

A GUIDE TO THE PANASONIC AU-EVA1 CAMERA

BY BARRY GREEN



Contents

Acknowledgements	XI
Frequently Asked Questions	1
Articles	8
Understanding Exposure	8
Understanding White Balance	19
Focusing	22
Benefits Of Shooting In 4K or UHD	25
SDHC and SDXC Card Best Practices	29
Rolling Shutter MOS Sensors	32
An Introduction to the Waveform Monitor & Vectorscope	38
Which Mode to Shoot In?	44
Recording Time on an SDHC/SDXC Card	55
Optimizing for Low Video Noise	55
Synchronizing Timecode in a Multi-Camera Shoot	58
Variable Frame Rates	60
HDMI vs SDI (6G-SDI, 3G-SDI and HD-SDI)	66
Using V-LOG	68
Using SDI Raw Output	78
Lenses and Lens Mounts	84
System Settings Menu and Sub-Menus	88
SYSTEM MODE sub-menu	88
Frequency	88
SDI Raw	90
Sensor Mode	91
Main Pixel	92
Main Codec	93
COLOR SETTINGS sub-menu	94
Main	94
SDI Out / HDMI Out / LCD Out	96

USER SWITCHES sub-menu	97
USER1 through USER9	97
User Toggle	103
 SIDE LOCK sub-menu	 105
 LED & FAN sub-menu	 105
Access LED	105
Power LED	105
Fan Speed	105
 LCD sub-menu	 106
Brightness	106
Color Level	106
Contrast	106
Back Light	106
 INFORMATION sub-menu	 107
Version	107
Operation Time and Sensor Temp	107
USB Service Mode	107
Update	107
Initialize	107
 Camera Settings Menu and Sub-Menus	 109
FPS sub-menu	109
VFR SW	109
Value	109
Add	110
Edit	110
Delete	110
 SHUTTER sub-menu	 110
SW	110
Mode	110
Add, Edit, and Delete	112
 EI (Exposure Index) sub-menu	 112
Mode	112
ISO Select	112
Gain Mode	113
Native ISO, 800BASE ISO, and 2500BASE ISO	114
Gain Select	115

WHITE sub-menu	115
AWB	115
Value	116
Add, Edit, and Delete	117
NR (Noise Reduction) sub-menu	117
ISO800, and ISO2500	117
LENS SETTINGS sub-menu	118
A. Iris Level Effect	118
A. Iris Window	119
A. Iris Peak/Ave	119
Grip Iris	119
AF Offset	120
IR (InfraRed) SHOOTING sub-menu	120
E.I.S. (Electronic Image Stabilization) sub-menu	120
SW	120
Zoom Position Data	121
Zoom Position Value	121
Auto Black Balance sub-menu	121
Scene File Settings Menu	123
Name Edit	123
SCENE DATA sub-menu	124
Load, Save, and Initialize	124
BLACK sub-menu	124
M. Ped (Master Pedestal)	124
R Ped, G Ped, and B Ped	125
Pedestal Offset	125
GAMMA sub-menu	126
Gamma Select	126
Master Gamma	129
Black Gamma	129
B. Gamma Range	130

KNEE sub-menu	130
Knee SW	130
Knee Mode	131
Knee Point	132
Knee Slope	133
HLG KNEE sub-menu	133
WHITE CLIP sub-menu	134
SW	134
Level	134
DETAIL sub-menu	134
SW	134
Coring	135
Master Level	137
Frequency	138
SKIN DETAIL sub-menu	138
Skin DTL1, DTL2, and DTL3	138
CHROMA sub-menu	139
Level	139
MATRIX sub-menu	140
SW	140
R-G, G-B, B-R, R-B, G-R, and B-G	140
COLOR CORRECTION sub-menu	142
Rec Settings Menu	145
CARDS/MEDIA sub-menu	145
Format Media	145
CLIP NAME sub-menu	145
Cam Index	145
Next Reel Count	146
2 SLOTS FUNC sub-menu	146
Off, Relay Rec, and Simul Rec	146

PRE REC sub-menu	148
REC FUNCTION sub-menu	148
TC (Time Code) sub-menu	150
Set TC	150
Set UB	150
TC/UB/Dur.	151
Free/Rec Run	151
DF/NDF	151
UB Mode	151
TC In/Out Sel	152
TC Out Ref	152
Audio Settings Menu	154
AUDIO CH SETTINGS sub-menu	154
CH1 In Select & CH2 In Select	154
CH1 (and CH2) Mic Lowcut	154
CH1/CH2 Limiter	155
Head Room	156
AUDIO INPUT sub-menu	156
Input1 and Input2 Line/Mic Sel	156
Input1 and Input2 Mic Power	156
Input1 and Input2 Mic Level	156
Input1 and Input2 Line Level	157
AUDIO OUTPUT sub-menu	157
Monitor Out	157
Monitor Delay	157
Monitor Vol	158
REC BEEP SOUND sub-menu	158
Mode	158
Volume	158
ALARM sub-menu	158
Battery End and Media End	158

Output Settings Menu	160
SDI OUT sub-menu	160
Output SW	160
Signal Sel	160
Out Format	161
3G-SDI Out	162
SDI Rec Remote	163
Indicator Disp	163
Marker Disp	163
Menu Disp	163
 HDMI OUT sub-menu	 164
Signal Sel	164
Out Format	164
HDMI TC Out	166
HDMI Rec Remote	166
Indicator Disp	166
Marker Disp	167
Menu Disp	167
 SDI/HDMI Indicator sub-menu	 167
 SDI/HDMI MARKER sub-menu	 167
 LCD Indicator sub-menu	 168
 LCD Marker sub-menu	 168
 LCD Focus Assist sub-menu	 168
Expand Mode	168
Peak./Squares Mode	168
Peaking Level	169
Black & White	169
Open Iris Mode	170
 LCD EI ASSIST sub-menu	 170
Zebra	170
Zebra1 Detect	170
Zebra2 Detect	171

Zebra2	171
WFM Mode	172
WFM Transparence	172
Spot Meter Unit	172
Spot Meter Size	172
LCD LEVEL GAUGE sub-menu	173
Level Gauge	173
Level Gauge Reset	173
COLOR BARS sub-menu	173
Color Bars Type	173
Test Tone	173
FILE Menu	175
SCENE FILE sub-menu	175
Load	175
Save & Save As	176
SETUP FILE sub-menu	177
Load	177
Save & Save As	177
Network Settings Menu	179
Network Sel	179
NETWORK FUNC sub-menu	179
User Account	179
NETWORK PROPERTY sub-menu	181
MAC Address	181
Type	181
SSID	181
Band	182
Channel (2.4GHz) and (5GHz)	182
Encryption	182
Encrypt Key	183
DHCP	183
IP Address	183

NETWORK SETTINGS sub-menu	184
Connection History	184
NETWORK TOOLS sub-menu	184
Initialize	184
Thumbnail Screen	186
Working with the Thumbnail Screen	186
Thumbnail Screen Menu Options	190
PLAYBACK sub-menu	190
Slot Sel	190
Resume Play	190
CLIP sub-menu	191
Protect	191
Delete	191
Copy	192
Information	192
Physical Switches, Buttons and Jacks	194
Audio Controls	194
CH 1 / CH 2 Auto/Manu	194
Audio Level Controls	195
SD Card Access Lamps	195
ND Filter Buttons	196
User Buttons	197
User Toggle Switch	197
Menu Jog/Dial Wheel	199
Menu Button	199
Thumbnail Button	199
View Button	200
Info Button	200
Home Button	200
LCD Monitor	200
E.I.S. Button	202
WFM Button	202
Remote Jack	203
SDI/HD-SDI/3G-SDI/6G-SDI Connector	203

Timecode In/Out	204
DC In 12V	204
HDMI Connector	205
XLR Audio Connectors	205
USB Ports	206

About the Author	208
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Frequently Asked Questions

If you're a new shooter, or new to professional cameras, you may find some of the topics in this section relevant. Even some shooters with years of experience behind them, might be new to the Panasonic line of professional camcorders. There are many differences in the way a professional camcorder works, as compared to a consumer camera or DSLR. I've collected a series of frequently-asked questions here, so be sure to check these out before getting frustrated with your new camera.

Where Did My Clips Go?

After shooting some clips and experimenting with the various recording modes, new shooters frequently toggle over to playback mode and find that many of their clips aren't shown. Where did they go? Are they lost? Did they fail to record? Is there something wrong with your SD cards?

No, none of the above, and there's no reason to panic. What's happening is a byproduct of the camera having two different recording modes available: AVCHD, and MOV. In playback mode, the camera will only display clips that were shot in the same mode as it's currently set in. What this means is, if you shoot some clips in MOV format, and another couple of clips in AVCHD, and then you go to the thumbnail screen to play them back, the only clips you'll be able to play back will be the AVCHD clips you just shot! The MOV clips won't even show up. Now, there's nothing wrong with the other clips, they're all still there, but the camera was last set in AVCHD mode, so that's the only mode of clip that's available for playback.

Resolving this is really very simple; just change the playback format to match the clips you want to play. Go to the menus and choose **SYSTEM SETTINGS>SYSTEM MODE>MAIN CODEC**, and choose either an AVCHD

codec (AVCHD PS, PH, HA, or PM) to view AVCHD thumbnails, or you can choose any other choice (ALL-I or LongGOP) to view MOV thumbnails.

That will get all the thumbnails displayed, but there may still be cases of some clips that allow playback and some that won't. Generally, you will have to configure the camera to match the frequency and possibly the resolution you shot in. If you shot some clips in 25.00P and some others in 24.00P, you can't view them all together, you have to pick which ones you want to see and change the SYSTEM SETTINGS>SYSTEM MODE>FREQUENCY to match. The camera displays the frequency and frame size right in the thumbnail, so you just have to go to the menus and match them to enable playback of those clips.

Sounds like a hassle, but in reality it's not a big deal. Usually you only change recording modes when you're experimenting, but once you settle down to shoot a particular project, you'll usually pick one recording mode for the entire project, so the mode-changing issue becomes largely irrelevant in actual practice. Just remember that if you can't see a clip's thumbnail, that just means you need to change the playback format before being able to play the clip back.

How can I view the footage on my computer?

Generally, a multi-purpose file playing program should be able to handle playing back the footage; for .MOV files you may want to use Apple's Quicktime Player or VLC Player; for AVCHD files you may want to use something like VLC Player.

Do be aware, however, that playing 4K or UHD footage can be extremely processor-intensive, and may benefit greatly from a modern graphics card. Which means — it's possible that your computer just may not be powerful enough to properly play 4K or UHD footage. Furthermore, unless you have a very modern monitor that's capable of 4K (or UHD) resolution, you may not be able to see the full detail and quality of the footage on your computer. There's no solution for that other than to try to play the footage back on a system that's fast enough to properly display it, and on a monitor that's large-enough and high-enough resolution to properly display the footage. On smaller or lower-resolution monitors, your video playback software can be configured to "full-screen" mode, in which it will automatically re-size (or "scale") the footage to fit the resolution of your screen. That will enable you to watch the footage, but not at 100% quality.

What is the red light on the front of the camera, and why is it on? Or, why is it not on?

That's the Rec Lamp or "Tally Lamp" which lets you know if the camera is currently recording. You can turn it on or off, whichever you prefer. See LED & FAN>TALLY LED for more information.

Why Does My SD Card Show Up In The Camera As "Incompatible Data"?

Well, assuming that there's nothing wrong with your memory card(!), there's likely no need to panic. The EVA1 is a "world" camera; each camera has the ability to shoot 50Hz or 59.94Hz footage. However, the AVCHD recording system specifies that only one type (50Hz or 59.94Hz) can be recorded on each card. A memory card formatted by a camera set to 59.94Hz (or 23.98 or 29.97), cannot be used to record AVCHD clips (or play back AVCHD clips) in a camera set to 25Hz/50Hz mode (and vice versa). If you're encountering a card where it's telling you it's an incompatible format, check your SYSTEM SETTINGS>SYSTEM MODE>FREQUENCY menu setting, and make sure that you're operating in the mode you should be in, for that card.

This restriction doesn't apply to .MOV clips; you can freely mix clips recorded in any frequency on a memory card regardless of how that memory card was formatted. The 50Hz-only or 59.94Hz-only restrictions apply only to AVCHD clips.

Note that if you are using a high-bitrate codec (like ALL-I 400mbps), and you insert a card that doesn't support the necessary minimum speed rating (in this case V60), the camera will tell you that your card is incompatible. You can change your recording mode to a lighter bitrate (in this case, LongGOP 150mbps) so that the recording will be compatible. Or, you can change your memory card to one that is appropriately speed-rated for the bitrate you want to use. In some cases the camera will tell you the card is incompatible, but won't prevent you from recording on it anyway. It sometimes works because sometimes memory cards are faster than the speed rating that they report back to the camera. But even if it works sometimes, this is certainly not a recommended practice; it's something you may be able to get away with, but there's no telling when the card might fail to record. It's well worth it to buy high-quality, properly-rated cards when recording valuable video footage.

Why Can't I Record Onto My Memory Card?

The camera is capable of many different bitrates, depending on the recording mode you select. Memory cards come in a variety of specifications and speeds that they can support. If your memory card is too slow — then the camera just won't be able to record your chosen recording format onto that card. To use that memory card, you may have to drop your recording format down to a lower-bitrate mode.

In general, you can use a Class 6 SD card only for recording AVCHD. If you want to record the MOV modes (LongGOP or ALL-I) you're going to need an SDXC memory card that meets the new V30, V60, or V90 speed ratings. Older memory cards may or may not work; generally a UHS-3 card can support some of the recording modes but not all. The camera is designed to work with the new V30/V60/V90 standards. It requires at least a V30 card to support recording modes up to 150 megabits, and a V60 card to support the 400 megabit ALL-I intraframe recording codecs. Strictly speaking, V90 isn't required, a V60 card is capable of recording anything the AU-EVA1 can deliver. A V90 card is capable of handling all V30 and V60 speeds, so you're definitely safe for all recording modes with either a V60 or V90 memory card.

Finally, if you've met the other criteria listed above, verify that your memory card works. Sometimes memory cards go bad, so you'll want to test to see if your memory card is working properly. Try putting it in another camera, or in a computer, to see if the card is recognized. On that note, always buy and use the best brand-name cards you can get; it's true that you can usually use cheaper memory cards, but the old adage "you get what you pay for" still applies, so always use the very best memory cards you can afford. And don't be ripped off by counterfeit memory cards! If you're shopping on auction sites or through less-than-reputable resellers, there is a very real prospect of receiving counterfeit ("knockoff") cards. Stick with reputable resellers who are factory-authorized dealers for the memory cards you're shopping for.

Why did the camera split my footage up into multiple clips?

If you record one long continuous clip, you may find that on the memory card there are actually multiple clips. Generally this happens most often when using SD or SDHC cards (instead of SDXC cards). The reason for this is because SDHC memory cards use the FAT32 file system, and the maximum

file size on an SDHC memory card is 4 gigabytes. One way to minimize this issue is to always use SDXC memory cards; they use the exFAT file system, and can record much larger files.

On the SDHC card, FAT32 has a maximum file size of 4 gigabytes, and 4 gigabytes can accommodate about 20 minutes of AVCHD PH footage. So if you're recording AVCHD on an SDHC card for 30 minutes, what happens? Well, the camera knows to automatically split the recording into two files, close off the first file at the 4gb file limit and continue recording into the second file. The camera will also create "pointers" for the two clips, so that each section of the clip "knows" that it is only part of a larger master clip and it will know what clip follows it, and what clip precedes it.

For AVCHD, all of this is done automatically and seamlessly behind the scenes. When you view the AVCHD clip in-camera it will look as if there's only one clip on the card, because, essentially, there is only one clip (it just happens to be made up of several pieces, but inherently it's all intended to be treated as one continuous clip). If you use an NLE that is properly AVCHD-aware, it will know how to properly reassemble all the pieces into one contiguous clip, seamlessly and effortlessly. If your software doesn't recognize the attached nature of the clips, then you'll have to manually copy over all the pieces, and string them together end-to-end on your timeline. Note that some earlier versions of NLE software didn't know how to do this seamlessly, and would introduce small gaps between the pieces of a clip. That is a software error, not a footage problem! The camera records all the footage seamlessly. If your NLE software can't display it seamlessly, look into upgrades or fixes for your software; as of the time of this writing most if not all major NLEs can now seamlessly handle spanned AVCHD clips.

If you're recording in the MOV file formats onto an SDXC card, you can expect that the camera may also split the clip into individual files at the limit of its maximum file size. It takes a LOT of recording to reach this point though, so this should be a generally rare situation unless you're recording multiple-hour events. Unlike AVCHD recordings, the camera will display each and every one of those MOV clips with individual thumbnails, and they will import into your NLE as individual clips; you'll have to manually align them end-to-end on your NLE timeline.

Why can't I take a manual white balance? The camera just keeps saying "INVALID".

The AU-EVA1 operates slightly differently from prior Panasonic Broadcast handheld cameras. There is a white balance button on the front of the camera (right where you'd expect) but, pressing it doesn't necessarily cause a white balance procedure to start. The AU-EVA1 has a lot more power in its white balance capabilities, so you have to understand that the button and the white balance switch may operate differently from how you're used to. But, you can make it work just like the prior cameras do; you just have to take one additional step before you can use the camera that way. In the camera menus, set CAMERA SETTINGS>WHITE>VALUE to "AWB MEMORY". Once that's set, then you can use the AWB button to take a white balance.



Articles

Some of the articles in this section are going to be really basic, and some will be more advanced. It's impossible to know the experience level of the reader, so I've taken the tactic of explaining things from the beginning. Even if you're an experienced shooter, you may find some nuggets of knowledge in these pages.

Understanding Exposure

Perhaps the primary ingredient in getting good-looking video is to get a proper exposure. In this section we're going to cover the ins and outs of the exposure system and talk about all the various ways that you can control the exposure in the camera, as well as attempt to define what qualifies as a "good exposure" and how you know when you've got it!

To understand exposure, we have to really narrow it down to a couple of very key concepts – we're talking about how much light falls onto the camera's sensor, and for how long. Both elements (the amount of light, and the duration) when taken together, result in the total quantity of light hitting the camera's chip. The art of getting a proper exposure is to control that amount of light so that you don't get too much, and you don't starve the camera either, you need to get the amount of light "just right" and, when you do, the camera can work magic.

If you starve the camera of light, the results will be unpleasant. You'll get a noisy, grainy, muddy, flat, ugly mess of a picture. How do you avoid that and get beautiful results? Feed the camera enough light.

If you give it too much light, the results will also be unpleasant. You'll have harsh, blown-out, ugly images. How do you avoid that and get beautiful results? Again, the key is to control the light and make sure that the right amount gets through – not too much, and certainly not too little.

There are three primary ways we as shooters control the amount of light entering the camera. The first, and most important, is the lens aperture (or “iris”). The aperture is a variable-sized hole in the lens, which the light flows through. The bigger the hole, the more light gets let in. The smaller the hole, the less light gets through. The size of the aperture is known as its f-stop; the smaller the number (such as $f/1.4$) the bigger the hole and the more light comes through it; the larger the number (such as $f/11$) the smaller the hole and the more light it stops from coming through.

The second way we control the amount of light is through the shutter speed. The shutter speed controls the amount of time that light is allowed to enter the lens; the longer the time, the more light gets through, and the shorter the time, the less light gets through. However, while the shutter is capable of helping us control the flow of light, it’s not really something you want to be using for that purpose, because the shutter speed also affects the way motion is captured. Typically a video shooter will use the iris/aperture to control the amount of light, and they’ll leave the shutter speed alone (unless the shooter has a very specific need and a thorough understanding of what the side effects of changing the shutter speed will be!)

The third way of controlling the amount of light is through Neutral Density (ND) filters. ND filters are like “sunglasses” for your camera. They darken the incoming light, with no side effects (no color shifts, no polarization, etc). ND filters are used in bright conditions (sunny day exteriors) and are usually not necessary in darker or indoor conditions. The AU-EVA1 has three built-in ND filters, allowing the user to select from various levels of light-cutting capability. You can also get additional external ND filters that attach to the front of the lens (by screwing into the lens threads) or in an external filter holder (such as a matte box).

Automatic or Manual Exposure?

Now that you know the basics of how to control the amount of light entering the camera, the next major question is: how much is enough? What’s the right amount, and how do you know?

There are primarily two ways to judge, either automatically or manually. The camera has the ability to automatically control the iris (on electronically-controlled lenses), and it will judge how much light is necessary and open up or close down the iris to the appropriate size.

Automatic exposure can work well in some circumstances, and it’s certainly handy to be able to turn over the task of exposure to the camera

so that it frees you up to concentrate on other things, but rarely does the best video come from automatic exposure. Professionals frequently (if not exclusively) rely on manual exposure control, for many reasons. Manual exposure control lets you decide what's the most important element in the scene to expose for, and it keeps the exposure from changing in the middle of a shot (something that can happen during auto-exposure).

Manual exposure is the professional way to control the camera's exposure system. The camera gives you complete control over shutter speed, iris setting, gain/ISO, and ND filtration.

How do you know how much exposure you're getting?

The key to getting proper manual exposure is to know how much light the sensor is receiving, and to know if it's too little, too much, or just right. And the way you know this is by using a wide variety of monitoring tools, including:

- 1. the LCD monitor
- 2. the Zebras
- 3. the Spotmeter
- 4. the Waveform monitor
- 5. an external monitor
- 7. relying on the auto-exposure system to tell you

Learning how these monitoring tools work will greatly improve the overall look and quality of the video your camera generates. Let's start with the LCD monitor.

Using the LCD Monitor to Judge Exposure

This is probably far and away the most common way that shooters, especially new shooters, use to judge exposure. It is also a terrible way to judge exposure! Seriously, it's a bad, bad idea to just look at the LCD and say "yep, hey, that looks good, let's shoot it." There are many reasons why, and I'll go into some of them, but please trust me when I say that you simply must not rely on just looking at the LCD, you have to learn how the other tools work and USE THEM.

Okay, so why is just looking at the LCD a bad idea? I mean, if it looks good there, it looks good, right? Well, no. Not necessarily. Because the LCD monitor isn't an absolute reference point, it's subjective, and it can be influenced by a lot of things, including the lighting conditions you're in (a dark room? or broad daylight?) And the LCD is quite reflective; if you're in

a bright environment the reflections can make it look washed-out, which might adversely affect your opinion of what the exposure actually is.

A second reason judging exposure off the LCD is a terrible idea is, the backlight setting on the LCD can change the brightness in the LCD by a huge amount – yet it's not changing the brightness of the video at all! So if your LCD is representing the video as brighter than it really is, you could end up underexposing your video without even realizing it. And if the LCD is representing the video too dark, you might be tempted to overexpose the video just to get it to look brighter on the LCD — when in reality, you're destroying the recorded footage!

So, the moral of the story is: don't rely on how the image looks in the LCD to be the deciding factor on whether you've exposed the image properly. The LCD is a relative display, and how it looks is relative to how high you have the backlight set, it's relative to what angle you're viewing the LCD at, and it's relative to the prevailing lighting conditions (meaning, if you're in a very bright environment, the LCD is going to look too dark, and if you're in a dark environment, the LCD might end up looking too bright). So, for the sake of your footage, don't rely on just looking at the LCD, and instead learn how to use the more accurate professional monitoring tools built into your camera. And if you insist on using the LCD, at least set the LCD Backlight according to the color bars, to have a prayer of it being at least in the ballpark of accurate. See SYSTEM SETTINGS>LCD for more info.

The LCD is handy, if not terribly informative. But there are many highly accurate professional measuring tools included for exposure too.

The IRE Scale - How to Know How Bright “Bright” Is

When we talk about professional monitoring tools, we're going to be talking about devices and meters that tell us definitively, objectively, how bright the video signal is. And the scale that we use is the IRE scale (IRE being the Institute of Radio Engineers), and on that scale, video brightness is measured from 0 (pure black) to 109 (clipped white). So as we talk about video levels, just keep in mind that we're basically talking about percentages, with about 50 to 55 IRE representing a medium gray, and 0 to 5 being pretty much pitch black, and anything over about 100 being pure white. (*Note: these IRE numbers are very different for different gamma curves; we're using the general VIDEO gamma as our point of reference here.*)

Zebras

The first monitoring tool we're going to talk about are the zebras. Zebras are an overlay on the video monitor that show up any time an element in your image is brighter than a predetermined level (and who determines that level? You do, using the OUTPUT SETTINGS>LCD EI ASSIST>ZEBRA DETECT menu settings). Zebras are great because they let you know instantly, at a glance, what areas of your video might be too bright. If you set your zebras on 105, then you'd only ever see zebras on areas that are dangerously near overexposure (with 109 IRE representing a totally overexposed signal, zebras at 105 would show any portions of the screen that were at 105, 106, 107, 108, or 109 IRE). If you set your zebras to 80, then a zebra pattern would show up on the screen for any areas that were brighter than about 80% of maximum (again, on the 0-109 scale). The great thing about zebras is that they remove the subjective guesswork entirely from the equation, and they plainly and clearly tell you when something is brighter than your predetermined threshold. As a general guideline, you never want to see 105+ zebras anywhere on your screen if you can avoid it (some things, like the sun or a light bulb in the shot, might be unavoidable, but you definitely want to avoid it in the sky or on white buildings, etc). Also, when shooting a fair Caucasian face, you don't really want to see any higher than about 70 IRE showing up on the face, so if you set your zebras at 70 IRE and you set exposure on a light-skinned face, you don't want to see zebras anywhere other than maybe a little bit on the very brightest areas (typically the forehead or nose). For darker skin colors you'll need to adjust, there is no hard and fast rule for other specific skin colors because they vary in shade so widely. And, again, remember that these IRE levels are general guidelines for the VIDEO gamma setting; the levels will be different for the V-LOG or other gamma settings.

Spot Meter

The Spot Meter goes hand-in-hand with the zebras. Where the zebras will tell you what areas of the screen are exceeding a certain brightness threshold, the Spot Meter will tell you exactly what brightness is occurring at the center of your screen. Turn on the Spot Meter and a little box will show up in the center of the screen, and a numeric readout shows up at the bottom of the screen, which will tell you basically the IRE value of what's being displayed in that central box (or, alternatively, it can tell you how many stops over- or under-exposed the area within the box is.) By using the Spot Meter and panning the camera around your scene, you can tell exactly how bright the brightest patch of skin is, or how dark the shadowed areas are, etc.

Waveform Monitor

The ultimate exposure guide for video is the WaveForm Monitor (WFM). This is like a million zebras and spot meters all combined, it's almost like a three-dimensional zebra. The waveform monitor tells you the brightness of your image not just in a 2-D scale like the zebras, but in the third dimension by showing relative brightness across the screen, and how many pixels in each column are at what brightness. Learn to read the waveform monitor and you'll be able to tell at a glance whether your image is properly exposed, underexposed, overexposed, clipping, and where any trouble spots are in the frame. [CLICK HERE](#) for a detailed introduction to the WFM.

Using an External Monitor

Whenever possible, using a proper external production monitor is a great idea to see what your actual video will look like. Unlike the on-camera LCD, a properly-calibrated external production-quality monitor is a great way to judge what your image will look like. However, you do have to observe two restrictions here: 1) the monitor has to actually be a professional production monitor, and not some cheap portable DVD player or other non-professional solution, and 2) the monitor has to be properly calibrated under the prevailing lighting conditions. And an external monitor isn't really a substitute for the zebras or (especially) the waveform monitor; instead it's the "last line of defense," meaning that if you've calibrated your image properly, you're exposing properly, and everything looks good on the zebras and the waveform, then it's time to take a look at the external monitor to make sure it looks as beautiful as it's supposed to.

A professional monitor will have controls for calibrating the monitor to color bars. The camera has the capability to output SMPTE color bars, so if you have a professional monitor that has a blue-only gun and chroma, brightness, contrast, and (in NTSC territories) phase controls, you can configure your monitor to very accurately display the color bars signal. When the monitor is displaying the color bars absolutely accurately, that's when you know it will also display your camera's picture accurately. And monitors need to be re-calibrated every time you set them up – every time you move them to a new location, or every time the prevailing light changes, you need to calibrate again to the color bars. If you are shooting outdoors in the sun, you'll have to calibrate the monitor. If you then put a sunshade over the monitor, you may have to re-calibrate it. And if you go indoors, you may have to calibrate again. Always make sure the monitor is accurately displaying the color bars before you rely on it to trust that your video signal is being displayed accurately.

Asking Autoexposure for Help





Lastly, a way to monitor the exposure might be to ask the autoexposure system what it thinks the exposure should be. You can quickly pop into autoexposure mode by assigning the ONE PUSH A.IRIS function to a User Button and pressing that button; when you do so the system will judge the exposure, set the iris, and then switch back to manual iris control (note: as always, the camera can only set the iris if your lens uses the EF mount and allows electronic lens control.) Autoexposure may not get it exactly right, but it's frequently pretty close. For example: a situation when you can use autoexposure to help you determine proper exposure could include a case of when you're shooting a wide shot of people, but you want the faces to be accurately exposed. In that scenario you might zoom all the way in on someone's face, use the ONE PUSH A.IRIS function, and let it expose for the face. Then it will lock the exposure, you can zoom out, and compose your shot. Just be careful when you do so; you have to check to make sure that the rest of the shot is reasonably exposed (for example, you don't want the sky to be terribly blown out, so pop on the waveform monitor or the zebras to check the sky). If the sky is too bright, you have three choices at that point – either frame out the sky as much as you can, or stop down the iris (knowing that you'll be losing some exposure brightness off the faces too), or re-compose the shot by putting the sun at your back. With the sun at your back, the sky will be its darkest, and should be the easiest opportunity to control overexposure. Or, of course, you could always shine more light onto the faces, but that's not always an option.

Learning how to control the exposure, and framing shots so that you've included only the portions you want (at the proper exposure levels) will cause the quality of your video to skyrocket. Automatic exposure is of course the easiest way to go, but it usually results in the worst quality video, because constantly-changing exposure looks pretty bad to a viewer. If you want great quality you have to do the work yourself, but you'll be rewarded with more professional-looking, more artistic, and better overall video. In this article I've given you the basics, but now let's go into more detail on each of the exposure systems so you have a thorough understanding of how exposure works and what your camera can do.

Aperture or Iris

As said before, the aperture is the size of the hole that light flows through, and by controlling the size of that hole, you control the amount of light that gets through. The size of the aperture is measured in "f-stops."

F-stops are basically a way to describe the amount of light the iris STOPS from getting into the lens. In simple terms, $f/1$ would be admitting as much light as the lens is possibly capable of (think of it as “ $f/1$ ” = “ f divided by one”... “ f ” = the maximum amount of light, so “ f ” divided by 1 would still be “ f ”). F-stops are numbered according to the following sequence: $f/1$, $f/1.4$, $f/2$, $f/2.8$, $f/4$, $f/5.6$, $f/8$, and $f/11$. Each additional f-stop cuts in half the amount of light admitted by the previous f-stop; $f/1.4$ admits half as much light as $f/1$ does, $f/2$ admits half as much light as $f/1.4$, and so on. F-stop numbers are based off of two base numbers, $f/1.0$ and $f/1.4$. Each new f/stop number is a double of the previous number:

	1.0	→	1.4
	2.0	→	2.8
	4.0	→	5.6
	8.0	→	11 (rounded down from 11.2)

So if you remember 1.0 and 1.4, you can calculate the rest of the sequence easily.

You can think of the f/stop notation as a diameter formula for the lens iris. Whatever “ f ” stands for, when expressed in the term of “ $f/2.0$,” would mean an iris size of “ f ” divided by 2, which would let in $1/4$ as much light as an “ f ” divided by 1. Remember, if you want half the light, you’d use $f/1.4$, so $f/2$ actually lets in half of half, or a total of $1/4$. Think in terms of a square: if you cut the length of the sides of a square in half, the new square isn’t half the area, it’s actually $1/4$ the size of the original: a 4” x 4” square has an area of 16 sq inches, but cut those sides in half and you get a 2” x 2” square, with an area of 4 square inches, which is $1/4$ the area of the 16 square inches of the 4x4 square. So to get half as much area, you don’t divide by two, you need to divide by 1.4 (the square root of 2). If you take the 4” side of the square and divide that by 1.4, you’d get a square of 2.83” x 2.83”, which has an area of 8 square inches ($2.83 \times 2.83 = 8.0$). And 8 sq. in. is $1/2$ as much area as the original 4x4 square’s 16 square inches. So to get half as much light coming in, you need to divide by 1.4 (which is why the first f-stop after $f/1$ is $f/1.4$.)

Therefore, the numbers you divide “ f ” by are: 1, 1.4, 2, 2.8, 4, 5.6, 8, 11. Each successive number lets in half as much light as the previous number. So if you want to cut in half the amount of light coming into the lens, you’d “stop down” by one f/stop. (Note, there are some lenses that are actually

brighter than $f/1$; such lenses may start their f -stop range with something like $f/0.95$).

Shutter Speed

The shutter speed is another way to increase or decrease the amount of light entering the camera. Whereas the aperture is a hole that lets in a certain amount of light (and the bigger the hole, the more light that comes in), the shutter is more like a gate – the longer it's open, the more light gets in, and when the gate is “shut” the light stops coming in.

Because the shutter speed affects the amount of light coming in, you could use it to help control exposure. If you cut the shutter duration in half (i.e., use $1/120$ instead of $1/60$) then only half as much light will reach the sensor. To compensate, you will need to add twice as much light to get the same level of exposure (or, open up the aperture by one f -stop). If you double the shutter duration (i.e., $1/24$ instead of $1/48$) then twice as much light will get through to the camera's chip, and your image will be twice as bright. You'd need only half as much light at $1/24$ for the same exposure as you would need at $1/48$.

However, video shooters generally don't use the shutter speed to control exposure except in rare circumstances, because there's a great big side effect to changing the shutter speed: it affects the motion blur of your shot. Photographers use the shutter speed all the time to control exposure, but in video it's not used nearly as frequently, because changing the shutter speed will affect the motion blur of anything moving in your shot (and, because you're shooting video and not stills, that means it'll pretty much affect everything!)

Generally, when shooting video-style footage, you will turn the electronic shutter off, which results in the most light hitting the sensor and results in a shutter speed that's basically the same as the system frequency (i.e., about $1/50$ shutter in 50.00i or 50.00p, and $1/60$ in 59.94i or 59.94p). When shooting film-style footage, you generally use the HALF SHUTTER setting, which results in a shutter speed that's half the duration of your frame rate (so, about $1/48$ for 24.00p, $1/50$ for 25.00p, and $1/60$ for 29.97p). Small variations in shutter speed won't affect the look of your video much (i.e., $1/60$ will pretty much look the same as $1/50$ or $1/48$). Film cameras use anywhere from $1/43$ to $1/60$ as a standard, and it all pretty much looks like film motion, so small variations won't normally matter. However, there is one place where it matters very much: when you're shooting under fluorescent or HMI or stadium lights or other ballasted light sources! I'll

explain why, but before I do, let me just say this loudly and clearly: if you're shooting under fluorescent lights or HMI lights (with a magnetic ballast) or sodium-vapor or mercury vapor lights (such as streetlights or stadium lights), or LED lights on a dimmer, you have to be extremely careful with the shutter speed. In territories that use 60Hz power, put the shutter speed on 1/60th and do not change it without a very, very good reason. (and yes, that does include when shooting 24p!) In territories that use 50Hz power, put the shutter speed on 1/50th and do not change it without a very good reason. Changing the shutter speed when shooting under magnetic/ballasted light sources may cause a noticeable and annoying artifact in your video footage, where you see orange or black bands or scrolling waves cycling through your image.

You can usually totally avoid this artifact by simply leaving the shutter speed at 1/60th (in 59.94Hz territories) or 1/50th (in 50Hz territories). If you're using high-frequency electronic ballasts (such as Kino Flo™ fluorescent lights or electronic flicker-free HMI lights) then you'll have more flexibility with the shutter speed, but even so, you'd only ever want to change the shutter speed for specific looks.

Here are examples of the type of circumstances where you'd want to use alternate shutter speeds:

1. For a stuttery/choppy action sequence (such as the "Saving Private Ryan" or "Gladiator" effect): try a fast shutter speed such as 1/250 or 1/500. (of course, be cautious when trying this under fluorescent lights as mentioned above).
2. Overcranking for slow motion: if you're shooting variable frame rates for slow motion, you should probably change the shutter speed. Try 1/120 for 60 fps or 1/100 for 50p. A film camera running at 60 frames per second would have a shutter speed of about 1/120, so if you're shooting 60fps for slow motion, you would normally want to match the shutter speed for film-style motion blur. This camera makes this easy when shooting different frame rates; you can set the shutter to HALF SHUTTER and it will automatically compensate the shutter speed to correspond to 1/2 the duration of the frame rate.
3. Sync'ing with monitors: you may have to modify the precise shutter speed (or use 1/60 in NTSC countries or 1/50 in PAL countries), to match the camera's refresh rate with computer monitors or televisions in the shot to stop the "rolling dark band" syndrome.

4. Special blur effects: the opposite of the “Saving Private Ryan” effect. Use a slower shutter speed (like 1/24 or slower) to add smear and blur to the motion in your shot. Shutters as slow as 1 second (1 fps with 357-degree shutter) can make for excellent smearing of taillights in a long-exposure freeway shot, for example.

5. Minimize strobing: If you think there’s too much strobing in your 24P/25P footage, you can try a slower shutter speed to introduce a little blur into your footage. 1/43 or 1/36 are popular choices, but again, watch out for fluorescent or HMI or vapor lights.

6. Extreme low light situations: when in 24P mode, using 1/36 instead of 1/50 will gain you half a stop of low-light performance, and still look reasonably like film. Using 1/24 will gain you a whole stop of light performance, but with smearier motion.

7. If you’re shooting in a different territory, such as when shooting 59.94Hz footage under 50hz lights, or 50Hz under 60hz lights, you may have to adjust the shutter speed to avoid flicker or pulsing. Set it to match the frequency of the power system where you’re at, to have the best chance at minimizing any conflict with the lighting; you might have to choose 1/100 for a 59.94Hz camera in PAL territories, for example.

8. Freezing water droplets or rain: for specific instances like shooting a food commercial where someone pours champagne or squeezes a lemon and you want to show the individual droplets clearly, you might try using a very short shutter speed (like 1/2000). Typically these shots are done using strobe lights, but strobe lights generally won’t work with the EVA1 (see the Partial Exposure section of the article on ROLLING SHUTTER MOS SENSORS to see why). Although you probably can’t use strobes with an MOS rolling-shutter camera, you may be able to get a satisfactory facsimile of the effect by using a super-fast shutter speed, as long as you aren’t trying to do so under magnetic fluo/HMI lighting; you’ll need high-frequency electronic ballasts to pull that off.

Be aware that when using a shutter speed slower than your frame rate, the net result will be dropping frames. You cannot have a shutter speed slower than your frame rate; trying to use 1/30th shutter in 59.94p mode will result in duplicated frames, in essence dropping your frame rate to 29.97p.

Also, when using a slower shutter speed, definitely use a tripod!

Gain (or ISO)

Gain is an electronic amplification of the video signal. In other words, it artificially makes the picture brighter. While brightness sounds good,

you have to understand that the penalty for making it brighter is that the picture gets “noisier.” Electronic noise is a byproduct of electronic gain, and the more gain you apply, the brighter your picture will get, and the noisier your picture will get. The camera can employ sophisticated noise reduction that can help compensate, but the tradeoff is that it may result in losing some of the fine detail in the picture and the colors may become flatter, softer, and more “washed out”. Generally the best images come when the ISO is as low as possible, or when using as little gain as possible.

Gain is measured in decibels, or dB. Zero dB means that no gain is applied, the picture is unmodified and no brightness or noise is added. Every 6 dB of gain amounts to doubling the brightness of the picture, so 6 dB of gain would make the picture twice as bright, or the equivalent of 1 f-stop brighter. 12 dB of gain would be twice as bright again (or four times as bright as zero gain), and 18db is twice as bright as that (for an image that appears to be eight times as bright as zero gain).

Another thing to understand about Gain is that it can only amplify the signal that the camera is currently seeing; it cannot add detail that can't be currently seen. If you're shooting under low light conditions and need to employ gain to get the picture bright enough, you should understand that your video is in all likelihood underexposed, and using gain will artificially brighten up the picture, but it will not restore detail that wasn't properly captured due to the underexposure. Gain is usually used as a “last resort” – when shooting under dim conditions you should take other measures to increase the brightness of the scene first, including removing all neutral density filters, opening up the iris to its maximum opening, perhaps using a slower shutter speed, and adding light whenever possible.

The camera has Dual Native ISO technology, meaning that you can set the native ISO at either 800 ISO or 2500 ISO. It's generally better to use the native ISO that's closer to your target ISO; if you intend to be shooting at 640 ISO for example, you'd generally be better off setting the camera at native 800 ISO and then stepping the gain down a little bit. On the other hand, if you will need 2000 ISO to get your shot, you're better off starting with a native 2500 ISO than you would be by starting at 800 ISO.

Understanding White Balance

Yet another element to understand in videography is the concept of White Balance. In the simplest explanation, light is not all the same color. Even though it may look the same to the human eye, the camera sees a

particular light for what it is: reddish, greenish, blueish, etc. Daylight does not give off the same color as an incandescent light bulb, for example. Our eyes may automatically compensate, but the camera doesn't, and it needs to be told what "white" should be – which is why we have the White Balance function. Executing a proper White Balance will help the camera to record colors more accurately.

Light color is measured in degrees Kelvin, in accordance with what color a hunk of platinum will glow when heated to certain temperatures. When heated to about 3200 degrees Kelvin (or 3200K), the platinum will glow an orangish-red color (which is pretty much how regular household lamps work: they're small filaments of metal that are heated until they glow that orangish-red color). If the metal is heated more, the color will shift towards the blues, and at 5600K the iron will glow blue-white. These temperatures, and their corresponding colors, are referred to as "color temperature." In general there are two color temperatures you need to be aware of: 3200K and 5600K. Daylight is typically said to be around 5600K, and tungsten (or most artificial) lights burn at around 2900K to 3200K.

Proper white balance is vital to accurately record the colors in a scene. To white-balance the camera, first decide if you want to use one of the existing presets or if you want to use a manual white balance. The presets are selected by setting the CAMERA SETTINGS>WHITE>VALUE menu item to one of the existing presets in the list; alternatively you can put the User Toggle switch to the WB position and then use the menu wheel to scroll through the available presets. There several presets available; two common ones are 3200K and 5600K. These presets generally correspond to indoor lighting (3200 Kelvin) and outdoors/daylight (5600 Kelvin). While the presets are perhaps a good starting point, there are many circumstances where a preset will not deliver the most accurate color rendition. For example, many incandescent and halogen lamps burn at color temperatures different from 3200 Kelvin; some may burn as low as 2700 K. If you're using 2700 K lamps to light your scene, and you have the white balance set to 3200K, your white walls will not look white, they'll look orange-ish. Also, daylight varies tremendously in color temperature, from around 3000 K during sunrise/sunset to over 10,000 K on an overcast, cloudy day. So the presets are a good starting point, and good for on-the-run shooting, but if you have the time to take a manual white balance you can get more accurate color rendition.

To set the white balance, first set the white balance value to AWB MEMORY. Go into the camera menus, to CAMERA SETTINGS>WHITE>VALUE (or just use the HOME screen and touch the white balance display) and then scroll through the options until you find AWB MEMORY. Next, you'll need a white card (or other white object – a sheet of paper, a T-shirt, whatever you have, although the purer the white the more accurate results you'll get; I highly recommend getting a DSC Labs CamWhite card.) Place that white card/object into the light where you intend to be shooting. Don't just hold it up in front of the camera! You have to move the white card into the light that's hitting your desired subject. Ideally you'd have your subject hold a white card up in front of their face; you need to make sure that the light that your subject is lit by, is the same light that's lighting up the white card. Frame up that white card until it fills the screen (or as close as you can get). Now you're ready to take a white balance. Press the AWB button; the camera will let you know when the white balance has been properly set. Any time your lighting conditions change, you'll need to re-white balance if you want your colors to continue to be rendered accurately.

Another white balance option is to use Automatic Tracking White (ATW). In this mode, the camera will automatically attempt to continually monitor and change the white balance to what it thinks is correct. To enter ATW mode, set the CAMERA SETTINGS>WHITE>VALUE to ATW; the camera will then automatically start tracking white balance by itself, updating as lighting conditions change.

ATW is an automatic function, along the same lines as autofocus and auto-exposure. For professional shooting situations you may not want to use ATW very often, but for run 'n' gun type situations it may come in handy.

Black Balance

The camera also offers the ability to perform a Black Balance. It's really simple, and I recommend you get in the habit of doing it frequently. The black balance procedure is simpler than the white balance, because black (unlike white) isn't relative. Black is the absence of all light, so it doesn't really matter what the prevailing lighting conditions are. As such, you put on the lens cap (or the body cap, if no lens is attached) to block all light from hitting the camera's sensor. Then execute the CAMERA SETTINGS>AUTO BLACK BALANCE menu function, and the camera then analyzes the signal coming off its sensor, and compensates for any noise issues or other situations which cause the sensor to be delivering anything other than a pure black signal. I recommend black balancing frequently.

Focusing

Getting precise focus is not so easy in Ultra-High Definition or 4K; certainly not as easy as it was in standard-def! In this section we'll explore focusing and explain the techniques you need to use to get razor-sharp focus.

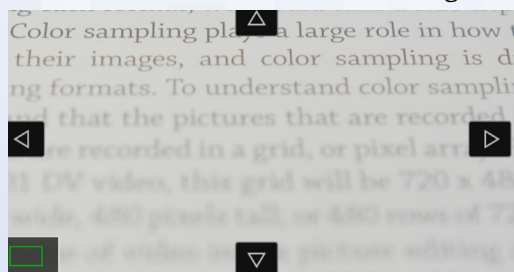
First, understand that proper focus is absolutely critical in UHD or 4K. UHD video means a frame that has four times as many pixels as a high-def video frame, and as much as 24x as many pixels as a standard-def frame. Standard-def's low resolution could mask small focus errors; ultra high-def's sharpness will point out focus errors blatantly, each and every time. You have to get your focus right.

Second, it's important to acknowledge another fact: it's impossible to judge focus properly using only the on-camera LCD. The very best you can do is get in the ballpark; it's mathematically impossible to judge focus of an 8-million-pixel image on a 1-million-pixel display device like the EVA1's LCD. No small display is going to be adequate, by itself, to show you true proper focus; it's just not possible. You simply must rely on some focusing aids.

Setting focus involves finding the exact spot where the focus is pinpoint-sharp on your subject. Usually you do this by adjusting the focus ring until the subject looks as sharp as possible, and then adjusting the ring too far until it actually starts to go out of focus; then you pull back until it comes back into focus and keep adjusting until it goes out of focus again, and keep refining this process and splitting the difference until you get the absolute sharpest image. Obviously this technique relies on being able to actually see the image sharply! And with the LCD not having nearly enough pixels to render the image sharply, you can't truly count on this technique alone.

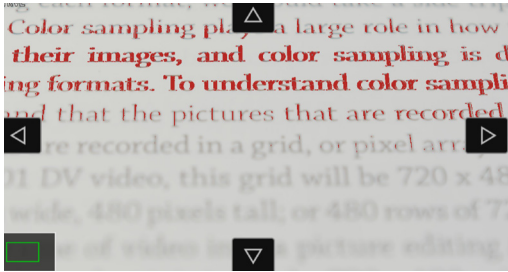
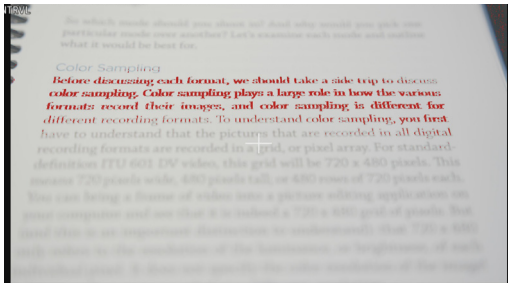
Fortunately, there are several focus assist methods available to assure you're getting the best focus possible. Use them all: you're going to find they all are helpful.

First, there's the EXPANDED focus assist, which magnifies the center extraction from the frame. The magnified focus assist is a wonderful



option and indispensable for achieving sharp critical focus. It shows you much more detail than the full frame view does, and lets you see exactly what's in focus and what's not.

The EXPAND focus assist is ideal for setting focus on your subject, but won't show you the full frame when actually recording. That's where



another focus assist comes into play: colored PEAKING. This option draws an outline around objects that are in sharp focus, in the color of your choosing (in this example, it's using red peaking). The colored peaking is a great option that works even while recording. Generally I highly recommend using both the EXPAND and the PEAKING together. It gives you the most detailed, easily-focusable focusing aid when lining up your

shot, and on the EVA1 they both work even during recording.

When using the EXPAND FOCUS ASSIST, you can modify the level of magnification, and you can move the magnified box around the frame to check or set focus on different sections of the video frame. You can move it by either using the arrow buttons on the touchscreen, or by just dragging the magnified box around the touchscreen, or rotating the wheel on the handgrip.

The caveat with the PEAKING focus system is that it only functions when it sees suitable contrast in the scene, and doesn't work on low-contrast scenes. In bright light it's usually very easy to see, but in darker scenes on flatter subjects, it may be a struggle to see the colored PEAKING at all. You can make it bolder and more visible by adjusting the LCD FOCUS ASSIST>PEAKING LEVEL menu option, but that may just make the system more generous in assessing what it believes is actually in focus; taken too far, it might report that items are in focus when in fact they might be slightly out. So the colored PEAKING focus assist is a great tool, and I highly recommend its use; just be aware that there are some limitations with the system.

