

# EXHIBIT 4

<p><b>US7493030B2</b></p>	<p>Canon's Cameras with Dual Pixel CMOS AF, including, but not limited to, EOS M5 EF-M 18-150mm IS STM Kit, EOS M6 Mark II, EOS R, EOS RP, EOS 90D, EOS 6D Mark II, OS 5D Mark IV, EOS Rebel SL3 EF-S 18-55mm IS STM Lens Kit Black, EOS Rebel T8i EF-S 18-55mm IS STM Lens Kit, EOS M200 EF-M 15-45mm IS STM Kit Black, EOS-ID X Mark III, EOS Ra, EOS 90D Video Creator Kit, EOS M200 Content Creator Kit, EOS M50 EF-M 15-45mm IS STM Kit Black, EOS 5D Mark IV with Canon Log, EOS R5, EOS R6, EOS M50 Mark II Content Creator Kit, EOS R RF24-105mm F4.7.1 IS STM Lens Kit, EOS R5 C, EOS R3, PowerShot G1 X Mark III, CR-X500, EOS C70, EOS C500 Mark II, EOS C700 FF, EOS C700 FF PL, EOS M100 EF-M 15-45mm IS STM Kit, EOS C200, EOS Rebel T7i EF-S 18-55mm IS STM Lens Kit, EOS C700, EOS C700 PL, EOS C700 GS PL, EOS C300 Mark II, EOS 77D, EOS 70D, EOS 80D, and EOS 7D Mark II (collectively, the "Accused Products")</p>
<p><b>ISPre.</b> A memory storing a program of machine-readable instructions, executable by a digital data processor, to perform actions directed toward operating a camera, the actions comprising:</p>	<p>The accused products implement an apparatus comprising a memory storing a program of machine-readable instructions, executable by a digital data processor, to perform actions directed toward operating a camera, the actions comprising:</p> <p>Canon Inc is a multinational corporation specializing in the manufacture of imaging and optical products, including cameras, camcorders, professional displays, etc.</p> <p>Canon provides the Dual Pixel CMOS Auto Focus (AF) feature in its cameras (e.g. Canon EOS M5) that can operate with a wide range of lenses. When a user selects, the accused products to operate in the AF mode, the Dual Pixel AF feature automatically (i.e. executing a set of predefined stored instructions) adjusts the lens of the camera (i.e. actions directed to toward operating) to get the best focus and image clarity. See Fig. 1.</p> <p>Fig. 2 shows an image of the motherboard of the accused product having a Memory, Processor, etc.</p>

### Citation 1: Canon EOS Models using Dual Pixel CMOS AF Technology Canon Cameras with Dual Pixel CMOS AF

This list is constantly growing, as new cameras are developed and introduced. The first EOS camera with Dual Pixel CMOS AF was the EOS 70D, introduced in 2013. As of April 2018, the following Canon EOS models use Dual Pixel CMOS AF technology:

*EOS M-series "mirrorless" models:*

EOS M5

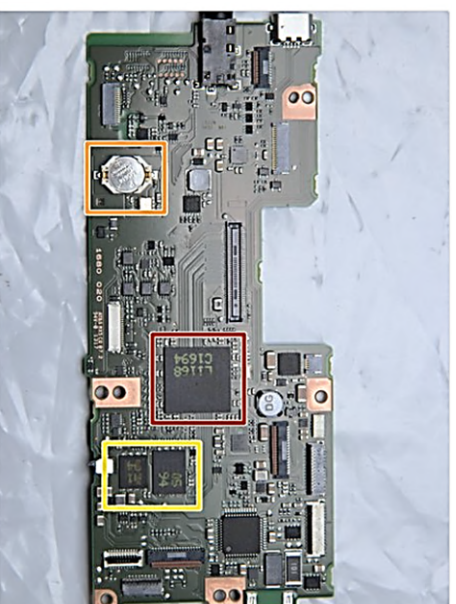
EOS M6

EOS M50\*

Fig. 1

Source: <https://www.usa.canon.com/internet/portal/us/home/learn/education/topics/article/2018/July/Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-Explained>, Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-Explained, Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-Explained, Page 4, Last accessed May 5, 2021, Exhibit B

