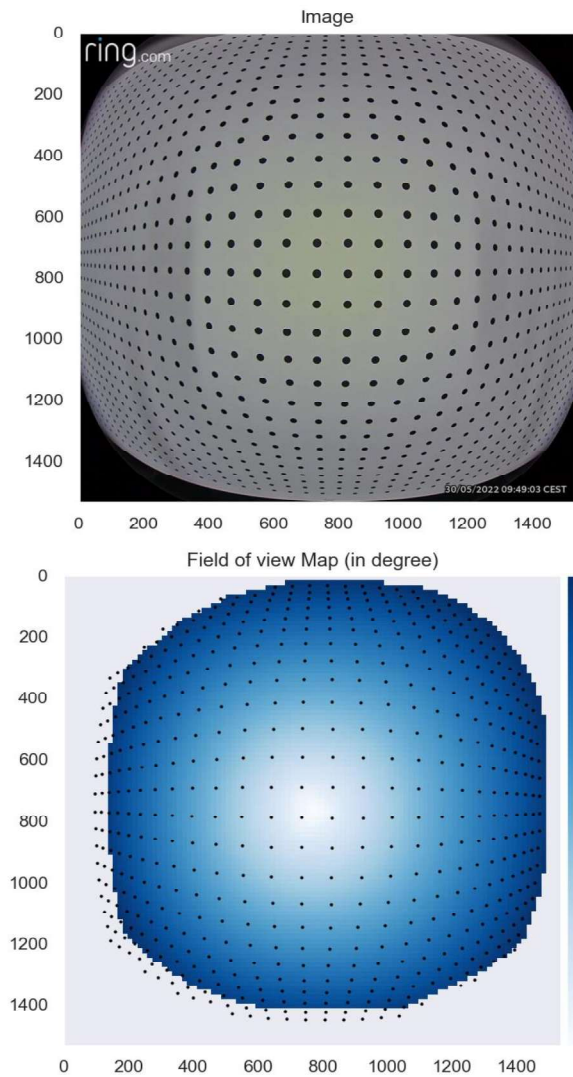
### Pros:

- In night condition, faces are recognizable as target exposure is generally accurate and level of details is acceptable.
- In day condition, on low dynamic range scene, level of detail is acceptable.

### Cons:

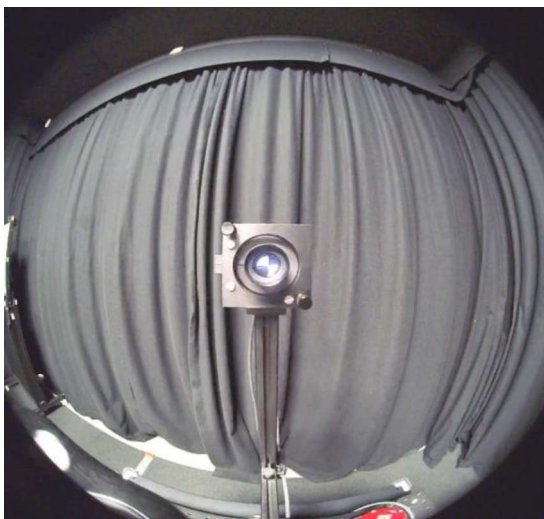
- In day condition, on high dynamic scene, faces are generally underexposed, and sometimes not even recognizable.
- It is sometimes not possible to identify a moving person as details are lost on moving parts.
- Ringing is visible.
- In night condition, noise is visible on moving parts.

### Objective measurements - Field of View



	Horizontal Field of View	Vertical Field of View	Diagonal Field of View
Non-extrapolated	118.17°	115.19°	121.7°
Extrapolated	141.13°	134.35°	180.19°
	tilt	Pan	
Orthofrontality angles	0.67°	0.2°	

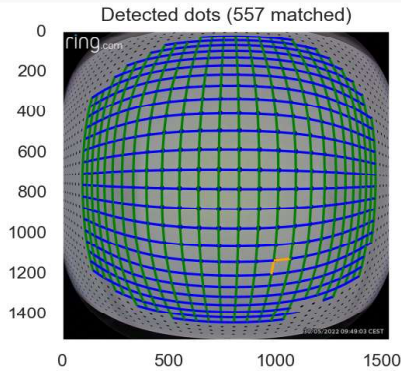
Warning : the field of view of the camera is above the use case of the measurement, so result may be not precise.



