LDX Advanced
Shader session
2016/17

FUTURE-READY

Your Host for today

Jan Paul Campman

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LDX Advanced *New Features(2)*

LDX Shader Training program

10:00 Introduction & Basic information.
10:30 Menu structure LDX Head,VF,XCU and OCP & MCP
11:00 LDX basic functions overview and explained. (1)

12:00 Lunch.

13:00 **LDX advanced controls and features.** (2)
15:00 Diagnostics. (3)
15:30 Exercises (Hands-On)
16:30 Discussion and Questions time.
17:00 End Training.

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LDX Advanced *New Features(2)*

Part 2:

- New Features (LDX)
- LDX 86 4K and XDR
- Under development
- OCP MCP hints / tips

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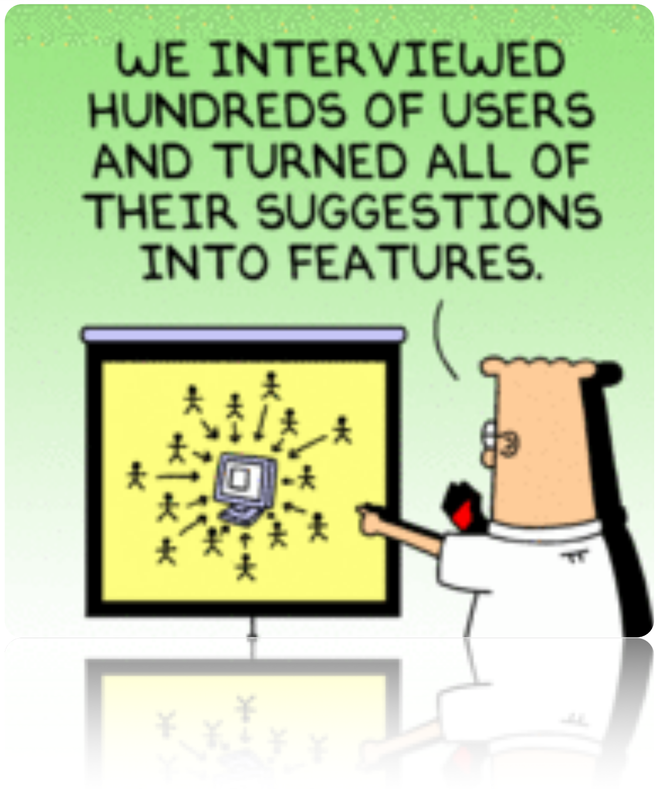
What’s New LDX series

This part gives you some more details about the LDX Features

- **LDX “New” Features**
- LDX 86 4K and XDR
- Under development
- OCP MCP hints / tips

LDX Features "New"

- ☑ Sensitivity modes
- ☑ Correlated Color Temperature
- ☑ Power curves: Knee, Gamma, Contras control , Knee Saturation
- ☑ Matrix: Saturation, Color Protect
- ☑ Detail: Skin detail, Detail equalizer,
- ☑ Pixel corrector, Noise Reducer
- ☑ Lens Dependencies: CLASS, Depth of Field DoF indicator
- ☑ Color Gamut
- ☑ 4K native
- ☑ XDR (HDR)



What's New LDX series

Sensitivity Settings

mode	Noise(0dB)	Sensitivity	Stop
HiQ	low (good)	2000 lux	F8
Nom	standard	2000 lux	F12
HighSens	acceptable	2000 lux	F17

Optimized for there own odB position

Example: HiQ only until 300-400% dynamical range but very good S/N values

Sensitivity Settings

The following settings and ranges are in use with the different sensitivity modes :

	High Quality mode[1)]	Nominal mode	High Sensitivity mode[1) 2)]
Basic sensitivity[3)]	typ. F8 @ 2000 lux	typ. F12 @ 2000 lux	max. F17 @ 2000 lux
Video gain range	-3 .. +12 dB	-3 .. +12 dB	-3 .. +18 dB
Signal-to-noise ratio	64 dB	60 dB	54 dB
Texture representation	Excellent	Very good	Fair
PowerCurves exposure input range (available only in Elite and WorldCam versions)	up to 300%	up to 800%	up to 800%
Exposure time range	down to 1/1000 s	down to 1/1000 s	100 Hz/120 Hz to Nom.

1) Not available in the LDX Flex version.

2) Not available in the LDX Première version.

3) Actual basic sensitivity depends on selected video mode/frame rate.

What's New LDX series

Correlated Color Temperature

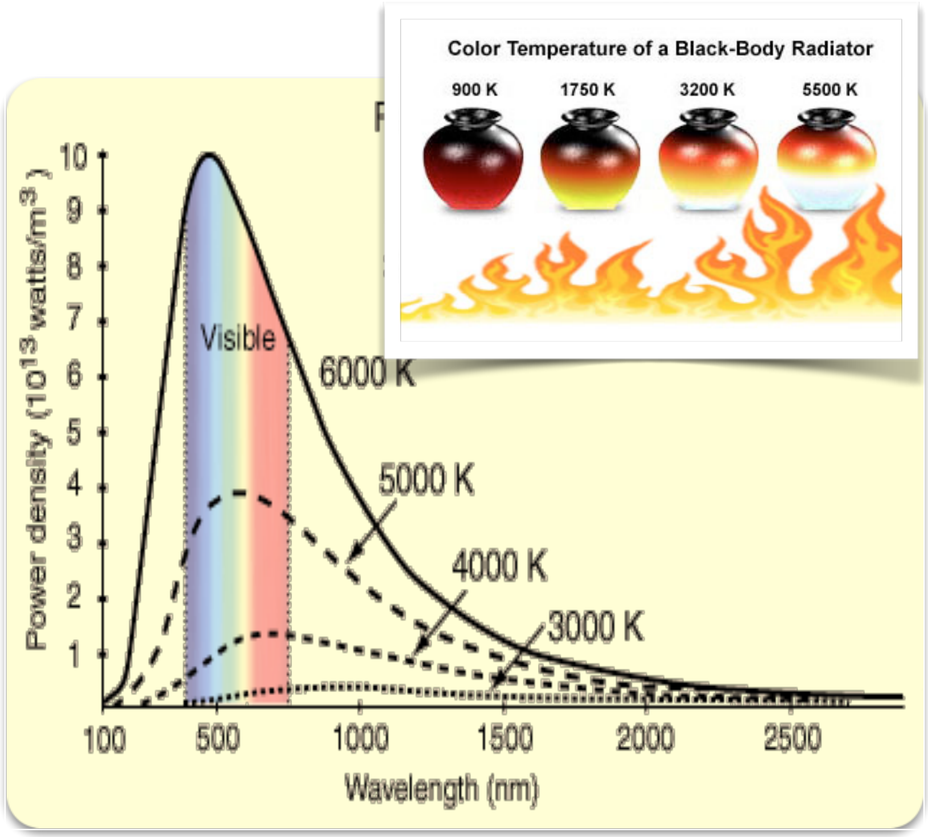
Light and Color Temperature

A perfect

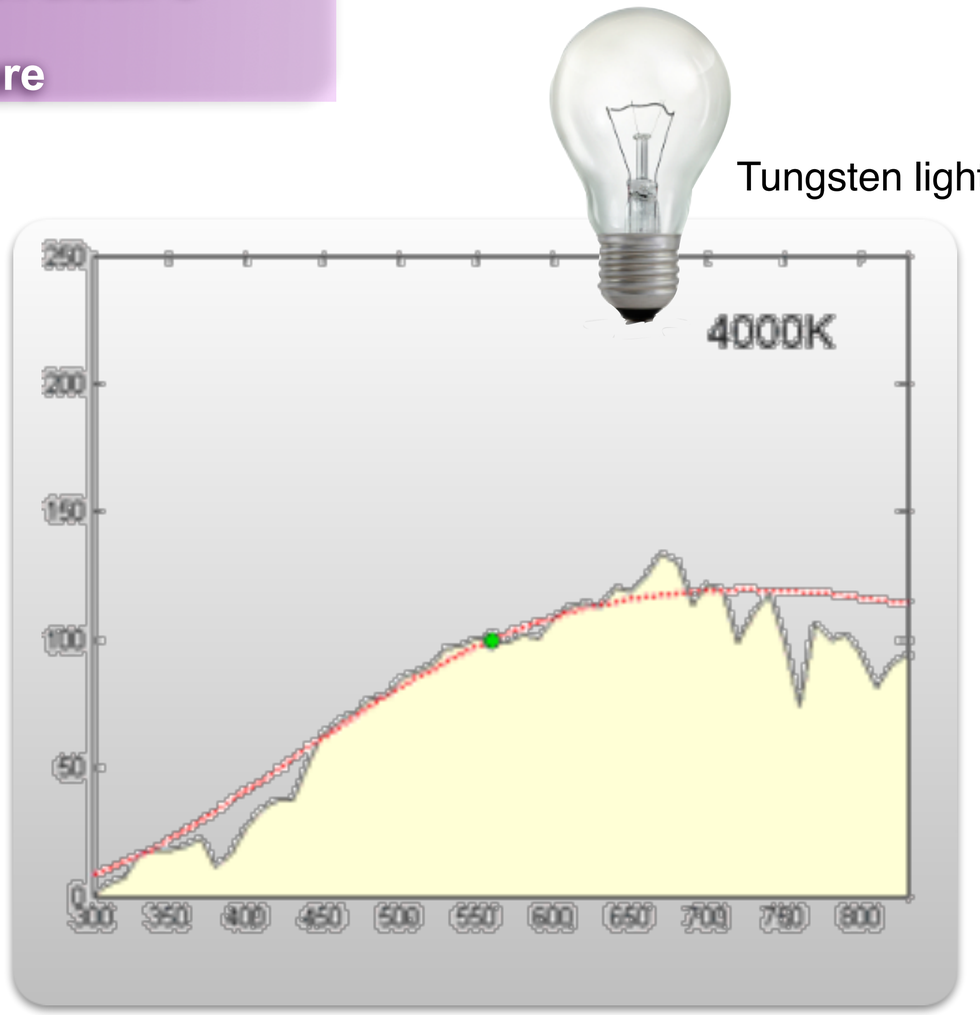
blackbody

is one that absorbs all incoming light and does not reflect any

The color temperature of a light source is the temperature of an ideal black-body radiator that radiates light of comparable hue to that of the light source.



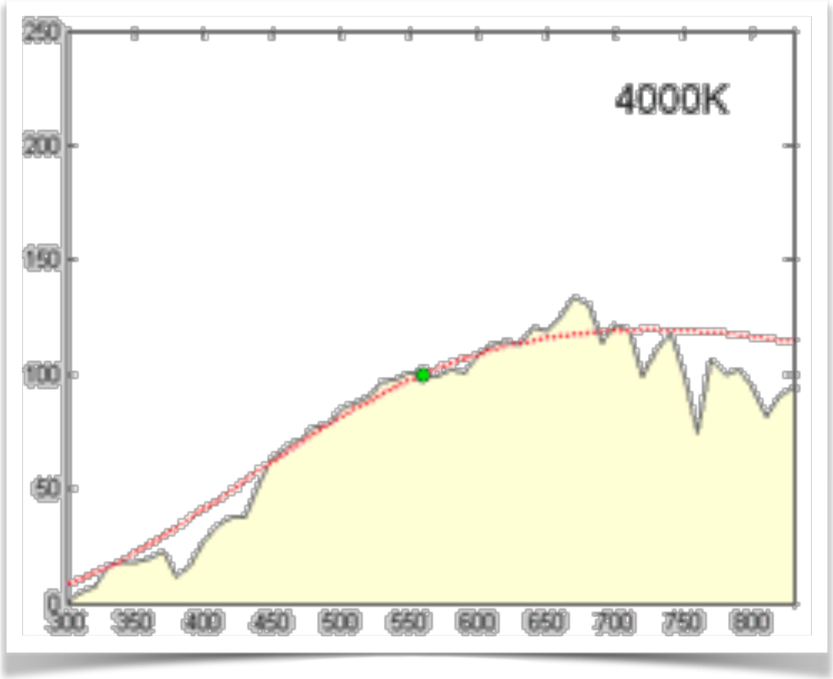
Black body radiator

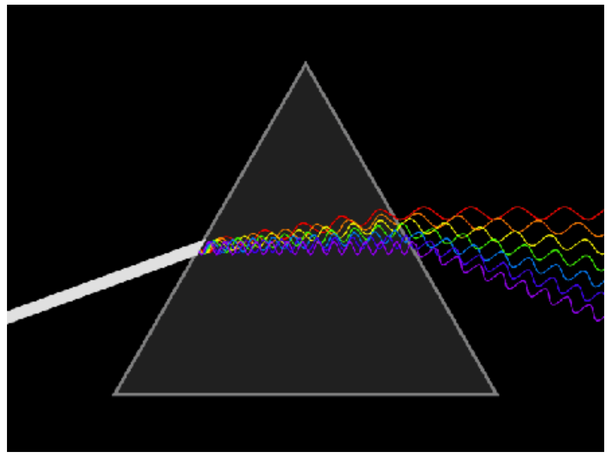


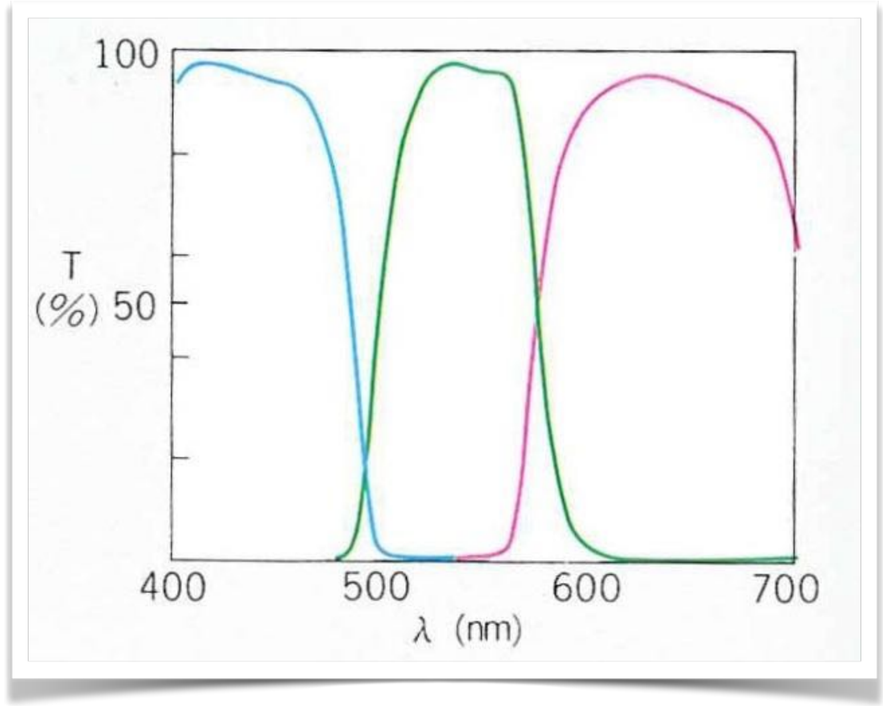
Visible light

Correlated Color Temperature

Light and Color Temperature





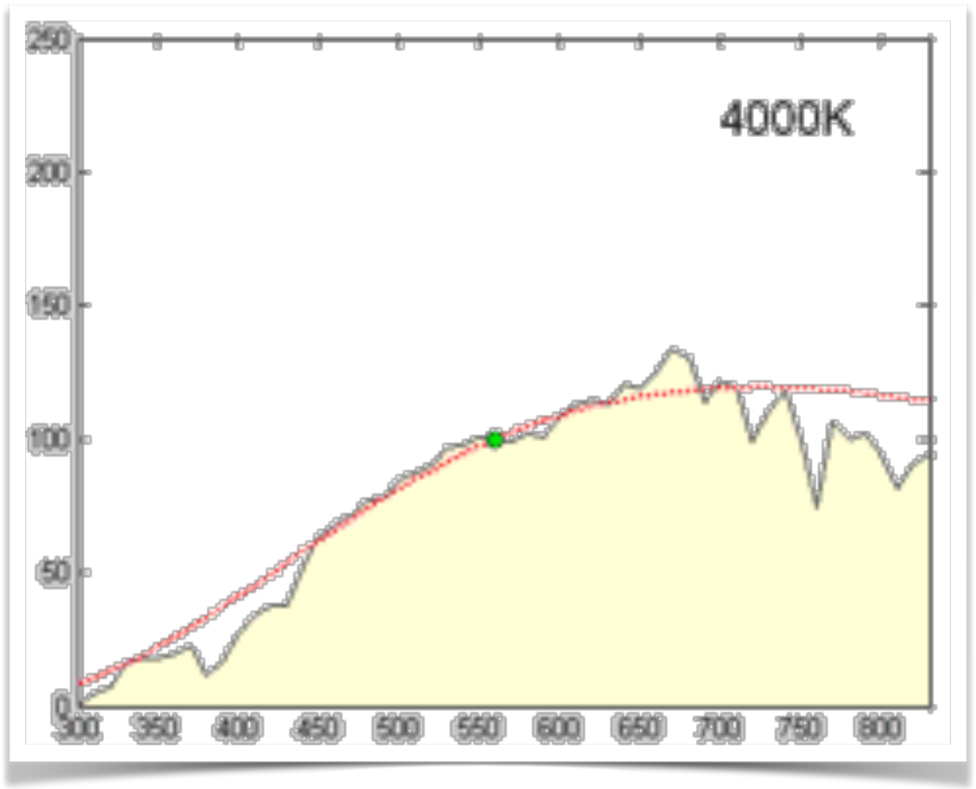


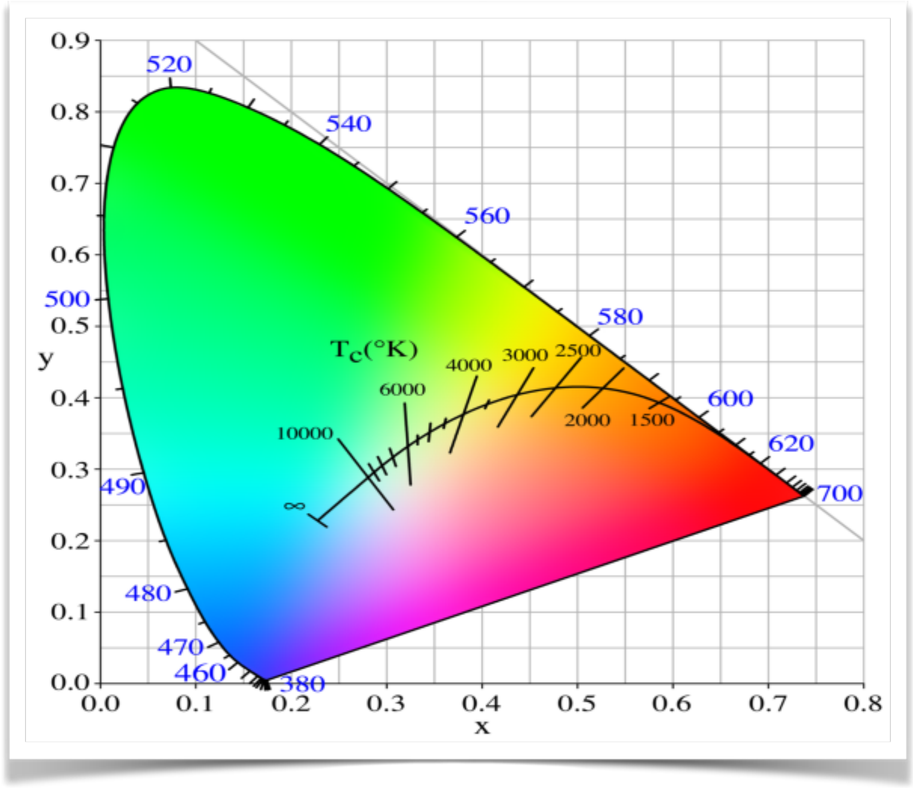
Visible Light

Camera RGB response

Correlated Color Temperature

Light and Color Temperature





Visible Light

Mapped in the x y color triangle

What's New LDX series

Correlated Color Temperature

Light and Color Temperature

Two parameters are necessary to adjust color

There are different ways of adjusting color :