### Citation 2: Motherboard Canon EOS M5



- Ladies and gentlemen, the motherboard
- Digic and RAM
- RTC battery
- Some Flash
- SD socket
- Some power supply

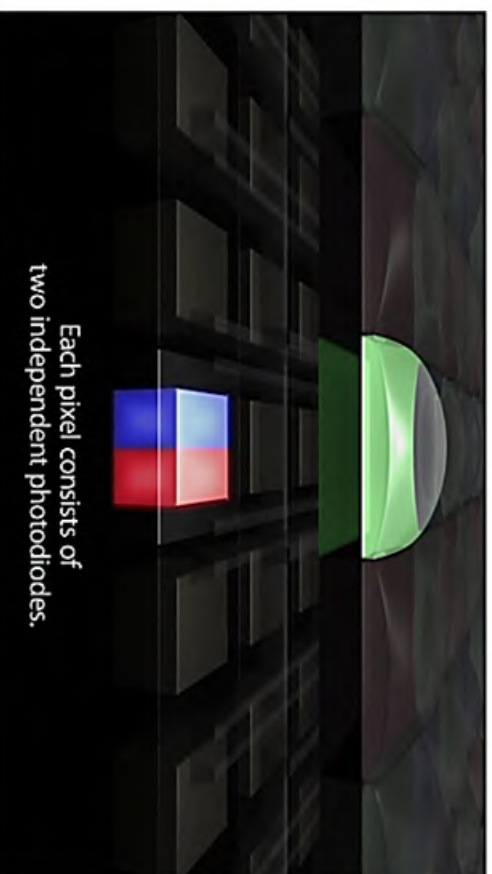
Fig. 2

Source: <https://www.ifixit.com/Teardown/Canon+EOS+M5+Teardown/133466>, Page 9, Last accessed May 5, 2021,

Exhibit A

As an example shown in Fig. 3, when a user selects a camera with the accused feature to operate in AF mode, both the photodiodes (i.e. Dual pixel) operate independently to collect light information from groups of pixels. The data is processed by a processor to adjust the distance of the lens automatically for best focus (i.e. a processor executes instructions stored in a memory to perform actions directed toward operating a camera).

**Citation 3: Electronic signal from pixel sent to the processor of the camera**



*During focus, the two light-sensitive areas of each pixel operate independently. Each receives light from the camera's lens, and sends its own electronic signals to a processor. These are gathered, and compared (A vs. B). From deviations between the two, Dual Pixel CMOS AF is able to detect whether the area being sampled is already in sharp focus, or whether we need to move the lens to a closer or more distant focus position to get the sharpness we need.*

Fig. 3

	<p>Source: <a href="https://www.usa.canon.com/internet/portal/us/home/learn/education/topics/article/2018/July/Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-Explained">https://www.usa.canon.com/internet/portal/us/home/learn/education/topics/article/2018/July/Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-Explained</a>/Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-Explained, Page 3, Last accessed May 5, 2021, Exhibit B</p>
<p><b>15a.</b> during an exposure frame period, maintaining an image sensing surface at a variable effective image distance from a lens synchronously with exposing different portions of the sensing surface, wherein the image sensing surface comprises an array of photosensitive pixels.</p>	<p>The accused products implement an apparatus comprising, during an exposure frame period, maintaining an image sensing surface at a variable effective image distance from a lens synchronously with exposing different portions of the sensing surface, wherein the image sensing surface comprises an array of photosensitive pixels.</p> <p>As described in the patent US'030B2 [Page 14, Column number 9, Line numbers 23-25] "<i>A single frame period is the continuous exposure time over which any of the entire array of pixels or plate of film is exposed.</i>"</p> <p>Canon Dual Pixel CMOS AF is an advanced technology introduced by Canon to provide sharp &amp; consistent focus for both stationary and moving subjects. All effective pixels on the sensing surface of the camera's (e.g. EOS M5) Dual Pixel CMOS AF array consist of two individual photodiodes, which are read separately for auto-focus and together for imaging. Dual Pixel CMOS AF is possible over 80% of the width and height of the Live View frame and is highly accurate without compromising on image quality. See Fig. 4.</p>

**Citation 4: Canon Dual Pixel CMOS AF**

Dual Pixel CMOS AF, as of April 2018, is the only industry AF technology that uses every pixel on the imaging sensor to detect focus, and also to capture actual image information for still and video imagery. Focus can be detected anywhere, within a "live" area covering about 80% of the horizontal and vertical width of the entire CMOS imaging sensor.

