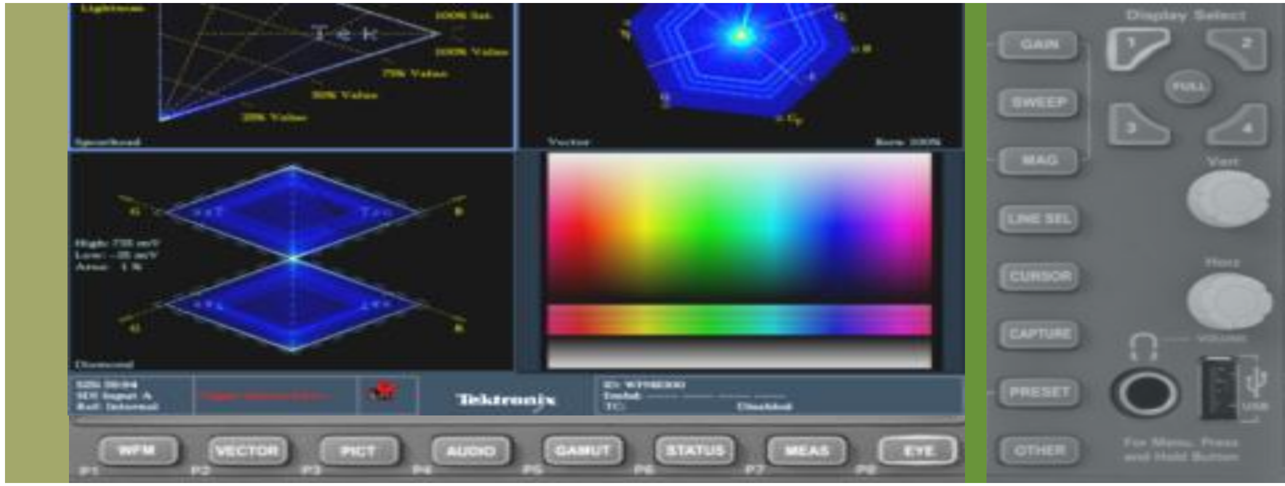
Video And Cameras

Presented by John Bradford



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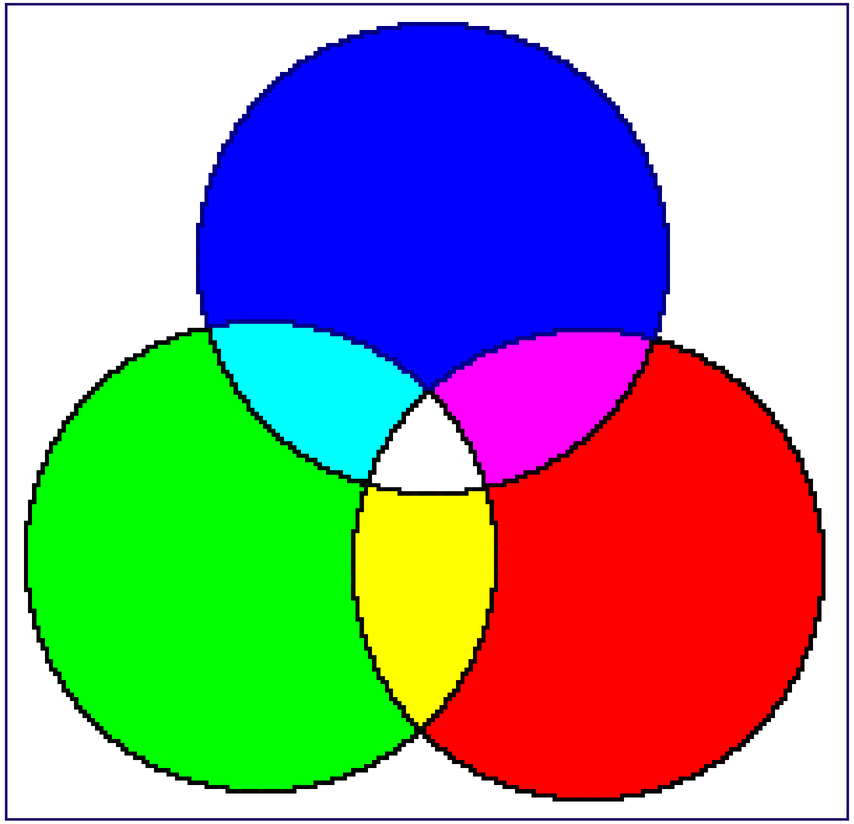
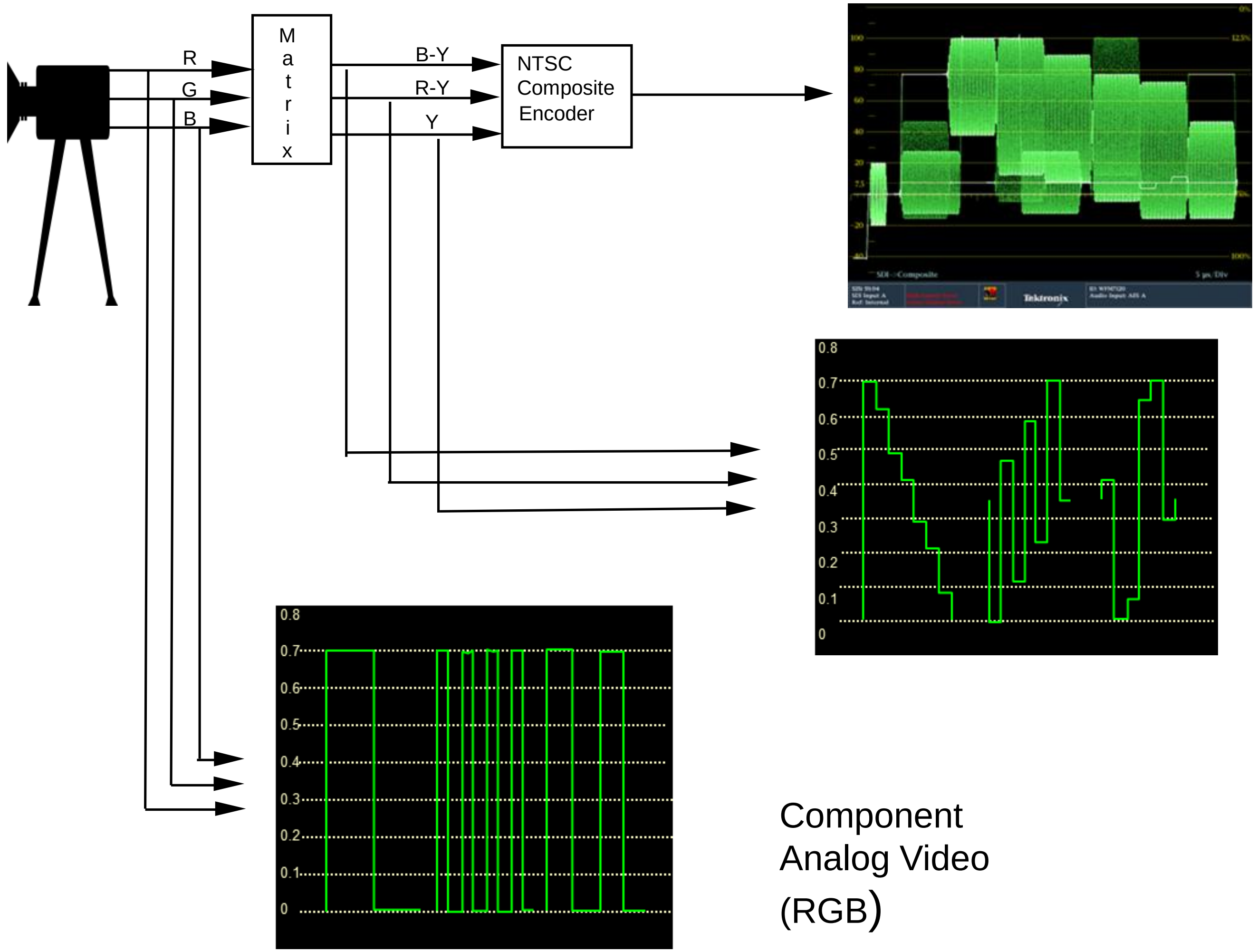
Additive Color System



Television Signal Formats--- Tektronix



Analog Composite Video (PAL/NTSC/SECAM)

Color Difference Component Analog Video (Y, B-Y, R-Y) 4,2,2 sampling

Y is Created from RGB
The Approx. mix is
60% is Green
30% is Red
10% is Blue

Component Analog Video (RGB)

What could go wrong?

- Color Not Correct
  - Company logo/brand incorrect color in commercial or graphic.
  - Format conversion caused clip of color in change from one color space to another

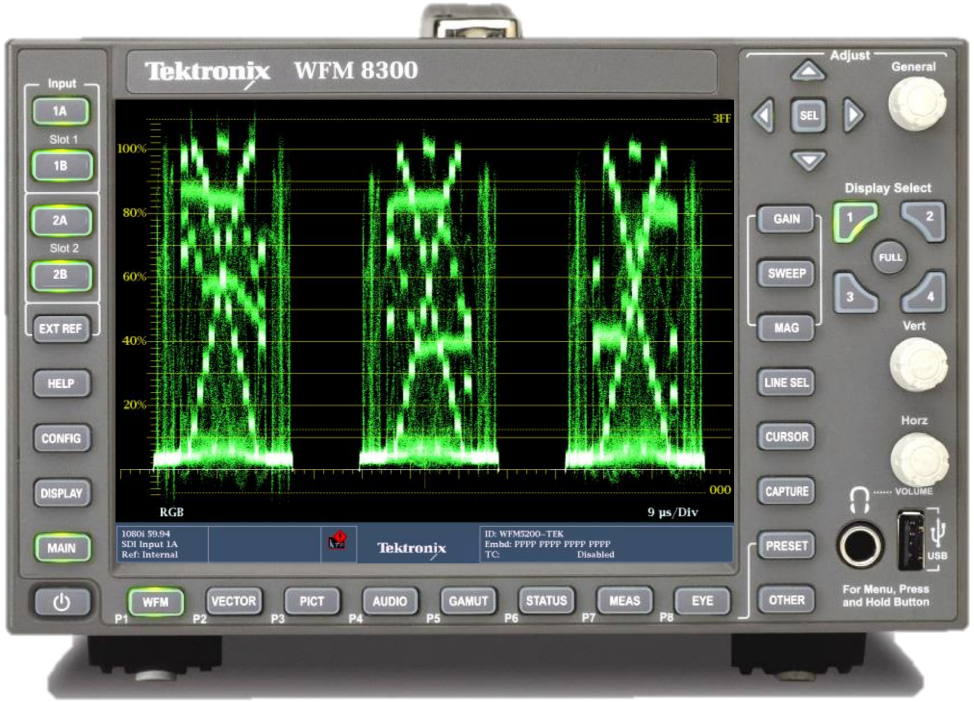
- Color Balance
  - Overall image appears washed out
  - Image appears to dark
  - Cameras incorrectly balanced produced different look from scene to scene

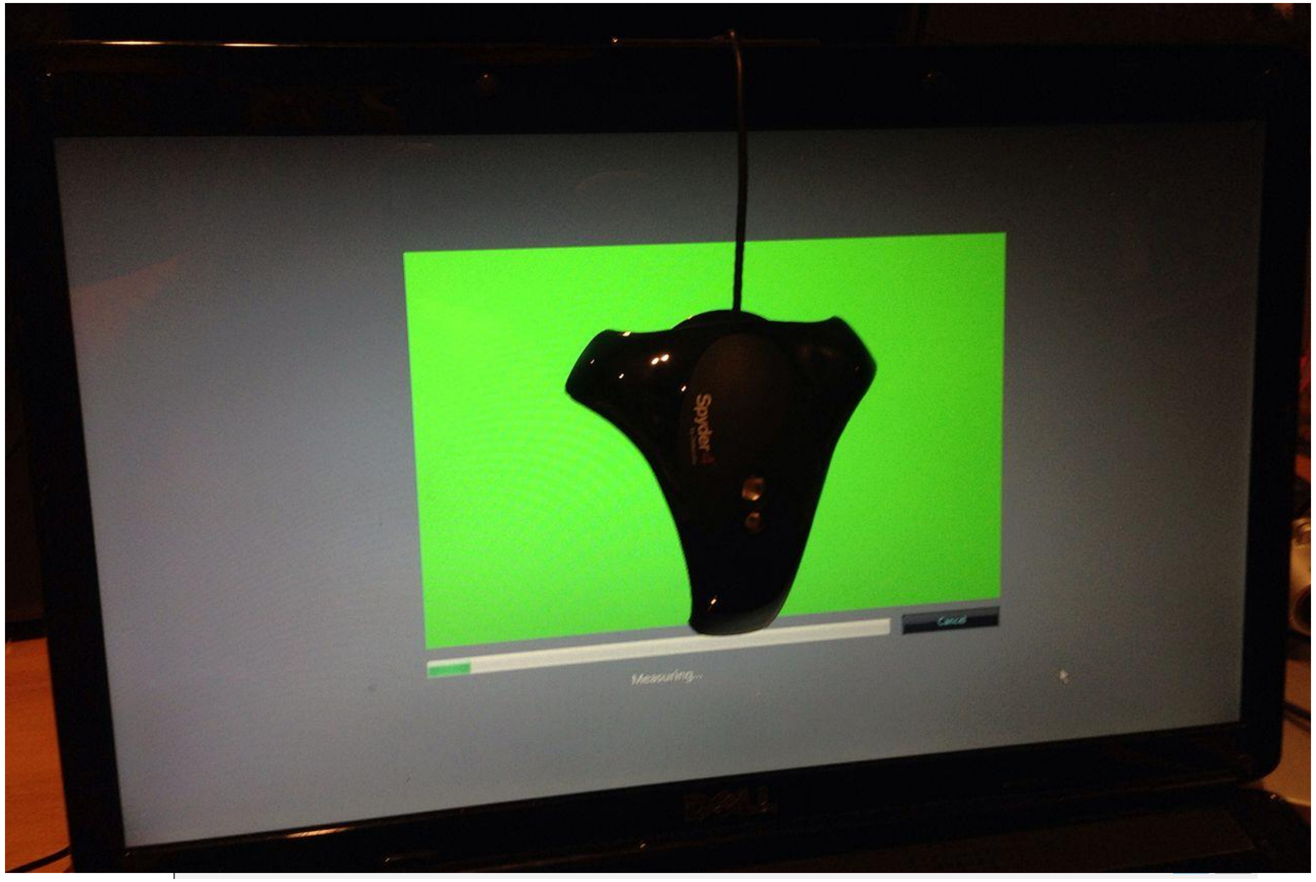
What’s Your Reference

Computer Display

Consumer Displays

What's Your Reference





Test Equipment

Calibrated Monitors

Calibrate Your Eyes

6500K light panels are used in many Color Correction Suites

HDMI Color Accuracy

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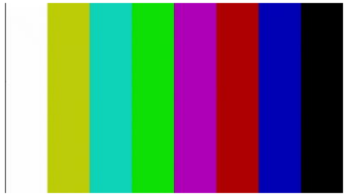
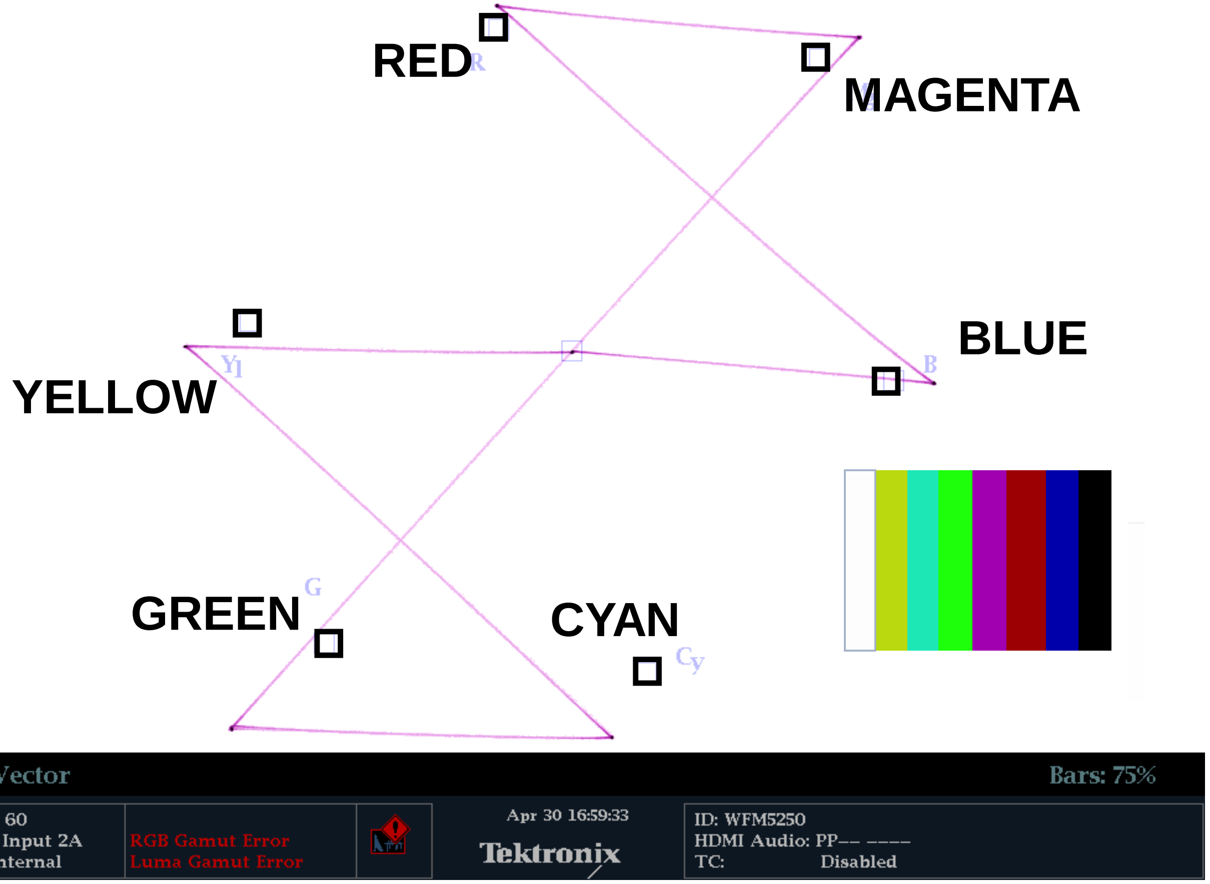
Measuring HDMI Performance

Android Tablet
75% Colorbars 1080i@29.97



Converted to 1080P @60



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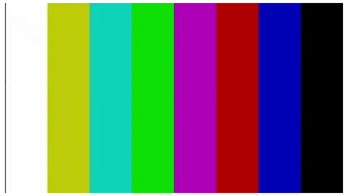
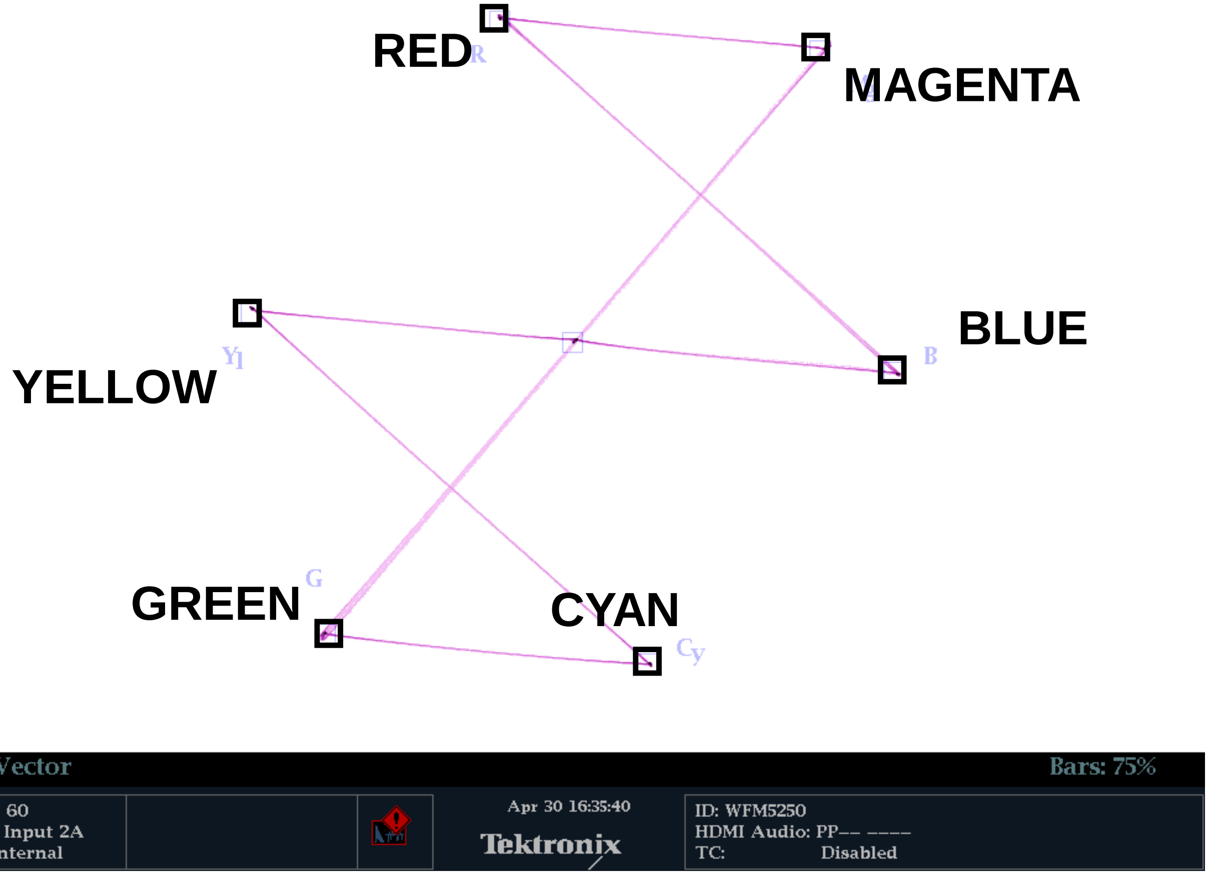
Measuring HDMI Performance