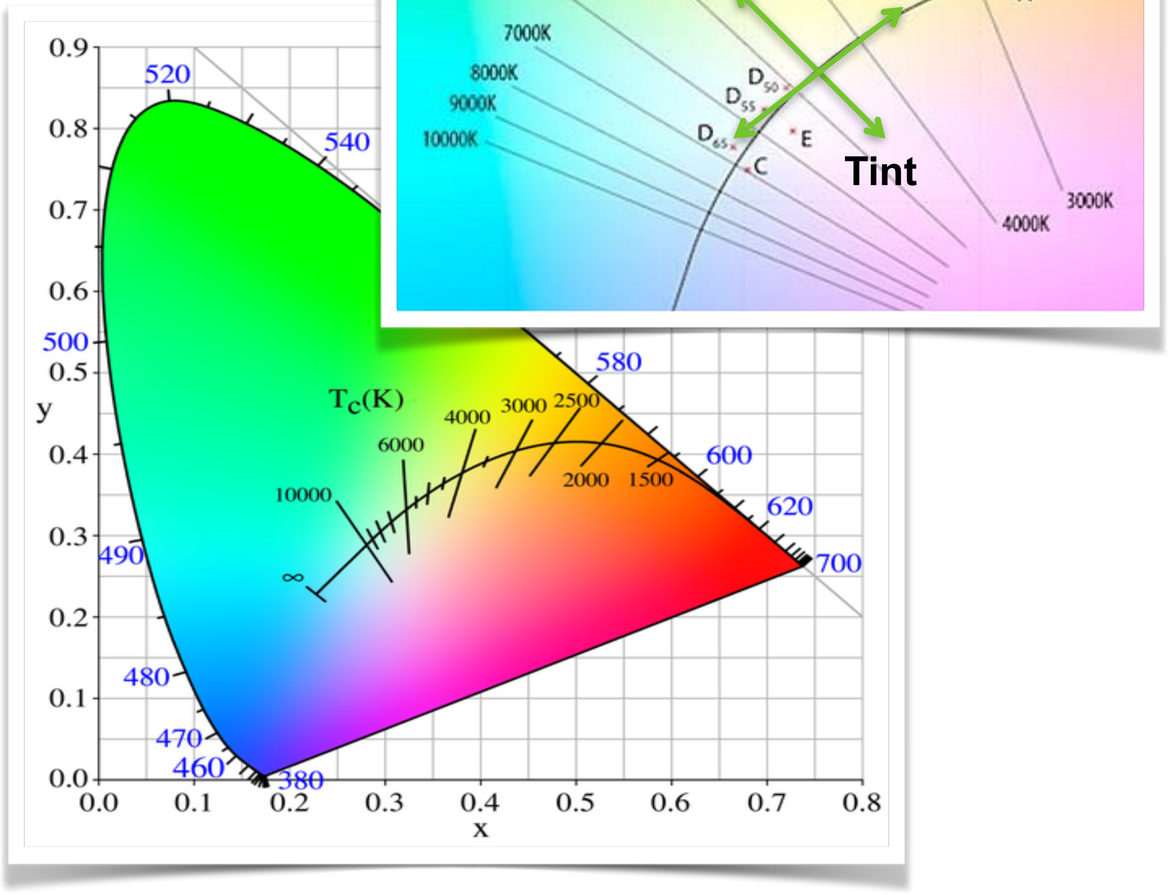
- Red Blue Gain. With Green fixed. (common in cameras)
- x and y or u and v (physics, colorimetrie)
- Correlated Color Temperature and Tint (lighting, perceptive)

We use CCT and Tint in LDX

- Better communication about camera settings
- Matches more with our perception of colors than just camera gains.

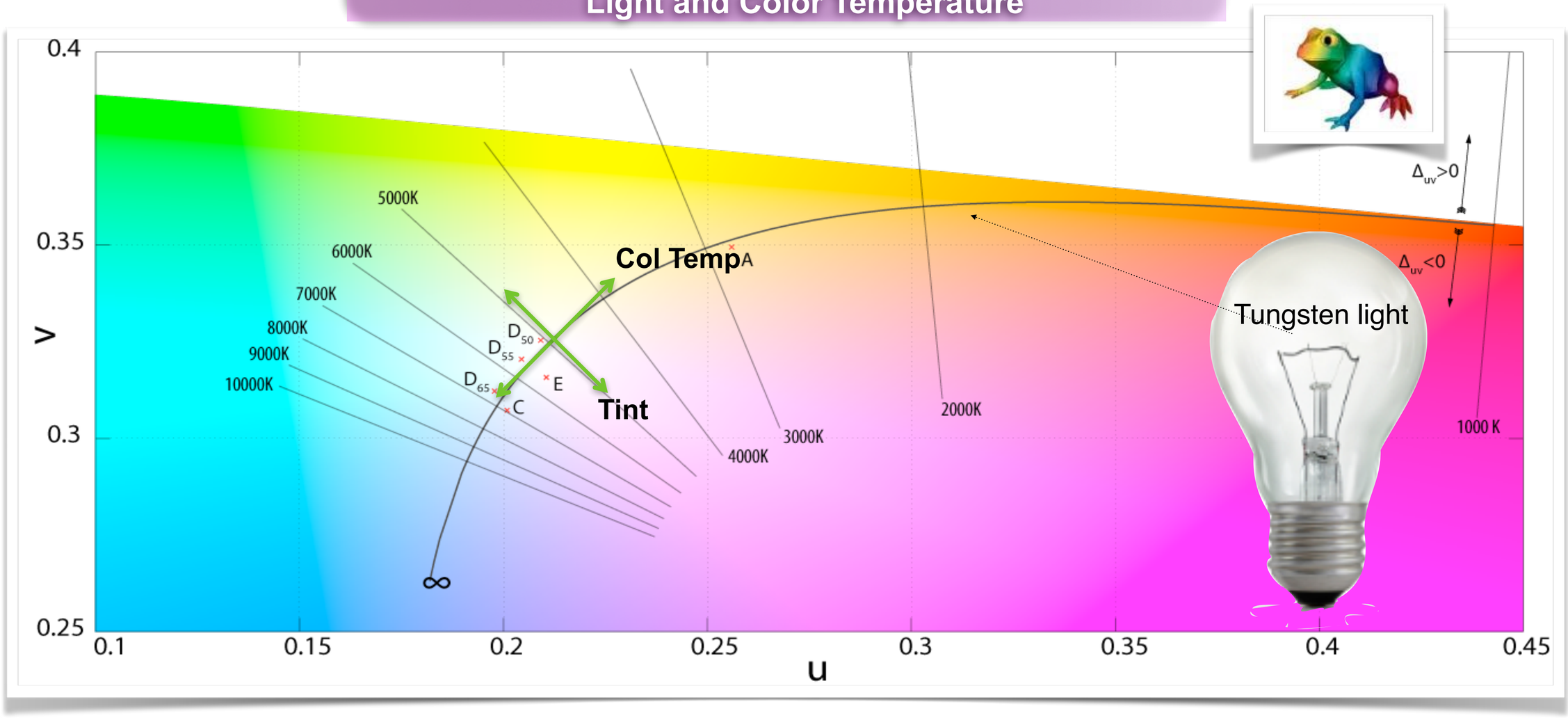
CCT and Tint:

- White balance the camera
- Determine from camera gains the xy colorpoint
- Calculate from x y the CCT and Tint of this whitepoint
- Display CCT and Tint
- Display In addition x y to the user



Correlated Color Temperature

Light and Color Temperature



Correlated Color Temperature

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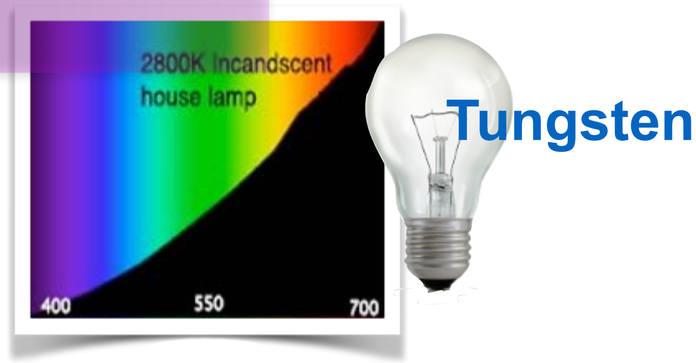
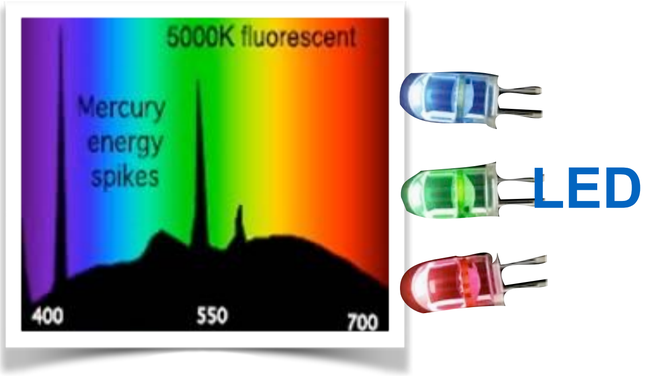


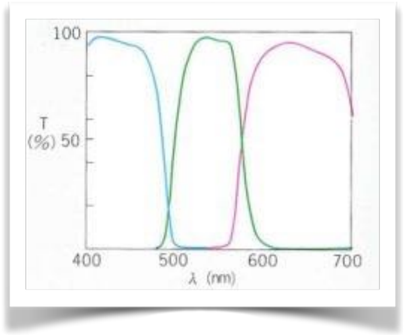
Limitations of
Correlated Color Temperature and Tint:

CCT works with predictable light sources (Tungsten, daylight), but can give strange color temperatures for e.g. LED or fluorescent light.

The optical block spectral response is specified accurately, but tolerances can cause some differences between cameras.

A camera is not a color temperature meter because of differences in light sources and tolerance in spectral response.



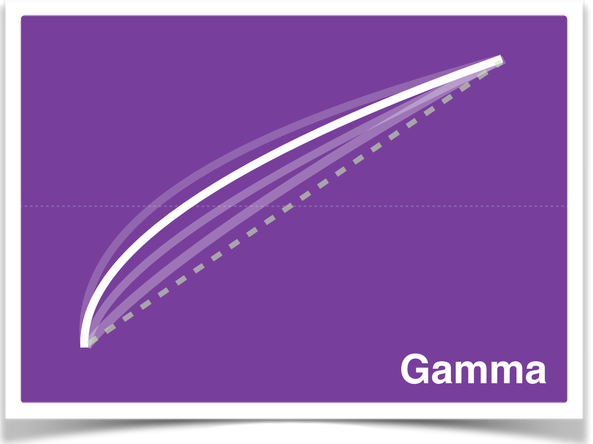


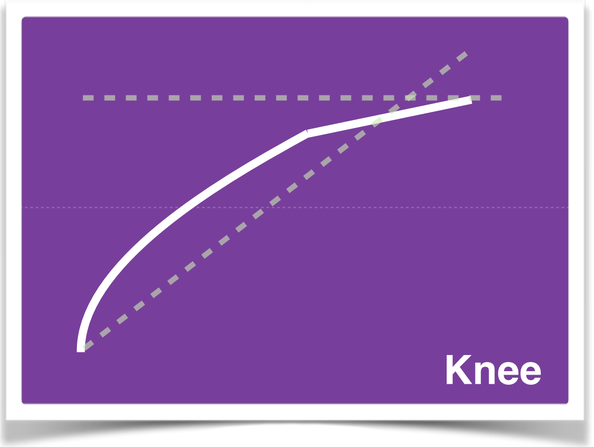
What's New LDX series

Power Curves

Gamma,Contrast,Knee

- Gamma: According TV organizations standard
- Gamma variable: Fine tune gamma Master and RGB
- Contrast curves: Adjust Shadows, Midtones and Highlights
- Dynamic range control: Flexible contrast and highlight compression curves
- Knee saturation: Reduce excessive colors in knee
- Knee detail: Maintain sharpness in knee
- Color protect: Preserve luminance from excessive monochromatic colors





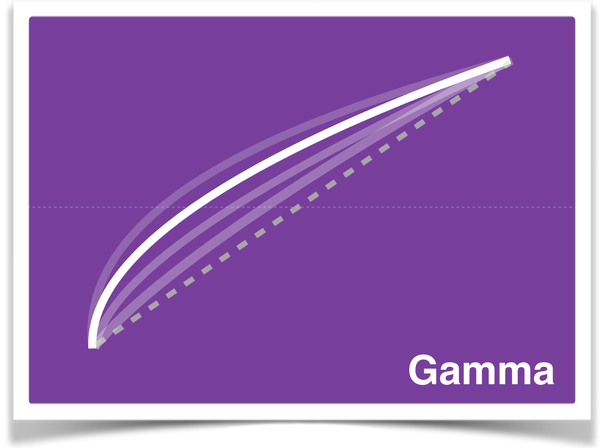
Power Curves

Gamma, *Contrast, Knee*

Gamma: Standard ITU709 HDTV curve

- Other basic curves can be selected

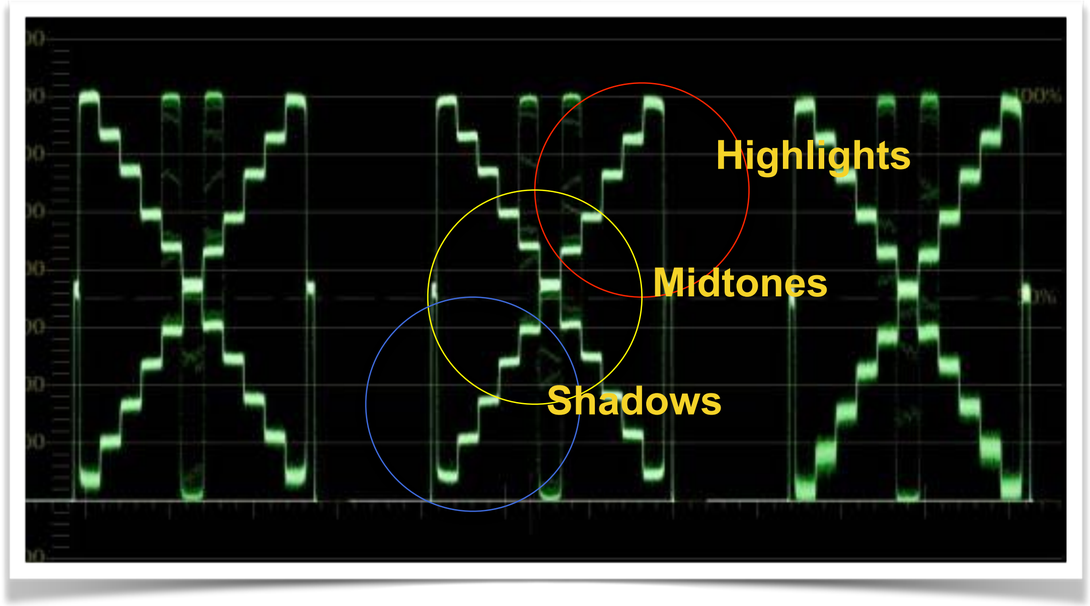
  BBC04, BBC05, BBC06, ARD, Linear
- Variable Master gamma controls
- Variable RGB gamma controls.
- Linear for test and special applications