An entirely different way of tackling the same task is to use the SQUARES focus assist. The SQUARES system is a different take on the idea of peaking.

Instead of drawing outlines around areas that are in sharp focus, the SQUARES system draws green boxes at various points around the frame. The larger the boxes, the more in-focus that element is; the smaller the boxes, the more out-of-focus that element in the frame is. A major benefit of the SQUARES is that the squares are hollow, allowing you to see the detail that's being focused on within them, as opposed to how PEAKING can obscure fine detail on the LCD by covering it with red outlines. You can combine the EXPAND focus with either PEAKING or SQUARES, but you can't have both PEAKING and SQUARES simultaneously displayed.

Yet another focus assist tool (which can be combined with all of the above) is the OPEN IRIS F.A. user button. When judging focus it's obviously much easier to judge what's in focus if the depth of field is extremely narrow (meaning, very little is actually in focus in the shot; when only the part you want is in focus and everything else is out of focus, it's obviously easier to know that you've properly focused your shot). By assigning OPEN IRIS F.A. to a User Button and pressing that User Button, the camera will automatically open your lens' electronic iris to its most open position, to narrow the depth of field as much as possible, and simultaneously the camera will temporarily engage its electronic shutter to compensate for any exposure changes caused by opening the iris. That way you can judge focus on a properly-exposed display. This focus assist can't be used during recording, but it's a great way to prepare focus prior to hitting the record button, especially when combined with the EXPAND focus assist.

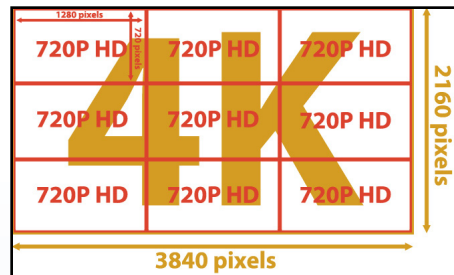
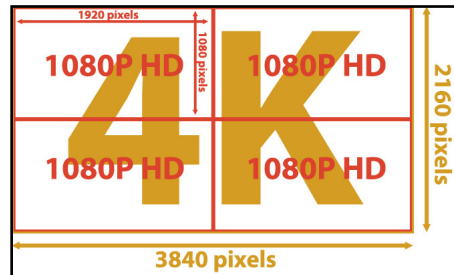
A very common technique on conventional video cameras is to zoom all the way in to your subject before setting focus. That's not necessarily a recommended practice for the AU-EVA1. The AU-EVA1 camera can use still-camera lenses, and still-camera lenses are not necessarily parfocal: they aren't necessarily designed to hold the same focus position throughout their zoom range. Remember that there's no such thing as zooming during a still shot; still-camera lenses are meant (generally) to be focused at the focal length that you'll be taking the picture at. Now, this zoom-in-to-focus technique will work if you're using a lens that's designed specifically to hold focus throughout the zoom range, such as some of the cinema-oriented lenses that have been recently introduced. You just really need to know whether or not your particular lens will hold focus before trying something like this, and it's probably a good practice to assume that still-camera lenses won't hold focus throughout a zoom operation.

Finally, another focus assist tool you may want to consider is auto focus; you can assign ONE PUSH AF to a User Button and then press that User Button

to invoke a quick autofocus operation. When you press that button, the camera will attempt to quickly lock into focus; as soon as it does, the camera automatically returns to manual focus. There is no way to have continuous autofocus on an AU-EVA1, but you can ask the camera to grab focus on the current frame. There's no guarantee that the focus will be perfectly accurate, however; auto focus may not choose to lock onto the part of the frame that you prioritize as being most important. The autofocus uses the center of the frame, about 1/4 the width and 1/3 the height of the frame, to determine what area to focus on. If your subject is off-center, you would be best served to change your framing so that the autofocus will grab focus on your desired subject, and then you'd re-frame for your shot. If you have no other way of double-checking your focus, temporary auto focus is better than nothing, but it certainly shouldn't be your primary focus assist tool.

Benefits Of Shooting In 4K or UHD

Originating footage in 4K/UHD brings a host of benefits to the video shooter, not the least of which is that your source footage is literally four times sharper and more detailed than 1080p HD footage would have been, or nine times more detailed than 720p HD footage. It's really rather remarkable; you would need to set up nine 720p HD cameras, each pointing at different sections of the scene, to capture as much image detail as a single 4K camera could!



All that additional detail can be used in many different ways and provides many potential benefits to the video shooter. First and foremost, shooting in 4K (or Ultra HD / UHD) means that your footage can be displayed on larger displays or projected on larger screens without losing detail. For movie screens, digital signage, large-screen 4K televisions, or other environments where the largest displays will be used, 4K origination means the sharpest images for those displays.

But what if you're not delivering your footage in 4K (or UHD)? What if you're producing footage that's intended to be broadcast in HDTV (in

1080 or even 720 resolution) — or, perhaps, even in standard definition? What if you're delivering content for web streaming in HD (or lower) resolution? Are there still benefits from, and reasons for, shooting 4K/UHD in the first place? Most definitely!

Shooting 4K/UHD for 1080 (or 720) HD Delivery

When your final delivered footage is going to be mastered in 1080p, 1080i, or 720p, there are still substantial and significant benefits that can be derived from shooting your source footage in 4K/UHD. Some of these may or may not apply to your particular scenarios, but it's still interesting to explore the implications of all of them.

Future Proofing: How many times have you seen a good, vintage television series, and bemoaned that it looks lousy on your HDTV because it was shot and mastered in 4:3 standard-definition television? Many older television series were shot on standard-definition video cameras, but some were shot on film. Those film-shot series are sometimes “remastered” into high-definition versions — and they look so much better! When the series were produced, standard-definition television broadcast (and perhaps VHS video or maybe, at best, DVD) were the anticipated delivery mediums, so mastering the series and distributing in standard-def were practical decisions at the time. But with the advent of HDTV and Blu-ray discs and HD streaming, it opened new markets for remastered high-definition versions — which created new opportunities and new revenue streams for those producers. Unfortunately for those who shot their projects on standard-definition TV cameras, there is no higher-definition master footage to go back to. Accordingly, while you may not necessarily see a need or even an opportunity to deliver a 4K or UHD version of your projects, wouldn't it be nice to have the higher-resolution master copies of the footage to go back to in case such an opportunity were to arise?

Sharper HD Footage: When you have a much larger source image to work from, shrinking it down to HD size can make for the sharpest, clearest HD images possible. A super-sampled ultra-high-definition image, when resized down to HD frame sizes, can result in images that hold as much detail as the HD frame size is capable of retaining. This means that you will get sharper HD images from scaled-down 4K or UHD footage, by resizing the images in post, than you would get from shooting in HD in the first place.

Reduced Noise: Another benefit to downconverting 4K/UHD footage to HD in post production is that you'll see a significant reduction in visible noise in the image. When converting UHD/4K footage down into 1080p footage, each 2x2 group of UHD pixels are used to create a single pixel in HD. Combining the 2x2 group of UHD pixels can result in "averaging" the noise from each pixel together, resulting in smoothing out the noise and greatly reducing its visibility.

Increased Color Resolution: One excellent benefit of downconverting UHD/4K footage to 1080 HD in post is that you can realize an increase in proportional color resolution. The EVA1 is capable of recording 4K or UHD footage using 4:2:2 color sampling, but when employing frame rates faster than 30 frames per second the recording is reduced to 8 bits per pixel and utilizes 4:2:0 color sampling. If you're going to be delivering in HD, you'll be downconverting your UHD/4K footage. After downconversion, the 4:2:0 UHD/4K footage will become HD footage with 4:4:4 color sampling. You can convert 3840x2160 8-bit 4:2:0 recorded footage into 1920x1080 4:4:4 footage in post.

To understand the color sampling advantage, you'd have to first understand that the camera records some of its footage in 4:2:2 and, depending on the resolution and frame rate and codec bitrate, it may record some of its footage in 4:2:0 color sampling. 4:2:0 means (simply put) that there is one color sample for every 2x2 block of pixels. In any given 2x2 block of pixels there are four different "brightness" samples, but they all share one "color" sample. Effectively, within the 3840 x 2160 frame, there is a 1920 x 1080 matrix of color samples, one for every 2x2 block of pixels. During the downconversion to HD, each block of 2x2 brightness samples are converted into one HD pixel, creating a 1920 x 1080 matrix of brightness pixels. This 1920 x 1080 "brightness" (luminance) matrix can be effectively married to the originally-recorded 1920 x 1080 "color" matrix, resulting in one individual and unique color sample for each and every brightness pixel. The result is effectively 4:4:4 color sampling at high-definition resolution.

Extended Zoom Range (in post): The AU-EVA1 is able to take a wide variety of lenses, ranging from ultra-wide-angle to super-telephoto. And, when shooting 4K/UHD, you can take advantage of the "Digital Zoom" feature to give your images the effect of having been shot with a lossless 1.4x teleconverter, so you can achieve even more

telephoto reach. But sometimes, you just need more. And if you've shot your source footage in UHD or 4K, there's a way to get more. If you're delivering in 1080 HD, you can crop in post into the central 1/4 of the UHD frame and use that crop as your full 1920 x 1080 frame, effectively "zooming" in post for a lossless 2x increase in your telephoto shot. If your final delivery is going to be 720p footage, you can zoom in post even further, to the central 1/9th of the screen, while still retaining full resolved detail.



*Full optical
zoom*

*Post crop of
center of image,
for 2x "post zoom"*



Reframing and Post-Production Camera Moves: Sometimes when you frame up a shot, you think you've got it perfect, only to get to the editing suite and realize that there's a microphone in the shot, or something ugly in the background, or perhaps your composition wasn't quite level, or maybe you really wish that you'd zoomed in just a little tighter. When you're shooting in 4K/UHD and finishing in HD, you've got quite a bit of flexibility in resizing, trimming, cropping, rotating, or otherwise adjusting your footage in post. In fact, you can even turn a locked-down stationary tripod shot into a simulated pan, tilt, or even zoom, by cropping into the UHD frame and then moving that cropped portion across the UHD frame during the shot. You can also turn a wide shot into a close-up, perhaps giving you more editing flexibility in post.

Shot Stabilization: The AU-EVA1 can take advantage of the optical image stabilization built into various lenses, or it can use its own Electronic Image Stabilization. While good on their own, these stabilization systems may not be sufficient for more extreme shooting scenarios. Maybe you decide you need more stable footage than you were able to get when using the camera handheld (or on a boat, or from a car window, or wherever you were shooting from). Most modern nonlinear editing programs include excellent image stabilization capabilities, but taking advantage of these programs usually means cropping off a notable chunk of your footage (to give the stabilizing software "room to work.") The more unstable your footage is, the more that would need to be cropped off; the remaining footage then gets magnified to fill the full frame, and that normally might lead to soft, low-res-looking footage. The nice thing about originating your footage in 4K or UHD is that

you'll start with so much resolution in the image, that you could devote a large percentage to the post-production image stabilizing software and still retain plenty of resolution for the resulting stabilized image. Knowing this beforehand, and knowing that you may need to stabilize the footage in post, you would be best served to consciously shoot your footage at a wider angle than you might otherwise have done, with the express intent of allowing that wider field of view to be cropped off as the "buffer zone" that the image stabilizing software will need. The resulting footage can be substantially stabilized in post, while still retaining plenty of resolution to be suitable for use in your Full HD project. Used judiciously, this could even mean that you could occasionally leave your tripod at home and work lighter, while still being able to deliver tripod-stable shots in post.

To see examples of some of the techniques described in this article, I recommend [this excellent video](#) produced by Park Camera in the United Kingdom.

The advantages of shooting in UHD/4K are numerous, even if your final project is destined for only an HD or even standard-definition finish and delivery. The AU-EVA1 is flexible enough to provide for the ability to record in 720p or 1080p high definition, in 2K, and ultra high definition and DCI 4K). Whenever possible and practical, I recommend shooting in 4K/UHD for the flexibility, future-proofing, and post-production advantages that UHD/4K acquisition provides. You may or may not need it, but if you ever do need to do some of the tasks outlined in this article, you'll be very glad you had that high-resolution source footage to work from.

There do remain some advantages to shooting in HD instead of 4K/UHD, and those will be covered in the WHICH MODE TO SHOOT IN? article.

SDHC and SDXC Card Best Practices

Recording video on an SD card will be new to many users, so it seemed like a good idea to put together a "Best Practices" guide to help new users avoid common mistakes.

1. Always format the memory card in the camera.

This is a vital first step. Even though the memory card comes pre-formatted when you buy it, it's still advisable to format it in the camera. Reports of glitches in the footage seem to be greatly reduced when cards are formatted in the camera instead of by a computer. Never format the card in a computer

using your operating system's "format" command. If you must format a card in a computer, only use the SD Card Formatter software program (a free download on Panasonic's website). It is especially important to format the cards properly depending on what kind of card they are; SD and SDHC cards should be formatted as FAT32, but SDXC cards need to be formatted as exFAT. The camera will always do this properly, so it's best to format the cards in the camera.

2. Never pull the card out when it's being accessed.

This is a big one; if a card is being written to, or read from, and you eject that card, it has the potential to not only ruin the current clip, but perhaps to glitch the entire card! Always make sure a card is not being accessed before you pull it out of any device. This is one reason for the presence of the card door – closing that door will remind you to double-check that recording has stopped. However, do be aware that the camera has hot-swap capability; you can leave the door open and eject a memory card that's not currently being accessed. This gives you the ability to perform an endless RELAY REC, where you can continually swap in new cards and record perpetually. The danger in this scenario is, of course, ejecting the card that's being currently written to. Always double-check yourself and look for the access lights to make sure you only eject that dormant card, and never the card that's currently being written to.

And when removing a card from a computer, be sure to eject the card through your desktop (on Mac, "Eject" or drag its icon to the trash, on Windows, use the green-arrow "Safely Remove Hardware" utility.)

3. Carry the cards in some sort of protective case.

SDXC and SDHC cards should be carried in a protective plastic case, or in a dedicated card holder. You really don't want to have cards roaming around loose in your pockets or at the bottom of your camera bag, where they can be crushed, be subjected to static electricity, be spilled on, or forgotten in your clothes and subsequently washed! Always put a card in a case when you're not using it.

4. Always write-protect the cards the instant they come out of the camera.

This has been a backbone of my tapeless workflow for years – the instant the card comes out of the camera, write-protect it. This does several things for you:

- A. It prevents your valuable footage from being overwritten.
- B. It alerts you that this particular card hasn't been offloaded to a computer yet.
- C. It prevents you from getting that card mixed up and formatting it(!)

My standard workflow is to write-protect the card, and leave it write-protected until I've successfully offloaded the footage onto a computer (at least once, and maybe to two separate drives). Once I know the footage is safe, the write-protection tab gets moved to the "unprotect" position. Things can get confusing quickly in a production environment, but with this procedure I always know that my footage is safe from being lost or overwritten. Get in the habit of immediately write-protecting your cards and you'll save yourself from some grief.

5. Use the very best cards you can afford.

This one almost goes without saying, but – I'm going to say it. There are cheap cards out there, and some of them are junk, and some of them are even counterfeit! Not all SDHC/SDXC cards are the same! Some employ technologies for protecting your footage from write errors, from power failures, from wearing out — and the cheaper ones don't. If you're buying no-name cards from third-world countries off internet auction sites, don't be surprised if they don't perform as well as a top-of-the-line card. In fact, don't be surprised if it's a fake/counterfeit/knockoff! There are plenty of examples on the internet of people who received fake cards; unscrupulous sellers have printed their own labels and stuck them over low-quality cards to deceive unwary buyers into thinking they've received a higher-quality, more-expensive card than they actually have.

It's not a matter of footage quality, it's a matter of data integrity. If a card works, it'll record the footage the same as any other card will. But a cheap card might not have as much reliability, it might have "bad sectors" or it might fail unexpectedly. While anything's possible, it's reasonable and practical to expect that a better-quality card will perform more reliably, and in my experience that has held to be the case. They say "you get what you pay for," and going with super-cheap cards may bring nasty surprises when it comes to reliability. Always get the best media you possibly can. And always buy your memory cards from the manufacturer's authorized resellers. You might pay an extra \$10 per card, but if it helps you avoid a reshoot, it's extremely cheap insurance!

As to what cards are supported: the minimum requirements are shown in the owner's manual / Operating Instructions. Panasonic produces three cards that are compatible with the EVA1: a 64GB V90 SDXC, a 128GB V90

SDXC, and a 64GB MicroP2 card. You're not limited to only using Panasonic cards, but you are guaranteed that these particular cards are going to work properly in the EVA1.

6. Always use SDXC cards whenever possible.

The camera is capable of recording low-bandwidth footage (like AVCHD footage) to SDHC cards, but in general you should stick with modern SDXC cards. SDXC cards are preferred for a number of reasons, but the two most obvious are that 1) the newer cards carry the speed ratings that the camera needs to record its higher bandwidth footage (V30 and V60); and 2) the SDXC cards have a much bigger file size limit on them. SDHC cards were limited to a maximum of 4 gigabytes per file, and had the potential of creating many spanned clips if you recorded long duration events on them. SDXC cards have no file size limit, although the camera may still limit the maximum file size. That means that even if you're recording the longest events, you'll have very few if any spanned clips, and that can make life much easier when working with the footage in post.

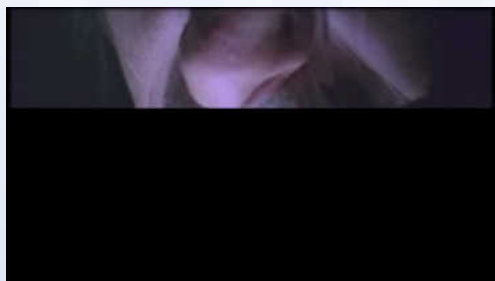
Rolling Shutter MOS Sensors

The AU-EVA1 uses an MOS sensor, and like virtually all MOS and CMOS camcorders on the market, it uses what is known as a "rolling shutter." This is a subject you should be aware of, because rolling-shutter chips perform differently in several ways from the CCD chips of older video cameras.

First, what is meant by "rolling shutter"? It's a difference in the way the camera exposes. On a CCD camera (or on a camera with a global shutter),



Video simulation of global shutter



Video simulation of rolling shutter

the entire chip is exposed top to bottom, all at once. Across the entire frame, it goes from black to fully exposed, simultaneously. Click the video to the left for an example.

A rolling shutter exposes progressively from top to bottom. Simplified, a rolling shutter camera will expose the very top line first, and then the next line, and then the next line, and on and on, until the entire frame has been exposed.

This differs significantly from the “global” approach of the CCD, and it can result in some image artifacts or differences in the way the camera renders images, that you need to be aware of.

For purposes of this discussion, we’re going to talk about three main image artifacts: Skew, Wobble, and Partial Exposure.

Skew

Perhaps the best-known and most-talked-about rolling shutter artifact is known as “skew.” This refers to the tendency of objects to lean or tilt (or, well, “skew”) when the camera pans past them. Take a rolling shutter camera, with a long telephoto lens, point it at a picket fence, and rapidly pan it back and forth, and you’ll see that the vertical lines start leaning depending on which way the camera is panning, and as you reverse direction they actually start to look “rubbery.”

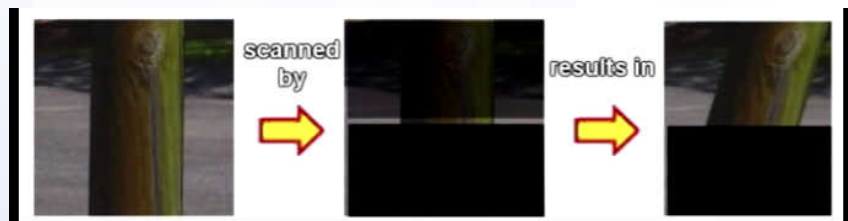
It’s pretty easy to understand why this happens – again, in the prior section, we talked about how the rolling shutter works, and how it “rolls” through the frame. Well, think about panning past a tree: when you start the pan, and the first line is starting to be exposed, the tree might be on the left side of the frame.

As you continue to pan, the tree is moving across the frame, but the shutter is still rolling down the screen – so as it exposes each new line, the tree has moved some. As the camera frame moves across the tree, the tree may be in a different position as each line is exposed as the shutter rolls down the frame. The resulting frame is a diagonally skewed image.

Moving Image

Rolling Shutter Scan

Skew in Final Frame



[Click the video above for a simulation of a rolling shutter](#)

Frankly, that’s going to happen on any image that you pan quickly past, not just vertical poles or trees or fence posts. It will happen with buildings or flagpoles or cars or signs or... well, anything, really, because that’s how a rolling shutter works. And it’s not just limited to panning the camera,

it happens with any image motion across the sensor, whether you're moving the camera, or the image is moving relative to the camera (as in, speeding cars going by; you'll notice that the cars may be leaning, especially noticeable on big square vehicles like train cars or moving trucks.)

There are many ways to work with this, but let's get one thing out of the way first – changing the shutter speed will not help. The shutter speed controls how long each row gets exposed for, but it does not cause the scanning to happen any faster. The only difference the shutter speed will make is in how much blur happens in your shot, but the exact same amount of skewing will still exist.

The sensor scanning mode, however, does have a lot to do with it. The smaller the area the sensor scans, the faster the shutter will roll down the frame, and the less “skew” you will see. S35 MIX 2.8K scans the sensor much faster than S35 5.7K does, and shows less skew. 4/3 CROP&MIX 2.2K scans the sensor even faster, and shows the least amount of skew.

Another major contributor to skew is the amount of relative motion. The faster you're panning, or the faster the object is moving, the more skewed it will appear. But you can change the amount of relative motion by using a wider-angle lens, for example. The further you're zoomed out, the longer it will take for an object to cross the frame, and the longer it takes, the less skewed it will be. Skew is at its strongest at telephoto focal lengths, and it's at its mildest at wide angle.

So how do you control it?

1. Whenever possible use the fastest scanning sensor mode you can. “S35 5.7K” shows the most skew; “4/3 CROP & MIX 2.2K” shows the least amount of skew. If you're shooting 1080p or 2K, any of the choices could be considered. If you're shooting UHD or 4K however, the only way to take advantage of faster scanning would be to record 4K raw to an external recorder. The MIX modes are only for 2K or 1080p.

2. Zoom out. Telephoto = more skew, wide-angle = less skew.

3. Control the relative motion. That means either slow down your pans, or slow down the object you're tracking. One way to slow down an object you're tracking is to pan with it as it goes across; the more time the object spends on the screen, the less relative motion it's exhibiting, and the less relative motion, the less skew. Remember, it's not about the actual ultimate speed, it's about how fast the object moves across the camera's sensor.

Wobble

The second major image artifact to discuss is “wobble.” Wobble gives a rubbery, gelatin-ish, bouncy/stretchy texture to the footage. Wobble happens primarily in cases of vibration, where the camera is being constantly moved up and down or side to side very rapidly. Wobble is really an extension of Skew, and happens for the same reason. If you put the camera in 24p mode and use a 1n9 telephoto lens and wave the camera back and forth, you’ll see vertical lines get kind of “wobbly”; the same thing will happen with vibration. Another example would be if you had the camera mounted on a tripod, and somebody bumped into the tripod — during that bump, you’re going to see the image get “wobbly.”

How can you deal with wobble?

1. Use a lens with Optical Image Stabilization. It can’t overcome all instances, but a good OIS can be quite helpful at dealing with minor, momentary wobble. It’s not a fix-all, but the OIS can certainly help minimize some instances of wobble. Of course, there are reasons to avoid using OIS when on a tripod, too, so you’ll have to make a judgement call as to when OIS on a tripod is an appropriate choice. Note that the Electronic Image Stabilization is not going to be nearly as effective as good Optical Image Stabilization would be at minimizing wobble.
2. Using a faster sensor-scanning mode will result in less observed wobble in the footage. See the above discussion under “skew”.
3. The ultimate cure here is to avoid those scenarios! If you’re going to be mounting the camera to a highly vibratory surface (such as an ultralight airplane or a helicopter or dirt bike) you can expect wobbly footage. You have to minimize or eliminate the vibration whenever possible. A lens’s internal optical stabilizer usually does help to overcome a lot of high-frequency vibration, and a vibration-absorbing mounting (such as a [CineKinetic CineSaddle™](#)) can help absorb the vibrations and eliminate or at least minimize the rubbery effect. Regardless of how you choose to approach it, recognize that if the camera is put in a vibration-prone environment or is used in a herky-jerky handheld style, you’re going to see wobbling, and the only real way to prevent it is to prevent the wobbles from reaching the camera in the first place.

Partial Exposure

This artifact is also known as “flash banding.” This is perhaps the most prevalent of the rolling shutter effects. What happens is that when a flash goes off, only part of the flash is recorded.

Again, think back on how that rolling shutter rolls through the frame;



as it rolls from top to bottom, it exposes the frame onto its sensor. If the image is uniformly lit, you'll get a uniform image, such as the one on the left. However, what if a flash was happening in the frame when the rolling shutter starts exposing, and then halfway down the frame the flash stops? It'll record the bottom half of the frame without the flash, but the top half has already been recorded when the flash was happening! The result is you'll see a frame where only part of the frame is lit up by the flash, and the lower half is darker.

The AU-EVA1 doesn't have any special feature to minimize flash-banding. About the best you can do is use a faster-scanning sensor mode (S35 2.8K MIX or 4/3 CROP&MIX 2.2K), that may help slightly minimize the appearance of the flash bands but frankly they'll probably still show up. Perhaps a better way to deal with them is in your approach to how you'll be shooting the scene. Flash bands are most apparent when there's a big difference in brightness between the lit and unlit portions (which seems obvious, of course) and so you can minimize the appearance and distraction of the flash bands by lighting up your scenes more. A stronger on-camera light can greatly minimize the distracting nature of the flash bands by minimizing the difference between the flash- and non-flash portions of the screen.

Perhaps the only way to fully address the flash banding is in post; overlaying a white frame or blending portions of the frame together can minimize the effect of flash banding or partial exposure. In general, the advice is to be aware that all rolling-shutter cameras exhibit this artifact, and if you are planning on shooting a red-carpet Hollywood premiere or a press conference or some other event where there are likely to be many flashes going off, you can expect that you'll have flash banding in your footage.

Another effect you need to watch out for is scrolling bars in your image, which are mainly caused by using a shutter speed that doesn't match the light frequency when shooting under fluorescent, sodium vapor, mercury vapor, or HMI lighting. If the shutter speed isn't timed to the same frequency



Video of "partial exposure" bands

that the light is operating at, then the rolling shutter will cause brightening/darkening bands to appear (similar to when you shoot a computer monitor or television at an "off" shutter speed.) The way to minimize

this is generally to

always use a shutter speed that matches your country's power frequency (in the USA or NTSC territories, that means use 1/60th; in Europe or PAL territories, use 1/50th). There are some other shutter speeds that may prove safe in these scenarios, such as 1/25th in PAL territories, or 1/24, 1/30, or 1/40 in NTSC territories, but those are only available if you're shooting in a slower frame rate anyway. In general it's easiest to remember that in NTSC territories, the way to best avoid any bars/bands in the footage is to stick to 1/60th, and in PAL territories, stick to 1/50th. This won't guarantee that you'll never have the problem, but it should minimize instances where the problem occurs.

How do you know if your fluorescent/HMI lights are likely going to cause a problem? Sometimes the scrolling bands are not very apparent on slow shutter speeds (such as when shooting 24P at 1/50), but they will become glaringly apparent if you use a short shutter speed. One easy way to test for the problem is to set the shutter speed to something very fast, such as 1/250 or 1/500. If you don't see black bars or scrolling orange bars at those short shutter speeds, you're very unlikely to see them at more normal shutter speeds. But if the black bars do show up, you know that you're shooting under potentially problematical lighting. The safest course of action is to replace that lighting with your own, but if you can't re-light the scene, keep a close eye on your shutter speed and manipulate it to minimize the prospect of scrolling bars in your footage.

Note that with some LED lights, their dimmers can cause rolling bands too — and you can't eliminate that banding with the shutter speed! Some LED lights dim their lights by actually cycling the light off and on briefly, and the rates at which they do this are not easily trackable by adjusting the shutter speed. You really have to be careful when working with dimmed LED lights, and keep them at full brightness to avoid the rolling band issue.

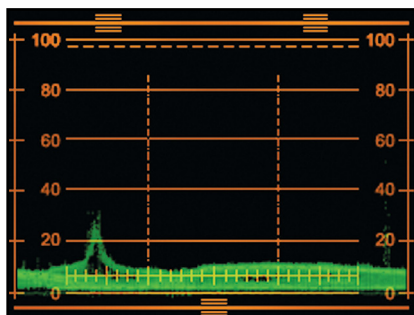
An Introduction to the Waveform Monitor and Vectorscope

The best tools for calibrating the color accuracy and exposure accuracy of your video signal are the WaveForm Monitor (WFM) and the VectorScope (VS). These tools have been a staple of professional video production for many years, and they provide a way to evaluate the actual video signal. Buying a standalone waveform monitor is an expensive proposition, but the EVA1 actually offers a free, built-in waveform monitor and vectorscope!

An exhaustive look at all the possibilities afforded you by a waveform monitor and a vectorscope is far beyond the scope of this article. This section will introduce you to these tools and show you basic fundamental operations, which should allow you to evaluate and monitor your video signal more accurately than you may have experienced before.

The waveform monitor ("WFM") is the most useful tool for judging your video's exposure levels. The waveform monitor can tell you at a glance whether your footage is overexposed, underexposed, clipped, and – if any of those conditions are true, the waveform monitor will also tell you where your footage is overexposed, underexposed, or clipped. The waveform monitor is like having the ultimate light meter available to you, but it's infinitely more informative and precise than a light meter, because the waveform monitor takes into account all the signal processing the camera does – the gamma curves, the master pedestal, the effect of the knee, all of these effects can be discerned from looking at the waveform monitor, and none of these things could be known by just using a light meter. Light meters work great for lighting film, but when working with video a waveform monitor is a far more useful tool to have on hand.

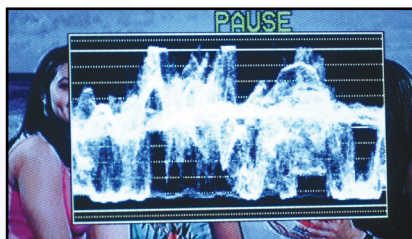
In simple terms, a waveform monitor is essentially a graph of your video signal. It draws a mathematical representation of the brightness of the image, from left to right, and it plots its pixels according to the brightness of the image: the brighter the source image, the higher up on the scale it will plot the pixels.



Here's an example of a waveform monitor screen. Vertically you can see that there are certain denominators at predetermined reference points (0, 20, 40, 60, 80, and 100 IRE; on the camera's waveform monitor the solid lines are at zero, 50, and 100, with dotted/dashed lines at the other reference points). You can think of

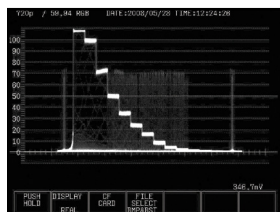
these numbers as basically telling you the overall percentage of brightness; a dark gray object might illuminate around the 10 to 20 IRE mark, and a bright white light might stretch all the way up to or even past the 100 IRE mark (up to as much as 110 IRE). The brighter the signal, the higher up the chart it will mark. In this example you can see an extremely underexposed image; the plot of image brightness is almost entirely down at the 0 to 10 IRE level (but there's a small spike about 15% of the way across the screen, in our video image there was something a bit brighter there.) If your waveform monitor looked like this, you'd get terrible video quality: the image would be underexposed, muddy, and probably very grainy and noisy.

Ideally, for most real world scenes, you want a rich saturated image with brightness distributed across the full scale, which shows that you're taking advantage of the maximum dynamic range the camera affords. Look at this next image for an example of a fully saturated, brightly exposed scene. In a moment I'll show you how to read the waveform monitor and fine-tune the image in order to get the best overall exposure; this example is just to show you more of what you should be aiming for in terms of a rich, saturated, full signal.



As said before, the waveform samples the brightness (luminance) of the picture and plots a graph of the image on its screen. Horizontally, the waveform monitor plots out the image just like on your video screen; if a very bright object was located in the center of your monitor, you should see a bright spike in the center of the waveform display. The next pictures show what a waveform monitor looks like when shooting a chart full of gray bars. The brighter bars are represented on the left side, and the darker bars are on the right. The waveform monitor looks at the brightness of the image as it scans horizontally and it plots the relative brightness vertically, so white

is the highest point and black is the lowest point, and the shades of gray are distributed in-between.



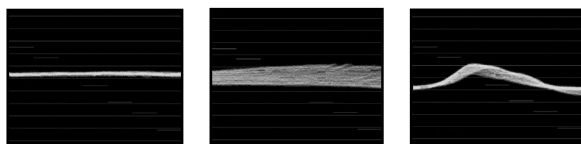
These waveform plots show clean lines where each bar appears on the screen. That's because the waveform will plot

the entire vertical height of each vertical line of the display, and it will plot pixels on top of each other – so, the more pixels that appear at a certain brightness level, the brighter that section of the waveform monitor will be plotted. In our example there's only one level of brightness in each gray bar, so the waveform monitor plots a thin clean line. If you looked at a waveform display of a perfectly flat white sheet of paper, you'd see a razor thin line running across the waveform monitor's display. That's because, with no variation in brightness, there's no variation of where the pixels get plotted, so they all get plotted on top of each other, making that section of the waveform display brighter and brighter. If, on the other hand, we were to feed the waveform monitor a signal that had wildly varying brightness in each vertical column, you'd see a large swath of pixels plotted on the waveform display.

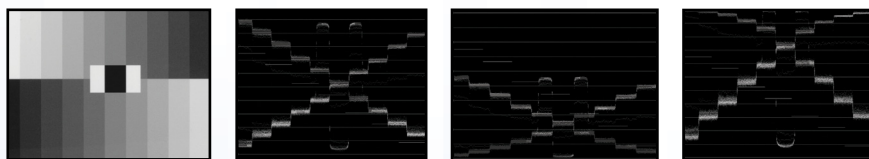
This is a very valuable aspect to a waveform monitor because you can use this to evaluate the relative brightness of your scene, especially when shooting something like a greenscreen. If your greenscreen lighting is perfectly flat and even, you should see a tiny thin line plotted across the waveform monitor's display. The thicker the waveform's plot, the more variation there is in your lighting (which will make it more difficult to pull the best-quality key from your footage). Also, if the line is not perfectly flat, but it dips in the corners or has peaks and valleys across the screen, that is telling you that your lighting is uneven; wherever the waveform monitor dips, that's showing you have a darker spot, and wherever there are peaks or hills on the display, that's telling you that there are hotspots on your greenscreen. The waveform monitor is the best tool for helping you light a perfectly flat, perfectly even greenscreen.

Here are three examples of lighting a greenscreen using a waveform monitor. In the first example the screen is evenly and flatly lit, so the

waveform shows a tight thin horizontal line of brightness. In the second example the screen is unevenly lit, so the line on the waveform is much thicker. In the third example there's a brighter spot on the screen about 1/3 of the way across.

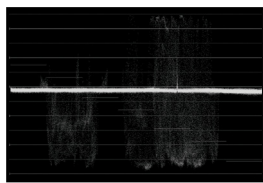


Besides telling you evenness of lighting and overall exposure levels, the waveform monitor tells you what sections of your footage might be overexposed or underexposed. If you see a big clump of bright plots down at the bottom of the waveform, you know that your exposure level is really low in that section. Conversely, if you see a flat line clipping off the top of the waveform, that alerts you that portions of your video signal are “too hot” and are, in fact, clipping (losing all detail and becoming a big blob of overexposed white). Keep an eye on your video signal and watch for those clipping hot spots, and either lower the light level on those hotspots, or stop your iris down some to keep them from blowing out. Blown out highlights on video are ugly, ugly, ugly, and are best avoided. And if you're seeing sections of your video that are grossly underexposed, either iris up or shine some light onto that portion of the scene to prevent you from getting stuck with noisy, muddy, underexposed video.



The above examples are of a gray 10-step chart; notice how the gray bars form an “X” on the waveform. The first example is properly exposed. The second example is quite underexposed, look at all the wasted range at the top end of the waveform. And the third example is very overexposed, look at how the white bars are actually clipping off the top of the waveform.

The great thing about a waveform monitor is that it tells you absolutely what your video signal is doing. You don't have to try to trust your eyes to a perhaps - miscalibrated monitor, or strain to see where the zebras may or may not be hitting, or (worst of all) just guess. Instead, at a glance, you can see whether you're getting a full and proper exposure and whether your image is clipping or crushed.



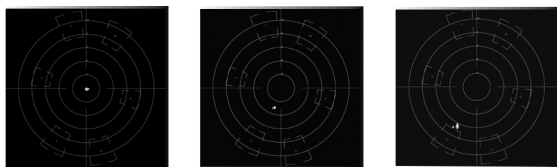
In this example, you can see that the greenscreen is evenly and flatly lit at about 57 IRE (as shown by the thin line running throughout),

the wooden car is darker on the left, and the monster is both dark and light on the right (and its white teeth are coming close to clipping off the top of the waveform). Diligent use of the waveform monitor will be your best method for ensuring strong, richly exposed video.

Whereas a Waveform Monitor (and especially the waveform monitor in these cameras) is designed to monitor brightness, the Vectorscope is a tool to help you judge the accuracy of color rendition and the level of color saturation in your image. When used with proper test charts the Vectorscope can give you an overview of your camera's color rendition at a glance, and you can also see exactly what the menu setting changes do to the way the camera manipulates the color of the images.

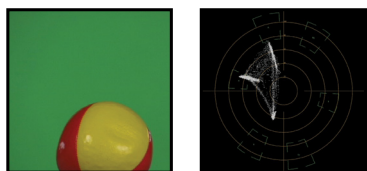
The vectorscope plots colors along certain vectors. The graphical overlay (or "graticule") of a vectorscope will always have some boxes to indicate where the pure color vectors should be lining up, and frequently a vectorscope's graticule will include some circular or graduated marks to show the percentage of saturation (in terms of IRE) of the color signal. The camera's vectorscope only shows the color boxes, so we'll focus on that aspect of the vectorscope.

The vectorscope features six boxes, representing (clockwise from the top, starting at about 11:00) red, magenta, blue, cyan, green, and yellow. The vectorscope analyzes the video frame and plots dots on the display according to how many pixels it finds in each particular group (or, obviously, between groups for mixed shades). When shooting a black and white picture, ideally you should see a tight bunching of pixels at the center of the vectorscope. When shooting an object of a pure color (such as a greenscreen), you should see all the plotted dots bunched tightly in one place, ideally towards the green box. The plotted dots will be closer to the center or closer to (or even beyond) the color box, depending on how saturated the color is. These next three examples are of: 1) a black and white picture, 2) a very low-saturated greenscreen, and 3) a highly saturated greenscreen.



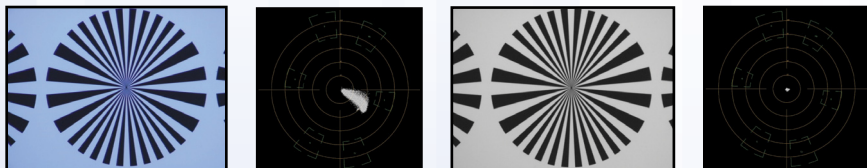
In these examples, the only color involved was green, so you only see pixels plotted on the screen either at the center (the black

and white picture, no color present), or slightly towards the green box (a greenscreen picture with low color saturation), or a lot of plotted pixels closer to the green box (a highly saturated greenscreen). It's uncommon to see such simple vectorscope plots; most scenes have a lot of color in them and so the plot will be "busier."



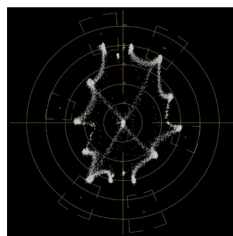
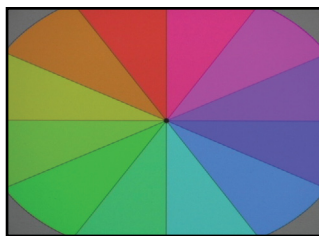
Here's an example of a red and yellow ball against a green screen. There's a good deal of color purity here with intense plots at the red, yellow, and green boxes.

In real-world monitoring, you're not likely to use the vectorscope nearly as much as you will the waveform monitor. The vectorscope is a more useful tool for setting up and evaluating camera performance, whereas a waveform monitor can (and ideally should) be used on every shot to evaluate exposure and lighting. However, a vectorscope can be useful to solve lighting problems because, like the waveform monitor, it reports exactly what's happening in the video signal – rather than trusting your eyes to a perhaps - miscalibrated production monitor. In the following example the white balance is grossly off; we white-balanced for tungsten light but the actual light was daylight, so the image is too blue. The effect of this is clearly observable at a glance in the vectorscope, as the plot is bleeding towards the blue vector instead of being a tightly-controlled pack of pixels as in the second example.



A vectorscope may be most useful with test charts, to see how the color is being rendered by the camera under controlled conditions. Here is an example of a DSC Labs CamBook™ color chart, and the vectorscope display.

This is a 12-color chart so you'll see heavy plots in the six main boxes for the six specified colors (red, magenta, blue, cyan, green, and yellow)



as well as heavy plots in-between those colors.

The goal, for accurate color representation, is to adjust the lighting and the camera settings until the primary six colors align as best as possible with the color boxes on the vectorscope's graticule, and the intermediate colors appear halfway between the primary colors.

Whether you choose to use the vectorscope or not, my advice to all video shooters is to become thoroughly versed with the waveform monitor and use it on every shoot you possibly can. Proper use of the waveform monitor will help you to more accurately expose your video image, keeping you from getting noisy underexposed images or clipped/overexposed video. You'll find that the waveform monitor (especially used in tandem with a properly-calibrated production monitor) will help you in your lighting and exposure far more than any light meter would be able to. These cameras make it extremely easy to spot-check with the waveform monitor. Other options would include getting a dedicated waveform/vectorscope device, or using a production monitor with a built-in waveform monitor (such as the Panasonic BT-LH series of LCD monitors).

Which Mode to Shoot in?

The AU-EVA1 presents a dizzying array of formats, frame rates, frame sizes, and recording modes to choose from. Everything from 720p, 1080i, 1080p, 2K, UHD, and 4K, in base frame rates of 23.98, 24.00, 25.00, 29.97, 50.00, and 59.94 frames per second, in various combinations of bitrates in long-GOP as well as some choices for intraframe recording, and most of that is available to be recorded in your choice of two different file formats (AVCHD, or MOV)! So which mode should you shoot in? And why would you pick one particular mode over another? Let's examine each mode and outline what it would be best for.

We'll evaluate the different choices that are available in six basic categories: aspect ratio, frame size, frame rate, Long-GoP or All-I, color sampling/bit depth, and bit rate.

Aspect Ratio - Let's start with the simplest of choices, aspect ratio. This refers to the shape of the video frame. In general, the AU-EVA1 should be considered a 16:9 camera. Most of the recording formats it offers are in a 16:9 aspect ratio, but there are two exceptions: 4K and 2K utilize an (approximately) 17:9 aspect ratio. These modes are Digital Cinema Initiatives standardized formats, and they match the widescreen aspect ratio of digital cinema cameras and projectors (approximately 1.85:1).

All of the UHD (3840 x 2160) and FHD (1920 x 1080) and HD (1280 x 720) recording modes use a 16:9 aspect ratio.

Frame Size - The next consideration is the frame size of the video you intend to produce; this is set in the SYSTEM SETTINGS>SYSTEM MODE>MAIN PIXEL menu. There are six different options available, depending on which sensor scanning mode you've chosen.

The 4096x2160 choice delivers a (obviously) 4,096 x 2,160-pixel image. This is the highest resolution that the camera offers for internal recording, with the widest field of view. It's actually the same height as the UHD 24p frame, but slightly (128 pixels) wider, on each side. This is a Digital Cinema Initiative (DCI) standard format, known as "4K" or "Cinema 4K".

In Ultra High Definition (UHD) shooting modes, the frame size is always 3,840 x 2,160. This frame size is generally referred to as "4K" or "TV 4K".

The 2048x1080 choice delivers a "Cinema 2K" frame. This is also a DCI-standard format, offering the same vertical resolution as FullHD 1080p, but with an additional 64 pixels on each side of the frame for a wider aspect ratio.

The 1920x1080 size is used for HDTV frame sizes, or distribution on Blu-Ray. In Full High Definition (FHD), the frame size is always 1920 x 1080, and can use either progressive-scan or interlaced recording. The 1920x1080 size can be used for recording in MOV or AVCHD formats.

There is one AVCHD mode which records in 720p, the PM mode. Its frame size is 1280 x 720. The only available MAIN CODEC is automatically set to AVCHD PM when you choose a frame size of 1280x720.

Finally, there is one last frame size: 5.7K RAW. This is not available for internal recording, but you can configure the SDI port to output raw

footage in the 5.7K frame size. You'll need an external SDI recorder (that's compatible with the EVA1) to be able to record footage in this frame size.

Frame Rate - There are eight different base frame rates to choose from, not including variable frame rates! Not all frame rates are available in all modes. The camcorder calls these base frame rates the "FREQUENCY", and you set the base frame rate in SYSTEM SETTINGS>SYSTEM MODE>FREQUENCY. The base frame rate you choose is the frame rate at which the footage will be played back. In editing terms, what you set in this menu would be the same as what type of timeline you'd set in your editing program. The choices are:

23.98P - This frequency is available in 4K, UHD, FHD, and in PH AVCHD modes. It is not available in the 1280x720 frame size. Technically 23.976 fps, it is frequently rounded off to "23.98" and in common vernacular it is usually referred to as "24P". Note that the frame rate is not exactly 24.00 frames per second (as you'll see below); this frame rate is 0.1% slower. This is the standard frame rate for shooting film-looking footage for display on 59.94Hz televisions, or for release on Blu-Ray or DVD discs. Generally if you're shooting footage that you want to have the "film look", this is the frame rate that you will normally be choosing.

24.00P - This frame rate is generally not used when shooting footage for display on a television; instead, it's suitable for matching the frame rate of a film camera that's running at exactly 24Hz. This Frequency is only available in 4096x2160 or 2048x1080 frame sizes. It is designed to exactly match the frame rate of a film camera, not a video camera; as such, video footage shot in this mode may not synchronize exactly with external audio recordings if the footage is edited on a conventional video 23.976 fps (or "23.98p") timeline. As such, this is somewhat of a "specialty" frequency, and is not a general-purpose video mode.

25.00P - When shooting with the camera in 50Hz frequency, 25.00P is essentially the 50Hz counterpart of 23.98P. It is a "film look" mode that creates footage that is compatible for broadcast or display on 50Hz televisions, or for synchronizing with a film camera that is running at precisely 25.00 frames per second. If you live in a "PAL" territory (i.e., if your country's standard-definition television was PAL), then 25.00P is the "film-look" frame rate that you'd want to choose to create film-looking footage for television. 25.00P is available in 4K, UHD and FHD modes, but is not available in AVCHD.

29.97P - This is also frequently called "30P". This mode offers a faster frame rate than 23.98P/24.00P, and delivers sort of a hybrid between the "film look" and the "video look". The frame rate is faster than

23.98P/24.00P, resulting in smoother motion, but it's nowhere near as fast as the 50.00P or 59.94P fps of "live video". The result is a sort-of-film-ish, sort-of-video hybrid, which integrates nicely into a 1080/59.94i broadcast stream. This frequency is available in all frame sizes except 1280x720, and in all recording modes except AVCHD.

50.00P - This is a fully progressive version of the "live video" look. Fundamentally it delivers the same general feel as 50.00i video, with the benefit of more resolution because each motion sample is made from a complete frame, rather than a "half frame" field as used in 50.00i. 50.00P is available in all frame sizes and in the AVCHD PS and PM modes. 50.00p footage can be easily converted to 50.00i for broadcast if necessary, and in general is a superior choice to 50.00i except for instances where the footage is going to be broadcast unedited or unconverted. This frequency is best suited to televisions that operate on the 50Hz standard. Also, note that the internal recording of UHD or 4K at the 50.00P frequency is restricted to 8-bit 4:2:0 codecs, and outputting SDI RAW at 50.00Hz cannot be done using the full S35 5.7K sensor size.

59.94P - (aka "60P") - This is a fully progressive version of the "live video" look. Just as with 50.00i/50.00p, 59.94p delivers the same general look and feel as 59.94i, but made with pure progressive frames. 59.94p footage can be easily converted to 59.94i for broadcast if necessary, and in general is a superior choice to 59.94i except for instances where the footage is going to be broadcast unedited or unconverted. 59.94P is available in all frame sizes and all recording modes. This frequency is best suited to televisions that operate on the 59.94Hz standard. Also, note that the internal recording of UHD or 4K at the 59.94P frequency is restricted to 8-bit 4:2:0 codecs, and outputting SDI RAW at 59.94Hz cannot be done using the full S35 5.7K sensor size.

50.00i - This is the "live video" look for recording footage to be broadcast or delivered on Blu-Ray or DVD in 50Hz territories in the world ("PAL" countries). It is available only in the 1920x1080i frame size, and can be recorded in MOV format, in high-quality AVCHD PH format, and in low-bandwidth AVCHD HA format. 50.00i video is interlaced and would be appropriate for footage that is going to be broadcast in 1080i or standard-def. It would make for a poor choice for computer video though; 50.00P would be a far better choice.