Apple iPad Lightning to HDMI Adapter
75% Colorbars 1080i@29.97

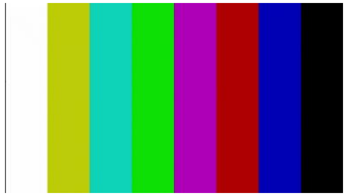


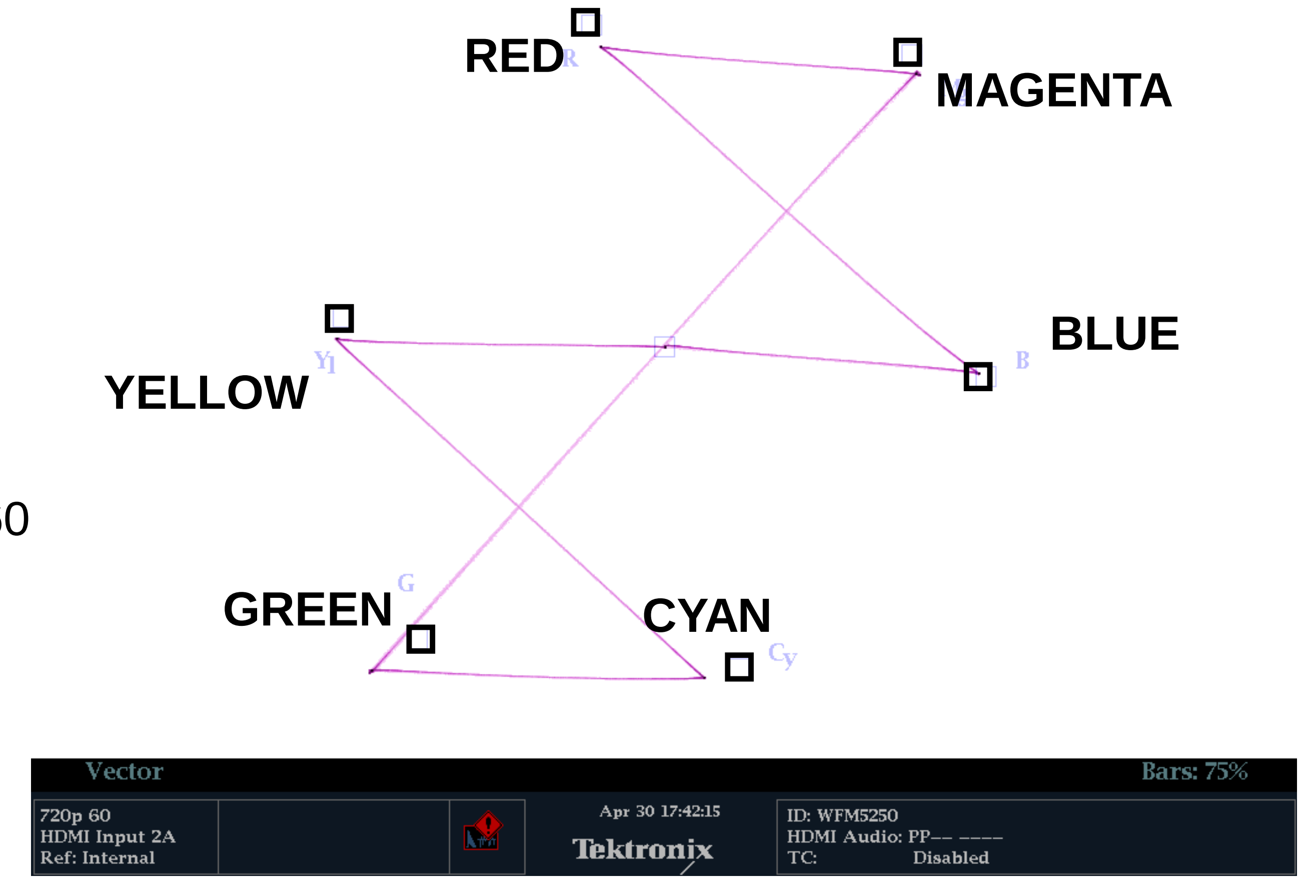
Converted to 1080P @60



Measuring Set Top Box Performance

Roku3
75% Colorbars 1080i@29.97

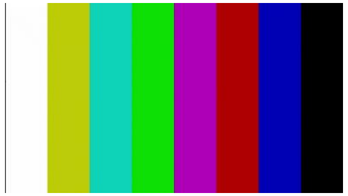


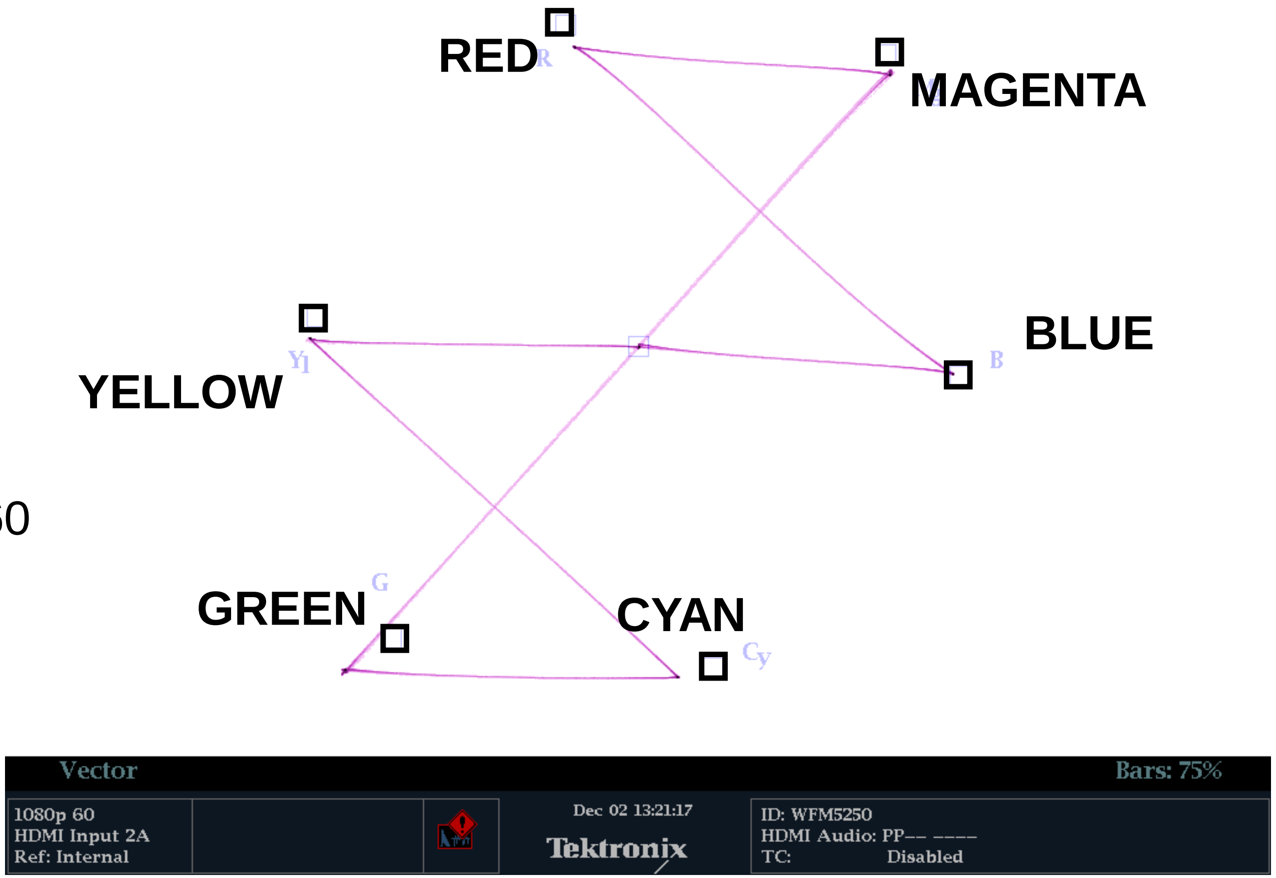


Converted to 720P @60

Measuring Set Top Box Performance

Amazon fireTVstick
75% Colorbars 1080i@29.97





Converted to 1080P @60

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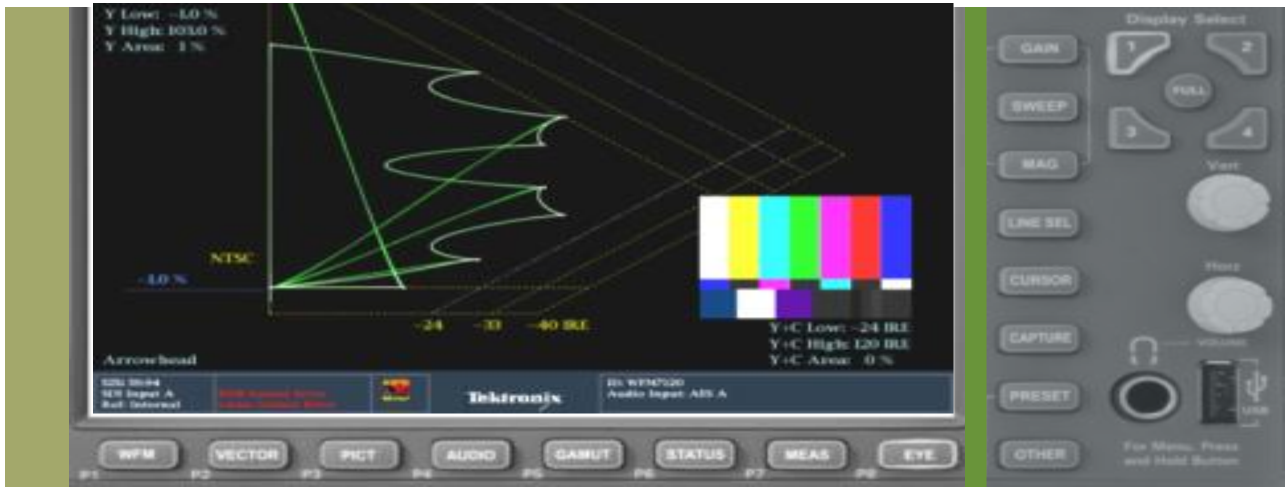
Gamut and Color Space



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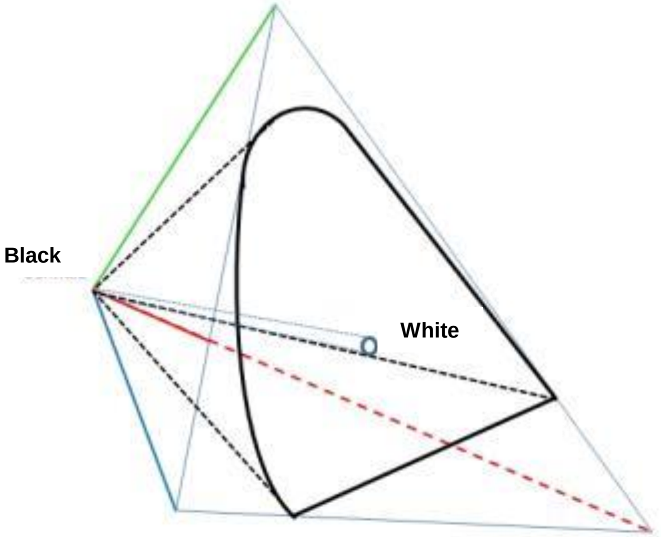
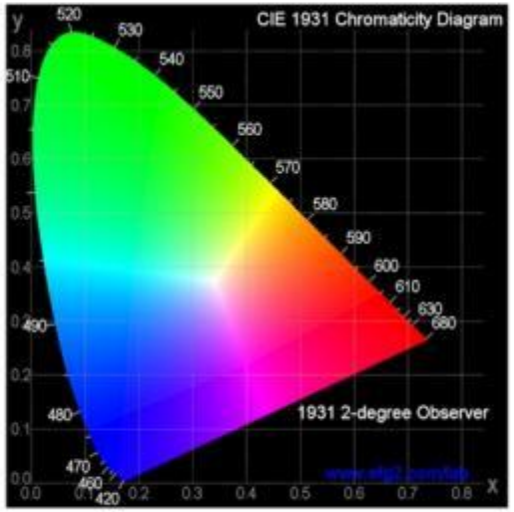
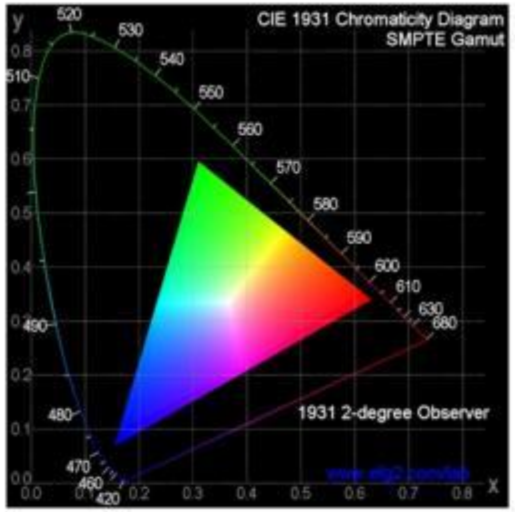
Color Model – developing color spaces







- CIE 1931 XYZ color space is still foundation of most color models
- Trichromatic stimulus (color value)
- Lightness decreases towards not shown third dimmension
- Saturation inceases towards edges

Colourimetry change between HD and SD

Notice difference in Green-Magenta transition

- HD YPbPr Waveform display 709
- SD YPbPr Waveform display 601

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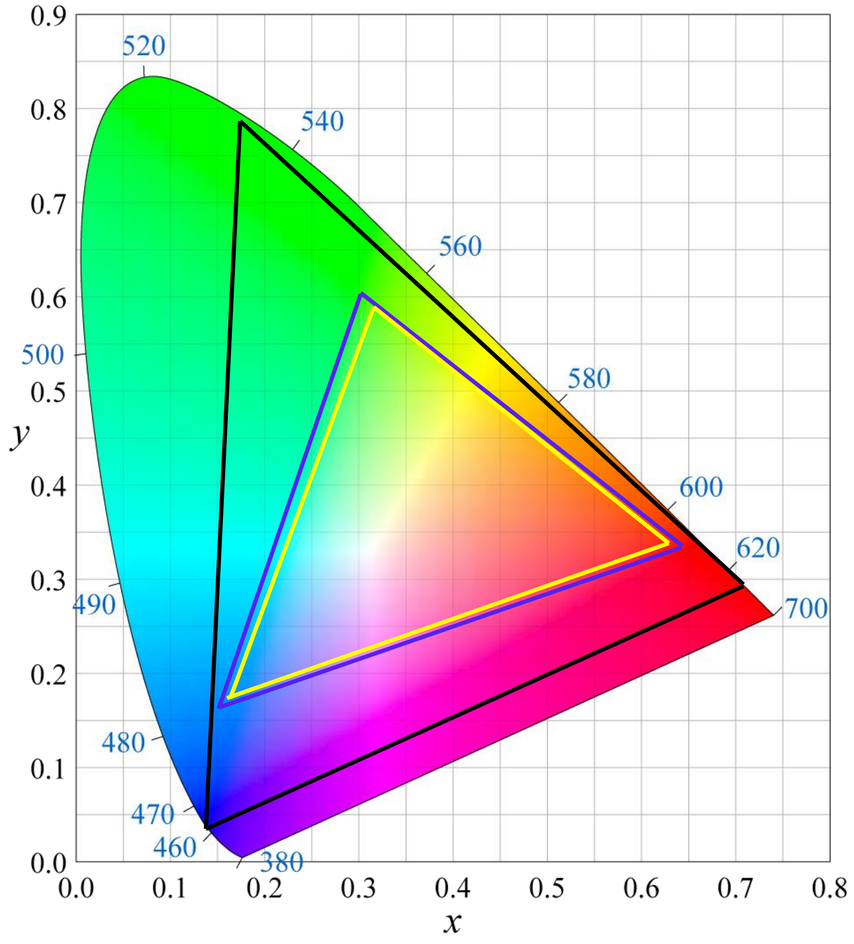
When things are not correct…

- Input format was signaled as 1080P
- But received data was 601 color space

Color is washed out

Chromaticity



ITU 601 Gamut

	CIE x	CIE y
Red	0.630	0.340
Green	0.310	0.595
Blue	0.155	0.070
White	0.3127	0.3290

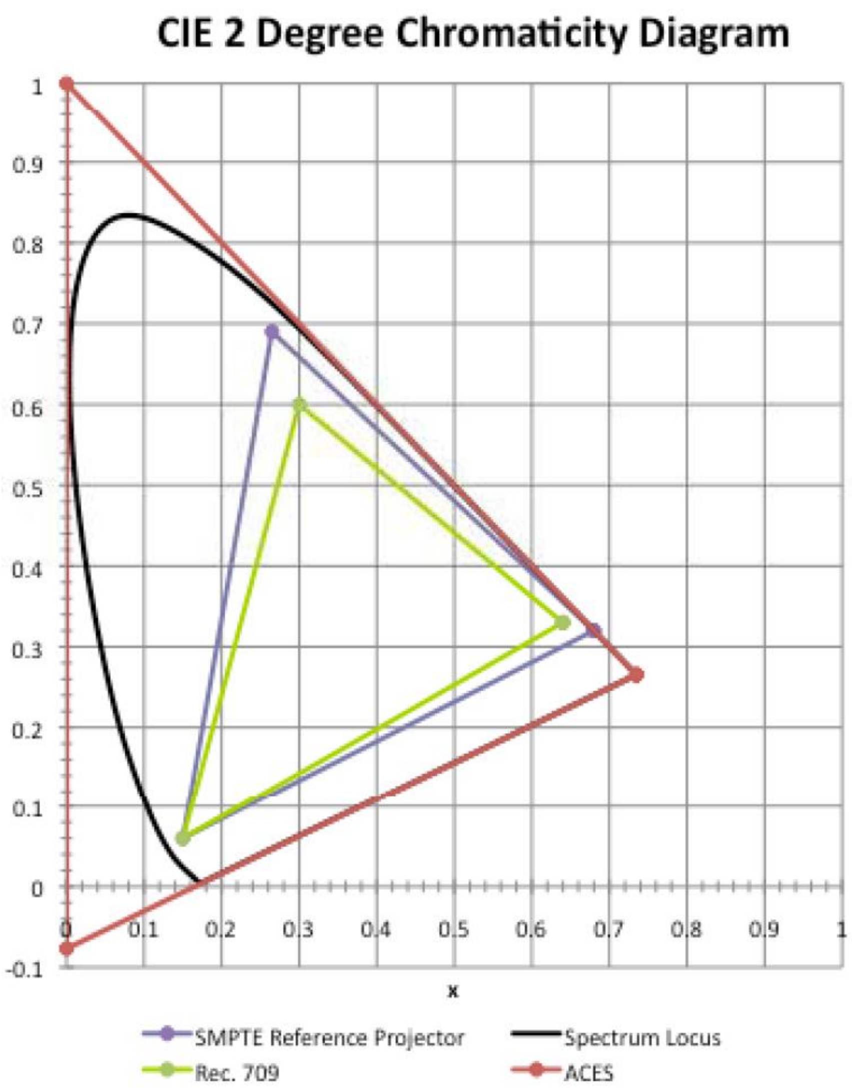
ITU 709-5 & sRGB Gamut

	CIE x	CIE y
Red	0.640	0.330
Green	0.300	0.600
Blue	0.150	0.060
White	0.3127	0.3290