What's New LDX series

Power Curves

Gamma,Contrast,*Knee*



Emphasize or suppress selected levels of the picture

Three Regions of interest: Shadows, Midtones, Highlights

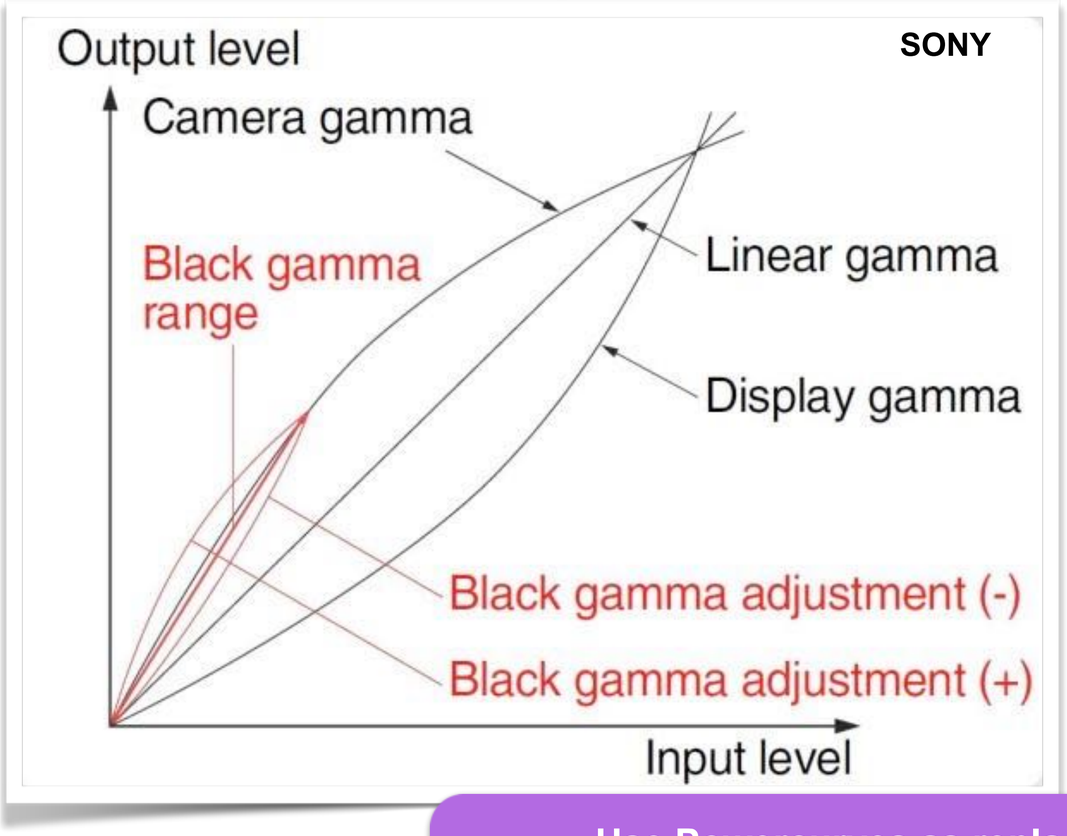
Added to the gamma curve

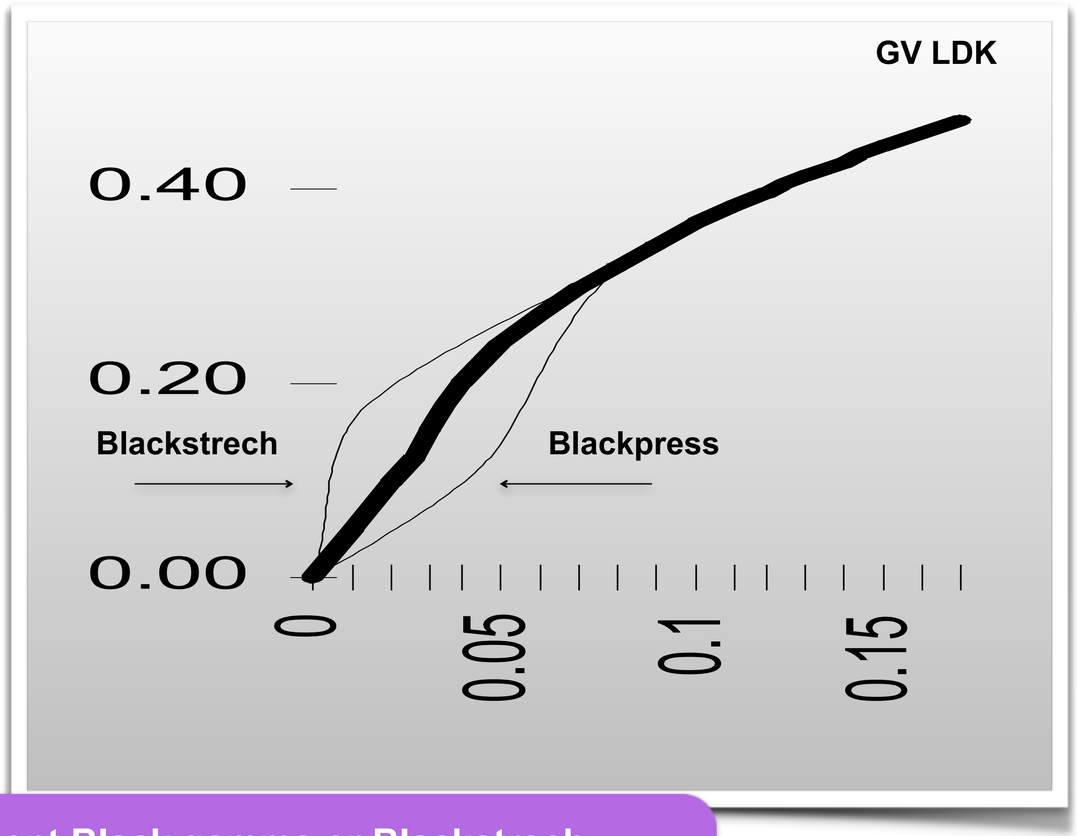
Can be switched On and Off

What's New LDX series

Power Curves

Gamma,Contrast,*Knee*





Use Powercurves as replacement Black gamma or Blackstrech

Adjust with Shadows in the Contrastcurve

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What's New LDX series

Power Curves

Gamma,Contrast,*Knee*

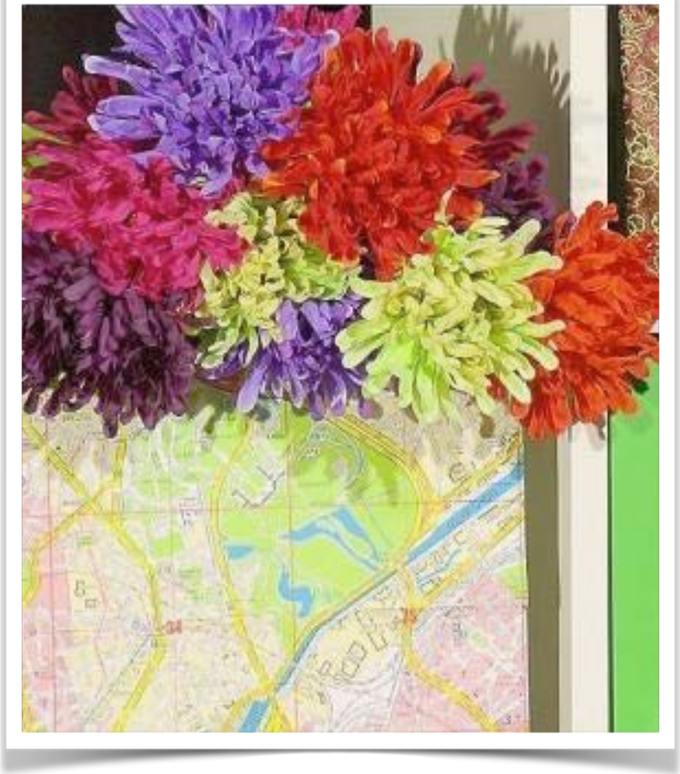
What’s New LDX series

Power Curves

Gamma, Contrast, Knee

Dynamic Range Control, Knee:

- Map up to 800% exposure in to 100% output range
- Map the input range of RGB video into 100% video in and artistically convincing way.
- Take care that colors are properly mapped.
- Smooth transition curve is replacing the sharp knee point
- Highlights are mapped with transfer curves,
- Color corrections with knee saturation
- Maintain sharpness with knee detail



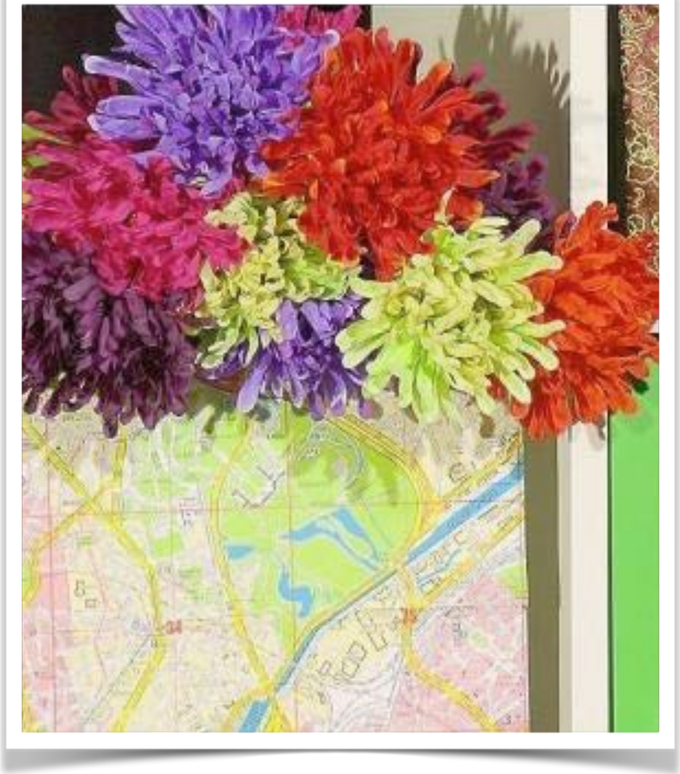
What's New LDX series

Power Curves

Gamma, Contrast, Knee

Dynamic Range Control, Knee:

- Low starting point: Similar to Hypergamma
- High starting point: Similar to Knee
- Auto knee will compress from linear down to the set curve
- Control on maximum allowed overexposure and curve
- The Knee has a very smooth character
- Compatibility mode for traditional knee



What's New LDX series

Power Curves

Gamma, Contrast, Knee

Knee functions

- Knee - Off, Auto, Variable
- Knee Max in -100%...600%
- Knee Out – 100%...118%
- Knee point – 0%…90%
- Knee Fade – 00…99
- Knee Out limit -100%...118%
- Knee Source - NAM, Y
- Knee Saturation – 00…85
- White Clip – 85%...109%
- Knee detail – Off,1,2,3,4

LDX Knee

LDK Knee

What’s New LDX series

Power Curves

Gamma, Contrast, Knee

Dynamic

LDX Knee

Traditional (LDK)