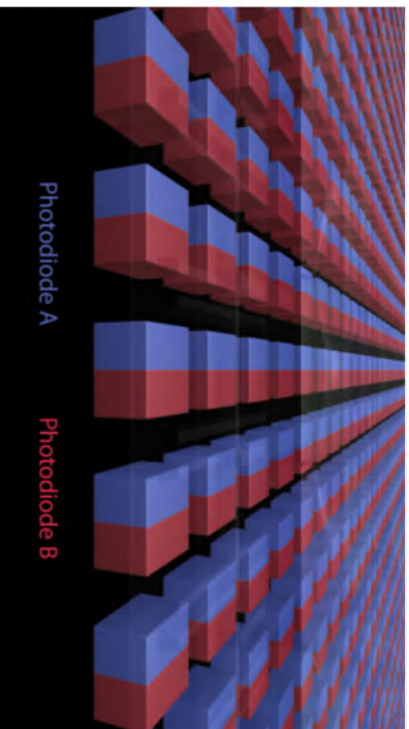


Fig. 4

Source: <https://www.usa.canon.com/internet/portal/us/home/learn/education/topics/article/2018/July/Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-Explained>/Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-Explained, Page 2, Last

accessed May 5, 2021, Exhibit B

Unlike normal AF technologies that rely on contrast-based focus detection, Dual Pixel CMOS AF uses phase-detection technology. Phase detection technology helps in determining not only the sharpness or lack of sharpness but also in which direction and by how far the lens of the camera needs to be shifted with respect to the image sensing surface. See Fig. 5.

**Citation 5: Dual Pixel CMOS AF uses Phase Detection**

The Canon Dual Pixel CMOS AF method is 100% phase-detection, so the two primary benefits are always there when using autofocus with EOS DSLRs and mirrorless models with this technology at the imaging sensor.



The first important thing to keep in mind is that this utilizes the phase-detection concept of focus detection. This means comparing multiple rays of light, and being able to immediately determine not just sharpness or lack of sharpness, but two vital things:

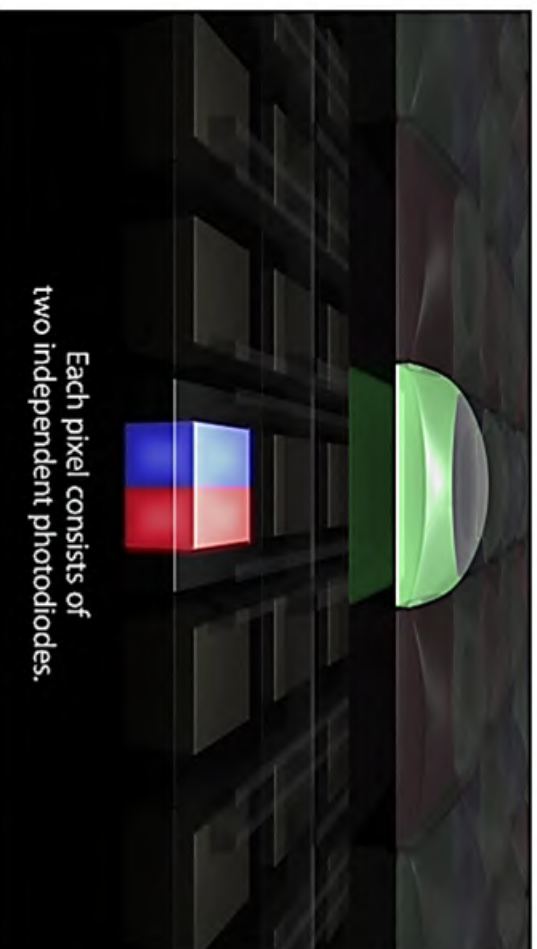
- Which direction the lens needs to be driven, to get sharp focus
- How far it will need to be driven

Fig. 5

Source: <https://www.usa.canon.com/internet/portal/us/home/learn/education/topics/article/2018/July/Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-Explained>, Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-Explained, Page 1, Last accessed May 5, 2021, Exhibit B