59.94i - (aka "60i") - This is the "live video" look for recording footage to be broadcast or delivered on Blu-Ray or DVD in 59.94Hz territories in the world ("NTSC" countries); 59.94i is frequently referred to as "60i". 1080-resolution HDTV broadcasts in the USA are broadcast

as 1080/59.94i; in this mode the camera would be producing footage that could be used for broadcast directly. However, it would be a poor choice for video that will be viewed on a computer, and in general 59.94P would be the better choice for any footage that will be displayed on a progressive-scan TV or computer.

Long-GOP or ALL-I: The compression system of the EVA-1's recording formats offer two distinct encoding mechanisms: either all intraframes (ALL-I) or groups of pictures (Long-GOP). While this could become a complex subject, you'll see that the choice is actually very easy to make between them.

ALL-I - The ALL-I recordings are made using nothing but so-called "intraframes". In this compression system, each and every frame is compressed individually; nothing that happens in any frame will have any influence on anything that happens in any other frame. Every frame is recorded distinctly. Each frame stands alone. This is much easier for a computer to decode, and you may find that working with ALL-I footage is more responsive or "snappier" on your computer, than Long-GOP footage is.

Long-GOP - This method groups images together into a big Group Of Pictures (GOP) and compresses them all at once. The first picture in the group will be an "intraframe", and then all successive pictures in the group are encoded by only charting the changes between frames. If you think about it, in many if not most video scenes, the amount that changes from frame to frame is generally not very much. In a tripod-based interview, for example, the background may never change from frame to frame, and large portions of the person's face may not change. Long-GOP encoding takes advantages of these similarities and results in much smaller file sizes, at equivalent video quality, when compared to ALL-I. These groups of pictures are however harder for a computer to decode, taking more processing power, so it's possible that people working with older computers may find that working with Long-GOP footage may be more sluggish on that computer.

In general, Long-GOP footage averages to be about 2x to 3x more efficient in encoding space than ALL-I footage is. In terms of visual quality, Long-GOP 150-megabit is generally comparable to ALL-I 400-megabit. Long-GOP 50-megabit is about on par with ALL-I 100-megabit. When using LongGOP encoding, you'll generally get longer record times on your memory cards, and faster file transfers, with the possible downside of slower editing performance. When using ALL-I encoding you'll have larger file sizes and slower file transfers, with the possible upside of faster editing

performance. There is not a substantial quality difference between them so long as you're comparing comparable levels (i.e., the highest-bitrate LongGOP will perform on par with the highest-bitrate ALL-I; the lowest-bitrate LongGOP will perform on par with the lowest-bitrate ALL-I.)

Color Sampling and Bit Depth - I've grouped these two very distinct concepts together because the EVA1's recording formats group them together. There are recording formats that record 4:2:2 color sampling and 10 bit quantization, and there are other recording formats that record 4:2:0 color sampling and 8-bit quantization, but none of the recording formats offer 8-bit 4:2:2 or 10-bit 4:2:0. So when choosing color sampling, you are inherently also making a choice about bit depth (and vice versa). So we'll discuss both of these unique topics in this section. Note, though, that these choices are only relevant to the LongGOP MOV recording modes. In the other modes (AVCHD and ALL-I), the choice is inherently already made for you; AVCHD is always 8-bit 4:2:0, and ALL-I is always 10-bit 4:2:2. It is only in the LongGOP codecs where you have a choice between them.

Color Sampling: - There are two color sampling systems offered: 4:2:2 and 4:2:0. We could get very complex in the description, but it's also possible to explain this very simply: 4:2:2 color sampling results in recordings that retain literally twice as much color information as 4:2:0 color sampling does. You could say that both systems are a way of compressing the amount of data that gets stored, by throwing away information that is not likely to be noticed by the human eye.

In 4:2:0 color sampling, each 2x2 block of pixels is assigned a single color, equivalent to the average of all 4 pixels. So each 2x2 block retains individual brightness information for each of the 4 pixels, but all 4 pixels share the same color information. In 4:2:2 color sampling, the color is dealt with for each pair of pixels. Instead of averaging the color among four pixels (as in 4:2:0), the color is averaged among every pair of pixels. This results in higher color fidelity and more accurate color recording, and can result in higher quality footage. Further, 4:2:2 color sampling can make for more accurate greenscreening, since the edges will be rendered with twice as much color information. As a pure question of which is "better", there can be no question: 4:2:2 is "better" than 4:2:0. However, when it comes time to compress the footage for recording or broadcast, 4:2:2 requires a lot more data to encode than 4:2:0 does. 4:2:0 in general looks quite good; all HDTV broadcasts and all Blu-Ray encoded discs are encoded using 4:2:0 color sampling.

4:2:2 is undoubtedly better. But the question you face when choosing a recording format is one of resource allocation: you only get so many megabits per second to encode all the properties of the footage. If you are choosing a low-bandwidth recording mode (like, say, 50 megabits) then -- it may actually result that 4:2:0 color sampling looks better, in the final recorded footage, than 4:2:2 would. Why? Because if you're using up your available bandwidth encoding something that is not as visually distinguishable, like color information, then you will have less available bandwidth to encode something that is more visually distinguishable (brightness information). So a really well-encoded 4:2:0 picture might look better than an overly-compressed 4:2:2 picture. So there is not one easy answer, other than to say: always record at the highest bitrate you can get; that way you won't likely have to concern yourself with having to prioritize brightness over color encoding.

Bit Depth: Hand-in-hand with color sampling, you'll be choosing the bit depth you want to encode your footage at. The choices are 8-bit quantization, or 10-bit. Now, you don't get to make this choice actively; instead it's tied to the color sampling you've chosen: if you've chosen 4:2:2, the bit depth will automatically be set at 10 bits; if you've chosen 4:2:0, the bit depth will automatically be set at 8 bits. When deciding between them, the simple truth is that "more = better." 10 bits looks better than 8 bits. 10 bits holds more data than 8 bits does. In 10-bit recordings, each pixel has its brightness individually coded to one of 1,024 levels; in 8-bit recordings the brightness is encoded in 1 of 256 levels. 10-bit recordings are literally capable of distinguishing 4x as much brightness information, which means the differences between pixels can be much finer. There are 1,024 shades of gray (or shades of blue, or green, etc) in a 10-bit recording, whereas there would be only 256 shades in an 8-bit recording. The tangible visible benefit of this usually shows up in gradients (such as a blue sky, or a light shining on a white wall); where there is a subtle variation in shade or tone, the 10-bit recording will capture more detail and will render finer tones without "banding". So 10 is better than 8, yes -- but we come back to the same question of prioritizing what to capture when allocating our limited bandwidth. If you use up all your bandwidth preserving 10-bit shading and 4:2:2 color, will there be sufficient bandwidth left to properly encode the picture? Maybe, maybe not -- although the higher the bit rate you choose, the more likely that you'll be able to sufficiently handle 10-bit shading and 4:2:2 color sampling. Taken together, a 10-bit 4:2:2 image results in about 50% more data to compress than

an 8-bit 4:2:0 image. That's a lot more data! Now you can see why a low-bandwidth codec like 422LongGOP 50Megabit might not deliver as clean, crisp, and noise-free images as 420LongGOP 50Megabit might -- even if the 420 version has fewer shades of color and half the color information, it's possible that the overall look of the recorded/compressed image will look less compressed than the 422 version. The best answer, usually, is to use a format that includes enough bandwidth that it can easily support the deeper bit depth. This is especially true when recording with V-Log, or the Hybrid Log (HLG) or EVA-look gammas, as these gammas attempt to keep the entire dynamic range of the sensor intact, so the higher bit depth of 10-bits may help the recording hold all that dynamic range while reducing visible banding in the footage.

Bit Rates - All AU-EVA1 internal recordings are done in MPEG-4; the differences generally involve the frame size (discussed earlier), color sampling, encoding method (ALL-I or LongGOP) and bit rates. The bit rate is how much data is involved in recording each second of video.

There are four main bitrates that the camera employs when recording footage in MOV mode. In AVCHD, there are several more.

MOV 50 Mbps - This is available only for 2K or 1920x1080 Full HD footage, at slower frame rates (23.98p/25.00p/29.97p), and interlaced at 50.00i/59.94i. Since 50 megabits is such a low bitrate, it is only offered as LongGOP to get more encoding efficiency into the limited bandwidth available. At 50 megabits per second, the camera uses a fairly modest bitrate to encode footage, and can record approximately two minutes per gigabyte (i.e., a 64-gigabyte memory card can hold about two hours of 50 Mbps footage). The quality of the recordings is quite good; 50 Mbps recordings retain more detail and show less artifacts than AVCHD footage. 50 Mbps recordings are always done at 4:2:2/10-bit.

MOV 100 Mbps ALL-I - This is available to record some versions of 2K and 1080p at frame rates of 29.97p and below. This is the intraframe alternative to the 50Mbps 422LongGOP 50M codec.

MOV 100 Mbps LongGOP - There are two versions of the 100mbps Long-GOP codec, one that records at 4:2:2 and one at 4:2:0. The 4:2:2 version is only available for 2K and 1080p at either 50.00p or 59.94p. The 4:2:0 version is only available for 4K and UHD at frame rates of 29.97p and below. It is a space-efficient codec, but it is not the highest-quality codec for 4K/UHD; either the 150Mbps LongGOP or the ALL-I 400Mbps should be able to render cleaner recordings.

As for 1080 FHD and 2K at 50P/59.94P, this is the highest-quality recording format offered. It uses approximately 4x as much bandwidth as AVCHD's PS mode, and it records the full 4:2:2 and 10-bit signal. The bitrate is half that of the 200 Mbps ALL-I mode discussed below, but the efficiencies gained by the long-Group Of Pictures ("long-GoP") encoding make it able to render even higher detail than the 200 Mbps ALL-I mode. At 100 Mbps, one minute of footage takes up approximately one gigabyte of space on the memory card; a 64GB card holds approximately one hour of 100 Mbps footage.

MOV 150 Mbps - This is only available for Ultra HD and 4K. Depending on the system frequency, this codec can be either 4:2:0 or 4:2:2. At slower frame rates (29.97p and slower) it can encode the full 4:2:2 10-bit signal, but at the faster frame rates (50.00P/59.94P) it can only encode 4:2:0 8-bit. It's the only choice offered at 50.00P/59.94P.

MOV 200 Mbps ALL-I - This intraframe-only 10-bit 4:2:2 codec is offered only for 2K and Full HD 1080P, and only at the fastest frame rates (50.00P/59.94P). By being an intra-frame-only codec, it's possible that this choice may result in faster editing on some computers that can't handle the LongGOP nature of the other recording formats. However, you shouldn't assume that just because this mode has the highest bitrate, that it will also result in the highest quality — that's not necessarily the case. It may, or it may not, depending on the complexity of the subject being filmed and amount of motion and color changing happening in the scene. In general, you can expect that the 100 Mbps LongGOP codec should be able to generally match or perhaps exceed the performance of a 200 Mbps intraframe codec in terms of quality.

MOV 400 Mbps ALL-I - This intraframe-only 10-bit 4:2:2 codec is offered only for 4K and UHD, and only at the slowest frame rates (23.98P to 29.97P). By being an intra-frame-only codec, it's possible that this choice may result in faster editing on some computers that can't handle the LongGOP nature of the other recording formats. At 400 megabits, it should produce the highest quality 4K or UHD recordings the camera can create internally.

AVCHD - The AVCHD recording formats are available for recording HD footage, and only HD footage; AVCHD cannot be used for 2K, UHD, or 4K recording. AVCHD recording modes use extremely low bitrates, ranging from 8 to 25 megabits per second, which can provide for very, very long record times in reasonable file sizes. Further, AVCHD can be recorded on SDHC memory cards, whereas SDXC cards are required for recording the MOV file formats. AVCHD cannot be used to record at a system frequency of 24.00p or 25.00p. Finally, be aware that AVCHD recording modes cannot be used to record VFR; if you want to record

Variable Frame Rate recordings, you'll need to use one of the MOV codecs. The AVCHD choices are:

AVCHD 25 Mbps - This is used only to record PS mode, which is 1920x1080 at 50.00P or 59.94P. PS means "Progressive Scan."

AVCHD 21 Mbps - This is used only to record PH mode, which is 1920x1080 at 23.98P, 50.00i, or 59.94i. PH can be thought of to mean "Progressive High Quality."

AVCHD 17 Mbps - This is used only to record HA mode, which is only used for interlaced 1080i at 50i or 59.94i. HA can be thought of to mean "High Advanced" quality. For interlaced footage this is a decent choice, but the PH mode is definitely higher quality, and includes higher-quality audio recording as compared to HA mode.

AVCHD 8 Mbps - This is used only to record PM mode, which is 720P HD at 50.00P or 59.94P. That's not a lot of bitrate for encoding a whole lot of data, so you shouldn't expect PM mode to deliver the highest-quality footage; it's for when you want high-definition footage in the smallest file sizes possible.

Putting It All Together - Deciding On A Format - Now that you know what the choices are, you should feel more empowered to make the right decision on what formats and recording options best suit your projects.

There is no overall "best" choice, there's only "the best choice for the current project." If you're shooting news for a 1080i station and uploading footage from the field, it's possible that AVCHD HA mode might be the best choice for you, for that project. If you're shooting a film to enter the Sundance Festival, it's far more likely that 4K/24P or UHD/23.98P would be the right choice.

Generally when approaching this decision, I rely on a few basic factors to inform the final choice. First — what do I want this project to look like, "live video" or "filmic"? If it's a live event, news, sports, or some other project that generally benefits most from the "live video" look, I would choose 59.94p whenever possible, and 59.94i only if the client specifies and requires 59.94i. On the other hand, if producing a project that would benefit most from a cinematic look, I'll shoot 23.98p every time — unless the footage is destined for integration with other footage that's being shot at 24.00p; in that case of course I'd set the system frequency to 4K/24.00p.

(note: for users in 50Hz countries, just substitute 25.00P for 23.98P or 24.00P, and 50.00P/50.00i for 59.94P/59.94i).

As for ALL-I (intraframe) or LongGOP, I generally hold that with sufficient bandwidth, LongGOP is more efficient and makes for smaller file sizes. The ALL-I codecs are very good, especially the 400Mbps version. It really depends on how you intend to edit the footage (as in, do you get sufficiently responsive performance from LongGOP footage, or does your computer perform much better with ALL-I?)

As for bitrate, I hold to the general rule that more = better. 50Mbps MOV looks better and retains better quality than 25Mbps AVCHD. 100Mbps MOV looks better and retains better quality than 50Mbps, etc. The only caveat being, as stated before, the tradeoff between allowed bitrate and how much data you're asking that bitrate to encode (meaning, 4:2:0 8-bit vs. 4:2:2 10-bit). Whenever possible, I would always choose the highest bitrate codec with 4:2:2 encoding. The bigger numbers really do help the quality of the footage.

When it comes to frame size, it's a little more complex than that. Yes, generally, bigger = better, so UHD 3840x2160 is usually the better choice over 1920x1080. And if your project needs to be shot in UHD or 4K, then the decision is already made for you. But what if your project is meant to be an HD delivery? As elucidated earlier, there are several considerations as to why choosing UHD may make sense even if your final project is going to be finished in 1920x1080 or 1280x720 or even in Standard Definition. But it's not a hard-and-fast rule, because there are some times when 1920x1080 origination just makes more sense. For example, if you're delivering the footage to the client and the client has requested 1920x1080. Or, if you're shooting for news delivery and the news station wants interlaced 1080i footage. Or, if you need the best (meaning fastest) rolling shutter performance: selecting a SENSOR MODE of S35 MIX 2.8K will give you much less skew, and still provide more than enough detail for a 1920x1080 production. The 4/3 CROP&MIX 2.2K setting provides the fastest readout and the least skew, but the footage will not be suitably detailed for a 4K or UHD production, but might be acceptable for a 1920x1080 or 1280x720 production.

The advantages that UHD/4K offers are generally significant enough to make it my first choice, but there are still some good reasons why the camera offers its 1080 mode, so you'll have to make that decision on a case-by-case basis on the merits of each mode and the suitability to the project at hand.

If shooting a project for NetFlix, the choice is easy -- go straight to 4K with the ALL-I 400mbps codec. That combination has been certified by NetFlix to qualify the EVA1 as a Tier 1 camera.

Finally -- you may have noticed that I didn't even mention RAW footage. Why? Because in the EVA1, raw isn't a recording format. It's an output option on the SDI port, but it cannot be recorded internally. If you choose raw, the frame size is automatically chosen for you based on the mode of sensor scanning you chose, and all the other choices (bitrate, color sampling, codec etc) become irrelevant, as the footage will be recorded as raw sensor data.

Recording Time on an SDHC/SDXC Card

How much footage can you fit on a card? That's a question that doesn't have a very simple answer, from the perspective that each shooting mode takes up a different amount of space on the card, and, furthermore, the camera can employ variable bitrate recording — which means that for easy-to-encode scenes, it may take less space than you might otherwise think.

The following table should give you ballpark estimates for how much footage will fit on a card, with the understanding that these are probably worst-case estimates and real-world recordings may actually fit more footage than what is listed here.

Bitrate	32GB SDHC	64GB SDXC	128GB SDXC
400M ALL-I		20:00	40:00
200M ALL-I		40:00	80:00
150M LongGOP		55:00	1:50:00
100M ALL-I or LongGOP		1:20:00	2:40:00
50M LongGOP		2:40:00	5:20:00
AVCHD PS 1080P	2:40:00	5:20:00	10:40:00
AVCHD PH 1080i & 1080P	3:00:00	6:00:00	12:00:00
AVCHD HA 1080i	4:10:00	8:30:00	17:00:00
AVCHD PM 720P	8:30:00	17:10:00	34:20:00

Optimizing for Low Video Noise

“Noise” in a video signal is a random variation in the color and intensity of each pixel. This random variation is very small compared to a strong

signal (i.e., a bright part of the image), but becomes relatively more apparent as the signal level decreases (i.e., in dark parts of the image). In general, a properly-exposed image will show much less noise than an underexposed image!

Depending on the settings of the camera, noise can be minimal, or quite invasive (just try 25,600 ISO for an example). A small amount of noise is usually present in all scenes, but there are steps you can take to minimize the appearance of the noise. By taking advantage of the various menu settings, as well as employing proper lighting, you can reduce the appearance of some of the image noise.

The most important determining factor for how much noise is in the image is the electronic gain level (or ISO). In general, the higher the gain, or the higher the ISO, the more noise will be in the image. Now, sometimes it's easier to just crank up the gain or raise the ISO to get a shot in challenging lighting — but just understand that doing so can raise the noise level slightly, moderately, or even significantly, depending on how much gain you add (or how high you push the ISO). If you need the picture brighter, adding light to the scene will do much more for the quality of your picture than gain ever would, because adding too much gain can cause the image to get very noisy, muddy and soft. Adding light will give you a cleaner picture and adequate light can help to suppress noise that might otherwise have been there. Underexposing video leads to increased noise in the signal; giving the camera proper exposure will clean up the signal nicely. A camera is a light-gathering device, so giving it enough light will help it perform its best. A camera feeds on light – feed it, and it will reward you with gorgeous imagery; starve it and you may not be as pleased by its results. The AU-EVA1 offers a unique Dual Native ISO feature. You can set the base ISO at either 800, or 2500 ISO. If you're going to need more than about 1250 ISO, it's generally probably better to set the base ISO to 2500 and then gain down from there. If you set the base ISO at 800 and then gain up, you'll be increasing noise and grain more than if you'd started at the native ISO of 2500 and stepped down a bit.

As for menu settings, there are a few that can help. The first and most obvious is the CAMERA SETTINGS>NR menu. This is a dedicated Noise Reduction menu. You can set the noise reduction off, Normal 1 (mild), Normal 2 (medium), or SMOOTH (maximum). The Noise Reduction can be applied to each base ISO separately, so you can assign a different level of noise reduction to the ISO800 base level, and to the ISO2500 base level.

Noise reduction can be quite effective, but keep in mind that a side effect of noise reduction can be the loss of fine detail in the image. Generally the least amount of noise reduction is better, but if you're seeing more noise than you prefer, you can definitely use the Noise Reduction settings to clean some of it up. The nice thing about the NR menu is that its settings will work even when shooting V-Log; generally the image controls menus are disabled when shooting V-Log.

If you're not shooting V-Log, there are some more menu options that can have a significant impact on the visibility of noise in the image. In the SCENE FILE SETTINGS>DETAIL menu, you'll find the master detail control (SW OFF). If the Detail circuit is switched on, it can contribute to the perception of noise. Lowering the MASTER LEVEL can mask the visibility of noise. It doesn't really change the presence of noise itself, but the higher detail level settings will actually accentuate the edges of the noise, and can even draw edge-enhancement outlines around the noise, making it much more noticeable. The lower you set your detail level, the less visible the noise will be (but, of course, the softer the image will look, too).

Hand in hand with the detail level control is CORING. Coring is designed to suppress edge enhancement on noise. What this means is, the higher you turn up CORING, the less visible noise you'll see in your picture, but it really depends on your overall MASTER LEVEL settings. If the MASTER LEVEL is very low, then there will be little to no visible edge enhancement happening on the noise, so there won't be much of anything for CORING to do. So when you have the MASTER LEVEL really low then you really won't see much if any effect on noise from CORING no matter what you set it to. But the higher you set the MASTER LEVEL of detail, the more effect CORING will have in suppressing the visibility of the noise. Just be aware: CORING can't tell the difference between fine high-frequency image detail and general noise though, so setting CORING up to a high level may reduce the apparent sharpness of high-frequency detail too. You can also rein in the visibility of the overall DETAIL by setting the SCENE FILE SETTINGS>DETAIL>FREQUENCY to a lower setting. The higher that's set, the more visible the edge enhancement will be, and if the edge enhancement is outlining the noise, the obviously a higher setting will make the noise more visible.

Also, the SKIN DETAIL function can help smooth out noise in skin tones. It works just like CORING but only on colors that it perceives to be skin tones

(the general idea being to smooth out skin blemishes.) If you're aiming to minimize noise as much as possible, enabling SKIN DETAIL may help.

Another way to really clean up the noise is to shoot in 1920x1080 FHD instead of UHD or 4K. When in FHD mode, the camera averages four pixels together to create each HD pixel, and the noise gets averaged out in the process. FHD mode is cleaner than UHD or 4K footage in terms of noise performance because of this; you can get away with about 6dB of gain in FHD and still have comparable noise performance to UHD/4K at 0dB of gain.

Also, remember to Automatic Black Balance frequently. Black Balancing may help the camcorder's sensor to sort out, minimize, and mask noise in the darker regions.

Synchronizing Timecode in a Multi-Camera Shoot

The camera offers the ability to synchronize timecode to another camera, or you can also sync to an external timecode generator, timecode slate, or other device that sends or receives LTC timecode.

The key to synchronizing timecode is to use FREE RUN timecode. For most normal recording situations, it's typical to use REC RUN. However, for synchronizing multiple cameras, FREE RUN is the only way to maintain synchronization if one of the cameras stops recording. With FREE RUN, all of the cameras should maintain sync (or extremely close to sync) no matter how many times a camera operator stops or starts recording. This can make matching up takes in the edit bay easy and effortless.

You'll designate one camera as the "master timecode" camera, and all other cameras will sync to the master camera. Make sure the cameras (or timecode slate or decks or whatever devices you're synchronizing) are set in FREE RUN mode, they all need to be set in the same recording format and frame rate (i.e., all need to be in 1080/50.00p or all need to be in UHD/59.94p or whatever format you're using) and all the cameras need to be set equally to either DROP FRAME or NON DROP FRAME. In short, make sure that the recording modes and timecode settings are identical among all the cameras.

If you're using your AU-EVA1 as the master timecode source, first ensure that it is in camera mode, not playback (press the VIEW button so that you're seeing live pictures). Then:

- 1) Set the timecode generator to FREE RUN. Use REC SETTINGS>TC>FREE/REC RUN and choose FREE RUN.

- 2) Set the timecode preset to whatever you want it to be (typically you'd set it to match the current time of day, or you might set it to 0:00:00:00 at the start of each shoot day.) Use REC SETTINGS>TC>SET TC to program the timecode preset to what you want.

- 3) Configure your camera's TC IN/OUT port for output. Go to REC SETTINGS>TC>TC IN/OUT SEL and choose TC OUT.

- 4) You'll also want to make sure that the output timecode is real-time, and not delayed to match the output video. Go to REC SETTINGS>TC>TC OUT REF and choose RECORDING.

At that point, your camera will be able to serve as a master timecode source for any other camera or for things like a timecode slate or external recorders. At this point you'll want to connect the other cameras so they can receive the timecode. Connect the other cameras or devices to it using a double-shielded BNC cable (the manual recommends a 5C-FB cable). Then, assuming you're connecting another AU-EVA1, you'll want to go into this camera's menus and:

- 1) As said before, ensure that the recording format and system frequency are the same as the master camera. They must be set identically.

- 2) Set the timecode generator to FREE RUN. Use REC SETTINGS>TC>FREE/REC RUN and choose FREE RUN.

- 3) Configure this camera's TC IN/OUT port for INPUT. Go to REC SETTINGS>TC>TC IN/OUT SEL and choose TC IN.

At this point, the camera should be receiving timecode from the master camera and you should see identical timecode on both cameras' displays.

You can leave the cable connected, or you can disconnect it and continue on with your shoot; the cameras should stay basically in sync although, as noted before, you may encounter some timecode drift throughout the day. The receiving camera will conform its timecode to the master camera's timecode so long as the cable is connected, but only when the receiving camera is not currently recording. The timecode will be jammed to the receiving camera during standby, but once the camera goes into record mode it uses its internal timecode generator to advance the clock. There should be little to no drift during the day, but it's possible there will be a small amount of drift if the cameras' clocks are not perfectly synchronized. If you need the timecode to be as consistent as possible, keep the cable connected as much as you can.

Finally, do be aware that the AU-EVA1 does not have GENLOCK capability (meaning, it doesn't have the ability to sense the start of a new frame and synchronize that with the other camera's start of frame). Accordingly, it's possible for the timecode to be out of sync by up to one frame. The timecode will always be transmitted, but if the cameras' cycles are slightly mismatched, the synchronized timecode could be off by no more than one frame. As such, absolute frame accuracy is not guaranteed when using the timecode sync method. It should be very very very close throughout the day, but you cannot expect it to maintain perfect frame alignment among multiple devices when all the devices are running on their own internal clocks. If you notice timecode drift happening, you can always re-sync by re-attaching the cable when the receiving cameras are in recording standby.

Variable Frame Rates

The AU-EVA1 allows variable-frame-rate shooting in a wide selection of frame rates and frame sizes. The variable frame rates provide you with a variety of creative choices.

To start with understanding why variable frame rates even matter, let's reference back to how movie film gets shot. In film, slow motion is shot by running the camera at a faster frame rate. Film normally runs at 24 frames per second (fps), but for slow motion the camera operator might shoot it at something like 48 fps. When those 48 frames are played back at the 24 fps speed, it'll take twice as long to play back, so everything will be moving at half speed, giving that superb film-style slow-motion look. Shooting at a faster frame rate is called "overcranking," because in the early days cinematographers used a hand-crank to drive the camera, and for slow-mo they would actually crank the film faster. Similarly, shooting at a slower-than-normal frame rate results in a "fast motion" effect – think of the Keystone Kops or an old Charlie Chaplin movie and you'll get the idea. If you only shoot 12 frames in a second, but you play those frames back at the 24fps speed, it'll only take 1/2 second to play back action that took a full second to record – accordingly, the motion will be twice as fast as normal. This is referred to as "undercranking."

Using actual overcranking and undercranking can yield dramatically smoother, superior off-speed effects in your productions. Prior to the introduction of genuine over/undercrank, video shooters had to try to synthesize slow motion effects in their nonlinear editors. This led to frames being blended together, footage being de-interlaced, new frames being interpolated, motion artifacts, and all sorts of other compromises

that resulted in lower-quality footage and a less-than-filmlike slow motion experience. With the true overcranking and undercranking potential of this camera you no longer have to settle for those types of compromises; now you can shoot genuine frame-accurate film-style slow motion effects (or fast-motion effects).

I will discuss some examples of what many of the frame rates might be useful for, and ways that you could use them. This is not by any means an exhaustive list, there are likely many, many more uses where each frame rate could be used, but this listing will give you a basic overview. Each of the choices listed below assumes that you're going to be playing back the footage at the film-look rate of 23.98 or 24 fps or 25fps.

2 fps: Extreme fast motion, also for time lapse type photography. If you wanted to record a city street at night, with cars smearing by and leaving trails of taillights, 2fps with the shutter off would be an excellent choice for that.

12 fps: Usable for fast motion, twice as fast as normal motion. Traditionally used for comic effect.

18 fps: This is the frame rate that early silent films were shot at, and the frame rate that most 8mm and Super 8mm home movies were filmed at. Since film has been standardized at 24fps these older films usually are played back with fast-motion effects. If you're looking for the "Keystone Kops" or "Charlie Chaplin" look, 18 fps is where you should start.

20 fps: 20 fps is a fast-motion effect that's not nearly as exaggerated as 12fps is, but it's fast. If you wanted to show someone running extremely quickly, 20 fps might be a good choice for that. It starts to push the bounds of what the audience can believe is "real," but it's very fast motion without being exaggeratedly fast (like 12 fps is).

22 fps: This is a subtle fast-motion effect. 22 fps is a very popular frame rate for karate action movies – shooting at 22 fps and playing back at 24 fps makes motion look very fast but completely believable. Shooting a car chase or a fight scene at 22 fps will lend an added edge of excitement and action to your scenes. The 50Hz mode equivalent would be 23fps.

24 fps: This is the standard movie film speed. Shooting at 24 fps and playing back at 24 fps gives your footage the temporal feel of motion picture film. This is the speed you'd normally shoot all dialogue scenes and

“normal action” scenes. If you’re producing footage for “PAL” territories or broadcasters who broadcast at 50Hz, the equivalent would be 25fps.

26 fps: This frame rate can add a subtle, subliminal slow motion effect to your footage, but the effect is very mild. Things moving slower than normal can be perceived as being “larger than life” – if you want to add a bit of elegance and grandeur to your scene, but don’t want it to be obvious that you’ve done so, 26 fps can add that additional element of drama. The 50Hz mode equivalent would be 27fps.

30 fps: This is a slow motion speed. It’s mild slow motion, but noticeable. 30fps is not too subtle, it’s the first of the “real” slow motion speeds.

36 fps: At 36 fps, the scene is obviously slow motion. Action takes 1.5 times as long to play out as it took to shoot it. 36 fps is as slow or slower than many movie cameras can shoot.

48 fps: Full-fledged slow motion. 48 fps makes everything take twice as long to play back as it did to shoot it.

60 fps: Super-slow motion. 60 fps is suitable for shooting explosions or extreme slow motion scenes. It’s the slowest slow motion possible on a conventional video camera (certain high-speed specialty cameras can go faster). Note that if you’re shooting 4K or UHD, 60 frames per second is the highest frame rate you can choose that still uses the entire sensor (using the SENSOR MODE of S35 5.7K). For UHD or 4K footage, frame rates up to and including 60 fps will utilize the full quality and resolution that the camera is capable of delivering.

61-120 fps: Ultra slow motion. In 120 fps, motion takes five times as long to play back, as it took to shoot it (if shooting in a base frame rate of 24p). Even if your main project is set to 59.94p, 120 fps footage will still be quite slow motion. Be aware that you’ll have to use a different sensor scanning mode in order to achieve frame rates faster than 60 fps. Setting the SENSOR MODE to S35 MIX 2.8K will enable frame rates up to 120 fps. The field of view will stay the same, but the overall image resolution will be lower. This may be quite noticeable if the rest of your project was shot in 4K or UHD, but if it was shot in 2K or 1080p the change in quality between regular-speed and high-speed footage should be fairly small.

121-240 fps: Super-ultra slow motion. In 240 fps, motion takes ten times as long to play back, as it took to shoot it (if shooting in a base frame

rate of 24p). 240 frames per second is the fastest the camera can deliver, but do be aware that you'll have to use a different sensor scanning mode in order to achieve frame rates faster than 120 fps. Setting the SENSOR MODE to 4/3 CROP&MIX 2.2K will enable frame rates up to 240 fps. The field of view will crop in somewhat, and the overall image resolution will be notably lower. This will likely be noticeable when integrating the footage with footage shot at 4K or UHD, and may also be noticeable even if the rest of your footage was shot in 2K or 1080p.

Obviously, having dozens of different frame rates gives the camera operator a great degree of flexibility and creative choices. But remember that there's also an intervalometer feature. You can use that to shoot one single frame at certain specified intervals. While not quite the same thing as having more frame rates, it does give you even more options for creative interpretation in how you want to record motion.

Next, consider that each of the frame rates can deliver a different look, depending on what your playback rate is (i.e., what you set the SYSTEM MODE>FREQUENCY to, and what you set our editing system's timeline to). Since there are five basic playback rates (23.98/24p, 25p, 29.97p, 50p and 59.94p) you actually can get up to five different looks out of each frame rate. Depending on the playback rate you set, each of those frame rates can deliver a different look. Take the example of 28fps. When you set the camera to record at the 23.98p FREQUENCY, and you set the variable frame rate to 28fps, it will deliver a very mild slow-motion effect. But if you had instead set the camera to the 29.97p FREQUENCY, at the same VFR of 28fps, it would instead be delivering a mild fast-motion effect! The frame rates and their overall perceived motion are dependent on the playback rate that you've chosen. Obviously 60fps is going to be slow motion when played back at a FREQUENCY of 29.97p, but it's even slower motion when played back at the 23.98p FREQUENCY. And when played back at the 59.94p FREQUENCY, it's not slow motion at all -- instead, it's "live", "video"-style footage!

The acquisition rate, and the playback rate, are two different things. Under normal circumstances you want them to be the same – i.e., acquire at 24 frames per second, play back at 24 frames per second, and you get real-time action. Acquire at 29.97 fps and play back at 29.97 fps, and you also get real-time action – a bit smoother than the 24fps/24fps sequence, and less film-like, but still real-time. Acquire at 59.94 frames per second and play back at 59.94 frames per second, and you also get real-time motion. 59.94fps/59.94fps looks nothing like film, it looks like "video," and gives the smoothest strobe-free motion possible. In the 50Hz mode, the equivalent would be to shoot 50fps and play back at 50fps for the "video" look.

But what happens if you acquire at 60 fps and play back at 29.97fps? The result is slow motion, a 2-to-1 slowdown factor. And what if you acquire at 60fps and play back at 24fps? It's also slow motion, but it's even slower: it's a 2.5-to-1 slowdown factor. And if you acquire at 30fps and play back at 29.97fps, it'll be real-time, but if you acquire at 30fps and play back at 59.94fps, the result is 2:1 fast motion. The same frame rate, played back at different time bases, delivers different looks to the viewer.

Selecting your time base, and selecting your acquisition frame rate, are therefore interconnected when you decide what type of look you're choosing for your program. With 24P or 25P you'll have film-like footage, and the most wide-ranging slow-motion capabilities. With 30P you'll have hybrid film/video footage – it'll be smoother/less stroby than 24p, but it will still have some strobing and a somewhat film-ish look to it, and it'll still be capable of up to 2:1 slow motion. With 59.94p you'll have video-looking footage, with the capability for slow motion but also with tremendous fast-motion capability: imagine 2fps acquisition played back at 59.94fps – it'd be 30-to-1 fast motion.

Because of this, you can't just think of "60p=slow motion," because it depends on your playback rate. 60p played back at 59.94p is the "reality" look, or the "video" look. The acquisition rate and the playback rate work hand-in-hand to generate the final look. Frame rates faster than 60 (i.e., 61 to 240 fps) are always going to be slow motion, but the question of HOW slow they are depends on what your playback rate is set to.

A simple rule of thumb to determine what the footage will look like is to divide the playback rate by the acquisition rate. Acquiring 50p and playing back at 25p, you'd divide 25/50 for a result of 0.5:1. That means the acquisition footage will play back half as fast as real-time (0.5 times as fast). That means slow motion. On the other hand, acquiring at 24p and playing back at 29.97p would give you a playback rate of 1.25:1, meaning the 24p footage would play back 1.25 times as fast as real-time, for a mild fast-motion effect. 24p acquisition played back at 24fps means film-like footage; 24p acquisition played back at 29.97fps means mild fast-motion, and 24p played back at 59.94fps means super-fast motion.

Something else to consider: sound will not be recorded when you're filming "off-speed" footage. What that means is: when shooting 23.98P, sound will only be recorded if you set the frame rate to 23.98. If you shoot at slower or faster frame rates, no sound will be recorded. The same holds true for 25.00p, 29.97p, 50.00p, and 59.94p — sound is only recorded when the selected frame rate matches the recording frame rate. Don't worry though,

a warning will be displayed in the LCD display to tell you when audio won't be recorded.

You should also know that using variable frame rates may result in a brief pause in very long-form recordings. Generally, you can record up to 10 hours in one continuous recording; any more than 10 hours and the system will have to pause recording for a few frames and re-start with a new recording. When using VFR, that will still need to happen, but it will happen at different times depending on the ratio of frames being imaged vs. frames being recorded. For example, if recording at the 29.97 FREQUENCY but imaging 60 frames per second, the recording will be paused briefly after five hours, rather than 10 hours.

As said before, frame rates faster than 60 fps will result in some quality loss. The footage will be lower in resolution than normal footage, and you may notice some aliasing and colored moire patterns. The resolution loss is milder for 61-120 fps, and more substantial for 120-240 fps.

You cannot record high-speed variable frame rates externally on an HDMI or SDI video recorder. The SDI and HDMI outputs are capable of a maximum of 59.94 frames per second; if you set the camera to a VFR of 120 fps, the monitor outputs will show every other frame (thus lowering the actual output to the max of 59.94p). You won't see the slow motion effect during monitoring, you can only view it properly during footage playback. The exception to this rule is if you're using an external SDI raw recorder; in that case, yes, you can record variable frame rates up to 240 fps if the recorder supports variable frame rate recording.

To configure for variable frame rate recording, you first have to decide what your maximum frame rate will be, and then set the SYSTEM SETTINGS>SYSTEM MODE>SENSOR MODE to the appropriate setting.

S35 5.7K: This is the highest-quality mode with the highest resolution and the cleanest imagery in terms of aliasing or moire, and the widest field of view. This setting allows frame rates from 1 to 60 frames per second (or 1 to 30 fps, if recording in 10-bit 4:2:2).

S35 MIX 2.8K: This mode provides optimal resolution for 2K or 1080p recordings. It is not available for 4K or UHD recording. This mode allows the widest field of view and frame rates from 1 to 120 frames per second.

4/3 CROP&MIX 2.2K: This mode allows the fastest frame rates, but it is also the lowest-resolution mode and will result in a narrower field of view. It will not be as sharp as the other modes but it should provide

reasonable quality for 2K/1080p. This mode allows for the fastest frame rates, from 1 to 240 fps. It is not available when recording 4K or UHD.

Once you've selected your SENSOR MODE, you enable VFR recording by going into CAMERA SETTINGS>FPS>VFR SW and choosing ON.

To select an individual variable frame rate, you can choose from the list at CAMERA SETTINGS>FPS>VALUE. If the frame rate you want isn't already included in that list, you can add it using CAMERA SETTINGS>FPS>ADD.

Another way to select frame rates is from the HOME screen; you can touch the upper-left frame rate icon and then select the frame rate value by pushing in the menu wheel; you can then scroll through the list of available frame rates using the wheel.

Finally, there's a third way to select a variable frame rate. If you configure the SYSTEM SETTINGS>USER SWITCHES>USER TOGGLE to FPS, and then set the User Toggle switch to the middle "USER" position, you can use the menu wheel to change your variable frame rate. Regardless of how you choose a frame rate, know that you can't change the frame rate during a recording. You have to settle on a frame rate before hitting RECORD.

HDMI vs SDI (6G-SDI, 3G-SDI and HD-SDI)

The AU-EVA1 offers two digital video output ports: HDMI 2.0, and 6G-SDI. What's the difference, and what is each best suited for?

First, the similarities—both HDMI and SDI will output a fully uncompressed 10-bit 4:2:2 image, suitable for using with an external monitor or recording unit. The data coming out of these ports is digital, uncompressed, full-raster 4K, UHD, and high-definition footage (either 1920x1080 or 1280x720). Also, both HDMI and SDI can output embedded audio and timecode, and record start-stop flags. So the question of which one to use, for which purpose, isn't really about the quality of the video image, at least as far as 1080p/1080i and standard definition go.

The SDI port is a 6G-SDI port. It incorporates 6G-SDI, 3G-SDI, and HD-SDI. It is fully compatible with HD-SDI, but 3G-SDI is an extension to HD-SDI that allows for transmitting full 1080/59.94p (and 1080/50.00p) video. HD-SDI is limited to 1080i, but 3G-SDI offers everything HD-SDI does and extends it to include 1080p at 59.94p and 50.00p. 6G-SDI offers twice the bandwidth of 3G-SDI, which lets it output 4K or UHD at up to 29.97 frames per second. The SDI port is not capable of handling 4K or UHD at 59.94p or 50.00p.

HDMI has traditionally mainly been used in consumer devices, and almost exclusively for monitoring. Consumer televisions, for example, will have HDMI input, but they won't have SDI inputs. SDI is routinely found on professional video monitors, and on professional video recording devices. SDI uses a substantially more robust connector, with a locking mechanism to keep it from becoming accidentally disconnected. For this reason, if you're recording to an external recording device, it would be preferable to use the SDI output to connect to that recorder. Even though many of those recording units do offer HDMI input, the SDI is generally the much better choice for 1080p or for UHD/4K up to 29.97p.

The HDMI port does something the SDI port cannot do however: the HDMI port is the only way to output 4K or UHD footage at the full 59.94 or 50.00 frame per second rate. 6G-SDI is limited to 29.97 frames per second when outputting 4K or UHD. The HDMI port is fully capable of outputting every format that the camera can record, at full resolution and full frame rate, and in 4:2:2 color. The HDMI connector is far from ideal for connecting to a recorder, but — if you need to monitor or record externally, the HDMI port is the only way to monitor or transmit UHD or 4K footage at 59.94 or 50.00 frames per second. If you're using the camera in UHD or 4K mode at 59.94 or 50.00 fps, and are monitoring through the SDI port, the camera can perform a very high-quality downconversion to 1080p for SDI output.

Note that the AU-EVA1's HDMI port is an HDMI 2.0 port. Many monitors and recorders on the market may still be using HDMI 1.4 connectors. HDMI 1.4 supports 4K and UHD up to 29.97 frames per second, but cannot handle UHD or 4K at 50.00p or 59.94p. The camera is capable of transmitting that signal, but many recorders and monitors are incapable of receiving it. You'll want to make sure that your devices have HDMI 2.0 ports to take full advantage of the camera's capabilities.

Finally, the EVA1's SDI port does something unique that the HDMI port cannot do: it can be configured to output a raw sensor signal to an external recording unit. Raw is not suitable for monitoring, but it can be recorded for later post-processing via a third-party external recording device. If you intend to work with raw footage, the SDI port is the only way to access it. You can configure the camera to output raw on the SDI, and conventional video on the HDMI, although do be aware that the HDMI port will be limited to a maximum of 1920x1080 resolution when the SDI is configured to output raw data.

Using V-Log

The AU-EVA1 includes a logarithmic gamma mode, called V-Log. It is, in fact, the same V-Log gamma as employed in their premium VariCam 35. Using V-Log gives the user the most power over the image for post-processing and grading, when recording internally or to a video recorder.

Many cinema cameras offer logarithmic gammas. A logarithmic gamma is a different way of storing the raw sensor's brightness information; it isn't magic, but it is a more post-production-friendly storage method that provides for preservation of the maximum latitude and dynamic range, while also providing more flexibility in adjusting brightness levels in post while minimizing the prospect of "banding" in the shadow areas (the darker areas of your images). V-Log is not just a gamma, it is a "mode" — when you enable V-Log (by choosing SYSTEM SETTINGS>COLOR SETTINGS>MAIN>V-LOG), the camera will disable the entire SCENE FILE SETTINGS menu. Nearly all image processing is disabled in V-Log mode; the camera bypasses all that internal processing, and delivers a smooth, flat, clean image that is ready to be graded in post.

Logarithmic gammas provide for more power in post, but as a famous webbed superhero was once advised, "with great power comes great responsibility." A logarithmic gamma is not the same thing as a raw sensor image, but there are some similarities in the amount of post-production processing that needs to be done between a raw image, and a logarithmic gamma image. Raw camera sensor images undergo a lot of image processing before they can be said to look pleasing. The raw data off of a camera sensor does not look pleasing at all to viewers. It needs to be de-Bayered (or "demosaicked"), most raw footage needs to be gamma-corrected from raw linear sensor data into a monitor-friendly gamma, it will need to be graded for pleasing contrast and tone, it will need noise reduction applied to it, and it will need sharpening, and it will usually need to be converted into a video-compliant format (meeting the EBU and/or ATSC specifications for UHD or HDTV). All that processing needs to happen to the signal, one way or the other. When the camera's MAIN COLOR is set to one of the SCENE FILE settings, the camera supplies all that necessary processing. When the MAIN COLOR is set to V-Log, the camera does a bare minimum of that processing; the camera will de-Bayer the footage, and convert the linear brightness data into the V-Log logarithmic gamma, and it will store the footage in an EBU/ATSC compliant format. The images will be recorded or output in a format suitable for grading, but that's where the hard work starts. You can bypass (almost) all the camera's internal processing, but you will have to replace it with post-processing.

In some ways it's much easier to shoot in V-Log than it is to use the camera's Scene File menu system. For one thing, you can bypass learning about what all those various Scene File menu items do, because V-Log disables them all! It really does mean that the job of "painting" the image is not needed on set; all painting of the image gets delayed to post-processing. When shooting in V-Log, pretty much all you need to do is get a proper white balance, and get proper exposure, and then shoot. Just please understand, there's far more to imagemaking than just shooting — if you were to hand an average client V-Log footage without grading, they would probably be very disappointed in it. The footage needs extensive processing before it is ready for viewing, and professional colorists can charge several hundred dollars per hour to work on footage. Using V-Log doesn't mean less work, it just delays when that work needs to be done, and shifts the burden from the camera operator (or Digital Imaging Technician) over to the editor or colorist.

When is V-Log The Right Choice?

V-Log is probably most suitable for shooting cinema, drama, music videos, and other types of footage where extensive post-processing, color correction, and "stylized" video are the expected final result. When you know that the footage is going to be extensively post-processed, V-Log provides the flattest exposure and the flattest color palette, and the most dynamic range possible. It really is like raw footage in several ways. V-Log is the right choice when you will be controlling the post-production process yourself, and when you understand and accept the responsibility for performing all the necessary post-production steps that will turn V-Log footage into viewable footage. And, of course, V-Log is the ideal choice when you're using your AU-EVA1 in a multi-camera environment where the other cameras are also running V-Log (as an example, when your EVA1 is operating as the B-camera to a VariCam Pure running as the A-camera).

When is V-Log The Wrong Choice?

I would suggest that V-Log would be the wrong choice for any scenario where heavy and extensive post-production is not expected or is not the norm. For example, I would say that V-Log would probably be the wrong choice when shooting sports, live events, concerts, conventions, news, any live broadcast, or any scenario where you are expected to turn over the unedited master footage to the client. Unless your client specifically requests V-Log footage, they probably don't want V-Log and may not necessarily know what to do with it. The camera offers extensive image processing and more power and control over the image processing than

perhaps any prior Panasonic handheld camera; when you understand and use that power, you can deliver gorgeous footage right out of the camera, and that's the kind of footage that most clients are likely expecting. V-Log does not look good right out of the camera, it looks flat and pale and muted, because it is not designed for viewing directly, and is not the kind of footage that most clients will be expecting. Furthermore, when a job requires a rapid turnaround from shooting to delivery, V-Log may not be the right choice in that scenario. Post-processing takes time. If someone were shooting a wedding and expected to deliver a same-day edit, shooting in V-Log may be problematic in that the post-processing rendering process might slow down your ability to deliver finished footage.

Post-Production Processing

There are several crucial aspects of image processing that are necessary to turn raw (or V-Log) footage into pleasing, monitor-ready final images. It seems obvious that we need to color-correct, and to gamma-correct (usually by applying an S-curve to make the images really “pop” on the monitor), but that's not all. Many producers have taken those steps only to have people may look at the resulting images and complain that they're “noisy” and “soft.” Post-processing is not strictly about color and contrast! Sensor images have always needed noise reduction applied, and the EVA1 is no exception. The EVA1 can do noise reduction internally when it is normally processing footage, and includes several menu options for controlling sharpening and noise, but many of those processes are bypassed when recording V-Log. You can still use the camera's CAMERA SETTINGS>NR noise reduction choices, but you won't have access to the detail level or detail coring settings or skin tone detail features. The camera may still be doing some noise reduction, but without the benefit of user controllability of how it performs that task, the job may not be done to your satisfaction. If you are bypassing the internal processing by using V-Log mode, you should expect to do noise reduction on the recorded V-Log footage or, yes, the footage may indeed look noisy, especially in the darker shadows and lower midtones. Likewise, video footage generally benefits enormously from some manner of sharpening. The EVA1 provides options for sharpening the footage, including the Detail and Coring controls. If you bypass that processing by using V-Log, then you're likely going to need to apply some sharpening in your post-production phase or, yes, the footage may look soft. The EVA1 is an extremely sharp camera, but video needs some degree of edge enhancement (sharpening) to really make that resolved detail apparent to the viewer. As always, the level of sharpness you add should be governed by the anticipated size of the final display device; the smaller the

screen your footage will be viewed on, the more sharpness you can add to the footage in post. The larger the display (such as a movie theater screen), the less sharpening you would want to add in post.