ITU-R BT.2020

	CIE x	CIE y
Red	0.708	0.292
Green	0.170	0.797
Blue	0.131	0.046
White	0.3127	0.3290

Academy Color Encoding System (ACES) Color Space

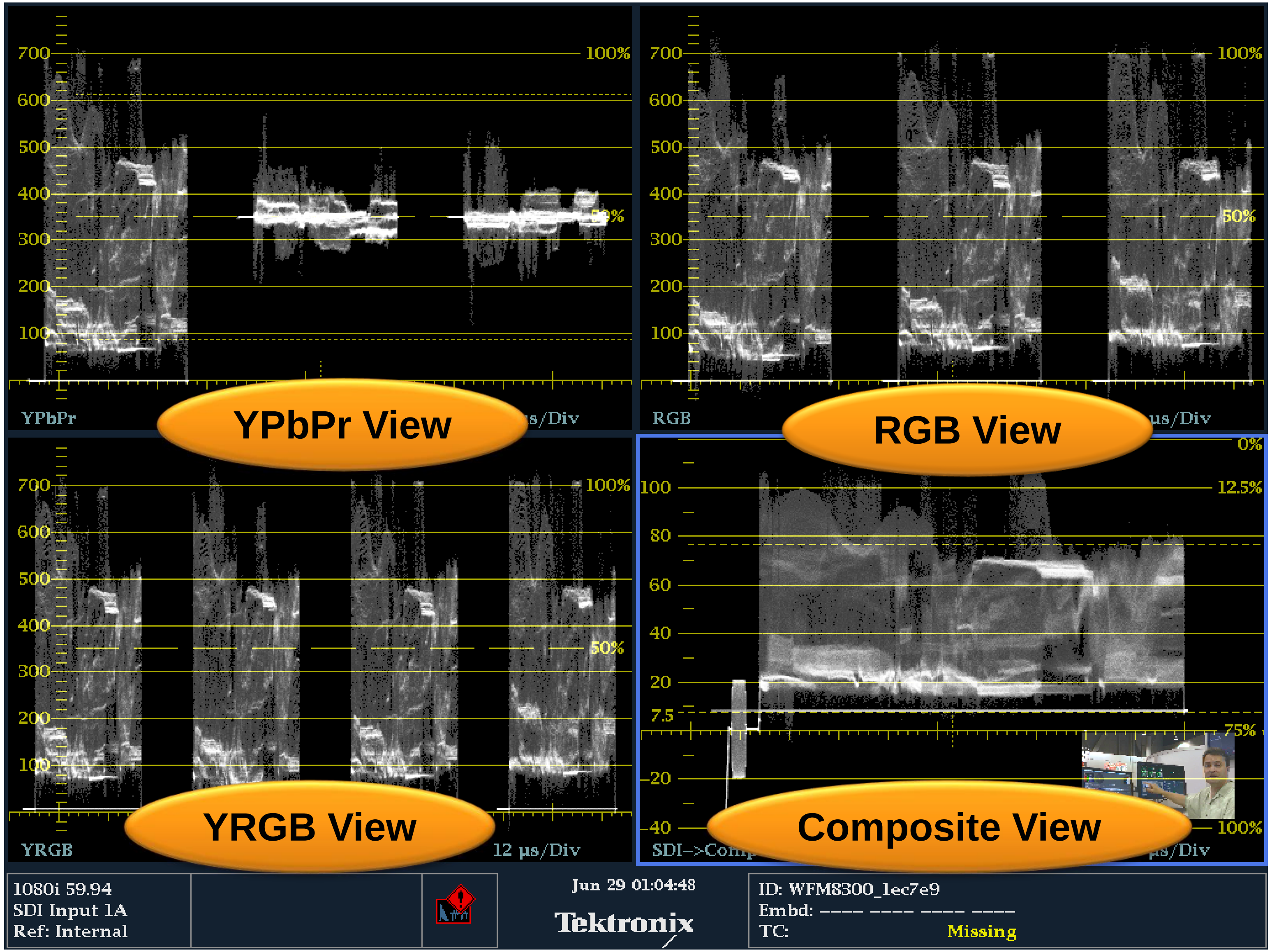


	CIE x	CIE y
Red	0.73470	0.26530
Green	0.00000	1.00000
Blue	0.00010	-0.07700

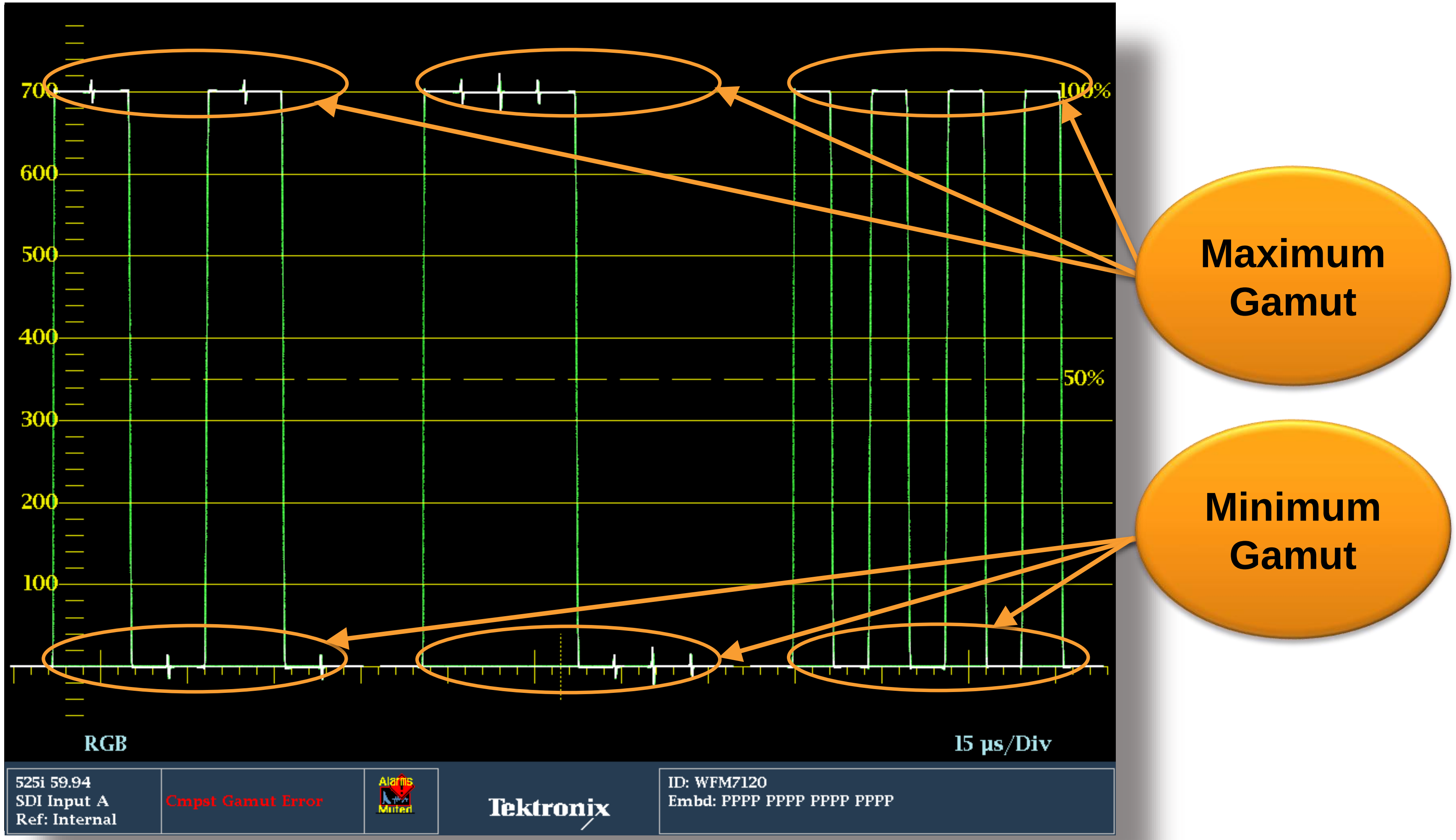
ACES

- File based System
- Method for conversion between range of color spaces

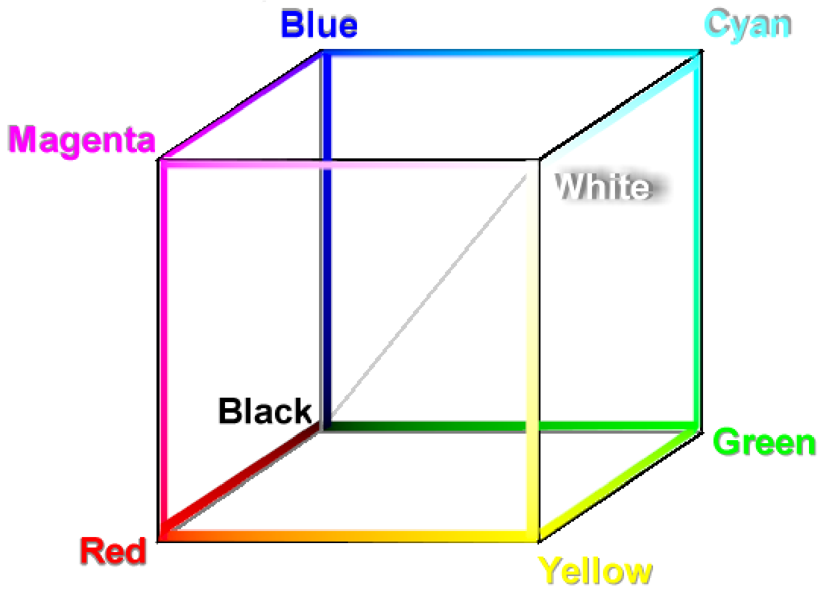
Waveform View



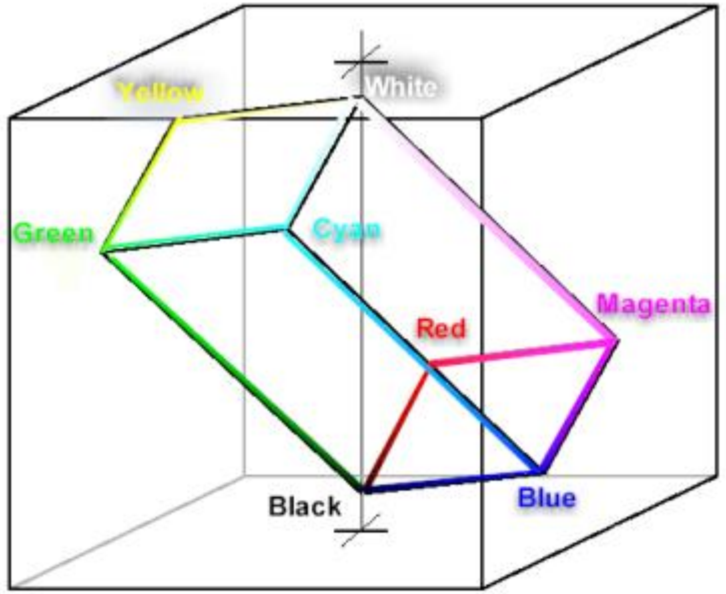
Gamut monitoring - The traditional way RGB domain



RGB and YPbPr Color space.



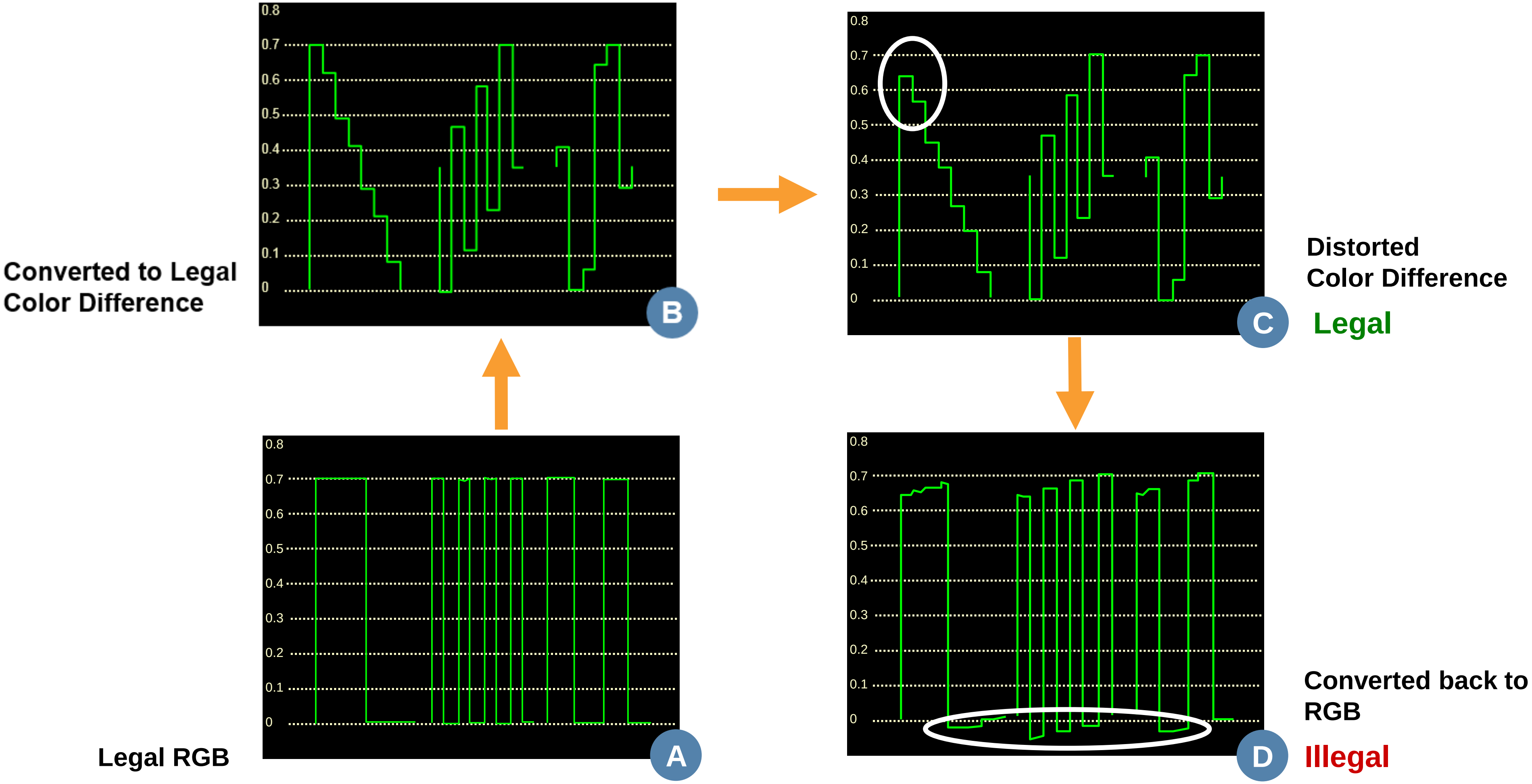
RGB Color Cube



YPbPr Color Cube

- YPbPr color cube shows Parallel-Piped of RGB colors
- Certain YPbPr values when converted to RGB will fall outside the allowed range and will be out of Gamut

Impact of Distortions on Different Color Spaces

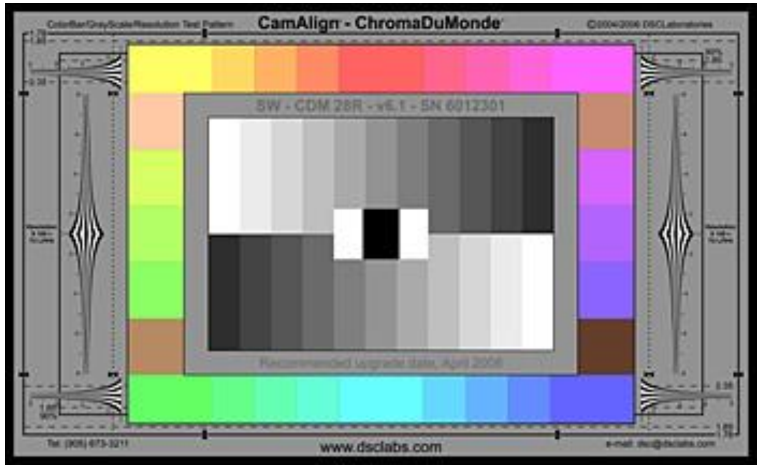


A signal can be legal in one color space but not valid when converted to another

Cameras

Camera Balancing

- Use calibrated test charts of reference patterns such as step-scales
- Compare measurements with theoretical targets on waveform, vector, and gamut displays
- Test charts complement electronic pattern generators by including the camera's "taking characteristics"
  - Lens and adapters
  - Filters
  - Characteristics of the CCD



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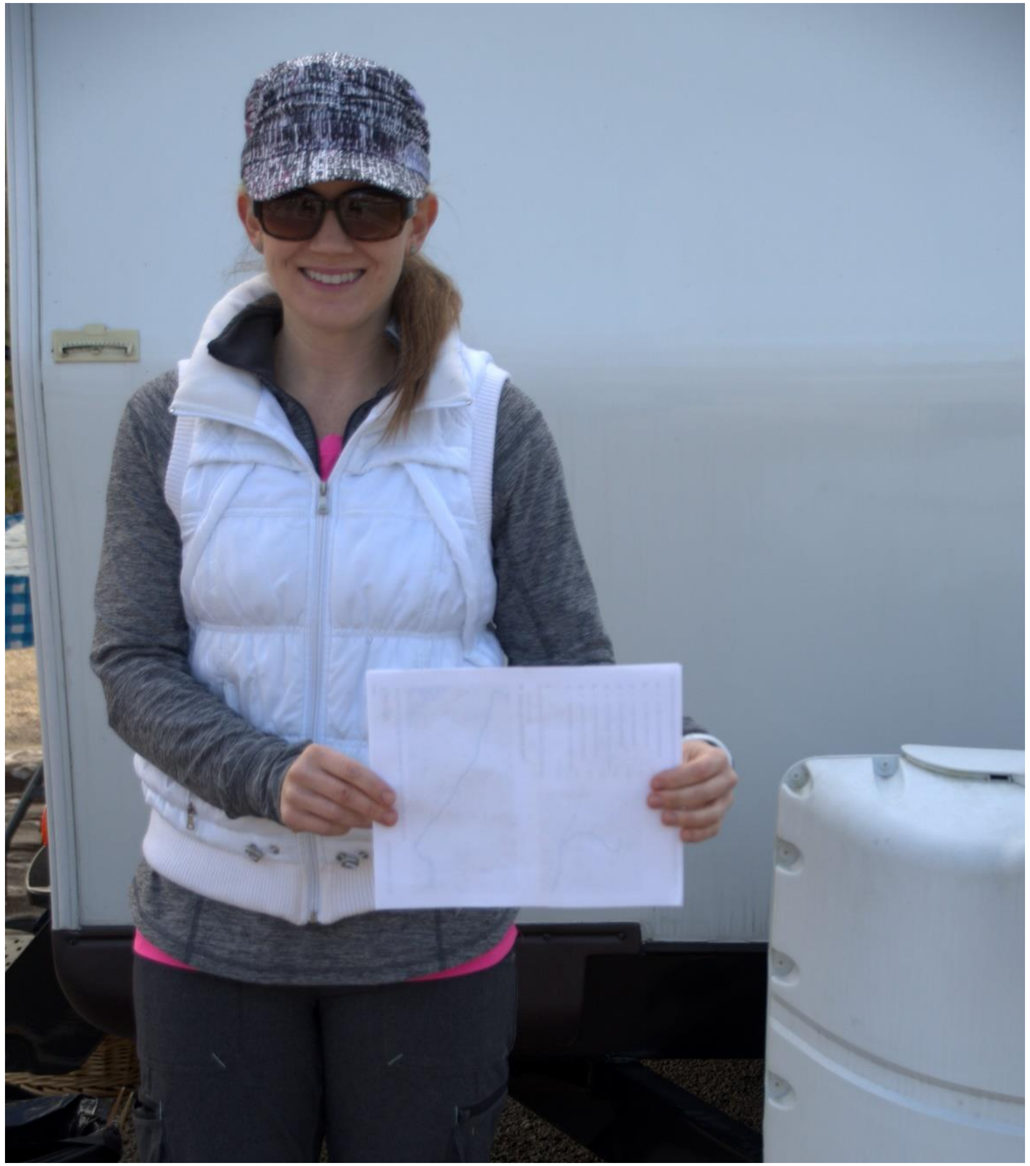
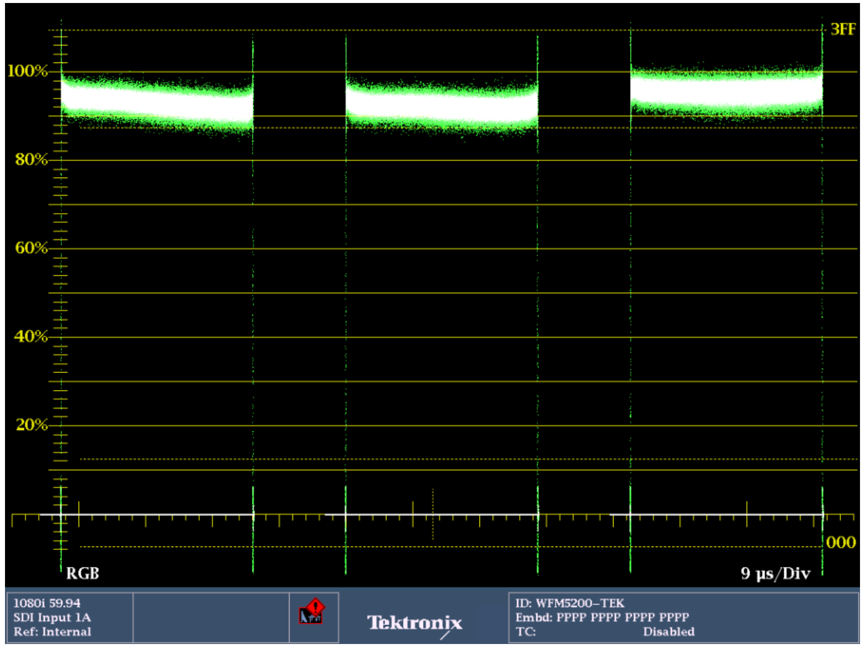
White Balance – Camera Shading

