Extending Reality

what you should know about filming LED screens

CreatiF Center

Innovative Hochschule

EINE GEMEINSAME INITIATIVE VON

Bundesministerium für Bildung und Forschung

Gemeinsame Wissenschaftskonferenz GWK

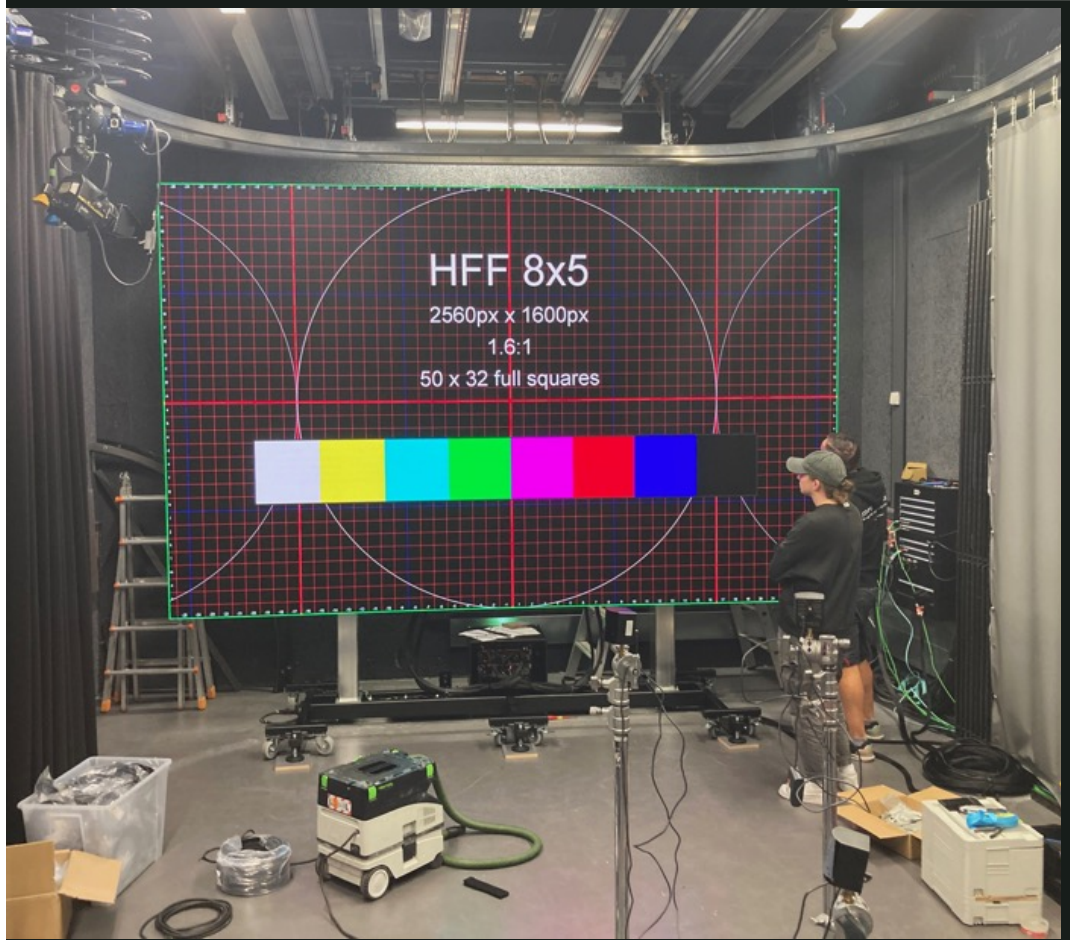
VIRTUAL PRODUCTION

In Camera Visual Effects

- Virtual backgrounds
- Real Time Rendering
- Camera Tracking
- LED Screens

Quelle: https://www.unrealengine.com/de/explainers/virtual-production/what-is-virtual-production