Exposing For V-Log

V-Log distributes the EVA1's 14 stops of dynamic range logarithmically (or, for the brighter stops, that means it distributes it roughly equally) in its recorded format. Other gamma curves do not, and this means that you have to expose somewhat differently for V-Log. Most video camera gamma curves are designed to replicate what-you-see-is-what-you-get when the footage is displayed on a video monitor. They're convenient, but there are sacrifices made in the amount of dynamic range that can be preserved when using a conventional video gamma. Furthermore, video gammas are more linear in design, and that means that more "bits" are allocated to storing the brightest stops, than are allocated to store the darkest stops. This can result in mushy shadows, and noise and banding in the shadows if you try to brighten them in post. With V-Log, the bits are allocated more evenly, with approximately the same number of shades of gray allocated to each of the midtone and highlight stops; and while the darkest stops do have fewer shades of gray than the midtones might, they generally have significantly more than in a conventional video gamma.

This re-allocation of bits means that V-Log is suitable for recording, but it is not all that suitable for viewing. It simply doesn't look "right" when displayed on a video monitor; it looks very flat and muted (unless, of course, your monitor is capable of applying a Look Up Table (LUT) to the footage.) As mentioned before, V-Log requires post-processing to convert it into something that will look suitable on a computer monitor or television. You can always configure the HDMI or SDI outputs to overlay a V-709 LUT on their monitor outputs, so that people viewing the live feed will see a monitor-friendly version, but that V-709 LUT may or may not represent your final post-production decisions. The V-709 LUT is good for making the video feed client-friendly, but it is not necessarily representative of what the final footage will look like.

Unlike the video gamma curves in the EVA1, V-Log is designed to mimic the characteristics of a film negative that has been scanned digitally. It is not designed for monitoring and exposure, it's designed to provide a broad, flat scene that can be manipulated in post production. While the camera itself can output the footage with the V-709 color overlaid on the signal, the camera doesn't provide any way to use alternative LUTs. If you're

using an external monitor/recorder, those monitors frequently have the ability to apply LUTs and some even allow loading in user-created LUTs. If you know the LUT you're going to be using in post, loading that into your monitor can make for a much more pleasant viewing experience during production. You would then configure the SYSTEM SETTINGS>COLOR SETTINGS>SDI OUT and/or HDMI OUT to output the plain V-Log signal, and that signal is suitable for recording on the external recorder, and you can then choose to have the external monitor overlay a viewing LUT to make it look more like what the finished footage may look like.

You can (and should) use the zebras and the waveform monitor and the spotmeter as exposure tools for V-Log, but you have to use them differently than you would for a video gamma. The levels that you may be familiar with (such as 70% IRE for skin tones, and 100% IRE for highlights) simply aren't appropriate for use with V-Log; you'll have to adapt and learn to use new levels when judging the exposure of your footage.

There are two general schools of thought when exposing raw footage or logarithmic gamma footage: exposing for middle gray, or Expose To The Right (ETTR). Let's discuss ETTR first.

Option 1: Exposing To The Right (ETTR)

Exposing To The Right is a technique based on using a histogram for exposure. A histogram shows the distribution of brightness in the image, and the further the image is shifted towards the highlights, the further right the image moves on the histogram. Proponents of the "Expose To The Right" technique argue that the darker tones and shadows are the noisiest parts of the image, so if you can lift your image up out of the shadow area, you can take advantage of the cleaner upper range of the sensor and gamma curve; later, you can drop the footage's levels back down to where proper exposure would dictate it should be. Furthermore, those who shoot raw footage frequently embrace ETTR because raw sensor data is generally stored linearly, not logarithmically; that means that the vast majority of available "bits" are allocated to the brightest stops, and the darkest stops receive the fewest "bits" (i.e., the least number of shades of gray that they can represent). For more on linear vs. logarithmic storage, see the article USING SDI RAW OUTPUT; for now let's just summarize it as that the very brightest stops are allotted the most data and retain the finest gradations, moreso than the darker stops do. This is indeed a concern with many cameras' raw footage, but is not nearly as much of a concern when using a logarithmic gamma; a LOG gamma redistributes the bits so that they are

more equally dispersed along the entire dynamic range of the sensor. (and the EVA1's raw output also encodes the brightness levels logarithmically). It is true that the darkest stops will still have fewer "bits" allocated to them than the brightest stops will, but over much of the range they will be treated more or less equally, and as such, the value of lifting the shadows and dark tones up is less important when recording with a logarithmic curve than it would be with linear sensor data. Both the EVA1's V-Log recording and raw output encode the signal logarithmically, so this is generally not a concern on the EVA1.

The general idea behind ETTR is to expose the image as bright as you possibly can, so long as none of the video information "clips" off the top. Regardless of how dark an image should look in the final footage, the idea is that if you expose it in the top part of the exposure range, you'll get the cleanest, lowest-noise images, and you can always push it back down to proper exposure in post. ETTR proponents use the histogram as an exposure tool to accomplish this, because the histogram plots out all the exposure levels in a given scene, and if there is any unused space on the right edge of the histogram, that means that you have room to brighten up the exposure (which will shift the histogram's graph over to the right within its frame; hence *Expose To The Right*). In theory, it sounds great; on still photographs, it can work great.

Now, as a general technique there's nothing wrong with ETTR, it does work and it is a reasonable choice. However, it is not necessarily the best choice, because ETTR is designed to preserve the highlights with no consideration of what happens to the midtones. It can result in retaining a lot of detail and in making the least-noisy footage, but it will mandate extensive post-production correction on every single shot. When exposing using ETTR, skin tones may end up being recorded brighter or darker in every scene, simply based on where the highlights happen to be in that particular shot, and every shot will need to be corrected to bring the skin tones back to a reasonably consistent level so that your footage will intercut cleanly and seamlessly. And, depending on just how bright the highlights are in any given scene, ETTR may result in a scenario where the skin tones and midtones are significantly underexposed in an effort to catch and preserve all the highlights. That might make for nice highlights but it might also result in noisy skin tones and midtones, since in post production you may have to stretch the skin tones up out of the darker (and noisier) sections of the sensor. Generally, cinematography is (and should be) more about the subject than it should be about the highlights; excessive attention to the highlights may mean compromising other aspects of the footage, so a strict

“ETTR” approach is not always going to provide the overall best results in a video project.

The ETTR approach has traditionally relied on using a histogram to set exposure. The AU-EVA1 doesn’t offer a histogram, it offers a waveform monitor. Still, the same principle applies -- the exposure would generally be set to saturate the waveform monitor and fill it up top to bottom. You could perhaps say that you’re using “ETTT”, as in, Expose To The Top, when using the waveform. You’ll still want to keep the brightest areas under control though, or you risk clipping one or more color channels in the very brightest sections of the footage, which can cause color shifts in your highlights.

Option 2: Exposing For Middle Gray

An alternative method of exposure would be to expose for middle gray. Video systems are frequently referencing “middle gray” or “18% gray.” 18% gray is a photographic and film standard, it’s a shade of gray that reflects 18% of the light that hits it. It is frequently incorporated into test charts, and you can easily buy an “18% gray card” at photography stores. 18% reflectiveness represents approximately the average overall brightness of many scenes, and camera autoexposure systems are typically designed to expose to where the scene represents approximately 18% reflectance levels. In Ansel Adams’ “Zone System”, middle gray is known as Zone V.

When exposing for middle gray, you’ll find the zebras and the waveform monitor extremely useful. In this section I’ll refer to exposure levels in terms of IRE; if you need to brush up on your IRE terminology, see the article on the Waveform Monitor.

In conventional video gammas, middle gray is usually exposed properly at somewhere around 50 to 55 IRE. However, not so in V-Log. In V-Log, middle gray is properly represented at 42 IRE. If you happen to have a gray card in your scene, it should show up on your waveform monitor at approximately 42 IRE for “proper” exposure (note, here I am using the term “proper” in an idealized, mathematical way; the artistic merits of the scene may very well dictate that the exposure needs to be higher or lower than this).

The V-Log gamma curve maps the following brightness levels to the following IRE levels:

0% reflectance (black):	7.3 IRE
18% reflectance (middle gray):	42 IRE
90% reflectance:(white):	61 IRE
absolute clipped superwhite:	109 IRE

If you are using test charts, you will likely have access to 18% “middle gray” and 90% “white”; many gray cards sold in photographic stores will have 18% gray on one site, and 90% white on the other. 90% reflectance doesn’t necessarily indicate “pure white” or the brightest object that can be seen or recorded; rather it is (as its name suggests) a white where 90% of the light that hits it is reflected. The camera is capable of seeing and rendering brightness above 90% reflectance, as illustrated by the fact that 90% reflectance is mapped to 61 IRE.

In V-Log, the curve is laid out so that there are 8 stops below middle gray, and 6 stops above middle gray. You can, of course, choose to modify that by underexposing middle gray some; if you underexpose by one stop, you’ll then have 7 stops below middle gray and 7 stops above it. In all cases you’ll get 14 stops of dynamic range; the recommended allocation is for middle gray to be at 42 IRE with 8 stops below and 6 stops above, but you can shift that on an as-needed basis, so long as you account for it in post. This is one reason why it is such an excellent idea to shoot a standardized test chart at the head of every scene, so the colorist knows exactly what the intended exposure was and can account for any individualized decisions that were made on a scene-to-scene basis.

The technique of exposing towards middle gray is similar to conventional video gamma exposure, where you frequently will have some typical “anchor points” in your exposure plan (such as having Caucasian skin highlights peak at about 70 IRE on a standard video gamma, and keeping your highlights at or below 100 IRE). Keeping skin tones comparable shot-to-shot makes matching footage easier in post, obviously; keeping middle gray levels constant will make matching V-Log footage easier in post too. (Note: I’m not saying that you should expose skin tones at middle gray level, nor am I saying that you may necessarily want to expose middle gray at 42 IRE; I’m just pointing out that exposing at a consistent level makes matching footage in post much easier.)

Exposing for a logarithmic gamma isn’t necessarily as simple as putting an 18% gray card in the scene and exposing it for 42 IRE. It can be that simple, if you want it to be, but there are steps you can take to perhaps

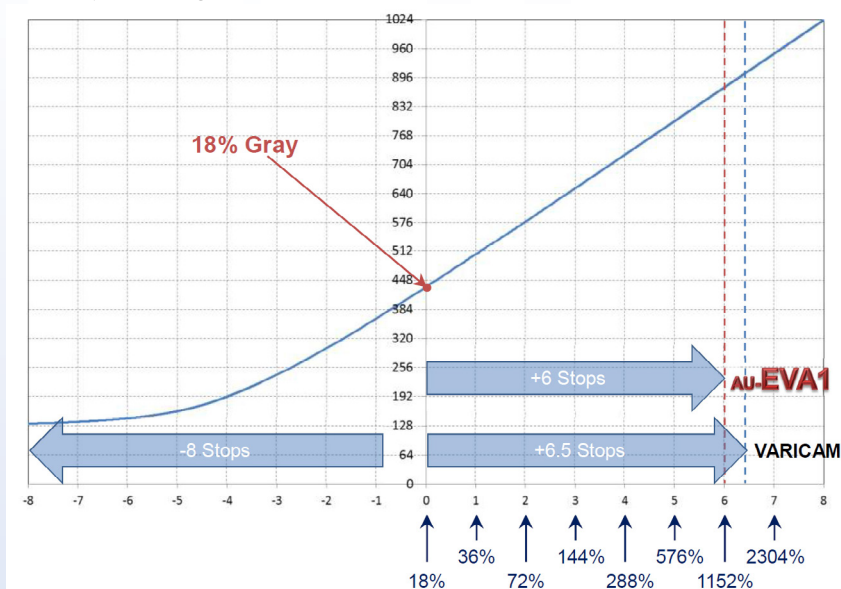
improve the images the camera generates. The question is usually one of balancing noise versus retaining highlights. As with all digital camera sensors, the darkest regions of the image are typically the areas that show the most noise. Exposing To The Right is a technique designed to lift the image up out of the noisy area and have it render in the “sweet spot” of the sensor’s exposure range, which you can then drop down to proper exposure in post-production while avoiding some of the sensor noise. And that’s a valid technique, but it does sacrifice some of the sensor’s dynamic range (dropping the footage back down crushes off the darkest tones), and it can result in highly inconsistent midtones from shot to shot, which will require extensive correction in post. When you overexpose the image, you also run the risk of clipping the highlights earlier. When you properly expose the image, you may maintain the highlights but you may also encounter some noise in the shadows. If you are filming a scene where there are a lot of very bright highlights, you may actually need to underexpose the scene to preserve those highlights, even if it means pushing your subject down into the noisier darker sections of the sensor’s range. Or, you may just have to bite the bullet and accept that sometimes highlights clip and there’s nothing you can do about it — or, rather, there may be nothing that you should do about it; compromising the quality of the main subject in a quest for preserving highlights may not be an acceptable tradeoff in some cases. Of course the ideal solution is to adjust the lighting in the scene so that the highlights aren’t too bright; depending on the type of production you’re doing that may or may not be an option.

There is no one overall “right” answer, there is only a question of your priorities — if you cannot stand clipped highlights under any circumstances, maybe you should use ETTR, understanding that in the quest to preserve every bit of highlight detail you might end up underexposing the image, resulting in noisier images. If you cannot abide noise at all, maybe you should consider establishing a “noise floor,” an IRE level which you will not allow the important elements of your image to fall into. Perhaps you find the range from, say, 0 to 10 IRE too noisy for your tastes, so you may choose to overexpose your images so that the darkest significant details in the image are at least 10 IRE or brighter. Such overexposure may possibly result in clipped highlights, and will certainly lead to reduced dynamic range, but perhaps that’s the tradeoff you’re willing to make for minimizing any appearance of image noise.

Adapting the Zebras And Waveform to V-Log

Whichever method you choose is a matter of personal preference. I find that the easiest way to work with V-Log is to expose for middle gray.

Placing middle gray at 42 IRE, 90% white at 61 IRE, and black at 7 IRE gives a wide exposure range that allows for 6 stops of exposure over middle gray, and 8 stops under middle gray. Using these general exposure levels, you'll find that properly-exposed highlights on skin tones will usually fall between about 42 IRE for dark-skinned subjects, on up to about 55 IRE for light-skinned subjects. The full range of skin tones will of course be much wider; in this section I'm making some recommendations on what you might want to consider for the peak brightness levels on the skin tones (example: on a light-skinned Caucasian model, you might want to aim for the brightest portion of their skin — such as a reflection off the cheekbone or forehead — to peak at a maximum of about 55 IRE). Doing so will mean that the rest of the model's skin will fall in lower IRE ranges, but that the peak will be controlled at no higher than 55 IRE. It also means that shot-to-shot, the density of tonality should be similar between shots without the need for substantial correction. When shooting in REC 709 gamma, I'm used to setting my zebras at 70 and 100; I would use 70 to check highlights on skin, aiming for there to be just a little bit of 70-IRE area on Caucasian skin tones highlights; then I would check Zebra 2 to check for highlight clipping. With Zebra 2 set at 100 IRE, that would show areas that were approaching clipping, without necessarily meaning that they were indeed clipping. Modifying this approach for V-Log, I now set Zebra 1 at 55 IRE, and Zebra 2 at 90 IRE. In this way I can use the same monitoring tools that I'm used to, in the same way I'm used to, but gain the wider latitude and post flexibility of V-Log.



In the above graph, Panasonic has charted the full V-Log curve, for both the EVA1 and for the Varicam. Middle gray is represented by the 18% mark in the center of the chart. The legend across the bottom represents the number of f-stops away from middle gray for each vertical column; you can see that the chart accounts for 8 stops below middle gray and up to 8 stops above middle gray. V-Log was designed to account for sensors that deliver up to 16 f-stops of dynamic range. But the EVA1's sensor can't generate that much; the EVA1's sensor is capable of 14 stops, and the Varicam's sensor is capable of about 14.5 stops.

If you decide to underexpose to retain more highlights, be aware that you're going to have to stretch the shadows and midtones up more in post, and that will likely reveal more noise that will have to be dealt with by noise reduction in post.

A Word About Recording 10-bit vs. 8-bit

The EVA1's internal recordings can be done at 8-bit quantizing and 4:2:0 color sampling, or 10-bit quantizing and 4:2:2 color sampling. AVCHD always records as 8-bit 4:2:0, and the ALL-I modes always record as 10-bit 4:2:2. Some of the LongGOP recordings are 8-bit 4:2:0 and some are 10-bit 4:2:2. 8-bit 4:2:0 recordings may be perfectly suitable for many purposes and jobs, but 8-bit is not as robust as 10-bit, and 4:2:0 is not as robust as 4:2:2 color sampling (obviously).

When working with V-Log, you'll be stretching and pushing the footage quite a bit. You will probably experience notably better results with a 10-bit 4:2:2 recording, than you would from an 8-bit 4:2:0 recording. It's not that you can't work with 8-bit 4:2:0, it's just that -- well, 10-bit 4:2:2 is better. The further you push the footage, the more 10-bit and 4:2:2 will hold up as compared to 8-bit and 4:2:0. When recording V-Log, I recommend you record in the highest-bitrate, highest-color sampling codec you can.

Using SDI Raw Output

In addition to being able to output a video signal, the AU-EVA1's 6G-SDI output port can be configured to stream raw, uncompressed, logarithmically-encoded video, intended to be captured on an external recording unit.

Photographers have been recording raw pictures for many years; in general photography cameras you typically have the option of recording your pictures as JPEG (compressed images) or as RAW (raw sensor data). The JPEG files are much smaller and are generally ready to view right away; the raw pictures are much larger files and need to be processed by external

software before they're ready to view. With the EVA1, the situation is similar: it can internally record compressed video images to reasonably small file sizes for ready-to-view footage, or it can output the raw sensor images through its SDI port. In some ways you can think of the raw output as being like taking 30 to 240 raw still photos every second on your photography camera.

Raw output was first enabled on version 2.0 of the EVA1 firmware. If your camera's firmware is less than 2.0, you won't find the appropriate menu items; be sure to visit Panasonic's website frequently to check for firmware updates and download the latest firmware.

You access the raw mode by entering the SYSTEM SETTINGS>SYSTEM MODE menu, and then choosing SDI RAW. There are three choices, somewhat similar to the SENSOR MODE choices but there are some substantial differences.

S35 5.7K: In this mode, the camera outputs the entire contents of the full surface area of its sensor: approximately 5,720 x 3,016 pixels. This is a tremendous amount of data, and extremely high resolution. In this mode, the camera can output variable frame rates between 1 and 30 frames per second. This mode provides the widest field of view the camera can create. This pixel matrix is huge -- it's approximately 8x as large as a 2K camera's pixel matrix would be.

CROP 4K: In this mode the camera outputs the central 4,096 x 2,160 pixels out of its 5,720 x 3,016 pixel sensor. This mode outputs the full resolution of other "4K" cameras; it is a full 4,096 x 2,160 extraction from the center of the frame. The camera can support frame rates between 1 and 60 frames per second in this scan mode. There is no pixel mixing or any other compromise to the footage, it is true full 4K quality, at a pixel-to-pixel ratio. But, because it is a central crop out of the larger sensor, that does mean that the field of view will be narrower (in other words, your lenses will act as if they were more telephoto than they would in the 5.7K mode).

CROP&MIX 2K: In this mode the camera outputs a frame size of 2,048 x 1,080 pixels. However, it is the exact same field of view as the CROP 4K mode. Instead of scanning all 4,096 x 2,160 pixels individually, the camera uses the "pixel mix" function to combine groups of four pixels into one large "superpixel". The result is a genuine, fully-resolved 2,048x1,080 pixel image that has the same field of view as the 4,096x2,160 image; it's just that the individual pixels are 4x larger in the 2K version. This is an extremely quick way to scan the sensor, and accordingly the frame rates are

higher: the camera supports frame rates from 1 to 240 frames per second in this mode. This mode is not suitable for making 4K footage though; it's more suitable for delivering 2K footage or 1080p footage.

Once you've chosen to output a raw signal, you'll find that a lot of menu items become disabled. You can no longer select your system's MAIN PIXEL or CODEC, for example, and the entire SCENE FILE SETTINGS menu becomes disabled as well. You won't be able to change the color saturation or the gamma or anything, because all system processing is completely bypassed when outputting raw. In fact, that's really the whole point -- you don't want any processing at all, you're after the raw sensor image, and so that's what the camera outputs.

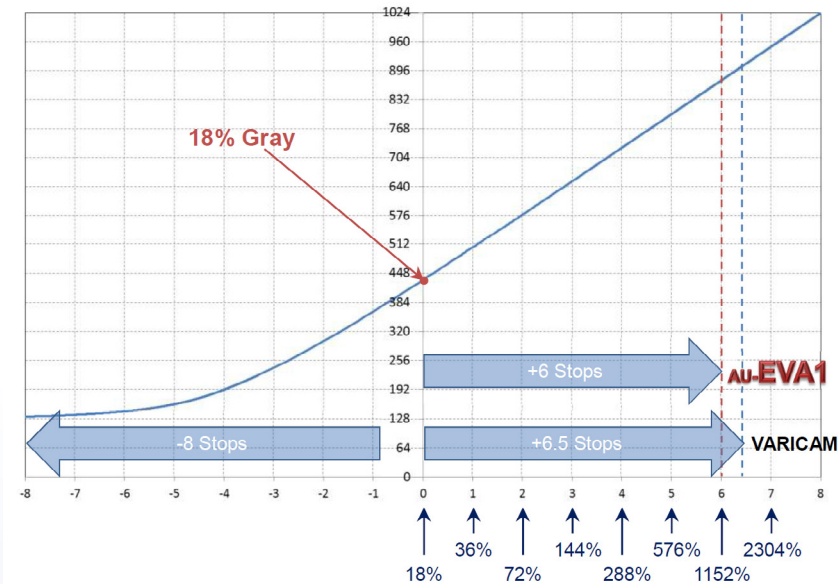
You also won't be able to record footage internally while the SDI RAW option is enabled. You can still monitor on the LCD and the HDMI, but the HDMI will be limited to 1920x1080 resolution. Note that you can also configure the HDMI or LCD to display as either V-Log, or as V709. Why would V-Log be a choice? It's because the raw sensor data does undergo one level of processing - instead of being output as linear data, it is encoded logarithmically. This results in huge data savings and much better data distribution throughout the sensor image.

Linear Vs Logarithmic Encoding

Sensors store data in a linear fashion. For example, the very darkest stop (represented by, say, only one photon hitting a pixel) is linearly encoded using either a zero (no photon) or a 1 (a photon hit the sensor in this particular pixel). Makes sense, right? Encoding that darkest stop needs only one bit of data (zero or 1). So with the next-darkest stop, the one that's barely brighter than that first one, that's represented by two bits of data, and can distinguish up to four shades of gray. And the next brighter stop is represented by three bits of data, and can discern up to 8 shades. And the next stop is encoded in by four bits, and on and on. That's how sensors work, and how data is stored linearly. But there's a problem with that, especially when you work with a high-dynamic-range sensor like the EVA1's 14-stop capability: when encoding linearly, the very brightest stop takes up HALF the data stream! It takes up as much data to encode that last stop, as it takes to encode all the stops that came before it. This is incredibly wasteful and inefficient. In a 32-bit encode, the darkest stop would be encoded on 1 bit, and the brightest stop would require 16 bits to encode it. That one stop literally uses up half the bandwidth of the entire signal. It would have incredible gradation within that one stop, but

every other stop would be bit-starved because so many of the available bits went to encode that last one stop. When you're talking about 14 stops of dynamic range, using up half the data stream to encode just one of the 14 stops is simply unrealistic and there are better ways to go about it.

Logarithmic encoding distributes the data far more efficiently. While the details of logarithmic encoding are complex and probably best served by reading a math book, the principle is very simple to grasp: in the simplest terms, logarithmic encoding attempts to distribute the bits evenly among all the stops. I'm going to re-use a graph from the V-Log article to demonstrate an example of how a logarithmic gamma encodes stops.



In a 10-bit logarithmic encode, there are 1,024 available encodable values. V-Log was designed to handle up to 16 stops. So, with 16 stops of dynamic range, you'd think that each stop would be allocated 64 shades to encode with. And that's -- well, it's not accurate, but it's not far off! Look at the curve above. You'll see that the stops to the right of middle gray are all pretty much encoded at 64 shades each. Middle gray itself (stop 0 on the chart, right at the center) is encoded with a value of almost 448. Every stop above middle gray is encoded with 64 values, so $448 + 64 = 512$; you can see that 1 stop above middle gray intersects the chart right at 512. Go one more stop (so 2 stops above middle gray) and that intersects the graphed line at 576 ($512 + 64 = 576$). So yes, for the upper range above middle gray, each stop is allocated 64 values for encoding, and each stop

can then represent up to 64 different “shades of gray”, as it were. The lower stops are not allocated 64 shades each; V-Log starts at a minimum value of 128, and the first 4 stops are encoded all within the first 64 values. So there’s less distinction in shades of gray among the very darkest stops -- and, coincidentally, the human eye is least able to discern shades in the very darkest areas as well. So the bits are taken from the darkest stops and re-allocated among the midtones and bright stops, where the eye is much more sensitive to differences in brightness.

Compared to linear encoding, logarithmic encoding just makes much more sense. Consider that in a 10-bit signal using linear encoding, the very brightest stop would be allocated 512 of the available 1,024 values! The next-brightest stop would use 256 values, and the stop below that would use 128, and the next stop would use 64. So out of 1,024 values total, just encoding the four brightest stops has already used up 960 of all the available values! You’d have to encode the remaining 10 stops of dynamic range using just 64 codes, a tall task indeed. Especially when you consider the next stop is going to use half those values for itself, leaving just 32 codes for encoding 9 stops.

I could go on, but I think the point is made - linear encoding is an extraordinarily inefficient way to represent dynamic range. Sensors generally work internally on a linear basis, but the EVA1 encodes that linear data logarithmically, allowing it to easily handle 14 stops of data with approximately 64 distinct shades per stop, and the ability to encode this data into 10 bits of data. The result is that EVA1 outputs 10-bit logarithmically-encoded raw sensor data.

The raw encoding is not exactly the same as V-Log, of course, but in general the concept is applicable enough that you can see how logarithmic encoding would distribute the dynamic range more equitably across the available encoding values. And knowing that the raw sensor data will be encoded logarithmically, the EVA1 allows you to view the LCD and HDMI as either V-Log, or as V-709. You can see a sample logarithmic encode and see all the stops of data fairly accurately represented when putting the LCD or HDMI into V-Log color. Or, alternatively, you can put the LCD and/or HDMI into V-709, to view a monitor-friendly version of the footage that provides a representation of what the footage might look like after it’s been graded.

Recording RAW

The AU-EVA1 cannot record the raw footage. Instead, the process requires you to supply an external SDI recorder that is compatible with the EVA1’s

raw output. Raw recorders will be offered by third-party companies, and it is incumbent upon those companies to ensure compatibility with the EVA1's signal output. At the time of this writing (April 2018) the Atomos Shogun Inferno and Atomos Sumo support recording the EVA1's raw footage into the ProRes Raw codec, and can record 4K or 2K into CinemaDNG files. Variable frame rate recording is not supported on the initial release but may be added in the future. As the market is always changing, other recorders may become available too. Panasonic will post a list of recorders that Panasonic has tested and verified are compatible with the EVA1 on Panasonic's EVA1 website, <https://pro-av.panasonic.net/en/eva1>.

Why would you want to record raw? For the same reason that professional photographers record photographs in raw -- it provides the most detail in the most pristine state that the camera can generate. The camera's output is a fully uncompressed signal that holds all the resolution and color data that the camera can generate. If you capture that data, it gives you the widest canvas to work from to create the final images. But, working with raw footage means extensive processing in post-production. In many ways working with raw footage is similar to working with V-Log footage, only even moreso. Just as with V-Log, you'll have to grade the footage, apply contrast curves, do noise reduction, enhance the color, sharpen the footage, etc. But in addition to that, you'll also have to convert the raw Bayer-pattern data into RGB pixels for viewing. That means you'll need to de-Bayer (or "demosaic") the footage. And, in the case of 5.7K raw, you'll probably have to resize or scale the footage as well, since 5.7K is not a currently-common delivery format. You will probably be scaling the footage to 4K, although with such a large frame to start with you can easily reframe the images in post, or even do post-zooms, or post-pans, or image stabilization.

Raw footage is about choices. It's about flexibility. It's about storing the footage in its most-manipulatable state, so that you can manipulate it to look its best. And, if better de-mosaic algorithms come along in the future, you could even re-process the footage and perhaps end up with an even higher-quality master! Raw footage is very much like a film camera's negative -- it's all the data that can be captured, but it's not suitable for viewing until you put some work into it. If you take the time and put in the effort and have the skills, working with raw footage can bring out the most detail, the most dynamic range, and the most pleasing shading, colorimetry, and tone that the EVA1 can produce. If you don't want to or can't afford to put that much effort into post-production, you can gain much of raw's advantages by shooting in V-Log. And if you need immediate footage delivery or live broadcasting or small file sizes, recording in one of the Scene Files is probably the most practical way to proceed for those purposes.

Lenses and Lens Mounts

The AU-EVA1 is an interchangeable-lens camcorder, and it comes equipped with a mount capable of attaching Canon EF-mount lenses. The Canon EF mount is one of the most popular lens mounts in the world, and a very wide variety of lenses are made in the EF mount. Note that not all of these lenses will be compatible with the EVA1; many of them will work fine, but there may be some instances where a particular lens won't autofocus, or can't be used for optical image stabilization, for example. Panasonic has tested many lenses from a variety of manufacturers for compatibility with the AU-EVA1, and you can find their list on the internet at <https://pro-av.panasonic.net/en/eva1>.

Please understand that Panasonic isn't going to be able to test every possible lens out there. There are certainly lenses that are compatible with the camera, that aren't on Panasonic's list; this would be simply a case of that particular lens having not been tested and verified yet.

The EF mount is designed for lenses that can cover the full photographic frame of 35mm film. That image circle is quite a bit larger than the Super35 cinema-sized sensor that the AU-EVA1 uses. Canon also offers a different but somewhat compatible mount, called EF-S. The EF-S mount lenses are designed to cover an image circle that is as big as the sensor that the EVA1 uses, and sometimes EF-S lenses are less expensive than EF lenses. But note: not all EF-S lenses can be used on an EF-mount camera. Some indeed can; but some are engineered to prevent their being used on an EF-mount camera. The reasoning is generally that the rear elements of the lens might protrude too far into the camera and interfere with the photography camera's mirror when it flips up. That is not a concern for users of the AU-EVA1, however, because the EVA1 doesn't have a mirror. As such, it is possible that the EVA1 could use some EF-S mount lenses that otherwise wouldn't work on an EF-mount photography camera. Even so, do be aware that some EF-S lenses have an extra physical protrusion on the back of the mount, designed to prevent the lens from being mounted on (and potentially endangering) a full-frame photography camera.

As a general rule, lenses that create a large-enough image circle to cover a photography 35mm-sized sensor, are generally offered in EF mount. And lenses offered in EF-S mount generally don't create an image circle large enough to cover a photography 35mm-sized sensor; lenses in EF-S mount generally create image circles large enough for an APS-C sensor but not big enough for a "full frame" 35mm-sized sensor. However, this is not a firm

and fast rule. There are several lenses on the market that create the smaller Super35/APS-C image circle, but are offered in the EF mount rather than EF-S. An example would be the SIGMA ART 24-105 F/4.0 lens. It creates an APS-C/Super35-sized image circle, but the lens mount is an EF mount. How would you know the lens creates the larger or smaller image circle? Generally, lenses have a locator mark on the lens mount that you match up with a locator mark on the camera body. Lenses with red locator marks are generally suitable for 35mm photography-sized sensors, lenses with white locator marks are generally suitable for APS-C or Super35 cinema-sized sensors.

As far as the AU-EVA1 is concerned, it doesn't matter whether the lens is designed to use the photography sized sensor, or the cinema-sized sensor. The larger image circle will certainly work with the smaller sensor. The only issue will be that the lens may not deliver as wide a field of view as you might be expecting; the smaller sensor results in an approximately 1.6x crop factor as compared to using the photography 35mm-sized sensor.

If an EF-S lens will physically mount to the camera, there's a good chance it will work. If the lens won't physically mount to the camera, don't try to force it. Remember that some EF-S lenses have been engineered to prevent being mounted on EF cameras. It's possible you could have the lens mount modified to make it work, you'd have to take the lens to a camera engineer who could consult with you on that.

Some EF-mount lenses offer optical image stabilization, and some don't. Depending on the manufacturer or the age of the lens, it's possible you might find some EF-mount lenses that don't support autofocus, or even automatic aperture. Generally modern lenses will support autofocus and automatic aperture, but if the lens doesn't support it, the lens doesn't support it. If the lens offers manual iris only, you're going to have to operate the iris manually; if the lens doesn't offer image stabilization, you can consider using the camera's Electronic Image Stabilization as an alternative.

The vast majority of EF-mount lenses have been designed for use with photography cameras. Generally this means that certain types of operation that cinema operators are used to, may be more challenging with a photography lens. An example would be that cinema lenses are typically designed to be parfocal lenses, which hold their focus throughout the entire zoom range; that is not generally a feature of photography lenses. However,

there are some EF-mount lenses that are designed for broadcast or cinema work. These lenses will usually feature powered zoom operation, perhaps a smoother iris, and perhaps image stabilization. Two examples of these types of lenses are the Canon CN-E 18-80mm T4.4L IS, and the Canon CN-E 70-200mm T4.4 L IS lenses. The AU-EVA1 is compatible with these two lenses, and can supply power to the lens for the lens's servo motor to operate its power zoom.

The AU-EVA1 is not limited to solely EF-mount lenses though. Through the use of a third-party lens adapter, you can adapt Nikon F-mount lenses to fit on EF-mount cameras. Using a Nikon F-mount adapter would mean that you would be using manual-only lenses, as EF-F adapters are typically “dumb” adapters (meaning, there are no electrical contacts in the adapters, and the adapter therefore can't electronically control the lens.

Another adapter would be an adapter for cinema PL-mount lenses. The industry standard for movie cameras is the Positive Lock (PL) lens mount. Cinema lenses operate differently from photography lenses, generally in offering more precise/longer/smooth focus ranges and much more precise zoom operation. Cinema lenses are typically larger than a comparable photography lens as well. For cinema-style work, the functionality of a cinema lens is a great advantage. Some cinema lenses come in EF mount and can be used directly, but a great many come in PL mount. There are some adapters out there to adapt PL lenses to EF bodies, but in general they carry quite a few restrictions, and not all focal lengths are easily adapted. As of the time of this writing, there is already an aftermarket PL modification being offered for the EVA1 by a third party, which removes the EF mount and replaces it with a genuine PL mount. Getting your camera modified in such a way would mean not being able to use EF lenses anymore, but it would then be fully compatible with PL lenses. As the AU-EVA1 grows in popularity you can expect that more options like this may arise. Be sure to check back frequently on Panasonic's website, and on a user forum such as www.DVXUser.com, for the latest on lens adapters and lens mounts available for the AU-EVA1.



System Settings Menu

The System Settings menu is full of menus for setting camera operations, recording formats, programming how the switches and buttons on the camera work, and performing simple maintenance such as setting the clock or reviewing the hours of operation the camera's been used.

These various functions are contained in their own sub-menus (such as the SYSTEM MODE menu, or the SIDE LOCK menu, etc). This book will refer to the various menu and submenu items together, like this: SYSTEM MODE>Frequency. That means that when you're in the SYSTEM SETTINGS menu, choose SYSTEM MODE, and then choose FREQUENCY. Each of the sub-menus in SYSTEM SETTINGS will be described in this chapter, using this naming convention.

SYSTEM MODE>Frequency

This menu item sets the overall project base frame rate. This is not necessarily the same as your acquisition/shooting frame rate; what this menu item is setting is what your playback frame rate will be.

The EVA1 is capable of recording projects in all the major frame rates and standards generally used in television and film worldwide.

This menu item sets the internal clock that governs what mode the camera operates internally at. This doesn't directly dictate the recording format, but it does set the operational format. This menu item offers six progressive-scan timebases to choose from: 23.98, 24.00, 25.00, 29.97, 50.00, and 59.94 frames per second. In addition, it offers interlaced video recording in 50.00i and 59.94i.

These base rates can be perhaps best be understood in context with the film or television standard that the camera is being set to comply with. There are three general choices: 24.00p for film projects, 25Hz or 50Hz for European/Australian/Asian/EBU/"PAL" television systems, and 23.98, 29.97 and 59.94Hz for compliance with American/Japanese/"NTSC" television systems.

The obvious benefit to being able to set the system frequency is that you are now prepared to create video in any territory in the world. If you are hired by an overseas company, for example, you can shoot video that is appropriate for editing and broadcast in their home country.

You can freely intermix recordings made at any frequency on the same memory cards if you choose, with one exception: AVCHD. If you want to record in AVCHD, only one type of footage (25/50Hz or 23.98/29.97/59.94Hz) can be put on any particular card. When a memory card is formatted in the camera, whichever frequency the camera is currently set to will dictate the only type of footage that can be recorded on that memory card. If the camera is in 25 or 50Hz mode when you format the memory card, and you later switch it to 23.98, 29.97 or 59.94Hz, you won't be able to record any AVCHD footage on that memory card so long as the camera is in 23.98, 29.97, or 59.94Hz mode.

One note about 24p - even though the EVA1 is a world camera and can be set to either 23.98p, 24.00p or 25.00p, users who live and work in 50Hz territories (countries that used to use or still use PAL television) should think long and hard before choosing a 23.98 or 24.00p frequency. Shooting footage in 23.98p or 24.00p that is intended for delivery on PAL or 50Hz HD systems can create some headaches for you in post production. 24.00p is not designed for television viewing at all, it's designed to match film cameras. 23.98P was designed to deliver the "24 fps" look in a 59.94Hz-compatible wrapper. And neither 24.00P nor 23.98P are designed for display on PAL or 50Hz televisions. That's why 25.00p exists — it provides fundamentally the same filmlike look, but in a frame rate and recording format that is appropriate for use in PAL or 50Hz HD areas. 23.98P is appropriate for ex-NTSC territories or for internet distribution, but if you're planning on broadcasting your footage in a PAL or 50Hz HD country, you should give careful consideration as to whether shooting in 25.00P just makes more sense.

Also, note that certain FREQUENCY settings will affect what MAIN PIXEL recording sizes that you can select. For example, 24.00 can only be used when the MAIN PIXEL recording size is set to 4096 x 2160 or 2048 x 1080. You can't select 24.00 frames per second and also record in an HD or UHD television-sized frame. And you can only select 1280 x 720 if you've selected a FREQUENCY of 50.00P or 59.94P.

SYSTEM MODE>SDI RAW

The camera has the capability of outputting a video signal on its SDI port, or it can output a RAW signal. When outputting raw, the camera sends out the raw uncompressed sensor data, with the brightness levels encoded logarithmically in 10 bits. The choices in this menu are:

OFF: in this mode, the camera's SDI port acts like a conventional SDI port, and can be connected to an SDI monitor for monitoring the video feed. The output is conventional video encoded in 10-bit 4:2:2, and as specified in the OUTPUT SETTINGS>SDI OUT menu.

S35 5.7K: in this mode, the SDI port outputs a raw data signal of the full sensor scan. The entire visible surface of the sensor is output exactly as it comes off the sensor's pixels. This mode outputs 5,720 x 3,216 pixels per frame, and is capable of outputting up to 30 frames per second. This raw signal cannot be displayed on a conventional monitor, but it can be captured by an external SDI recorder that complies with the EVA1's raw output format. If your project uses a 23.98, 24.00, 25.00, or 29.97 fps timebase, then your images would probably be best served to use S35 5.7K, as it provides the most detailed image and the widest field of view.

CROP 4K: this mode first crops in to the central 4096x2160 patch of the sensor, and outputs the raw data from that 4K patch. The result is a narrower field of view than S35 5.7K output, but it is also capable of outputting up to 60 frames per second. This mode is a full quality 4K raw, and would be the best choice if your project demands 4K (and only 4K) raw, or if you need to take advantage of frame rates between 31 and 60 frames per second. Additionally, this mode may be preferred if you need a slightly more telephoto field of view. Switching to CROP 4K provides the same effect as when using the D.ZOOM User Button.

CROP&MIX 2K: this mode first crops in to the central 4096x2160 patch of the sensor, the same way CROP 4K does, and results in the same field of view that CROP 4K does. Then, it performs a pixel-mix operation to result in a 2K raw data stream, and can output that data stream at up to 240 frames per second. The pixel mixing function is the same as that described in the SYSTEM MODE>SENSOR MODE function. This mode does not provide enough resolution for a fully-resolved 4K or UHD image, but is suitable for 2K or 1080p images. A primary reason for wanting to use this mode would be if you need the fastest possible frame rates for the smoothest slow motion.

Note that when you choose a raw output mode (other than OFF), the choices made override the other choices you would otherwise be making in this menu (such as the SENSOR MODE or MAIN PIXEL); choosing a raw

SDI output mode forces the camera's sensor into a specific configuration and also precludes making internal recordings, so those menu items are not relevant when raw output is chosen. Also, note that when the SDI is outputting raw, the LCD and the HDMI can still be outputting a conventional video signal (although the HDMI will be limited to a maximum of 1920 x 1080 resolution).

SYSTEM MODE>Sensor Mode

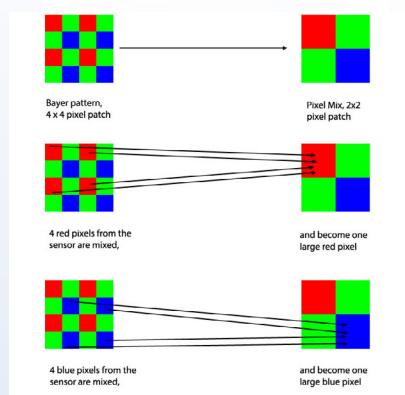
The EVA1 features a Super 35-sized sensor (24.6mm x 12.97mm) at 5.7k resolution (approximately 5,720 x 3,016 pixels), at up to 60 frames per second. The camera is also capable of supporting even faster frame rates, although at somewhat reduced sharpness and perhaps with a narrower field of view. This menu item lets you choose how the camera reads the data off its sensor, which directly affects how fast you can set the acquisition frame rate. There are three choices:

S35 5.7K: this mode reads all the available pixels within the sensor's active scanning range individually, and produces the sharpest, highest-quality footage the camera is capable of. In this sensor mode, the sensor is capable of generating images at a maximum of 60 frames per second, depending on your recording codec; the 422LongGOP 150M codec and the 422ALL-I 400M codec both support up to 30 frames per second, and the 420LongGOP 100M codec supports up to 60 frames per second..

S35 MIX 2.8K: This mode accelerates the potential frame rate up to 120 frames per second. It does so by reading the same area as S35 5.7K, but it doesn't read all the pixels individually. Instead, it uses "Pixel

Mix" technology to combine pixels together. It combines each block of 4x4 pixels into a block of 2x2 pixels. The sensor uses a Bayer pattern, which results in alternating pixels being covered by a different color in a red/green pattern on one line, and a green/blue pattern on the next line. In Pixel Mix mode, the camera reads each 4x4 block of pixels as if it was a larger 2x2 block. In a 4x4 block of 16 pixels, you would have eight Green, four Red, and four Blue pixels.

The Pixel Mix combines the four Red pixels into one large Red pixel; it combines the four Blue pixels into one large Blue pixel, and it combines



the eight Green pixels into two large Green pixels. Each of these new large pixels is 4x as big as the original sensor pixel, and contains the combined data from those four original sensor pixels. The result is, effectively, a sensor with half the horizontal resolution and half the vertical resolution of the normal S35 5.7K sensor, but retaining the full field of view of the S35 5.7K sensor. Accordingly, this mode is called S35 MIX 2.8K, because the effective resolution is about 2,860 (2.8K) x 1,508. Combining pixels in this fashion results in lower resolution than the S35 5.7K mode, but it also takes less time to read the sensor, and so this mode increases the maximum frame rate up to 120 fps. This mode is optimal for generating 2K or HD/1080P images, but is not available as a choice when recording UHD or 4K.

4/3 CROP&MIX 2.2K: This mode is fundamentally very similar to the S35 MIX 2.8K. This mode uses the same Pixel Mix technology to reduce the amount of data read off the sensor, but it also crops down the size of the sensor somewhat. Instead of using the full 24.6 x 12.97mm area of the sensor, this mode uses an extract of the central 19.4 x 10.25mm area. This smaller area, combined with the Pixel Mix, results in a final scanned area of about 2,260 x 1190. This results in a narrower field of view and less resolved detail, but it also results in an ability to scan the sensor at up to 240 frames per second. The resulting images won't be as detailed as the S35 MIX 2.8K mode, but should be acceptably sharp for 1080p or 2K productions. Not available when recording 4K or UHD.

SYSTEM MODE>Main Pixel

This menu determines the frame size of your recordings. The options are:

4096 x 2160: This is "4K" as used in cinema recordings. It is not conventional television 4K; rather it is a slightly wider field of view and a slightly wider aspect ratio than normal 16:9 television. The actual aspect ratio is approximately 1.89:1, very similar to the 1.85:1 traditionally used in "flat" widescreen cinema. If you wanted to display this on a conventional UHD or HD television, it would necessitate either a little bit of letterboxing (thin black bars at the top and bottom) or a slight bit of cropping (zooming into the central 3,840 x 2,160 pixels). Not available if your FREQUENCY is set to 50.00i or 59.94i.

3840 x 2160: This is "4K" as used in television productions. Also known as Ultra High Definition, or UHD, or "TV 4K". This mode results in 16:9 recordings, suitable for transmission to a UHD television set or downconversion to 1080P or 720P High Definition television. It is the same vertical resolution as 4096 x 2160 "4K", but with an ever so slightly narrower field of view as compared to the full wide 4096 x 2160 frame. Not available if your FREQUENCY is set to 24.00P or to 50.00i or 59.94i.

2048 x 1080: This is “2K”. It is basically the same vertical resolution as 1920 x 1080 Full HD, but the aspect ratio is a little bit wider (the same as 4096 x 2160’s aspect ratio, at 1.89:1). Not available if your FREQUENCY is set to 50.00i or 59.94i.

1920 x 1080: This is the conventional 16:9 Full HD frame size for 1080P high-definition footage. Not available if your FREQUENCY is set to 24.00P.

1280 x 720: This is the conventional 16:9 HD frame size for 720P high-definition footage. Note that you can only select 1280 x 720 when your project’s FREQUENCY is set to 50.00 or 59.94 frames per second, and the only codec choice for 720P is AVCHD PM.

SYSTEM MODE>Main Codec

This menu item is where you choose what recording quality and what file format to record your footage into. The AU-EVA1 always records using MPEG-4 compression, and offers a variety of file sizes, bitrates, and color sampling options to choose from.

The choices include a Quicktime movie in .MOV format, or high-definition footage in AVCHD format. Additionally, you may have to choose the color sampling you want to record (either 4:2:0 or 4:2:2) and, the amount of bandwidth you want to allocate to recording (50, 100 or 150 megabits per second). And, when recording MOV, you may have the option of choosing LongGOP or ALL-I compression systems.

AVCHD is a whole different kettle of fish. It is a recording format that is compatible with Blu-Ray players and other AVCHD camcorders. For more info on selecting the right codec, see the WHICH MODE TO SHOOT IN article.

Sometimes, you don’t get to choose the codec; sometimes the codec is forced by other choices you’ve made. For example, if you’ve set a FREQUENCY of either 50.00i or 59.94i, then you’ll find that the MAIN CODEC is only going to offer choices of 422LongGOP 50M, 422ALL-I 100M, or AVCHD. The camera can’t utilize the 150 megabit LongGOP or 400 or 200 megabit ALL-I versions of the codec when recording interlaced footage.

Generally, for the highest quality recordings, use the highest bitrate you can; use MP4 instead of AVCHD, and use Long-GoP instead of ALL-I for the highest-quality recordings (or, if you want to use ALL-I, use the 400mbps version). Use AVCHD for the smallest file sizes for HD footage.

The owner's manual has extensive cross-reference charts that show which functions are enabled or disabled within which modes, and that data will not be repeated here. Please refer to the owner's manual, Volume 2.

COLOR SETTINGS>Main

The EVA1 provides six options for “color palettes” that you can use to record your footage, or monitor your footage with. This menu setting, MAIN, is for controlling what color recipe your footage is recorded with. The choices are to use V-Log, or one of the five Scene Files.

V-Log: V-Log is a logarithmic gamma curve that provides for the widest dynamic range and the flattest contrast. This gamma curve was developed to mimic the characteristics of motion picture film. It is not, generally, intended to be viewed on a monitor; rather, recording V-Log is sort of like filming with negative camera film. It needs to be “processed” before it's ready to be viewed. V-Log is the best choice when you're planning on using the EVA1 with other cameras that support V-Log (such as the Panasonic VariCam LT) or when you expect that the footage will be undergoing extensive post-production processing and grading. V-Log is the most neutral palette to capture footage in. For more information on working with V-Log, see the article USING V-LOG.