- Even brightness white source
  - Ambi-Illuminator
- Often the center can be brighter than the edges
- Measure light output with a luminance spot meter
- Set camera gain to 0dB & camera controls to zero
- Set camera F-stop between f4 to f5.6
  - Adjust distance of camera to source
- Defocus Camera

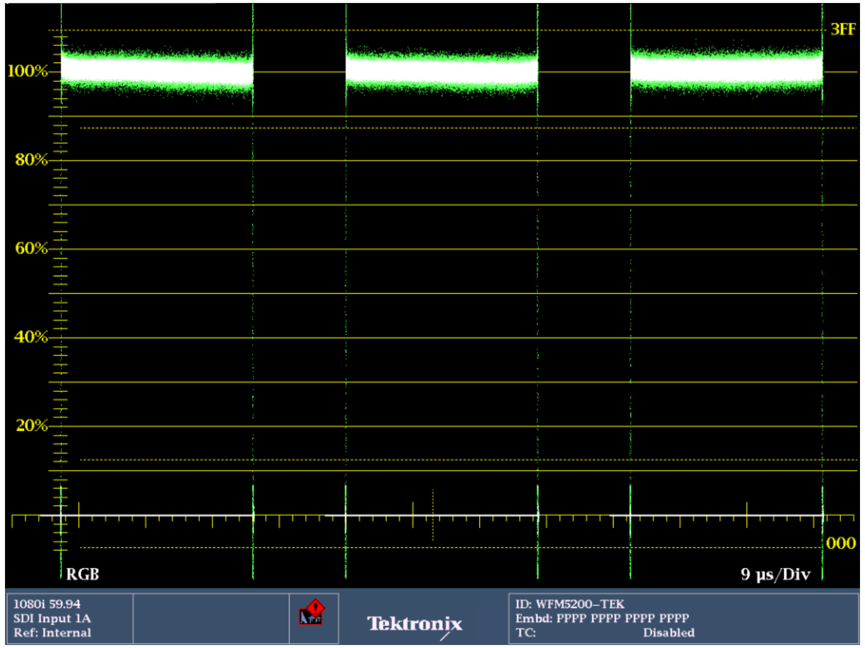


White Balance

- Select WFM display and configure for RGB parade.
- No color hue should be present
  - Red, green, blue channels must be balanced
  - Ideally RGB should be at same level and flat

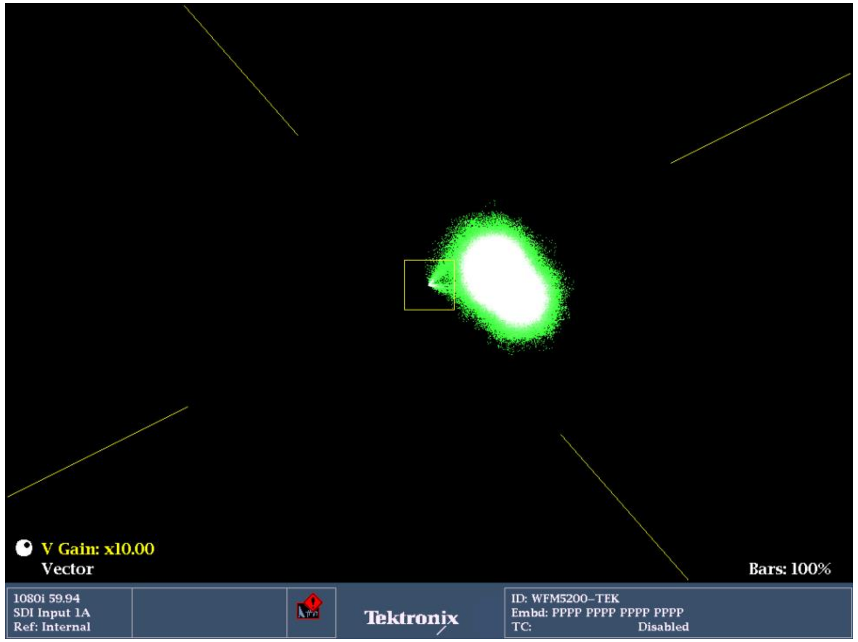


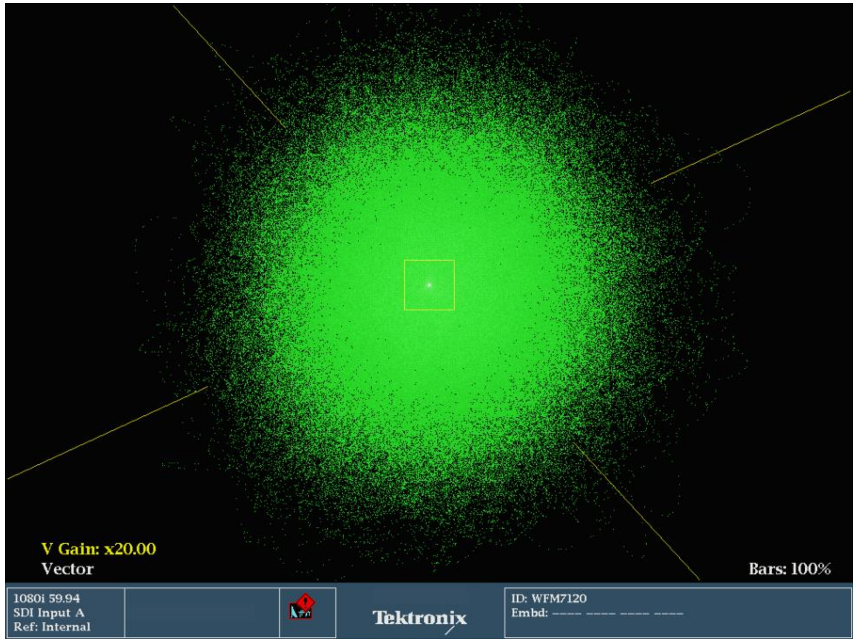
Original RGB parade waveform



After white shading adjustment

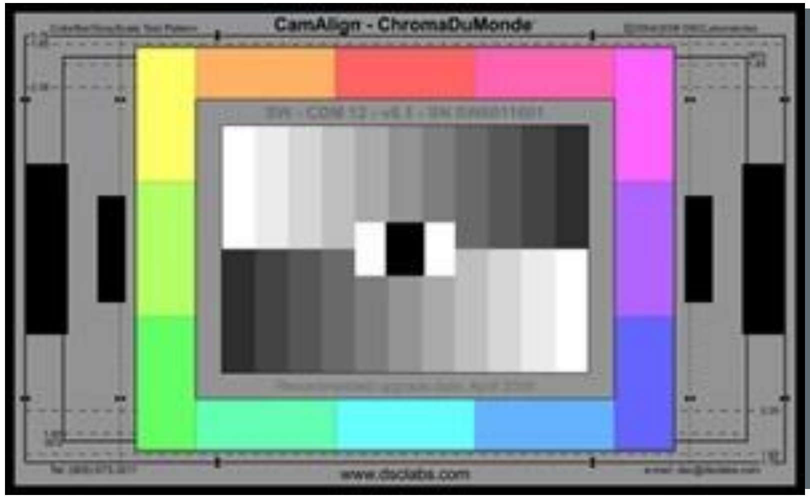
White Balance with the Vector Display

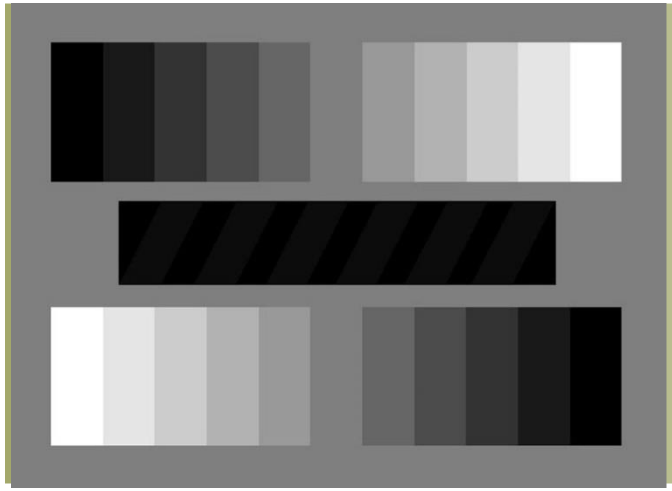




- Monochrome image should be centered tightly on the vector graticule
- Off-center ovular shape indicates shading error
- Use gain controls on the vector display to confirm correct white balance

Tools for Camera Alignment & Matching





Camera Matching

- No two camera are identical
  - Physical Differences
    - Lens
    - Sensor
    - Electronics
- Cannot load preset from one camera to another
- Scene to scene cameras need to match
- Comparison of video levels between camera is required

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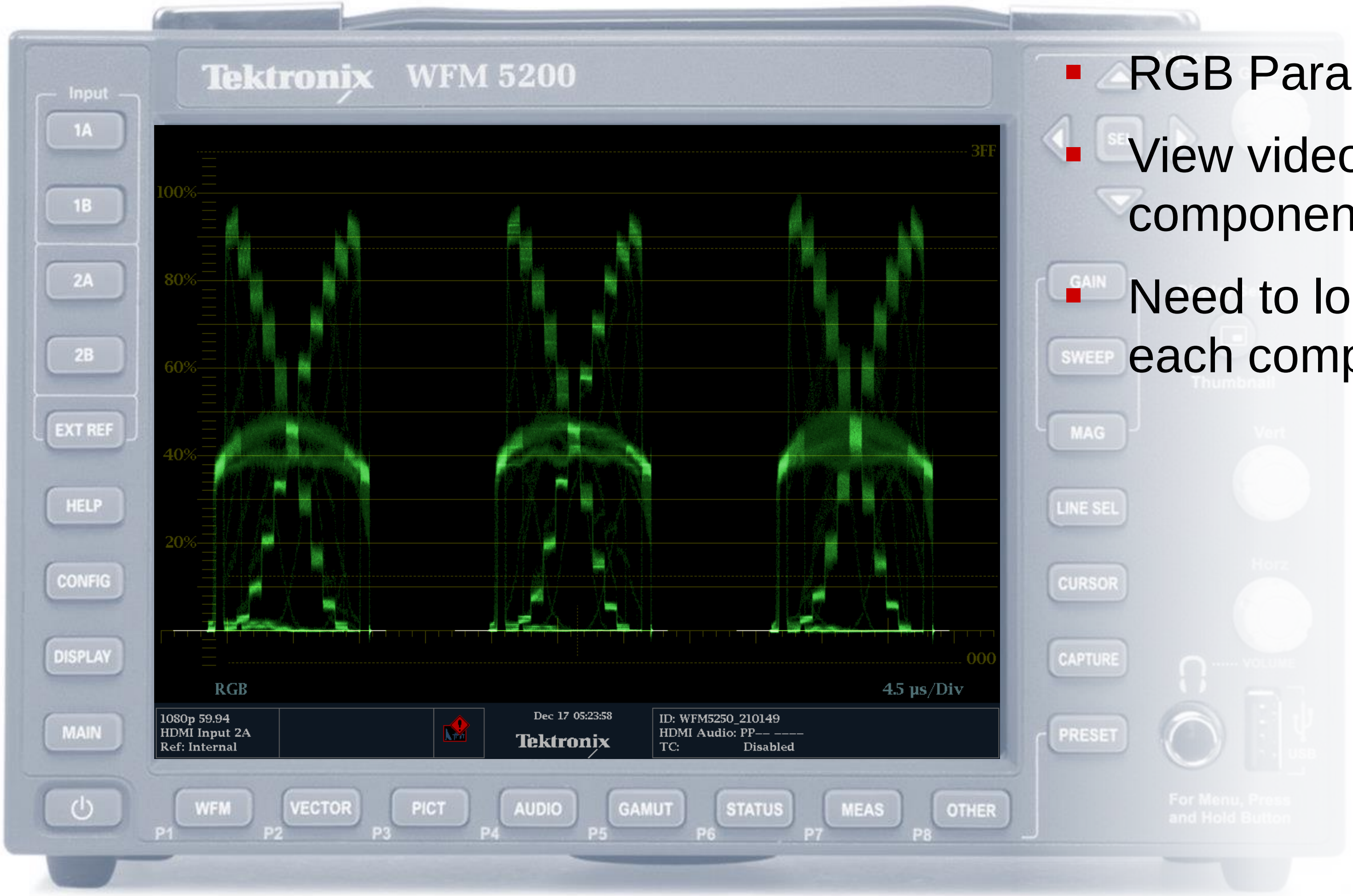
RGB Waveform Display - Traditional Method



- RGB Parade
- View video levels of each component
- Need to look and compare each component RGB

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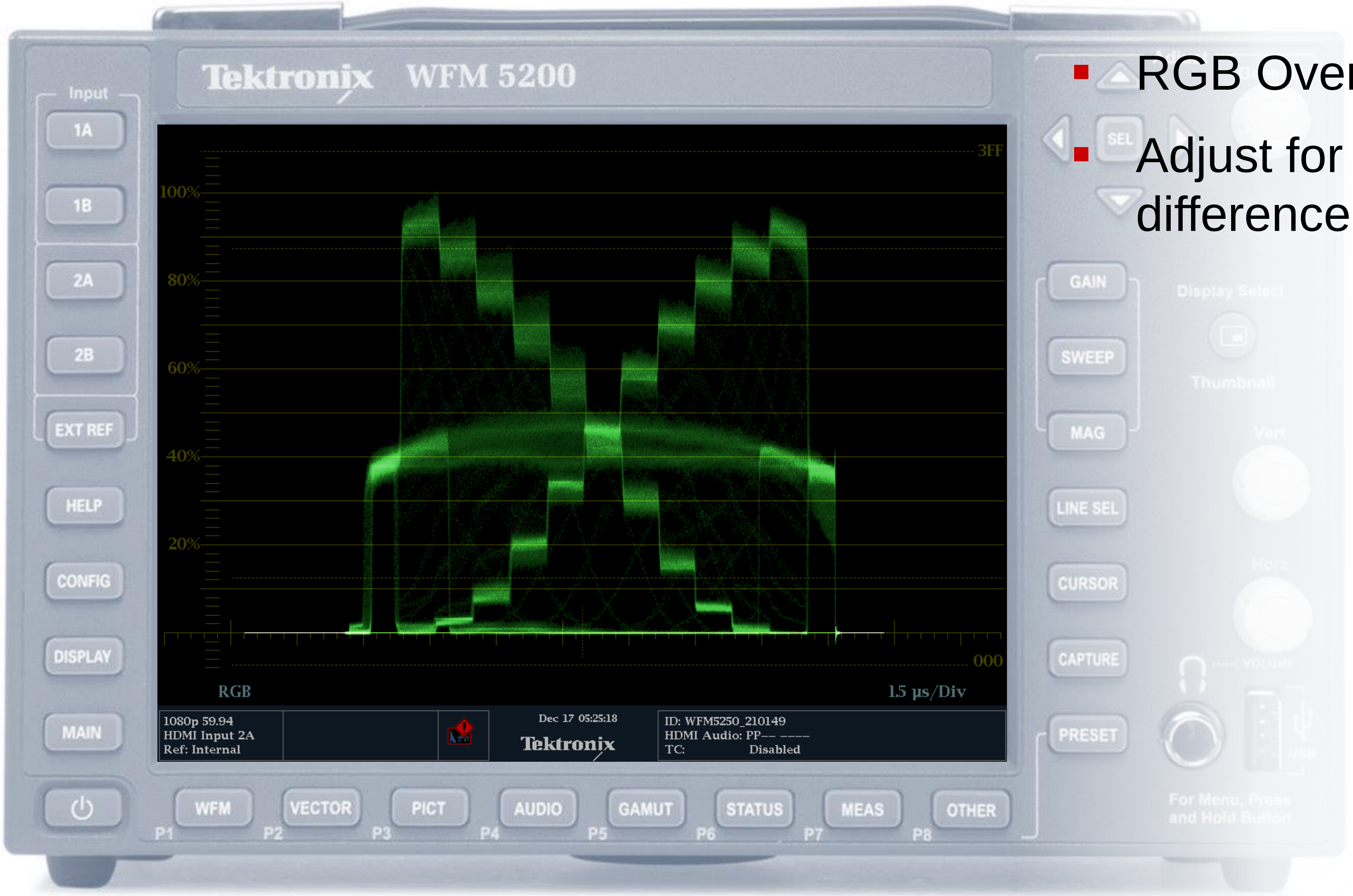
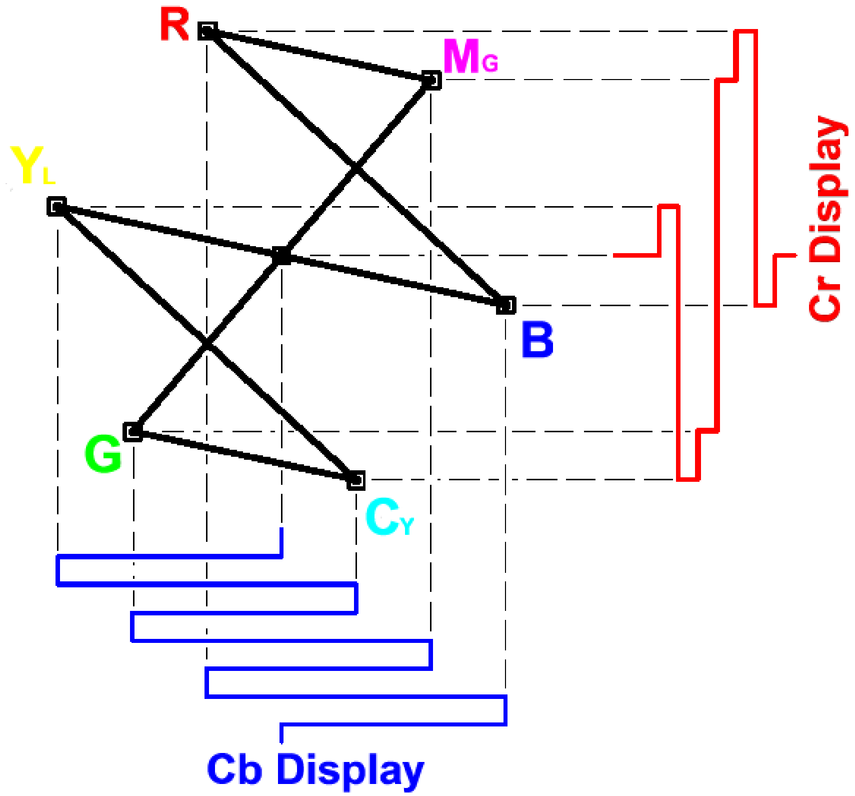
RGB Waveform Display - Traditional Method

