

# EOS C70 A NEW ERA OF CINEMA CAMERAS



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## Abstract

*The past decade has seen a progressive blurring of the lines that formerly separated still image photography from motion imaging cinematography. Many believe it was triggered in 2008 with the arrival of the gamechanging EOS 5D Mark II – a full frame DSLR that incorporated 1080P HDTV video at 30fps. The price point relative to then professional cinematography cameras and the attraction of the short depth of field associated with the large sensor captivated many. It was quickly adopted as a B/C-camera and “crash-cam” on movies and television productions. Most important, it set off a new wave in competitive still photography cameras with ever-expanding embedded video capabilities. Higher resolutions and higher picture capture rates followed. Meanwhile the Mirrorless camera arrived – offering creative alternatives to the still popular DSLR. Canon leveraged the Mirrorless to introduce an innovative extension to the long-established EF mount – the RF mount – maintaining the generous 54mm diameter of EF but significantly shrinking the flange back distance to 20mm. Year 2020 is witness to new professional Canon DSLR and Mirrorless cameras with impressive video capabilities all the way up to 8K.*

*Meanwhile global competitive dynamics were propelling professional digital cinematography cameras in numerous directions – reflecting the ever-widening creative aspirations of the worldwide movie and television production communities. The Super 35mm image format size remains entrenched worldwide – but is now flanked with numerous alternative full-frame lens-camera systems. Resolutions have marched past 4K – all the way up to 8K – and frame rates of 120 fps for 4K are increasingly available, while both HDR and WCG have become a new norm. Ingenious ergonomic designs speak to camera manufacturers responses to broad pleas for greater flexibilities and mobility in digital cinematography.*

*Canon believed that the separate advances in both digital cinematography cameras and video-empowered still photography cameras had reached a level where serious consideration of a new cross-breed camera that integrates the best of both would produce a significant new digital motion imaging tool for the cinematography universe. In particular it would offer a new level of compactness and mobility to digital cinematography while further empowering single operator shooting.*

*This white paper will make the case that the new EOS C70 is just such a new cinematography camera.*

## 1.0 BLURRING LINES BETWEEN PHOTOGRAPHY AND CINEMATOGRAPHY

In 2008 Canon introduced a photographic DSLR that offered full frame 1080P HD video – intended at the time to support the burgeoning web services being offered by major print publications. It unexpectedly triggered a worldwide interest in video shooting with cameras that were more compact and considerably lower in cost than the professional digital cinematography cameras of the time – while also exposing the merits of full frame digital motion imaging. Video capabilities have continued to advance – in both DSLR and Mirrorless cameras – propelled in part by the cinematography community who increasingly utilize these as flexible and cost-effective B and C cameras on multicamera shoots of movies and episodic television productions. One example, a new Canon DSLR [2] offers full-frame 5.5K RAW – fitting into a 5.9K full-frame Cinema EOS system – Figure 1.



Figure 1 A full-frame DSLR camera supports on board recording of 5.5K RAW or 4K DCI and offers B or C-camera support to established 5.9K cinematographic cameras

## 2.0 THE NEW ERA DIGITAL CINEMATOGRAPHY CAMERA

It was inevitable that Canon would produce a new form of digital motion imaging camera that can best be described as the formal bridge between the photographic camera and the digital cinematography camera. It marries the physical ergonomics of the former with the very latest in Super 35mm imaging and high performance video and audio recording of the latter. Specifically designed as a member of the Cinema EOS camera family, this new camera focused on achieving a new level of compactness and mobility intended to broaden shooting flexibilities in high-end digital cinematography. The paper will describe three core bridges between the Mirrorless and the cinematography worlds:

1. An integrated handgrip that is also multifunctional in terms of the multiple operational controls at the fingertip of the single operator – distinguishing the camera from other digital cinematography cameras
2. First use of the RF mount – developed by Canon for their full-frame Mirrorless cameras – in the Cinema EOS camera family.
3. Leveraging the extensive availability of EF and RF lenses – in optically bridging between all of these full-frame lenses and the Super 35mm image sensor in the EOS C70



Figure 2 Alliance between the best of EOS R and Cinema EOS produces a total new cinematography Camera

Figure 3 illustrates the extreme compactness of the new EOS C70



Figure 3 New EOS C70 (shown in black) is an innovative bridge between photographic and cinematographic cameras

The new camera borrows from the photographic world in terms of its form factor, ergonomics, and the use of the new RF-mount. Its compactness and lightweight and physical shape supports the familiar hand holding of the photographic camera while having all the imaging and recording features of the cinematographic camera.

### 3.0 INTRODUCTION TO EOS C70 CAMERA

Figure 4 shows the new EOS C70 – and its compact ergonomic design is readily apparent.



Figure 4 Two views of the EOS C70 camera

An ergonomic multifunctional grip enables easy hand held operation of the camera.

### 4.0 SIGNIFICANT ADDITION TO THE CINEMA EOS CAMERA LINE

Figure 5 positions the new EOS C70 as a full member of the Cinema EOS line – down to a precision matching of its optical height to the other members of the camera line.



Figure 5 The EOS C70 has the same optical height as the other Cinema EOS cameras shown here

Figure 6 conveys a sense of the new degree of compactness and shooting mobility that EOS C70 brings to digital cinematography. The base camera weighs only 2.6 lbs.



Figure 6 *The new cinematographic camera is compact and lightweight and empowers flexible handheld shooting*

There is one distinguishing feature of the EOS C70 that sets it apart – it is the first Cinema EOS camera based upon the RF mount whose unique advantages in terms of new optical designs are outlined in Reference [1].

## 5.0 RF LENS MOUNT

The EOS C70 is the first Cinema EOS camera to adopt the RF mount. The important innovations of this mount are described in reference [3]. Briefly, this mount opened optical opportunities to develop a new generation of lenses having higher optical performance – important for the long term Cinema EOS.

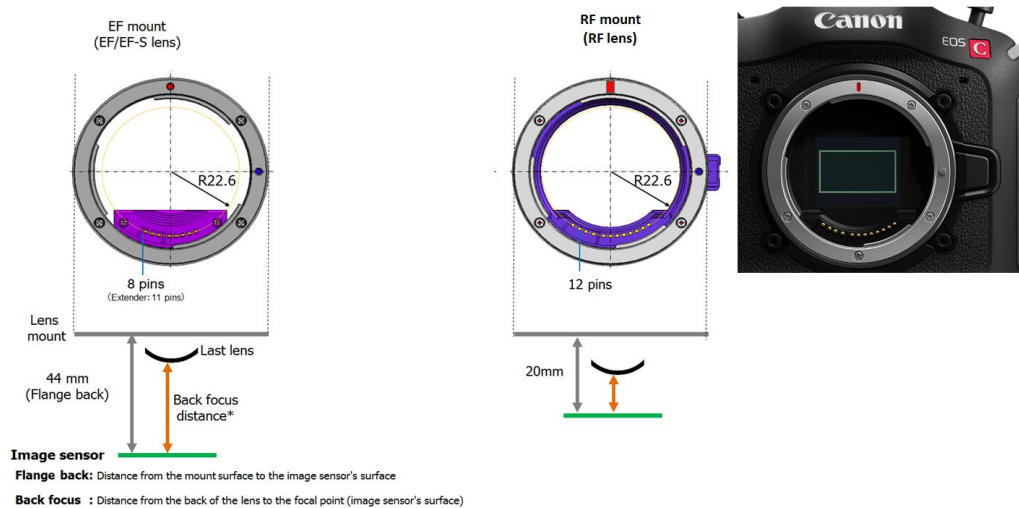


Figure 7 *The RF mount retains the wide 54mm aperture of the EF mount but it has a shorter Flange Back*



Central to the new mount strategy was the recognition that the large 54 mm diameter of the EOS system would continue to pay optical dividends far into the future. But the 44 mm flange back distance had surfaced as a constraint whose time had come to be dealt with. Significantly shortening this distance would yield immediate new degrees of freedom in optical design. But this, of necessity, would have to be balanced with rigidity of the new mount, ease of attaching and detaching lenses, durability, and dust and drip resistance. In-depth design reviews within Canon yielded the new RF lens mount — preserving the 54 mm inner diameter while significantly shortening the flange back to 20 mm. Now, positioning of large diameter lens elements much closer to the image sensor (especially the full frame sensor) would support an important enhancement of image quality.