SCENE1 through SCENE5: The camera is capable of storing five pre-created “looks” (known as “SCENE FILES”), and you can switch among them by choosing SCENE1, SCENE2, SCENE3, SCENE4, or SCENE5. The main thing to know here is that the SCENE FILES are generally more appropriate when you're creating footage that is meant to be used as-is; for example, if the camera is recording footage that's sent live to a switcher for a live broadcast, you'd probably want to apply a “look” to it to make it look suitable for the viewer's television. Similarly, if you're using the camera for a live event, and the output of your camera is being sent to a projection screen or direct to monitors, you'd probably want that footage to have been processed such that it will look good straight out of the camera. Or, perhaps you're shooting news, or footage that you intend to hand over to a client who is expecting edit-ready footage, and doesn't want to have to go through the post-production processes of grading or shading the footage or applying LUTs (Look Up Tables) to make the footage look good. The SCENE FILES are designed for that purpose -- to provide pre-programmed baked-in looks suitable for delivery to a television or to an edit suite, where the post-processing required with V-Log would not be desired.

The camera comes supplied with five default Scene Files, intended to provide a suitable look for a variety of shooting scenarios. However, you can also change, modify, save, load, and download the Scene Files to customize them to create whatever look you'd like. You can also use the Scene Files whenever you like the look, regardless of what the original purpose for the Scene File was. The default Scene Files include:

SCENE1: A look that retains the 14 stops of latitude of V-Log, while squeezing it all into a broadcast-appropriate tonal range. Generally you'll see sharper contrast (deeper blacks and whiter whites), with expanded midtones, as compared to SCENE2. Midtones and face tones will be a little darker than in normal Rec709 broadcast video; in SCENE1 you generally would expose darker skin tones at around 40 IRE and the fairest light skin tones at a maximum of about 55 IRE. If you're familiar with prior Panasonic camcorders and their scene files, they offered a scene file named CINE-V; this scene file is generally similar in concept to CINE-V.

SCENE2: A look that also retains the 14 stops of latitude of V-Log, while still fitting it into a broadcast-appropriate tonal range. This scene file will deliver a softer overall look, with more gentle transition into the shadows and into the highlights, but with a correspondingly narrower range of midtones as compared to SCENE1. Proper skin tone exposure would range from about 40 for the darkest, to about 60 for the lightest skin tones. If you're familiar with prior Panasonic camcorders, they offered a scene file named CINE-D; this scene file is generally similar in concept to CINE-D. This scene file delivers a look that is somewhere in-between the ultra-flat V-Log, and the monitor-suitable SCENE1.

SCENE3: This scene file is designed to provide a conventional "broadcast" look -- a baked-in look that delivers the standard HDTV color in Rec.709. This scene file is a good place to start if you're shooting live events, sports, news, or using the camera in combination with other cameras that are set to Rec.709 color.

SCENE4: This scene file is very similar to SCENE3; it is also a conventional broadcast look. It's been slightly modified to provide a little more saturated color and a little brighter midtones; in general this may make for a more pleasing "HD" look. Both SCENE3 and SCENE4 use the VIDEO gamma, which enables many other menus and provides for extensive customizability.

SCENE5: This scene file uses the Hybrid Log gamma to facilitate shooting and delivering "HDR"-compatible high dynamic range (HDR) footage. The entire 14 stops of dynamic range is retained and mapped into the HLG gamma, which is a delivery format capable of displaying properly on both HDR televisions and standard televisions. You can easily create

HDR footage from V-Log footage as well, but recording in HLG makes your existing footage already compatible with HDR television sets. This scene file would perhaps be best for scenarios where you want to deliver out-of-the-camera footage ready for display on an HDR television. It is perhaps not the best choice for footage where you intend to do extensive grading on the footage before output to a television.

COLOR SETTINGS>SDI Out, HDMI Out, LCD Out

This is where things get a little interesting. You can choose how the camera interprets the footage it's generating, when it puts that footage out on its video outputs. The camera is capable of creating V-Log footage internally, and displaying that footage as-is, or it can overlay a V-709 LUT on the footage before displaying it -- and it can make that choice separately for any of the three monitor outputs (the LCD, the SDI, and the HDMI). So if you're recording V-Log footage internally, you may want to set the LCD to display V-Log so you (the camera operator) see the image exactly as it's being recorded and you see the full range of exposure and gamma. But, V-Log footage isn't necessarily designed for viewing by an audience, so you might want the client's monitor to see a more representative, viewing-friendly version, so maybe you set the SDI output to V-709. That will lay a V-709 LUT onto the footage as it's output, making the SDI output's footage look more like what finished footage may look like (V-709 is a LUT that transforms V-Log footage into something that looks a lot like Rec.709 standard HD footage, although V-709 is not a strict representation of Rec.709, it's a stylized palette that is similar to V-709 but has been enhanced to make the footage more pleasant to view). So you might choose to record internally to V-Log, and to monitor your LCD in V-Log, and to send the client a viewing-friendly V-709 version. What about the HDMI output? Perhaps you have an external video recorder connected to the HDMI; in that case you'd probably want to set the HDMI to V-Log output so that the full V-Log signal gets properly recorded. Or, maybe the client has requested a daily copy of the footage that they could use to put together teasers on their website or something, so perhaps you send a V-709 version out the HDMI port to an external recorder, while recording the full V-Log version to the internal memory cards. When you choose a COLOR SETTINGS>MAIN setting of V-Log, you have the discretion to choose what type of signal (V-Log or V-709) to any of the video outputs. On the other hand, if you've chosen a baked-in look (SCENE1 through SCENE5), that baked-in look will be output on all your video outputs simultaneously.

USER SWITCHES>USER1 through USER9

The EVA1 has 9 programmable USER buttons, and you can assign any of 28 different functions to each of those USER buttons. This menu is where you choose which function is assigned to which button.

There are three circular buttons on the left side of the camera (User 1, User 2/VIEW, and User 3/INFO). There are two rectangular user buttons next to them (User 4/E.I.S. and User 5/WFM). On the front of the camera down near the bottom is a sixth button (User 6/AWB). On the back of the camera in the lower left is the 7th button (User 7/SLOT SEL). Finally, there are two buttons on the handgrip; one on top near the index finger (User 8/EXIT) and one inside the handgrip perhaps most appropriately reached by the middle or ring finger (User 9).

Notice that most of these buttons have a pre-assigned label next to them. The 4th User Button has an actual printed label on the camera body that says “E.I.S.”, and this button is programmed by default to control the Electronic Image Stabilizer. Likewise, User Button 7 has a preprinted label of SLOT SEL and is located on the back of the camera below the memory cards. The thing to note here is that while many of the User Buttons are already labeled for convenient functions, they are not restricted to those functions. You can reprogram any of the User Buttons to perform any of the functions contained in this USER SETTINGS menu. In fact, you can program a User Button (or even all of the User Buttons) to do nothing at all; if you set a User Button’s function to INHIBIT, then pressing that button will have no effect whatsoever. So the layout and programming of the camera’s buttons are completely modifiable and configurable to however you’d prefer to work. I would just point out that while you could set the Waveform Monitor to be activated by User Button 6/AWB, and you could program User Button 5/WFM to invoke the White Balance function, you should probably think twice before doing so, as the printed labels could make it confusing to operate the camera, especially if you have a secondary camera operator involved. But, the flexibility exists and the choice is yours as to how you want to program your camera and what functions you prefer to have quick access to.

You can always quickly verify what functions are assigned to which User Buttons by going to the HOME screen, press the INFO button, and then touch the SWITCHES tab on the LCD.

The various functions you can assign to the 9 User Buttons include:

Inhibit: Assigning this function essentially disables this particular user button. If you find yourself accidentally/unintentionally pushing particular user buttons, you might want to “inhibit” them with this function.

AWB: Enables the Automatic White Balance function. Note that you can only execute the Automatic White Balance function if you’ve previously set the white balance value to AWB MEMORY. Go to the HOME screen and look at the white balance display in the lower right corner; if the value displayed doesn’t start with an “A” (such as “A6600k” or “A3450 k” for example) then the AWB function is not available and pressing the button will result in the camera saying INVALID. First change to the AWB memory (either from the HOME screen, or going to CAMERA SETTINGS>WHITE>VALUE), and then the AWB user button will work. Note: if you have reassigned User 6 to no longer be AWB, you can still access the Auto White Balance function by going to CAMERA SETTINGS>WHITE>AWB.

One Push AF: This function enables the ability for an autofocus-equipped electronic lens to perform an autofocus procedure. This function will “grab” focus, but it will not continually adjust focus. It locks onto the object to focus on, executes the best focus it can get, and then reverts to manual focus mode. This function is only possible if the attached lens has autofocus capability; if you’re using a strictly manual-focus lens or if the autofocus on your lens has been disabled, then executing this function will produce no results. Note that when executing the One Push AF focus process, the area the camera will attempt to focus on is a small square in the center of the frame, about 1/4 the width of the frame and about 1/3 the height of the frame. Clearly you’ll need to center up the frame on any object that you want to have the camera focus on.

One Push A.Iris: This function causes the camera to adjust the lens’s iris to appropriate exposure given the current lighting conditions, current shutter speed, and current ND Filter setting. This is not a continuously-operating automatic exposure feature however; like ONE PUSH AF, this is a one-push feature. Press the button, and the camera will grab an appropriate iris setting, and then return to manual exposure mode. Note that this function can only operate with lenses that have electronic iris control; on a fully manual lens this button will have no effect.

ATWLock: When using ATW (Automatic Tracking White balance), the system will constantly hunt for what it considers the optimal white balance under the prevailing light conditions. You can stop the camera from hunting and tell it to lock in the current white balance setting by using the ATWLOCK function. If you use ATWLOCK to lock in the

white balance, and then press ATWLOCK again, it will un-lock and return to hunting in ATW mode. This function will be canceled if you power down the camera.

E.I.S.: This function will enable the camera's Electronic Image Stabilization feature, but only if the lens doesn't have its own optical stabilization feature (or, if the lens' optical stabilization has been disabled). E.I.S. lets you have image stabilization even on lenses that don't offer optical stabilization. However, do note that the camera will crop into the sensor somewhat, to provide a buffer around the image that the camera can then use for stabilization purposes. This means that the field of view will be slightly narrower whenever E.I.S. is enabled. E.I.S. is not available in all modes; for example, when using the 4/3 CROP & MIX 2.2K sensor scanning mode, E.I.S. is not available. Also, be aware that the stabilization effectiveness is highly dependent on how fast the camera receives new images to process; E.I.S. might be quite effective at 60 fps but it might be much less effective at 24 fps; the slower the frame rate, the less effective the stabilization will be. Stabilization is also limited to a focal range between 8 and 200mm; if your lens is wider than 8mm or longer than 200mm, stabilization will be disabled. For a manual lens (that doesn't automatically report its focal length), you can tell the camera what the focal length is in the CAMERA SETTINGS>E.I.S. menu.

D.Zoom: D.Zoom stands for "Digital Zoom" even though this function is not, in any way, a typical digital zoom. Digital zoom, as it has been understood on camcorders of the past, usually used blocky digital scaling to artificially magnify the image, which could be interpreted as increasing the perceived zoom of the lens. This D.Zoom feature is nothing like that -- instead, this function toggles between scanning the entire width and height of the AU-EVA1's 5.7K sensor, or cropping in to scan the central 4K of the sensor. The result is a perfectly-sampled 4,096 x 2,160 patch out of the center of the sensor, which is as sharp and clear as many other 4K cameras can manage at all. The normal field of view uses 5.7K worth of pixels which results in "oversampling" for extremely sharp imagery; the D.Zoom uses a full 4K worth of pixels to make its image, so upon close inspection you may possibly see a slight loss of resolution or a bit more noise in the D.Zoom footage, but for many scenarios both modes will look extremely comparable. The D.Zoom gives you a 1.4x "free" zoom, which is a nice way of saving time between having to change lenses -- a 25mm prime lens, when using the D.Zoom feature, will give you the same field of view as a 35mm lens would have. Don't confuse this feature with the EXPAND focus assist; they're entirely different functions for different purposes.

IR Shooting: This User Button removes the camera's built-in infrared (IR) filter, allowing it to record footage via infrared light (as well as visible light). Normally the IR filter is in place to prevent the visible light hitting the sensor from becoming contaminated with infrared light. Infrared light is invisible to the human eye, but it can affect camera sensors. You can remove the IR filter; this literally lets the camera see in the dark (as long as there is some infrared light available). This function can be used for unusual artistic effects under normal lighting, or when supplemented with infrared light it can be used to film in low- or even no-visible-light conditions. Press the IR SHOOTING User Button to remove the IR filter; press it again to restore the IR filter.

REC SW: The camera features two recording buttons, one on the body (above the ND Filter switches) and one on the handgrip. However, if those aren't convenient for some reason, you can designate any of the User Buttons to act as a Record button. Pressing a User Button assigned to REC SW will resort in the camera starting or stopping recording.

PRE REC: The REC SETTINGS menu offers a PRE REC menu item. Assigning this function to a User Button lets you toggle PRE-REC on or off without having to go into the menus. Note that PRE-REC won't work while recording VFR. PRE REC buffers about five seconds of 4K or UHD footage, or about 10 seconds of 2K/1080P/720P footage and, when you start recording, it will commit that buffer to the memory card and continue recording live footage thereafter. So, in effect, PRE REC lets you start recording even before you pressed the REC button.

REC Check: This will play back the last (approximately) three seconds of footage you shot, without having to switch the camera over to thumbnail mode. You can't use this button to actually rewind and watch the whole clip; you'd have to toggle over into playback mode to review the entire clip.

DEL Last Clip: This function allows you to immediately delete the last clip you've just recorded. Instead of toggling over to the playback mode and manually selecting and deleting a clip, you can instead delete the last clip with the press of a USER button (and, of course, verifying that you actually do intend to delete that clip). It's convenient, but it's not dangerous; it's difficult to accidentally delete a clip because the system asks you to confirm that you really intend to delete it. The DEL LAST CLIP function generally only works if you immediately choose to delete the most recent clip you shot; some examples of when it won't work include if you've changed recording formats since shooting your last clip, or if you've powered down the camera, or if you've gone into playback mode, or if you've ejected a memory card since recording the clip.

SLOT SEL: The camera is equipped with two memory card slots. This function lets you toggle between the two slots as to where the next recording will be made. Or, alternately, if you've set the camera in Thumbnail mode, this function can toggle between the two cards so you can select which card you want to play back footage from.

Expand: This function triggers the camera's expanded focus assist function, effectively zooming into the central portion of the image and magnifying it so you can see the critical focus point more easily. The amount of magnification, and the behavior of the EXPAND function, can be set in the OUTPUT SETTINGS>LCD FOCUS ASSIST menu's EXPAND MODE and EXPAND VALUE settings. Note that the expanded area will not necessarily be the center of the frame; you can actually move the expanded area around the frame, either by using the arrows on the touchscreen, or by rotating the dial on the handgrip. There are 9 potential sections of the frame that you can view. The area of the frame you're currently viewing will be represented by the green square in the lower left corner of the frame.

Open Iris FA: This function will trigger a different type of focus assist, the Open Iris Focus Assist. Generally when grabbing focus, it's easiest to see the critical focus point when the iris is at its most open, which reduces the depth of field. This function will automatically open the iris to its maximum open value, and will engage the automatic shutter to restore reasonable exposure during the focus assist operation. As soon as you start recording, the shutter will be returned to normal and the iris will return to what it was before you triggered this function. If recording isn't started within a set time limit, the OPEN IRIS FA will cancel itself after a set amount of time (which you can specify in the OUTPUT SETTINGS>LCD FOCUS ASSIST>OPEN IRIS MODE menu).

PEAK./SQUARES FA: This lets you enable either the PEAKING or the SQUARES focus assist function. This can be used in combination with the other focus assists (Open Iris and Expand), but you can't use both PEAKING and SQUARES simultaneously. You can configure the system to either invoke and disable PEAKING, or you can have it invoke and disable SQUARES, or you can have it invoke PEAKING, and the next press of the PEAK/SQUARES FA will disable PEAKING and invoke the SQUARES, and a third press of the button will disable the SQUARES assist. You make that choice in the OUTPUT SETTINGS>LCD FOCUS ASSIST>PEAK./SQUARES MODE menu item.

WFM: This enables (or disables) the WaveForm Monitor (WFM) or Vectorscope (or both), depending on how you've configured the OUTPUT SETTINGS>LCD EI ASSIST>WFM MODE menu item. Note that User Button 5 is configured for the WFM by default, so assigning WFM to a different

button may be redundant. The WFM cannot be used while you're using the EXPAND or SQUARES focus assists.

Spotmeter: This function toggles the SPOTMETER on and off. The Spotmeter is represented by a small square in the center of the display, and the Spotmeter function reports on the exposure value of what's within that square. There are two choices: STOP, or %. In STOP, it will report how many f-stops over- or under-exposed the central region is; in % mode it will report the average IRE level of the video contained within the central box. The choice of STOP or % is available in the OUTPUT SETTINGS>LCD EI ASSIST>SPOT METER UNIT menu if you've set your SYSTEM SETTINGS>COLOR SETTINGS>MAIN to V-Log; however if you've chosen one of the Scene Files for your Main color, then the Spotmeter will always be presented as %. You can also choose the size of the box that the spotmeter samples, using the OUTPUT SETTINGS>LCD EI ASSIST>SPOT METER SIZE menu item.

Zebra: This User Button allows you to designate one of the User Buttons to enable and toggle through the various Zebra options. See the section on ZEBRAS for more information.

Level Gauge: The camera has a built-in two-axis level gauge that can display both horizontal skew (camera tilted or rotated as compared to the horizon), and vertical tilt (the camera being tilted up or down, and not level), at angles up to 30 degrees. This can be a great way to keep your eye on your horizons to keep them nice and flat. It's also a great way to level the camera when setting up a tripod, especially if your tripod head doesn't have a bubble level. The level gauge works great from a tripod, but is not necessarily as useful for handheld work; it does work, but it doesn't necessarily update instantly, so — it's best for stable work, but it doesn't read out its best when the camera is actively moving.

Level Gauge Set: This function works together with the LEVEL GAUGE function. With this function, you can instruct the camera as to what "level" should be considered. Even if the camera's tilted upwards and sideways, you can "set" that position to be considered "level", and the displayed LEVEL GAUGE will now show that orientation as level, and deviations from that orientation will show up on the LEVEL GAUGE display. And that new orientation will be remembered even if you power off the camera. Obviously things could get out of hand if you forgot you re-set this LEVEL GAUGE SET function to an alternate orientation, so remember you can always go back to the factory default by using the OUTPUT SETTINGS>LCD LEVEL GAUGE>LEVEL GAUGE RESET function.

SDI COLOR / HDMI COLOR / LCD COLOR: These functions can be assigned to a user button as a shortcut to determining

whether or not to apply the V-709 LUT to any of the various outputs, when the main recording is being done in V-Log. If the SYSTEM SETTINGS>COLOR SETTINGS>MAIN is set to any of the Scene Files, then these User Buttons will have no effect at all; when the main recording is a Scene File, all the video outputs will output that Scene File's color. However, when the main recording is V-Log, then each output has the option of outputting either the untouched V-Log footage, or adding the V-709 LUT onto the output. You can assign this function to a user button to be able to instantly change any of the outputs between V-Log or V-709, or you could even assign three user buttons, one to each monitor output, and be able to toggle any of them between V-Log or V-709.

LCD Clean View: This function toggles the display overlays on or off the LCD. One press of the button will remove all the readouts, timecode, center marker, audio level meters, and pretty much everything else, resulting in a (as it says) Clean View of the LCD. Press this User Button again and it will restore all your displays.

LCD Marker: Similar to LCD CLEAN VIEW, this User Button will toggle the various marker displays on or off your LCD. Examples of the types of markers that will be affected include the center crosshairs, the framing guidelines, and the safe zone marker.

Color Bars: This function displays Color Bars on the LCD and on all available outputs. The color bars can also be recorded. You can configure which type of color bars (SMPTE or full-height) and also what type of tone will be played (if any) when the color bars are displayed, in the OUTPUT SETTINGS>COLOR BARS menu.

Power LCD: This User Button brightens up the LCD display. It's designed to make the LCD more viewable and readable when the camera is in bright light conditions. Using the POWER LCD will make the image on the LCD brighter and will use more battery power, but it may make the image easier to see when the prevailing light conditions are bright.

USER SWITCHES>User Toggle

There is a switch at the lower left corner of the left side of the camera with three positions: WB, USER, and ISO/dB. When that switch is set to the middle USER position, then using the jog wheel when using the VIEW screen (or during recording) will control one of four user-settable functions. Which function it controls is set here, in the USER TOGGLE menu. The choices are:

Inhibit: This disables the jog wheel when the three-position switch is in the middle/USER position.

Shutter: This setting allows you to modify the shutter speed. Just rotate the dial and you can see the immediate effect on the exposure. The choices of shutter speeds are displayed on the bottom of the LCD (unless you've chosen to hide all LCD overlays using the LCD CLEAN VIEW).

FPS: This allows you to change the variable frame rate (VFR) the camera is shooting at. Press the wheel in (like a button) to toggle VFR on or off; when VFR is enabled, the frame rate will be displayed at the bottom left of the LCD, next to the audio level meters. Pay attention to the audio meters, because if you choose a frame rate different from the camera's FREQUENCY setting, audio will not be recorded. As you change the frame rate by rotating the wheel, you'll see that the audio meters get replaced by an "A.REC" symbol with a slash through it, signifying that audio recording is not active. The availability of VFR mode depends on your FREQUENCY setting; variable frame rates are not available at all if the system is set to 50.00i or 59.94i, for example. And, the range of available frame rates will vary depending on what you have the SENSOR MODE set to: S35 5.7K allows up to 60 fps, S35 MIX 2.8K allows up to 120 fps, and 4/3 CROP&MIX 2.2K allows up to 240 fps. And, if the SENSOR MODE is set to S35 5.7K, then the frame limit will also be dependent on which MAIN CODEC you've set; the 422ALL-I 400M and 422LongGOP 150M only allow up to 30 frames per second; the 420LongGOP 100M allows up to 60 frames per second. Also once you've made your frame rate selection, don't push the wheel in again -- that would cancel VFR mode and return you to normal shooting. The VFR frame rate mode is active only when the actual frame rate is displayed in the lower left of the LCD. Lastly, note that the exposure may change as you change the frame rate, depending on how you have the shutter set. If the shutter is set to a certain angle (such as "180.0deg" or "90.0deg"), then the shutter speed (and your overall exposure time) will be calculated based on the frame rate. A shutter setting of 180 degrees will expose for only half the duration of each frame, so if shooting 24 frames per second, a 180-degree shutter will provide 1/48 exposure. A shutter setting of 90 degrees is even shorter and will provide less exposure; at 24 frames per second a 90-degree shutter will open for 1/96 of a second. At 30 frames per second a 180 degree shutter provides 1/60 exposure, and a 90 degree shutter provides 1/120 exposure.

Monitor Vol: This allows the wheel to set the volume level of the headphone jack or the built-in speaker. To activate the volume control, first push in the jog wheel like a button; that will bring up a display where you can then choose the desired volume level.

SIDE LOCK

This menu item lets you control which buttons are locked out, and which ones remain available, when the sliding LOCK switch is slid to the locked position.

LED & FAN>Tally LED

The camera has two “tally” lamps, which light up when the camera is recording. You can select the behavior of those lamps in this menu. For example, sometimes interview subjects may get nervous when they see the red light on the camera come on; you could configure your camera so that only the rear tally light comes on, thus avoiding spooking your interview subject. Or, if you’re filming into a reflective surface, you may not want the red light to be visibly reflected in the shot. Or, perhaps you don’t want anyone to know the camera is even on at all, during stealth recording -- you may want to turn off both tally lamps in that case. Or, if you’re a news reporter tasked with also operating the camera, you’d probably certainly want to make sure the front tally lamp is on, so you know for sure it’s recording. In any case, this menu lets you control the operation of both lamps.

LED & FAN>Access LED

This menu item controls whether the green or amber lights next to the memory card slots will light up. Generally you’d want these on, as you usually want to know which card is currently being recorded to and you most definitely want to avoid ejecting a card that’s currently being accessed! Turning the lamps off would essentially enable a “stealth” mode where someone observing the camera wouldn’t even know that it was actively recording. Unless you have a strong need for such stealth, I highly recommend leaving this menu item set to ON.

LED & FAN>Power LED

This enables or disables the red “POWER” LED located above the power switch. Disabling this light can make the camera look like it’s not even on, even if it is, perhaps useful for stealth recording. Don’t confuse this menu item with the User Button function POWER LCD, which is a way to set the LCD panel’s brightness higher.

LED & FAN>Fan Speed

The cooling fan in the camera can operate at various speeds depending on how hot the camera is. Generally in AUTO, it will operate at low speeds

unless the camera's temperature gets higher than the system determines is too high; at that point the fan will kick into a higher speed to cool the camera off. That may or may not occur at a convenient time; if you're recording in a quiet environment it's possible that the fan kicking in might be audible on your soundtrack. Generally the fan is extremely quiet and it would be unlikely for it to be audible to an off-camera microphone, but if you want to make sure the fan noise is consistent you might want to set this menu item to FULL, which keeps the fan on high speed continuously.

LCD>Brightness

The LCD panel in the camera can be adjusted for a number of parameters; this menu item adjusts its brightness. The brightness can range from -15 to +15. Setting the brightness is a task best left for when calibrating the LCD to properly display the color bars. You shouldn't think of this as a quick fix for shooting in bright light conditions by just arbitrarily cranking up or closing down the brightness, as this can affect the accuracy the LCD screen is able to display. Put on the COLOR BARS first, and you will then be able to see better how the LCD>BRIGHTNESS menu item is affecting the LCD's black level and white levels. Note also that this function is entirely independent of the POWER LCD function; even with the LCD>BRIGHTNESS at its maximum, the POWER LCD will still make it brighter.

LCD>Color Level

The amount of color saturation the LCD displays is settable with this menu item. At -15, the LCD is a monochrome display; at +15 it will be overly saturated. It's probably best to set the color level in accordance with the color bars, to make sure the LCD is displaying a proper picture that accurately reflects the footage that's being recorded.

LCD>Contrast

Yet another LCD display adjustment, the CONTRAST control is capable of a wide range of adjustment. Use the COLOR BARS to calibrate the LCD monitor properly for an accurate display.

LCD>Back Light

This is an overall brightness control, generally similar to POWER LCD but with the ability to set the LCD slightly darker (-1) or slightly brighter (+1). It does not work together with POWER LCD; if you enable POWER LCD it will take precedence and ignore what you've set in this BACK LIGHT menu. The brighter you set the LCD, the more power will be used; for maximum

battery life you may want to set this to 0 or even -1. On the other hand, the brighter the LCD, the easier it is to see in daylight/bright light conditions; a setting of +1 may help, but generally POWER LCD is probably the better choice for bright exterior use.

INFORMATION>Version

The current version of the camera's firmware and other diagnostic information is available in this menu. You should monitor Panasonic's website for new firmware releases; using this menu item you can check what version of firmware your camera is currently running.

INFORMATION>Operation Time and Sensor Temp

These menu items let you view, but not change, the hours of operation, the # of turns of the Iris Dial, and the current temperature of the sensor. Sensor performance may degrade a bit under hotter temperatures; hotter sensors may display more noise, for example. If the sensor is getting warm, you may want to turn the cooling fan on FULL for a while.

INFORMATION>USB Service Mode

There is a mini-USB port located on the back of the camera, labeled "SERVICE". If you enable USB Service Mode, and then plug the camera into a computer using this mini-USB port, the camera will mount to your computer's desktop as an external USB memory card. You can then open that memory card and see the LICENSE.TXT file, which contains various legal licenses for public domain or other software as used in the camera.

INFORMATION>Update

This menu item is for executing a firmware update. If Panasonic releases newer firmware than what you currently have installed, you can place that firmware (called UPDATE.HDC) onto the root of a memory card, and install that memory card in the camera. Then, go into the menus and execute this UPDATE command to start the firmware updating process.

INITIALIZE

This menu item will restore the camera to its factory-original default settings. If the camera's behaving in unexpected ways or you don't understand what's changed and you just want to basically hit the "reset" button, this menu item will restore the factory settings.



Camera Settings Menu

The Camera Settings menu is where you'll be able to set the basic operational parameters of the camera, such as frame rate, shutter speed, and ISO sensitivity.

FPS>VFR SW

VFR stands for Variable Frame Rates, this menu enables, or disables, the variable frame rate feature. If VFR SW is set to OFF, then variable frame rates are not enabled. If it's set to ON, then you can use the variable frame rate feature. The main reason to set this to OFF is to avoid accidentally entering VFR recording, which could seriously compromise your footage and, perhaps more importantly, could disable sound recording. When VFR is enabled, sound is only recorded when the frame rate chosen matches the SYSTEM MODE>FREQUENCY parameter (so, 24 fps in a 24.00P frequency, or 59.94 fps in a 59.94P frequency). Note: this function does not override the USER TOGGLE switch's ability to enable or disable VFR. If you press the jog wheel when the three-position toggle switch is set to USER, and the function in SYSTEM SETTINGS>USER SWITCHES>USER TOGGLE is set to VFR, then it will change the state of this menu item between OFF and ON. Also note, the other items in this menu (VALUE, ADD, EDIT, and DELETE) are disabled when the VFR SW is set to OFF. You can only change those items when VFR SW is set to ON.

FPS>Value

This menu item lets you select what frame rate will be used when VFR SW is set to ON. The lowest entry of the list is called SYSTEM FREQ, and setting the VALUE to the SYSTEM FREQ will effectively disable variable frame rates and will enable audio recording. Setting the VALUE to anything other than the same number as the SYSTEM FREQ will disable audio recording. Note that the list of available frame rates is not all-inclusive; the factory

default is to allow a wide variety of frame rates but it doesn't include every possible frame rate. You can modify the list by using the FPS>ADD, EDIT, and DELETE functions.

FPS>Add

This function allows you to add a frame rate to the existing list of selectable frame rates. Do be aware that the list has a maximum possible size of 150 entries, so if you are trying to add a frame rate to the existing list and the camera won't let you, it's possible that you've already exceeded 150 entries (in which case you'd have to go in and edit and delete some of your unused entries to make room to add the new frame rate.)

FPS>Edit

This function lets you change the currently selected frame rate, in two ways. It changes the frame rate you're currently shooting at, but it also modifies the list of available frame rates. For example, in the standard frame rate list, there's an entry for 36, 42, and 48 frames per second. If you chose 42 fps (using FPS>VALUE), but you decide what you really wanted was 39 frames per second, you have two choices: you could use FPS>ADD to add '39' to the list, or you can use this FPS>EDIT command to change the '42' entry to become '39'. That way your list stays the same size (important if you've already used the maximum 150 entries) and the '42' will no longer exist, it will be replaced by a new '39' entry.

FPS>Delete

This will remove the currently-selected variable frame rate speed from your list of available frame rates. It will shrink the overall size of your list as well, making it quicker and easier to select among your chosen frame rates. Be aware that you can't delete the last entry in the list; your list must be at least 1 item long.

SHUTTER>SW

This function enables or disables the electronic shutter. Generally the shutter is "on", and you can select the exact shutter speed from the list of available speeds. You do have the ability to disable the electronic shutter. Doing so will allow the maximum amount of light to enter the camera, as the shutter would be considered constantly "open".

SHUTTER>Mode

The shutter has two operational modes, SEC and DEG. SEC stands for "seconds", and in this mode the shutter will remain open for a fixed amount

of time (such as 1/60.0 or 1/48.0). When using SEConds, the actual frame rate doesn't really influence the exposure time; the exposure time is set to a fixed amount of time; for example, 1/250 will deliver the same exposure whether you're shooting at 2 frames per second or 240 frames per second). The only influence the frame rate will have on your shutter speeds is that you cannot select a shutter speed that has a longer duration than the frame rate of the camera (meaning, at 24 fps, the slowest shutter speed you can set would be 1/24.0; at 120 fps the slowest shutter speed you can set would be 1/120.0). Or, another way the frame rate can vary based on shutter speeds is the "HALF SHUTTER" option; this functions equivalent to setting the shutter to 180.0 degrees (see below).

When using DEGrees, the frame rate has a direct influence on the shutter speed. The shutter duration is not fixed per se; it is instead fixed based on a mathematical ratio between the degrees you select, and the frame rate you select. In DEGrees, the shutter speed is calculated as the reciprocal of multiplying the frame rate * 360, and dividing by the shutter degree that you set. A full circle contains 360 degrees; a half circle would contain 180 degrees, and a quarter circle would contain 90 degrees. So if you want the shutter to be open for half the duration of a frame, and closed for the other half, you'd choose a shutter angle of 180 degrees. 180 degrees is a common film camera shutter speed, and choosing 180 degrees should impart generally film-like motion blur to your footage at whatever frame rate you've selected, since a 180-degree shutter generally mimics the exposure time of a 180-degree film camera shutter. At 24 fps, a 180-degree shutter results in 1/48.0-sec exposure times: $1 / (24 \text{ fps} \times 360 \text{ degrees} / 180 \text{ degrees}) = 1/48$. If you were shooting high-speed footage and wanted to maintain that same shutter relationship, a 180 degree shutter at 120 frames per second results in a 1/240.0 shutter speed.

The main thing to understand is that in SEConds, the exposure time is absolute and independent of the frame rate. In DEGrees (or HALF SHUTTER), the exposure time is relative and entirely dependent on the frame rate.

If you're trying to synchronize the camera's shutter with a television or computer monitor, you should probably use SEConds, and point the camera at the computer monitor and then scroll through the shutter speeds until you find one that makes the monitor stop flickering. For television screens in the USA, you'll normally want to use a shutter speed of 1/60.0, and in PAL territories you may want to use 1/50.0. Computer monitors operate at

a wide variety of scanning frequencies, so you'll just have to scroll through the options until you find one that works.

Also, be aware that since the AU-EVA1 camera uses a rolling-shutter CMOS sensor, modifying the shutter speed can sometimes cause side effects depending on what type of lighting you're shooting under. See the section on ROLLING SHUTTER CMOS SENSORS for more information.

SHUTTER>Value, Add, Edit, and Delete

The camera maintains two lists of commonly-selected shutter speeds: one list for DEGrees, and a second list for SEConds. You can add, edit, and/or delete entries from those lists, using the same procedure as described under CAMERA SETTINGS>FPS, with the exception that the shutter list can only hold 12 entries, as opposed to the 150 entries possible in the FPS list.

EI>Mode

"EI" stands for "Exposure Index". The camera's sensitivity can be expressed in one of two ways, either ISO (using common film speed terms) or in terms of decibels of gain (dB). If you're a film/cinema shooter, the ISO settings will probably be most familiar; if you're from the broadcast/TV side of the industry, you may be more familiar with decibels of gain. Either way, the functionality of the camera stays the same, all you're really selecting here is the naming terminology for expressing how light-sensitive the camera is and how far you're "pushing" the sensitivity.

Note that the choice you make here will change what menu items will appear. For example, if you choose "ISO", then menu items for ISO SELECT, NATIVE ISO, 800BASE ISO, and 2500BASE ISO will appear. On the other hand, if you choose "dB" all those menus will disappear, and be replaced by the GAIN MODE and GAIN SELECT menus.

EI>ISO Select

If you've chosen an EI>MODE of ISO, this menu item lets you choose the base native ISO you want the camera to operate at. The camera has two native ISO settings, 800 and 2500. Both are considered "native" ISOs. Due to the DUAL ISO technology in the camera, the sensor can be set to read out as "full" when at 2500 ISO sensitivity, or at 800 ISO sensitivity. 2500 is not arrived at by electronically "gaining up" the 800 ISO version; they are two separate operational modes. This menu item lets you choose the mode the sensor operates in. There are three choices:

800 BASE: This choice sets the camera in its 800 ISO native operation, and allows adjustability from that base. You can adjust the ISO using electronic gain between 200 to 2000 ISO depending on what gamma setting is currently employed, using the EI>800BASE ISO menu item. Generally setting the 800 BASE is more appropriate to use when shooting in brighter light conditions.

2500 BASE: This choice sets the camera in its 2500 ISO native operation, and allows adjustability from that base. You can adjust the ISO using electronic gain between 640 to 25,600 ISO depending on what gamma setting is currently employed, using the EI>2500BASE ISO menu item. Generally setting the 2500 BASE is more appropriate to use when shooting in lower light conditions.

NATIVE ONLY: This setting restricts the selectable ISOs to only the native ISOs; no adjustment is possible. When you've selected NATIVE ONLY, you don't have the option of applying a little bit of gain to make the image slightly brighter, or applying a whole lot of gain to make the image much brighter. Instead, you're restricted to only the native ISOs. The native ISOs are generally either 800 or 2500, but there is a case when the native ISOs are actually lower: if you set the SCENE FILE SETTINGS>GAMMA>GAMMA SELECT to "VIDEO", the native ISOs become 400 or 1250. Change that menu item to anything other than VIDEO, and the native ISO range becomes 800 and 2500 again.

Note: this menu item does not set the camera's actual operating ISO! Instead, it sets the operation mode of the sensor. You will be setting the actual ISO using one of the three commands below (EI>NATIVE ISO, EI>800BASE ISO, or EI>2500BASE ISO) depending on how you've set this ISO SELECT menu.

EI>Gain Mode

If you've chosen an EI>MODE of dB, this menu item lets you choose the base native sensitivity you want the camera to operate at. The camera has two native sensitivity options, NORMAL (ISO 800) and HIGH (ISO 2500). This menu item lets you choose the mode the sensor operates in. There are two choices:

NORMAL: This choice sets the camera in its normal mode, with a base sensitivity of 800 ISO, and allows adjustability from that base. Using the GAIN SELECT menu item, you can adjust the sensitivity using electronic gain between -12dB to +8dB when the SCENE FILE SETTINGS>GAMMA>GAMMA SELECT is set to anything other

than “VIDEO”, and between -8dB to +20dB when it is set to “VIDEO”. Generally setting the NORMAL gain mode is more appropriate to use when shooting in brighter light conditions.

HIGH: This choice sets the camera in its high sensitivity mode, at 2500 ISO, and allows adjustability from that base. Using the GAIN SELECT menu item, you can adjust the sensitivity using electronic gain between -6dB to +8dB when the SCENE FILE SETTINGS>GAMMA>GAMMA SELECT is set to anything other than “VIDEO”, and between -6dB to +26dB when it is set to “VIDEO”. Generally setting the HIGH gain mode is more appropriate to use when shooting in lower light conditions.

Note: this menu item does not set the camera’s gain level; instead, it sets the operation mode of the sensor. You will be setting the actual gain using the GAIN SELECT menu.

EI>Native ISO, 800BASE ISO, and 2500BASE ISO

These three menu items are taken together here because they’re basically three different ways of setting the current camera ISO. Once you’ve set the base ISO operational mode, you can then use one and only one of the three following menu items to choose what the actual ISO sensitivity of the camera will be.

NATIVE ISO: This setting is only available if you’ve set ISO SELECT to “NATIVE ONLY”. This menu item lets you choose either 800 or 2500 ISO in most circumstances; however, if the SCENE FILE SETTINGS>GAMMA>GAMMA SELECT is set to “VIDEO”, the native ISOs become 400 or 1250.

800BASE ISO: This setting is only available if you’ve set ISO SELECT to “800 BASE”. This menu item lets you choose your actual ISO from a range of generally 200 to 2000; however, if the SCENE FILE SETTINGS>GAMMA>GAMMA SELECT is set to “VIDEO”, the range will be 200 to 1000. The camera uses negative gain to set the ISO lower than native, and positive gain to set the ISO higher than native. The more positive gain that is used, the grainier and noisier the image will become. The more negative gain that is used, the more compressed the dynamic range may become. In other words, the further you push or pull the actual ISO from its base ISO, the more the quality of the images will be affected. As such, if you’re stretching the ISO quite far, such as pushing the 800 base up to 2000, you may find a more pleasing image quality by instead choosing the 2500 base ISO, and then lowering it to 2000.

2500BASE ISO: This setting is only available if you've set ISO SELECT to "2500 BASE". This menu item lets you choose your actual ISO from a range of generally 1000 to 25,600; however, if the SCENE FILE SETTINGS>GAMMA>GAMMA SELECT is set to "VIDEO", the range will be 640 to 25,600. See the discussion about gain and pushing/pulling in the "800BASE ISO" menu item above; the same effects will apply to the 2500BASE ISO.

Now that you've read all that, let's simplify ISO selection to two choices: when you want to establish a particular ISO, you first select your base ISO (either 800 or 2500, generally whichever is closest to your target ISO) and then you set the actual ISO using either the NATIVE ISO, 800BASE ISO, or 2500BASE ISO menu item (only one of them will be active, depending on how you set the ISO SELECT menu item).

EI>Gain Select

This menu item lets you select the amount of gain (negative or positive) you want to apply to the image, to adjust the sensitivity of the camera. The range of adjustability will change based on what EI>GAIN MODE you chose, and what GAMMA SELECT you chose. The range is much wider when GAMMA SELECT is set to VIDEO, and more restricted when GAMMA SELECT is set to something other than VIDEO. Excess use of gain can degrade the image quality; too much high gain can result in grainy/noisy pictures, and too much negative gain may result in loss of dynamic range. It's best to set the EI>GAIN MODE to the closest setting for your available light conditions, so that you can minimize the amount of GAIN SELECT you use to push or pull the image.

WHITE>AWB

This menu item executes an automatic white balance process. However, it will be disabled unless you set the next menu item (WHITE>VALUE) to "AWB MEMORY".

To take an automatic white balance, first set CAMERA SETTINGS>WHITE>VALUE to "AWB MEMORY". Then, set a pure white or true gray card in the same light that's hitting your subject (ideally, have the person hold the white card in front of their face). Zoom in on the card to fill the LCD display screen with all white, and adjust the camera's exposure so that the card isn't too white or too dark; anywhere between maybe 50 to 80 IRE should do. If the card is too bright (higher than about 90 IRE)

then it's possible that one or more of the color channels might be clipping, and your white balance might not be perfectly accurate. Once you have the screen full of a properly-exposed white card, then execute the WHITE>AWB command and the camera will sample the card and adjust its parameters until the card is rendering a proper white. Keep in mind that whenever the lighting conditions change, you should take another white balance to keep the camera's color rendering as accurate as possible.

WHITE>Value

This menu item tells the camera what color temperature (Kelvin temperature plus an adjustment offset for the green/magenta color axis) it should use to properly render colors in the current lighting conditions. The camera maintains a list of possible white balance values, including:

ATW: This setting instructs the camera to automatically adjust the white balance continuously. The Auto Tracking White function will compensate for changes in the lighting conditions, but, like all auto functions, it might change noticeably in the middle of your shot, so -- use good judgement as to when to employ ATW. Also, note that ATW is not an option when you've set the camera's SYSTEM SETTINGS>COLOR SETTINGS>MAIN to V-Log.

AWB Memory: This setting is what allows you to take a manual white balance. When executing the AWB command, the camera samples a white card and stores the appropriate color temperature into its AWB memory. When you set this WHITE>VALUE to AWB MEMORY, you're using the sampled white balance function. It is a prerequisite to set this WHITE>VALUE menu item to AWB MEMORY if you want to use the WHITE>AWB command.

3200K+0.0GMg: This is the equivalent to a 3200K preset on traditional video cameras. It is generally used when shooting under tungsten lighting. This preset has no green/magenta compensation for low-color-rendering light fixtures, so if you're using fluorescent lamps with 3200K tubes or LED fixtures, it may not be perfectly accurate; you may need to execute a manual white balance to properly compensate for any green/magenta shift that may be present in the light.

4300K+0.0GMg: This is a mixed-light preset. When your scene is lit by both daylight and tungsten lighting, this preset is designed to split the difference.

5600K+0.0GMg: This is the equivalent to a 5600K preset on traditional video cameras. It is generally used when shooting under daylight. This preset has no green/magenta compensation for low-color-

rendering light fixtures, so if you're using fluorescent lamps with 5600K tubes or LED fixtures, it may not be perfectly accurate; you may need to execute a manual white balance to properly compensate for any green/magenta shift that may be present in the light.

6300K+0.0GMg: This preset is generally used when shooting under daylight, but when the sun has gone behind the clouds and the light becomes a bit bluer, or when you're shooting in the shade, etc. This preset has no green/magenta compensation for low-color-rendering light fixtures, so if you're using fluorescent lamps with 3200K tubes or LED fixtures, it may not be perfectly accurate; you may need to execute a manual white balance to properly compensate for any green/magenta shift that may be present in the light.

WHITE>Add, Edit, and Delete

The camera maintains a list of commonly-selected white balance color temperatures. You can add, edit, and/or delete entries from those lists, using the same procedure as described under CAMERA SETTINGS>FPS, with the exception that the white balance list can only hold 12 entries, as opposed to the 150 entries possible in the FPS list.

When adding or editing, you can choose the Kelvin color temperature (basically choosing on the red/blue axis of the color wheel from 2,000 to 15,000K, lower numbers = more red, higher numbers = more blue). Then, you can also add a color correction factor on the Green/Magenta color axis, ranging from -10.0 to +10.0. The camera displays a vectorscope so you can see the effect your changes are having on the actual perceived color the camera is rendering. The ideal color balance on a neutral white card should result in the vectorscope displaying a single tiny pixel in the very center of the center square of the vectorscope. If you're seeing a long line or other shape, your white balance is probably notably off, and you may want to resort to doing an AWB to at least get a good idea of what the Kelvin temperature and G/Mg offset should be.

NR>ISO800, and ISO2500

The AU-EVA1 camera has sophisticated noise reduction circuitry that can help minimize the appearance of grain or noise in the picture. You can choose to selectively enable or disable noise reduction for either the 800 base ISO, or the 2500 base ISO.

Noise reduction works to minimize the amount of visible grain in the image, but a possible side effect may be that the finest details in your

image are smoothed over. With NR set to OFF, the image will be the sharpest it can be, and you may or may not notice a little “grittiness” in certain areas of the picture, especially out of focus areas. Setting NR to NORMAL 1 will smooth out some of that grit, setting NR to NORMAL 2 will smooth out even more. The maximum noise reduction comes with using the SMOOTH setting; this setting was designed to aggressively reduce noise for high-ISO shooting (but it’s not limited to just high-ISO scenarios; you can use the SMOOTH setting regardless of what your ISO is set to). While the SMOOTH setting eliminates the most noise, do note the name: SMOOTH. Generally the EVA1 is an exceptionally sharp camera, making very sharp pictures; in SMOOTH you may see some of that smoothing effect mentioned earlier. The results may be a loss of some high-frequency detail and the overall impression that the image is not quite as sharp as it previously was (although, even so, the oversampling of the 5.7K sensor means the image will still likely be as sharp or sharper than most cameras with 4K sensors).

You will probably notice noise more on the higher-resolution shooting modes (Raw 5.7K, and UHD and 4K). The downconversion process to 1080p inherently averages some of the noise out, so noise should be less visible (and noise reduction less necessary) when shooting in S35 5.7K sensor mode and downconverting to 1080p for recording. Similarly, the MIX modes (2.8K and 2.2K) result in the averaging together of noise values, so using the MIX sensor modes should result in somewhat lower noise than the S35 5.7K sensor mode does.

Note that Noise Reduction works whether you’ve chosen the ISO or dB mode of nomenclature; when setting EI>MODE to dB, the settings you set for ISO800 will also apply to when you’ve set an EI>GAIN MODE of “NORMAL”, and the NR settings you set for ISO2500 will also apply when you’ve set the EI>GAIN MODE to “HIGH”.

LENS SETTINGS>A. Iris Level Effect

With this menu setting you can bias the camera to automatically overexpose, or underexpose, when using the automatic iris exposure setting. The range is from 0 to 100. The camera default is 50, and at 50, the camera will expose the image at the proper video levels to the best of its ability. The lower you set the number, the smaller the iris the camera will choose, and the darker the camera will auto-expose. The higher you set the number, the larger the iris the camera will choose, and the brighter the camera will overexpose. With a setting of 0, the camera will underexpose the image by approximately two f-stops. At a setting of 100, the camera will overexpose the image by about two f-stops.

LENS SETTINGS>A. Iris Window

The automatic iris system judges exposure and adjusts exposure based not on the whole frame, but on only a portion of the visible field of view. You can modify that window to suit your shooting needs. The choices are:

NORMAL1: This is the default setting, and the automatic iris system sets the exposure based on an average of the central portion of the frame. It uses a large area of the frame to set the exposure.

NORMAL2: In this setting the camera ignores the top area of the frame, and uses an average formed from the bottom central area of the frame. This would be useful in exposing for landscapes while ignoring the sky, for example.

CENTER: In this setting the automatic iris system sets the exposure to a small window at the center of the frame. This is roughly equivalent to using a spotmeter to set exposure; you point the crosshairs at the exact tone you want the camera to expose to, and you'd probably want to lock exposure at that point. It is still sampling an area around the center so it's not a true spot exposure, but the area sampled is tighter in CENTER than it is in NORMAL1.