As an example shown in Fig. 6 - Fig. 10, when a user selects a camera with the accused feature to operate in AF mode, both the photodiodes (i.e. A and B sides of the diodes) operate independently to collect light information (i.e. collecting exposure information during an exposure frame period) from groups of pixels (i.e. exposing portions of pixels of Dual Pixel CMOS AF array) and the data (i.e. electrical signals) is sent to the processor. Information from each pixel contributes to determining the desired sharp focus. The information from the groups of pixels is gathered at the processor, where it is analyzed. Using the Dual Pixel CMOS AF technology, the processor detects which direction and distance the lens must be adjusted to provide sharp focus. A control signal is generated by the processor to adjust the lens automatically.

**Citation 6: Synchronous exposure of image sensing surface to light w.r.t lens**



*During focus, the two light-sensitive areas of each pixel operate independently. Each receives light from the camera's lens, and sends its own electronic signals to a processor. These are gathered, and compared (A vs. B). From deviations between the two, Dual Pixel CMOS AF is able to detect whether the area being sampled is already in sharp focus, or whether we need to move the lens to a closer or more distant focus position to get the sharpness we need.*

**Fig. 6**

Source: <https://www.usa.canon.com/internet/portal/us/home/learn/education/topics/article/2018/July/Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-Explained>, Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-Explained/Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-Explained, Page 3, Last accessed May 5, 2021, Exhibit B



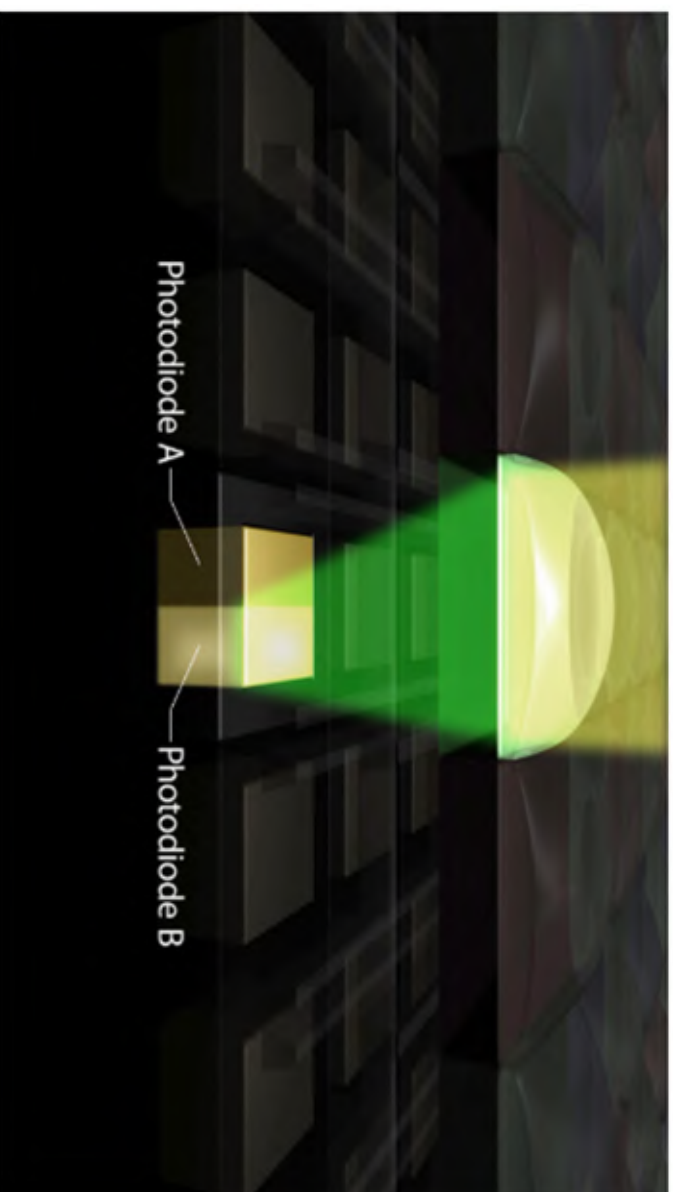
**Citation 7: Dual Pixel CMOS AF uses information from each pixel for sharp focus**

Accordingly, you won't hear claims of focus from "xx number of AF points" with Dual Pixel CMOS AF. It's not restricted to limited numbers of locations on the image sensor, where dedicated pixels for AF replace ordinary light-gathering pixels, for focus detection exclusively. Information from each and every pixel is available, before image recording of a still image or video frame, to contribute to determining sharpness at the area of a subject you've asked it to focus upon.