Users can take full advantage of their EF lens assets by attaching an existing EF-EOS R mount adapter to the camera. Various mount adapters are available – from multifunction mount adapters with control rings, variable ND filters, and circular polarizing filters, along with the EF-EOS R 0.71x – newly developed for the EOS C70.

## 6.0 EOS C70 CAMERA – WITH SUPER 35mm IMAGE SENSOR

The EOS C70 camera is physically evocative of the full frame EOS R mirrorless camera. But, its imaging system is different – it is a 4K Super 35mm image sensor. It originates 4K DCI (4096 x 2160) or the alternative 4K UHD (3840 x 2160) – with the associated active image dimensions shown in Figure 8. The Super 35mm CMOS image sensor is an innovative development by Canon – one that offers an important extension to dynamic range. The technologies underlying this Dual Gain Output (DGO) image sensor [4] are explained in the next section.



Figure 8 Showing the total photosite count for the Super 35mm image sensor in the new EOS C300 Mark III and the sensor active image dimensions for 4K DCI and 4K UHD

The 17:9 aspect ratio 4K DCI has an active image diagonal of 29.6mm (approximately 8.85 megaphotosites) and the 16:9 UHD has a diagonal of 28.2mm (approximately 8.29 megaphotosites). The individual photosites are 6.4µm x 6.4µm.

## 7.0 LENS MOUNT ADAPTORS FOR EOS C70

An integral part of the overall design of EOS C70 are the three options available for lens mounting :

1. RF lens – which mount directly to the camera
2. Cinema EOS EF lenses – both primes and zooms – using an EF to EOS R adaptor (left in Figure 9)
3. Full Frame EF lenses – both Cinema EOS primes and EF L lenses – using a new Canon-developed full frame EF to Super 35mm RF mount adaptor (with built-in optical conversion) – shown on the right of Figure 9. Four screws firmly attach the two adaptor lock plates to the camera body as shown in Figure 9



Figure 9 Two different mount adaptors offer an impressive range of lens options for the EOS C70 camera

The EF-EOS R 0.71x mount adapter was developed by Canon using high performance optics to ensure the full angle of view of the full-frame lens is transferred to the Super 35mm image sensor of EOS C70 while benefiting from approximately a one-stop increase in brightness on to that sensor.



Figure 10 The EF-EOS R 0.71x mount adapter ensures a highly secure EF lens attachment to the camera RF mount

## 8.0 SUPER 35MM IMAGING – WITH A DIFFERENCE

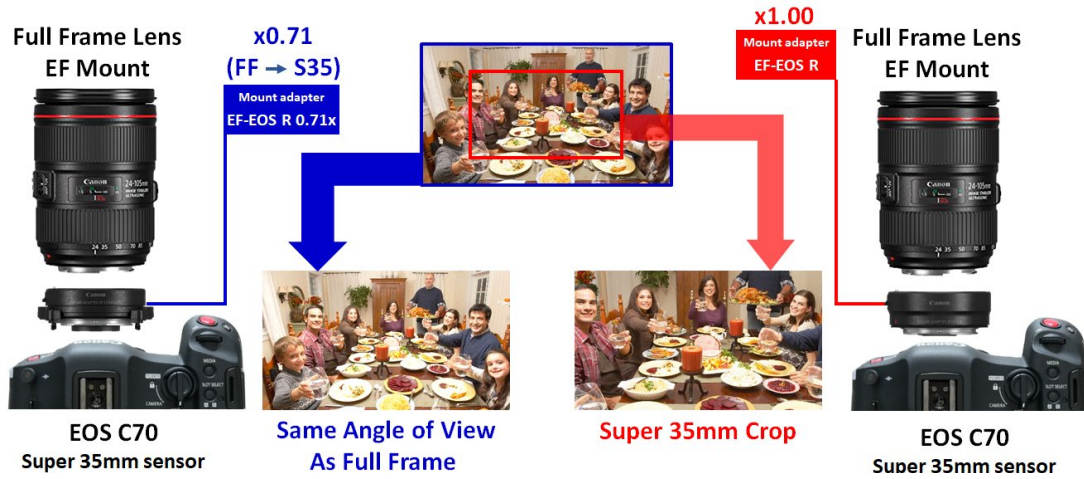


Figure 11 The EF-EOS R 0.71x adaptor (shown on the left) projects the full frame image on to the Super 35mm image sensor with enhanced brightness

The EF-EOS R 0.71x Mount Adapter is an EF-to-RF mount adapter that can be used in combination with EF lenses on the EOS C70. It is a Canon-developed precision wide optical system that allows users to shoot while maintaining a full-size angle of view without tele-conversion. Users shoot with a brighter f-number and take advantage of other assets and functions made possible by EF lenses.



Figure 12 The EOS C70 is supported by a wide array of lens options

## 9.0 NEW SLIM MOTORIZED ND UNIT SUPPORTS RF MOUNT

In a remarkable feat of mechanical design the newly-developed slim motorized ND filter unit is built into the small RF system body – fitting into the 20mm flange back RF system. Its depth is approximately 6 mm, about half that of the EOS C200 unit. It offers adjustment up to 10 stops (with extension). The ND selection button is placed on the body's right side, making its operability familiar to CINEMA EOS users. The action of the ND selection is quite fast.

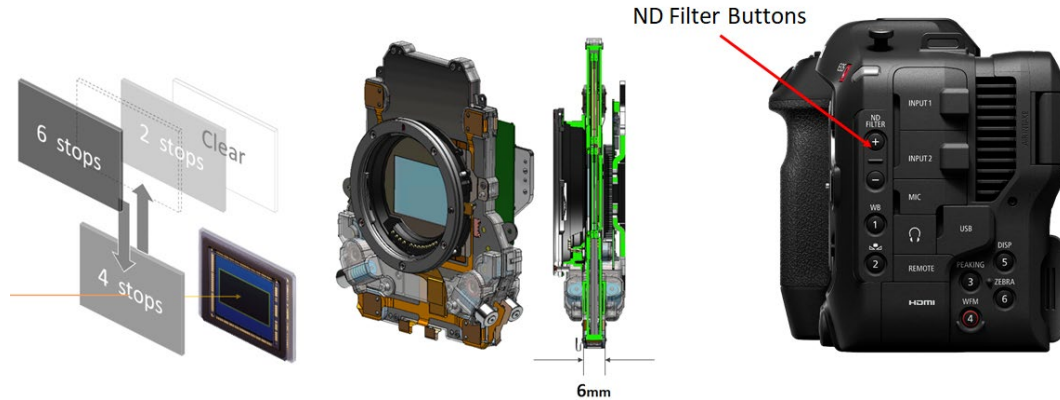


Figure 13 ND filter unit is a mechanical innovation designed to fit within the 20mm flange back distance of the RF mount

## 10.0 DUAL GAIN OUTPUT (DGO) IMAGE SENSOR

The original C300 (debuted in 2011) employed a totally new Super 35mm CMOS image sensor that Canon developed specifically for digital motion imaging. Among numerous design strategies was an innovative new photosite design that employed two separate photodiodes – each being 6.4 x 3.2 micrometers. For simplicity this novel design is referred to as Dual Pixel CMOS Image Sensor. The smaller individual photodiode supports a faster readout which in turn facilitates a greater efficiency in emptying the accumulated charge from each (the two charges are summed following readout and A/D conversion) [1]. The photodiode was also designed as a higher density N-type which elevates the number of saturation electrons. The net effect of these strategies is an elevation of the overall dynamic range of each photosite. This has been maintained in all of the Cinema EOS image sensors to date.