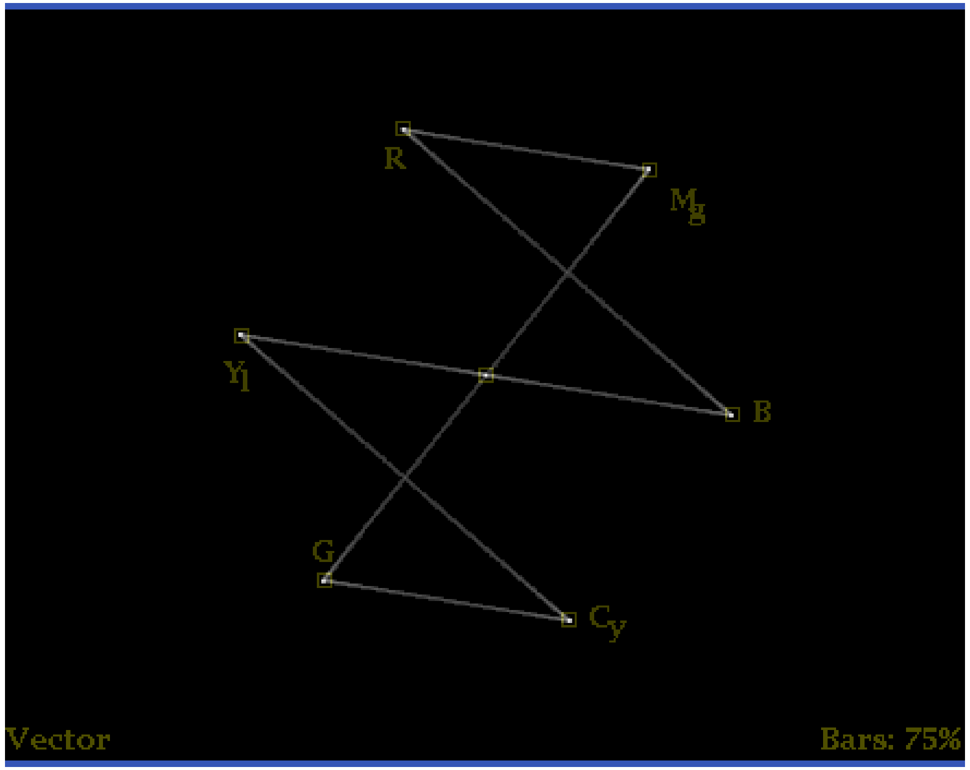


- RGB Overlay
- Adjust for minimum difference

Camera Alignment with Luma Qualified Vector Display

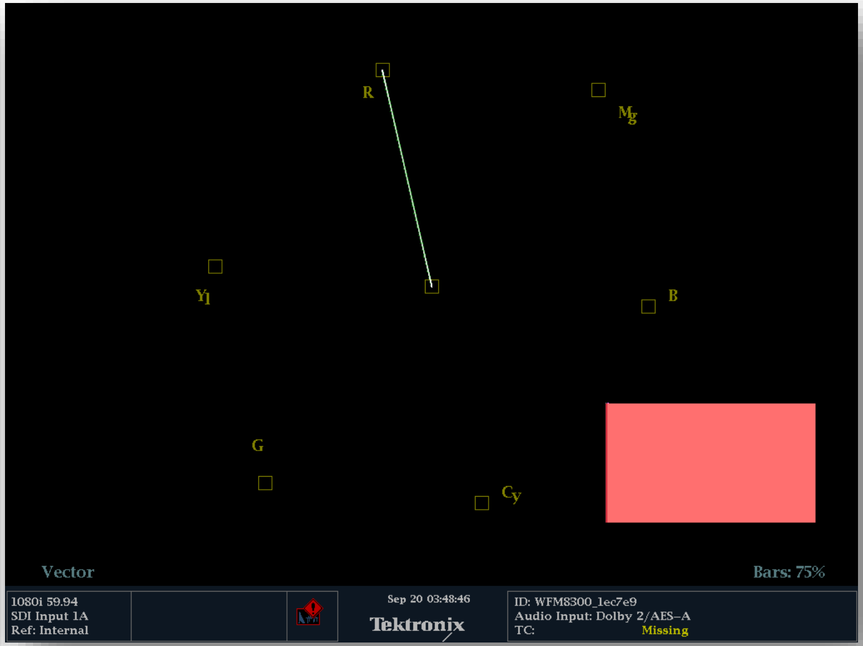
Camera Setup with Vector Display





Saturation

- The purest (most saturated) color is achieved by using just one wavelength at a high intensity, such as in laser light. If the intensity drops, then as a result the saturation drops. To desaturate a color of given intensity in a subtractive system (such as watercolor), one can add white, black, gray, or the hue's complement.

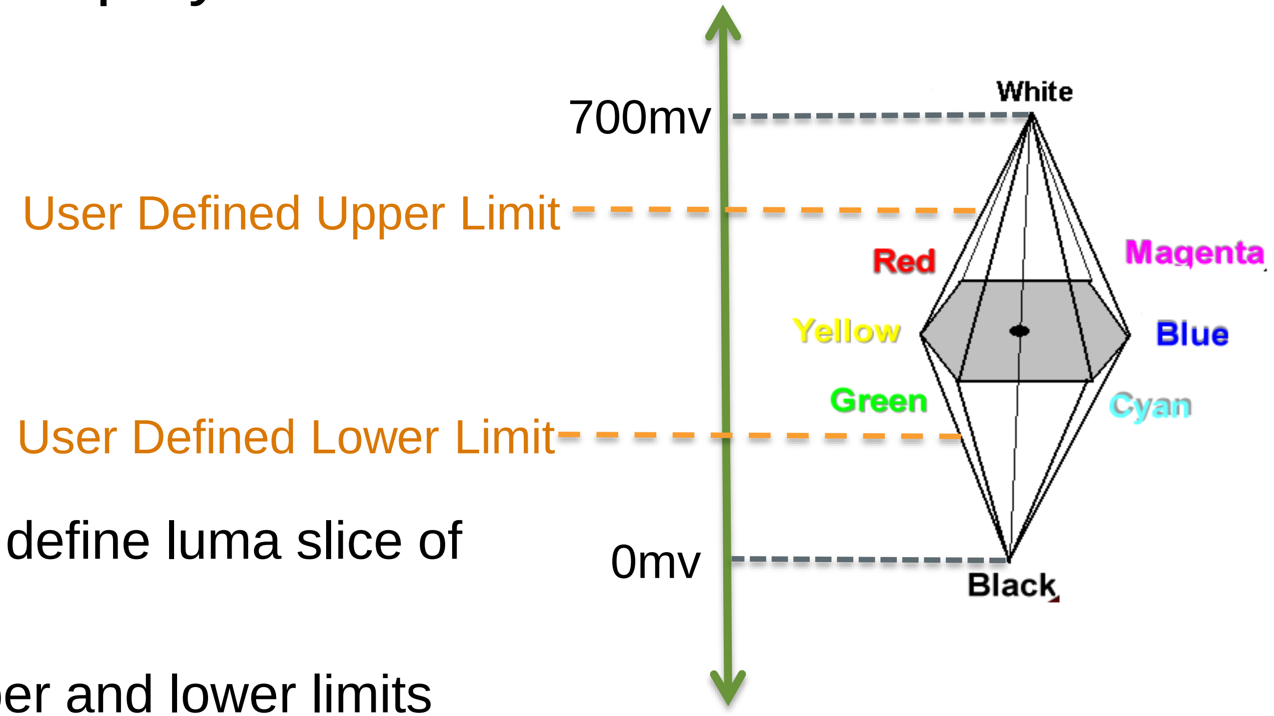


In this case the picture on the right I have added some white to
And the Vector still shows the same as the one on the left

Vector Waveform Display - Method

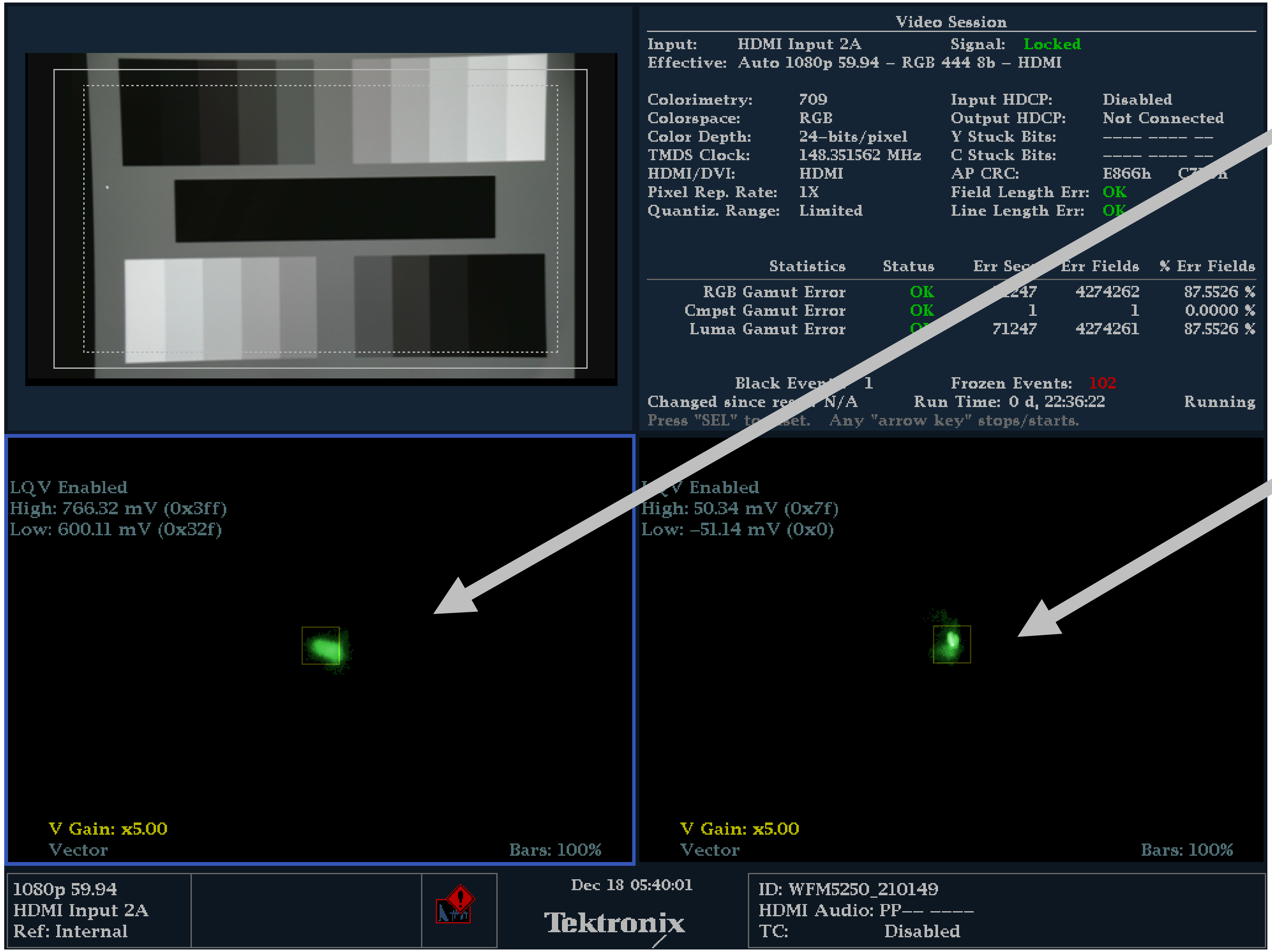
- Vector
- Turn on Gain (X5)
- Adjust for smallest centered dot
-

Luma Qualified Vector Display



- Allows User to define luma slice of vector display
- Selectable upper and lower limits
- Allows user to select low, medium and high ranges to isolate certain luma regions.

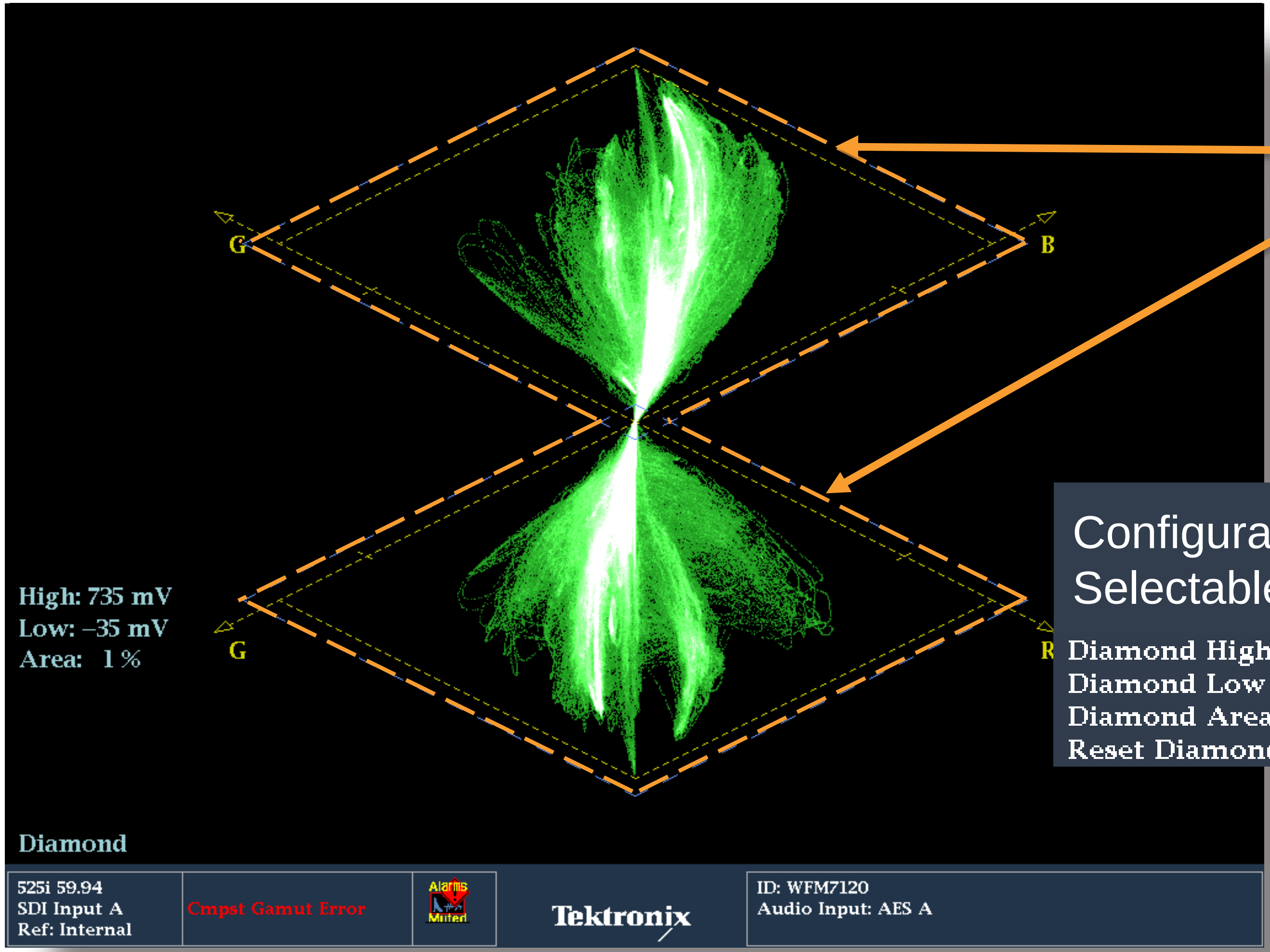
Luma Qualified Vector Display



- Focus on White region to remove color offset
  - Upper limit 766mv
  - Low limit 600mv
- Focus on Black region to remove color offset
  - Upper limit 50mv
  - Low limit -51mv

Camera Alignment Diamond Display

Gamut monitoring — *Diamond* display

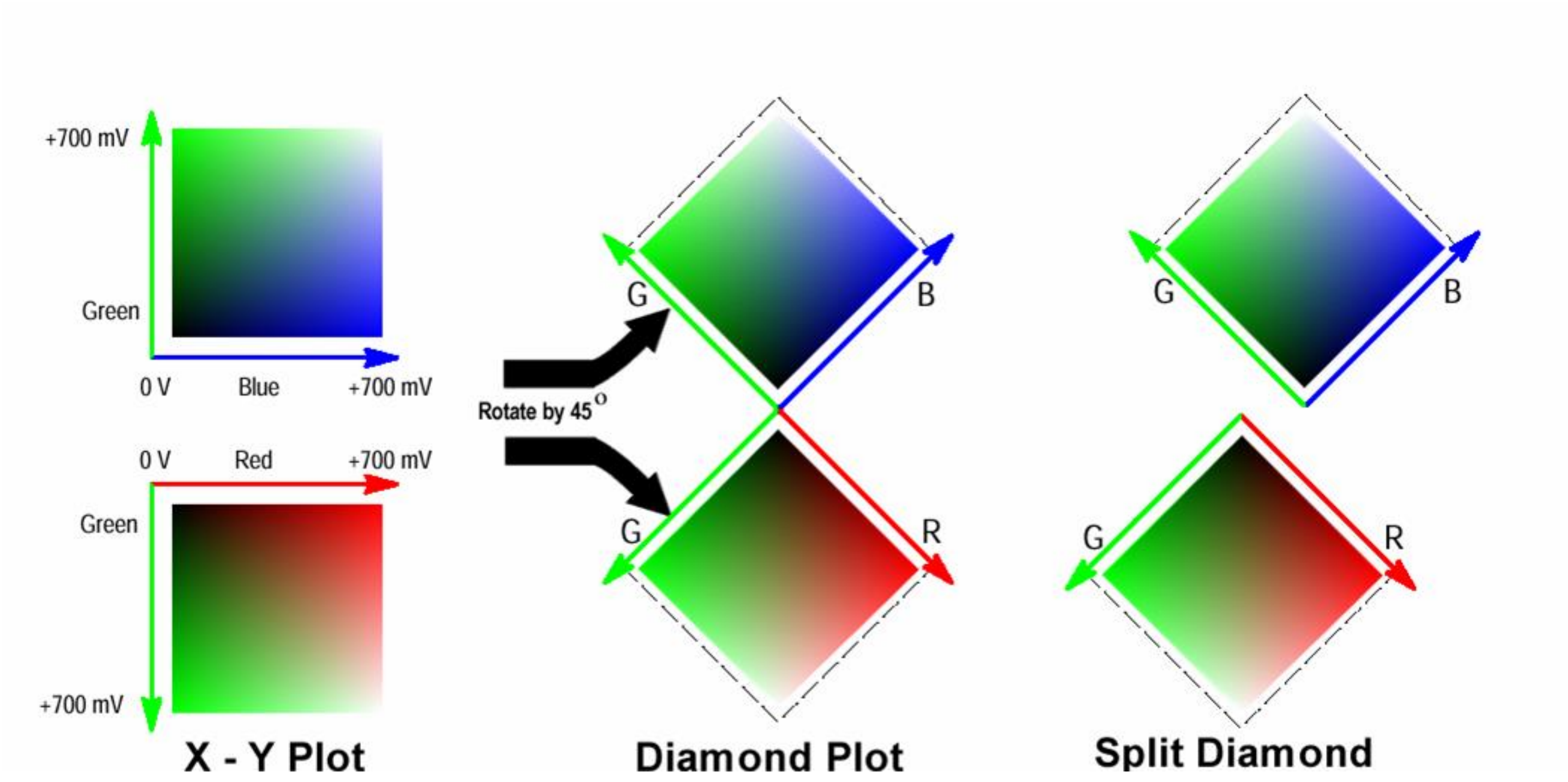


Gamut Limits

Configuration Menu
Selectable Gamut Thresholds

Diamond High	735 mV
Diamond Low	–35 mV
Diamond Area	1 %
Reset Diamond Defaults	Press SEL