MOTIVATION



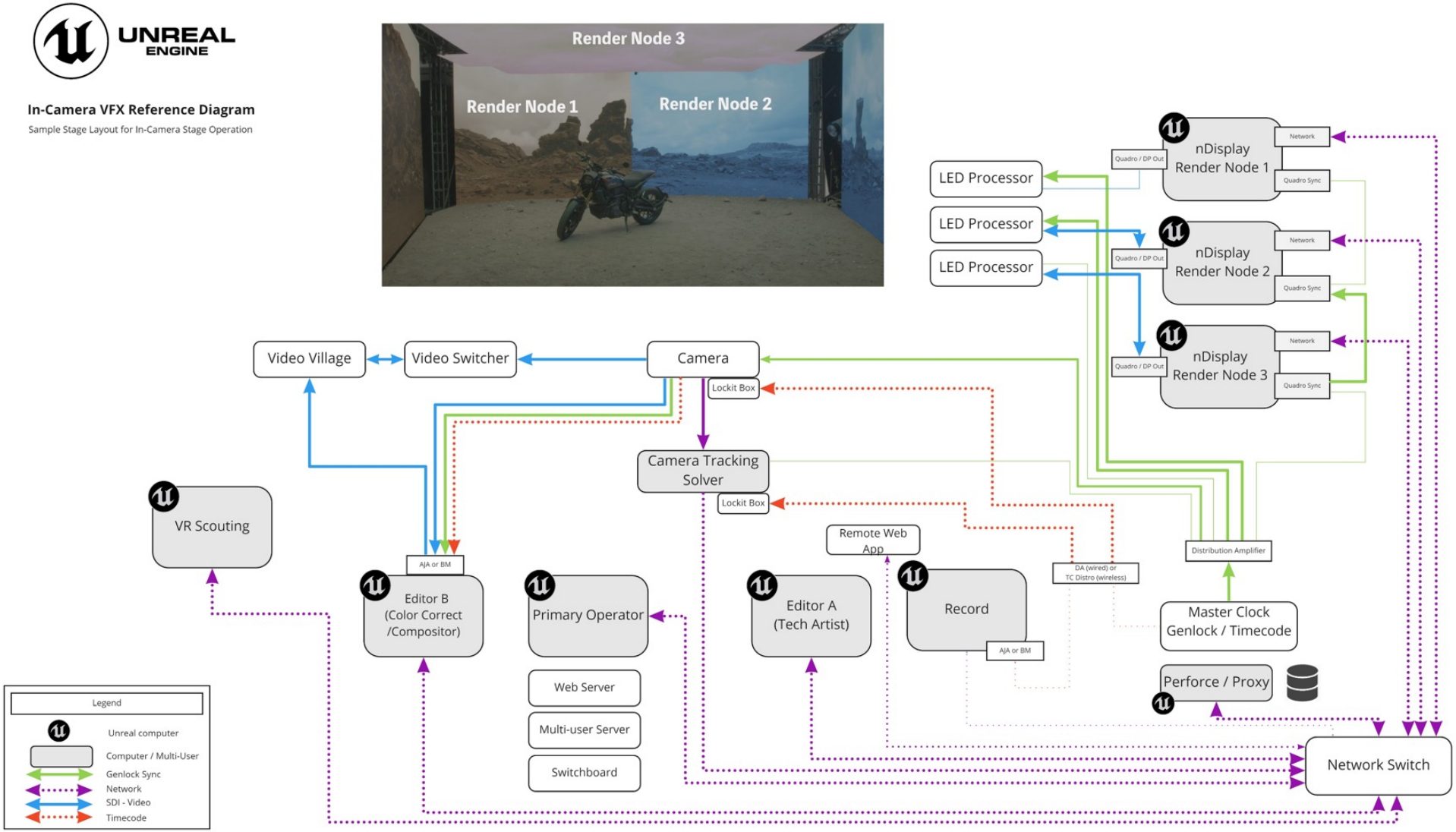
Lessons learned

- Asking “the right questions” when planning an ICVFX Virtual Production System
- BS detector