Some six years later Canon exploited the dual photodiodes in a second innovation – one that mobilized the dual photodiodes to create two separate images that facilitated a phase detection system that indicates the degree of defocusing. Allied with a sophisticated algorithmic data processing system the now well-established *Dual Pixel CMOS Auto Focus* system was born.

Now, three years later, the two photodiodes are being additionally deployed in a new and innovative way. While each photodiode has a structure that inherently expands dynamic range, that is now being augmented with additional processing to add a further extension of their respective dynamic ranges. This is termed the Dual Gain Output (DGO) system – allowing the image sensor to further extend into the deep shadowed areas of a given scene while simultaneously preserving all of the highlight information. It is important to note that the three separate deployments of the two photodiodes all operate independently of each other

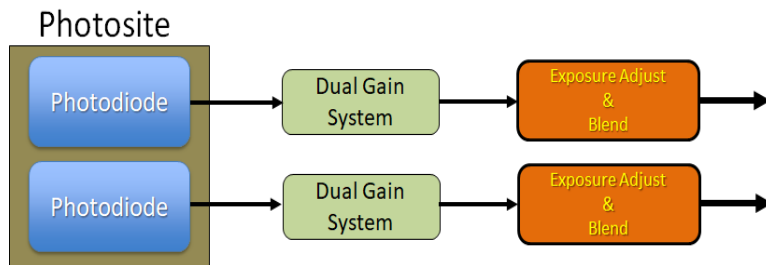


Figure 14 Principle of the Dual Gain Output (DGO) system that protects highlights and extends low light range

An additional processing strategy is implemented on each of the two photodiode outputs – in the form of application of two separate gain settings of the narrow bandwidth analog column amplifier.

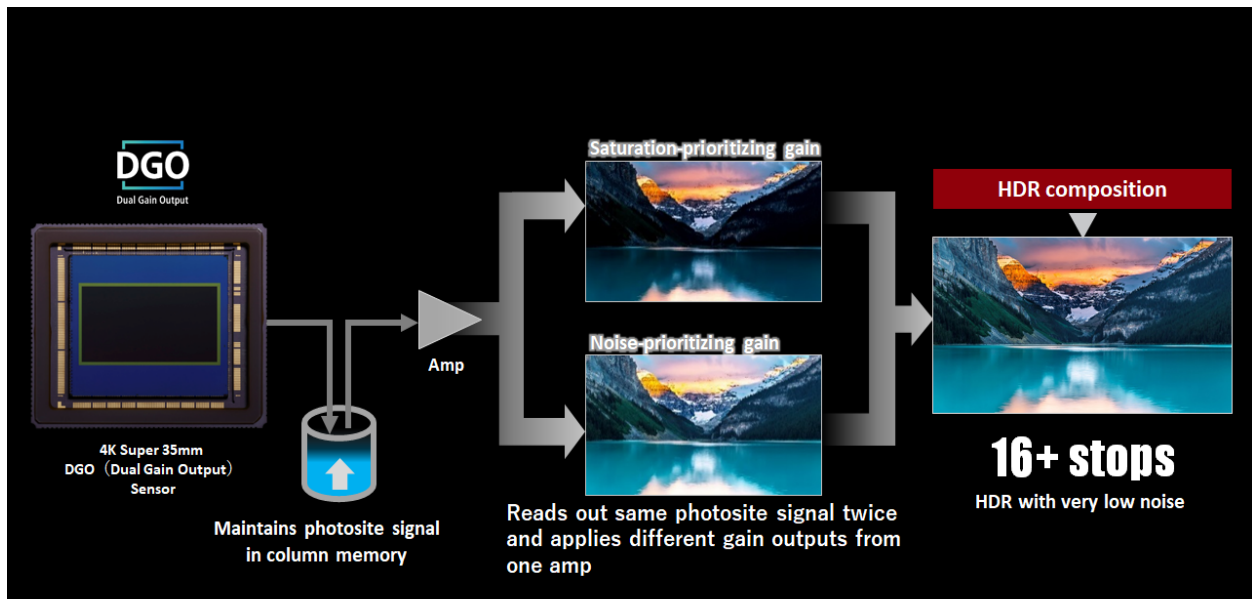


Figure 15 Simple representation of the two images that are ultimately blended to achieve the desired extension in dynamic range

The fact that the new EOS C70 camera has a Super 35mm imaging system identical to that of the EOS C300 Mark III makes this camera a very attractive B or C-camera to the EOS C300 Mark III – offering essentially identical 4K image quality and 16-stops of dynamic range.

## 11.0 INTELLIGENT TRACKING AND RECOGNITION AUGMENTS DPAF

Canon's Dual Pixel CMOS AF system continues to be improved – the high-speed one-shot AF and continuous AF (within an 80% horizontal and vertical range of the screen) provides highly accurate face detection AF by simply touching the LCD – as shown on the left of Figure 16. It also supports Tracking AF -- maintaining sharp focus on a chosen subject (that may not be a face) within the scene – that has been selected via the touch screen or joystick – and smoothly tracks that subject (such as the motorbike shown on the right in Figure 16).



Figure 16 *Touch Focus provides a range of options including Continuous, Face Detection, and Tracking AF*

The EOS C70 is the first CINEMA EOS camera to feature Canon's new EOS iTR AF X system (iTR : Intelligent Tracking and Recognition) – which includes a head detection algorithm developed with deep learning technology. In Face Detection AF, the system combines conventional face detection with an advanced head detection algorithm that dramatically improves distance measuring and tracking reliability. As illustrated in Figure 17 – even if the person whose face has been focused turns to the side or back, tracking will continue (once the head has been detected).



Figure 17 *Auto Focus on Face*

*Focus tracking continues with head detection*

## 12.0 CHOICES IN OETF

The EOS C70 is designed to support both High Dynamic Range (HDR) and Wide Color Gamut (WCG) – in both 4K / UHD and 2K / HD. The camera conforms to ITU international standards – BT.2020 for WCG and to BT.2100 for HDR. The camera allows a selection of the following Opto Electronic Transfer Functions:

BT.709 Normal / BT.709 Wide DR / PQ / HLG / Canon Log 2 and Canon Log 3 [5]

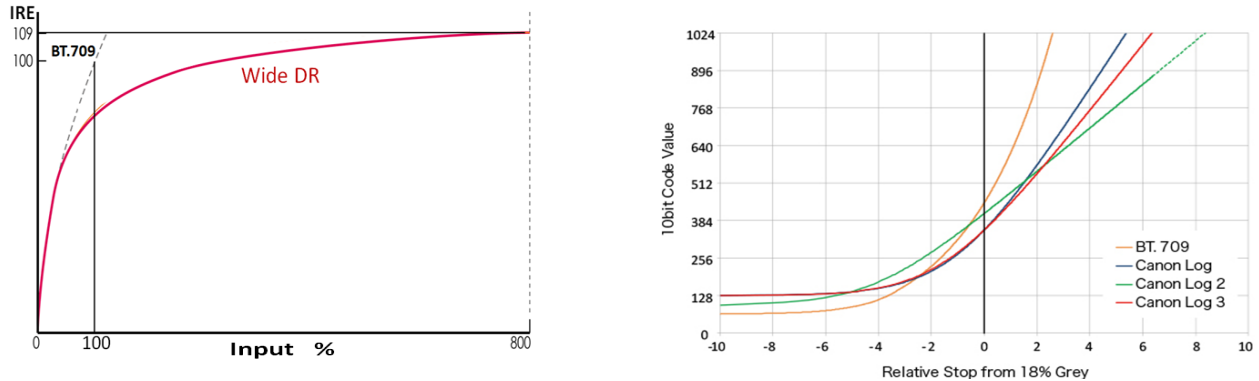


Figure 18 Showing the Wide DR OETF relative to BT.709 (on left) as linear representations – and on the right is shown Canon Log 2 and Canon Log 3 and BT.709 in the relative Stop to Code Values representation preferred in cinematography

## 13.0 SENSITIVITY OF EOS C70

### Formal Broadcast HDTV Sensitivity Specification

With the EOS C70 set for 1920 x 1080 @ 29.97P and ISO 800 (or Master Gain at +12 dB), and Canon Log2 – and framing a gray scale chart under 2000 Lux of 3200 degree Kelvin illumination, the lens aperture setting to achieve 58.4 IRE on the 89.9% reference white is f/14. The Luma signal to noise should measure greater than 70 dB. When set for 2048 x 1080 @ 59.94P under the same conditions, the lens aperture for 58.4 IRE is f/10.