How the *Diamond* Display is constructed



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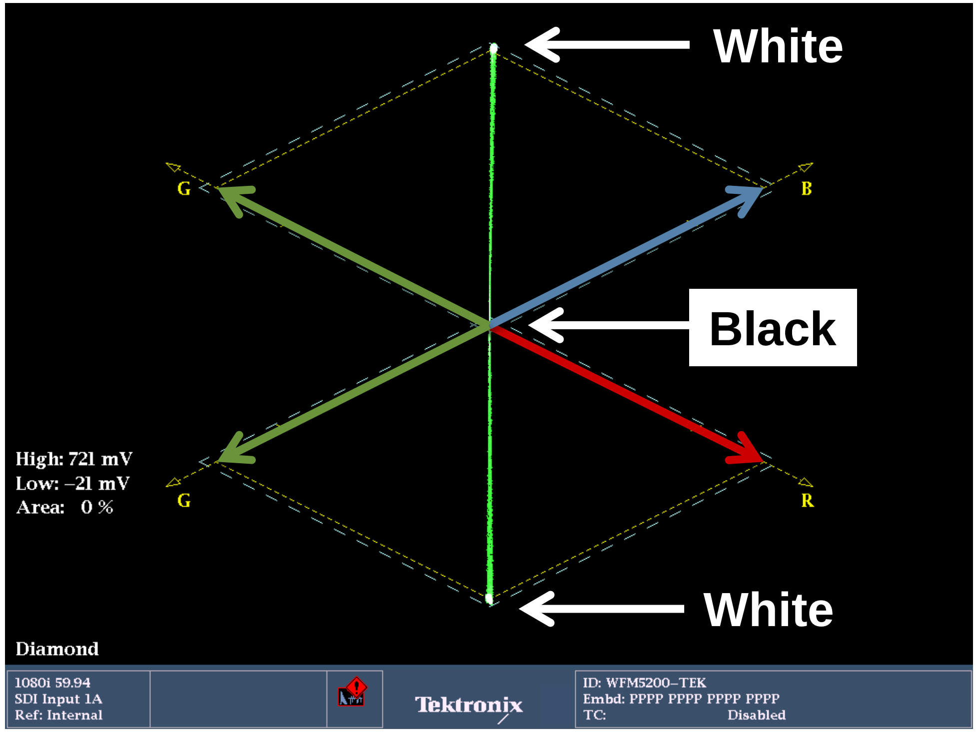
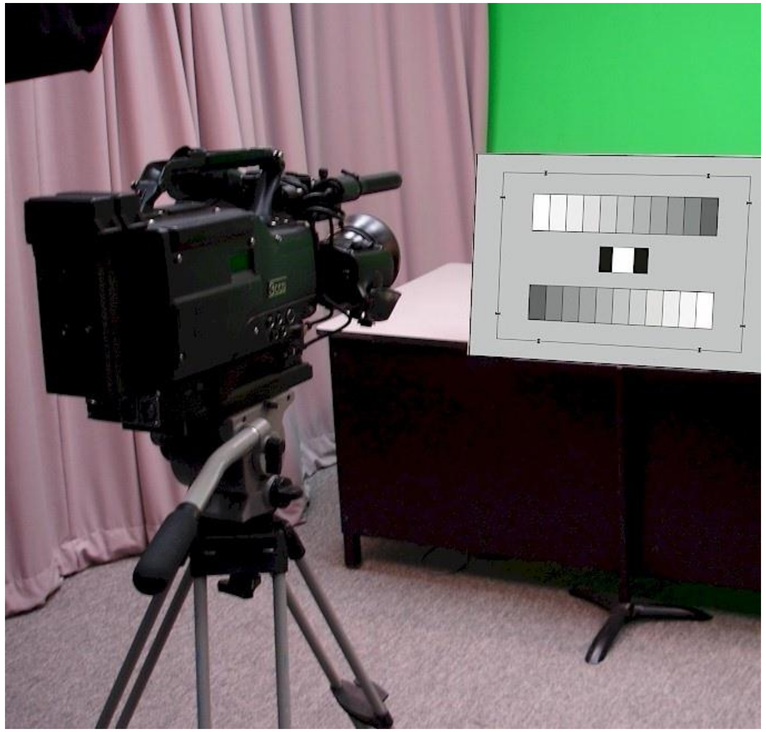
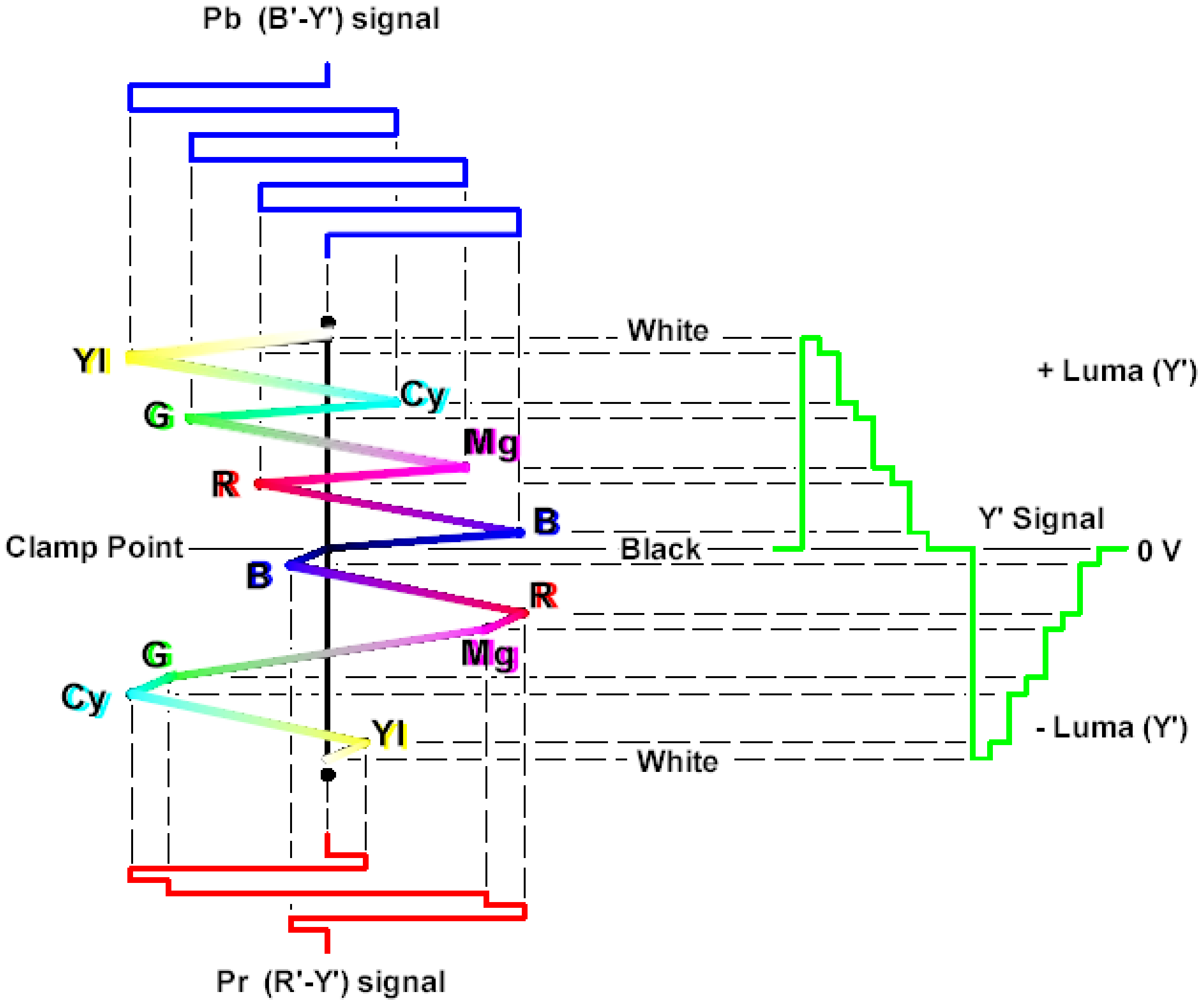
Diamond Display for Grayscale Luma signal



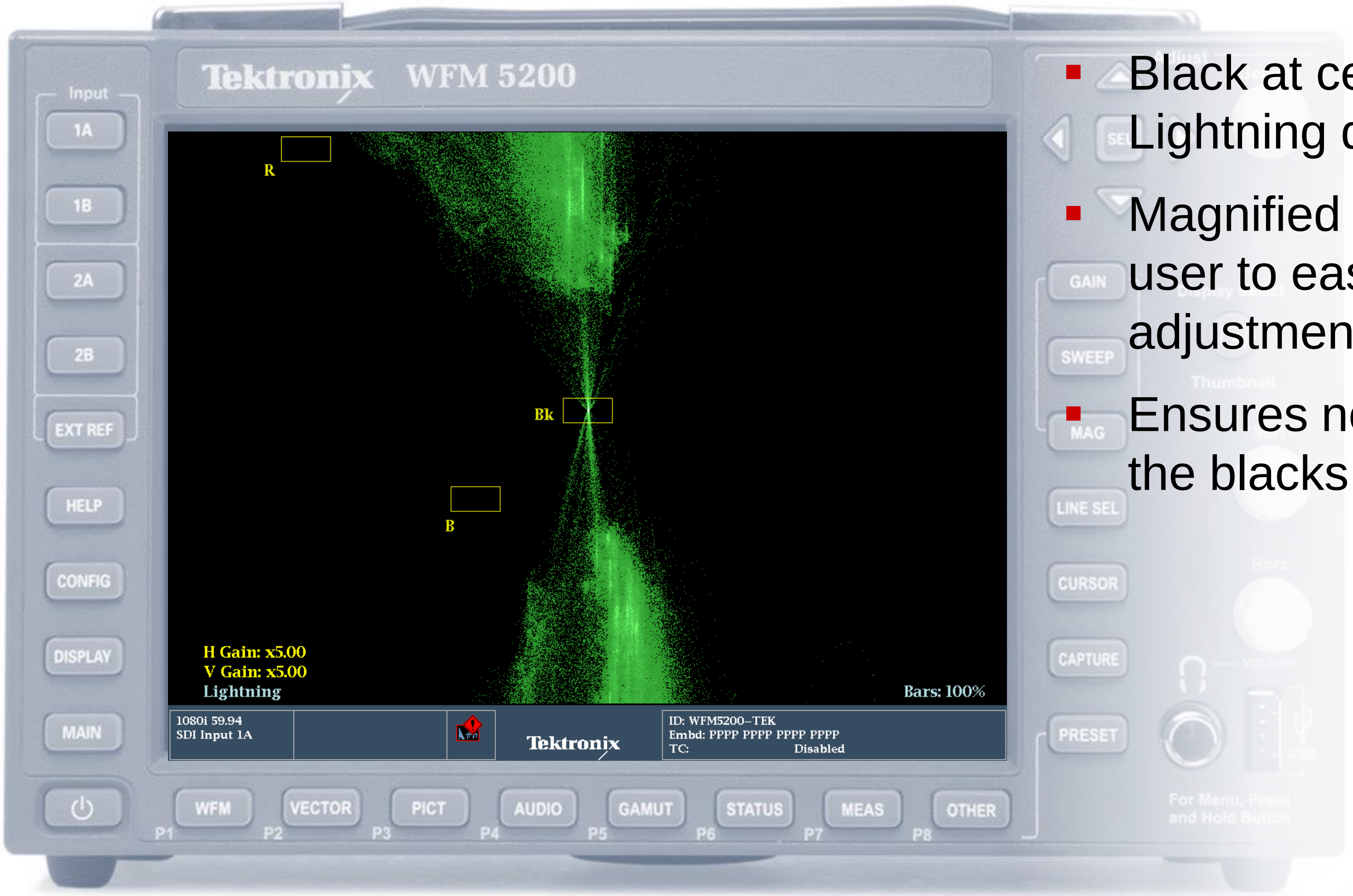


- Luma produces vertical straight line on Diamond Display
- Black at center of double Diamond
- White at Apex of double Diamond

Understanding Lightning display



Lightning display for Black Level Adjustment

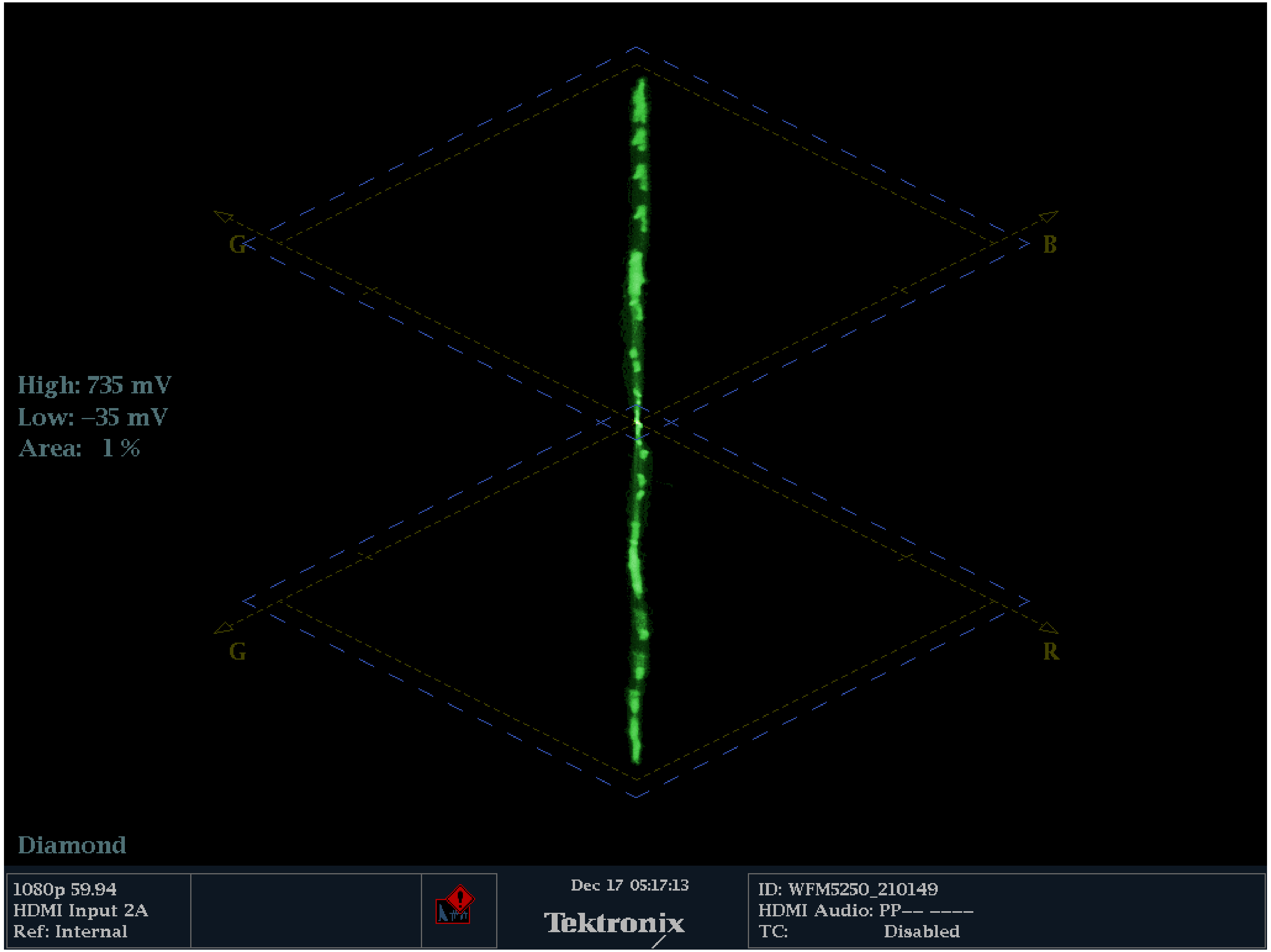


- Black at center of Lightning display
- Magnified view allows user to easily make black adjustments
- Ensures no color cast in the blacks of the signal

video

video

Diamond Display – Chip Chart



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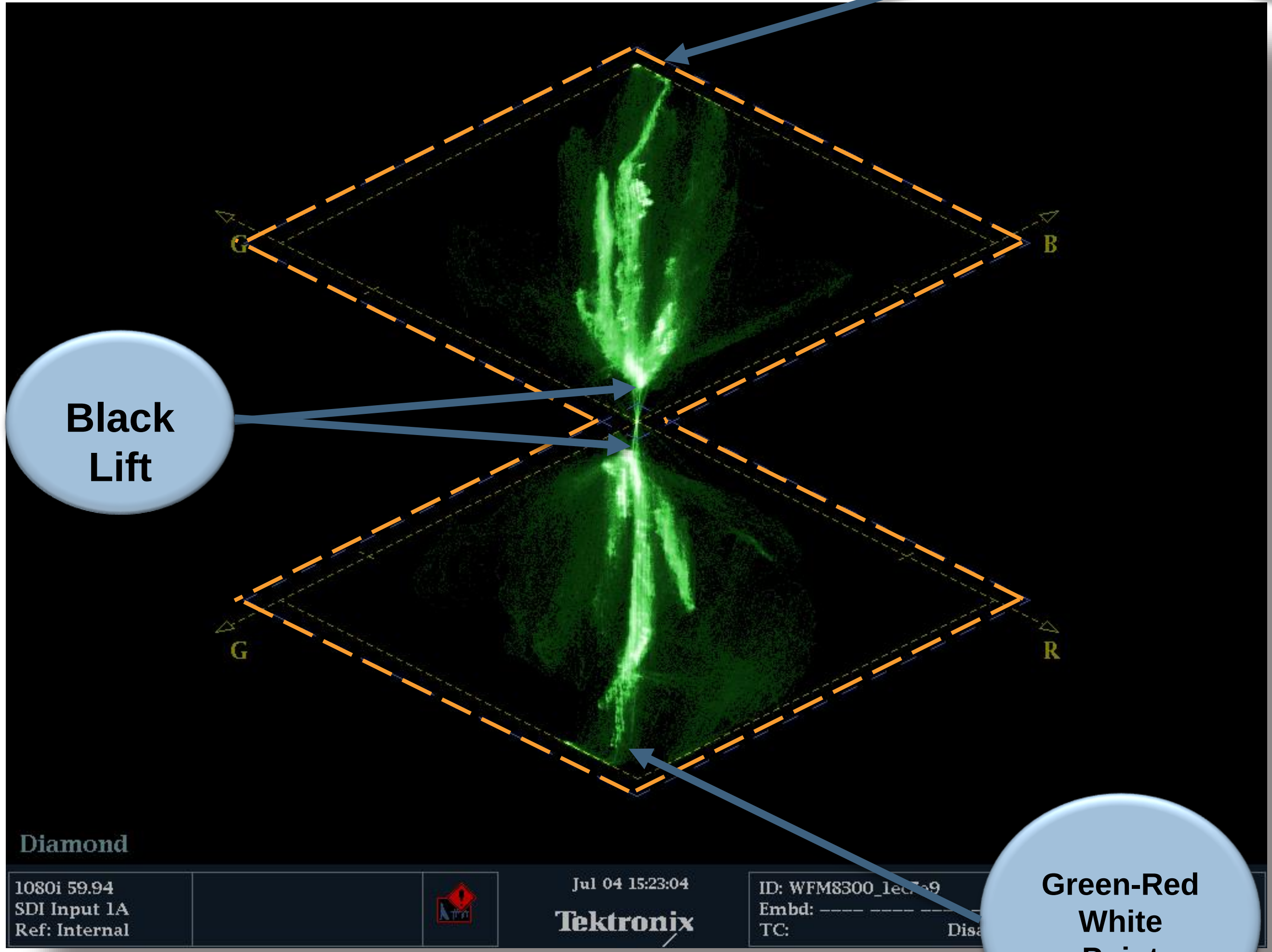
Lens Flare Adjustment

Flare

Lens flare is the light scattered in lens systems

Flare manifests itself as swift in black levels with a change light level.