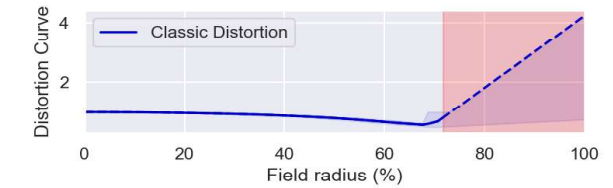
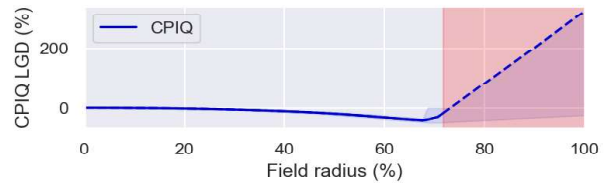
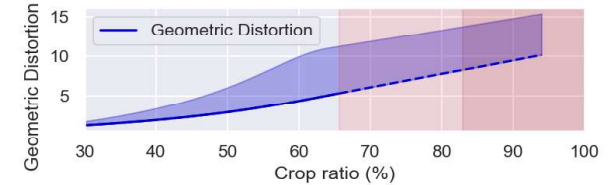
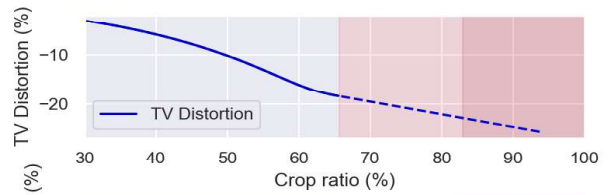
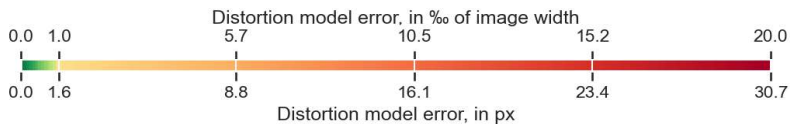
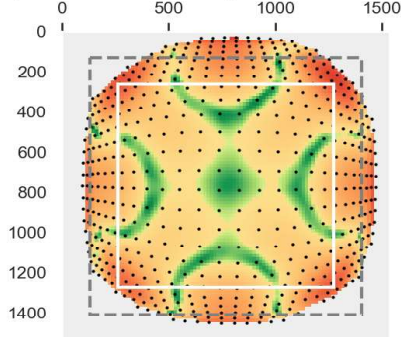
### Compass Measurement

Horizontal Field of View	146°
Vertical Field of View	140°

### Objective measurements - Distortion measurement



Error Map (OpenCV) & Maximum Crop Factor (dashed: contains the largest corrected rectangle)



	Results	Results (Non-extrapolated)
TV Distortion	-25.56 %	-18.37 %
Geometric Distortion (Avg)	+10.19 %	+5.36 %
Geometric Distortion (Max)	+15.35 %	+11.31 %
CPIQ LGD (Max)	+321.69 %	-49.51 %
CPIQ LGD (JND)	-15.17	-15.17

## Target exposure technical overview

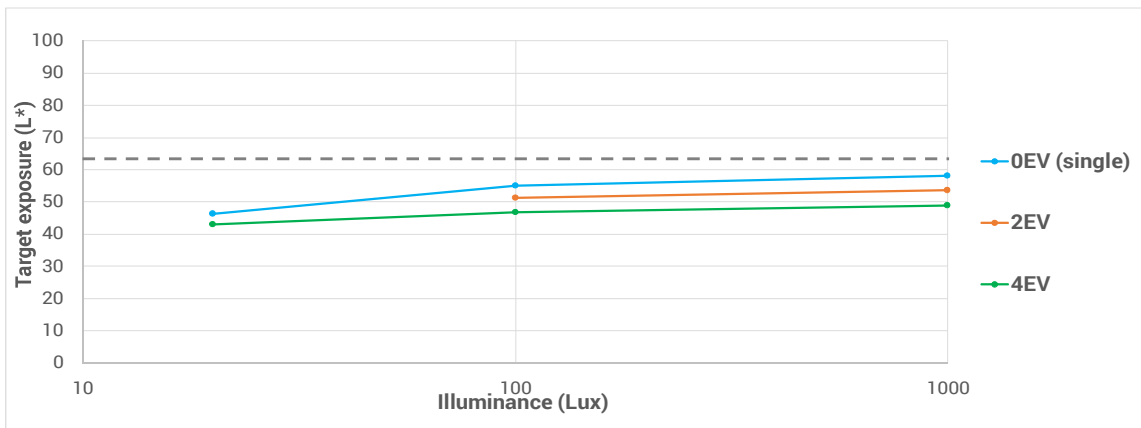
### Static attributes

Lux level for  $L^* < 25$  (lx) 1

Target exposure ( $L^*$ )	low light			indoor			outdoor		
	Average	Min	Max	Average	Min	Max	Average	Min	Max
	53	50	59	54	52	56	54	-	-