In the cinematography context the ISO range is ISO 100 to ISO 102,400

Base Sensitivity required to achieve specified dynamic ranges:

BT.709	BT.709 / Wide DR / HLG	Canon Log 2 / Canon Log 3 / PQ
ISO 160 or above	ISO 400 or above	ISO 800 or above

### 13.1 Auto ISO / Gain Function

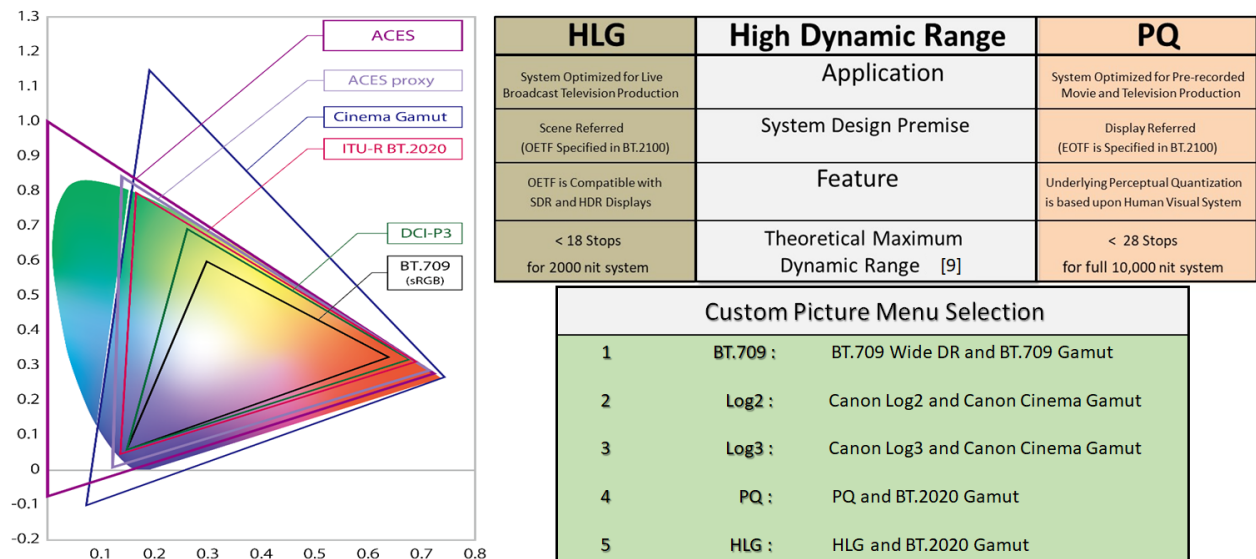
EOS C70 has a novel function that is new to Cinema EOS cameras – it can automatically adjust sensitivity by utilizing the DGO sensor characteristics which were optimized for smooth switching of gain. It allows the camera operator to concentrate on image framing without worrying about aperture and other camera settings when moving between significant changes in scene illumination (for example, from a indoor to an outdoor setting). This function can be especially useful for drones and other remote applications.

## 14.0 HIGH DYNAMIC RANGE (HDR) & WIDE COLOR GAMUT (WCG)

For HDR imaging the EOS C70 offers an OETF selection of Canon Log2 or Canon Log3 [5]. Canon Log2 supports a 16-stop dynamic range and Canon Log3 supports a 14-Stop range. In terms of HDR recording the camera further supports the two standardized HDR systems – the Hybrid Log Gamma (HLG) and the Perceptual Quantization (PQ) system [6] – whose respective primary attributes are summarized in Table 1. Both HLG and PQ are compliant with the latest HDR operational guideline ITU-R BT. 2408 [7] and ITU-R BT.2390 [8]. The theoretical maximum dynamic ranges offered by these two systems is shown in TABLE 1 and are discussed in reference [9].

The camera also offers a selection of standardized color gamuts including BT.709, and the Wide Color Gamut (WCG) BT. 2020 [10]. In addition, it supports the Canon-developed Cinema Gamut – an ultra-wide color gamut specifically tailored for moviemaking – shown in TABLE 1 relative to other standardized color gamuts.

TABLE 1 HDR systems and Color Gamuts in EOS C70



The Custom Picture menu in the EOS C70 is used to select the Gamma and Color Space of choice – from the five combinations listed in TABLE 1.



## 15.0 VERTICAL IMAGING

The growing deployment of vertically oriented framing for large screen digital signage has stirred requests for more convenient operation of professional cameras to support this form of shooting. The EOS C70 is the first in the Cinema EOS line to directly address this mode of shooting. A tripod hole is incorporated on the side of the camera-grip allowing easy attachment to a tripod without a special accessory. Most of the input/output terminals are placed on the other side of the tripod hole so that cables do not interfere with this tripod mount. Upon selection of this vertical shooting mode the viewfinder can be positioned as shown on the right of figure 19 and recording Start / Stop can be a touch control from rear-mounted LCD screen.

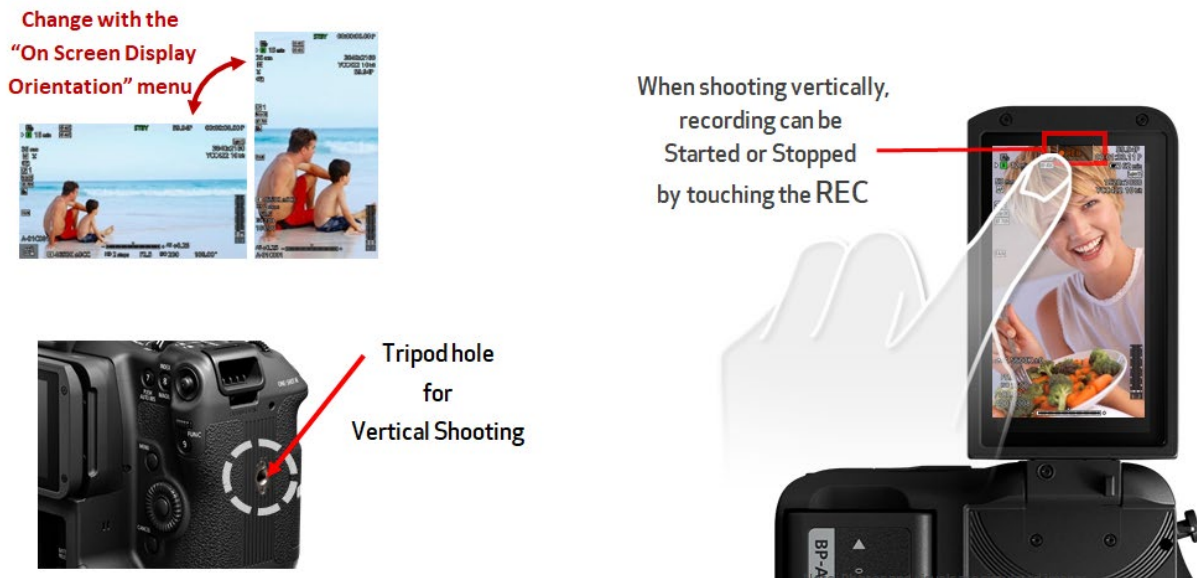


Figure 19 The camera can be oriented for vertical shooting on a tripod and the viewfinder orientation and image portrayal support convenient monitoring of the imagery

## 16.0 ELECTRONIC IMAGE STABILIZATION (EIS)

The EOS C70 embodies Electronic Image Stabilization (EIS) – based on the same system as EOS C300 Mark III [1]. The camera system offers five-axis electronic correction when coupled to a lens that has no internal image stabilization. The essence of the correction strategy is to spatially move that frame under software control in a manner that counters the image shift created by the external vibrations and restore the image to its central position. However, the special feature of EOS C70 is that it offers a Combination Image Stabilization system in that there is a coordination between image-stabilized lenses and the electronic correction in the camera – see Figure 20. When operating with an RF lens having internal IS (right side of Figure 20) there is a higher degree of handshake optimization between the lens and the camera IS system that implements a better anti-vibration compensation than the EF system. When operating with an EF lens that does have internal IS the lens manages the Yaw and Pitch compensation while the camera deals with the Roll and Horizontal / Vertical (X/Y) movements as shown in the left side of Figure 20.