LDK Knee

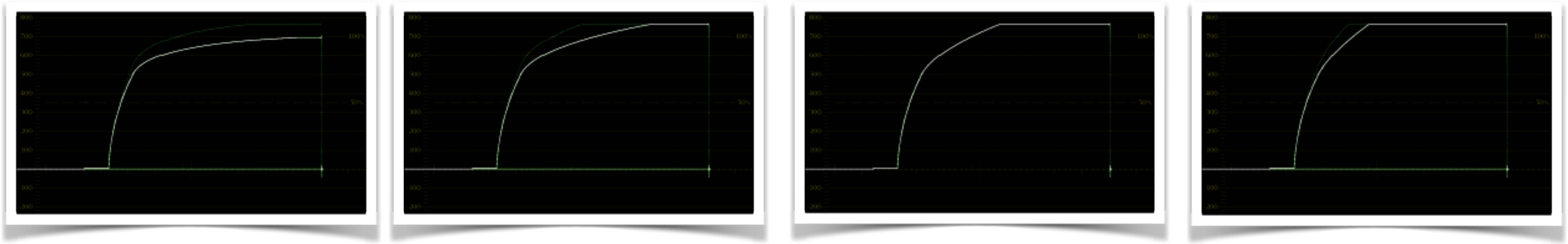
What’s New LDX series

Power Curves

Gamma, Contrast, Knee

Dynamic Knee

Fade between Dynamic Knee and Traditional Knee



Fade Knee

Dynamic ⟷ **Traditional**

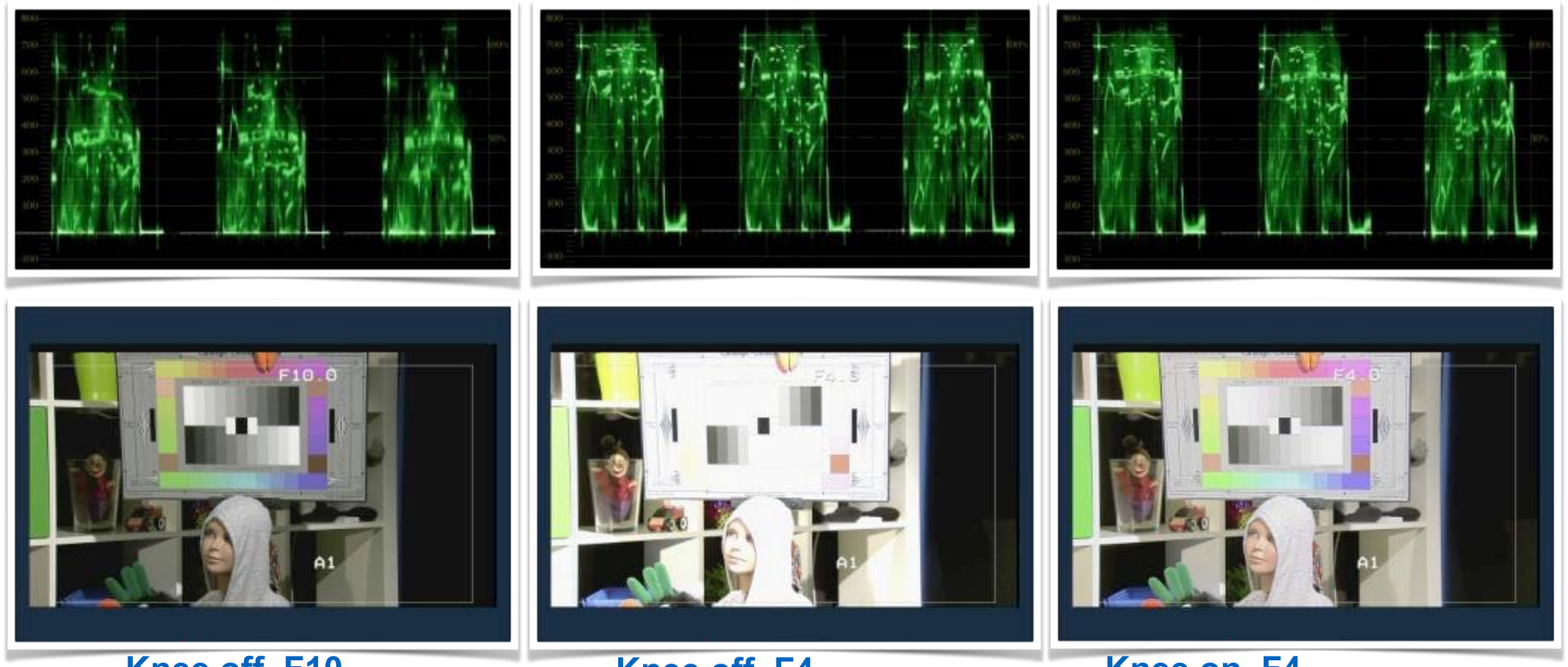
What's New LDX series

Power Curves

Gamma, Contrast, Knee

Dynamic Knee

Pushing the knee to the limits



Knee off, F10

100% exposure

Knee off, F4

800% over exposed

Knee on, F4

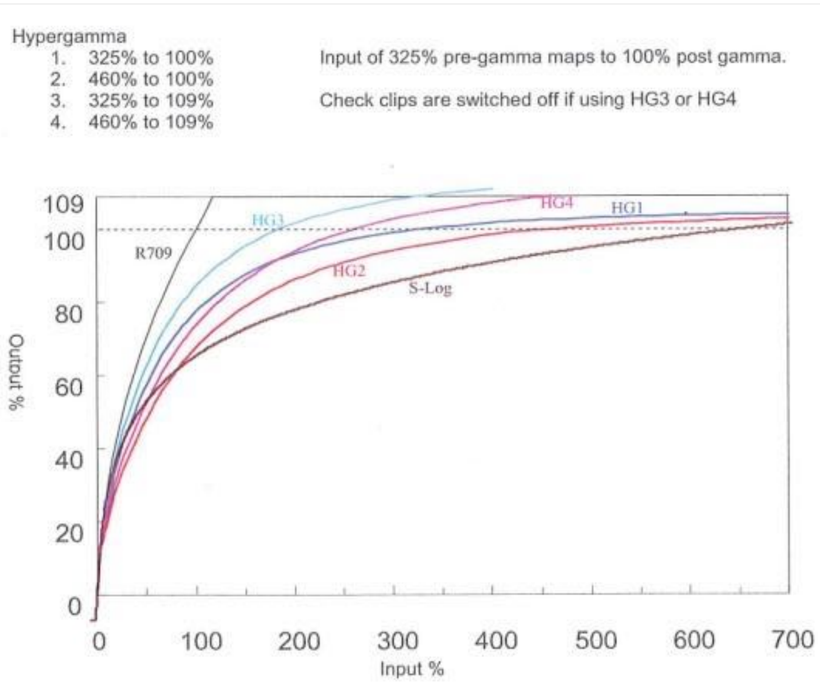
800% over exposure

What's New LDX series

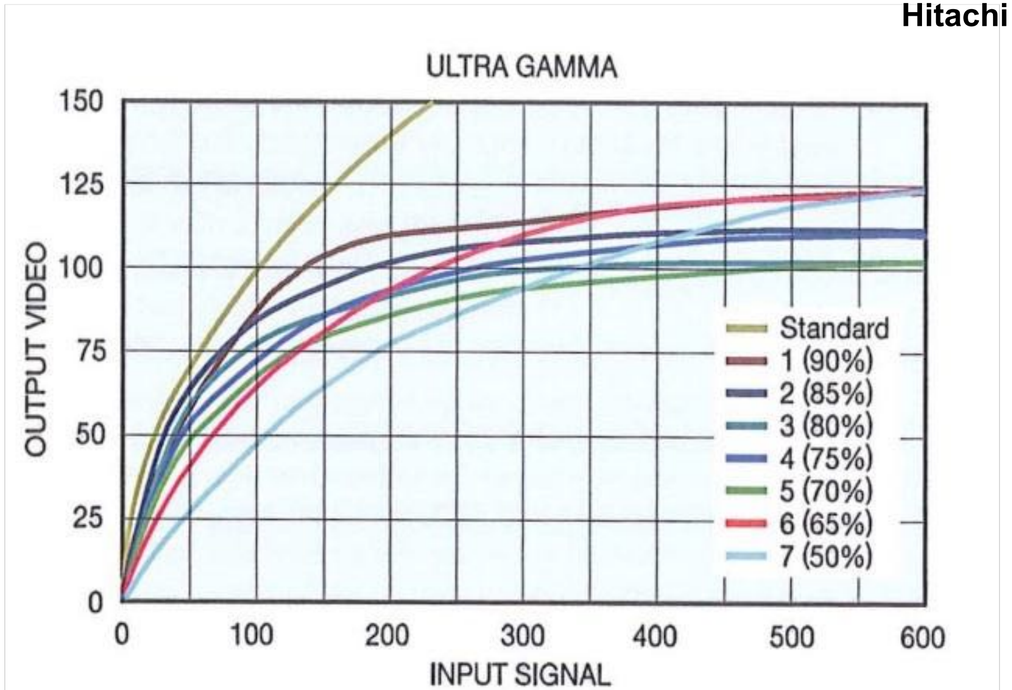
Power Curves

Gamma, Contrast, **Knee**

SONY



Hitachi



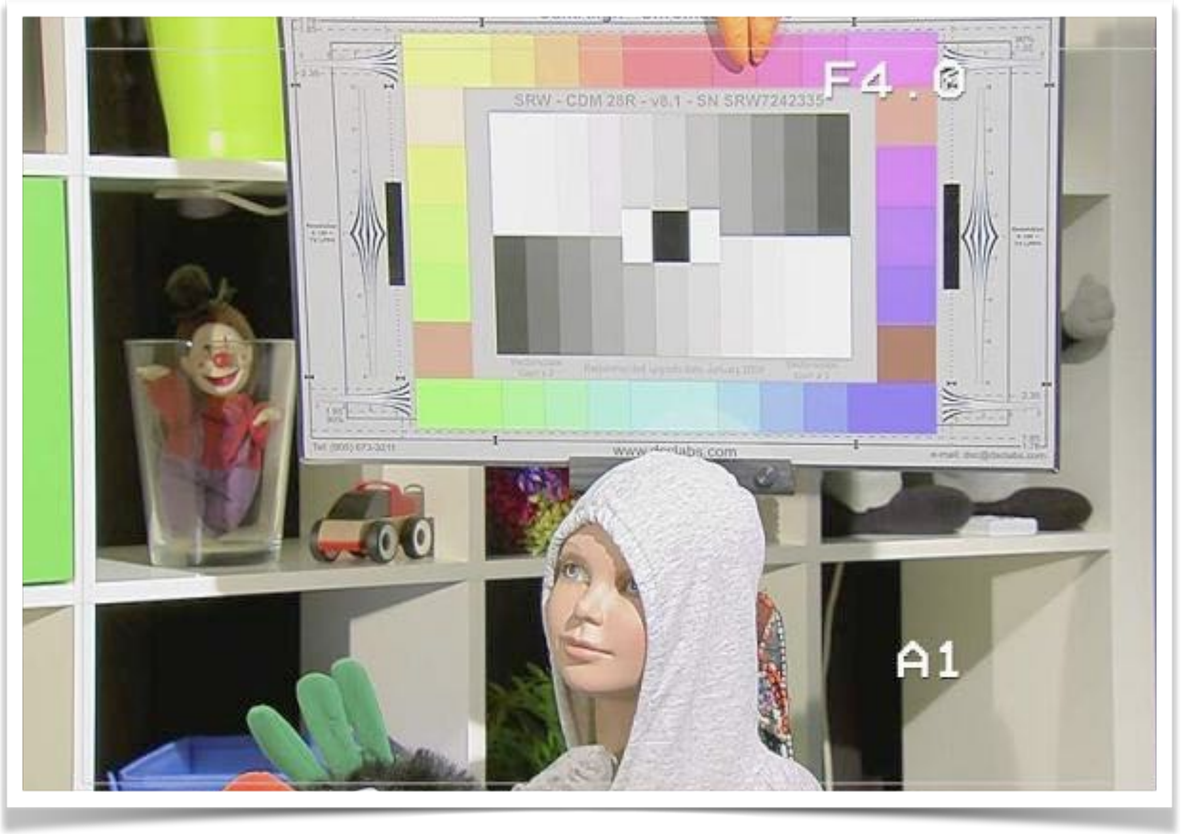
Use Powercurves as replacement for Hypergamma or Ultra gamma

Adjust with Dynamic range control

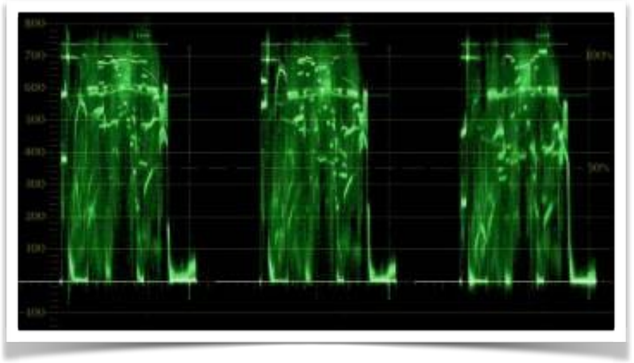
What’s New LDX series

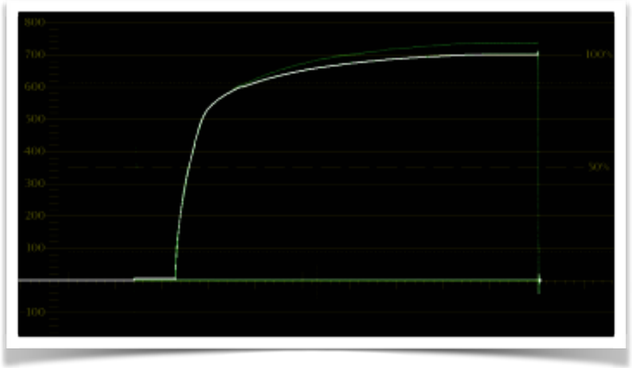
Power Curves

Gamma,Contrast, **Knee**



800% over exposure



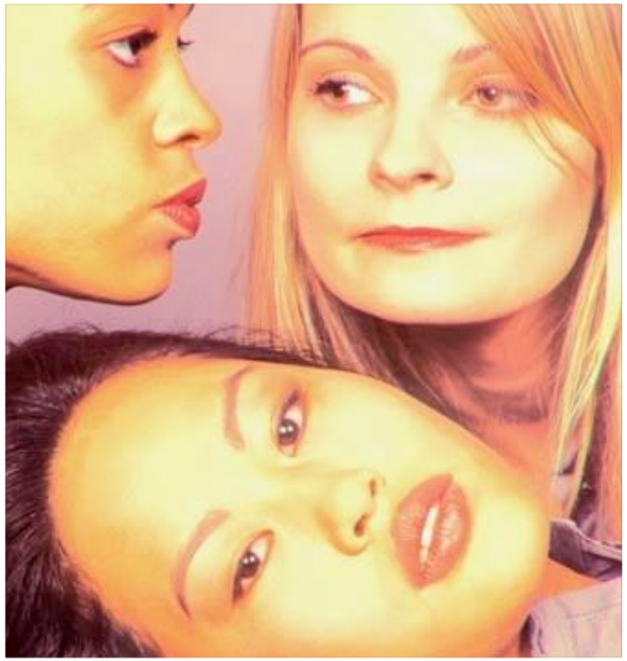


Power Curves

Gamma, Contrast, Knee

Knee Saturation:

Reduce excessive colors when dynamic range control is active.

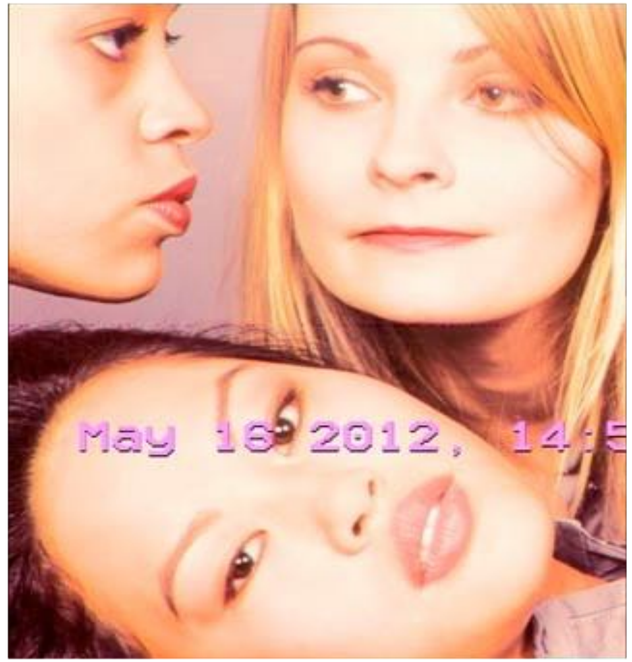


LDK

2 stops overexposed

Knee only

Skin colors go yellow



LDX

2 stops overexposed

Dynamic range control

Desaturation

Matrix

Basics Video / Image processing

Matrix:

Adding and subtracting R,G or B into each others channels,in such way that the sum of the mixing coefficients remains 1

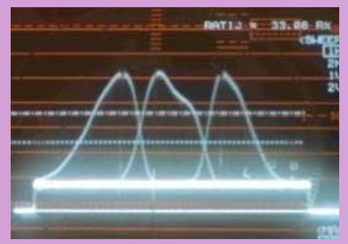
Black, grays and white are not effected,

Only colors have changed after the matrix

Purpose:

Correct the optical color splitter (prism)

Obtain specific color reproduction (standardization, artistic)



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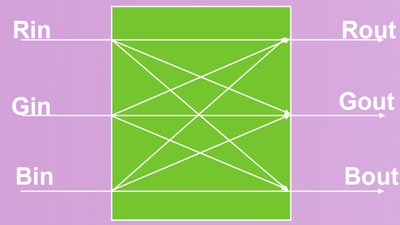


Functional LDX series

Matrix

Basics Video / Image processing

Matrix:

Default XGL = Vivid colors

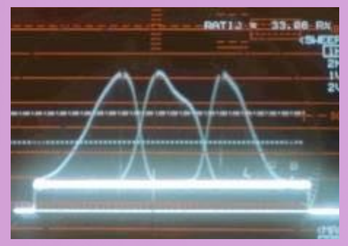
Other presets:

- Skin = Optimized for LDK camera look
- EBU = Optimized for EBU reference colors
- BBC = Optimized according BBC
- CoolFL = Optimized for Fluorescent and Incandescent light mix
- 1:1 = Matrix off
- B&W = Black and white

Variable: VAR1, VAR2 (six direction +/- vector adjustment)

Matrix position:

- M/G = Pre Gamma (default)
- G/M = Post Gamma



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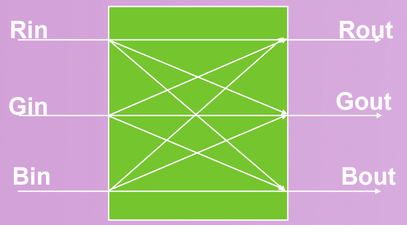
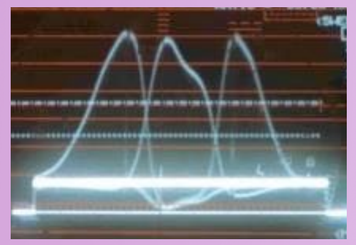




Functional LDX series

Matrix

- **Basics Video / Image processing**

Matrix:

.LDK 8000

- **Skin**
- **G/M**

M/G is Sequence Matrix / Gamma

LDX

- **XGL**
- **M/G**

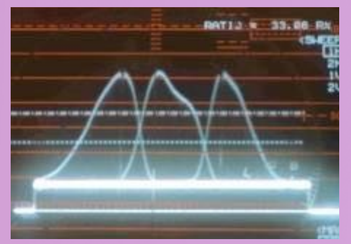
Gamma:

LDK 8000

- **ARD**

LDX

- **ITU 709**
- **(CCIR from LDK8000)**



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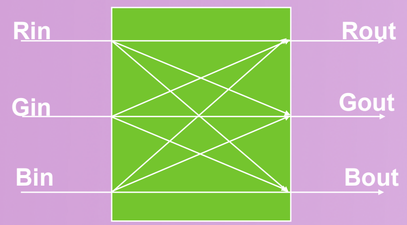


Saturation

Saturation:

Adjustment of the color content in the picture
Normal setting 100%
Saturation range from 0% (B&W) to 200% (Very bright colors)
Saturation is part of the Matrix circuit

0 %

100 %

200 %

What’s New LDX series

Color Protect

Color Protect

Monochromatic LED and Theatre lights are used in studios and show programs

This typically appears in blue and magenta

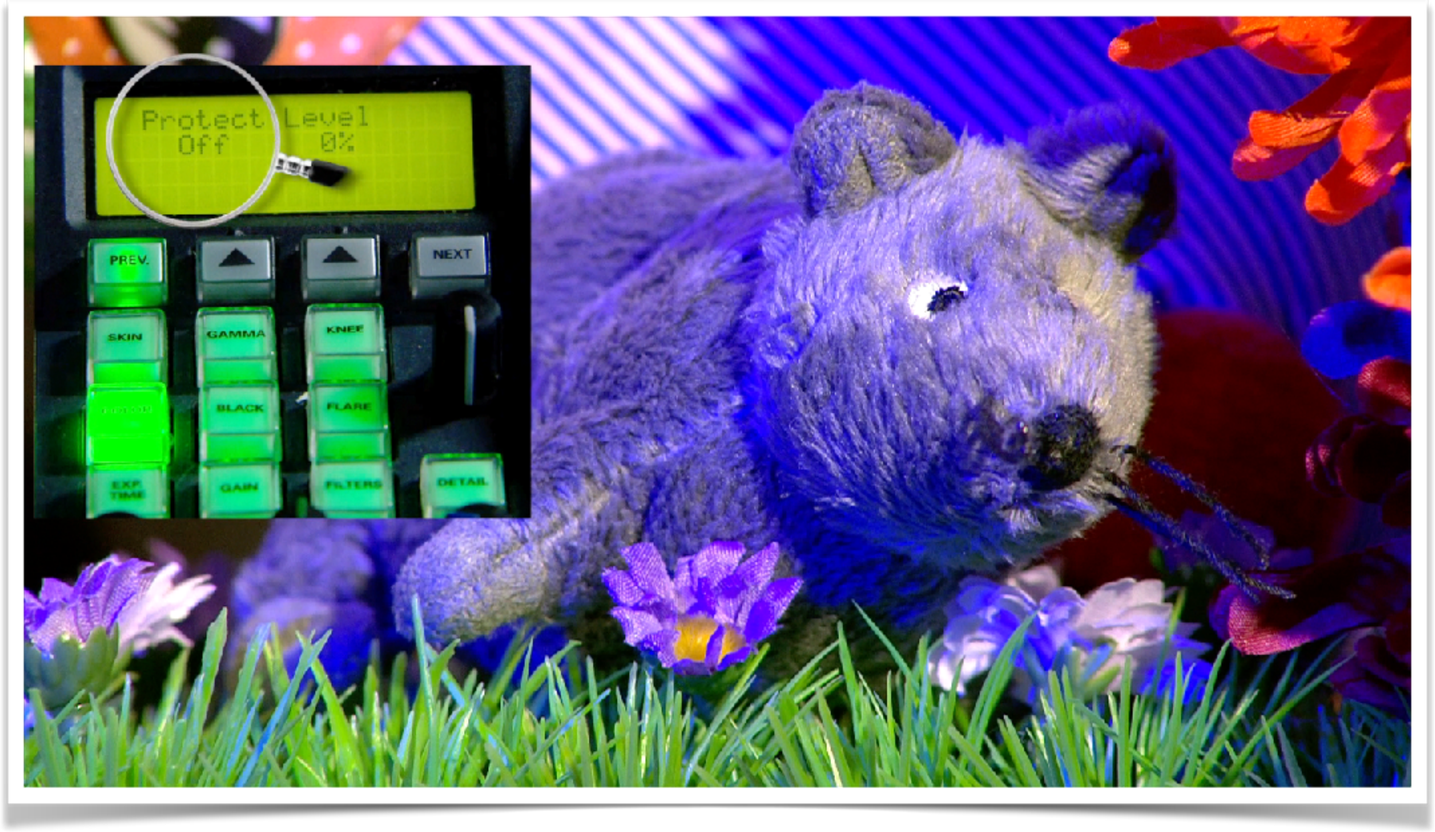
Monochromatic lights like Blue LED become dominant when their intensity is high

Blue only presents 7% of Luminance according ITU709

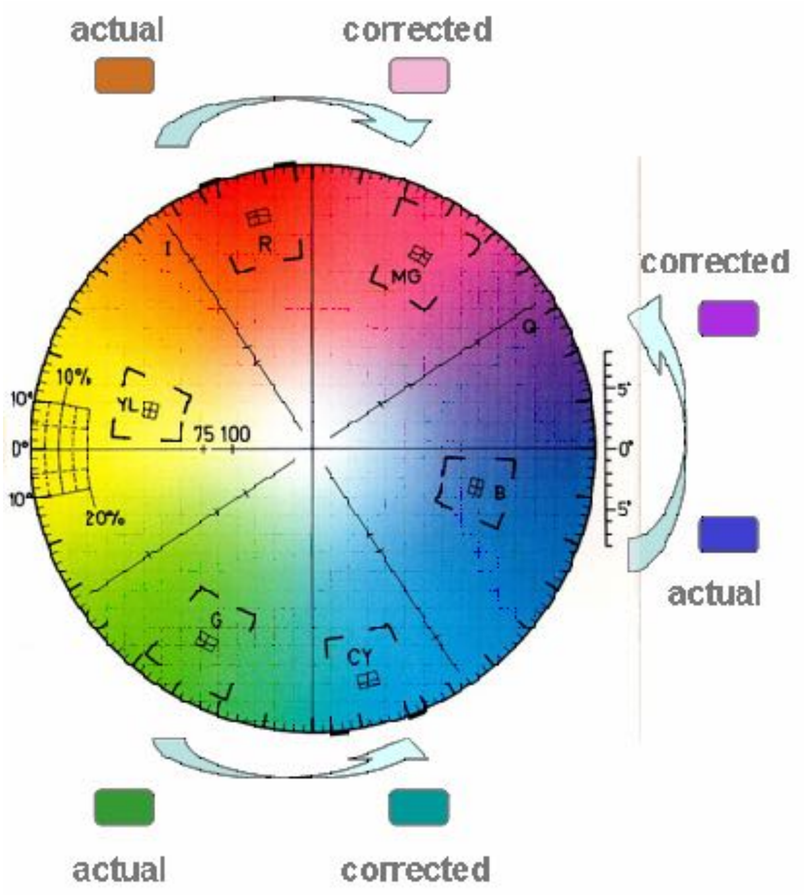
The dominance destroys all the luminance content

Resulting in blue over saturated areas with no detail.