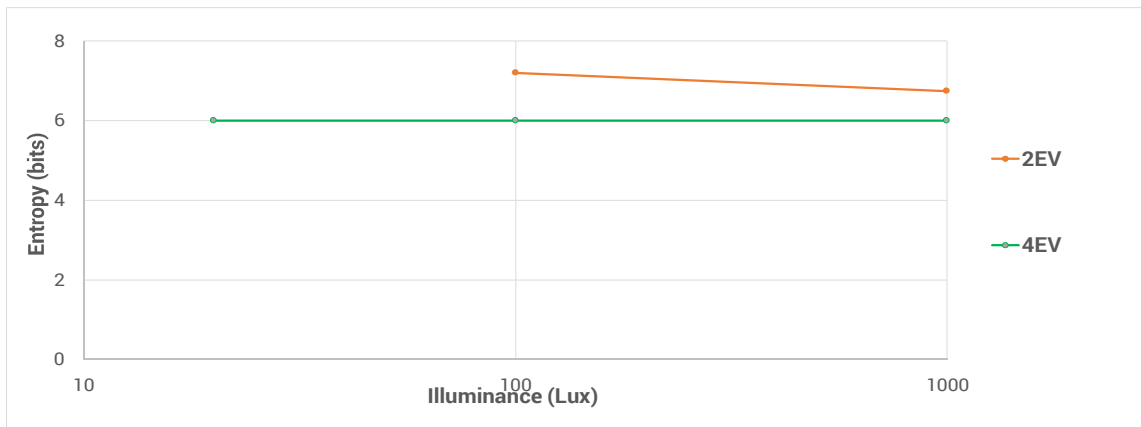
## Target exposure

$L^*$  value on fair realistic mannequin for different illumination conditions and dynamic ranges



	Lux level		
	1000	100	20
0EV (single)	58	55	46
2EV	54	51	
4EV	49	47	43

Measured contrast entropy at different lighting conditions and exposure differences

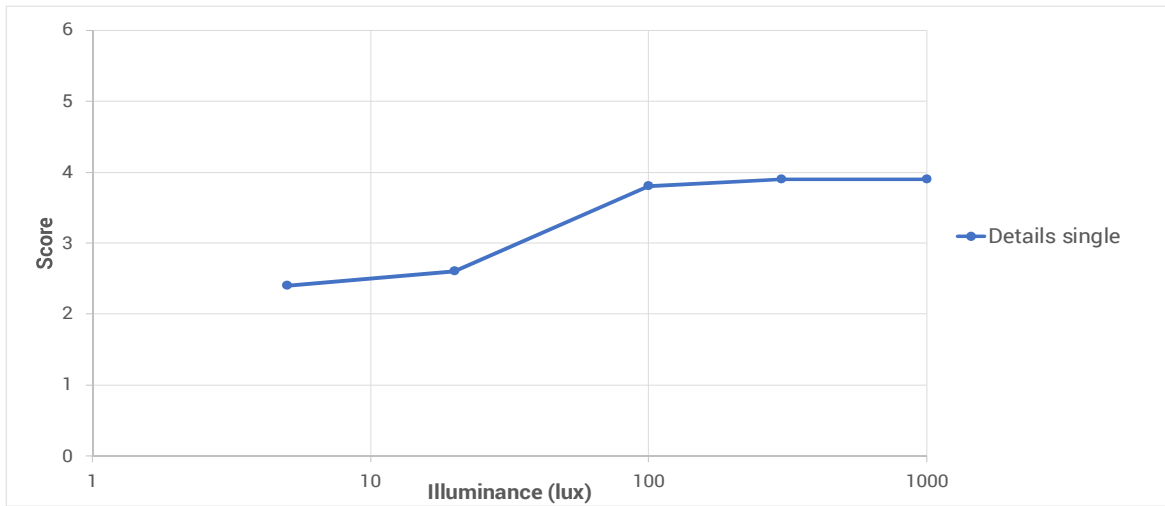


	Lux level		
	1000	100	20
2EV	7	7	
4EV	6	6	6



### DXOMARK natural scene: realistic mannequin

Detail preservation scores per illuminant (from 0 to 100)



Daylight (1000 lux)



Detail preservation 3.9

TL84 (300 lux)



Detail preservation 3.9

LED (100 lux)



Detail preservation 3.8

LED (20 lux)



Detail preservation 2.6

LED (5 lux)