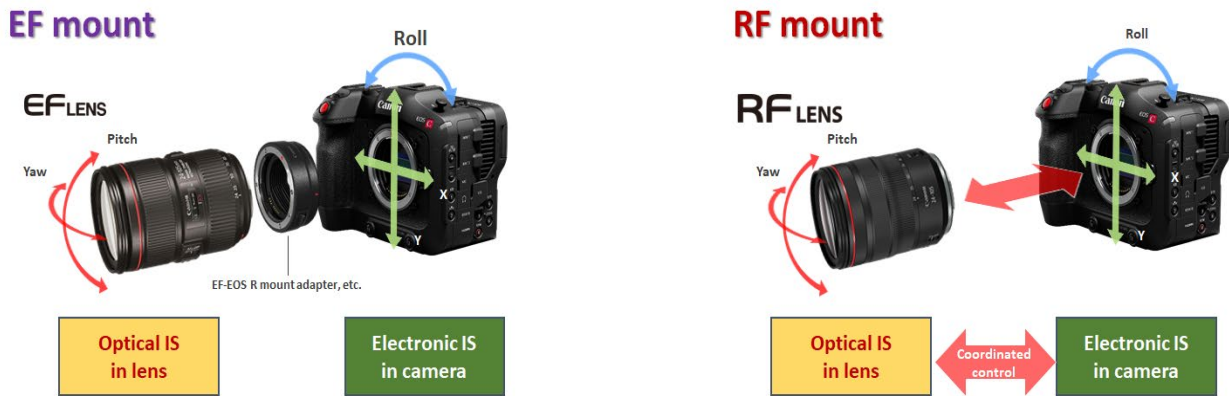


Figure 20 The greater coordination between the RF lens and the camera offers improved overall image stabilization than the EF lens system

When using lenses that have no built-in image stabilization the EOS C70 implements electronic five axis IS within the camera. The focal length of the lens should first be entered via the menu system.

## 16.1 Super 16mm Digital IS

In addition to the current EIS, the EOS C70 adds a new mode termed Super 16 Digital IS – utilizing the 4K sensor to stabilize the 2K image by using the peripheral area around center 2K as the correction range to provide high performance stabilization.

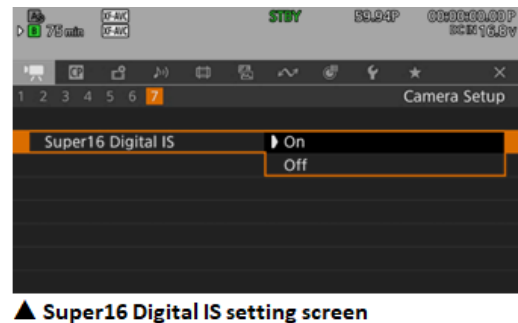
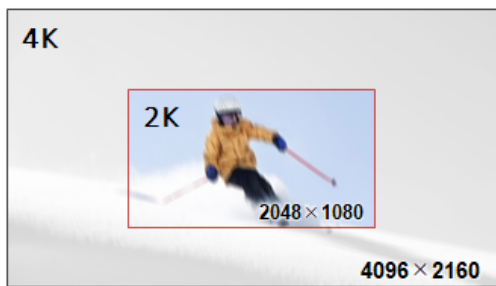


Figure 21 The cropped Super 16mm video format (2K or HD) is electronically moved around the larger 4K area offering a heightened degree of image stabilization

## 17.0 RECORDING OPTIONS IN EOS C70

Three recording codecs are built into the EOS C70 -- a choice between XF-AVC and HEVC for 4K/ UHD /2K /HD recording of YCbCr 4:2:2 @10bit and an AVC / H.264 for YCbCr 4:2:0@8-bit.

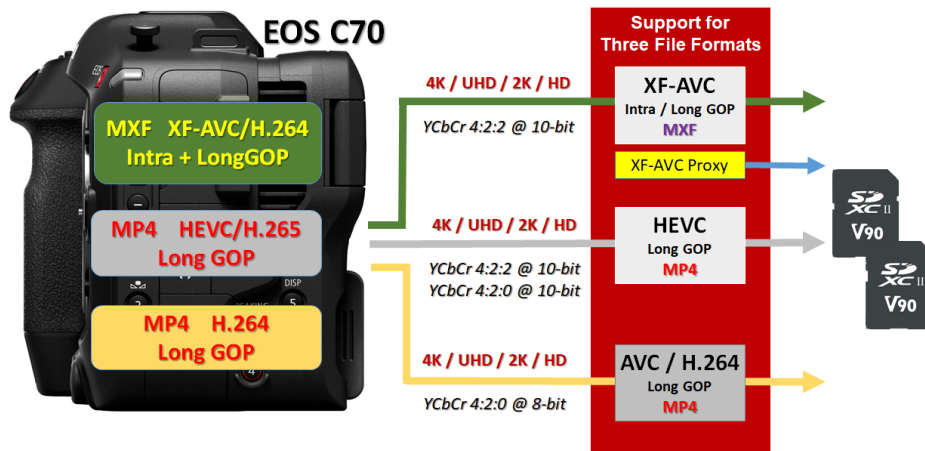


Figure 22 Summarizing the three codecs that support the video recording options in EOS C70

Cost-effective and widely available SD card is the recording media – and the dual card slots are mounted within the multifunctional handgrip. The high-speed UHS-II card (U3 V30 or higher) is recommended. Specifically, for recording XF-AVC Intra or LongGOP YCbCr 4:2:2 @ 10-bit the V60 or V90 (three times faster than UHS-I) are recommended. They are also recommended for recording 4K MP4 HEVC YCbCr 4:2:2 @ 10-bit and also for Slow & Fast Motion recording.

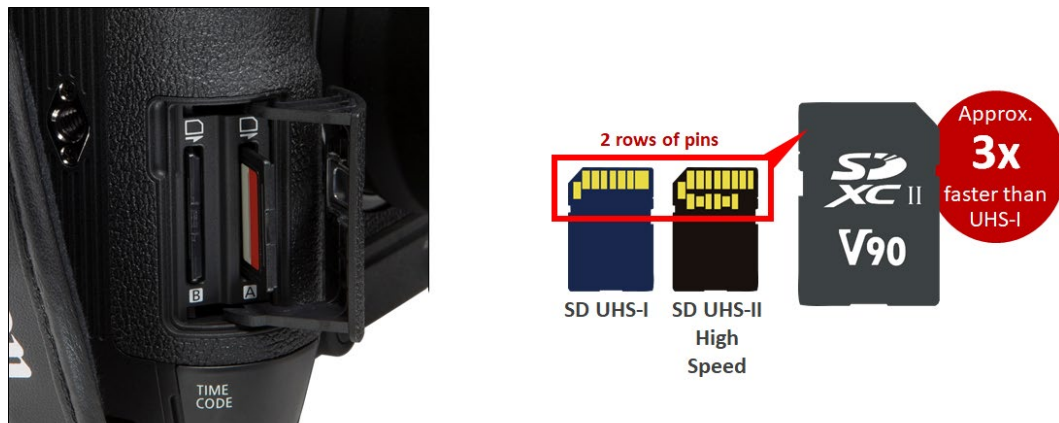


Figure 23 Long duration and simultaneous recording options are supported by dual SD UHS-II high-speed cards