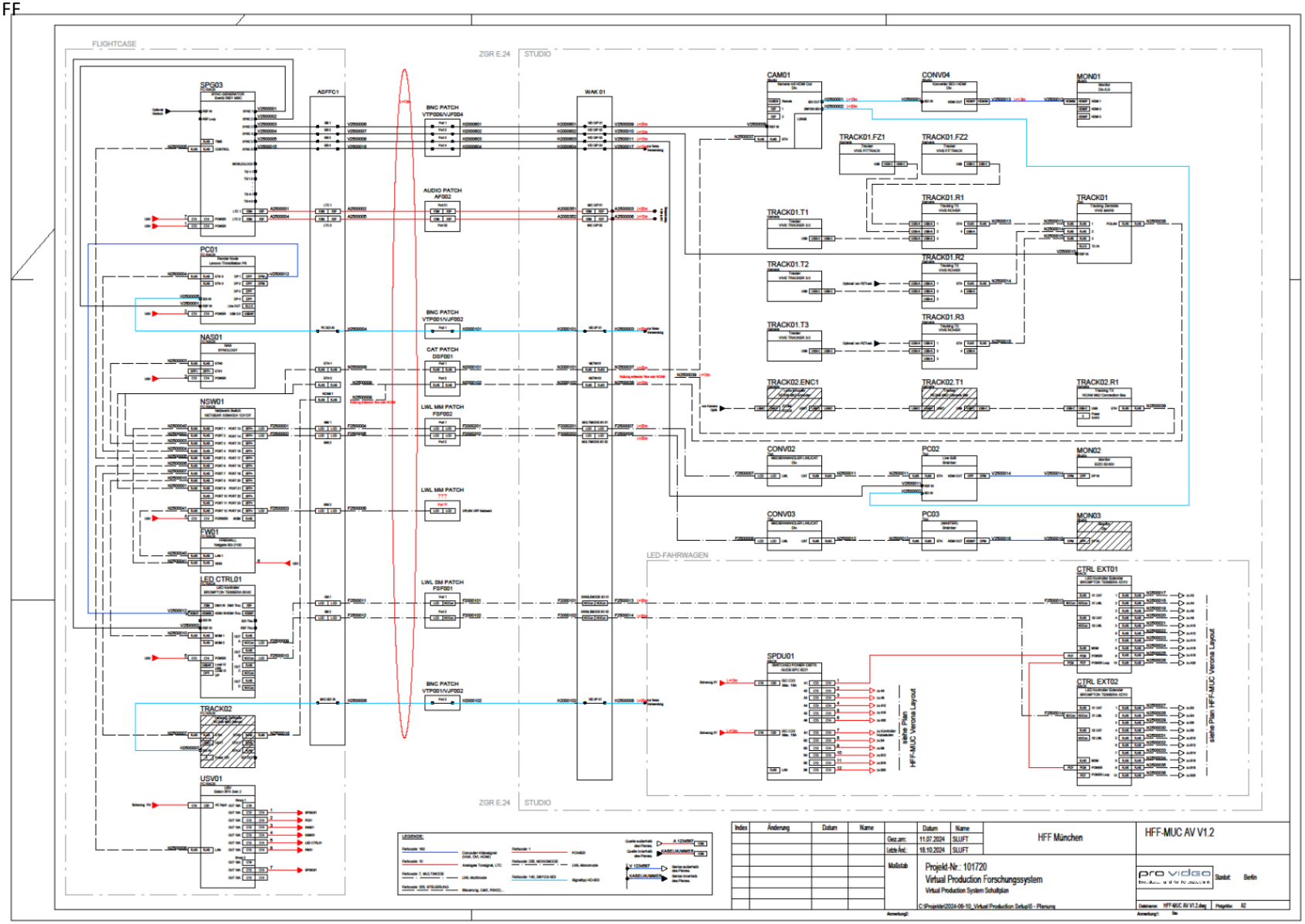
LED-VP components

- LED wall and processor
- Game Engine
  - Brainbar
  - Render Node(s)
- Camera
- Camera tracking
- Sync generator
- Network technology