Color protect restores Luminance without being effected from Blue



Color Corrector



16 vector color corrector

- Change colors into other colors
- Adjust Hue, Saturation and Luminance
- Six different color changes allowed
- Independent view via basestation monitoring (fiber)
- Adjustable smooth transitions

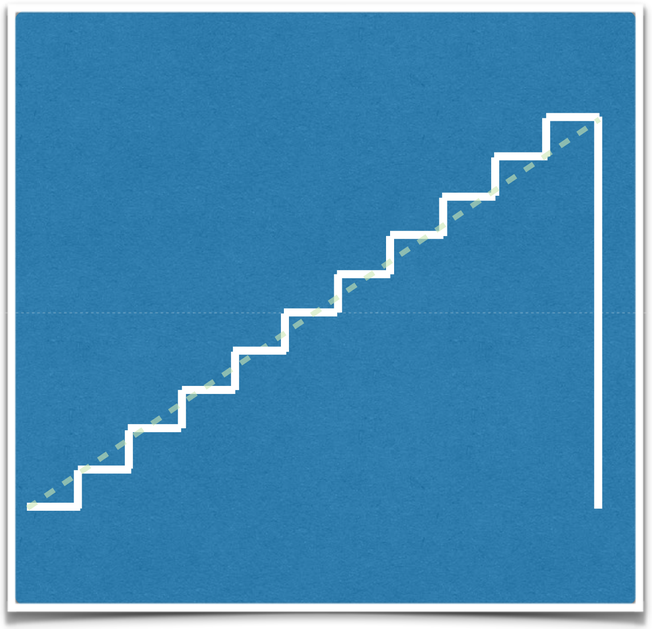
Details

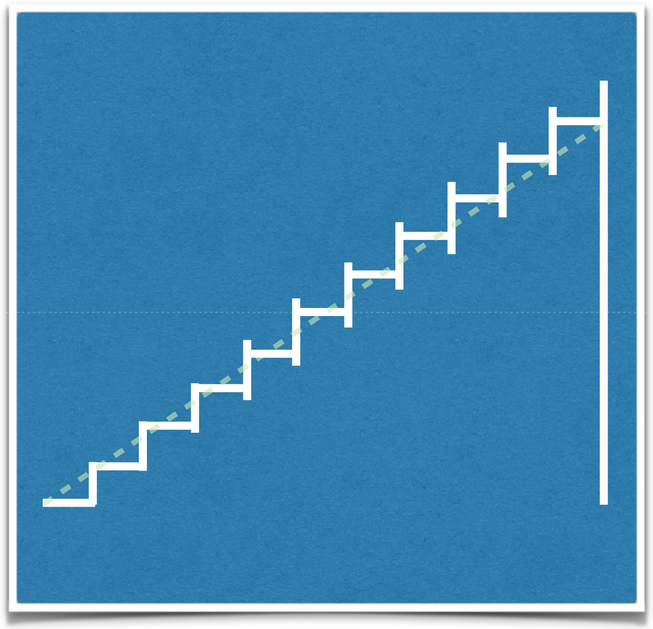
Why detail correction

Correct for limitation of pixel aperture and lens aperture

User sharpness perception

Details





Detail correction:

Main control is Level will be renamed in future

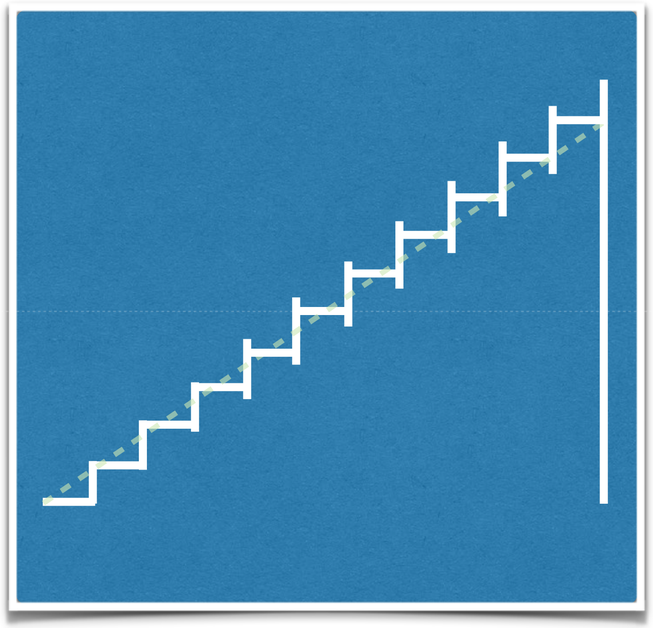
Level (Texture)
Soft detail (Edge)

Details

Detail correction:

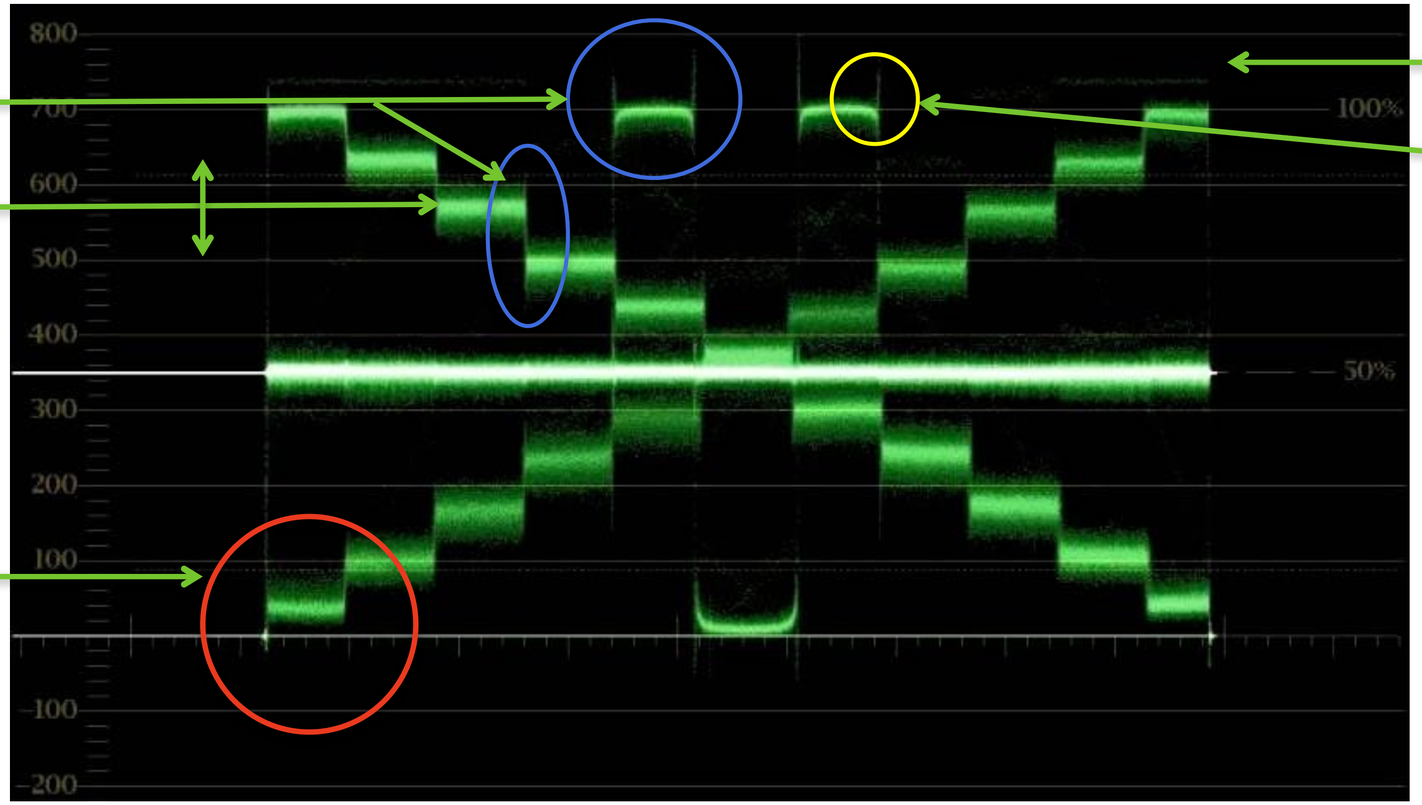
Other detail controls:

- Level dependency
- Noise slice
- Course / Fine detail
- Vertical detail
- Knee detail
- Soft detail (Texture)



What's New LDX series

Details



detail level

noise slice

level dependency

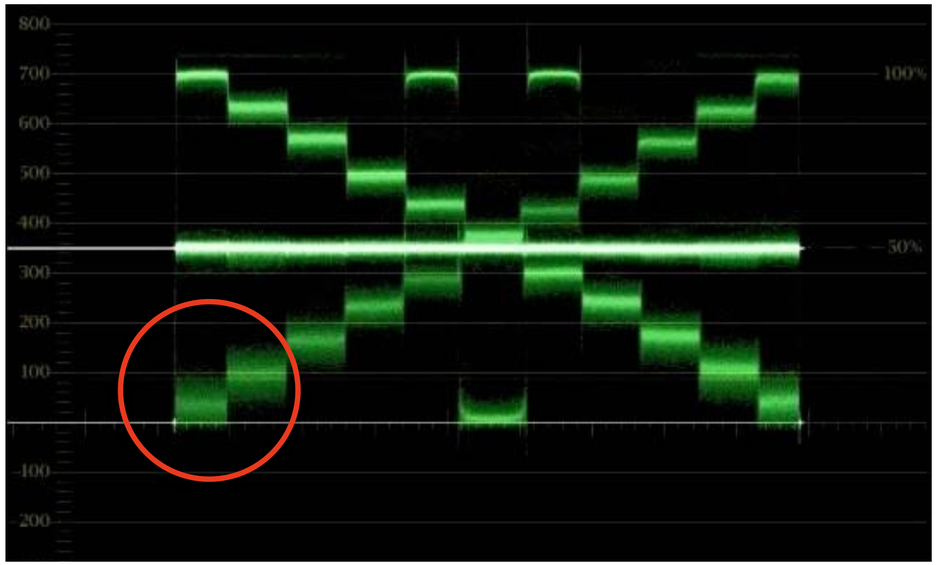
vertical detail

soft detail

(Texture)

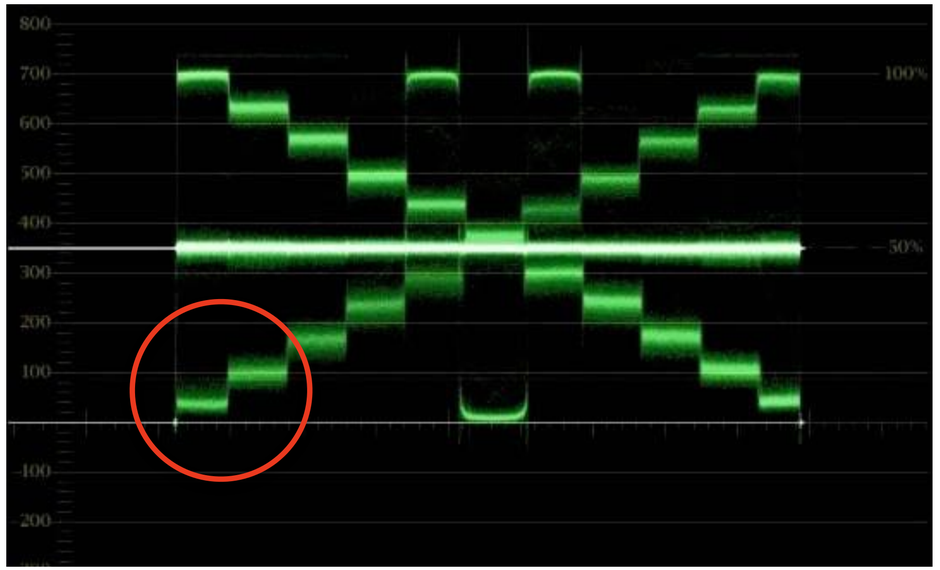
What’s New LDX series

Details



Level dependency

Off



Level dependency

On

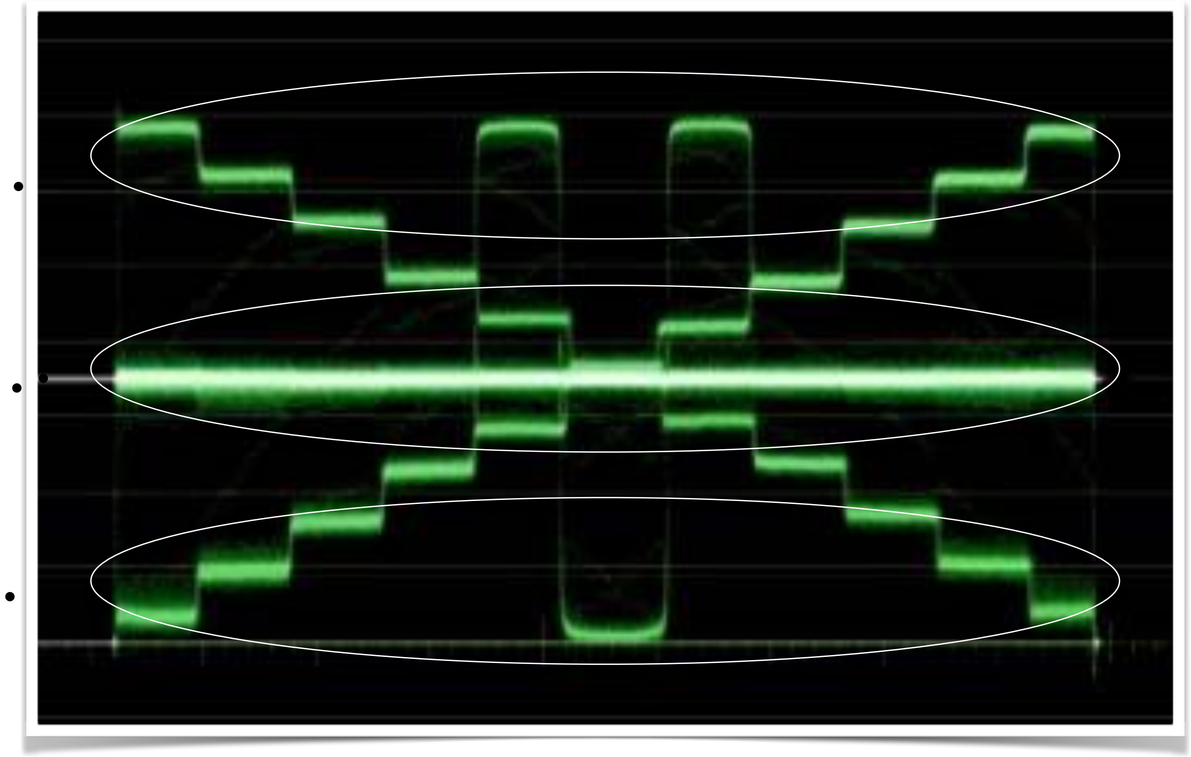
Details

Detail equalizer:

The amount of detail can be adjusted depending on the video level

Three regions of interest:

- Highlights
- Midtones
- Shadows



New
LDX Feature

Details

Low,Mid,High

Details

Skin detail:

Operators tool to soften or sharpen selected color areas
360° Color range

Adjust detail on selected colors

Three independent Skin memories

Detection remains unchanged over

No need for re-adjustments after

lightning changes
Independent view via basestation (fiber)

Normal detail

Color Selection

Reduced detail on selected color

Details

Skin (Color) detail

Viewfinder detail

VF processing functions

- Indicators = Inserts in the VF channel
- VF monitoring =
  YCrCb (color), Y,R, G, -G
- VF Detail
- Focus and Sharpness tools
- Zebra level tool,

Viewfinder detail

New
LDX Feature

The viewfinder channel has fully independent detail adjustment

Viewfinder detail settings:

- Detail - on, off
- Super source (boost)
- Detail level
- Slicer
- Vert detail level
- Course / Fine
- Soft detail – on, off
- Soft detail level

Freeze

Picture is captured in a frame store at the input of the video processing

Camera setup can be done on the frozen picture (accept lens iris, zoom, focus)

Reverse Scan

Reverse Scan

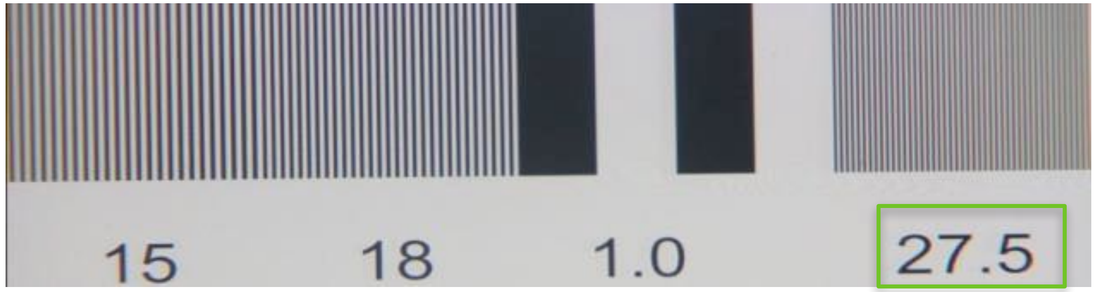
- Horizontal
- Vertical
- Both

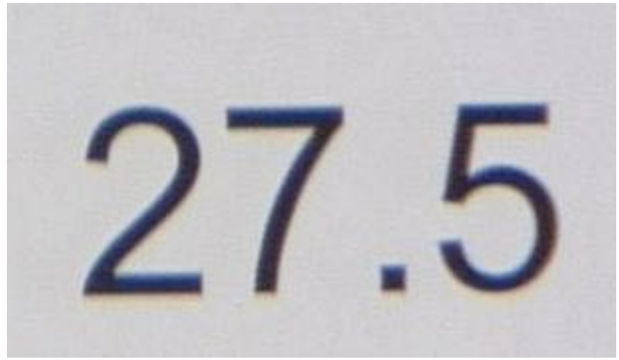
V-Shift

- Adjustable time shift between picture capture and processing
- Continuous variable shift up to 1 frame
- Compensate for screenshot effects on large screens like DLP
- Compensate delay with other cameras
- 3D applications

Class (H+V)

Chromatic Lens Aberration Sharpness Solution
Automatic Electronic Correction of lens errors
Correcting for H and V lens registration errors





The lens error information data is initially send from the lens to the camera.
Depending on zoom and focus position the camera electronically corrects for lens errors.
Only for digital lenses with lens error information files. Also known as CAC or ALAC in other cameras types.
SXP support pending

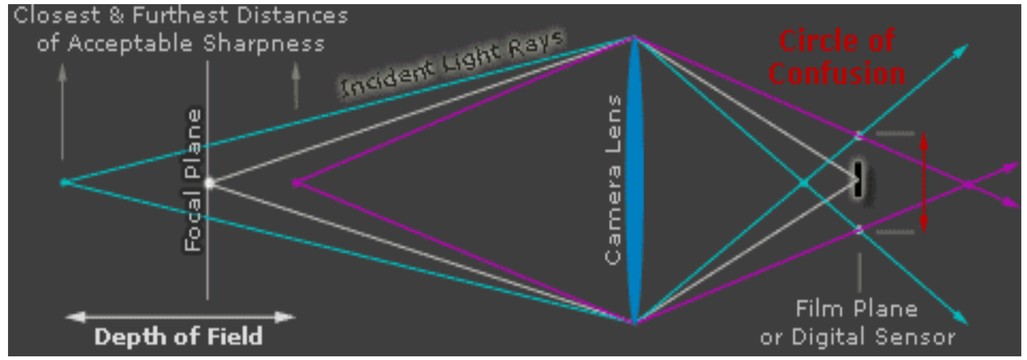
Class (H+V)

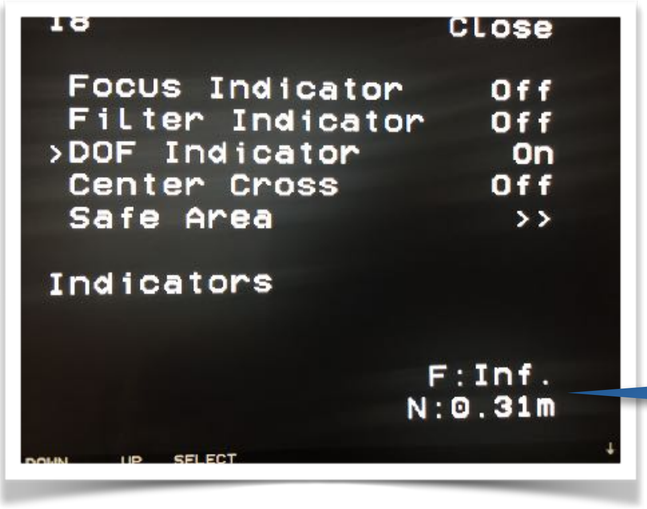
Depth of Field indicator

Depth-of-Field: the distance of the camera in which the picture is sharp

Depends on what we call sharp, determined the circle of confusion. For 5um pixels we can set the CoC for instance on 10um, covering 2 pixels

We will calculate & display for the user the min distance, nominal distance and max distance





Far
Near

Only WorldCam and Digital lens

Under development (Partly implemented)

Lens dependent controls

- Aperture correction (dependent on iris)
- Skin detail (dependent on zoom, focus)
- Detail follow zoom/focus
- CLASS (zoom, focus, iris) (partly implemented)
- General approach: dependency is described by LUT s and interpolation
  F(1.4 2 2.8 4 5.6 8 11 16 and beyond)

Aperture Correction

- Aperture correction corrects the loss of MTF due to lens aperture (and sensor aperture of course)
- Lens aperture is diffraction limited with smaller iris opening (increasing f-numbers)
- Roughly spoken: lens MTF at 27 MHz 1080i is 100%-5*f-stop
- If the f-stop is known we can increase the aperture correction dynamically following that f-stop
- We will partly compensate the loss of MTF (not fully because of noise amplification

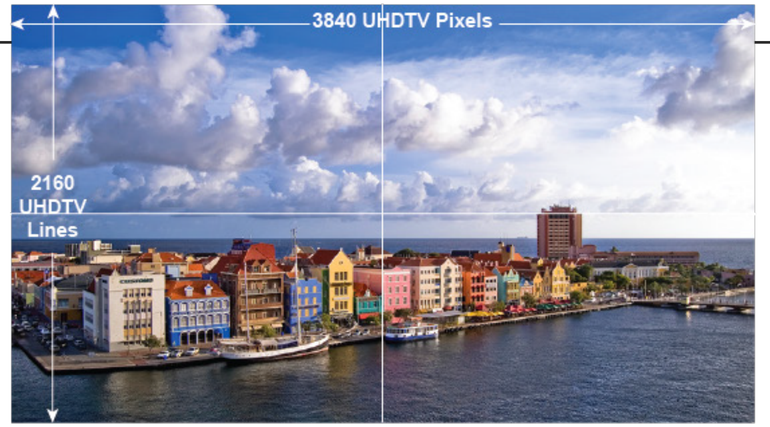
What’s New LDX series

from 2K to 4K

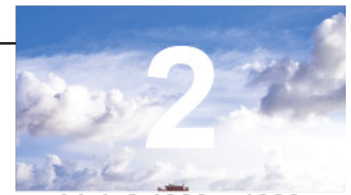
LDX 4K and XDR in 86 and 86N

4K explained

Square Division Quad Split
- Each link contains
  one quarter of the original image



Link 1 1920 x 1080

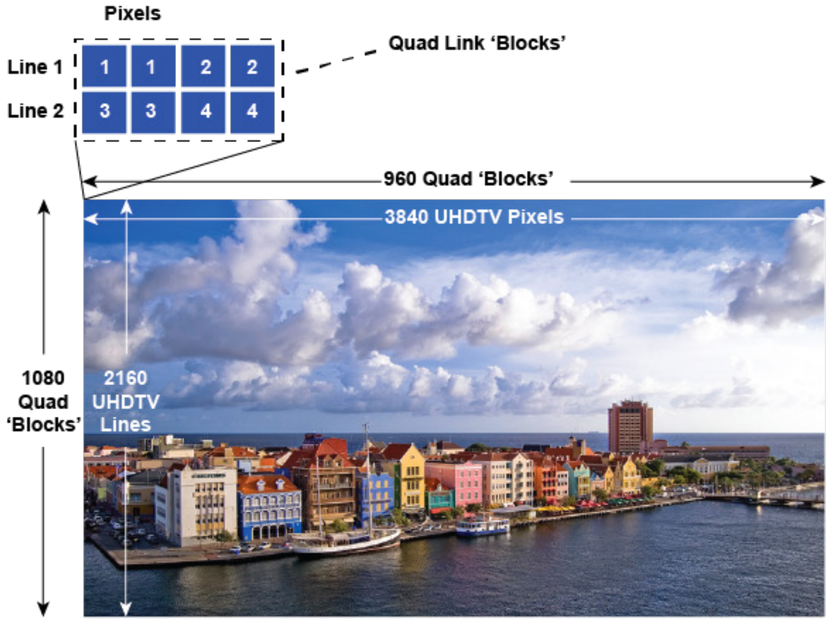


Link 2 1920 x 1080

Link 3 1920 x 1080

Link 4 1920 x 1080

Quad Link 2 Sample Interleave (2SI)
- Each link contains a full image
  at 1/4 resolution.



Link 1 1920 x 1080

Link 2 1920 x 1080

Link 3 1920 x 1080

Link 4 1920 x 1080

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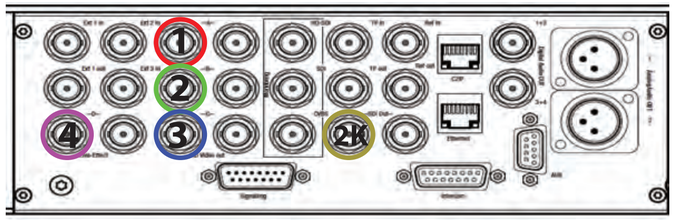
Quad mode

Square Division Quad Split
- Each link contains
  one quarter of the original image

Setting in Install menu XCU

2 SI mode

Quad Link 2 Sample Interleave (2SI)
- Each link contains a full image
  at 1/4 resolution.



or

4K mode

Set to 4K mode

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Many broadcasters think a 4x higher pixel count won't deliver the "wow factor" needed from a new broadcast for

HDR opens up the potential for more engaging, more beautiful content, as well as future proofing

XDR is new feature in GV Cameras (Ready for 2K and 4K)

Why HDR - For most natural images

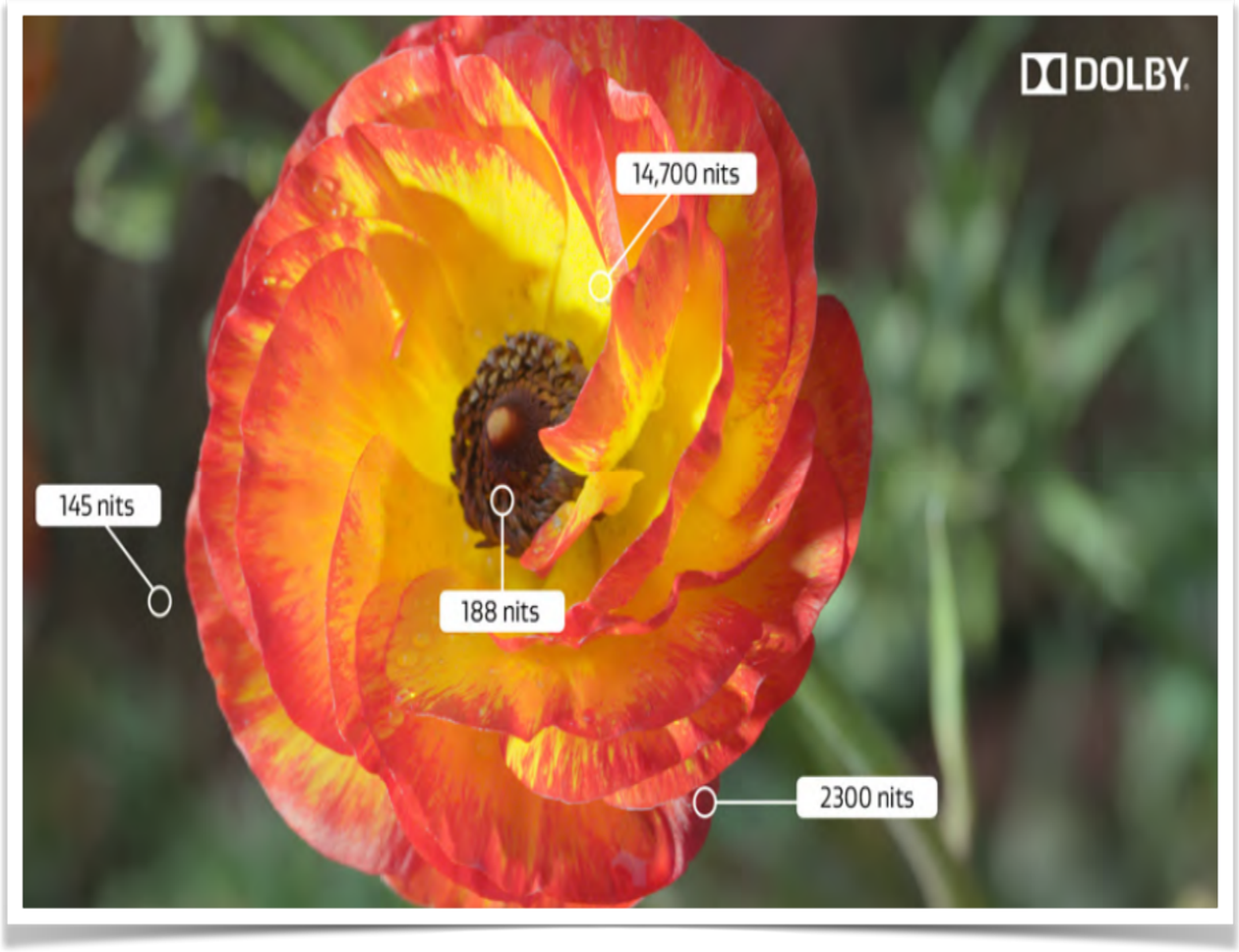
- **High scene contrasts can be found in many typical pictures**

A unit of measurement of luminance, or the intensity of visible light, where one nit is equal to one candela per square meter.
Nits are used to describe the brightness of displays, such as LCD and CRT monitors.

(1 nit = 1 cd/m2).

200 - 300 nits for Standard monitor
800 - 4000 nits for HDR monitor more in the future

100 Watts bulb emits 18000 nits
sunny day up to 50000 nits



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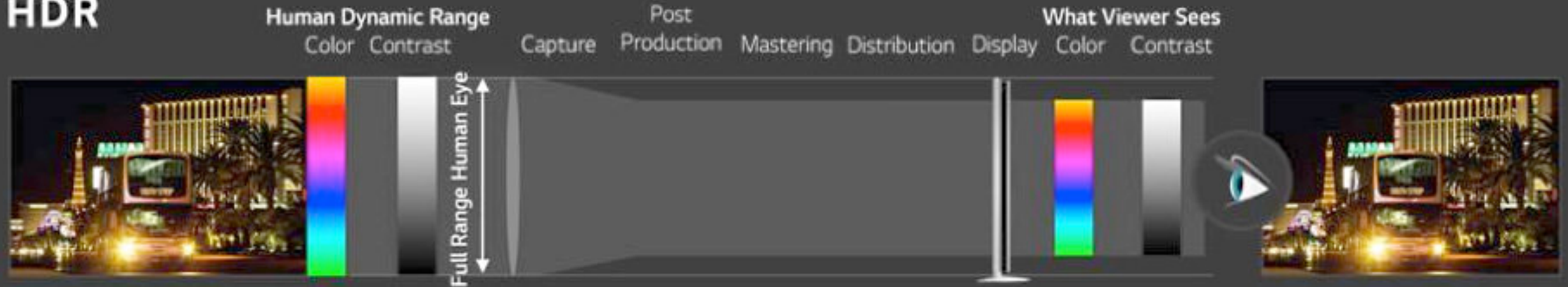
Dynamic Range in Television

SDR

HDR



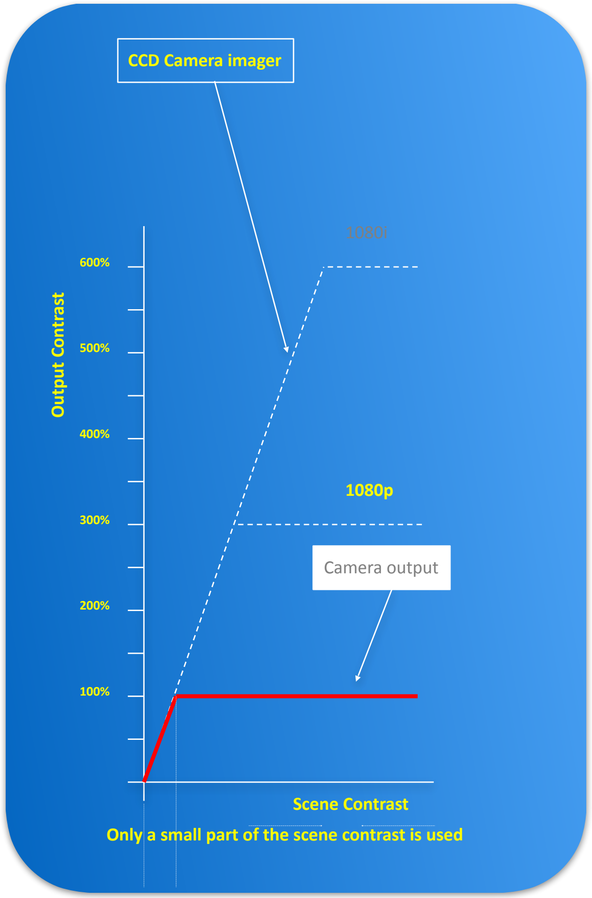
Why HDR - For challenging lighting conditions

- **High scene contrasts are most challenging in live broadcast applications**

  - Lighting conditions are typically not under control
  - Pictures must be perfect at any time, and can’t be fixed in post

Why HDR - For challenging lighting conditions

- HDR can be used to avoid washed out highlights



Note: For the sake of clarity, the gamma correction is not included in the graphs

How HDR is generated – What is required?