The EOS C70 supports a variety of recording modes that utilize the two SD card slots, including:

- Simultaneous recording for backup or proxy files for editing
- Simultaneous recording of different formats and resolutions
- Relay recording for long-duration shots

TABLE 1 XF-AVC Recording – Data Rates, Frame Rates, File Formats, and Recording Durations for 4K and 2K DCI / UHD formats YCbCr 4:2:2 @ 10-bit

Codec XF-AVC	Resolution	Color Sampling & Bit Depth	Data Rate (Mbps)	Frame Rate (fps)	File Format	Recording Media SD			Slow & Fast
						Recording Durations (Minutes)			
						64	128	512GB	
XF-AVC Intra (VBR)	4K (4096 x 2160) UHD (3840x2160)	4:2:2 10-bit	410	23.98P / 24P / 25P / 29.97P	MXF	19	39	156	
	2K (2048x1080) HD (1920x1080)	4:2:2 10-bit	310 160	59.94P / 50P 23.98P / 24P / 25P / 29.97P 59.94i / 50i		25 50	51 100	207 401	
XF-AVC Long GOP (VBR)	4K (4096 x 2160) UHD (3840x2160)	4:2:2 10-bit	260 160	59.94P / 50P 23.98P / 24P / 25P / 29.97P		30 50	61 100	246 401	
	2K (2048x1080) HD (1920x1080)	4:2:2 10-bit	50	59.94P / 50P 23.98P / 24P / 25P / 29.97P 59.94i / 50i		160	321	1284	
XF-AVC Proxy	2K (2048 x 1080) HD (1920x1080)	4:2:0 8-bit	35 24	59.94P / 50P 23.98P / 24P / 25P / 29.97P		229 334	458 668	1834 2675	
	XF-AVC Long GOP HFR (Special Record)	4K (4096x2160) UHD (3840x2160)	4:2:2 10-bit			23.98P / 24P 59.94P / 50P / 25P / 29.97P			
2K (2048x1080) HD (1920x1080)		4:2:2 10-bit		23.98P / 24P 59.94P / 50P / 25P / 29.97P 59.94i / 50i				12-180fps 15-180fps	

### 17.1 Simultaneous Recording in Different Formats on the Two Cards

Flexible workflow that can support different needs for backup or distribution is facilitated – as shown in Fig. 24.

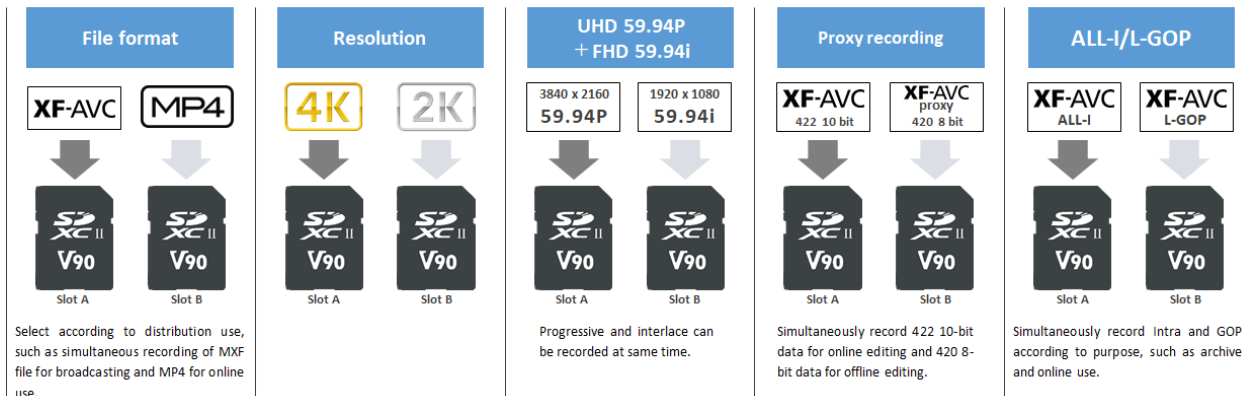


Figure 24 EOS C70 offers simultaneous recording options in different file formats, resolutions, and color sampling.16

TABLE 2 HEVC / H.265 Recording – Data Rates, Frame Rates, File Format, and Recording Durations for 4K DCI / UHD and for 2K DCI / HD formats – and the Slow & Fast Motion Options

Codec HEVC/H.265	Resolution	Color Sampling & Bit Depth	Data Rate (Mbps)	Max Frame Rate (fps)	File Format	Recording Media SD			Slow & Fast
						Recording Durations (Minutes)			
						64	128	512GB	
HEVC / H.265 Long GOP	4K (4096 x 2160) UHD (3840x2160)	4:2:2 10-bit	225 135	59.94P / 50P 23.98P / 24P / 25P / 29.97P	MP4	35 59	71 118	285 475	
	2K (2048x1080) HD (1920x1080)	4:2:2 10-bit	50	59.94P / 50P 23.98P / 24P / 25P / 29.97P 59.94i / 50i		160	321	1284	
	HD (1280x720)	4:2:2 10-bit	12	59.94P / 50P		668	1337	5350	
	4K (4096 x 2160) UHD (3840x2160)	4:2:0 10-bit	170 100	59.94P / 50P 23.98P / 24P / 25P / 29.97P		47 80	94 160	377 642	
	2K (2048x1080) HD (1920x1080)	4:2:0 10-bit	35	59.94P / 50P 23.98P / 24P / 25P / 29.97P 59.94i / 50i		229	458	1834	
	HD (1280x720)	4:2:0 10-bit	9	59.94P / 50P		891	1783	7133	
HEVC / H.265 Long GOP HFR Special Record	4K (4096 x 2160) UHD (3840x2160)	4:2:2 10-bit		23.98P / 24.0 P 59.94P / 50P / 25P / 29.97P				12-120 fps 15-120 fps	
	2K (2048x1080) HD (1920x1080)	4:2:2 10-bit		23.98P / 24.0 P 59.94P / 50P / 25P / 29.97P				12-120 fps 15-120 fps	

Details on the HFR special record modes shown here in Tables 2 and 3 are in the next Section 19.0 on Slow & Fast Motion.

TABLE 3 AVC / H.264 Recording – Data Rates, Frame Rates, File Format, and Recording Durations for 4K DCI / UHD and for 2K DCI / HD formats at YCbCr 4:2:0 @ 8-bit – and the Slow & Fast Motion Options

Codec AVC / H.264	Resolution	Color Sampling & Bit Depth	Data Rate (Mbps)	Frame Rate (fps)	File Format	Recording Media SD			Slow & Fast
						Recording Durations (Minutes)			
						64	128	512GB	
AVC / H.264 Long GOP	4K (4096 x 2160) UHD (3840x2160)	4:2:0 8bit	150	59.94P / 50P 23.98P / 24P / 25P / 29.97P	MP4	53	107	428	
	2K (2048x1080) HD (1920x1080)	4:2:0 8bit	35	59.94P / 50P 23.98P / 24P / 25P / 29.97P 59.94i / 50i		229	458	1834	
	HD (1280 x720)	4:2:0 8-bit	8	59.94P / 50P		1003	2006	8025	
AVC / H.264 Long GOP HFR Special Record	4K (4096 x 2160) UHD (3840x2160)	4:2:0 8bit		23.98P / 24.0P 59.94P / 50P / 25P / 29.97P				12-120fps 15-120fps	
	2K (2048x1080) HD (1920x1080)	4:2:0 8bit		23.98P / 24.0P 59.94P / 50P / 25P / 29.97P 59.94i / 50i				12-120fps 15-120fps -	

## 18.0 SLOW AND FAST MOTION

The EOS C70 camera supports Dual Pixel CMOS Auto Focus at a multitude of shooting frame rates up to 4K 120P. On Table 4 below, the rates in yellow support DPAF shooting. Even if the camera is mounted in gimbals or in a drone, accurate focus can be sustained during shooting.