Gamma monitoring — *Diamond* display



Blacks Lifted

Slightly Cool

Green-Blue White Points slightly Blue

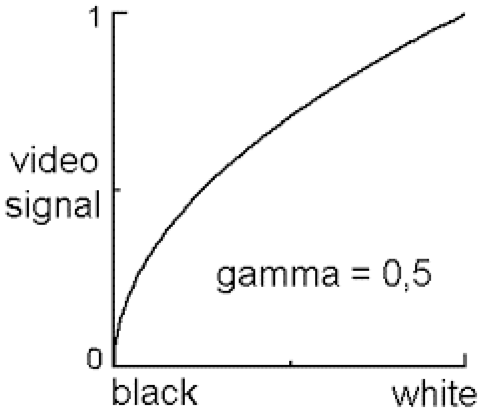
Green Red White Points slightly Green

Flare Adjustment

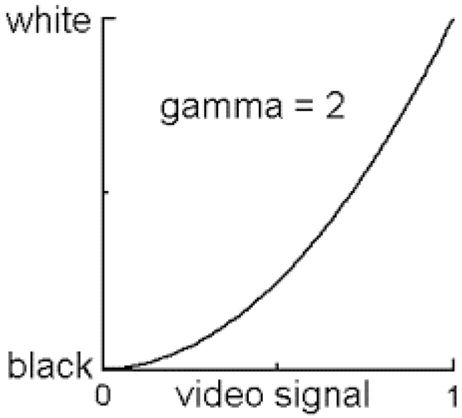
- Iris down the camera
- Set black level to 0mv
- Adjust Iris so white chip is 1 to 2 f-stop above 700mv
- Adjust the flares for black chip to 0mv

Setting Gamma

Gamma

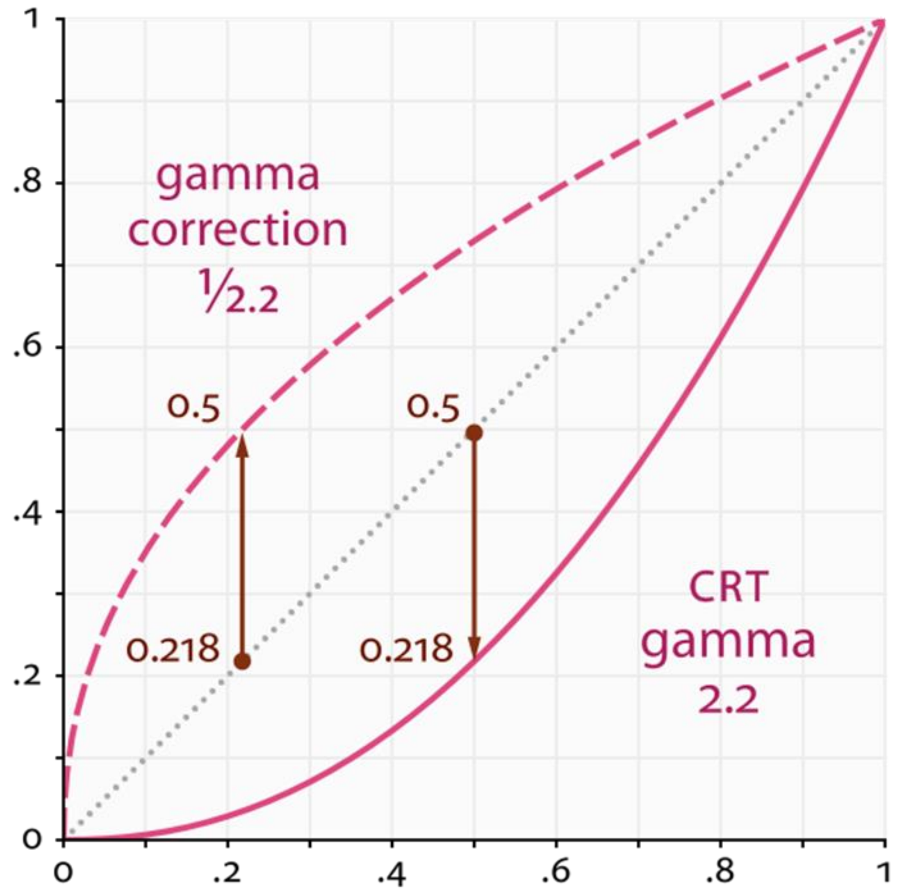


Camera Gamma



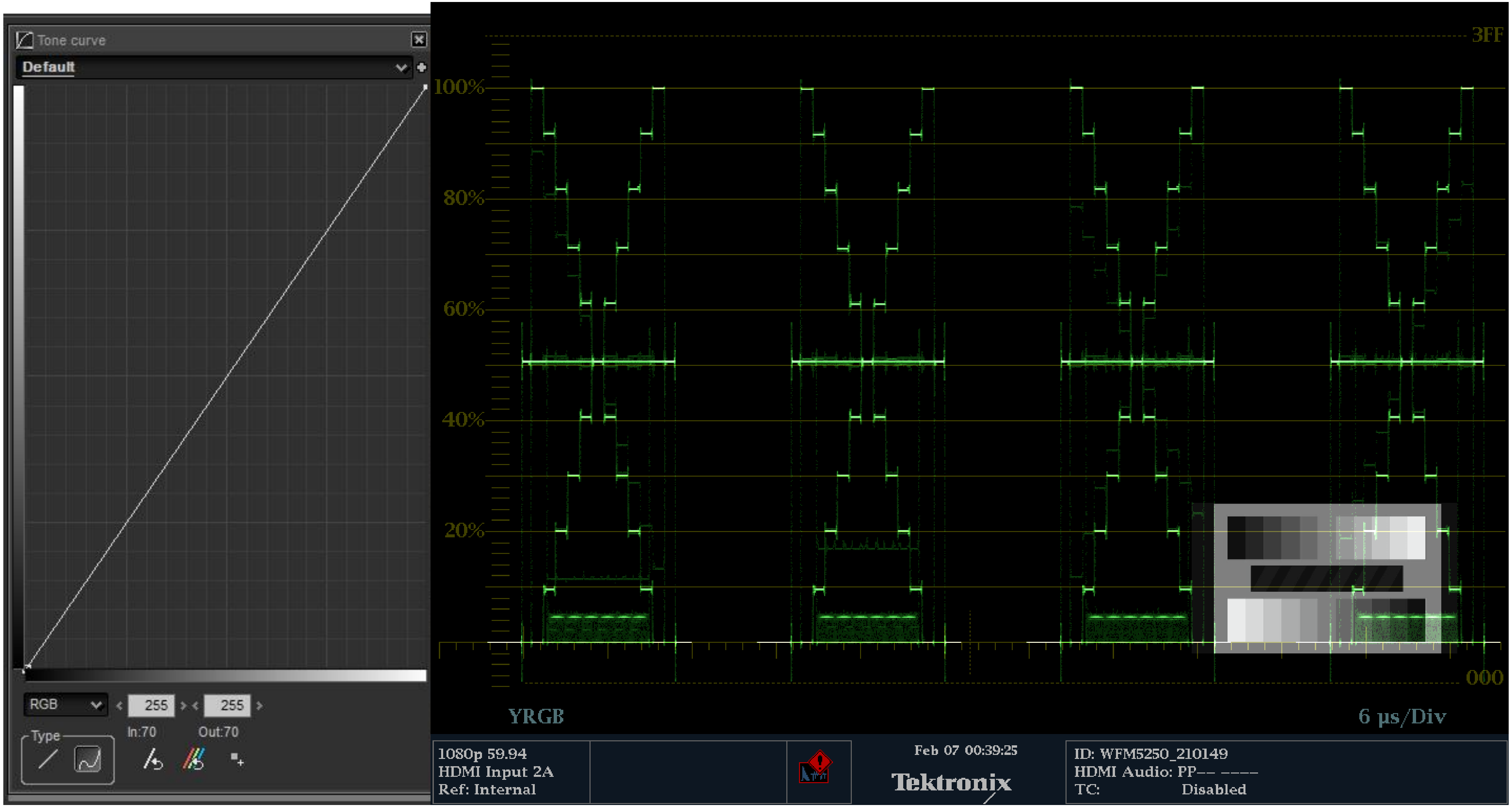
Monitor Gamma

Gamma Curve

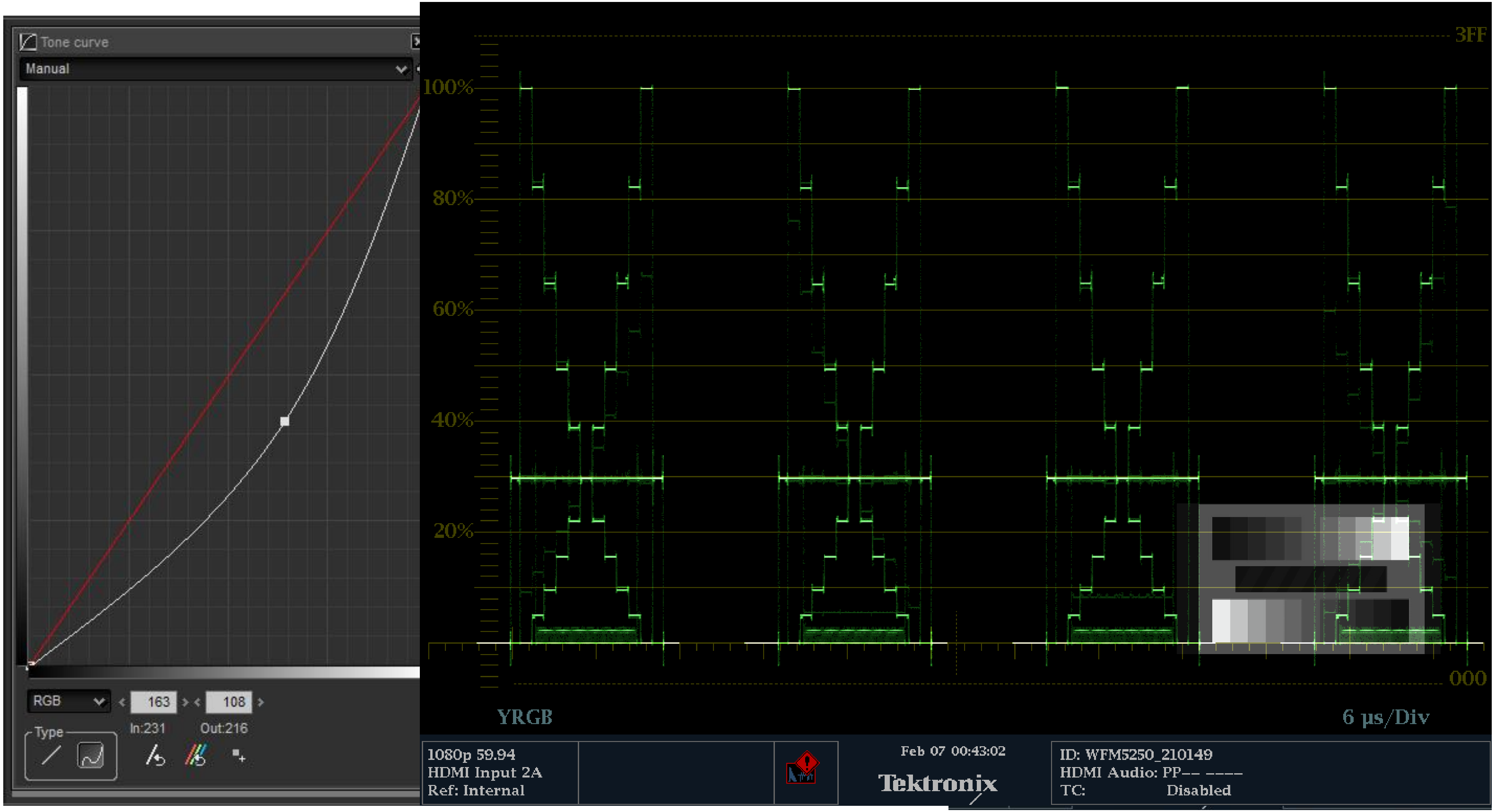


- Black gamma (aka black stretch) to change the lower end of your contrast curve.
- Adjust knee point and slope to change the upper end of your contrast curve.

Normal Gamma

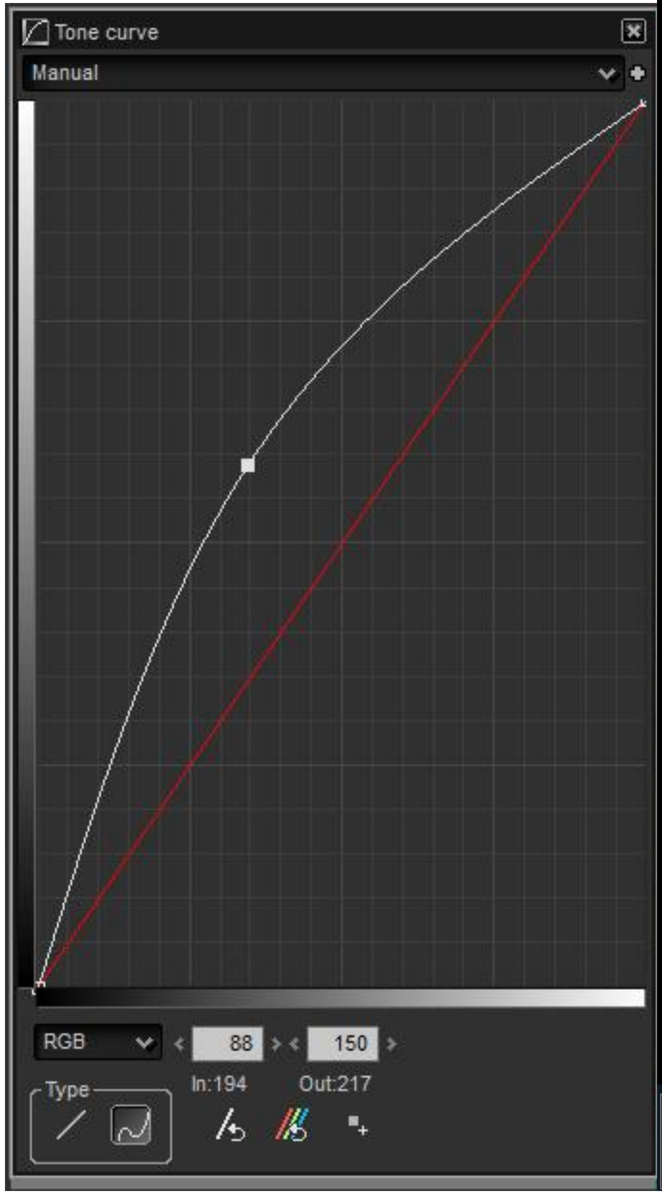


Low Gamma

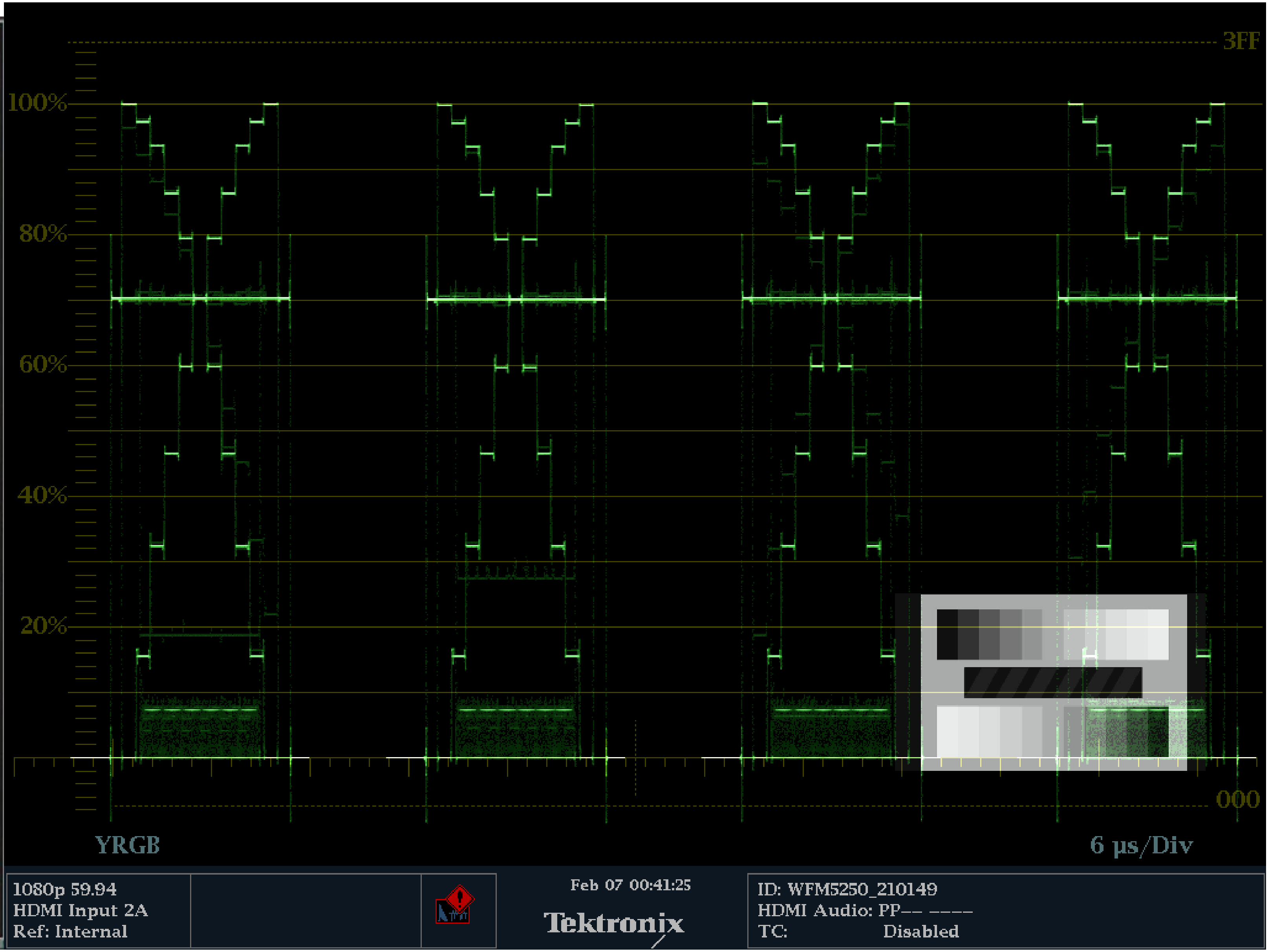


Tone curve
Manual
RGB
163
108
In:231
Out:216
Type
3FF
100%
80%
60%
40%
20%
000
YRGB
6 µs/Div
1080p 59.94
HDMI Input 2A
Ref: Internal
Feb 07 00:43:02
Tektronix
ID: WFM5250_210149
HDMI Audio: PP-- ----
TC: Disabled

High Gamma



Tone curve
Manual
RGB
88
150
Type
In:194
Out:217



3FF
100%
80%
60%
40%
20%
000
YRGB
6 µs/Div
1080p 59.94
HDMI Input 2A
Ref: Internal
Feb 07 00:41:25
Tektronix
ID: WFM5250_210149
HDMI Audio: PP-- ----
TC: Disabled

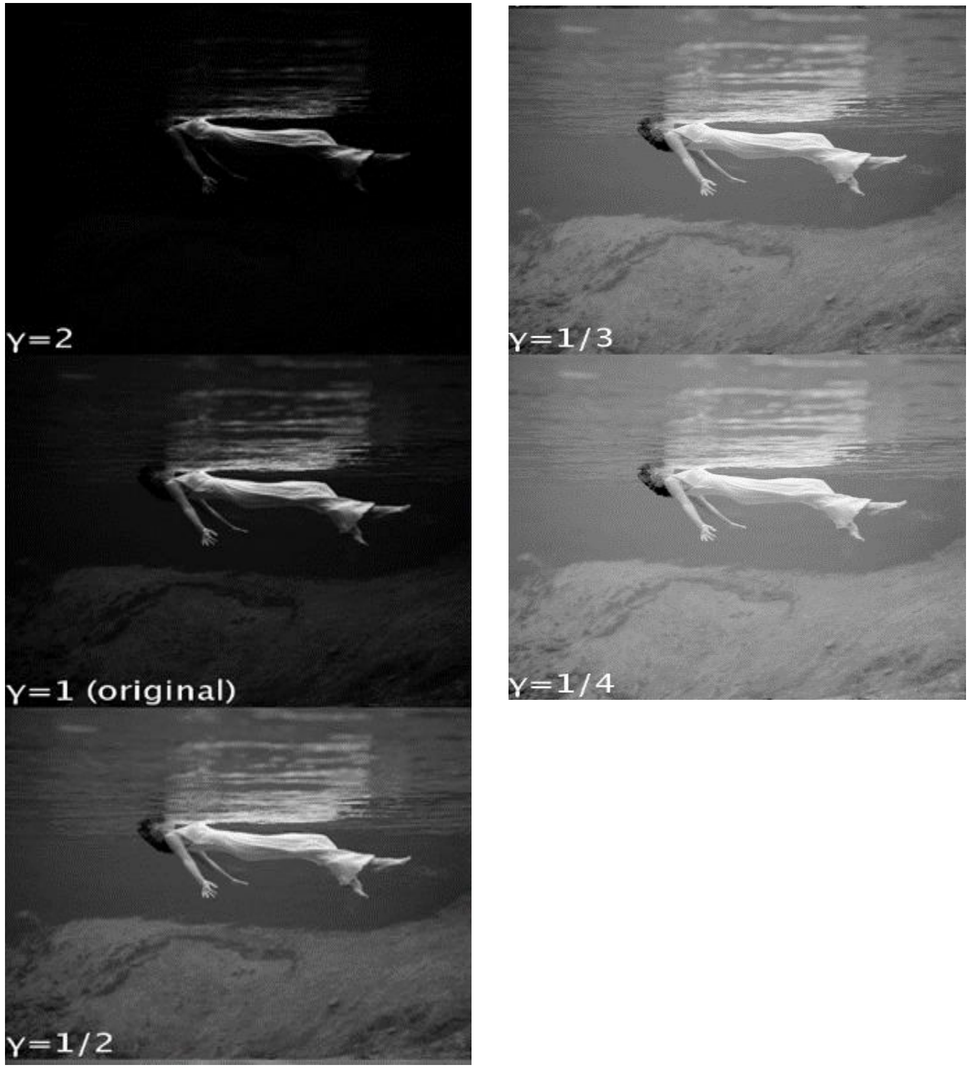
Gamma Curve

- Black gamma (aka black stretch) to change the lower end of your contrast curve.