An imaging technology delivering highest dynamic range

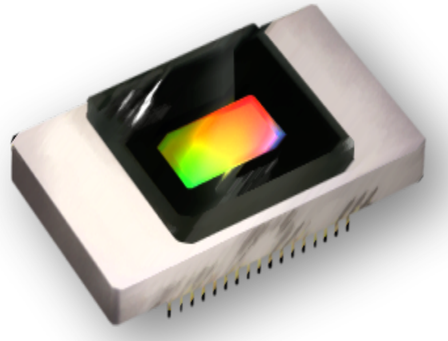
- ☑ CMOS delivers highest dynamic range in all formats, including progressive

Highest performance pixels

- ☑ “Large” pixel for 15 F-stops of live dynamic range without calculations
- ☑ 5T pixel for global shutter operation

A camera solution able to deliver HDR signals

- ☑ Supporting the requested “HDR mappings”
- ☑ True parallel processing of HDR and SDR signals
- ☑ Easy control of both signals at the same time
- ☑ Supporting 1080i/p, 720p, 4K (both 50 or 59Hz)



How HDR is generated – What is required?

- Display with a higher contrast range (higher peak white)

SDR Display

300 nits

HDR Display

1.000 – 10.000 nits

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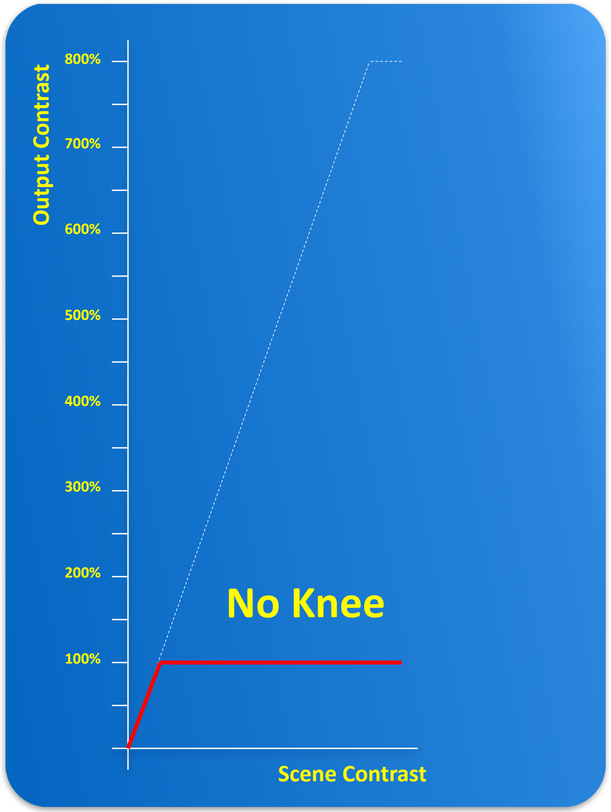
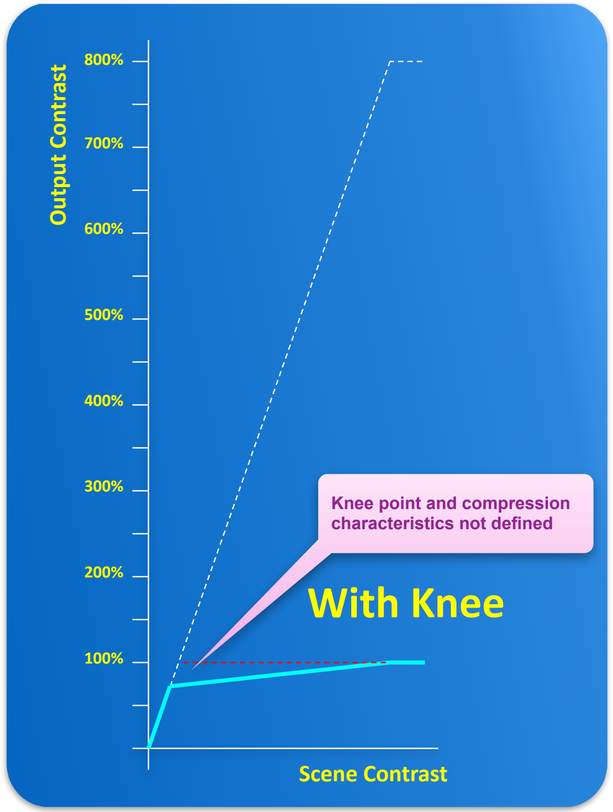
How HDR is generated – Signal mapping

- HDR needs a different signal mapping compared to SDR

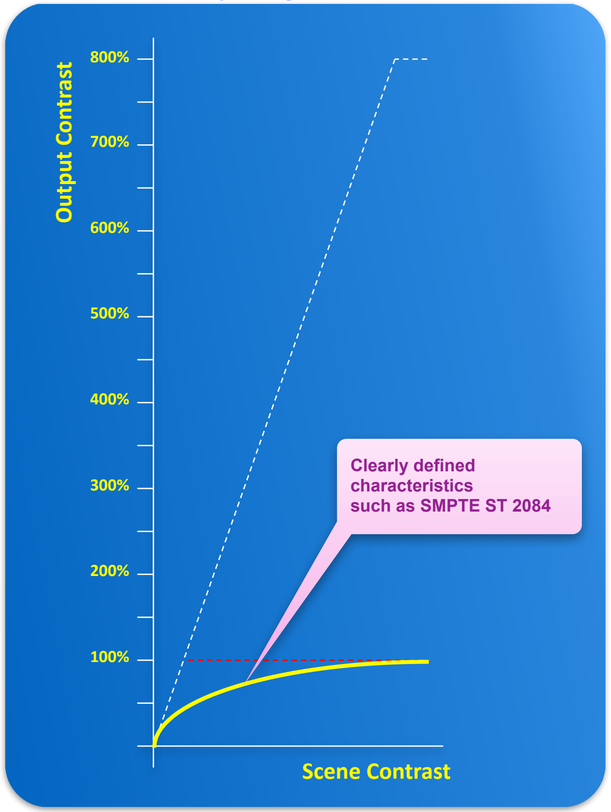
Signal processing with linear output
Only useable if scene contrast is controllable and low



Signal processing with knee compression
Highlights are heavily compressed , difficult to control



Signal processing for HDR operation
Scene contrast more even distributed over the output signal

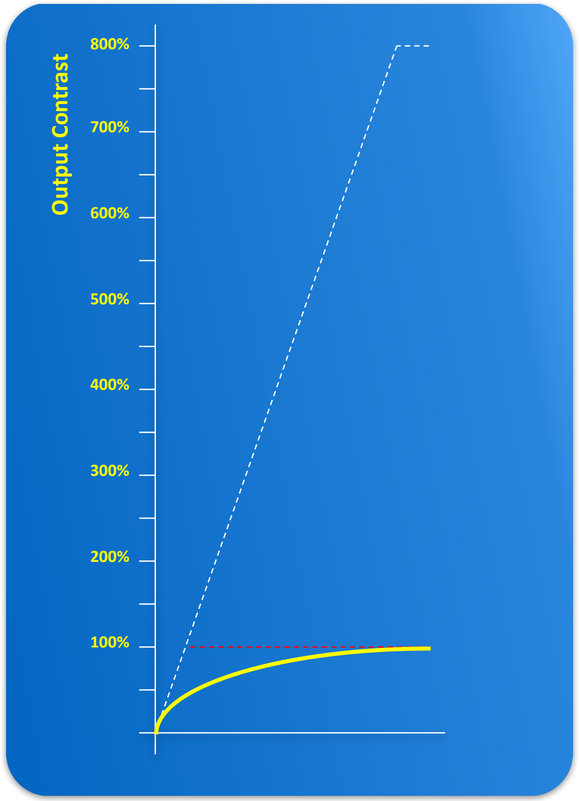


Note: For the sake of clarity, the gamma correction is not included in the graphs

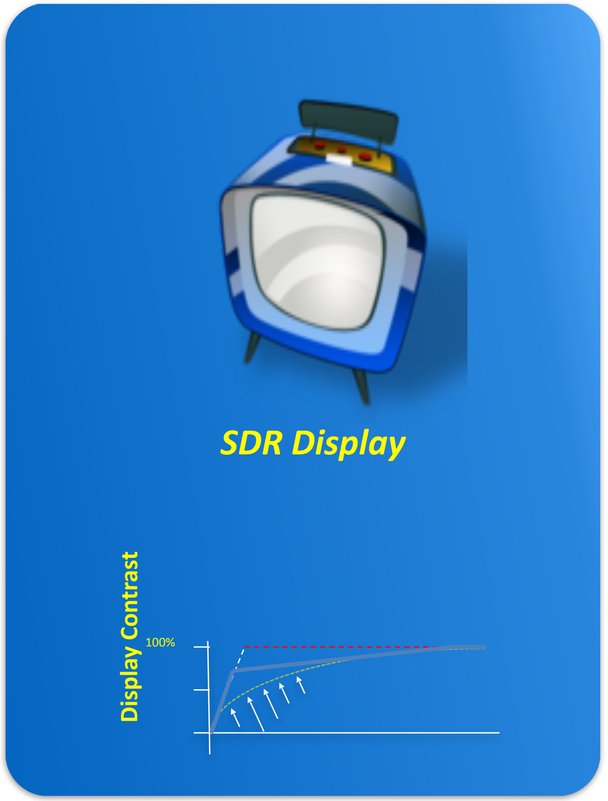
How HDR is generated – Signal mapping

- HDR signals can be re-mapped for simultaneous SDR operation

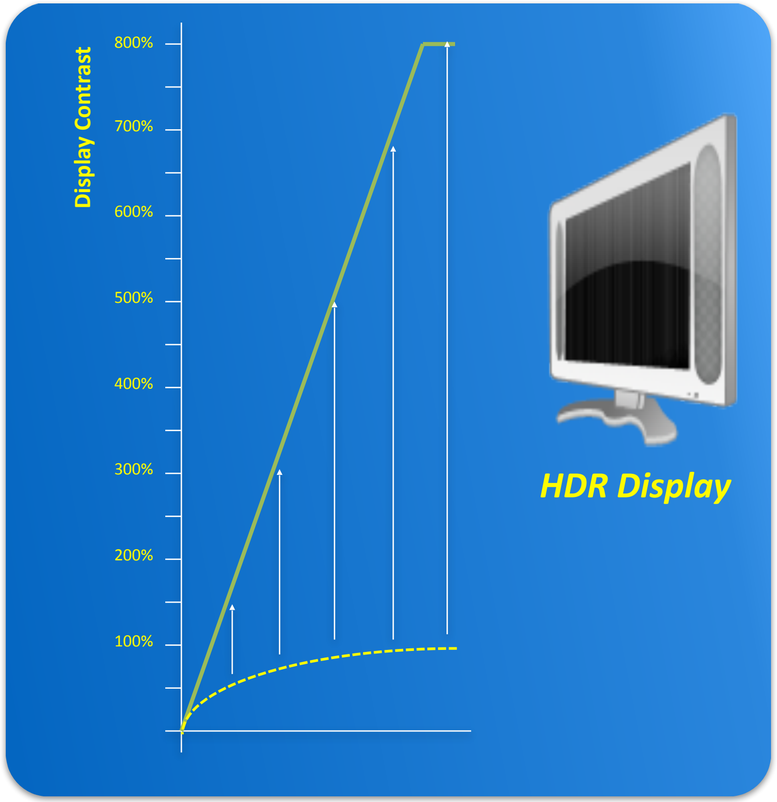
Signal processing for HDR operation
Scene contrast is more even distributed over the output signal



Re-mapping of the HDR signal for SDR use



Re-mapping of the HDR signal for HDR use



Note: For the sake of clarity, the gamma correction is not included in the graphs

HDR Explained

- **HDR offer a very clear improvement of the viewing experience**
  - ☑ Not resolution dependent
  - ☑ Visible from all distances and on all screen sizes
- There several competing system proposals
  - ☑ From Dolby, BBC, Technicolor, Philips, NHK
- They are not compatible to each other
  - ? Will there be one system for all markets, countries, etc.?
  - ? If not will one system be convertible into another?

XDR Solutions

- Delivering the full dynamic range of 15 F-stops
- ☑ Enough for all HDR displays in the foreseeable future
- Parallel HDR and SDR outputs for highest flexibility
- ☑ Dual control mode of the camera control panels for best results in both outputs

LDX 86 Series Camera Head with XF Fiber Transmission

XCU Universe XF with the Cradle

HD/4K out
HDR

HD/4K out
SDR

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Why called XDR - Extended Dynamic Range?

Many products claim HDR performance with limited 13-14 F-stops*[1] of dynamic range

[1] Equal to 200 - 400% of a regular camera

Grass Valley goes beyond this *full 15 F-stops*[*2]

[2] Equal to >800% of a regular camera

- **XensiumFT** imagers with
  15 F-stops of dynamic range
  - In regular operation with a linear exposure and readout of the imager

- **CMOS** imaging offers solutions for an even greater dynamic range
  - By using a multiple readout of the pixels during one exposure cycle
    - Because of the non-destructive readout

15 F-stops of dynamic range from Xensium FT imagers

XDR Solutions from LDX Series

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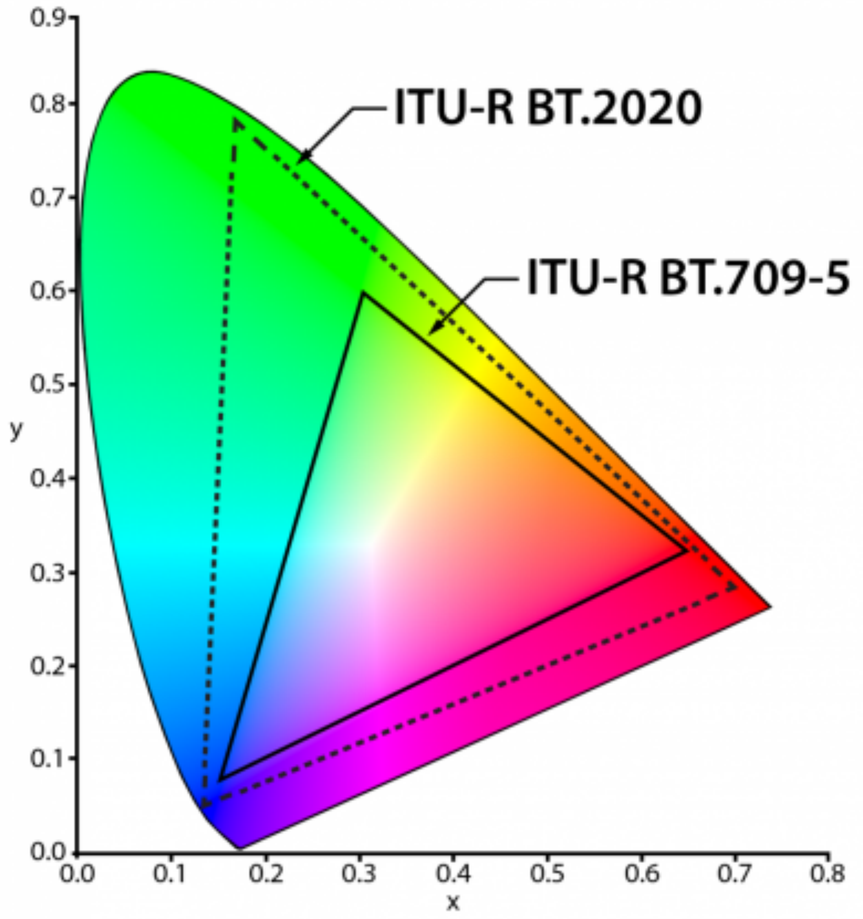
LDX86 HD Extended Color Gamut

Many 4K cameras still use the color gamut from HD as specified in the **ITU-R BT.709**

At the LDX 86 Series a wide color gamut can be selected as specified in the **ITU-R BT.2020**