Fig. 7

Source: <https://www.usa.canon.com/internet/portal/us/home/learn/education/topics/article/2018/July/Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-Explained>, Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-Explained, Page 2, Last accessed May 5, 2021, Exhibit B

**Citation 8: Information gathered from a group of pixels to adjust the lens for focus**



*Here's a conceptual illustration, showing how during focus, the "B" side of a pixel gathers light and delivers its own independent information to the processing system. When separate information from the A and B sides of groups of pixels is gathered, it can be analyzed and accurately provides sharp focus, during Live View and video recording.*

**Fig. 8**

Source: <https://www.usa.canon.com/internet/portal/us/home/learn/education/topics/article/2018/July/Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-E-Explained/Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-E-Explained>, Page 3, Last accessed May 5, 2021, Exhibit B

**Citation 9: Dual Pixel CMOS AF is used to detect lens adjustment**

The genius of Canon's Dual Pixel CMOS AF is that when groups of pixels are assessed, the differences in read-outs from the A-side and B-side can detect focus. And in true phase-detect fashion, they don't only see "sharpness," but can instantly detect which direction the lens must move for sharp focus, and by how much. Again, this is done so effectively that there is no need for contrast-detection technology as a backup to ensure good, sharp focus.

Fig. 9

Source: <https://www.usa.canon.com/internet/portal/us/home/learn/education/topics/article/2018/July/Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-Explained> Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-Explained, Page 3, Last accessed May 5, 2021, Exhibit B