6reatiF-Center @HFF



https://docs.unrealengine.com/4.26/en-US/WorkingWithMedia/InCameraVFX/InCameraVFXRecommendedHardware/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ABFFC1
BNC PATCH
VTP005VJP004
AUDIO PATCH
AF002
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VTP001VJP002
CAT PATCH
DSP001
LWL MM PATCH
FSF002
LWL MM PATCH
???
LWL SM PATCH
FSF001
BNC PATCH
VTP001VJP002
WAK01
CAM01
CONV04
MON01
TRACK01.FZ1
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TRACK01.T1
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Virtual Production System Schaltplan
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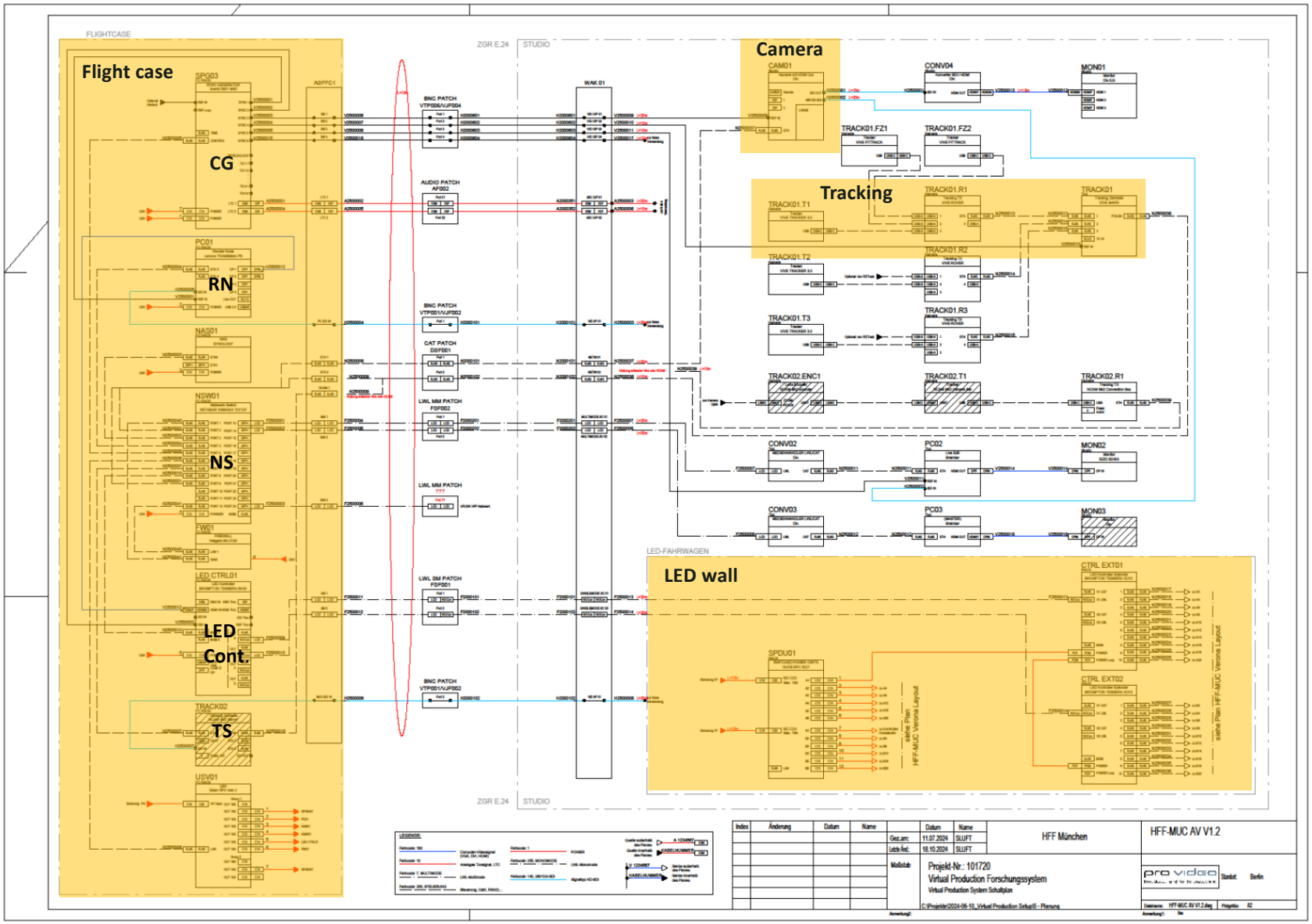
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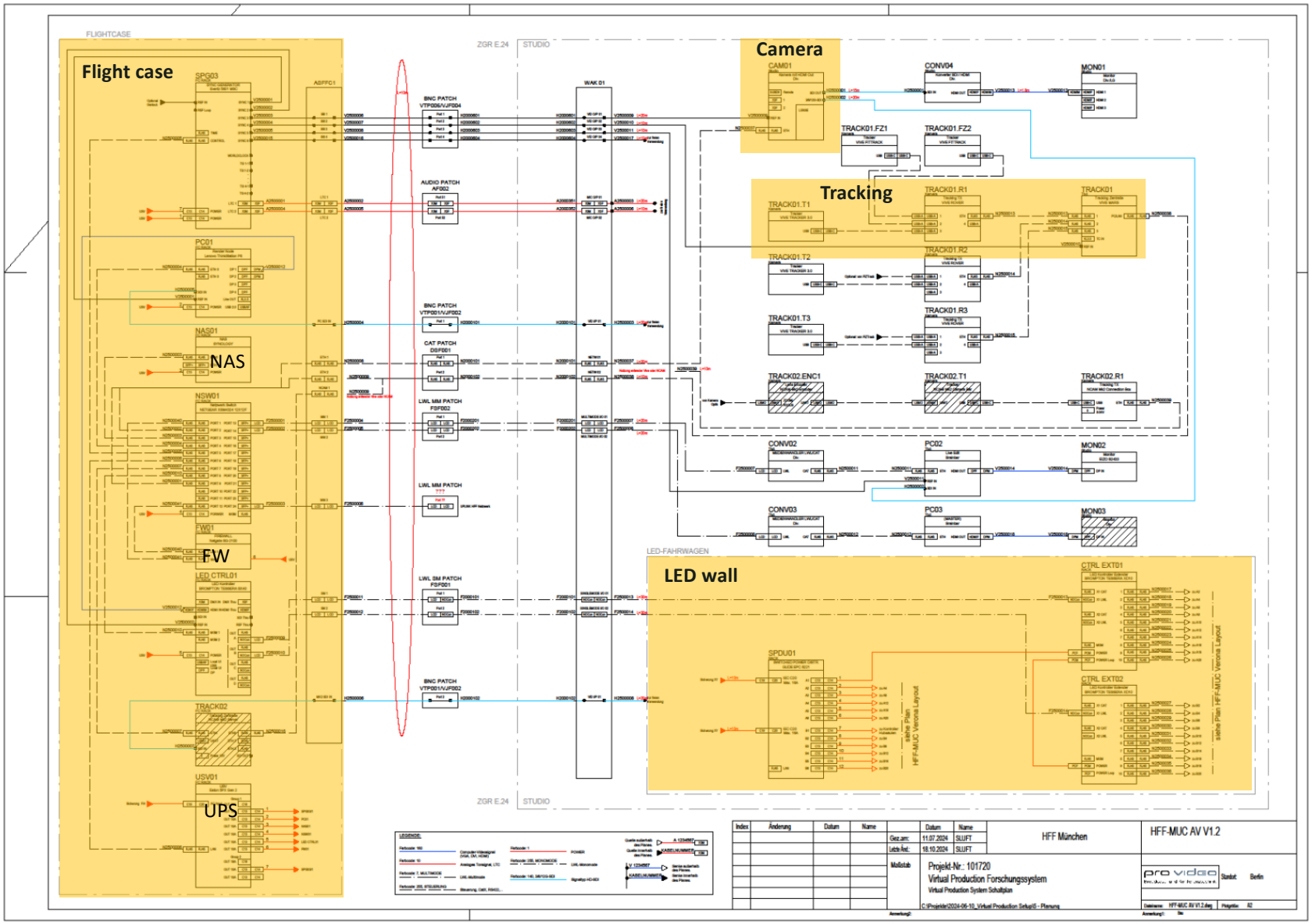
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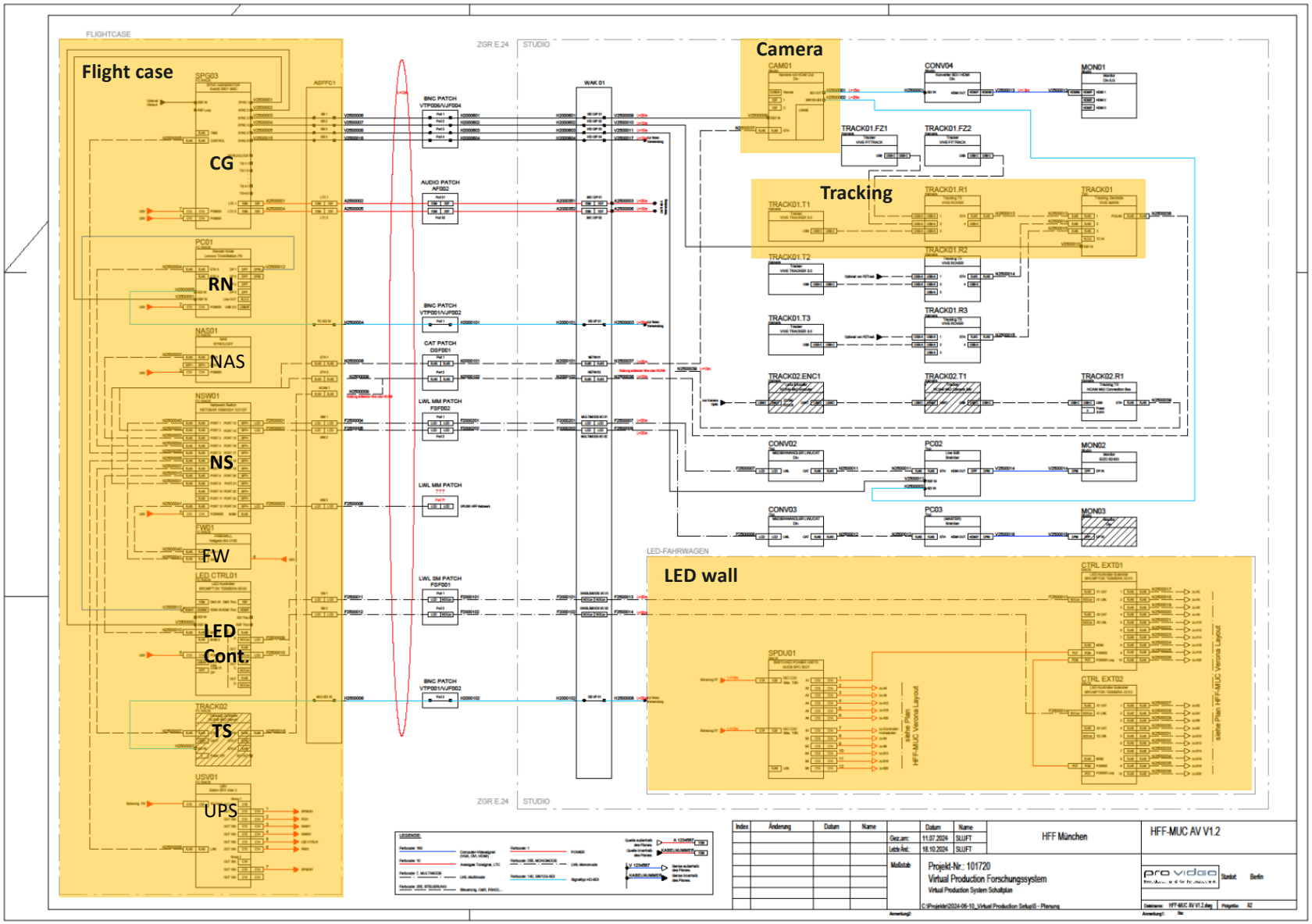
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VP OVERALL SYSTEM