Available in the next free of charge software package update



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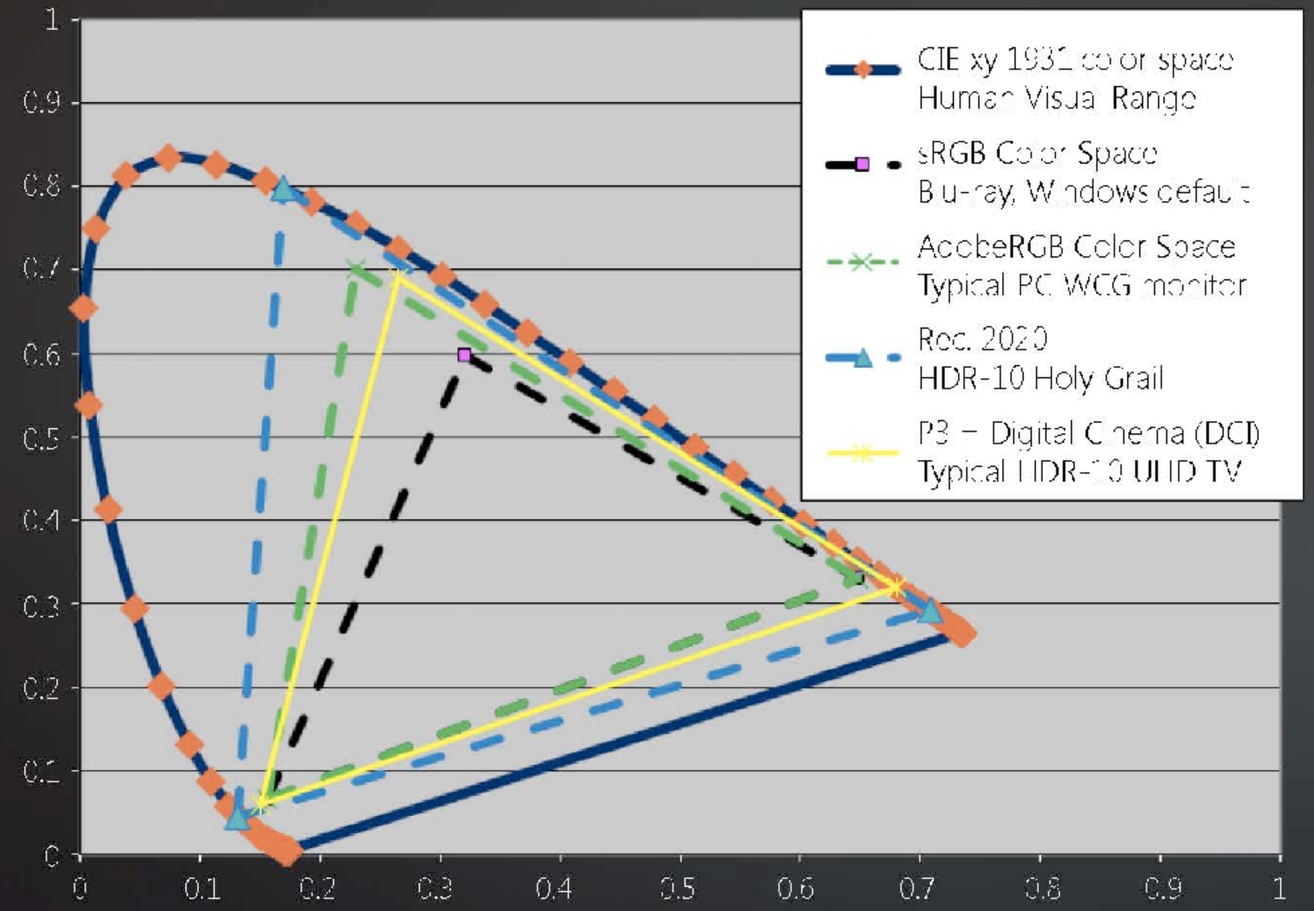
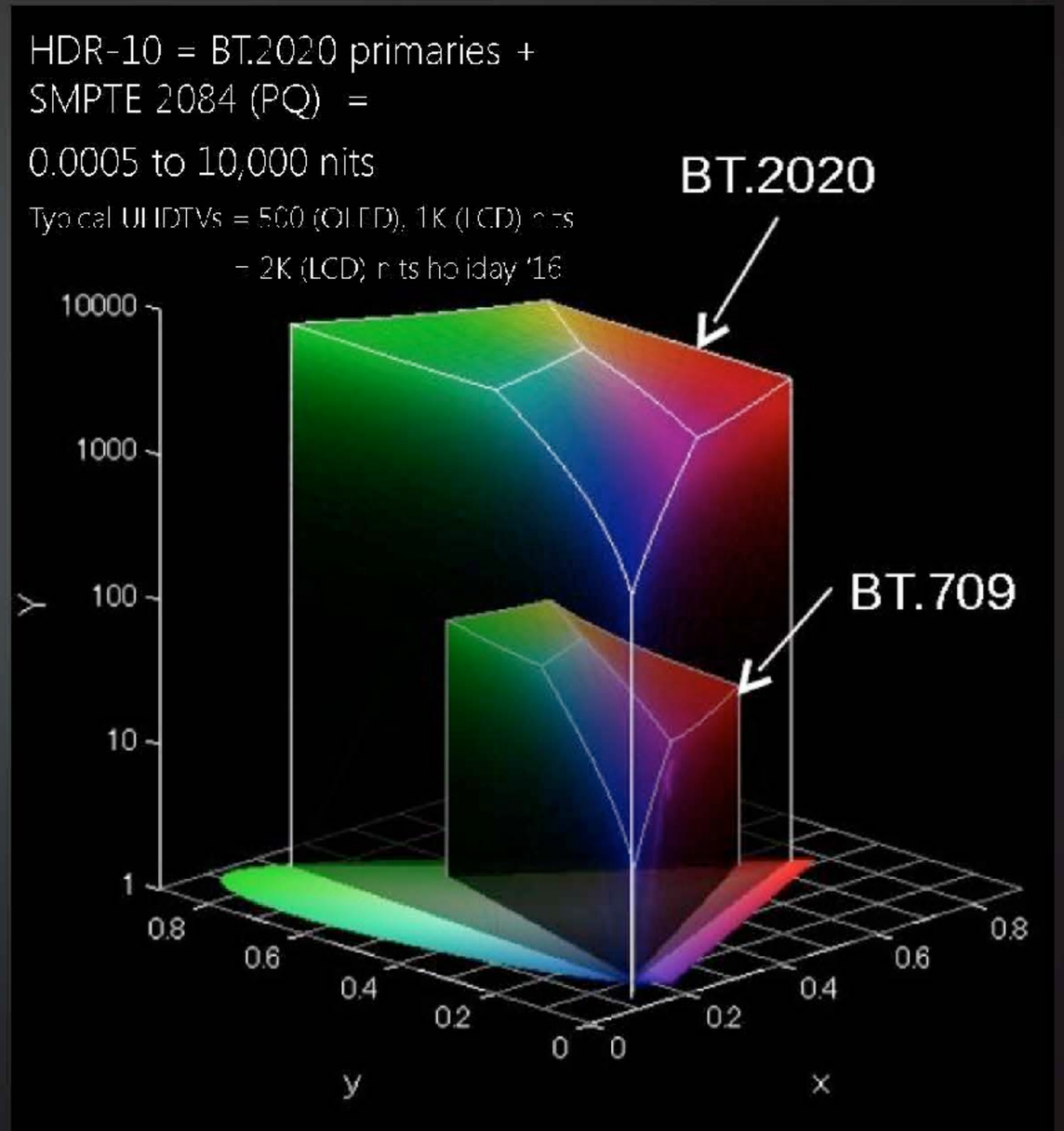
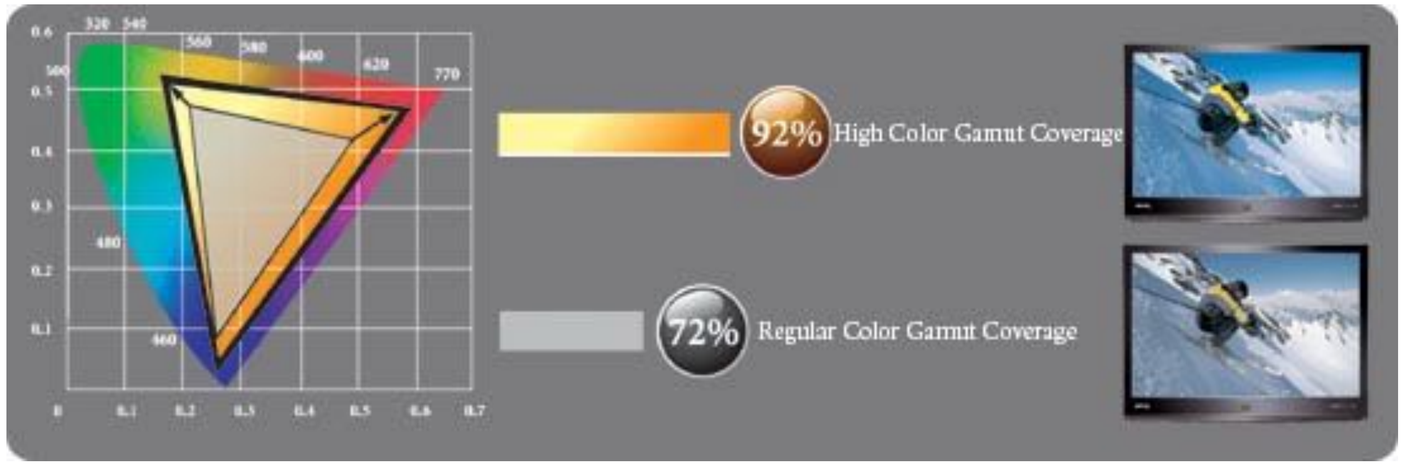
We Need More Color



- BT.709, sRGB, SMPTE 1886 (Gamma 2.4) = today's digital content
- BT.2020, SMPTE 2084 (PQ) = HDR Content's color container



LDX86 HD Extended color Gamut



Wide Colour Gamut for true-to-life colours

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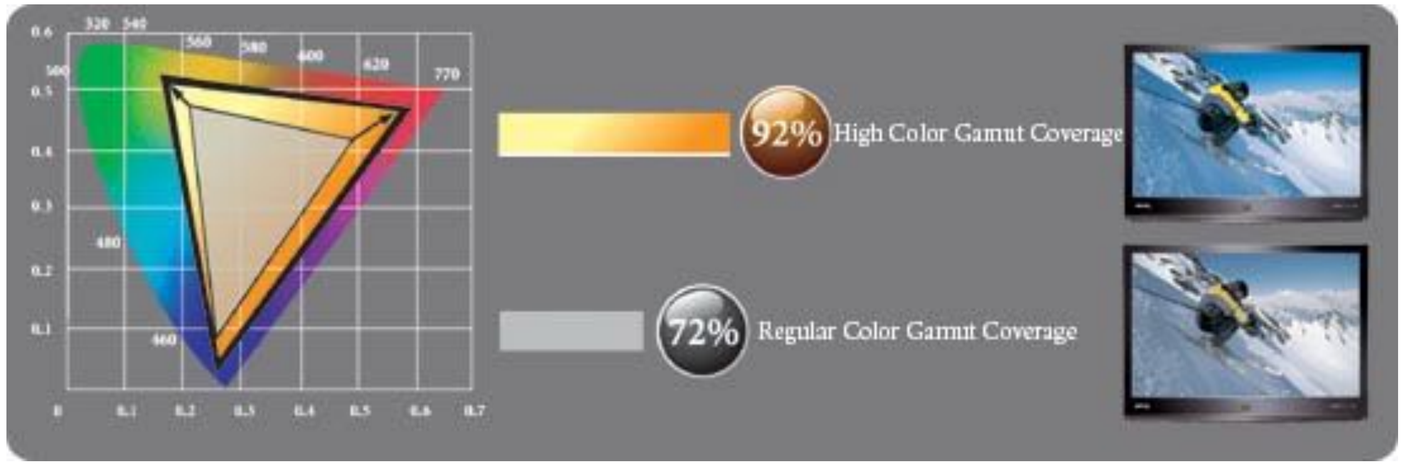
LDX86 HD Extended color Gamut



When using Extended color Gamut
It is important also to set the display in this mode

Set both devices in
Extended color gamut

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What’s New LDX series

Tips & Tricks

OCP and *MCP*

OCP tips

Partial Recall

Last recalled/stored
Standard: Scene 1

(= Part. Recall Ref)

In this example:

Press both on **FILES** and **FILTERS**
Now only the FILTERS are returning to the Scene 1 position

OCP tips

Iris mode

PRESS

DIAG OCP

BS CAM

NEXT NEXT

IP CONFIG NAME SRVR

BLACK
BlackPot IRIS

PRESS

Iris Mode Range
Normal 75

75
Center IRIS CAL

PRESS

Lens
IRIS

OPEN

CENTER

<-RANGE->

CLOSE

JOYSTICK CALIBR
Move to most upper
and lower position
OK CANCEL

OCP tips

USER Level

PRESS

DIAG OCP

BS CAM

NEXT 11x

OCP Set
Full

RESET
Reset Ocp

OCP Set:	Available Functions
✦ Full	All
✦ Basic	Limited
✦ Simple	Some

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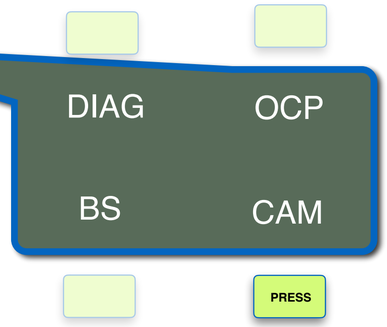
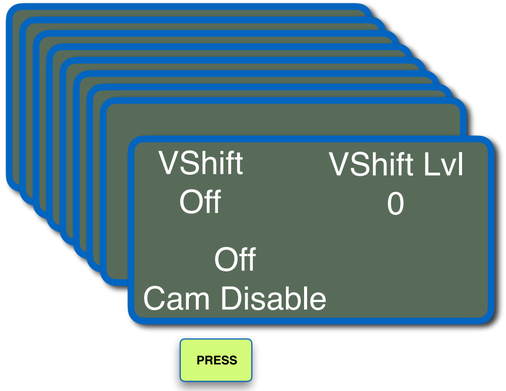
OCP tips

CAMERA Disable



NEXT 9x



With Camera Disabled ON
All the controls from the Camera are deactivated

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OCP tips

Knee parameters

Knee Off 0 Kn Fade	Kn Point 50% 400% Kn Max In	Next
Kn Sat Off Y Kn Source	Sat Lvl 50 100% Kn Out Lim	Next
WhiteClip On PwrCurves Knee Mode	WClip Lvl 105%	

Next

Auto Knee

In Auto Knee, the Knee Point is fixed to 50% and Max In is set to 400%.
The Limit Out can still be adjusted between 100% and 118%.
The circuitry automatically fades between the fixed Knee curve and the linear curve.

Knee Mode

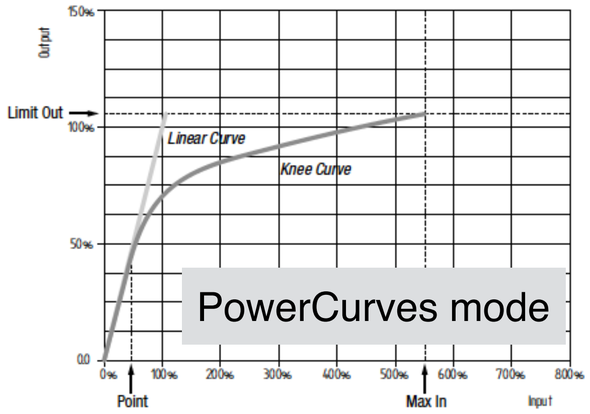
Compatable. Knee can be set up as an automatic or variable function. It can also be switched off, which is the default setting. Knee Circuit compatible to older cameras types

PwrCurves LDX extended knee functionality (not in Flex camera)

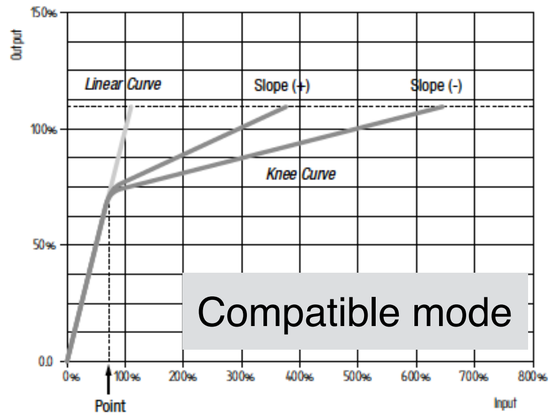
Variable Knee

The following parameters in the Knee menu can be used to set up variable Knee in PowerCurves mode:

- Kn Point/Point (0% to 90%): this is the video input level from which Knee starts compressing.
- Kn OutLim/Limit Out (100% to 118%): the highest video level that is produced at the video output.
- Kn Max In/Max In (100% to 800%): the maximum allowed video input level.



PowerCurves mode



Compatible mode

OCP tips

Detail parameters HD/SD

Dtl Level	Texture
50	50
30	10
Level Dep	Noise Sl

Next

V-Dtl	C/Fine
25	90
2	
Knee Dtl	DETAIL EQ

Next

	Y
	Dtl Source

Next

Flw Gain	Flw Zoom
Off	Off
Enable	On
Texture	Dtl Func

Next

Detail Eq	Shadow
Off	50
30	10
Midtone	Highlight

Continued

SD Lvl	SD Dtl
25	On
30	10
SD LvlDep	SD NoiseS

Next

SD V-Dtl	SD C/Fine
50	90

Next

	SD SoftLv
	50
On	Y
SD SoftDt	SD Sourc

MCP tips

Under development

LDX Advanced *New Features(2)*

Part 2:

- ☑ New Features (LDX)
- ☑ LDX 86 4K and XDR
- ☑ Under development
- ☑ OCP *MCP* hints / tips

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