TABLE 4 Allowable Shooting Frame Rates for Various Playback Frame Rates

Sensor mode	Frame Rate	Shooting Frame Rate																						
Super 35	59.94p	15	30	44	48	52	56	60	90	120														
	29.97p	15	22	24	26	28	30	32	36	40	44	48	52	56	60	90	120							
	23.98p	12	16	18	20	22	24	26	28	30	32	36	40	44	48	52	56	60	72	96	120			
	24.00p	12	16	18	20	22	24	26	28	30	32	36	40	44	48	52	56	60	72	96	120			
	50.00p	15	25	34	38	42	46	50	54	58	60	75	100	120										
	25.00p	15	17	19	21	23	25	26	28	30	34	38	42	46	50	54	58	60	75	100	120			
Super 16	59.94p	15	30	44	48	52	56	60	90	120	150	180												
	29.97p	12	15	22	24	26	28	30	32	36	40	44	48	52	56	60	90	120	150	180				
	23.98p	12	16	18	20	22	24	26	28	30	32	36	40	44	48	52	56	60	72	96	120	144	168	180
	24.00p	12	16	18	20	22	24	26	28	30	32	36	40	44	48	52	56	60	72	96	120	144	168	180
	50.00p	15	25	34	38	42	46	50	54	58	60	75	100	120	150	175	180							
	25.00p	15	17	19	21	23	25	26	28	30	34	38	42	46	50	54	58	60	75	100	120	125	150	175

The camera also supports audio recording during Slow & Fast Motion shooting – with the video being recorded to one SD card while the audio is recorded on the second SD card in a separate WAV file – enabling an improved capture experience for advanced frame rate shooting.

## 19.0 AUDIO RECORDING

The EOS C70 features two mini XLR terminals with 48 volt phantom power for attaching professional microphones enabling high quality audio recording. There is also a 3.5mm microphone input allowing connection of a variety of microphones. Stereo audio can be recorded for use as backup recording via two built-in microphones on the camera front when using an external XLR microphone. These can also be used to record guide audio for captions, or for timing with other devices to enable shooting without preparing an external mic. A Voice Memo mode can be selected for the stereo mics – that cuts high and low frequencies and focuses on the middle frequency for recordings to be used as audio memos,



Figure 25 Stereo mics are built-in to the camera front and two 3-pin mini XLR input terminals are on the camera side - while audio controls are on the camera rear

For all of the XF-AVC recording modes the four-channel audio is recorded as Linear PCM - 24-bit @ 48 kHz. For the MP4 (HEVC) /H.265 @ 10-bit and the MP4 AVC / H.264 8-bit video recording the audio recording can be selected to be as MPEG-2 AAC LC (16-bit, 48 kHz two-channel) or Linear PCM (16-bit, 48 kHz four-channel).

## 20.0 SYSTEM CONNECTIVITY



Figure 26 Most of the system interfaces are on the left hand side of the camera

The all-important Time Code input-output interface allows the EOS C70 to be readily incorporated as a B or C-camera within a multicamera Cinema EOS system. It supports IP streaming over a network by connecting the USB-C terminal with a specified 3<sup>rd</sup> party adapter.

## 21.0 HDMI OUTPUTS

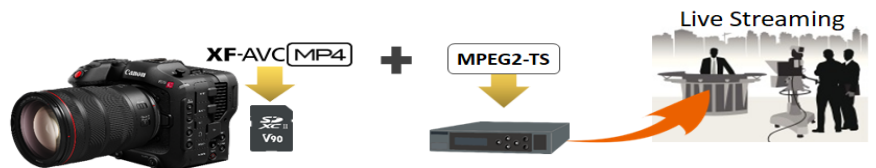
EOS C70 has a Type-A HDMI output terminal. The output frame rate generally corresponds to the frame rate set for the camera. In the 59.94P mode the output will be 59.94P and in the 50P mode the output will be 50P. However, in the 24.0 Hz mode the HDMI output will be 24P. In the Slow & Fast Motion mode the output will be 60P. In the PsF frame scan mode the HDMI output will be 59.94i in the 59.94 Hz mode, 50i in the 50 Hz mode, and it will be 60.00i in the 24.0 Hz mode.

Table 5 HDMI Video Outputs for Various Camera Settings

SD Card Record: <b>XF-AVC</b> and <b>MP4</b>				HDMI Video Output YCbCr 4:2:2 @ 10-bit
Recording Configuration		Menu Selection		
Resolution	Frame Rate	Frame Scan	HDMI Resolution	
4096 x 2160	59.94	P	4096 x 2160	4096 x 2160 3840 x 2160 1920 x 1080 1280 x 720
	50.0	P	3840 x 2160	
	29.97	P	1920 x 1080	
	25.0	P	1280 x 720	
	24.0	P		
3840 x 2160	24.0			1920 x 1080
	23.98	PsF		
2048 x 1080	59.94	P	1920 x 1080	1920 x 1080 1920 x 1080 1920 x 1080 (59.94i/50i/60i)
	50.0	P	1280 x 720	
	29.97			
	25.0	PsF		
	24.0			
1920 x 1080	23.98			
1280 x 720	59.94	P	1920 x 1080	1280 x 720
	50.0	PsF	1280 x 720	1920 x 1080 (59.94i/50i/60i)
1920 x 1080 (only in XF-AVC)	59.94i	PsF		1920 x 1080
	50.0i			

## 22.0 IP STREAMING

EOS C70 supports IP streaming by connecting to a network via the USB-C terminal with a specified 3<sup>rd</sup> party adapter. Supported IP decoders and software with IP streaming capability enables live streaming for news programs or online contents platforms.



Supported protocols	RTP / UDP / RTP+FEC / RTSP + RTP					
Main video signal format Resolution/frame rate	Streaming signal format					
	H.264 8bit	Video			Audio	
Bit rate		Resolution	Frame rate	Format	Bit rate	
<b>H.264 10bit</b> 3840 x 2160 59.94p, 50.00p 1920 x 1080 59.94p/i, 50.00p/i	9 Mbps	1920 x 1080	59.94p/59.94i, 50.00p/50.00i	MPEG2 AAC 2ch	256k bps	
	4 Mbps	1920 x 1080				

IP streaming (H.264) is possible during video recording (H.264), but not possible during MP4 (HEVC) recording

Figure 27 Showing the streaming format details



## 23.0 OPERATIONAL CONTROL – MULTIFUNCTIONAL GRIP

The very nature of the compact ergonomic design of EOS C70 anticipates a considerable amount of single operator shooting – and a large amount of that is likely to be handheld. Accordingly, much thought went into making the operational controls to be readily accessible. The integrated grip’s ergonomic design makes it easy to hold, fitting comfortably in the hand while offering multifunctionality – in that the hand has direct access to three custom dials and a joystick placed on the grip in a natural layout, enabling quick settings with fingertips – as shown in Figure 30. Among the functions that can be assigned, iris and ISO/gain, WB selection, and color temperature have been included. In addition to the front and rear custom dials, if an RF lens is employed the RF lens control ring can also be assigned different functions. This allows three different parameters to be set at the same time.



Figure 28 Three dials and a joystick are on the right hand side while various operational buttons are on the left

## 24.0 DIRECT TOUCH CONTROL

Canon has introduced for the first time within the Cinema EOS camera family a powerful new operational feature that allows direct, rapid, and easy access to setup menus that are commonly used. The development of a new direct touch interface in the LCD monitor allows access to many settings that are hierarchically structured in the camera menu system using one hand while holding the camera.



Figure 29 *A direct touch interface is incorporated in the LCD screen*

Parameters can be intuitively set onscreen with touch and flick action. Rapid and convenient setup of the camera using access on the large screen to parameters such as ISO, color temperature, lens aperture, white balance – empowers the shooter. Sequential selection can reach recording parameters and display settings.