LENS SETTINGS>A. Iris Peak/Ave

This menu item instructs the automatic iris system how highly to factor in the areas of peak brightness, as a percentage of the overall average brightness. The default setting is 30, meaning that 30% of the overall average brightness will be set according to the brightest peaks in the scene, but you can set it as low as 0 or as high as 100. At 0, the camera will ignore peaks and will set the overall automatic exposure according to the rest of the scene. At 100, the camera will expose to preserve the brightest peak sections of the frame, with no regard to how that affects the rest of the image. As a practical matter, the lower you set this number, the brighter the image will expose, and the higher you set this number the darker the image will expose. When you tell the camera to preserve the peaks (by setting this menu item to a higher number), the camera will frequently lower the overall exposure to capture and preserve the peak highlights without "blowing out". On the other hand, when you tell the camera to pay less attention to the peaks (by setting a lower number here), it's possible that you may see more highlights "blowing out" as the camera raises exposure to accommodate the rest of the scene.

LENS SETTINGS>Grip Iris

The detachable handgrip has an iris wheel located where the operator's index finger would land. You can adjust whether the iris wheel opens the

iris by turning that wheel more to the left, or by turning it more to the right, whichever is more instinctive for the operator.

LENS SETTINGS>AF Offset

This menu item is a way to offset where the camera thinks it should be focusing. Instead of locking in at the point of critical focus, you can bias the system to choose a point a little closer (using + numbers, up to +20) or a little further away (using - numbers, down to -20). The default setting is 0.

In operation, it's pretty much like the A.IRIS LEVEL command, except for focus rather than iris. A.IRIS LEVEL lets you bias the exposure system to over- or under-expose; this AF OFFSET menu item lets you bias the one-push autofocus system to focus closer or further than it normally would.

This function may prove useful for someone wanting to use the depth of field to keep an object in focus over a particular range of distance. Knowing that the depth of field extends for 1/3 of its distance in front of the point of focus, and 2/3 of the distance behind the point of focus, one could establish a focus point that may keep an object within the depth of field within a certain range of movement. An example may be an interview subject who may lean forward or sit back in their chair; if you would normally cheat the depth of field a little bit forward to accommodate your subject's entire range of movement, the AF OFFSET may be a way to accomplish a similar purpose while using the ONE PUSH AF feature.

IR SHOOTING

This menu item removes or re-installs the infrared filter in the camera. Setting this to ON or OFF is fundamentally the same as if you'd assigned IR SHOOTING to a User Button.

E.I.S.>SW

The E.I.S. menu governs the Electronic Image Stabilization settings. This first menu item, SW, can be set to ON or OFF. When set to ON, the camera will attempt to electronically stabilize the images (but note, the E.I.S. cannot be enabled if the lens is using its own Optical Image Stabilization). Setting this menu item here is functionally identical to having assigned E.I.S. to a User Button.

E.I.S.>Zoom Position Data

The E.I.S. system needs to know what the lens's focal length is, in order to work properly. Many EF-mount lenses can automatically communicate their focal length to the camera. If you're using a modern electronic EF-mount lens, you probably want to set this to AUTO. If you're using a fully manual lens (perhaps using a Nikon F-mount lens through the use of an adapter, or using a PL-mount lens on a camera that's been converted to an aftermarket PL lens mount), you may need to manually tell the camera what focal length the lens is. In that case, set this menu item to MANUAL and enter the focal length in the next menu item.

For a list of lenses that have been tested and verified to work with the AU-EVA1, visit <http://pro-av.panasonic.net>. Panasonic has tested and verified the functionality of certain lenses, and the list may be updated as newer tests are conducted. Understand that the list is not all-inclusive; it's entirely possible that there are many lenses that will work perfectly with the camera, but they just haven't been tested yet. Also, some lenses may work with certain versions of lens firmware, but not be compatible with other versions of lens firmware. Electronically-controlled lenses sometimes need their own firmware updates, so it is incumbent upon the user to keep their lenses up to date.

E.I.S.>Zoom Position Value

If you've set the E.I.S.>ZOOM POSITION DATA to MANUAL, then you'll need to enter the lens's focal length here in this menu item. Choose the closest match to your lens's focal length, and be sure to update this number whenever you change lenses. Note that the maximum range is 8mm to 200mm; if you're using a lens longer than 200mm, don't expect E.I.S. to work properly.

AUTO BLACK BALANCE

This menu item is how you make the camera perform an Automatic Black Balance (ABB). Put on a lens cap or body cap so the camera cannot see any light whatsoever, and execute this command. The camera will evaluate the signal coming off its sensor and make whatever adjustments are necessary to ensure that black is being rendered as true black. Black Balancing should be done frequently; it helps the camera deliver more accurate colors and it also may help it to mask some noise in the shadows.



Scene File Settings Menu

The camera offers the ability to store and recall groups of image-control settings, called “Scene Files.” You can have up to five different “looks” pre-programmed into the camera and many more readily accessible on your SD memory card. The settings that make up these Scene Files are contained in the SCENE FILE menu.

The following descriptions of the scene file properties will give you a better understanding of how these settings affect the image. You may need to zoom in to some of the pictures at up to 300% to see the differences clearly.

Please note: the color photos included in this book are for convenience, but should not be taken as absolutely accurate, that would depend on the color accuracy of each computer monitor it is being viewed on. As such, the photos should be considered approximations.

Note: many of these menu items can be adjusted over a wide range (Chroma Level, for example, ranges from -99% up to +99%, that’s a range of almost 200 steps). It would be slow and tedious to use the touchscreen to navigate through 200 steps of adjustment. Consider using the menu/jog dial wheel instead, it’s much easier to move through many steps of adjustment by using the wheel. It’s especially efficient if you push the wheel in and hold it in while you move it up or down; it will rapidly scroll through the available settings as long as you hold the wheel in.

Name Edit

Each Scene File can have an individual name. You select which scene file (SCENE1 through SCENE5) you want to work with by using the SYSTEM SETTINGS>COLOR SETTINGS>MAIN menu option, and choosing SCENE1 through SCENE5. Then, using this NAME EDIT function, you can

type in a distinct name so you can remember what this particular scene file is supposed to accomplish, image-wise (examples might be BROADCAST for a scene file that's meant to create a standard Rec.709 broadcast-style image, or DVX200-LOOK for a scene file that's meant to match to a DVX200 camera, etc.)

Scene Data

The camera maintains an internal memory storage area where the Scene File data can be loaded or saved to. Note, this is NOT saving to or loading from a memory card; to save to or load from a memory card you'd use the FILE>SCENE FILE menu option.

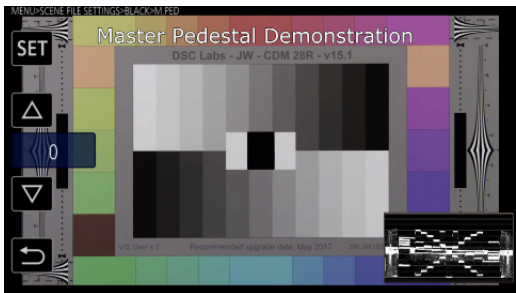
This Scene Data menu option provides the ability to “save” your current scene file into internal memory, or “load” the scene file back from that memory, or to “initialize” the scene file data back to the factory original state. Generally, whenever you're experimenting with a Scene File, you'd “save” it to memory before experimenting with various settings. That way you can discard any unwanted changes by restoring it to its saved state.

The camera maintains two sets of Scene Files. There's the current data that you're working with, and the “saved” data that's stored in internal memory. You can load the “saved” data in and overwrite the current data, or you can save the current data and overwrite whatever's stored in the “saved” data.

This “saved” Scene File will stay current in the camera until overwritten by another “save” operation. Changing the current settings doesn't change the saved data in internal camera memory; only executing a SCENE DATA>SAVE command will do that. If you want to export or share this Scene File data with another camera, or just keep it permanently, you can use the FILE>SCENE FILE menu option to write out the current Scene File data to the memory card in Slot 1.

BLACK>M. Ped

The MASTER PEDESTAL governs the overall brightness level of “black” in the picture. The lower you set the MASTER PEDESTAL, the lower, deeper, and richer the black level will be, and, correspondingly, the middle and darker tones overall may move lower. The lower you set it, the harder it becomes to distinguish between the darker items in the frame; at some point more dark items will all blend together into black, giving you stronger, harsher contrast and, after a certain point, a loss of detail in the shadow areas. Conversely, the higher you set the MASTER PEDESTAL, black will



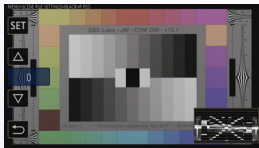
Click above for a video simulation of the M. Ped

gray than it is to discern between shades of deep black. Put another way, a higher MASTER PEDESTAL value may preserve detail in the darker areas of the picture but make the blacks “milky”; it may also affect the appearance of noise in the image.

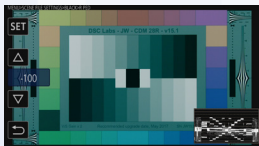
As such, there are very practical limits as to how far you’d want to adjust the MASTER PEDESTAL. Boosting or lowering the black level is certainly a valid image control to exercise, but exercise it in moderation; boosting or lowering it significantly will cause you to lose image detail due to crushing or clipping.

BLACK>R Ped, G Ped, and B Ped

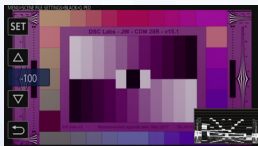
The MASTER PEDESTAL (M.PED) governs the overall black level for all three color channels. However, you can adjust each color channel individually to dial in a specific look. You can add or subtract any of the primary colors. The modifications you make here are temporary until the next Automatic Black Balance, but you can retain the offsets even through an ABB if you use the BLACK>PEDESTAL OFFSET menu item.



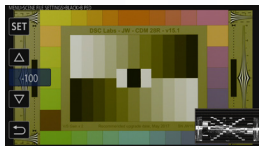
R.Ped/G.Ped/B.Ped at 0



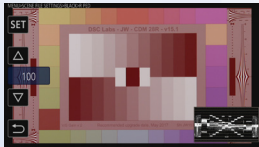
R.Ped at -100.



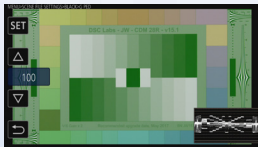
G.Ped at -100.



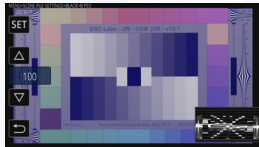
B.Ped at -100.



R.Ped at +100.



G.Ped at +100.



B.Ped at +100.

be rendered as a lighter and lighter shade of gray. This results in making the overall contrast look softer and flatter, but up until a certain point you may also preserve more detail in the shadows — it’s easier to discern between shades of medium

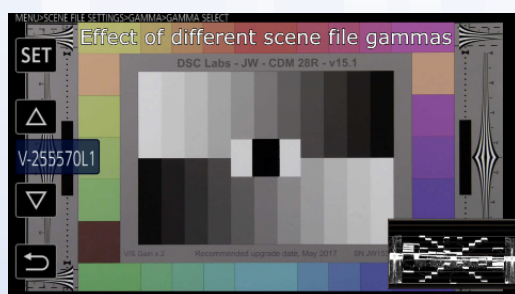
BLACK>Pedestal Offset

Generally, when performing an Automatic Black Balance (ABB), the camera will internally adjust its red, green, and blue channels to the appropriate levels to generate a true black output when seeing a true black image. However, the camera gives you the ability to adjust those individual channels using the BLACK>R PED, BLACK>G PED, and BLACK>B PED menu commands. This PEDESTAL OFFSET menu gives you the choice as to whether you want to retain your manual adjustments to the R PED, G PED, and B PED settings when doing an ABB process, or if you want the ABB process to automatically reset the R PED, G PED, and B PED to zero.

GAMMA>Gamma Select

The gamma curves control how brightness information is distributed in the picture. Gamma correction can correct for the nonlinear light-output characteristics of a standard TV picture tube. Picture-tube gamma (like on a CRT television) stretches the whites and compresses the blacks. Camera gamma compresses the whites and stretches the blacks. For the technically inclined, camera gamma can be properly set by using logarithmic gray scale charts and a waveform monitor. Camera gamma must be the reciprocal of picture gamma which is 2.2, so the camera gamma is usually 0.45.

Why is this a problem? Well, back when CRT monitors were the standard, their picture tubes created nonlinear response, and the cameras had to compensate in order to make proper-looking pictures. When new monitor technologies were being introduced (such as LCD, LED, and OLED), they didn't necessarily have to be constrained by the CRT tube's restrictions, but in order to work properly with the vast library of footage that had already been created, LCD/LED/OLED monitor manufacturers have continued the trend of using CRT-style gamma reproduction. And so, cameras need gamma functions to create images that will look "correct" when broadcast or displayed on these monitors.



Click above for a a video demonstrations of the gammas

The AU-EVA1 offers five different gamma curves (including V-LOG). The gamma curves in the camera affect how the sensor maps its tonality. If you are skilled in photo editing or video editing and post-production, you may

be familiar with the concept of applying “curves” to your photos or video footage, or of manipulating the “levels”. Essentially, that’s what the gamma function does, in-camera. By choosing among the gamma curves you can select from a variety of choices of how the camera maps the shadows, midtones, and highlights into displayable IRE values.

Note that you may or may not have access to the GAMMA function, or you may have limited access to its options, depending on how you’ve configured the SYSTEM SETTINGS>COLOR SETTINGS>MAIN menu item. If you’ve set it to V-LOG, then you won’t have an option of changing the GAMMA; the camera will automatically be recording using the logarithmic V-Log mode. If, instead, you’ve set the SYSTEM SETTINGS>COLOR SETTINGS>MAIN menu to one of the SCENE file options, then you will have your choice of four different gamma curves. The choices are:

V-255570L1: This is a video-appropriate gamma curve that attempts to generally retain the 14-stop latitude and the overall general shape of the V-Log gamma curve. It is more monitor-friendly than the very-flat V-Log curve. The name sounds confusing, but if we break it down to its component parts, it may make more sense (if you’re familiar with the video terms we’re about to use, that is).

V- stands for something like V-Log-Like.

25 - stands for the gamma’s rise, which is 2.5x.

55 - stands for the gamma factor, which is 0.55

70 - stands for 70%, the upper limit of the gamma rise.

Put that all together and you get V-255570, suffixed with L1.

The V-255570L1 gamma curve is designed to give a generally V-Log type of look, but with the emphasis on sharper contrast. The blacks will be deeper and darker, and the whites will be crisper and brighter, and the contrast between black and white will be more stark, when compared to V-Log or V-504580L1. The Operating Instructions recommend that darker skintones be exposed no lower than around 40 IRE, and lighter skintones should be properly exposed at no higher than around 55 IRE.

V-504580L1: This is a gamma that is pretty much halfway between V-255570L1 and the V-Log gamma curve. It is a little more monitor-friendly than the very-flat V-Log curve, but it is still quite flat. The name stands for:

V- stands for something like V-Log-Like.

50 - stands for the gamma’s rise, which is 5.0xx.

45 - stands for the gamma factor, which is 0.45

80 - stands for 80%, the upper limit of the gamma rise.
Put that all together and you get V-504580, suffixed with L1.

The V-504580L1 gamma curve is designed to give a generally V-Log type of look, but with the emphasis on preservation of dynamic range, and as such it will render a softer-contrast image. The blacks will be less crushed and perhaps more “milky”, and the whites will be softer, and the contrast between black and white will be softer, when compared to V-Log or V-504580L1. The Operating instructions recommend that darker skintones be exposed no lower than around 40 IRE, and lighter skintones should be properly exposed at no higher than around 60 IRE.

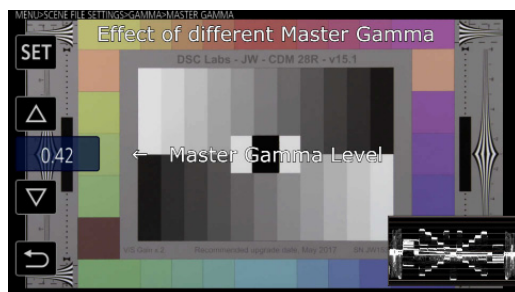
VIDEO: This gamma produces standard video-looking pictures according to the international standard Rec 709. It’s basically your typical, “video”-looking picture. The VIDEO gamma is an all-purpose gamma that can be used for many situations, but it is a particularly suitable choice for sports, news, or other footage where the immediate, “live” look is the goal. You can customize the shape of the gamma curve using other menu items such as BLACK GAMMA or KNEE. In terms of dynamic range, the VIDEO gamma is rated at 600%, which means it can hold about 3.5 stops above middle gray. Note that choosing the VIDEO gamma will enable a number of menus in the SCENE FILE SETTINGS menu that would otherwise be disabled.

HLG is a hybrid of a regular video gamma in the lower and midtones, and a logarithmic encoding of the upper half of the tones. The purpose behind HLG is to support High Dynamic Range (HDR) recording for television, and the HLG gamma curve extends the dynamic range to 1200%, when compared to the VIDEO gamma’s max of 600%, storing a full stop more dynamic range than VIDEO does. The Hybrid Log gamma also uses BT.2020 colorspace. To put it in perspective, conventional standard-dynamic range display devices can encode and display up to about 10 stops without visible banding. HLG extends that to up to 17.6 stops without visible banding. The AU-EVA1’s sensor is capable of rendering a full 14 stops of dynamic range, so HLG is more than enough to handle the entire range of the sensor (as is V-Log).

When comparing HLG to V-Log, it should be remembered that HLG was designed primarily as a transmission gamma. V-Log is designed as an acquisition gamma; it is designed to mimic the transfer characteristics of film to video. V-Log is not meant for final viewing, it is meant to be graded and colored and otherwise manipulated in post to make a final viewable image. HLG could be used to broadcast

High Dynamic Range (HDR) video as-is. HLG would be a suitable choice for a live production sending broadcast-ready HDR footage.

GAMMA>Master Gamma



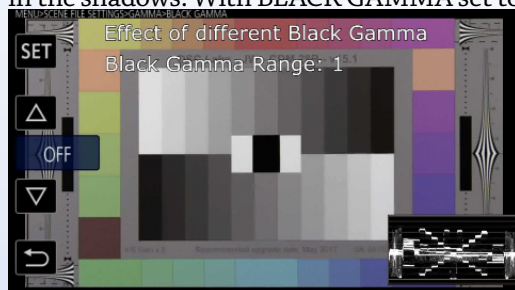
Click the video above for a demonstration of Master Gamma

When you choose the VIDEO gamma curve, you can also modify the shape of the gamma curve. You can take it as low as .30 or as high as .75. The lower you set it, the more the dark tones will stretch out, and the more the lighter tones will compress. And the higher you set it, the

more compressed the lower end of the tonal scale, while expanding the higher end of the scale. At 0.50, the central crossover point on a DSC Labs ChromaDuMonde chart is properly rendered at about 55 IRE. Setting the MASTER GAMMA to its lowest setting (0.30) results in that same crossover point being rendered at 65 IRE, effectively grabbing the midtones and dark tones and stretching them up higher. Setting the MASTER GAMMA to its highest setting (0.75) results in the crossover point being rendered at about 43 IRE, effectively grabbing the midtones and pulling them down some.

GAMMA>Black Gamma

When using the VIDEO or HLG gamma curves, the BLACK GAMMA function lets you pull the shadows down darker, or push them lighter. This function determines just how much to pull or push the dark range of the gamma curve. A setting of 0 is standard and leaves the gamma curve unmodified; a negative setting pulls the shadows/dark tones down (and the lower the number, the deeper the shadows are pulled); this can result in sharper and harsher contrast and, if taken too far, can result in losing detail in the shadows. With BLACK GAMMA set to positive numbers, that results



Click the video above for a demonstration of Black Gamma and Black Gamma Range

in pushing the shadows up, brightening up the darkest tones in the image. This will, of course, reduce the overall contrast in the image, but it can also help preserve shadow detail that might otherwise be lost. BLACK

GAMMA doesn't result in increased exposure latitude, but it does help you to discern and emphasize what latitude the camera has already captured. Do be aware that pushing the shadows brighter can result in noticeably more noise in the image; noise lives in the darker regions, so magnifying those regions will also magnify the noise that is in them. In some ways you can think of the BLACK GAMMA as sort of a "dark knee"; BLACK GAMMA lets you manipulate the dark tones of the image sort of similarly to how the KNEE lets you manipulate the brightest tones of the image.

GAMMA>B. Gamma Range

This menu setting determines just how much of the exposure range is affected by the BLACK GAMMA menu option. In general, setting "1" means that BLACK GAMMA will stretch or crush the range from 0 to about 20 IRE; setting "2" means that BLACK GAMMA will stretch or crush the range from 0 to about 30 IRE, and setting "3" means that BLACK GAMMA will stretch or crush the range from 0 to about 40 IRE. See the video under GAMMA>BLACK GAMMA for a demonstration of the Black Gamma Range.

KNEE>Knee SW

The KNEE helps smooth the transition to overexposure by compressing and rolling off the intensity of the brightest parts of the picture. With the KNEE circuit engaged, the camera will detect when the highlights are getting too bright and will start attenuating the signal to bring them back lower to be within the 109-IRE limit of video brightness. This can help to save detail in clouds in a bright sky, for example.

Why would you want to turn the knee off? It seems like a good thing, doesn't it? It saves highlights? Well, yes, it does, but it does so by artificially compressing the brightest range of tones. The result is that the highlights may not look natural, they may lose color saturation, they may lose detail, they may even shift color somewhat. For the most natural rendering of the scene, you would perhaps want to leave the knee OFF, and control your exposure to not let anything reach into the overexposure/clipping area. This is, of course, not always possible, and it's particularly challenging when shooting in uncontrollable scenarios (such as sports or news or live events); it's more practical to turn the knee off when you're shooting in a studio and/or under controlled lighting. Never ever let your flesh tones be adjusted by the knee! For the best skin tones, keep the knee OFF, or raise the KNEE POINT so high that it cannot possibly affect your skin tones.

KNEE>Knee Mode

The KNEE is only available if you've set the GAMMA>GAMMA SELECT to "VIDEO". If you've set it to "HLG", the HLG KNEE will be available instead.

First, understand how the knee operates in general, and then we'll discuss the specific operating modes.

Think of image rendering in terms of the IRE scale; the very darkest sections of the image (pitch black) will be represented at 0 IRE, a medium gray will be represented at about 50-55 IRE, and the brightest whites will be represented at about 100 IRE. You can establish a specific point on the IRE scale where you want the knee to start working -- this is called the KNEE POINT. So if you establish a KNEE POINT of 90, that would mean that the knee would ignore any areas of the image that are rendered from 0 to 89 IRE, and will only start working on the portions of the image that reach or exceed 90 IRE (because you set the KNEE POINT to 90). If you had set the KNEE POINT to 95, the knee circuit would ignore any parts of the image that are at 0 to 94 IRE, but would "kick in" to manage any image elements that reach or exceed 95 IRE.

What happens to those portions that exceed the KNEE POINT? That's what you determine by using the KNEE MODE, and the KNEE SLOPE.

The knee can operate in one of two modes, to determine what it does with the brightest tones in the image:

PRESS is a conventional interpretation of the knee. In this mode, the knee will commence attenuating the brightness of any parts of the image that meet or exceed the KNEE POINT, and the rolloff will be at a specific and defined rate (as set by the KNEE SLOPE). If you establish a sharp slope (more vertical), it's possible that potential image data will be lost (dynamic range will be sacrificed) because the knee would roll off the overbright portions at a mild rate. On the other hand, if you set too aggressive a slope (more horizontal), it's possible that you could force a hard clip situation where the brightness is rolled off so sharply and quickly that it effectively clips the image with little to no rolling off taking place. Either way, data may be lost, but what will be preserved is the ratio or slope of the rolloff. Regardless of how overbright the scene may be, the rolloff will be predictable and proceed at a predetermined rate, up until the image clips at the WHITE CLIP point. In PRESS, the most dynamic

range is preserved when you set a lower KNEE POINT, giving the knee the most room to work. However, because image data in the knee's area may be affected by color shifts, you definitely don't want to set the KNEE POINT low enough that it could interfere with your subject's skin tones!

D RANGE is a different interpretation of the knee. In this mode, the knee will always account for all the image data the sensor can see above the KNEE POINT. It will then compress as much of that information as it can into the area above the KNEE POINT, but it does have to take into account the KNEE SLOPE. The steeper the KNEE SLOPE (the more vertical it is), the less dynamic range will be retained. The more gradual the slope (the more horizontal the slope angle), the more of the sensor's dynamic range can be fit into the output signal before hitting the WHITE CLIP point.

KNEE>Knee Point

This setting lets you decide at what point on the IRE scale the knee begins working. The range is from 75% to 109%. What this means is, the knee circuit will ignore any area of the image that is less bright than the KNEE POINT. Only sections of the image that are as bright or brighter than the KNEE POINT will be modified. How much they will be modified depends on the KNEE SLOPE setting.

The lower you set the KNEE POINT, the more of the image will be affected by the knee. Generally, you want to keep the knee away from your skin tones; knee compression on skin tones can make them look quite ugly. The proper exposure range for skin tones varies depending on which gamma you are using; for the VIDEO gamma the lightest, fairest Caucasian skin should generally not be exposed over about 80 IRE whenever possible; when using V-LOG, that maximum should be around 55 IRE. The KNEE POINT's minimum value is 75%, so when shooting in VIDEO gamma, it's possible that the skin tones might encounter the knee. The solution, of course, is to set the Knee Point higher. The default is 93.0 IRE. At that setting, it's unlikely that the knee will interfere with skin, but it's more likely that it will come into play to try to retain detail on something that's superbright, such as clouds in the sky.

Generally, set the KNEE POINT as high as you can to keep it from interfering with image detail that has been exposed properly; you generally only want the knee working with superbright areas that are prone to overexpose. On the other hand, the lower you set the KNEE POINT, the more range the knee has to work with and the more gradual the highlight rolloff can be.

KNEE>Knee Slope

With the KNEE POINT you set at what IRE threshold the knee begins compressing the signal. With the KNEE SLOPE, you tell the knee how quickly to compress the signal. The range is between 0 and 100; at a setting of 0 there will be no compression, and at a setting of 100 the knee will extremely aggressively squash any highlights in the range at or above the KNEE POINT. At lower settings the knee slope is more like a vertical line, and at higher settings the knee slope is more like a horizontal line.

For maximum dynamic range retention you'd want to set the KNEE SLOPE as gentle (small) as possible while still holding on to the very brightest sections of the image. If you set the KNEE SLOPE too high, it's entirely possible that it will squash highlights so thoroughly that none of them ever reach the 109 IRE limit; in doing so, you wouldn't be avoiding signal clipping, you'd in fact be causing it. As an example: imagine you had a scene with the knee turned OFF, and highlights as high as 109 IRE. If you set the KNEE POINT to 80, and set the KNEE SLOPE to its most aggressive compression of 100, the result would be that everything in your image at 80 IRE and above would be squashed down to 80 IRE — effectively forcing a hard clip. Generally, that's not the desired outcome of using the knee!

Consider that normally, as the intensity of light increases, so does the signal proportionally until the signal exceeds the ability of the camera to record it; any brighter and it just clips to solid white. The knee extends the dynamic range by compressing high intensity signals, somewhat like an audio limiter compresses audio signals to prevent overmodulation and distortion. But, just like an audio limiter, limited audio doesn't sound all that great, and knee-limited video doesn't look all that great. It looks better than clipped whites, but it's still something to be used sparingly if image fidelity is your principle concern.

HLG KNEE

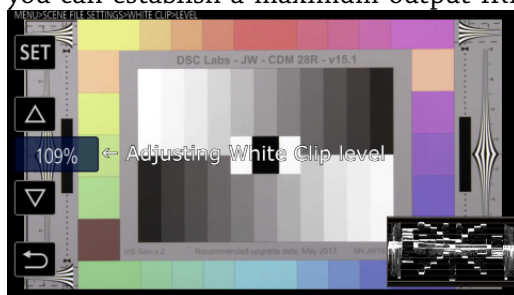
This menu is only available if you've set the GAMMA>GAMMA SELECT to "HLG". This menu's options work just like the KNEE settings do, so refer to KNEE>KNEE SW, KNEE>KNEE POINT, and KNEE>KNEE SLOPE. The settings are different because of the much wider highlight range HLG can accommodate as compared to a video gamma. Generally you'll use a lower HLG KNEE>KNEE POINT than you would use a KNEE>KNEE POINT, and a milder HLG KNEE>SLOPE than you would use a KNEE>KNEE SLOPE.

WHITE CLIP>SW

This menu is only available if you've set the GAMMA>GAMMA SELECT to "VIDEO". This menu item lets you enable or disable the white clip circuit. You can establish a hard level above which no data is allowed -- anything that would render above that given level would be rendered as pure white. Setting WHITE CLIP>SW to ON enables the white clip circuit.

WHITE CLIP>Level

If the WHITE CLIP>SW is set to ON, this menu item lets you establish the white clip level (from 90 to 109 IRE). Using the WHITE CLIP>LEVEL, you can establish a maximum output IRE signal that the camera will



Click the video above for a demonstration of White Clip Level

generate, and anything brighter than that level will be forced to match the WHITE CLIP>LEVEL setting. An example of when you might want to use this is if your broadcaster has specified that they want the white level set to 100 (or some other value).

Without the WHITE CLIP>SW enabled, the camera can generate values up to 109 IRE. With the WHITE CLIP>SW enabled, you can specify a maximum level between 90 and 109 IRE.

DETAIL>SW

In the simplest terms, the DETAIL circuit makes the image look sharper (or softer, depending on which way you set it). Now, that's not what it really does, but that's what it looks like it does. If you want the picture to look sharper, you can turn the DETAIL>SW on, and then just crank up the DETAIL>MASTER LEVEL level to the positive values (up to +31) and the image will, upon casual inspection, indeed look sharper. But there are side effects, and that's why it's valuable to know what the detail control is actually doing to the image. The more you know about it, the more prepared you are to use the right settings for any given circumstance.

In a nutshell, the DETAIL circuit controls edge enhancement and overall electronic sharpening of the picture. It doesn't actually make the image any

higher resolution, but it makes it visually appear to be sharper by enhancing the contrast around fine details. Video cameras use a sharpening circuit (or edge enhancement, or “detail”) to artificially increase the perceived contrast of the image. It works because humans use two main criteria to judge the sharpness of an image: resolution, and contrast. The camera always delivers the same amount of resolution (within each given mode), but the **DETAIL>MASTER LEVEL** can be used to control how much additional contrast is added to the edges. See the **DETAIL>MASTER LEVEL** menu option for more information.

This menu item governs whether any sharpening/edge enhancement is done at all, or if it’s all disabled.

DETAIL>Coring

DETAIL>CORING is another one of those functions that “appears” to do one thing, while “actually” doing something else. At its most basic level, you can think of Coring as a noise control; the higher you set it, the less noticeable the noise should be in your image. That’s not really what it does, but it appears to mask the appearance of noise in the image. To understand the effect of **DETAIL>CORING**, you have to understand the interaction between **DETAIL>MASTER LEVEL** and noise in the image. The **MASTER LEVEL** control tells the system to accentuate contrast between low-contrast elements of the picture, but it doesn’t know the difference between fine high-contrast detail, and noise in the signal. As such, a high **MASTER LEVEL** makes the noise significantly more visible; a high **MASTER LEVEL** actually causes the detail circuit to sharpen the edges of the noise, drawing attention to it. **DETAIL>CORING** can help bypass that process.

DETAIL>CORING can be thought of as a threshold control; the higher you set it, the wider the range of frequencies that will not be sharpened by **DETAIL>MASTER LEVEL**. The lower you set **DETAIL>CORING**, the more frequency range will fall under the jurisdiction of the **MASTER LEVEL** control. The higher the **DETAIL>CORING** setting, the more it will cause the system to ignore sharpening of high-frequency detail. This means that if you set it high enough, the noise won’t become sharpened/edge enhanced, making it less visible; the tradeoff is that your legitimate high-frequency detail won’t receive the contrast-enhancing sharpening effect either, so your image may not look as sharp as it otherwise could. Finding that level where you minimize the sharpening of the noise, but retain the sharpening you want, is the key to successfully using **DETAIL>CORING**.



Detail Coring 0 (view at 200% or higher)



Detail Coring 60

The effect of `DETAIL>CORING` is most noticeable when `DETAIL>MASTER LEVEL` is set to a high value (because the noise will be exaggerated when `MASTER LEVEL` is set to a high level; that makes the effect of `DETAIL>CORING` easier to observe.) When set to 0 (the minimum value), `DETAIL>CORING` has no effect on the noise. The higher you set it, the more it cleans up the image. At its maximum value of +60 it has a significant smoothing effect, and really cleans up the noise in the video signal (again, at the expense of legitimate detail).

Now, please understand it's not actually removing the noise, it's removing the sharpening that accentuates the noise, which makes the noise much less visible and less objectionable.

The higher the `DETAIL>CORING` setting, the smoother the image, but too high of a level can lead to your picture looking softer and even “blobby,” because if too much of the contrast-enhancing effect is removed, sections of the image with fine color transitions or detailed edges can look like one big “blob.” Removing all or most of the fine detail will affect surface texture and skin appearance. This is especially prone to happen if you're using a lower bitrate recording mode; the lower the bitrate, the more likely the compression engine will be to lump similar-looking sections together into one big blob. The presence of some noise can help the compression engine to avoid such “blobbiness” and can help to eliminate some gradient banding effects caused by low bitrate compression.

Also, the lower the `DETAIL>MASTER LEVEL` setting, the less effect `DETAIL>CORING` will have on the image. For maximum sharpness, detail and resolution on your image you may want to set `DETAIL>CORING` lower, but doing so may make noise more visible (noise manifests itself in a crawling texture on the surface of the video, sort of like film grain). With `DETAIL>MASTER LEVEL` set all the way down to -31 the image may look somewhat blurry if there's not adequate contrast in the scene already.

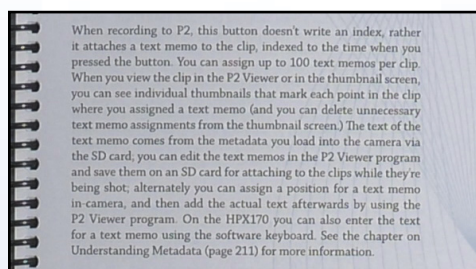
With MASTER LEVEL set up to +31 the image will look much sharper and crisper, but a higher MASTER LEVEL makes the edge enhancement more visible, resulting in artificial video sharpening that can look unnatural, or even coarse.

DETAIL>Master Level

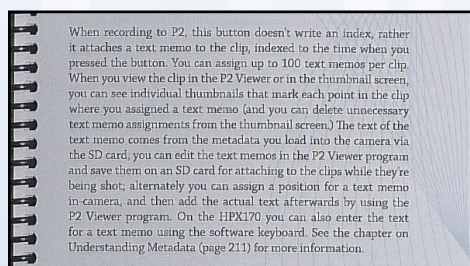
Please see the section on DETAIL>SW and DETAIL>CORING as these three topics are all interrelated.

The DETAIL>MASTER LEVEL menu option determines how much sharpening should be applied to the finer details in the image. This sharpening is also known as “edge enhancement.” When DETAIL>SW is OFF, no edge enhancement or sharpening will happen. When it’s set to ON, then the amount of edge enhancement is dictated by this DETAIL>MASTER LEVEL menu option. Note that the default value is “0”, but that does not mean there’s no edge enhancement happening! “0” is the midpoint; the scale ranges from -31 to +31. At -31, no edge enhancement will be applied; at +31 a significant amount of edge enhancement/sharpening will occur.

Also consider that the higher the MASTER DETAIL level is set, the more noticeable overall image noise will be! The noise is a fine fluctuation in brightness levels, which looks a whole lot like “fine detail” to the sharpening circuitry in the camera — and that’s why the edge enhancement process may actually sharpen the edges around the noise in the video signal. If you want



Master Level -31 (view at 300% for best results)



Master Level +31

to minimize the appearance of noise in your footage, lowering the MASTER LEVEL setting can go a long way towards accomplishing that. See the DETAIL>CORING section for more information on controlling noise from DETAIL>MASTER LEVEL.

When deciding on what MASTER LEVEL value to use, first consider how large your footage will be displayed. The larger the display, the less artificial detail you normally would want to use. On a small

screen a high detail setting can look fantastic, but on a movie theater screen it may look too artificial. Second, consider how much post-processing you might do to the image. If you're planning on extensive color grading or special effects work, you probably want to use as little artificial edge enhancement as possible. You can always add more sharpening in post, but you can never remove it from your footage once you've recorded it that way.

The smaller the MASTER LEVEL number, the softer and more organic the image will look. The larger the MASTER LEVEL level, the sharper (but perhaps more electronic) it'll look. For most purposes, this camera delivers enough raw resolution that you don't need to add much in the way of artificial detail; I usually use no more than about 0, ranging down to around -10. For a film transfer or projection on a movie theater screen you may want to go to as low as -31, but for normal use the camera benefits from a little dosage of detail; a small detail setting can sharpen up the image nicely without creating large objectionable "outlining" around high-contrast edges. For greenscreen work, a lower detail level (such as -31 to -10) may be preferred.

DETAIL>Frequency

Once the decision to add detail sharpening/outlining has been made (by the MASTER LEVEL and as attenuated by the CORING), then the question is: how thick should the outlining be? This menu item lets you determine that thickness. Smaller numbers result in thinner outlining, and larger numbers result in thicker outlines. Again, consider the size of the display your footage will be seen on. The larger the display, the more "electronic" a large outline will appear. Smaller numbers may be appropriate for very large displays, but may not show much enhancement on a small screen. A larger DETAIL>FREQUENCY setting will show up more prominently on a small screen, but may look unnatural and overly sharpened on a big screen.

SKIN DETAIL>Skin DTL1, DTL2, and DTL3

SKIN DTL is designed to help smooth the appearance of mild imperfections on people's skin. When set to ON, the overall detail circuit avoids sharpening anything it perceives as "skin tones," without affecting any other aspect of the picture. When set to OFF, it doesn't try to smooth skin tones. For a description of how the SKIN DTL function works, look at the description for DETAIL>CORING. SKIN DTL works like DETAIL CORING, except only on colors and tones that it perceives to be "skin." The higher you have the MASTER DETAIL set, the more noticeable the SKIN DTL effect

will be. Also, note that it doesn't smooth "skin", it operates on what it thinks are areas that are colored the types of colors it thinks skin colors are; I've seen it smooth out detail on blonde and red hair too, on beach sand, on a wooden desk or, well, anything that falls in the same basic tonal range as skin tones. If you find that your subject's face is looking too flat and smooth, consider turning this function off. If your subject is elderly, has acne or otherwise has "bad skin," you may find this function makes for a more flattering appearance on your subject.

There are three separate controls for SKIN DTL. When you enable one (or more) of them, the camera gives you a preview of what tonal ranges will be included with all the currently-enabled SKIN DTL functions. As an example, if you enable SKIN DTL 1, you should see zebra patterns superimposed over all the image areas that are being affected by SKIN DTL 1. If you then go to SKIN DTL 2, you will see the SKIN DTL 1 zebra patterns are already present; enabling SKIN DTL 2 will usually result in even more zebras being added. SKIN DTL 2 doesn't necessarily duplicate SKIN DTL 1, but there are large swaths of skin tone that are covered in both circuits. And SKIN DTL 3 covers a slightly different range than SKIN DTL 1 or SKIN DTL 2. You



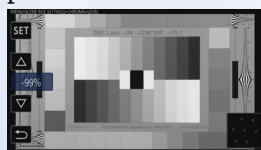
Click the video above for a demonstration of the tonal ranges of the various SKIN DTL levels.

can use all three together, or any combination thereof, to accommodate pretty much any skin tone you may encounter. The preview lets you see whether your subjects' skin will be softened, but it also lets you see if anything else (such as a sandy beach or a wooden desk) will also be included.

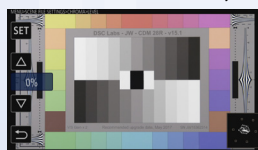
That way you can try various combinations of SKIN DTL 1, 2, and 3 to see what combination results in the best match against skin without including non-skin objects in its affected tonal range.

CHROMA>Level

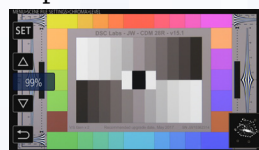
CHROMA>LEVEL refers to the overall amount of color saturation the picture has. The lower the CHROMA>LEVEL, the more pale and muted the



Chroma Level -99



Chroma Level 0



Chroma Level +99

colors will be, at -99% the color will be almost entirely gone, and going one step further will set the CHROMA>LEVEL to OFF, resulting in a true grayscale image. The higher the CHROMA>LEVEL, the more saturated the colors become.

Note: the more saturated the colors are, the more likely that overexposure will cause one or more of the color channels to “clip”, resulting in yellowish skin highlights or color shifts in bright objects like clouds. If you’re having issues with color shifting in clipped highlights, setting a lower Chroma Level may reduce the amount of color shifting.

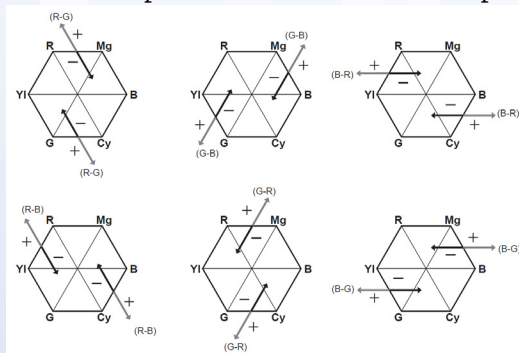
MATRIX>SW

The MATRIX settings let you manipulate the red, green, and blue gain channels independently. Doing so gives you a tremendous amount of control in painting the image. This menu item enables or disables the MATRIX settings.

It is important to note that each gamma starts with its own pre-selected color palette; the color palette the camera uses is optimized for each gamma setting. Because of this, switching gamma will also result in some changes in the color palette being used. And that means that the MATRIX settings that work ideally for you in one gamma, may not work so well in another gamma. You may need to develop your own matrix settings for each gamma independently.

MATRIX>R-G, G-B, B-R, R-B, G-R, and B-G

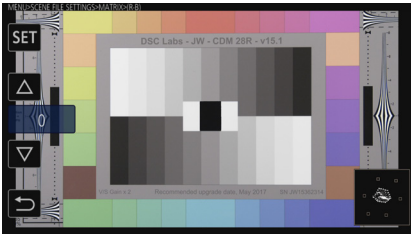
There are six primary colors on the “color wheel” of a video camera (Red, Magenta, Blue, Cyan, Green, and Yellow). If lines are drawn between each of the six anchor points, we end up with six slices of a hexagon-shaped pie. The camera’s MATRIX control allows you to adjust the color on each axis in that pie. Make sense? No? Perhaps this image from the Operating



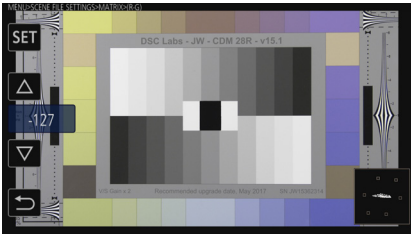
Instructions will help it make sense.

The color wheel is arranged with the six primary colors as the points of the “color hexagon”, and connecting the axes results in six slices of color pie. Each of the options in the MATRIX

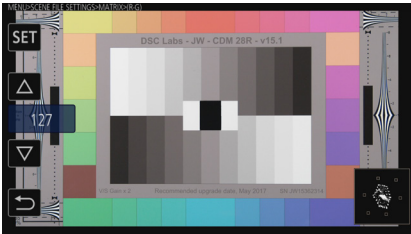
affects two slices of color pie. As shown in the above illustration, adjusting R-G will affect the slice of pie between Red (R) and Magenta (Mg), and it will simultaneously affect the slice of pie between Green (G) and Cyan (Cy). You can stretch or squash the color hexagon along any of these axes, but it will always affect two slices of pie. And, in reality, it's not just those slices that are being affected; the entire color palette is affected, but the changes are centered on the slices as illustrated above.



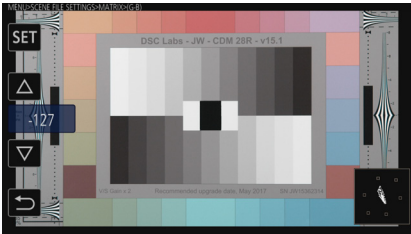
Matrix with all levels set to zero



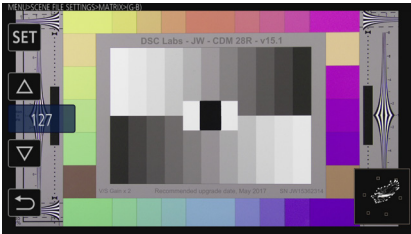
Matrix with R-G set to -127



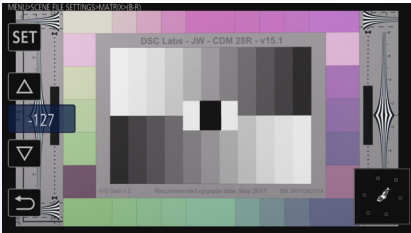
Matrix with R-G set to +127



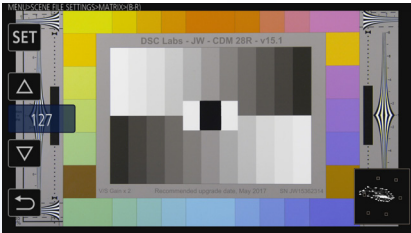
Matrix with G-B set to -127



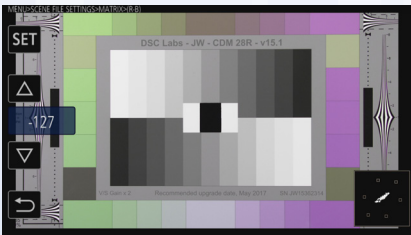
Matrix with G-B set to +127



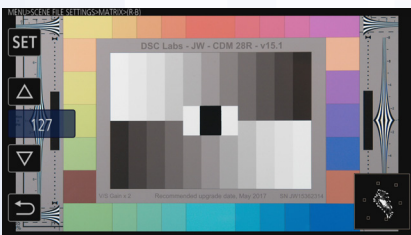
Matrix with B-R set to -127



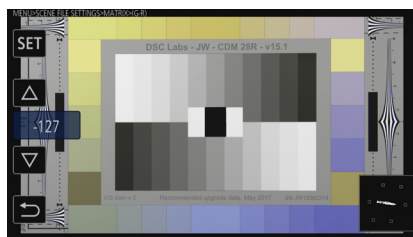
Matrix with B-R set to +127



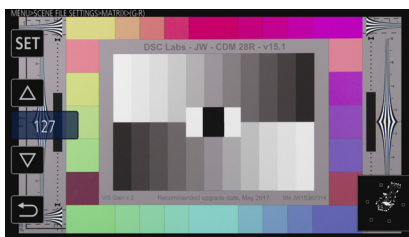
Matrix with R-B set to -127



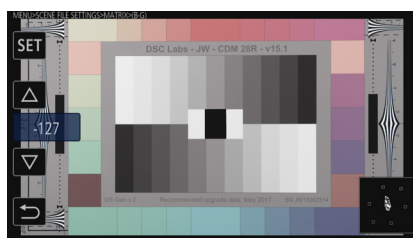
Matrix with R-B set to +127



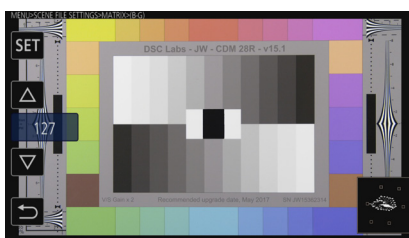
Matrix with G-R set to -127



Matrix with G-R set to +127



Matrix with B-G set to -127



Matrix with B-G set to +127

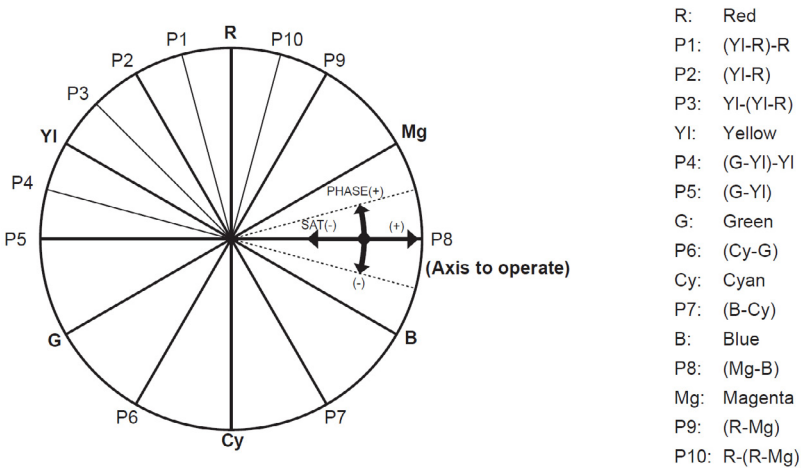
COLOR CORRECTION

The AU-EVA1 offers a 16-pole color correction matrix. You can individually control the saturation and phase of sixteen different points on the color wheel. This gives you a tremendous amount of control over how the images are rendered, as you can individually fine-tune the color axes to get exactly the look you're after.