Citation 10: Dual Pixel CMOS AF

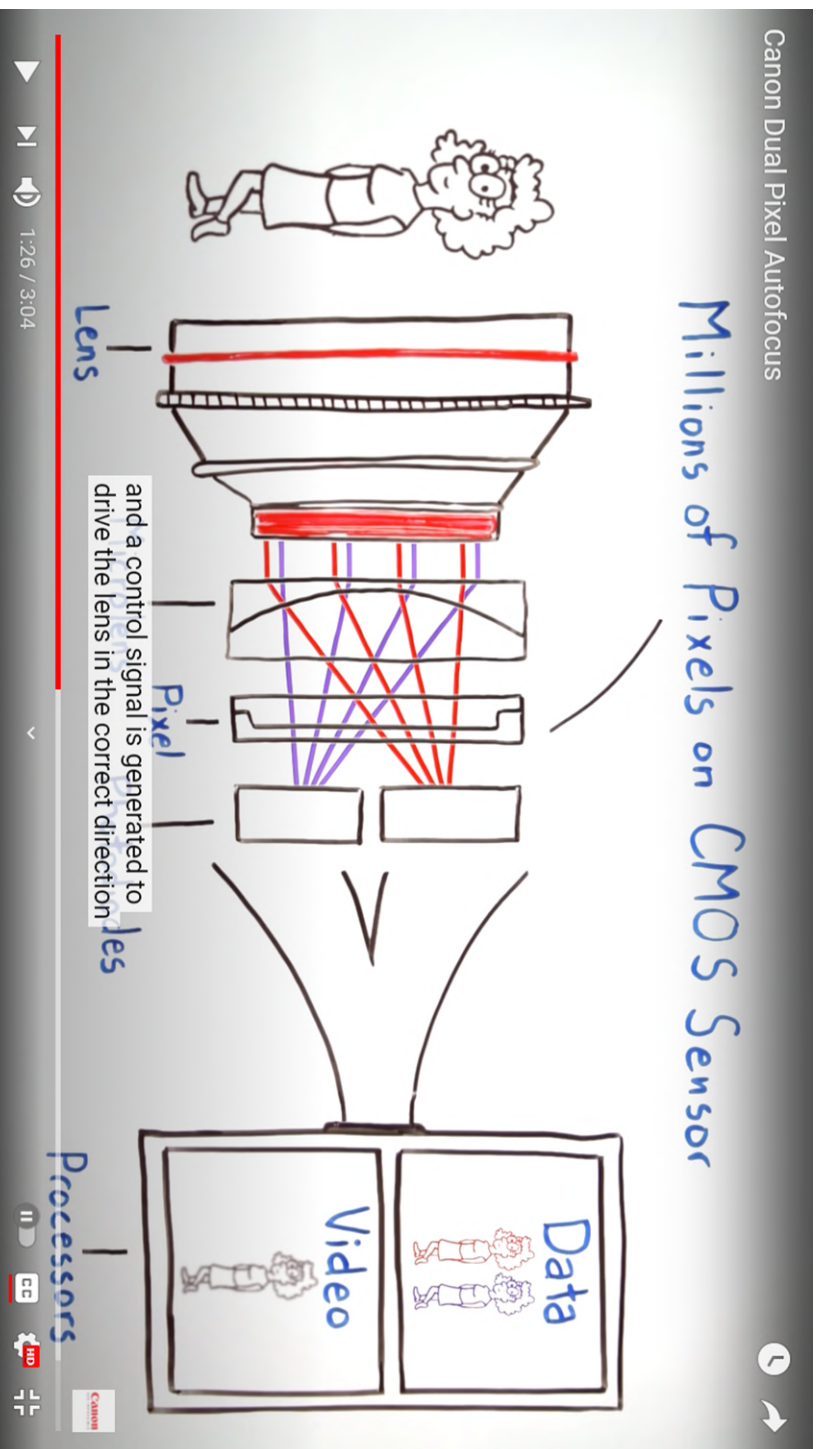
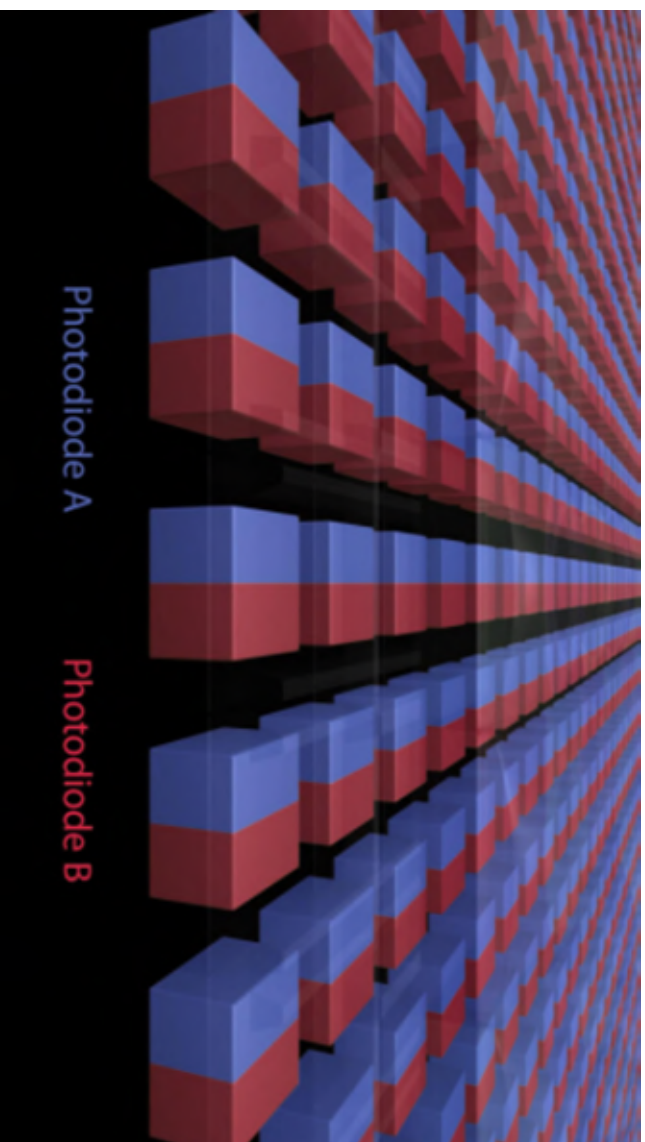


Fig. 10

Source: <https://www.youtube.com/watch?v=T3YRqGZ6C4>, Time [1:26], Last accessed May 5, 2021, Exhibit C

The image sensing surface (i.e. Dual Pixel AF array) comprises millions of pixels. Each pixel is light-sensitive and divided into two parts (i.e. A and B photodiodes) that act independently and provides information gathered in the form of electronic signals to the processors. See Fig. 11 and Fig. 12.