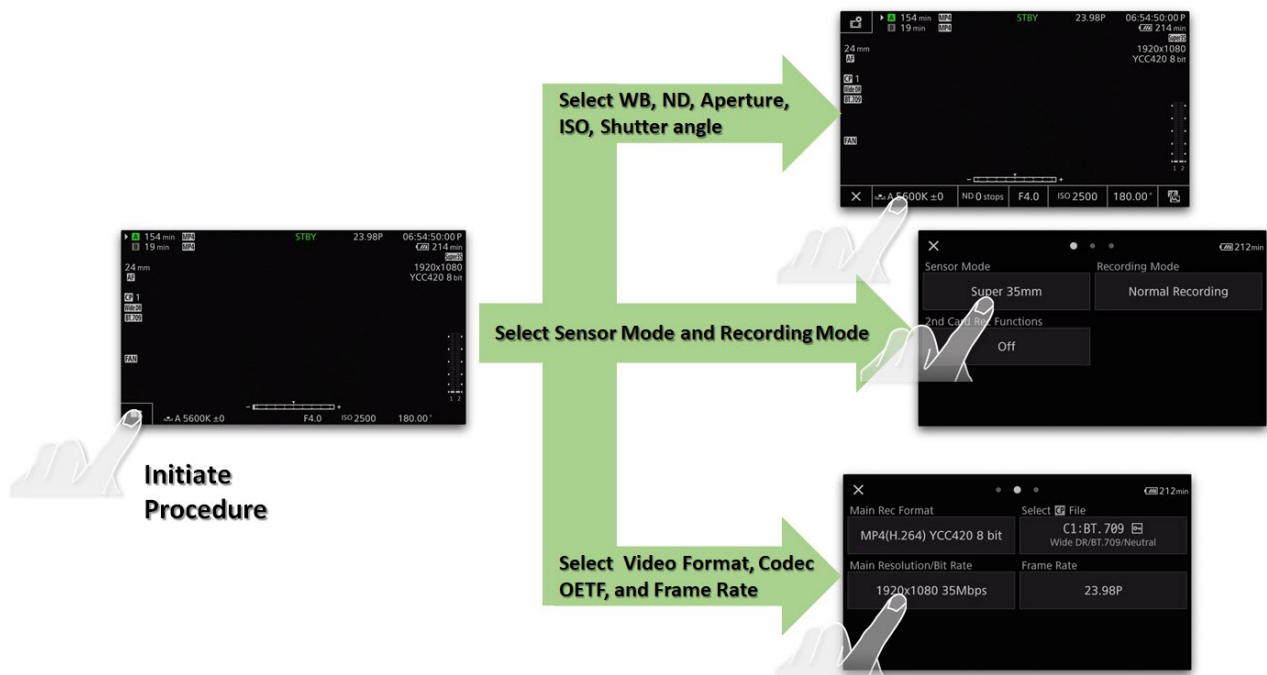


Figure 30 *Some of many operational settings normally selected via the camera menu that are now accessible on LCD screen*

## 25.0 REMOTE CONTROL OF EOS C70

### 25.1 Remote Video Control Panel

When the EOS C70 is mounted on a crane or jib-arm all of the basic video functions can be controlled from the RC-V100 remote video panel.



Figure 31 *The RC-V100 video control panel supports remote control of video and also lens zoom, iris, and focus (including the Canon CINE SERVO lenses)*

### 25.2 Browser Remote Operation

After connecting a network device to the camera via specified 3rd party Wi-Fi adapter the Browser Remote function allows the camera to be remotely operated from a tablet or other device – including remote focusing operations. The selected focusing area can be moved by touch on the tablet. In situations such as shooting from a crane or drone aerial shooting this empowers accurate AF shooting.



Note: Photos and visuals are simulated images.

Figure 32 *Browser Remote supports the control of the EOS C70 from a tablet*

## 25.3 GPS

Separately, the EOS GPS Receiver GP-E2 can also be connected to the USB Type-C terminal on the EOS C70 (using a USB cable) and provides location and time information that is added to video or still images when recording XF-AVC/MP4.

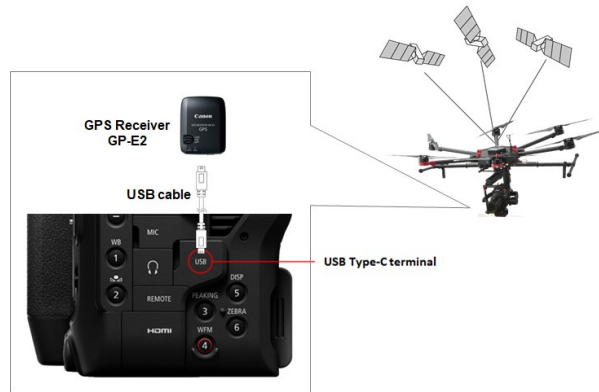


Figure 33 A GPS receiver can simply connect to the USB Type-C terminal on the EOS C70 and provide location and time information

## 26.0 CUSTOM PICTURE

The EOS C70 provides Custom Picture options to support a variety of production requirements – facilitating customized presets including gamma, color space, and color matrix. Custom Picture files can only be attached for XF-AVC (MXF) recorded files. 20 such files are provided within the camera body – from where they may be written to an SD card – via “CP File Save” in the menu – (they can also be loaded into the camera from the SD card). To more freely control recording image quality external LUT files can be imported into EOS C70. They can be created in DaVinci Resolve and imported in 3D .cube format. Imported LUT data is preserved even when the camera is powered down.

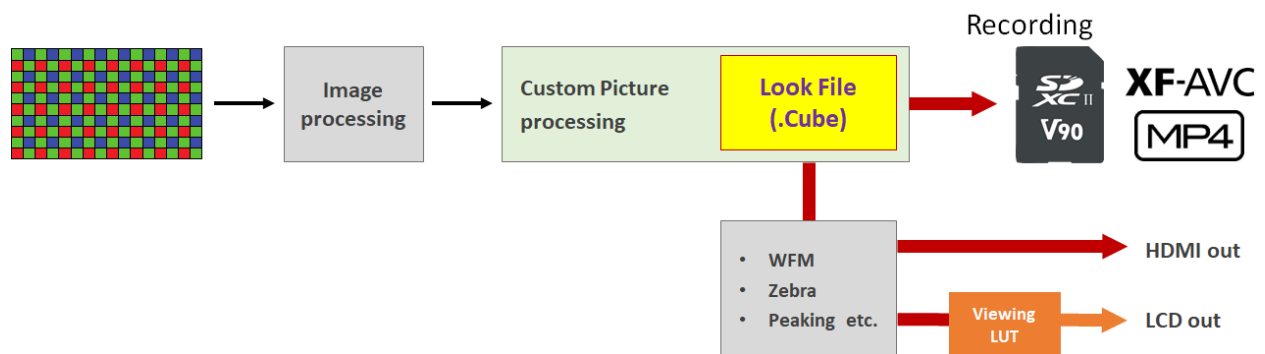


Figure 34 The EOS C70 supports importation of custom LUTS via the 3D .cube format

## 27.0 INDEPENDENT AIR DUCT STRUCTURE FOR VENTILATION

An independent air duct structure within the EOS C70 body ensures that air does not come into contact with the image sensor board and main electronics board inside. The main duct is an Aluminum diecast – which is a high heat dissipation material. In particular, this separation protects the image sensor from dust, dirt, and water.



Figure 35 Separation of the ventilation and the internal electrical systems ensure

## 28.0 SUMMARY

An important new digital motion imaging system has been added to the Cinema EOS lineup. It harnesses the new-found optical advances offered by the RF-mount with the highly refined ergonomics of Canon mirrorless still photographic cameras, and then combines these with the imaging prowess of the new Super 35mm Dual Gain Output (DGO) image sensor and the flexible recording capabilities of the Cinema EOS system. The importance of this addition lies in the new shooting flexibilities offered by the novel design of this camera. A highly operationally-endowed cinematography camera can be comfortably handheld for long shooting durations. The lightweight compact camera allows creative image capture capability in confined spaces.

The 16+ Stop dynamic range of the EOS C70 is supported by a choice of Canon Log2 or Canon Log3 – or a choice of either the HLG or PQ standardized HDR systems.

## 29.0 REFERENCES

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