If you're not used to working with an in-camera color correction feature, it can seem intimidating at first, but it's really quite simple. As you'll remember from the discussion on the vectorscope, there are six boxes on the vectorscope and those correspond to six colors: Red, Magenta, Blue, Cyan, Green, and Yellow. This COLOR CORRECTION menu gives you control over those six poles, as well as another 10 that sit in-between. Some of the poles are halfway between two colors (such as P9, which controls colors that are halfway between Red and Magenta). Some of the primary color axes have two colors in between them (such as between Yellow and Green, you'll find P4, which is 1/4 of the way from Yellow to Green, and you'll also find P5, which is 1/2 of the way from Yellow to Green).

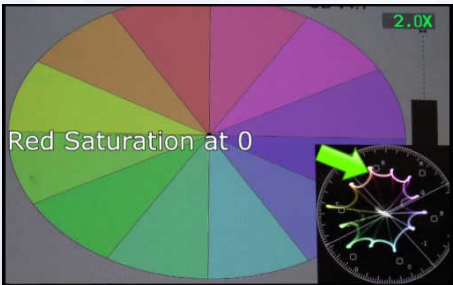
Some of the 16 poles are named according to the primary color that they represent; the others are named "Px", where "x" represents which of the 10 intermediate poles it is, in order from Red (P1) counterclockwise around the color wheel. This graphic from the Operating Instructions shows the specific locations of each of the poles, and their conventional names (such

as P8’s name “Mg-B”, since it represents a position halfway between the Magenta and Blue primary color poles.)



For each of these poles, you can control the SATuration, and also the PHASE. The SAT control governs the color saturation level of each particular pole, allowing you to intensify that color or make it more muted. The PHASE control adjusts the chroma phase for that individual color pole; setting lower values will rotate that pole counterclockwise on the color wheel, and setting positive values will rotate that pole clockwise on the color wheel. The effect is to move the color rendering closer to that of another pole; setting the Red color phase to positive values will move the red color rendition away from pure red and start moving it closer to yellow; the result is that the reds will start turning orange as you do so (red + yellow = orange).

The poles don’t operate in complete autonomy from each other; there is some overlap. If you increase the Green saturation substantially, you may see that its neighbors (the P5 and P6 axes) will probably become somewhat



more saturated too. You may have to go back and forth between the controls to get exactly the painted image you’re looking for.



Rec Settings Menu

CARDS/MEDIA>Format Media

This menu lets you format one of your media cards. Pretty straightforward, but there are two things to consider.

1) Always, always, always format the memory cards in the camera! Don't format the cards on a computer and think that they'll work reliably, they may not. Don't just delete files off the cards using a computer either, as there are all sorts of files and subdirectories that are interlinked and just deleting clips may render the remaining footage potentially inaccessible. Copy the media off to your computer (and copy the ENTIRE CARD CONTENTS, don't just cherry-pick files!) and then reformat the cards IN THE CAMERA.

2) The System Frequency doesn't matter when formatting cards unless you're using AVCHD mode. In that case, it matters quite a bit. AVCHD cannot store both 50Hz and 59.94Hz material on the same memory card, it's one or the other but never both. If you get a message saying "incompatible media", it's probably due to the camera being in one mode (such as 50Hz) and the media having been formatted under the other mode (in this case, 59.94Hz). It is necessary for AVCHD that you format the cards in the same System Frequency as you'll be shooting the footage in.

CLIP NAME>Cam Index

You can assign an identifying camera letter to each camera you're using, which can be very helpful when editing the footage; the identifying letter will let the editor know which camera each memory card came from. Choose a single alphabetical character from "A" to "Z". Note that the camera letter will be incorporated in the memory card's name when a card is formatted, and it will be embedded in filename of any recordings done in .MOV format. However, the AVCHD file format does not provide for having a camera index included in its filename, so in the case of AVCHD memory cards the only place the CAM INDEX will appear is in the volume

name of the formatted SD card. However, you can make use of the CAM INDEX in AVCHD mode; you would need to set the User Bits in TC>UB MODE to “CLIP NAME”; that way the CAM INDEX and the REEL COUNT will be embedded in the clip’s User Bits.

CLIP NAME>Next Reel Count

The .MOV file names are stored with generally three identifying marks: the Cam Index (a letter from A to Z that you set in CLIP NAME>CAM INDEX), a three-digit Reel Number, and a three-digit Clip Number on that reel. With this menu item you can choose what the next Reel Count number will be. The Reel Count is tied to the particular memory card you’re using; when you format a memory card, the Reel Count is attached to that memory card, and all clips recorded in .MOV format on that memory card will have that memory card’s Reel Count embedded in their filenames. Ideally each memory card should have different Reel Count numbers. It’s technically possible for you to set the Reel Count numbers the same on two different memory cards, but it would be an unwise practice to do so, as you’ll then end up with identical filenames on different memory cards. The Reel Count will advance one number every time you format a memory card. So, if you set this value to “000” and format a memory card, your memory card will have an embedded Reel Count of “000” and the CLIP NAME>NEXT REEL COUNT will now become “001”. If you format your second memory card, it will receive an embedded Reel Count of “001”. This can be an easy way to keep track of shoot days, if you offload all footage at the end of the day and reformat your memory cards you’ll always have separate and distinct identifiers in the volume labels and in the recorded clip filenames (except for AVCHD; AVCHD doesn’t use the REEL COUNT or CAM INDEX identifiers in its filenames). You can, however, get the REEL COUNT stored in the User Bits, which would be accessible in AVCHD recordings; see the TC>UB MODE>CLIP NAME function for more information.

2 SLOTS FUNC>OFF, Relay Rec, and Simul Rec

The camera has two memory card slots. You can configure it to work with only one at a time, or use this menu to direct the camera as to how to work with both memory cards. (Note that this menu item is disabled unless you have two memory cards loaded in the camera.) The choices are:

Off: This tells the camera to basically ignore the second memory card slot, and to only record footage onto the currently-active memory card (as selected by the SLOT SEL button). When the current memory card is full, the camera will stop recording. When this menu item is set to OFF, the camera acts as if it doesn’t know that it has a second slot when recording.

Relay Rec: recordings can overlap from one card to the next (this is known as creating a “spanned” recording). If you need to record long uninterrupted events or long interviews or long takes, RELAY REC may make sense. But for sheer simplicity in editing, and in making sure that the editor always has the complete footage, turning RELAY REC off will likely result in a simpler workflow in post. Spanned clips from one card to another will need to be manually aligned back to back in the editing suite, so it may be easier and cleaner to record each clip completely on its own card. RELAY REC can record continuously from one card slot to the other, and when that first card is full and the camera is actively recording on the second card, you can eject the first card and swap in a fresh card and the relay recording will be able to continue even after the second card is full. You have to be extremely careful to eject the proper card though! Ejecting the card that’s being written to will cancel the recording, and may result in loss of some footage.

Be aware that RELAY REC requires two cards, and they both have to be actively recordable (so one can’t be write-protected) and, if you’re using AVCHD mode, they both have to be in the same format (meaning, you can’t have one card for 50Hz mode and one for 60Hz mode, they both have to be formatted in the camera in the same mode, in order to be compatible).

Simul Rec: This allows you to record two identical copies of the footage, simultaneously. This can be an excellent option for security (giving you data redundancy), and it’s also a great method for being able to deliver footage that the client can take with them at the end of the shoot day, while you get to keep a backup of the footage (especially because it saves so much time in not having to make a manual backup copy.)

Ideally, you’d want to use two cards that were of comparable performance and comparable capacity. It’s possible to establish SIMUL REC recording with cards of different capacity, but the whole benefit of recording simultaneously will be lost when one card runs out of space.

Be aware that if you’re recording on two different memory cards, one card may fill up before the other one does; if that happens, the camera will ignore the full card and continue recording to the one slot that does have available space — but obviously you wouldn’t have a duplicate/backup of that material. And if one of your memory cards encounters a hardware failure, recording will continue on the other card — but obviously you won’t have a backup of that recording (since, of course, the other memory card failed!)

PRE REC

This menu item lets you enable or disable the pre-record function. When this function is enabled, the camera will continuously be buffering five to ten seconds of footage. Then when you press RECORD, the camera will commit the contents of that buffer to the memory card, and also begin recording everything from that moment onward. So, in effect, PRE REC lets you begin recording up to ten seconds BEFORE you pressed the record button! This can be very handy in news, sports, and nature photography; you may never miss a shot again because the camera will be recording even before you were ready!

When the MAIN PIXEL setting is 1280x720, or 1920x1080, or 2048x1080, the PRE REC buffer holds about ten seconds of footage; otherwise, it will hold about five seconds.

PRE REC isn't active when the thumbnails are displayed or when playing back footage; it's only active when in live camera mode. And PRE REC is not available if VFR is enabled; if you want to use PRE REC, you'll have to turn VFR off. Finally, note that PRE REC cannot be left on indefinitely; you only turn it on when you need it. If three hours have passed since you enabled PRE REC, the system will automatically shut it off.

REC FUNCTION>Normal or Interval

REC FUNCTION>NORMAL is what you'll use almost exclusively. But, REC FUNCTION>INTERVAL lets you perform time-lapse photography (such as buildings under construction, clouds moving across the sky, or flowers opening up). When in interval recording mode, the camera will periodically capture one individual frame, at intervals that you specify (which can be as short as one frame every second, or as long as one frame every 10 minutes). Once you set up for interval recording, and establish the interval you want to use, just press the record button and the camera will capture and record individual frames at the predetermined intervals.

INTERVAL recording can't be done when the camera is set to an interlaced SYSTEM (50.00i or 59.94i); you'll have to choose one of the progressive-scan options to enable this menu item.

The playback rate of your footage will be partly determined by the frame rate you're recording in; for any given amount of recording time, a clip that's been recorded in 59.94P will play back twice as fast as one that was

recorded in 29.97P. A clip recorded in 50P will play back twice as fast as one recorded in 25P, etc. The following chart will give you an idea of how the available interval options work to translate real-world elapsed time into actual recorded footage time, at various SYSTEM FREQ settings.

30P Interval	Speed	1 Hour Becomes
1 Second	30x	120 sec. (2 minutes)
10 Seconds	300x	12 seconds
30 Seconds	900x	4 seconds
1 Minute	1800x	2 seconds
2 Minutes	3600x	1 second

25P Interval	Speed	1 Hour Becomes
1 Second	25x	144 seconds
10 Seconds	250x	14.4 seconds
30 Seconds	750x	5 seconds
1 Minute	1500x	2.4 seconds
2 Minutes	3000x	1.2 seconds

24P Interval	Speed	1 Hour Becomes
1 Second	24x	150 seconds
10 Seconds	240x	15.5 seconds
30 Seconds	720x	5.2 seconds
1 Minute	1440x	2.6 seconds
2 Minutes	2880x	1.3 seconds

If you wanted to film a 2-hour event in 24P but have it play back in its entirety in around 30 seconds, you'd use 24P SYSTEM FREQ and the 10-second interval, because each hour of realtime would result in 15.5 seconds of footage, so two hours of realtime would play back in about 31 seconds. On the other hand, if you were filming a building under construction you might want to use an interval of 2 minutes, so each hour of realtime that passes will be played back in about 1 second.

No audio is recorded during INTERVAL REcording. Note that INTERVAL REcording cannot be done when VFR is enabled, either.

Time Code Options

Before discussing the timecode menu settings, let's discuss timecode itself. Timecode is a system that numbers and counts every frame of video, in the format of HH:MM:SS:FF (hours:minutes:seconds:frames). An internal timecode generator (TCG) stamps an 80-bit code on every recorded frame. The playback system or NLE will use this number for individually identifying

every frame. This code is recorded with the video and audio signals and is stored invisibly in the sub code area written to the memory card, and it's output over the SDI (and, optionally, over the HDMI). These 80 bits of time code contain a lot of information, such as drop frame information, frame rate information and user bit information. In NTSC/59.94Hz video, timecode can be counted in either Drop Frame (DF) or Non-Drop Frame (NDF) mode. In NDF mode, every frame gets counted and numbered sequentially. In DF mode, some timecode entries are skipped in order to make the running time of the video match the timecode display (by way of explanation, NTSC video runs at 29.97 "frames" per second, but timecode counts at 30 frames per second. Drop Frame counting was invented to resolve this .1% discrepancy, so when an hour of footage has gone by, the DF timecode will read 1:00:00:00, whereas in NDF timecode, after one hour the timecode would read 0:59:56:12.) PAL/50Hz users don't need to worry about this, since PAL televisions run at exactly 25.000 frames per second. PAL/50Hz cameras are always in NDF mode. The 24P and 23.98P modes use NDF only.

There are 32 User Bits in each 80-bit code; these user bits can be used to record a specific code that you can set separately for each camera.

TC>Set TC

You can choose the timecode that will be assigned to the next frame of video that gets recorded. When using REC RUN, this setting gets updated as the timecode runs, so the timecode on the next clip will continue where the last clip left off (i.e., it won't be reset to what this setting was first set to, it continues where it left off).

TC>Set UB

You can record custom data into the User Bits area of the timecode information. This setting lets you specify an 8-digit sequence that gets recorded invisibly in the metadata that's recorded with the footage. Using the numbers 0-9 and the letters A-F ("hexadecimal notation"), you can write an 8-character-long message. Example messages might be the name of your company (assuming you can spell it using just the letters A,B,C,D,E, and F!) or perhaps you'd want to specify a unique identifier code for each camera in a multi-camera shoot, so in the editing bay, the editor could identify which camera shot which clip. Note that even with this set, it may not be recorded in your footage; the actual information that gets recorded in the User Bits is determined by the TC>UB MODE menu item.

When recording .MOV files, this User Bit info isn't used, but there is an alternative way to identify which camera and which reel number get applied to each clip; see the REC SETTINGS>CLIP NAME menu options for more information.

TC>TC/UB/Dur.

This menu item chooses what will be displayed on the camera's LCD panel in the "timecode" display area: you can have it display the current value of the timecode, or the user bits, or you can have it display a running counter of how long the currently-recorded clip is.

TC>Free/Rec Run

This menu setting determines how the time code is treated when the camera is not recording. In FREE RUN mode the timecode clock is constantly advancing whether the camera is recording or not. In REC RUN mode, the timecode clock advances only when actual recording is occurring. In FREE RUN, the timecode is derived from a continuously-running clock of the camera regardless of how many times you start or stop the recording. Note: if you're using time-lapse INTERVAL recording, or variable frame rate recording, then the system will automatically force this menu into REC RUN mode. On the other hand, if you're using PRE REC, the system will force this menu item to FREE RUN.

TC>DF/NDF (29.97P/59.94P/59.94i Only)

This menu setting allows you to select Drop Frame (DF) or Non Drop Frame (NDF) timecode.

When in the 23.98P, 24P, 25P, 50P, and 50i modes, NDF timecode is used exclusively; when you select one of these SYSTEM FREQs this menu item will be disabled. DF is only really relevant when shooting 29.97P, 59.94i or 59.94P. In those cases, you may want to consider setting your timecode to DF when you're planning on delivering the raw footage for broadcast; if it's for your own editing, you may prefer the frame-accurate simplicity of NDF. Then again, if you need the timecode to be time-accurate (i.e., one hour of footage shows one hour of elapsed timecode), you'd be better served with setting this menu item to DF.

TC>UB Mode

The User Bit section of the timecode stamp can store a variety of different fields. You can choose from one (and only one) of the following options:

Frame Rate: You can embed the frame rate that the footage was shot at into the User Bits.

User: This allows you to record the custom information that you established in the TC>UB SET menu item. The TC>UB SET preset is only used when the TC>UB MODE menu item is set to “User”.

Time: This embeds the camera’s current local time (hh, mm, ss) into the User Bits.

Date: This embeds the camera’s current date (yy, mm, dd, hh) into the User Bits.

Clip Name: This embeds the camera’s unique camera index (as set in CLIP NAME>CAM INDEX) and the current Reel count, into the User Bits. This information is normally recorded in a .MOV file’s filename, except when using AVCHD recording mode. When using AVCHD, you can still access the CAM INDEX and REEL COUNT by embedding it here in the User Bits.

TC>TC In/Out Sel

The camera’s TC IN/OUT jack is bidirectional, it can function as either an input jack, or an output jack. You choose which one it will work as in this menu item.

TC>TC Out Ref

The TC OUT jack outputs the timecode for each frame, but you can choose whether that timecode output is immediate, or whether it’s delayed to synchronize with the SDI port’s video output. There are two choices:

Recording: When using the AU-EVA1 as a timecode source for other cameras, you generally want the timecode output immediately, with no additional delay. That’s what RECORDING does.

SDI OUT: When rendering images onto its SDI output, the SDI display may lag the EVA1’s internal recording by a few frames. And the SDI output has timecode embedded in it, which is synchronized to the frames of footage as they were shot. You can choose to have the TC OUT jack delay its timecode signal so that it synchronizes with the SDI OUT’s delayed output. Choosing SDI OUT ensures that both the timecode in the SDI video signal and the timecode on the TC OUT jack are synchronized. If you choose RECORDING, those two may very well not be in sync. However, be aware that if no video is being output from the SDI, then the system will not delay the timecode, so in that case the TC OUT REF will always be operating in RECORDING mode.



Audio Settings Menu

This section of the book describes the AU-EVA1's audio settings, including the limiters, automatic level control, test tone volume and other audio-related settings.

AUDIO CH SETTINGS>CH1 In Select & CH2 In Select

The AU-EVA1 camera always records with two channels of audio. You can select the input source for each channel. CH1 can come from either the onboard stereo microphone's left side (INT L) or it can come from XLR Audio Input 1. For CH2, you can choose to record from the onboard stereo microphone's right side (INT R), or from XLR input 1, or from XLR input 2. If you're using a single microphone, you may want to put it on XLR input 1, and that way both audio channels could look to that same microphone for their input. You could then configure the audio channels differently by, say, setting one channel's input knob to a lower volume level than the other one, to protect against sudden peaks in the audio; or, perhaps you'd want to set CH1 to manual audio level control but set CH2 to be on automatic level control, as an emergency backup in case the sound levels suddenly got louder or quieter than you were anticipating.

AUDIO CH SETTINGS>CH1 (and CH2) Mic Lowcut

You can assign a low-cut filter to each audio channel individually. Effectively, this will cut out or de-emphasize lower frequencies, while preserving middle and higher frequency sounds. Some examples of when you might want to use this would include if there's a big truck idling outside the location you're recording in, or if you're recording in a windy outdoors environment; when wind hits a microphone, the results are a rumbling muffling mess in your audio track. Sometimes this can ruin your recordings. The rumbling is usually quite low frequency, and establishing the MIC LOWCUT can knock out some of that wind rumbling and result in a less-distracting audio track.

If you need to cut out the rumbling or wind noise, consider setting the MIC LOWCUT feature on. However, if you don't need it, don't use it – the MIC LOWCUT works by chopping out some of the lower bass frequencies in your recorded audio, and that can result in your recorded audio sounding thinner. For maximum audio fidelity, you want this set to OFF. But if you're in a windy environment and relying on the onboard microphones, you might want to turn it on to minimize the rumbling wind noise, or if there's a low-frequency rumble or other unwelcome noise in the low frequency areas of the soundtrack, this feature might give you clearer and better sound without the low-frequency interference.

AUDIO CH SETTINGS>CH1/CH2 LIMITER

The AU-EVA1 has individual control over both of its audio channels, as to whether either, neither, or both of them use the automatic limiter capability. The Limiter is optional, and can help you avoid blown-out or distorted audio that gets too loud. Note that the limiter is only available when setting the audio levels manually; when in automatic level control these menu items become disabled.

When the Limiter is engaged, the camera will try to “clamp down” excessive volume to prevent clipping or overdriving the audio channel. It won't modify the overall signal level, it will just try to keep loud levels from distorting (sort of like the KNEE control for protecting against overexposure). It may not catch brief transitory peaks (clapping close to the mic may defeat the limiter and result in overmodulated sound) but in general if the overall sound level is too high for more than the briefest moment, the limiter will lower the volume to keep it below the maximum allowable threshold. When using mics directly hooked to the camera, it's usually a good idea to keep the limiter ON. When using an external mic-level mixer with its own limiter, you should set the camera's limiter OFF.

If you're recording audio film-style where you run one microphone into both audio channels, and you set one channel lower than the other to prevent clipping, then you probably don't want the limiter engaged. On the other hand, if you're recording ENG or news-style, you may not have time to ride the audio levels and in such a scenario the limiter can be very useful indeed. Generally, the purest quality audio will be recorded when the limiter is off (provided, of course, that you keep an eye on the levels and don't let anything get too loud). If you can't do that, then using the limiter can at least provide some insurance from badly clipped audio.

AUDIO CH SETTINGS>Head Room

Different territories in the world have different standards as to how loud audio signals should be recorded. The audio level meter in the lower left of the display shows the average audio level with indicators in the middle of the graph. This menu item lets you choose whether those indicators will be drawn at -18dB, or -20dB. When set to -20dB, the indicators will be drawn one square to the left of where they would have been drawn on -18dB, which thus provides for a little more room (2dB worth) on the right side of the scale.

AUDIO INPUT>Input1 and Input2 Line/Mic Sel

You can attach microphones or line-level audio sources to the camera's XLR input ports. These menu options (LINE or MIC) let you specify the expected signal level of the output of whatever device you've connected to the relevant XLR port.

Generally, microphones output at MIC level, and other devices (such as mixers, audio amplifiers, or DVD players, or DJ systems etc.) output at Line level.

AUDIO INPUT>Input1 and Input2 Mic Power

The camera is capable of outputting +48v Phantom Power on its XLR audio inputs. Some microphones need Phantom Power to operate properly (such as condenser mics). Some microphones shouldn't have Phantom Power sent to them (such as dynamic mics). And some mics have their own power supply and may or may not need phantom power; some electret condenser microphones can operate in either self-powered mode, or through Phantom Power. In these cases you may want to check with your microphone manufacturer as to whether better performance can be achieved using Phantom Power. If you're using a line-level input source, Phantom Power should be disabled.

AUDIO INPUT>Input1 and Input2 MIC Level

Different microphones have different levels of output. If you find that the audio level coming from your microphone is too low and that you're having to crank the audio dials up high just to get a usable level, then you'd probably be better off to try changing the appropriate channel's MIC Level setting to boost the audio levels. -60dB makes the mic input louder than -50dB, and would be appropriate for use with a less-sensitive microphone. -40dB is the least-resistance setting and would be used if -50dB isn't enough.

AUDIO INPUT>Input1 and Input2 Line Level

For line-level equipment, some signals are sent at a hotter level than others. The camera can compensate, by using this menu item. You can choose 0dB or +4dB. Generally professional equipment will be outputting signals at +4dB; if your signals are mismatched and your audio input is higher or lower than what you were expecting, you may be able to adjust this menu item to compensate.

AUDIO OUTPUT>Monitor Out

You can dictate how the two audio channels are output on the headphone jack. The choices are:

CH1: When setting is selected, only Channel 1 will be output in isolation. Channel 2 will be muted.

CH2: When setting is selected, only Channel 2 will be output in isolation. Channel 1 will be muted. Muting one channel can be a great way to isolate clothing rustling noises from a body-worn microphone, for example.

STEREO: When setting is selected, Channel 1 will be output on the left headphone output, and Channel 2 will be output on the right headphone output.

MIX: When setting is selected, both channels will be output on each output. Channels 1 and 2 get mixed together, and the mixed signal is output on both the left and right headphone outputs.

AUDIO OUTPUT>Monitor Delay

When the camera is in live recording mode, the internal processing of the image may result in a few frames' delay before it's routed onto the camera's LCD screen. You can choose whether to have the headphones' output delayed accordingly, so that the audio lines up exactly with the video. The choices are:

LIVE: In this case, the audio is not delayed to match the video. It's relayed instantly to the headphones. This is most appropriate when monitoring live footage, as it eliminates the potential echo that can happen when using the RECORDING option.

RECORDING: In this case, the audio is delayed to match the video. You will see and hear the video and audio exactly synchronized. While this sounds like the ideal choice, there is actually a pretty good reason to not use it: echo in the headphones. When recording, if the audio is delayed to match the video, you may hear an echo in the audio. What's

happening is that the spoken words by the actor are leaking through the headphones and hitting your ears, and then a couple of frames later the delayed audio comes through the headphone jack and hits your ears, and the time difference can cause a pronounced echo effect. This is generally not a problem if the microphones are located quite a way from the camera, but in a small room it can become an issue. Generally LIVE is the preferred setting, but if you have a client who's watching the LCD and is concerned about the apparent slight delay between the audio and the video, you can put the this menu item in RECORDING mode and let them see that indeed the audio and video are being recorded perfectly in sync.

AUDIO OUTPUT>Monitor Vol

Here's where you can set the headphone volume (or speaker volume, for when playing back footage with no headphones attached.)

REC BEEP SOUND>Mode

The camera can be configured to beep at the start and stop of recording. Some people find this annoying, others find the audio confirmation very useful to know for a fact that recording did start and/or did stop when requested. You can turn the beeping OFF, or have it beep only when you START recording, or have it beep only when you STOP recording, or you can have it beep when you both START&STOP recording.

REC BEEP SOUND>VOLUME

This menu item is only applicable if you've enabled the REC BEEP SOUND in the previous menu item. If you've enabled it, this sets the volume of the beep to HIGH, MED, or LOW volume.

ALARM>Battery End and Media End

In addition to beeping when recording starts or stops, the camera can also be configured to issue a warning alarm if certain conditions arise. If the camera is unattended (in a fixed position maybe, or in the case of a reporter doing a stand-up with a camera on a tripod) it might be very beneficial to know if the camera's battery is running out or if the recording media is full. You can configure the camera to issue a warning in either case, or both cases; in these menu items you can also choose the volume of the alarm warning for each case.



Output Settings Menu

This menu deals with settings related to the HDMI and 6G-SDI video output terminals, as well as the LCD.

6G-SDI is a professional monitor connector, which supports 4K (up to 30P) and UHD (up to 30p) signals, as well as full-bandwidth high-definition and standard-definition signals (when used for standard-def, it's called "SDI", when used for high-def it's called "HD-SDI"; when used for 1080/59.94P or 1080/50.00P it's referred to as 3G-SDI). In all its modes SDI signals can embed audio and timecode along with the video.

SDI OUT>Output SW

This menu item determines whether the SDI port will be used to output video signals. Generally you'd leave this set to ON; if you don't want SDI video you can just disconnect the cable. However, there may be some slight benefit to disabling the port, including slightly lower power usage for better battery life.

SDI OUT>Signal Sel

The SDI output can be configured to output a video signal of what the camera's shooting, or, optionally, it can output a mirror of what's on the LCD display - meaning it will output the markers, zebras, waveform monitor, frame lines, iris and shutter display, level monitors, etc. There are three choices:

SDI: In this mode, the camera outputs a straight video signal that represents what the camera is imaging. The particular output mode (whether it's outputting 4K, or a downconverted 1080p or 1080i or whatever else you set) is determined in the SDI OUT>OUT FORMAT menu option. If you're using an external SDI recorder, this is almost certainly the mode you'd want to select.

LCD(1080p): In this mode the SDI port will output a 1920x1080 progressive signal, regardless of what mode the camera is shooting in. This

image will be a mirror of what the camera's LCD is displaying, so all frame markers, guidelines, the level gauge, zebras, etc., will all be included on the SDI output. Note, this is almost certainly not the selection you'd want to use if you are using an external SDI recorder! (unless, for some reason, you wanted to record the various camera displays on the external recorder).

LCD(1080i): This mode is identical to the LCD(1080p) option, except the camera outputs a 1080i signal, useful for compatibility with older HD-SDI monitors that don't support 3G-SDI or 6G-SDI. Note, this is almost certainly not the selection you'd want to use if you are using an external SDI recorder!

Note that choosing one of the LCD mirroring choices, LCD(1080p) or LCD(1080i), will disable the SDI OUT>OUT FORMAT menu option. And, forcing the output to LCD(1080i) will disable the 3G-SDI OUT menu option.

SDI OUT>Out Format

The SDI terminal can be used to output a variety of formats, up to UHD/4K at 30p, and can even output a downconverted signal. This menu item lets you choose what output format you want, within certain restrictions. Specifically, the camera generally doesn't do an "up-convert"; you can't record 1080p but output 4K, for example. The SDI terminal can generally be set to output the same format as being recorded (with the exception of 4K/UHD at 50/60 frames per second) or it can output a downconverted version of that signal. The choices are:

4096x2160p: This choice is only available if the camera's MAIN PIXEL is set to 4096x2160, and the SYSTEM FREQ is 29.97, 25.00, 24.00, or 23.98. If you've set the SYSTEM FREQ to 50.00 or 59.94, this menu option will be disabled, and the SDI output will be forced to a letterboxed 1920x1080 output (so there will be thin black bars on the top and bottom of the image).

3840x2160p: This choice is only available if the camera's MAIN PIXEL is set to 3840x2160, and the SYSTEM FREQ is 29.97, 25.00, or 23.98. If you've set the SYSTEM FREQ to 50.00 or 59.94, this menu option will be disabled, and the SDI output will be forced to a 1920x1080 output.

1920x1080p: This menu item is available with all MAIN PIXEL settings except 1280x720. When the MAIN PIXEL is set to 4096x2160, the SDI will output a downconverted/letterboxed 1920x1080. When the MAIN PIXEL is set to 2048x1080, the SDI will output a letterboxed 1920x1080p.

1920x1080i: This setting is mainly for compatibility with

older monitors that only support the HD-SDI standard. This choice is generally not available when shooting at a SYSTEM FREQ of 29.97, 25.00, 24.00 or 23.98 frames per second; in those cases you'll have the choice of 1920x1080PsF. If you enable this option, the 3G-SDI menu option will be disabled.

1920x1080PsF: The PsF stands for Progressive Segmented Frame. It is an industry standard for embedding progressive footage inside an interlaced video signal. This menu option is available for when you have set the SYSTEM FREQ to 23.98, 24.00, 25.00 or 29.97 frames per second, and you want to output a signal that's compatible with an HD-SDI-only monitor.

1280x720p: This menu item is only available when the MAIN PIXEL is set to 1280x720. Note that the camera cannot generally perform an upscale to higher resolution; the only exception is if the camera's MAIN PIXEL is set to 1280x720 and the SDI OUT>SIGNAL SEL is set to mirror the LCD (which, of course, results in a 1920x1080 output).

Note: if you choose an OUT FORMAT, and then later change the MAIN PIXEL menu item, the possibility exists that you'll select a MAIN PIXEL that is incompatible with your chosen OUT FORMAT. If that happens, the camera will automatically select a compatible OUT FORMAT (usually 1920x1080i or 1920x1080PsF). So if you change the MAIN PIXEL, you may want to come back into this menu to confirm what OUT FORMAT is selected.

Also, note: this entire SDI OUT>OUT FORMAT menu is disabled if you've instructed the SDI port to output a mirror of the LCD display in the SDI OUT>SIGNAL SEL menu. Additionally, if you've chosen to output raw video through the SDI port, this entire menu will be disabled.

SDI OUT>3G-SDI Out

When the camera is outputting a 3G-SDI signal (generally 1920x1080p at 50.00p or 59.94p), this menu item is enabled. It's disabled if the camera is outputting HD-SDI (generally 1920x1080i) or 6G-SDI (UHD or 4K at 23.98 to 29.97 fps). There are two choices:

Level-A: This choice outputs uncompressed 1920x1080 video at up to 60 frames per second in one continuous stream.

Level-B: This choice uses the single 3G-SDI to carry a dual-link HD-SDI signal, resulting in uncompressed 1920x1080 video at up to 60 frames per second. This is known as Level B Dual Stream. This choice is also the factory default.

SDI OUT>SDI Rec Remote

When connected to an external SDI video recorder, the camera can optionally transmit a start/stop flag on its SDI video output. This flag is generated each time the REC button is pressed on the camera. If you want to configure an external SDI recorder so that it will start recording whenever you press the camera's red REC button, then set this menu item to ON.

SDI OUT>Indicator Disp

This menu governs whether or not to output various screen overlay information (such as shutter speed, remaining battery, etc) that you've separately configured in the OUTPUT SETTINGS>SDI/HDMI INDICATOR menu item. When you enable this, the displays you've chosen in the SDI/HDMI INDICATOR will be superimposed on the SDI output. Note: this is not the same as mirroring the LCD display, although it can result in a similar scenario if you enable many of the items in the SDI/HDMI INDICATOR menu. There are certain items (like the zebras or waveform monitor) which cannot be output when using the INDICATOR DISP function, but those items can be output when mirroring the LCD. An example of when you might want to use this feature would be if you want the camera operator to have a clean, uncluttered display, but you have an assistant who will be monitoring all the informational outputs on an external monitor. In a case like that, you can have the indicators displayed only on the external monitor; this results in a very different situation as compared to LCD mirroring.

SDI OUT>Marker Disp

This menu governs whether or not to output various screen marker information (such as the safety zone, frame guidelines, center marker, etc) that you've separately configured in the OUTPUT SETTINGS>SDI/HDMI MARKER menu item. When you enable this, the displays you've chosen in the SDI/HDMI MARKER will be superimposed on the SDI output. Note: this is not the same as mirroring the LCD display, although it can result in a similar scenario if you enable many of the items in the SDI/HDMI MARKER menu.

SDI OUT>Menu Disp

This menu item determines whether or not the camera menus will be displayed on the external monitor. The default is ON, meaning the menus do get displayed. You can turn it OFF, meaning that the external SDI

monitor will still show the camera live feed when you're accessing the menus. However, do note that in playback the menus will be shown on the SDI monitor regardless of how this MENU DISP menu item is configured.

HDMI OUT>Signal Sel

The HDMI output can also be configured to output a video signal of what the camera's shooting, or, optionally, it can output a mirror of what's on the LCD display - meaning it will output most of the same information that the LCD is displaying, such as the markers, frame lines, iris and shutter display, level monitors, etc. There are two choices:

HDMI: In this mode, the camera outputs a straight video signal that represents what the camera is imaging. The particular output mode (whether it's outputting 4K, or a downconverted 1080p or 1080i or whatever else you set) is determined in the HDMI OUT>OUT FORMAT menu option. If you're using an external HDMI recorder, this is almost certainly the mode you'd want to select.

LCD(1080p): In this mode the HDMI port will output a 1920x1080 progressive signal, regardless of what mode the camera is shooting in. This image will be generally a mirror of what the camera's LCD is displaying, although some elements may not be sent on the HDMI output. Note, this is almost certainly not the selection you'd want to use if you are using an external HDMI recorder! (unless, for some reason, you wanted to record the various camera displays on the external recorder).

HDMI OUT>Out Format

The HDMI terminal can be used to output a wide variety of formats; it can output any format that the camera can record, and even some that it can't. For example, the HDMI OUT>OUT FORMAT can be set to output a standard-definition 720x480p or 720x576p image. This menu item lets you choose what output format you want, within certain restrictions. Specifically, the camera generally doesn't do an "up-convert"; you can't record 1080p but output 4K, for example. The choices are:

4096x2160p: This choice is only available if the camera's MAIN PIXEL is set to 4096x2160. This menu option outputs a full 10-bit 4:2:2 color signal at the full 4096x2160p resolution, and at the frame rate you specified in SYSTEM FREQ.

4096x2160p(420/8bit): This choice is only available if the camera's MAIN PIXEL is set to 4096x2160, and the SYSTEM FREQ is set to 50.00p or 59.94p. This menu option outputs a lower-bandwidth version of the camera's processing signal; this version is a full 4096x2160p

resolution, and at the frame rate you specified in SYSTEM FREQ, but it is output at 8-bit quantization and 4:2:0 color sampling.

3840x2160p: This choice is only available if the camera's MAIN PIXEL is set to 3840x2160, and this menu option delivers a full-bandwidth 10-bit 4:2:2 signal.

3840x2160p(420/8bit): This choice is only available if the camera's MAIN PIXEL is set to 3840x2160, and the SYSTEM FREQ has been set to 50.00p or 59.94p. This menu option outputs a lower-bandwidth version of the camera's processing signal; this version is a full 4096x2160p resolution, and at the frame rate you specified in SYSTEM FREQ, but it is output at 8-bit quantization and 4:2:0 color sampling.

1920x1080p: This menu item is available with all MAIN PIXEL settings except 1280x720. When the MAIN PIXEL is set to 4096x2160, the HDMI will output a downconverted/letterboxed 1920x1080. When the MAIN PIXEL is set to 2048x1080, the HDMI will output a letterboxed 1920x1080p.

1920x1080i: This setting is mainly for compatibility with an ATSC-compatible TV that doesn't support 1080p. This choice is generally for when you've set the SYSTEM FREQ to 50.00i or 59.94i. It is available for the other modes; note that if the MAIN PIXEL is 4096x2160, the 1920x1080i output will include a downconverted and slightly letterboxed version of the signal. If the MAIN PIXEL is set to 2048x1080, the 1920x1080i signal will include a slightly smaller letterboxed version of the camera's signal.

1280x720p: This menu item is only available when the MAIN PIXEL is set to 1280x720. Note that the camera cannot generally perform an upscale to higher resolution; the only exception is if the camera's MAIN PIXEL is set to 1280x720 and the HDMI OUT>SIGNAL SEL is set to mirror the LCD.

720x480p: This choice results in a standard-definition resolution image being output at 59.94p. This choice is only available if you've set the SYSTEM FREQ to 59.94i.

720x576p: This choice results in a standard-definition resolution image being output at 50.00p. This choice is only available if you've set the SYSTEM FREQ to 50.00i.

Note: if you choose an OUT FORMAT, and then later change the MAIN PIXEL menu item, the possibility exists that you'll select a MAIN PIXEL that is incompatible with your chosen OUT FORMAT. If that happens, the camera will automatically select a compatible OUT FORMAT (usually 1920x1080i or 1920x1080p). So if you change the MAIN PIXEL, you

may want to come back into this menu to confirm what OUT FORMAT is selected.

Also, note: this entire HDMI OUT>OUT FORMAT menu is disabled if you've instructed the HDMI port to output a mirror of the LCD display in the HDMI OUT>SIGNAL SEL menu.

HDMI OUT>HDMI TC Out

You can instruct the camera to embed timecode into its HDMI output, or to leave the timecode out. Early standards for HDMI had no provision for timecode; it was added later. If you encounter a monitor that just won't work properly with the AU-EVA1's HDMI output, you might try turning off the HDMI TC OUT. Note that the next menu, HDMI REC REMOTE, requires that HDMI TC OUT be enabled.

HDMI OUT>HDMI Rec Remote

When connected to an external HDMI video recorder, the camera can optionally transmit a start/stop flag on its HDMI video output. This flag is generated each time the REC button is pressed on the camera. If you want to configure an external HDMI recorder so that it will start recording whenever you press the camera's red REC button, then set this menu item to ON. Note that this menu item is disabled unless you've also enabled HDMI OUT>HDMI TC OUT.

HDMI OUT>Indicator Disp

This menu governs whether or not to output various screen overlay information (such as shutter speed, remaining battery, etc) that you've separately configured in the OUTPUT SETTINGS>SDI/HDMI INDICATOR menu item. When you enable this, the displays you've chosen in the SDI/HDMI INDICATOR will be superimposed on the HDMI output. Note: this is not the same as mirroring the LCD display, although it can result in a similar scenario if you enable many of the items in the SDI/HDMI INDICATOR menu. An example of when you might want to use this feature would be if you want the camera operator to have a clean, uncluttered display, but you have an assistant who will be monitoring all the informational outputs on an external monitor. In a case like that, you can have the indicators displayed only on the external monitor; this results in a very different situation as compared to LCD mirroring.

HDMI OUT>Marker Disp

This menu governs whether or not to output various screen marker information (such as the safety zone, frame guidelines, center marker, etc) that you've separately configured in the OUTPUT SETTINGS>SDI/HDMI MARKER menu item. When you enable this, the displays you've chosen in the SDI/HDMI MARKER will be superimposed on the HDMI output. Note: this is not the same as mirroring the LCD display, although it can result in a similar scenario if you enable many of the items in the SDI/HDMI MARKER menu.

HDMI OUT>Menu Disp

This menu item determines whether or not the camera menus will be displayed on the external monitor. The default is ON, meaning the menus do get displayed. You can turn it OFF, meaning that the external HDMI monitor will still show the camera live feed when you're accessing the menus. However, do note that in playback the menus will be shown on the monitor regardless of how this MENU DISP menu item is configured.

SDI/HDMI Indicator

Generally the SDI and HDMI outputs can be used to output a clean video signal, without any of the informational displays typically found on the LCD panel. However, if you want to output some of that information to the HDMI and/or SDI outputs, this menu item gives you the ability to pick and choose among approximately two dozen indicators to determine which ones you want to have overlaid on the SDI/HDMI video outputs, and which ones you don't. The settings in this menu apply equally to the SDI and HDMI, but you can individually choose whether the SDI or the HDMI (or both, or neither) display the indicators that you've selected in this menu.

SDI/HDMI Marker

Generally the frame guidelines and markers are something that you only want on the camera operator's LCD panel, and not output over the HDMI or SDI outputs. However, if you want to output some of that information to the HDMI and/or SDI outputs, this menu item gives you the ability to pick and choose from various markers and safety zones to determine which ones you want to have overlaid on the SDI/HDMI video outputs, and which ones you don't. The settings in this menu apply equally to the SDI and HDMI, but you can individually choose whether the SDI or the HDMI (or both, or neither) display the markers that you've selected in this menu.

LCD Indicator

The LCD monitor is capable of displaying a tremendous amount of information about the camera's current state, on its LCD output. In this menu you can pick and choose which displays you want enabled, and which ones you want hidden. While all of the information is important, it may not be necessary for the camera operator to be the one monitoring it; perhaps you'd want to clear the display for ease of operation, and output the indicators over the SDI or HDMI to an assistant to monitor. This menu item lets you choose which elements you want to keep on the LCD; the SDI/HDMI INDICATOR lets you determine which elements will be output on the SDI and/or HDMI outputs.

LCD MARKER

This menu item lets you enable or disable the variety of frame markers and safety zones on the camera's LCD panel.

LCD FOCUS ASSIST>Expand Mode

There are three modes that can be chosen from to govern how long the expanded focus assist appears on the LCD display. If you've assigned the EXPAND focus assist to a User Button, and then press that User Button, the expanded focus assist will appear. It will disappear depending on how you've configured this menu. The choices are:

10SEC: This setting will cause the expanded focus assist to automatically disengage after 10 seconds of display. Note, if you press the User Button again (before the 10 seconds have expired) it will cause the expanded focus assist to disengage. In this mode, the expanded focus assist is available even when recording.

HOLD: This setting will cause the expanded focus assist to remain active until the user presses the EXPAND User Button again to cancel the feature. In this mode, the expanded focus assist is available even when recording.

UNTIL REC: This setting will cause the expanded focus assist to disengage as soon as the user presses the RECO button to initiate recording. Note that when using this mode, you cannot access the expanded focus assist during recording.

LCD FOCUS ASSIST>Peak./Squares Mode

The AU-EVA1 offers a number of Focus Assists, including the one-push AF, the open iris focus assist, the expanded focus assist, peaking, and focus squares. The focus squares method is, generally, an alternative version of

peaking. Peaking in its normal use is an outlining of areas that are in focus; the more in-focus an object is, the more peaking outlines you'll see on the object. Alternatively, you can use Focus Squares as a focus assist; when using the Focus Squares, the LCD will overlay green squares over objects that are in focus, and the more in-focus they are, the bigger the squares will be. This menu item lets you specify if you want to use conventional peaking, or focus squares, or both. You still need to invoke the peaking (or squares) by assigning PEAK./SQUARES F.A. to a User Button, and then press that button. If you've chosen PEAKING, then the peaking focus assist will appear and disappear with each press of the User Button. If you've chosen SQUARES, then the Focus Squares will appear and disappear with each press of the User Button. If you chose PEAK./SQUARES, then the first press of the button will bring up focus peaking; the second press of the button will bring up the Focus Squares, and the third press of the button will remove the focus assists.

LCD FOCUS ASSIST>Peaking Level

You can control the intensity of the outlining that the Peaking focus assist performs, with this menu item. When set to LOW, the peaking will be very unobtrusive. It won't be as easy to see what areas are being outlined as being in-focus, but then again, you can be pretty sure that if you do see a peaking outline, that particular area will be in crisp focus. When set to HIGH, the camera draws much bigger/brighter outlines around in-focus objects. It makes it very easy to see the peaking effect; however, it's possible that so much of the display will be covered in red peaking outlines that it's harder to see the detail in the scene, and the higher the peaking is set, the harder it is to discern whether an element is truly "in focus" or if it's just generally in focus. I prefer using LOW whenever possible, for true pinpoint focus accuracy. MID and HIGH can be used if you are okay with more general focus and less concerned with absolute pinpoint focus. If you're having trouble seeing the LOW intensity, consider using the next menu item to enable a black & white LCD when using peaking.

LCD FOCUS ASSIST>Black & White

You have the choice of turning off the color in the LCD, either at all times or only when using a focus assist. When using the DURING PEAK./SQUARES option, the colored peaking becomes much easier to discern, especially when set to LOW intensity.

LCD FOCUS ASSIST>Open Iris Mode

One of the many Focus Assist tools you can assign to a User Button is the Open Iris F.A. mode, wherein the camera will open the lens to its widest iris setting (and employ the electronic shutter to compensate for exposure changes). With the iris at its most wide open, the depth of field will be its shallowest, and it's easier to see when elements come into and out of focus. This menu item lets you establish how long the Open Iris F.A. mode will stay active before it automatically disengages (10 seconds or 30 seconds). Of course, you can always cancel the Open Iris F.A. sooner by pressing the User Button again.

LCD EI ASSIST

This menu is for configuring the various Exposure Index options (for exposure aids such as the zebras, waveform, and spot meter).

LCD EI ASSIST>Zebra

This menu lets you enable or disable the Zebras. Using this menu item is functionally equivalent to assigning ZEBRA to a User Button, and then pressing that User Button.

LCD EI ASSIST>Zebra1 Detect

There are two levels of zebra; you can assign a different IRE level for activation of each zebra setting. The zebras will draw a diagonal line pattern over any element in the image whose brightness exceeds the level you set here. The range is from 0% to 109%; at 0% everything in the image will be covered with diagonal lines. At 50%, anything in the image that's under 50 IRE will appear normal, any elements that are brighter than 50 IRE will have the diagonal line pattern drawn over them. With the Zebras, you can tell at a glance what elements of your image are brighter than your predetermined threshold. A common way to use the two levels of zebras is to establish a skin tone reference level for Zebra 1, and a peak level reference for Zebra 2. As an example, when shooting in the VIDEO gamma, skin tones should generally be kept between about 50 to 70 IRE, with absolutely no element of the fairest/brightest skin tone exceeding about 75 to 80 IRE. So you could establish 75 for Zebra 1, and that way you can set your exposure so that zebras only start appearing on the very brightest hot spots on your subject's skin. However, when shooting in V-Log, the levels are very different; you'd probably want to keep your skin tones within a range of about 40 to 55 IRE, so you might establish Zebra 1 at 75, and then monitor it for any signs of hot spots that might be overexposed.

The Zebra 1 pattern draws lines that head uphill (when looking at the LCD in a left-to-right fashion, the Zebra 1 lines start low on the left and are drawn diagonally upward to the right across the LCD). When you turn on the zebras, Zebra1 will always be enabled.

LCD EI ASSIST>Zebra2 Detect

There are two potential levels of zebra that you can set. If you've set Zebra 1 to detect skin tones, you may want to set Zebra 2 to warn when elements are getting so bright that they're close to blowing out. Generally a Zebra 2 setting of about 100 is useful for keeping track of white or very bright elements in the scene, you want to keep the amount of Zebra 2 lines to a minimum when possible. Zebra 2 lines are drawn going downhill (meaning, they start high on the left side of the LCD and are drawn diagonally down to the right side of the LCD). Zebra 2 may or may not be displayed, depending on how you have the next menu item configured (LCD EI ASSIST>ZEBRA2).

LCD EI ASSIST>Zebra2

The EVA1 allows you to choose how you want the Zebra2 display to operate. The choices are:

Off: This option disables Zebra2, so they'll never be seen, regardless of what you set the ZEBRA2 DETECT menu item to.

On: When this is set to ON, you'll see both Zebra1 and Zebra2 displayed at the same time. This is different from how some prior Panasonic cameras worked, where they would display solely Zebra1 first, and then use another push of the button to bring up solely Zebra2. In the AU-EVA1, it's either all zebras, or no zebras. The difference is in which angle the zebra lines are drawn; zebra1

Spot: This option effectively disables Zebra2, and instead functions as a top limit for Zebra1. Normally, if Zebra2 is disabled, then zebra lines will be drawn on any elements in the image that meets or exceeds the value you've set in ZEBRA1 DETECT. That means if you've set ZEBRA1 DETECT to, let's say, 70%, then any element in the image that's 70 IRE or brighter will have zebra lines drawn on it -- anything from 70 to 80 to 90 to 100 to 109 IRE, it'll all be covered in zebra lines. But what if you wanted zebras to appear only in a certain range (a "spot", if you will)? Like, what if you only want zebras to appear between 80 and 90 IRE? In that case, you can use the ZEBRA1 DETECT level as your "lower" limit, and the ZEBRA2 DETECT level as your "upper" limit, and then set this ZEBRA2 menu item to SPOT. In that case, only Zebra1 lines will be drawn, and they will only be drawn between the ZEBRA1 DETECT and ZEBRA2 DETECT IRE levels.

LCD EI ASSIST>WFM Mode

The AU-EVA1 includes two separate video scopes, a Waveform monitor and a Vectorscope. This menu item lets you determine which of those monitors are displayed when you press the WFM button. The choices are to toggle the Waveform Monitor (WFM) on and off, or to toggle the Vectorscope on and off, or to sequentially display first the Waveform monitor, and then the next button press brings up the Vectorscope, and the next button press removes the video scope.