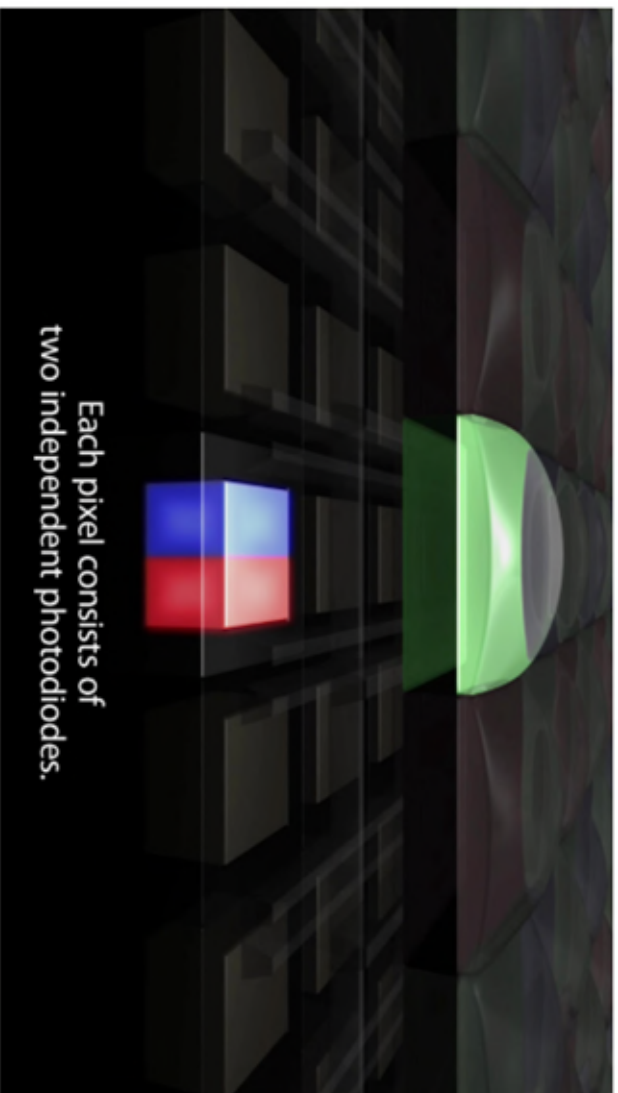
**Citation 11: Array of photosensitive pixels of Image Sensor**



**Fig. 11**

Source: <https://www.usa.canon.com/internet/portal/us/home/learn/education/topics/article/2018/July/Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-Explained/Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-Explained>, Page 2, Last accessed May 5, 2021, Exhibit B

**Citation 12: Array of photosensitive pixels of Image Sensor**



**Fig. 12**

Source: <https://www.usa.canon.com/internet/portal/us/home/learn/education/topics/article/2018/July/Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-Explained>, Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-Explained, Page 3, Last accessed May 5, 2021, Exhibit B



### References Cited

Exhibit(s)	Description	Link
Exhibit A	Teardown – Canon EOS M5	<a href="https://www.ifixit.com/Teardown/Canon+EOS+M5+Teardown/133466">https://www.ifixit.com/Teardown/Canon+EOS+M5+Teardown/133466</a>
Exhibit B	Canon – Autofocus Dual Pixel CMOS (DPAF)	<a href="https://www.usa.canon.com/internet/portal/us/home/learn/education/topics/article/2018/July/Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-Explained/Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-Explained">https://www.usa.canon.com/internet/portal/us/home/learn/education/topics/article/2018/July/Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-Explained/Canon-Autofocus-Series-Dual-Pixel-CMOS-AF-Explained</a>
Exhibit C	Canon Dual Pixel Autofocus – <i>Video</i>	<a href="https://www.youtube.com/watch?v=T3YfRqGZ6C4">https://www.youtube.com/watch?v=T3YfRqGZ6C4</a>