- Adjust knee point and slope to change the upper end of your contrast curve.

- Some camera have Gamma preset
  – Some Cine gammas or Hyper gammas preset take whites up to 109%
  – 709 or broadcast safe whites no higher than 100%

Gamma Curve

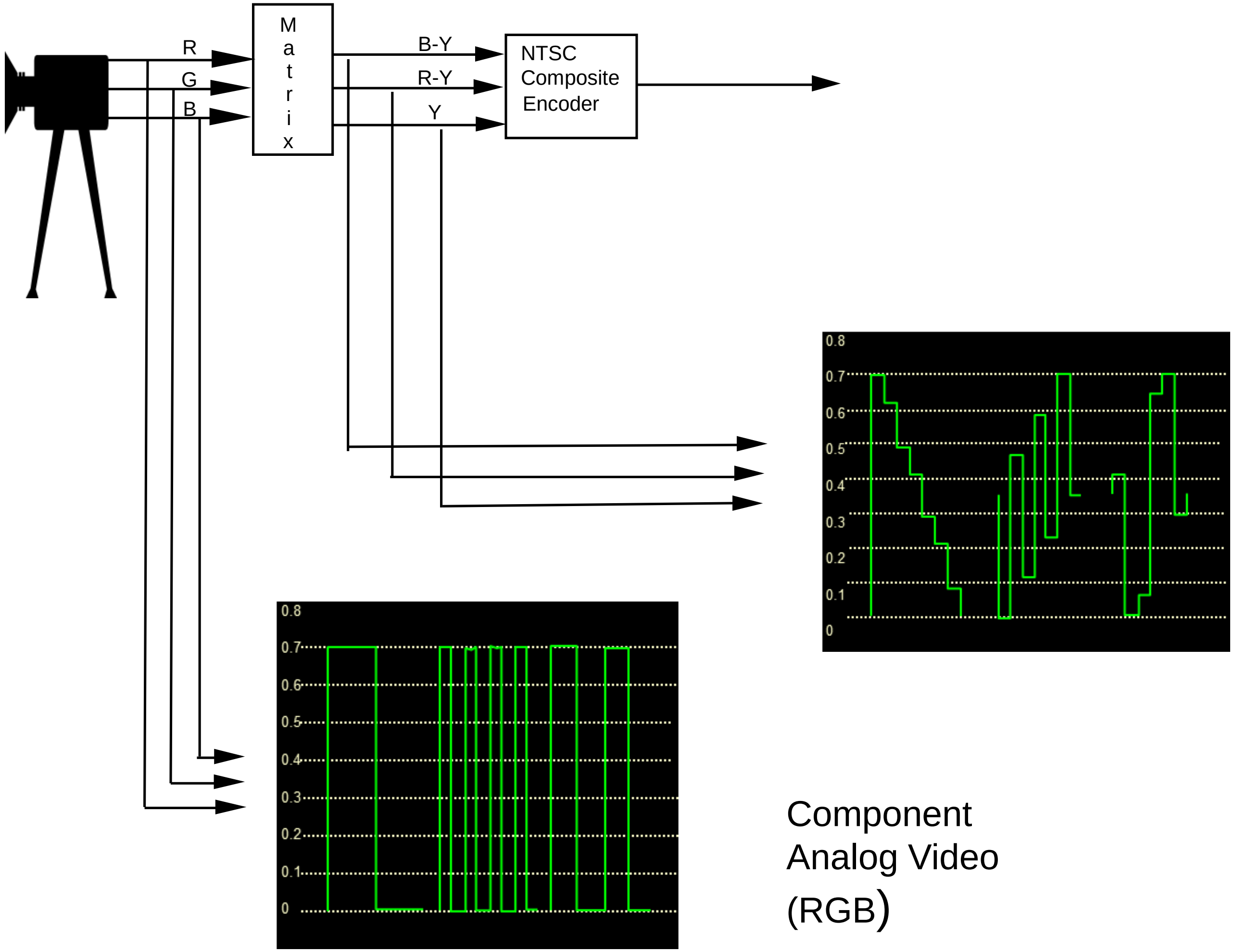


- Black gamma (aka black stretch) to change the lower end of your contrast curve.

- Adjust knee point and slope to change the upper end of your contrast curve.

The Matrix Adjustment

The Matrix

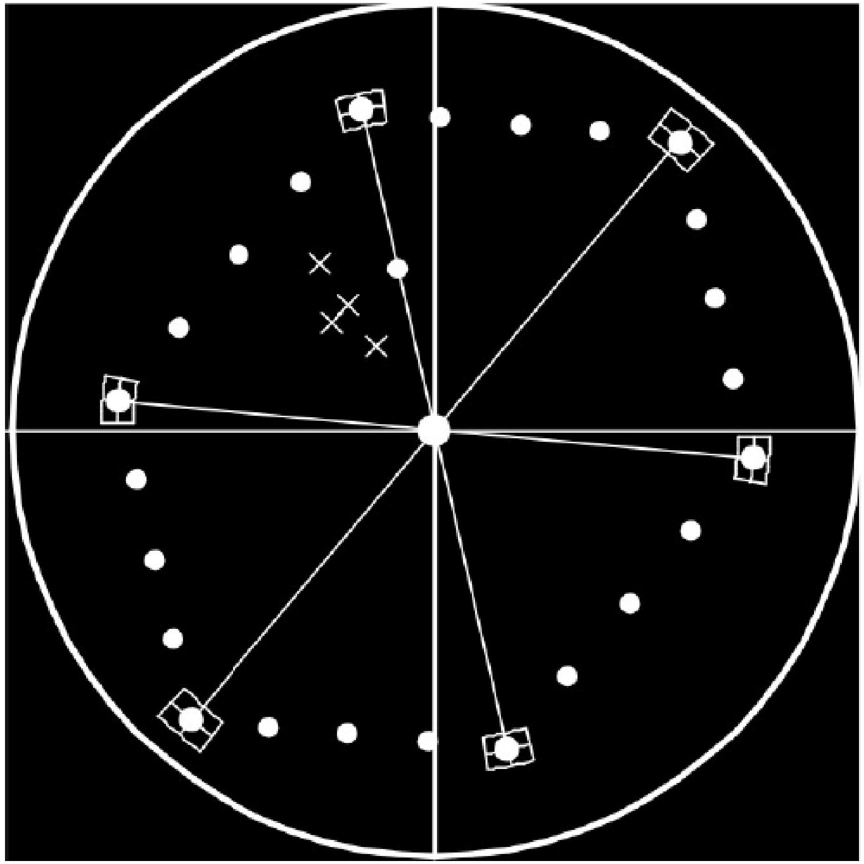


Color Difference
Component Analog Video
(Y, B-Y, R-Y)
4,2,2 sampling

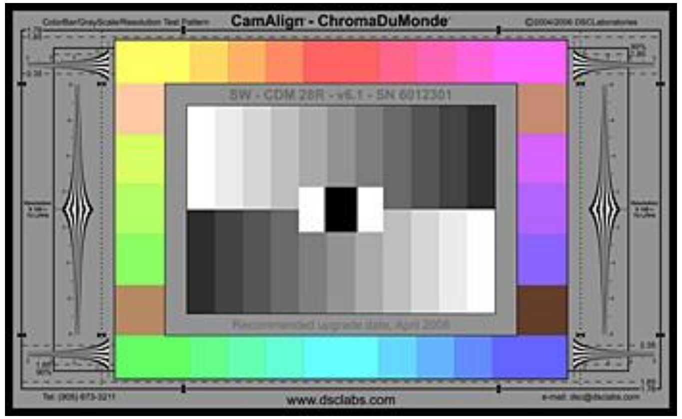
Y is Created from RGB
The Approx. mix is
60% is Green
30% is Red
10% is Blue

Component
Analog Video
(RGB)

Camera Test Chart



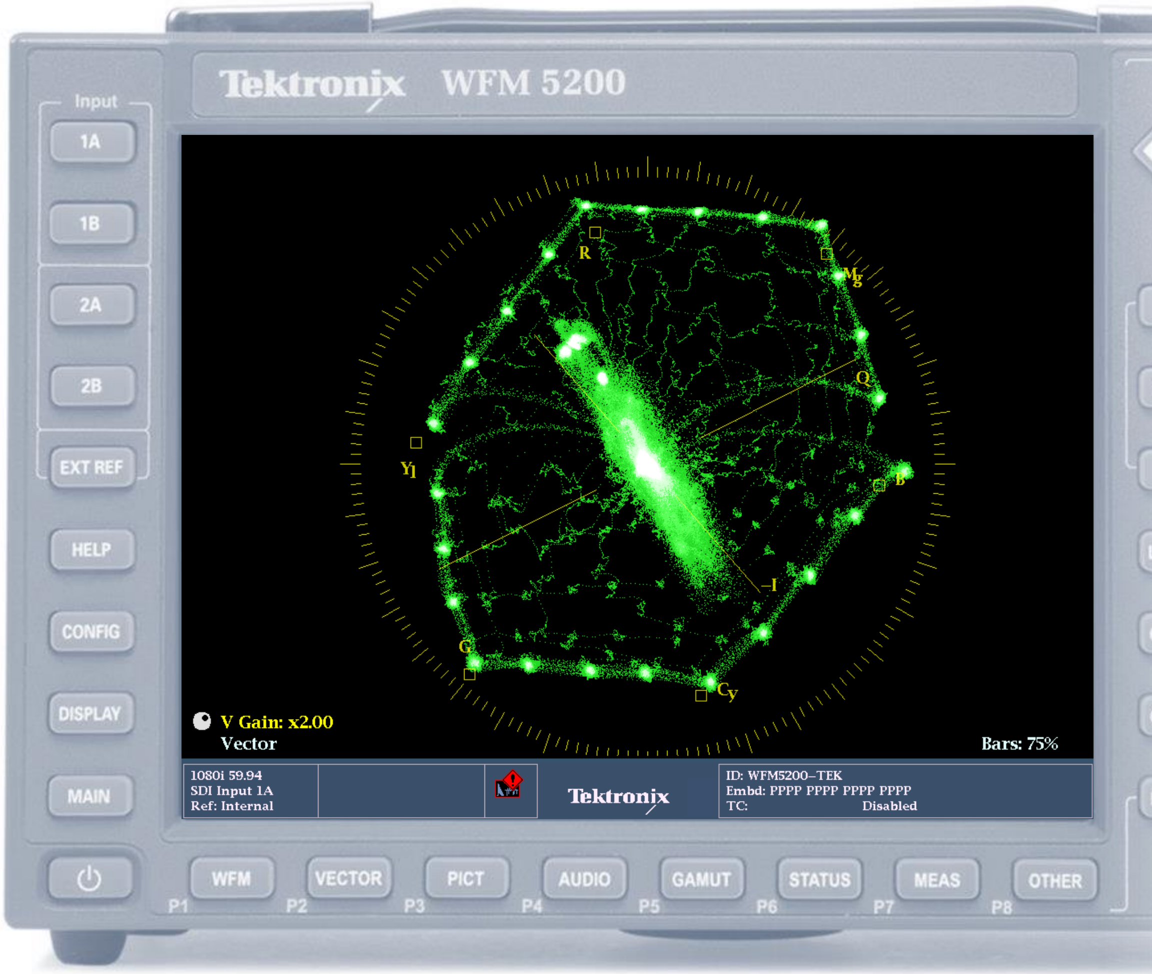
Ideal Vectorscope Display



www.dsclabs.com

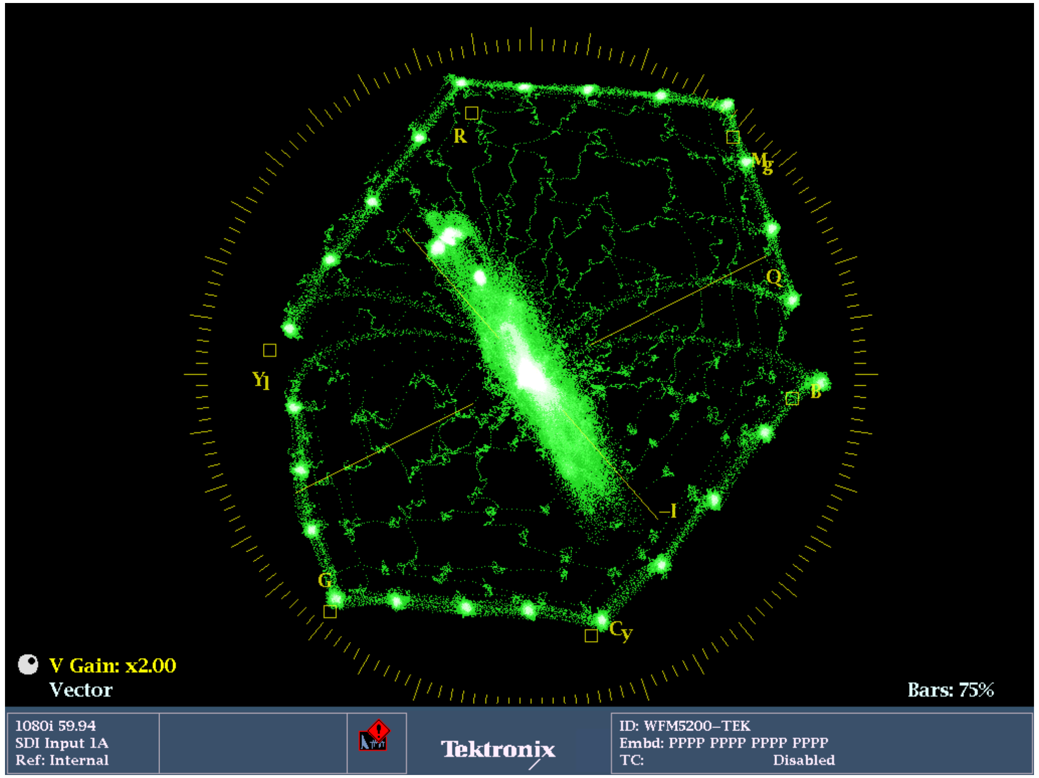
- DSC Labs Test Chart
- Test charts complement electronic pattern generators by including the camera’s “taking characteristics”
  – Lens and adapters
  – Filters
  – Characteristics of the CCD

Color adjustment using the Vectorscope



- Select Vector Display
- Configure 2.0X Var Gain
  - DSC Charts represent saturation level found in real life
- Original Camera Output
- Camera adjustment controls interact
  - May need to go back and forth to various controls
- Final Corrected Image

Color adjustment using the Vectorscope



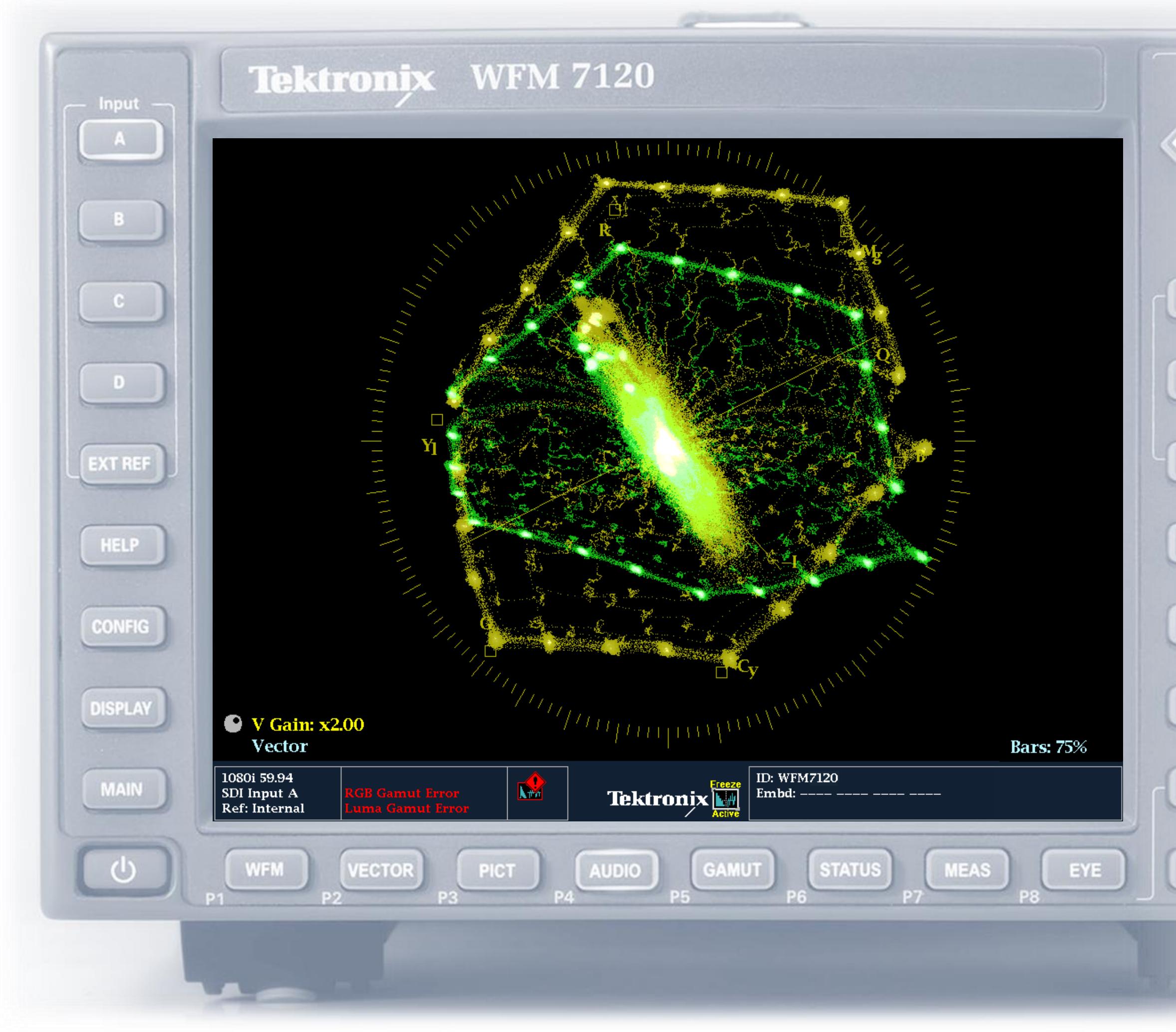
- Many cameras give you six matrix adjustment options: R-G, R-B, B-R, B-G, G-R and G-B
- The matrix adjustments allow us to adjust how red, green and blue images mix together.
- The R-G adjustment will change the Red saturation and but Green will change both in hue and in saturation.

Image matching with Capture

Freeze mode

- Freeze saves an image of the display.
- Allows comparison to other cameras or scenes
- To Enable Freeze press **Capture** button

CaptureVu™ on WFM



- CaptureVu saves a buffer capture of the SDI signal.
- Frame of data can be reconstituted to different displays
- Frame buffers can be saved to USB for later recall.

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