LCD EI ASSIST>WFM Transparence

With this menu item you can determine how transparent the waveform monitor (and vectorscope) are when they're displayed. At 0%, the waveform monitor and vectorscope will block the image area where they're displayed, and they will be the easiest to see and read. At increasing levels (25%, or 50%) the waveform monitor and vectorscope are more transparent; that makes it easier to see the image behind them, but it may make it more difficult to read the actual video scope.

LCD EI ASSIST>Spot Meter Unit

This menu item is only available if you've set a MAIN COLOR setting of V-Log. If you've set the MAIN COLOR to one of the Scene Files, then this menu item will be disabled and forced to %. If you've set the MAIN COLOR to V-Log, then this menu item lets you choose whether you want the Spot Meter exposure assist tool to display its results in IRE (%), or in the f-stop difference from middle gray (STOP). When set to STOP, if the spot meter is positioned over an item that's exposed as middle gray, the readout will show 0.0STOP. If the spot meter is positioned over something that's half an f-stop brighter than middle gray, the readout will show +0.5STOP. If it's positioned over something that's two stops below middle gray, the readout will show -2.0STOP. The reference is always in relation to the brightness of middle gray (42 IRE when shooting V-Log).

LCD EI ASSIST>Spot Meter Size

When using the Spot Meter exposure assist tool, this menu item lets you determine how big of a sample in the center of the screen that the spot meter will evaluate. The choices are Small, Medium, or Large. Obviously choosing "Small" results in only the smallest section of the center of the frame being analyzed and reported on; choosing the other choices means a bigger and bigger section of the center of the frame will be analyzed and reported.

LCD LEVEL GAUGE>Level Gauge

This is a simple on/off setting for the Level Gauge; setting it here is equivalent to assigning LEVEL GAUGE to a User Button and then pressing that button.

LCD LEVEL GAUGE>Level Gauge Reset

You have the ability to redefine what “level” means, to the level gauge, by using the LEVEL GAUGE SET User Button. If you’ve changed what the level gauge should consider as “level”, and you now want to reset it to the factory defaults, that’s what this menu item is for.

COLOR BARS>Color Bars Type

You can choose what type of color bars the camera displays when the COLOR BARS User Button is pressed. The choices are normal SMPTE bars with the PLUGE black levels in the lower right, or FULL-screen bars. The SMPTE bars are generally at 75% brightness; the FULL bars are at 100% brightness.

COLOR BARS>Test Tone

This governs whether or not a 1KHz test tone is generated when the color bars are displayed. This menu item lets you choose ON or OFF. The test tone volume that is output is a dependent on how you set the AUDIO SETTINGS>AUDIO CH SETTINGS>HEAD ROOM. Note that the test tone will be output on all the camera’s outputs except for its internal speaker.



FILE Menu

This menu deals with storing your Scene Files and camera setup file on a memory card, and retrieving saved files from a memory card.

The Scene File options are for saving the image control parameters you've set in the SCENE FILE SETTINGS menu, and only those parameters. A complete list of which items are saved, and which aren't, is available in the Panasonic AU-EVA1 Operating Instructions, under "Target Items For Scene File/Setup File/Initialization". Scene Files can be saved on a memory card, moved to another camera, and loaded into another camera; they can be saved as an archived element of a project so if you need to revisit that project in the future, you can recall the scene file settings; they can be downloaded from the Internet and saved on a memory card for loading into your camera, etc.

The Setup File options are for saving the operational parameters of the camera and all the various customization you've done to it (such as choosing your preferred zebra levels, your User Button assignments, the configuration of which pieces of information you've enabled on the LCD display, etc), except for the SCENE FILE SETTINGS. Some items (such as the current clock settings or the timecode preset or the network MAC address) won't be saved, but nearly all of the parameters are saved in the setup file. A complete list of which items are saved, and which aren't, is available in the Panasonic AU-EVA1 Operating Instructions, under "Target Items For Scene File/Setup File/Initialization".

SCENE FILE>Load

If you have saved scene files onto a memory card, or perhaps downloaded scene files onto a memory card, then this menu item will let you load those scene files into the camera and set them as the currently-operating scene files. Note that this is very different from the SCENE FILE SETTINGS>SCENE DATA>LOAD menu item; that menu item is concerned

with loading or saving scene file data into internal camera memory, not from or to a memory card. That's not what this menu item does; this menu item loads an individual scene file, or an entire package of all five Scene Files, from one of your SD memory cards.

This menu item will be disabled if there are no packages of Scene Files on the memory card in Slot 1, or if there's no memory card in Slot 1.

When you execute a Load command, you are given the choice of loading all five scene files in at once, or loading in just one of the individual scene files. If you chose ALL, then all five scene files in the currently-selected package on the memory card will be loaded in, and will overwrite the scene files in the camera's current settings. When loading ALL, all the scene files in the package on the memory card will be transferred to the same positions in the camera's memory -- so, the data for SCENE1 on the memory card will be transferred to the SCENE1 settings in the camera's memory, and SCENE2 to SCENE2, etc. If, however, you choose to load in only one scene file, then you can pick any of the five Scene Files in the package to load, and that particular scene file will be loaded into the camera's current SYSTEM SETTINGS>COLOR SETTINGS>MAIN scene file memory. This means that you could set the SYSTEM SETTINGS>COLOR SETTINGS>MAIN to be SCENE3, for example, and then when you go to LOAD in a scene file from the memory card, you could select a given scene file package, and then choose (for example) SCENE5. When doing so, the contents of the memory card package's SCENE5 will be transferred into the camera in SCENE3 position, because that's what you had set the COLOR SETTINGS>MAIN to.

SCENE FILE>Save & Save As

There are two choices for saving Scene Files onto your memory card: SAVE, or SAVE AS. The "SAVE" option is used for replacing or overwriting an existing package of scene files on the memory card. If there are no packages of scene files on the memory card, then the SAVE option will be disabled (but SAVE AS will still be enabled).

The first time you save scene files onto a memory card, you must use the SAVE AS function, and assign a name. Thereafter, you can either update that saved file (by using the SAVE command), or you can create a new package of scene files on the memory card by using the SAVE AS command.

Both of these menu options will be disabled if there's no memory card in Slot 1, or if the memory card is write-protected.

SETUP FILE>Load

If you have saved a camera setup file onto a memory card, or perhaps downloaded a camera setup file onto a memory card, then this menu item will let you load that setup file into the camera.

This menu item will be disabled if there are no setup files on the memory card in Slot 1, or if there is no memory card in Slot 1.

Saving your setup file can be useful if the camera is shared among many users (such as in a school's cinematography department, or when using a camera rented from a rental facility). With a saved setup file you can instantly configure the camera to all your favorite preferences.

SETUP FILE>Save & Save As

There are two choices for saving Setup Files onto your memory card: SAVE, or SAVE AS. The "SAVE" option is used for replacing or overwriting an existing Setup File on the memory card. If there are no Setupfiles on the memory card, then the SAVE option will be disabled (but SAVE AS will still be enabled).

The first time you save a Setup file onto a memory card, you must use the SAVE AS function, and assign a name. Thereafter, you can either update that saved file (by using the SAVE command), or you can create a new Setup file on the memory card by using the SAVE AS command.

Both of these menu options will be disabled if there's no memory card in Slot 1, or if the memory card is write-protected.



Network Settings Menu

The camera has the capability to utilize an optional, separate-purchase USB network adapter to create or join a wireless network, at which point you can control the camera remotely using an Apple iPad or an Android device that's running the Panasonic EVA ROP app. At the time of this writing, the only wireless adapter that has been certified as being compatible with the AU-EVA1 camera is the Panasonic AJ-WM50. You can check on the Panasonic Pro AV website (<http://pro-av.panasonic.net>) to see if any other adapters have been certified for use.

Note: be careful when downloading the ROP app from the App Store or Play Store. There are many apps out there, one is called the P2 ROP app, another is the AG ROP app. The AU-EVA1 requires the EVA ROP app. Do NOT download and run the P2 ROP app or the AG ROP app; those won't work properly with your AU-EVA1.

NETWORK SEL

This menu item is the master control setting for whether the network is active or not. You must have a compatible wireless network module plugged into the camera's USB 2.0 HOST port in order to enable this menu. To power-on and enable the network adapter, choose WLAN.

NETWORK FUNC>User Account

This menu lets you create one or several potential account names (and passwords) for various users. Each User Account can use different connection methods and other settings; you can almost think of the User Accounts as "Scene Files", but for network settings instead of image settings.

The User Account can be used by the EVA ROP app to connect to the camera. There are two layers of connections; you have to connect to the camera's network by using your tablet's wi-fi settings, and then you also have the option of connecting to the camera's User Account from the EVA ROP app.

On the EVA ROP app, go to the “settings” icon in the top left corner (the “gear wheel”). The connection options on the EVA ROP app will appear in a window on the upper left of the screen. The two elements of interest here are the User ID and Password fields; if you’ve created a User Account name using this menu option in the camera, then you can connect the app to the camera by entering the same User Account name and Password that you established in the camera, into the EVA ROP app’s User Account and Password fields.

For the ultimate in configuration and security, you should establish your own User Account on the camera. However, it’s not necessary to establish a User Account before you can use the EVA ROP App; if there are no custom User Accounts established, then the default User Account name is “guest” and the default Password is “auguest”. If you have not created a User Account on the camera, you can set the EVA ROP app’s settings to User Account: guest and Password: auguest (and note, yes, capitalization is important). However, note that even this is optional; if you don’t assign any user name or password in the EVA ROP app, then it will still connect to the camera through the default User Account.

If you have established your own User Account, then be aware that “guest” and “auguest” will no longer work. That username and password will only work if there are no custom User Accounts established in the camera.

Note that when creating a new User Account, the password requires a minimum of six characters before it will be accepted.

You can have up to 10 different User Accounts registered in your camera; once 10 accounts have been registered the “ADD” menu item will be disabled. Even though you can have up to 10 User Accounts in the camera, you can still only have one EVA ROP app connected to the camera at a time. Accordingly, you have to specify which User Account you want to connect to, and then make sure that you enter that User Account’s name and password in the app’s settings. If the camera is not currently connected to any app, then you can log on by using any valid User Account name and password that has already been established in the camera.

You don’t have to select which User Account you want active in the camera; any User Account can be the active account, it really is up to the app user: whichever account the EVA ROP app tries to log into, will be the currently-active User Account in the camera.

There is not any easily-accessible list of what User Accounts are available in the camera, but if you go to DELETE an entry in the list, it will then bring up a list of the active User Accounts. If you just wanted to see the list, then obviously you wouldn't want to actually delete anything here, so you can just press the EXIT button.

NETWORK PROPERTY>MAC Address

This isn't really a menu item, in that you can't select it. Rather, this line just displays the camera's MAC address. It is not something you can change, but advanced network users may need to know it when establishing connections from other devices.

NETWORK PROPERTY>Type

This menu item determines what kind of network the wireless adapter will create (or connect to). The choices are:

Direct: In this mode the camera will create its own new wireless network, and will broadcast its own network identification (SSID). When using a DIRECT network, configuration is easiest if you go to the WIRELESS LAN SETUP menu and set DHCP to "SERVER". When the camera creates its own network, the default password is "01234567890123456789abcdef".

INFRA (Select): In this mode the camera will be joining an existing wireless network. If you've established your tablet as a hotspot broadcasting its own network, or if you're using your own network router, you can connect to it using INFRA (Select). The first thing you should do is go into the NETWORK SETTINGS>NETWORK PROPERTY>DHCP menu and ensure that DHCP is set to CLIENT. Then, go back to this NETWORK PROPERTY>TYPE menu and press the INFRA (Select) menu option; this will bring up a list of all the wireless networks within range of your network adapter. Look for your desired network, select it, and press ENTER. If your network uses a password, you'll have to enter that password in the NETWORK SETTINGS>NETWORK PROPERTY>ENCRYPT KEY menu item.

INFRA (Manual): This is exactly the same as INFRA (Select), except that the camera won't scan for available networks. Instead, it asks you to specifically enter the name of the network you want to join. If your network's SSID is set to "hidden", then INFRA (Manual) is the way to go to be able to join that network. Enter the network name manually, and then follow all the other connection instructions as outlined above for INFRA (SELECT).

NETWORK PROPERTY>SSID

This menu item lets you change the name that the EVA1 camera generates, when it's set to create a DIRECT connection. The default name of the network it creates is "AU-EVA1". As you can imagine, that could be quite confusing in a multi-camera scenario, so you have the ability to change the name (perhaps "EVA1-A" and "EVA1-B", for example). The relevant thing here is that the name that it broadcasts, is the name you have to connect to on your tablet device before you launch the EVA ROP app. If you change this SSID name to "George", then in your iPad's wi-fi settings you should see a new network SSID called "George" that you can connect to.

If you're not using a DIRECT connection, this menu item becomes disabled and it instead reports the name (the SSID) of the network that the camera is joining, as chosen by INFRA(SELECT) or as specified in INFRA(DIRECT).

NETWORK PROPERTY>Band

Here you can instruct the network adapter in the camera to use either the 2.4GHz band, or the 5GHz band, to use when creating or looking to connect to a wireless network. The factory default is the 2.4GHz band.

NETWORK PROPERTY>Channel (2.4GHz) and (5GHz)

The network adapter is able to search on a number of different channels on the 2.4GHz band, and a number of channels on the 5GHz band, depending on which band you've chosen using the NETWORK PROPERTY>BAND menu item. You can tell it to automatically select a channel, or you can tell it to specifically look to certain channels. Generally leaving this on AUTO is the easiest way to connect, but if you're not having luck connecting or there are many other devices trying to connect, you may have more luck by specifying the channel to connect on.

NETWORK PROPERTY>Encryption

There are a number of different password-protection encryption protocols that are used in wireless communications. When you're trying to connect the camera to an existing wireless network, you want to configure the ENCRYPTION parameter to match what the router or other device is using. This parameter is not used in a DIRECT connection type (where the camera is generating the network and you're establishing a 1-to-1 connection between a tablet and the camera), but it is used when you're connecting to an existing wi-fi network (such as through a router). The camera will generally be able to detect the type of encryption a router is using and will automatically set

this menu item when you use INFRA (SELECT), but you have the option to override its choice if you know that another protocol is more appropriate.

NETWORK PROPERTY>Encrypt Key

This is where you enter the password for the network that you want to join when using INFRA (SELECT) or INFRA (MANUAL). It has to be at least eight characters long. You choose the SSID you want to join using INFRA (SELECT) or by manually typing in the name using INFRA (MANUAL), but you enter the password for that network here in this field.

NETWORK PROPERTY>DHCP

This menu item may be used to tell the camera how to automatically configure its various network settings. If you're using DIRECT, you'll need this DHCP field set to SERVER. If you're connecting to an existing network using INFRA (SELECT) or INFRA (MANUAL), you generally will want this set to CLIENT. And if you're manually configuring your network parameters, you can set DHCP to OFF.

NETWORK PROPERTY>IP Address

When you're connecting to an existing network, you will need to know the camera's current IP address; for example, when connecting to the EVA ROP app through a network, you have to enter the camera's specific IP address in the log-in box on the EVA ROP app. When the camera's DHCP is set to CLIENT, this menu item is disabled and it will display the current IP Address of the camera on the network that it's connected to.

If you're creating a new network or connecting without using DHCP, you may want to even establish your own specific IP Address. This menu item reports the existing IP Address, or it allows you to change the camera's IP Address.

If you're connecting through an existing wi-fi network, such as by using INFRA (SELECT), then you'll need to enter the camera's IP Address in the EVA ROP's log-in settings. Go to the app's upper-left corner (the gear icon), and you'll see three fields: IP Address, User ID, and Password. Enter the camera's IP Address as displayed here in this NETWORK PROPERTY>IP ADDRESS field, and enter an appropriate User ID and Password (if you haven't previously established your own User ID and Password, you can use "guest" for the User ID and "auguest" for the Password, or just leave both fields blank.) The EVA ROP app should then be able to successfully connect to and take control of your AU-EVA1 camcorder.

NETWORK SETTINGS>Connection History

If you've successfully connected to a particular wi-fi network with the camera, that connection information will be stored in this Connection History menu. Select this menu and it will display a list of prior successful connections. Selecting one of them will result in a quick and easy re-connection to that network.

NETWORK TOOLS>Initialize

Use this menu item to reset all the network settings to default. If you've been experimenting unsuccessfully with getting the camera to connect, it can certainly be helpful to re-set the settings to a known default state before trying different settings.



Thumbnail Screen

When you press the THUMBNAIL button, the camera switches to playback mode. The thumbnail display appears, and there are also a number of menu commands available if you press the MENU button; those are discussed in the next section.

Working with the Thumbnail Screen

The AU-EVA1's touchscreen makes playback effortless; you simply touch the picture of the clip you're interested in to play it. If there are more clips than can be seen on the screen at one time, you can touch the UP or DOWN arrows to scroll to the next batch of thumbnails.



When you've highlighted a clip (so that the thumbnail has a yellow outline around it), you can get detailed information about the clip by pressing the INFO button on the side of the camera.

When a clip is playing, a control bar appears on the screen that lets you stop, pause, play, rewind, or fast-forward through the clip (if you press fast-forward or rewind twice, it'll fast-forward or rewind twice as fast.) If you've paused a clip, then the fast-forward and rewind buttons instead become frame-advance buttons; pressing the frame-advance button causes the playback to show the very next frame, one at a time; if you hold down the frame-advance button you can get a nice smooth slow-motion playback effect. Note that if you try to do a frame-reverse, the camera doesn't go frame-by-frame in reverse, it'll jump back about 1/2 second of footage on each press. At the bottom of the screen is the "Direct Playback Bar" which allows you to jump to any portion of the clip, instantly. Finally, while a clip is playing the controls will disappear after a few seconds; you can bring

them back by just touching the touchscreen itself (i.e., not on a control or button).

Controlling playback through the touchscreen is the easiest way, but not the only way, to control playback of a clip. Instead of using the touchscreen, you can use the menu dial wheel or the controls on the handgrip to navigate and operate through the various controls -- but it's a lot easier to just use the touchscreen!

If you need to adjust the volume of the headphones or the on-camera speaker, stop playing the clip and press the MENU button; then go to AUDIO SETTINGS>AUDIO OUTPUT>MONITOR VOL and set the volume to your desired level.

In general, playback of clips is quite straightforward and simple, provided that the clip you want to play is displayed on the thumbnail page. This brings us to perhaps the most confusing element of using the AU-EVA1: finding the footage you shot to play it back. The EVA1 has a wide variety of recording formats and frame sizes, and the playback system is limited to only being able to play back clips that represent the current camera mode settings. Furthermore, the camera has two different recording methods (MOV and AVCHD); the camera can only display thumbnails from one of those recording methods at a time. When the camera is set to a MAIN CODEC of AVCHD, then none of your MOV clips will show up in the thumbnails display. It's not that your clips are gone, it's that the camera cannot display the thumbnails of both types of recordings at the same time. So, likewise, when your camera is set to one of the LongGOP or ALL-I recording choices, then none of your AVCHD clips will show up on the thumbnail display. This means that you may not be able to quickly find the clips on your memory cards, if you've been changing the recording format (MOV or AVCHD).

A helpful hint - on the top of the thumbnail display it will tell you whether it's displaying MOV or AVCHD clips, in black letters on a white background. If you see just one display (either MOV or AVCHD), then that means you only have that type of clip on your memory cards (either you have all MOV clips, or all AVCHD clips). But, if the top line displays both MOV and AVCHD (one in black letters on a white background, the other in white letters on a black background) then that means you have both MOV and AVCHD clips recorded on your memory cards. You'll have to go to the menus, and change the MAIN CODEC to be able to see the other

format's clips, but at least you'll know that there are more clips than you can currently see.

Once you see the thumbnail of the clip you want, that doesn't necessarily mean that you can play that clip. It all depends on whether the clip's properties match the camera's current settings. Generally the reason you might see a red "NO PLAYBACK" icon displayed on a clip is when the SYSTEM FREQUENCY the clip was recorded in, doesn't match the current SYSTEM FREQUENCY the camera is operating at. Take note of the system frequency in the upper right of the thumbnail; all thumbnails will tell you the frame size and frequency of the clip. You can then go into the menus, to SYSTEM MODE>FREQUENCY, and change the camera's frequency to match the clip's frequency -- and when you exit the menus, you should now be able to play that clip back. Another case that may cause a clip to not be able to play back is if the frame size of the clip doesn't match the camera's current MAIN PIXEL setting; an example is if you had a 1280x720 AVCHD PM clip on your memory card, and the camera is currently set to record 1920x1080 AVHCD PS mode. In that case, even though the FREQUENCY is the same, the frame size difference will mean that the clip can't be played back until you go into the SYSTEM MODE>MAIN PIXEL and change it to 1280x720.

Generally, it's much easier to play back clips from a computer, where you can see all the files, all the folders, and the thumbnails for all the clips simultaneously. It also is much easier to play back the clips on an EVA1 if you haven't been changing recording format or system frequency very much. While the camera can play back any clip it's shot, it can be challenging to find those clips; it's easier to do so from a computer.



Thumbnail Screen Menu Options

When the thumbnail screen is displayed, you can still press the MENU button to access many of the camera's menus. However, when MENU is pressed during thumbnail display, you'll see a new menu at the top: THUMBNAIL. This section describes the options found in that THUMBNAIL menu.

THUMBNAIL>PLAYBACK>Slot Sel

In this menu item you can choose whether you want to see the thumbnails from both memory cards (ALL SLOT), or you can limit the display to just one of the memory cards.

Note that when playing back clips, the camera will not span from one memory card to the other. If you used RELAY recording and you've recorded a clip that spans from one memory card to the other, the playback system will treat that as two separate clips. It will only play the portion of the clip that is represented by the thumbnail you selected. For a clip that spans from one card to the next, there will be at least two thumbnails, one for the portion on the first card, and the other for the portion that's on the second card.

THUMBNAIL>PLAYBACK>Resume Play

Normally when you go to play back a clip, the system will start the playback from the very beginning of the clip (the first frame). But if you set this menu item to "ON" the system will "remember" the last time this clip was played, and resume playing from that point. So if you're interrupted during clip playback and had to stop the playback, then the next time you go to play back this clip it'll start where you left off. A new indicator (looks like three arrows pointing right) will show up on the thumbnail icon of this particular clip, to show that it was in process of being played and will play back from where it left off the next time you play it.

THUMBNAIL>CLIP>Protect

You can protect individual clips from being modified or deleted by using the PROTECT function. When you choose this menu item and choose to SELECT clips to protect, the thumbnail screen will be displayed (and the text at the center of the top line will change to say “PROTECT” to let you know you’re in clip protection mode. Just touch the thumbnails of the clips you want to protect and a “key” icon will show on those clips to indicate that they are protected. Protected clips cannot be deleted, either accidentally or on purpose, when using the CLIP>DELETE command (see below). However, protected clips are not indestructible: you can still lose them if you choose to format the card that they’re on, or if you delete them by using a computer. To unprotect a clip, go back into this PROTECT menu and just touch the clip’s thumbnail again to make the key disappear.

Remember that you’re in PROTECT mode, and not normal thumbnail view mode; as long as the text at the top of the display says “PROTECT”, the only thing you can do is protect or unprotect clips. You’ll have to use the “return” arrow in the lower left of the screen to return to the menus.

THUMBNAIL>CLIP>Delete

You can delete an individual clip (or a group of clips, or all clips) off of the memory card. Deleting is immediate, and the space that the deleted scenes used to occupy will be made available for further recording. Deleting is also irreversible.

To delete all the currently-viewable scenes on the memory cards, choose ALL. Be aware that this does not necessarily mean that you will be erasing every clip on the cards – it will depend on whether you have both AVCHD and MOV clips on your memory cards. When you choose to delete ALL, it will delete all the clips that are currently displaying thumbnails. If the camera is showing all the MOV clips, then choosing DELETE>ALL will delete all the MOV clips, but it won’t delete all the AVCHD clips. You’d have to change the MAIN CODEC to an AVCHD codec, and then come back into the thumbnails and choose DELETE>ALL again to delete all the AVCHD clips. Note that even if you took both steps and deleted all clips of both recording types (MOV and AVCHD), the system still won’t delete clips that you protected (by using THUMBNAIL>CLIP>PROTECT). Note that it can take a while to delete clips using the ALL command; if you know for certain that you want every clip gone (whether AVCHD or MOV, whether PROTECTed or not) then it’s usually faster to just format the memory cards.

Instead of deleting all clips, you can choose to delete individual selected clips, either one by one or in a group. To do so, choose **SELECT**. The thumbnails will be displayed again, just like in **PROTECT** mode, except this time the text at the top of the screen will change to say “**DELETE**”. You can then select clips that you want to delete; each time you select a clip, a red trashcan icon will show up on the thumbnail. When you’ve selected all the clips that you want to have deleted, press the **DEL** button in the upper left corner of the LCD screen, and the camera will commence deleting those clips. There is no way to un-delete a deleted clip, so be sure that you have selected the proper clip(s) to delete!

THUMBNAIL>CLIP>Copy

This menu item lets you copy clips between memory cards, but only for AVCHD clips. If the camera is currently configured to record and display MOV clips, then this **COPY** menu will be disabled. If you’ve set the camera’s **MAIN CODEC** to an AVCHD codec, then this menu will be enabled and you’ll have the option to copy selected clips, or all clips, from one memory card to the other.

If you choose to select individual clips to copy, then the camera will display the thumbnails again, and you can mark clips to copy by touching the thumbnails. To execute the copy, press the copy icon in the upper left of the LCD display.

THUMBNAIL>CLIP>Information

This menu item brings up more detailed information about a particular clip. When the clip info is displayed, you can touch the arrow icons to move to the next or previous clip, or rotate the menu wheel to move to the next clip.

Note that this **INFORMATION** menu item is functionally identical to pressing the **INFO** button when on the thumbnail screen.

There are many other menu options than described here; however, their functionality is the same as when in camera mode, so please refer back to the camera menu options to learn how those functions work.



Physical Switches, Buttons and Jacks

This section will describe some of the features of the camera and observations about how those features work and how they can be best employed. Most descriptions will be accompanied by a photo of the button or switch being described.

Audio Controls: On the left of the camera under the transparent audio controls door are some switches and dials for controlling how the input ports work, which channels they get assigned to, and how volume is controlled. Of note: there are two inputs (XLR1 and XLR2) and there are two audio channels (frequently called L and R, but more appropriately called CH1 and CH2). XLR1 does not have to be routed to CH1, and XLR2 does not have to be routed to CH2. They can be, but it is not required.

CH 1 / CH 2 AUTO/MANU: You can configure either audio channel's levels to be automatically adjusted, or manually adjusted. In typical professional productions you'd want both channels to be manually controlled at all times, and especially if you're working with an external mixer — the sound mixer will control the levels, so you definitely don't want the camera trying to automatically compensate too. However, there are scenarios where one person can't do everything — say, news coverage or events or sports or some other intensive/fast-reaction setting, and if it means the difference between getting the shot or not, you may want to use automatic level control in those scenarios. Or, another technique would be to route the same microphone onto both channels, but set one to manual and the other to automatic control, just in case for some reason the manual audio level isn't accurately handled (i.e., sound suddenly gets very loud, and you can't react quickly enough mid-shot to crank the volume knobs down).



You can also assign the limiter to either channel to help control sudden loud bursts; see the AUDIO SETTINGS>AUDIO CH SETTINGS for more details.

Audio Level Controls: There are two audio level control dials. These potentiometers control the volume assigned to channel 1 and channel 2, regardless of what source is attached. If you have configured the AUDIO SETTINGS>AUDIO CH SETTINGS>CH1 IN SELECT and CH2 IN SELECT to INT(L) and INT(R), these dials will control the volume of audio coming from the internal microphone. If you set the CH1 or CH2 IN SELECT menu options to INPUT 1 or INPUT 2, these dials will instead control the volume being input through the XLR connectors. It should be noted that it's possible to record XLR input 1 onto both CH1 and CH2; when doing so, you may find it advantageous to set one of these audio control dials to slightly lower volume; this can give you a clean track of audio that's more protected against clipping and distortion in case you need it in post; or, you may choose to have one channel set manually, and let the other channel be automatically controlled.



SD Card Access Lamps: Each card slot has a glowing LED lamp near it, and that lamp lets you know the recording or access status of the card. You never want to eject an SD/SDHC/SDXC card when it's being accessed! If the light is on next to a card, leave that card alone. These lights will light up when the card is being recorded to, when it's being played from, and when it's being copied from and copied to. Perhaps most importantly, when you're doing a RELAY recording, the amber light will be flashing quickly next to the card that's currently being recorded to, and the other card's light will be green. When you want to swap cards, pay careful attention and only eject the card whose light is currently green.



ND Filter buttons: The camera includes three switchable ND filters. Neutral Density filters are used to control exposure, and ND filters act like “sunglasses” for your camera: they help cut down the amount of light passing through the lens, so in bright conditions you can engage the ND filters to lower the light level and get proper exposure. They’re called “neutral” density filters because they add no color shift to the image: they’re a neutral shade of gray, so the only image effect should be to lower brightness.



The ND Filter Buttons allow you to increase or decrease the amount of ND filtration being provided. There are four levels:

CLR: No ND filters (best used in lower light conditions);

0.6: The mildest setting of ND filtration, reducing the amount of light coming into the camera by two stops.

1.2: A medium setting of ND filtration, reducing the amount of light coming into the camera by four stops.

1.8: The strongest amount of ND filtration, reducing the amount of light coming into the camera by 6 f-stops.

The ND filters can be thought of as three 2-stop filters. ND filters are named according to how many thirds of an f-stop they reduce the incoming light, and typical ND strengths are ND .3 (three thirds, or one full f-stop), ND .6 (six thirds, or two stops) and ND .9 (three stops). An ND .3 reduces light by 3 thirds of an f-stop (or one full f-stop.) Put another way, an ND .3 reduces the amount of light coming into the camera by half. The exposure compensation of an ND .3 is the equivalent of closing down the lens by one f-stop; for example, a camera shooting at f/4 with an ND .3 filter will deliver the same exposure as a camera shooting at f/5.6 with no ND filter.

The AU-EVA1 is a very light-sensitive video camera, rating at between 200 ISO to 25,600 ISO. Because of this high speed you need to use the ND filters to control the amount of light that enters the camera. For indoors shooting you’ll usually want the ND filter set to CLR, but outdoors will almost always dictate using at least ND 0.6 and frequently ND 1.8.

User Buttons: The AU-EVA1 has seven customizable USER buttons on the camera body and two on the detachable handgrip. Five of these physical User Buttons are grouped together on the side of the camera (USER 1/VIEW/INFO/E.I.S. and WFM); User 6 is located on the front of the camera (pre-programmed for AWB), and User 7 is at the back of the camera (pre-programmed for SLOT SEL). The last two are located on the removable handgrip. The eighth button is on the top of the handgrip, pre-programmed as a menu exit function, and the ninth is on the inside of the handgrip, about where the tip of your middle finger would hit it. These buttons allow you to instantly switch in certain features, such as turning on a focus assist tool, the waveform monitor, or many other functions. [CLICK HERE](#) for a detailed discussion of what the various USER buttons can do.



User Toggle Switch: There is a 3-position toggle switch for determining what the menu jog/dial wheel controls. The switch can be set to White Balance (WB), to a USER setting, or to control the sensitivity (either ISO or dB of gain).



When set to WB, rolling the menu wheel will scroll through the list of preprogrammed white balance values. You can add values to that list, or delete values from that list; see the CAMERA SETTINGS>WHITE menu for more information. Two important entries on the list to take note of are ATW (which causes the camera to enter Automatic Tracking White mode, where it automatically and continually adjusts the white balance); and the AWB MEMORY setting. If you want to be able to take a manual white balance using the AWB button (or the AWB function in the menus), you must first set the camera's white balance to AWB MEMORY. You can do that in the CAMERA SETTINGS>WHITE>VALUE menu, or you can do it here using the User Toggle switch and the menu wheel. When scrolling through the list of available white balance choices, look for the one that starts with a capital A (example: A3200K+0.0). That leading "A" tells you that that's the entry in the list that corresponds to the AWB MEMORY setting.

When set to ISO/dB, the wheel controls the sensitivity of the camera, either by changing the ISO, or adjusting the amount of gain (positive or negative gain) being applied to the picture. You make the determination between Gain and ISO in the CAMERA SETTINGS>EI>MODE menu. Gain is an electronic amplification of the video signal, which means that by using gain you can make the picture brighter than it otherwise would look. The downside to using gain is that it introduces more noise into the picture. The more gain you use, the brighter the picture becomes, and the noisier the image gets. You can scroll through the available settings quickly and easily; the exact range of available settings is dependent on how you've configured the camera's sensitivity (either 800BASE or 2500BASE, or Gain Mode NORMAL or HIGH). Additionally, the available range of gain or ISO settings can be affected by whether you've selected the VIDEO gamma, or a different gamma curve. Generally the ISOs are half as sensitive when using the VIDEO gamma.

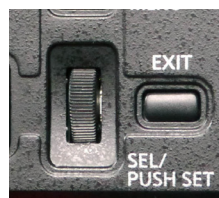
The ISO values show you the sensitivity of the camera in terms of film speeds. A doubling of the ISO is equivalent to making the camera more sensitive by one f-stop. As an example, if you're getting proper exposure at f/4 and 800 ISO, and you change the ISO to 1600, the picture will be overexposed by one f-stop, and you'd want to stop the lens down to f/5.6 to compensate. ISO 400 is twice as bright as ISO 200; ISO 800 is twice as bright as ISO 400 (and 4x as bright as ISO 200), and on and on.

Alternatively, you can configure the camera to use dB of gain. 6dB of gain is twice as bright (one f-stop brighter) than 0dB of gain. Each 6dB of gain results in doubling the sensitivity, so 12dB is twice as bright as 6dB (and 4x as bright as 0dB); 18dB is twice as bright as 12dB (and 8x as bright as 0dB), etc. The more gain you add (or the higher you crank up the ISO) the noisier the image will get.

Be sure to read the article on UNDERSTANDING EXPOSURE for a more thorough discussion of Gain, how it works, when it's good and how it can harm your picture.

Finally, if you've set the switch to USER, then you can customize what the wheel controls. Look at the SYSTEM SETTINGS>USER SWITCHES>USER TOGGLE menu to see the choices, which include inhibiting the wheel from working at all, or having it control the shutter speed, or the variable frame rate, or the headphone volume.

Menu Jog/Dial Wheel: This multi-purpose control is used to set the shutter speed, the ISO or gain level, to navigate the menus, to set a variable white balance temperature, and can also be used to choose a variable frame rate.



Note that there are actually two menu wheels, one on the camera body and one on the handgrip. Both function identically when operating the menus, but when in camera mode, the handgrip wheel is used to control the lens's iris, whereas the camera body wheel can be used to select among the User Toggle function options..

Menu Button: There are two menu buttons, one on the camera body and one on the handgrip by the record button. Press a MENU button to bring up the menus, and then just roll the wheel up and down to the menu option you want to change, and press the wheel in to make selections. The wheel is also useful in the menus even when using the LCD, because the wheel can be used to quickly navigate through some of the menu options that are tedious to adjust with the touchscreen. As an example, many of the SCENE FILE menus bring up adjustment choices that can be adjusted across a huge range; the Chroma Level is adjustable from -99 to +99 — that would take forever to navigate with the touchscreen, one press at a time. You may find that the wheel is much more convenient and quicker to use to adjust those menus. To quickly navigate through a large range of menu items, press the wheel in like a button and hold it in while you move the wheel up or down. That will cause the system to quickly scroll through the available options.



Thumbnail Button: This is one of the buttons you'll be pressing frequently. When you press it, the screen will fill with the thumbnail display of the recorded clips on the memory card. Press the THUMBNAIL button again to go back to camera mode (or, if you need to start recording immediately, just press the RECord buttons; the camera will automatically switch back to camera mode and start recording). Also, be aware there are menu options available in playback mode that can only be accessed by pressing the MENU button.



Pressing the MENU button will hide the thumbnails and bring up the menus; there is one thumbnail-specific menu that can only be accessed by pressing the MENU button while the thumbnails are displayed.

View Button: This button will take you back to the live feed from the camera. If the thumbnails or Home screen are currently displayed and you want to go back to camera mode, press the View button. Note that this button doubles as User Button 2. If either the thumbnail display or Home screen are displayed, then this button will work as the View button; if the live camera feed is already being displayed, then this button will work as User Button 2.



Info Button: This button will bring up more information about whatever's currently on the screen. For example, if the Thumbnail screen is displayed, the Info button will bring up detailed information on the clip that's currently selected. And if the Home screen is displayed when you press the Info button, it brings up a menu of options for diagnostics, seeing your current User Button assignments, the current firmware status, the current network status (if you have an AJ-WM50 networking adapter installed), the current audio settings, and the status of your media cards. Finally, the Info button doubles as User Button 3; if you press the Info button during live camera display, it will execute the function that's been assigned to User 3.



Home Button: This button brings up the Home screen, a quick-access display that tells you the status of many important camera settings, and also serves as a shortcut into the menu system. From the Home screen, you can see the frame rate, the scene file, the shutter speed, the white balance setting, the ISO, and many other pieces of information. To change any of them, just touch the display and the camera will take you to the menu option that governs that item. You can also navigate through the Home screen sections by using the menu jog/dial wheel, and pressing the wheel as a button to make a selection.



LCD Monitor: The LCD monitor is a touchscreen that is used for monitoring your shots and for controlling the camera's menus. The LCD is quite reflective, which can make it challenging to see in brightly lit

environments; the camera includes a collapsible sunshade to help in those situations. You can also get an optional third-party viewfinder attachment that sets a loupe over the LCD panel and lets you operate it like a conventional viewfinder.



The LCD can be mounted in many positions on the camera, or removed entirely if it's not needed (perhaps for aerial footage or for stripping the camera down to minimal size for mounting in hard to reach places.

There are many, many pieces of information displayed on the LCD screen; you can individually disable any that you don't need or don't intend to use, in the OUTPUT SETTINGS>LCD INDICATOR menu.

The SYSTEM SETTINGS>LCD menu gives you some control over the LCD display, including brightness, contrast and color. While it is tempting to think that you could calibrate the LCD to the color bars to match a professional monitor, it's not really practical because a slight change in the ambient light level or changing the BACK LIGHT level may change how the LCD's display looks. It's much better and safer to rely on a true external production monitor to gauge color, exposure and contrast, or, if one isn't available, use the zebras and waveform and vectorscope.

The touchscreen element of the LCD may take a little getting used to. It is not an electrical capacitance touchscreen; instead, it relies on pressure. This means that you can use it while wearing gloves, for example. The touchscreen doesn't respond to the mere presence of a finger (like an electrical capacitance screen might); instead, it needs to register pressure. When using the touchscreen, it's not affected by how long you hold your finger in place, what matters is whether you've pressed the screen long enough for it to register. And, the touchscreen registers the release of the finger -- so if your finger has slid on the screen, it may not trigger the option you thought you were triggering. Instead, the menu will respond to the last place that was touched, so -- it's not so important where you touch it, what matters is where you release your touch. A little bit of practice with it should have you navigating the touchscreen efficiently in no time.

Note: the LCD monitor is removable, but removing it may impair some of the functionality of the camera unless you also mirror the LCD's output to an HDMI or SDI monitor. There are some buttons that may serve multiple functions and, if pressed at the wrong time (and no way to see what the

camera's expecting) you may find yourself locked out of being able to operate the camera. An example would be the EXPAND focus assist; if you don't have the LCD enabled and don't have the other monitor outputs mirroring the LCD, you may not even see that the EXPAND focus assist is active; you just won't be able to see the cursor or navigate the menu properly because when in EXPAND mode, the menu wheel is repurposed to move the expanded window around the screen. And the handgrip's EXIT button serves dual purpose as an EXPAND button. If you're exiting the menus using repeated presses of the EXIT button, that's fine, but if you press it one time more than necessary, then it will invoke the EXPAND feature and at that point, if you don't have the LCD attached and you aren't mirroring the LCD feed to one of the other monitor outputs, you may end up stuck. The solution is quite simple, of course -- either always have the LCD plugged in or, if you don't have it plugged in, then assign your other monitor output to mirror the LCD.

E.I.S. Button: The camera includes an Electronic Image Stabilization (E.I.S.) system, which can help smooth out shaky handheld shots. E.I.S. is an option for manual lenses, or lenses that don't have an optical image stabilizer. If your lens has Optical Image Stabilization, use it; it will do a better job than electronic stabilization will. However, if you're using a lens that doesn't have optical stabilization, that's when the E.I.S. is available and it can certainly do a good job. Do be aware that the E.I.S. needs to know the focal length of the lens that's attached; electronic lenses will typically automatically convey that information to the camera but if you're using a fully manual lens, or a lens adapter such as a Nikon F converter, or if you've adapted your camera to use a PL mount, then there will be no way for the camera to automatically know what the lens focal length is. In those scenarios, you have to go into the CAMERA SETTINGS>E.I.S. menu to enter the ZOOM POSITION VALUE.



The E.I.S. button is also a reprogrammable User Button, User Button 4.

WFM Button: This button enables or disables the WaveForm Monitor (WFM) or VectorScope (VS), according to the menu setting you've assigned to the WFM button. You can display either the waveform monitor or the vectorscope, but not both. The integration of a waveform monitor is perhaps the most valuable exposure tool. A waveform monitor is an excellent



tool for analyzing the video signal and getting excellent exposure. For an introduction into how to read the waveform monitor, see [THIS ARTICLE](#).

The WFM button is a re-programmable User Button, and you can also access the waveform monitor or vectorscope by assigning the “WFM” function to any other User Button.

Remote Jack: On the right side of the camera, under and behind the XLR inputs, there’s a jack labeled REMOTE. Generally this port is used for the included removable handgrip. The handgrip is, in essence, a remote control, offering menu access, a couple of user buttons, menu/iris control, and record start/stop. All these signals are passed through one cable and into the remote jack. While the cord on the handgrip is only a few inches long, it is possible to get an extension cable to be able to use the handgrip from a further distance (as an example, perhaps if the camera was mounted on a jib arm). A perhaps better way to go would be to get a third-party remote control that’s compatible with the AU-EVA1, or pick up an AJ-WM50 wi-fi adapter and control the camera using the EVA ROP app from a tablet or smartphone.



Note: the remote port is not backward-compatible with any prior Panasonic-compatible remote control, but it is compatible with popular remote controls used by other camera manufacturers.

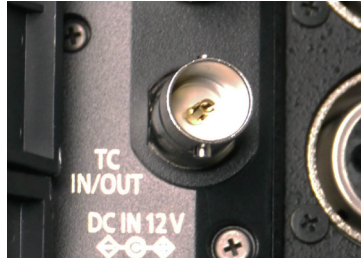
SDI/HD-SDI/3G-SDI/6G-SDI Connector: The AU-EVA1 includes an industry-standard 6G-SDI output terminal. SDI stands for Serial Digital Interface, and the SDI port lets you monitor (or even record) fully uncompressed digital high-definition video at up to 2K/59.94P or 4K/29.97P.



This port is a regular locking BNC connector and is capable of transmitting either high-definition or UHD or 4K footage, and it can also output raw video (when attached to a compatible 3rd-party recording unit). The SDI port is a 6G-SDI port that is fully backward compatible with 3G-SDI, HD-SDI and standard-definition SDI. The OUTPUT SETUP menu settings govern what type of video signal is sent through the SDI port, whether

full-resolution or downconverted video. The camera also sends embedded timecode and audio in its SDI signal, making it suitable for use with computer SDI capture cards or portable recording units. The SDI port can also be configured to mirror the output of the LCD display, thus sending all the camera information, battery and memory card information, and even focus assists and video scopes out the SDI port.

Timecode In/Out: The TIMECODE IN/OUT port is used to synchronize timecode with other cameras or timecode slates or other TC-enabled devices. This is a traditional timecode port that can be continuously sending timecode to any receiving device. It can also be continuously receiving timecode from another device, as long as the camera is in recording standby mode. When actively recording, the camera cannot receive timecode; it will instead rely on its internal timecode generator during recording, but when recording is stopped it can then receive timecode from a connected device.

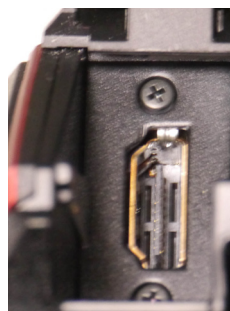


The camera does not have genlock capability, so absolute frame precision is not possible; it's possible that the timecode could be off by up to one frame. See the article on [SYNCHRONIZING TIMECODE](#) for more information.

DC In 12V: The same power supply that plugs into the battery charger, can be plugged directly into the camera in this port. Note that that means you can either run the camera off AC power, or you can charge batteries, but you cannot do both at the same time (and no, the battery in the camera won't charge when the AC power supply is plugged in). However, do note that it's a good idea to keep a charged battery in the camera even when operating off AC power. The camera will switch seamlessly between AC and battery power; if you need to move the camera to a new location you can unplug the AC power and the camera will instantly switch to battery power, without missing a beat or dropping a frame. Alternately, if you want to change out the battery in the middle of a recording, you could plug in the AC power, then swap the battery, and then unplug the AC power, all continuously and without interfering with the ongoing recording or live output.



HDMI Connector: The EVA1 includes an industry-standard HDMI 2.0 video output terminal. HDMI stands for High Definition Multimedia Interface, and HDMI ports are common on HDTV sets, Blu-Ray players, game systems and other consumer electronics devices. HDMI can also be easily converted to DVI through the use of a simple adapter; using an HDMI->DVI adapter will let you use a computer monitor as a video monitor (which is not necessarily that good of an idea, but hey, it's an option; also, converting to DVI will mean losing the audio that is carried in the HDMI signal as DVI doesn't support embedded audio).

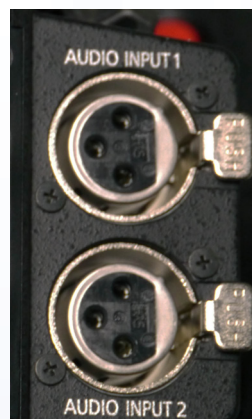


The HDMI port lets you monitor (or even record) fully uncompressed digital video in standard def, high definition, UHD, and 4K. This port is a standard full-size HDMI connector and uses standard HDMI cabling available at electronics stores; but because it is compliant with HDMI 2.0, you're going to want to use quality high-speed cables. Cheaper cables might work for high-def, but might fail when using UHD or 4K.

The camera also sends embedded audio in the HDMI signal, and can optionally send timecode as well. When configured to send timecode, the HDMI can also be used to send a RECOrd start/stop flag, which can be interpreted by external recorders to start and stop recording, thus enabling one-button recording for both onboard and external recorders.

One thing to be aware of regarding the HDMI — if the SDI port is outputting raw data, the HDMI port will be limited to 1920x1080 output.

XLR Audio Connectors: There are two XLR audio connectors for attaching microphones, wireless mic receivers, mixers, or other professional audio devices to the camera. These XLR connectors are input-only, no audio can be output from them. Also, the XLR connectors only function when in camera mode. The XLR ports can also supply phantom power if desired, and can be configured to line level or mic level. You can also configure the sensitivity of the XLR inputs (in either line or mic level) in the audio menus.



USB Ports: The camera includes two USB 2.0 ports; one is a USB Host port, the other (Service) is for attaching the camera to a computer so that you can view the licensing agreements. These ports are on the back of the camera, next to the HDMI port.



The HOST port can supply USB bus power, and is designed to be equipped with the optional AJ-WM50 wi-fi adapter to allow the camera to be remotely controlled by the EVA ROP app on an Android phone or tablet, or an iOS phone or iPad tablet. This adapter provides the ability for the camera to generate a wi-fi network, or to join an existing wi-fi network. When combined with the EVA ROP app running on a compatible handheld device, you can remotely control most every function on the EVA1.

The SERVICE port allows you to plug the camera into a computer using a standard mini-USB cable. You then need to enable USB Service Mode by using the INFORMATION>USB SERVICE MODE menu item. The camera will then appear as an external hard disk on your computer's desktop. If you double-click that icon to access the contents of that disk, you'll then see and be able to open the licensing agreements for the various operating system software in the camera.



About the Author

Barry W. Green is the author of many camera guides including the original “The DVX Book and DVX DVD”. He’s an Emmy®-award-winning producer with four Emmy nominations for writing and producing television commercials and public service announcements. His technical background includes 13 years as a professional computer programmer and producer for Westwood Studios, creating some of the most popular video games in history. Since leaving the videogame industry in 1999, he now writes and produces award-winning corporate and industrial films, commercials, screenplays and films for Fiercely Independent Films Inc. He’s been an instructor in HD training seminars and been an invited guest speaker at video conferences worldwide, is an imaging technician for aerospace cinematography company FlightLine Films, and also serves as partner and moderator for www.DVXUser.com, one of the world’s largest online communities for filmmakers, shooters, and content producers of all types, and is the leading source of information for users of the AU-EVA1, as well as the DVX200, UX cameras, DVX100, HVX200, HPX, and HMC series of cameras. He also produces training videos for filmmakers, including the “Sound for Film and Television” and “Lighting for Film and Television” DVD series. You can find more products at www.WrightsvilleBeachStudios.com as well as on www.Amazon.com.

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