- Latency
- Color depth
- Linearity
- Genlock / Sync
- Stability

ICVFX MINDSET

In Camera Compositing

- The virtual background displayed on the LED wall is a data stream which the camera must capture with as little loss in quality as possible.
- The LED wall does not display an image, but a data stream that is to be transmitted as effectively as possible.

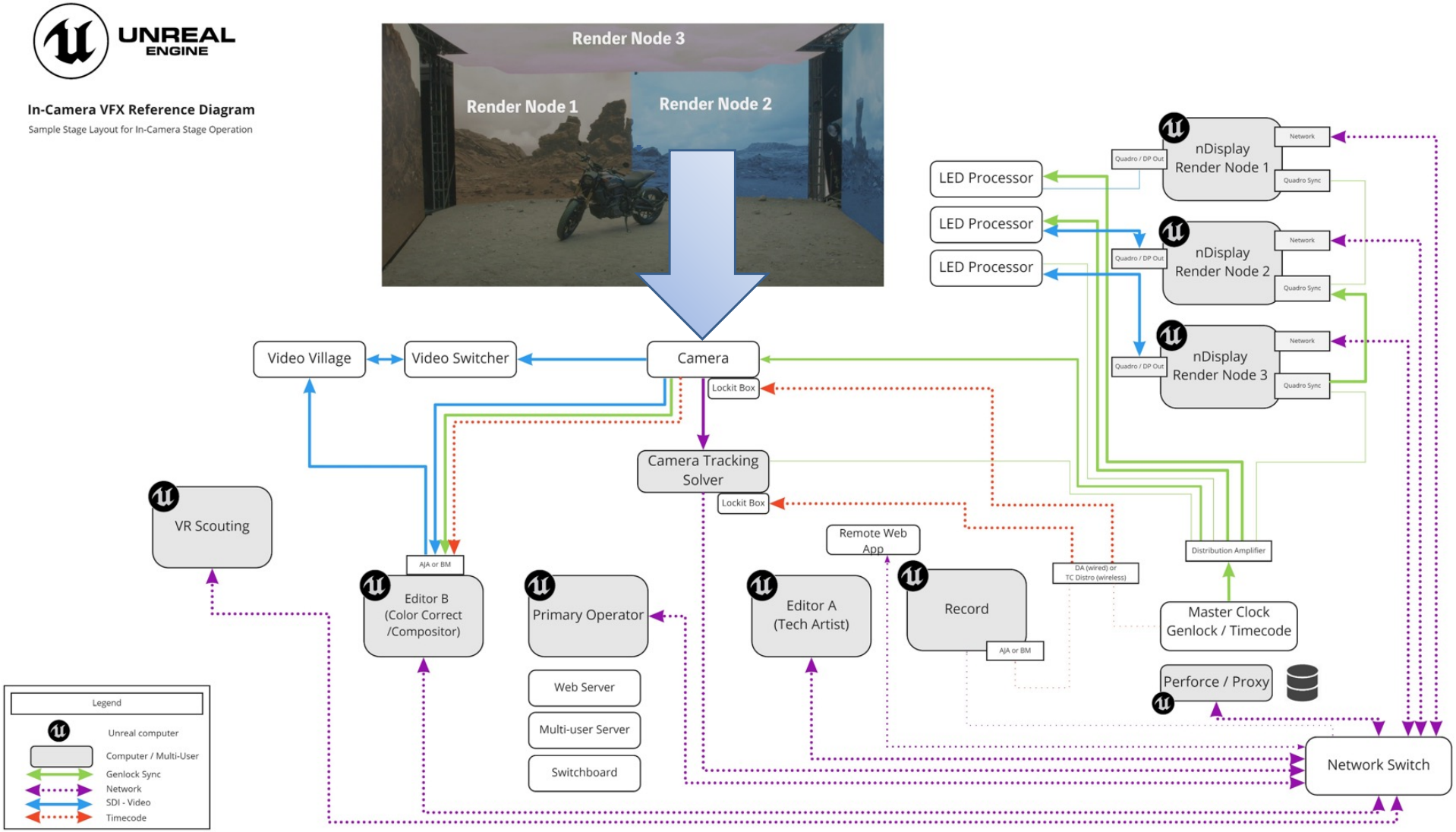

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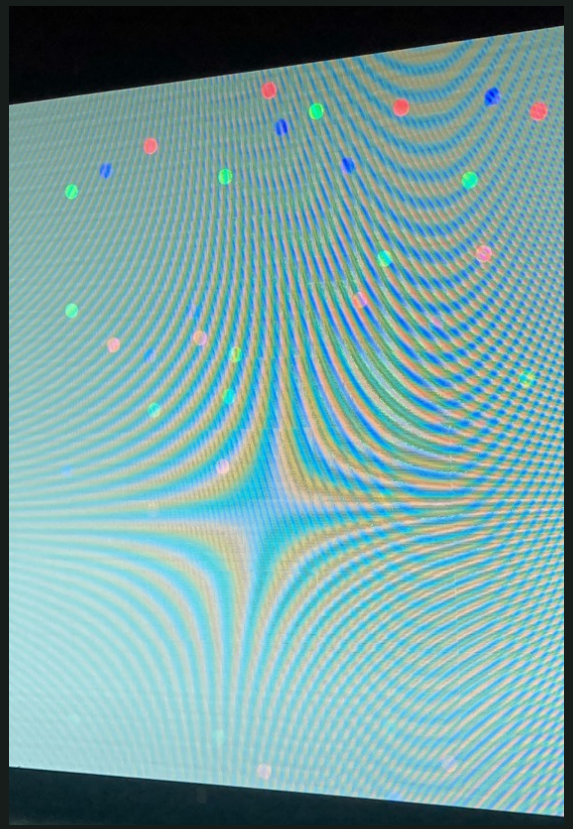
IMAGE TRANSMISSION

- Moire
- Nonlinearity
  - Banding
  - Color and contrast distortions
- Temporal artifacts
- Reflections / light spill
- …