Detail preservation 2.4



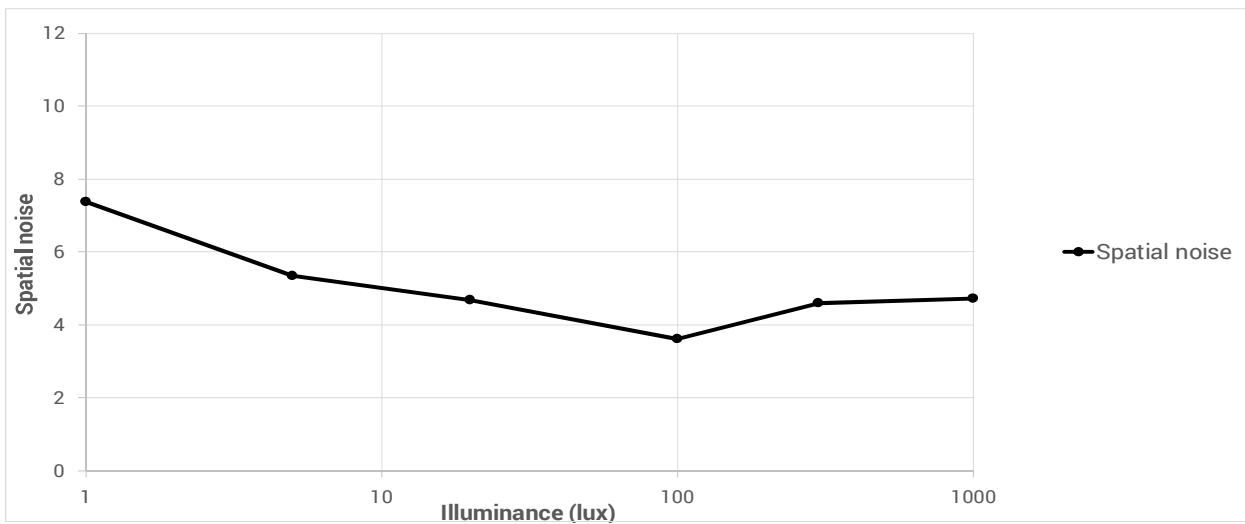
#### Noise technical overview

##### Noise

Illuminant/lux	outdoor		indoor		low light		
	D65 (1000 lux)	TL84 (300 lux)	TL84 (100 lux)	TL84 (20 lux)	TL84 (5 lux)	A (1 lux)	
Temporal analysis	Noise	1.4	1.1	1.6	2.2	0.5	0.5
Spatial analysis	Noise	4.7	3.9	3.3	4.7	5.3	7.4

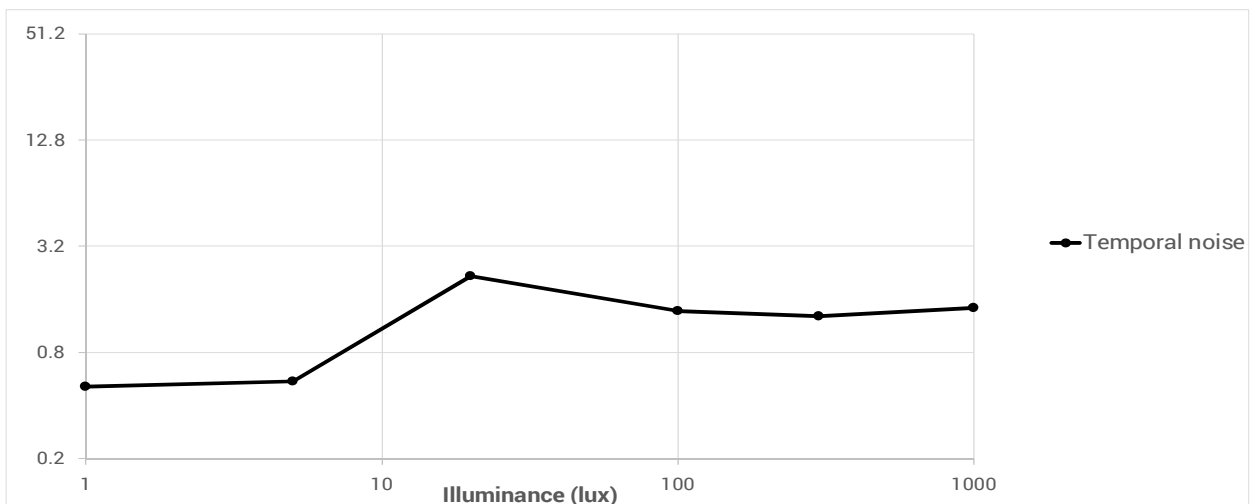
#### 1.1 Spatial noise per lighting condition

This graph shows the evolution of spatial noise with the level of lux.



#### 1.2 Temporal noise per lighting condition

This graph shows the evolution of temporal noise and chromaticity index with the level of lux.





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