IMAGE TRANSMISSION

Moire



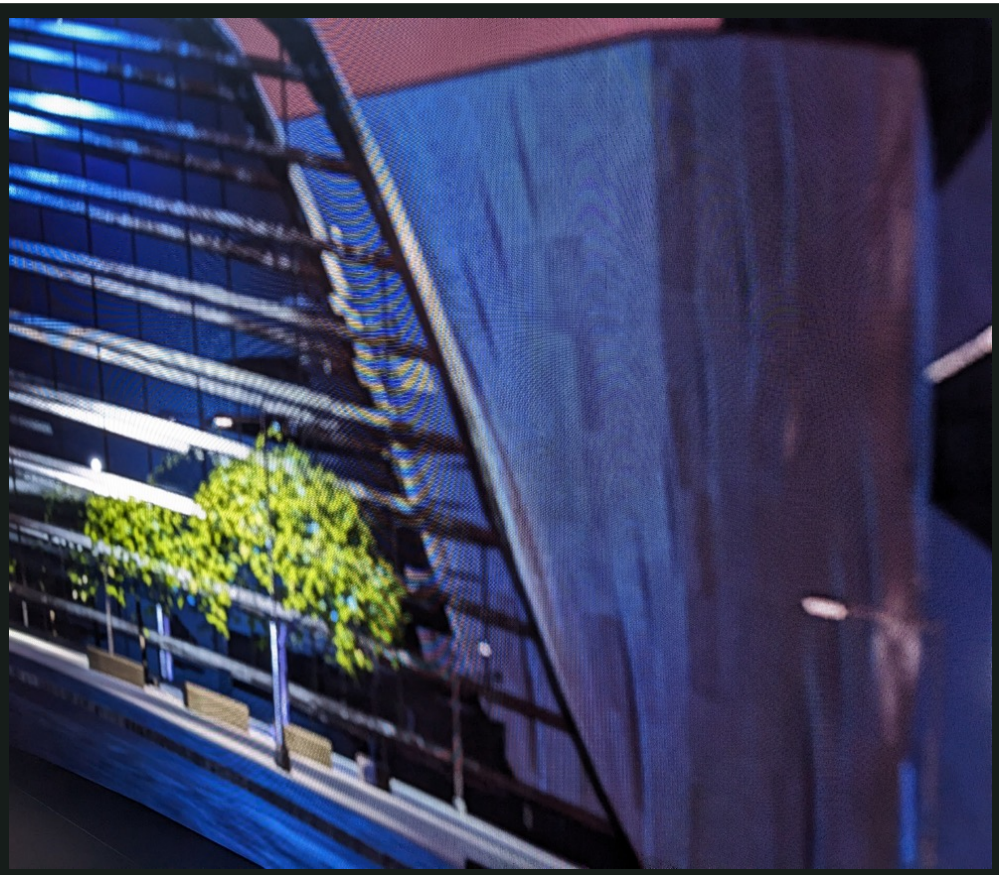


IMAGE TRANSMISSION

Banding

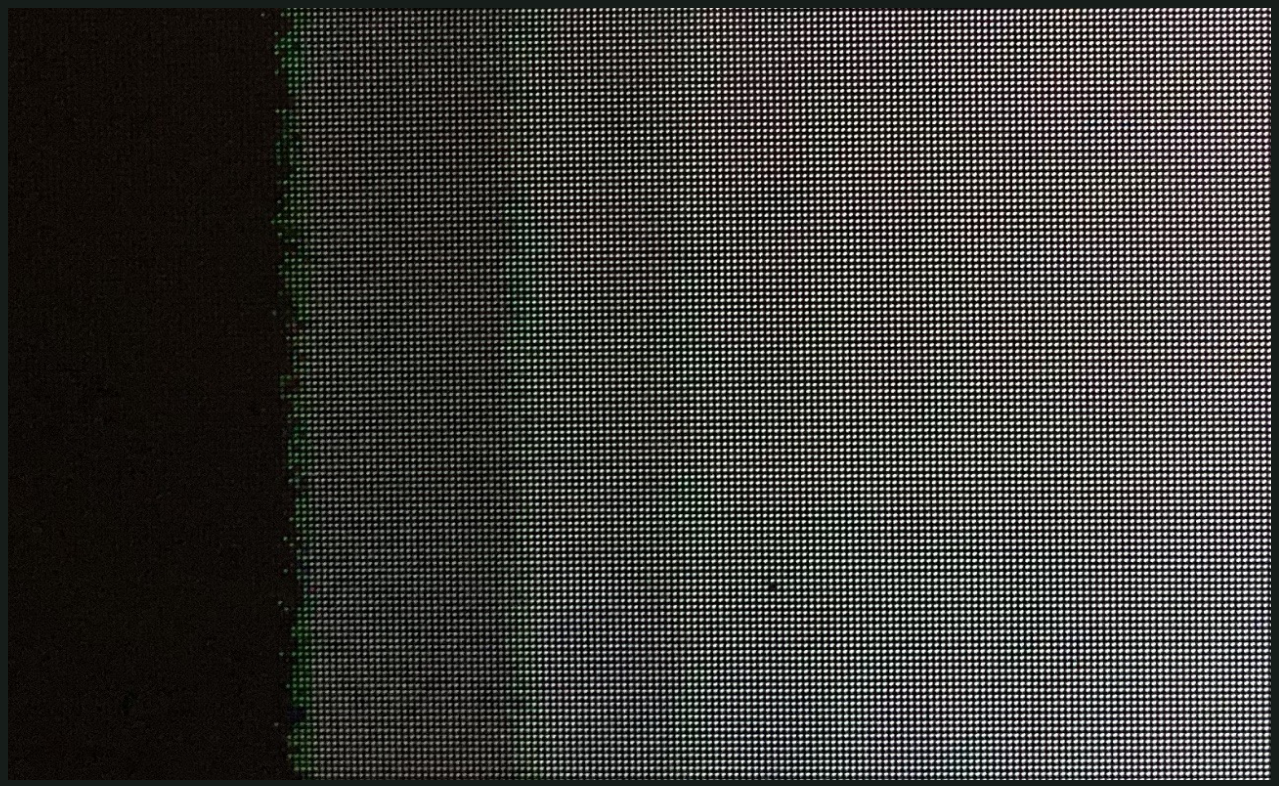
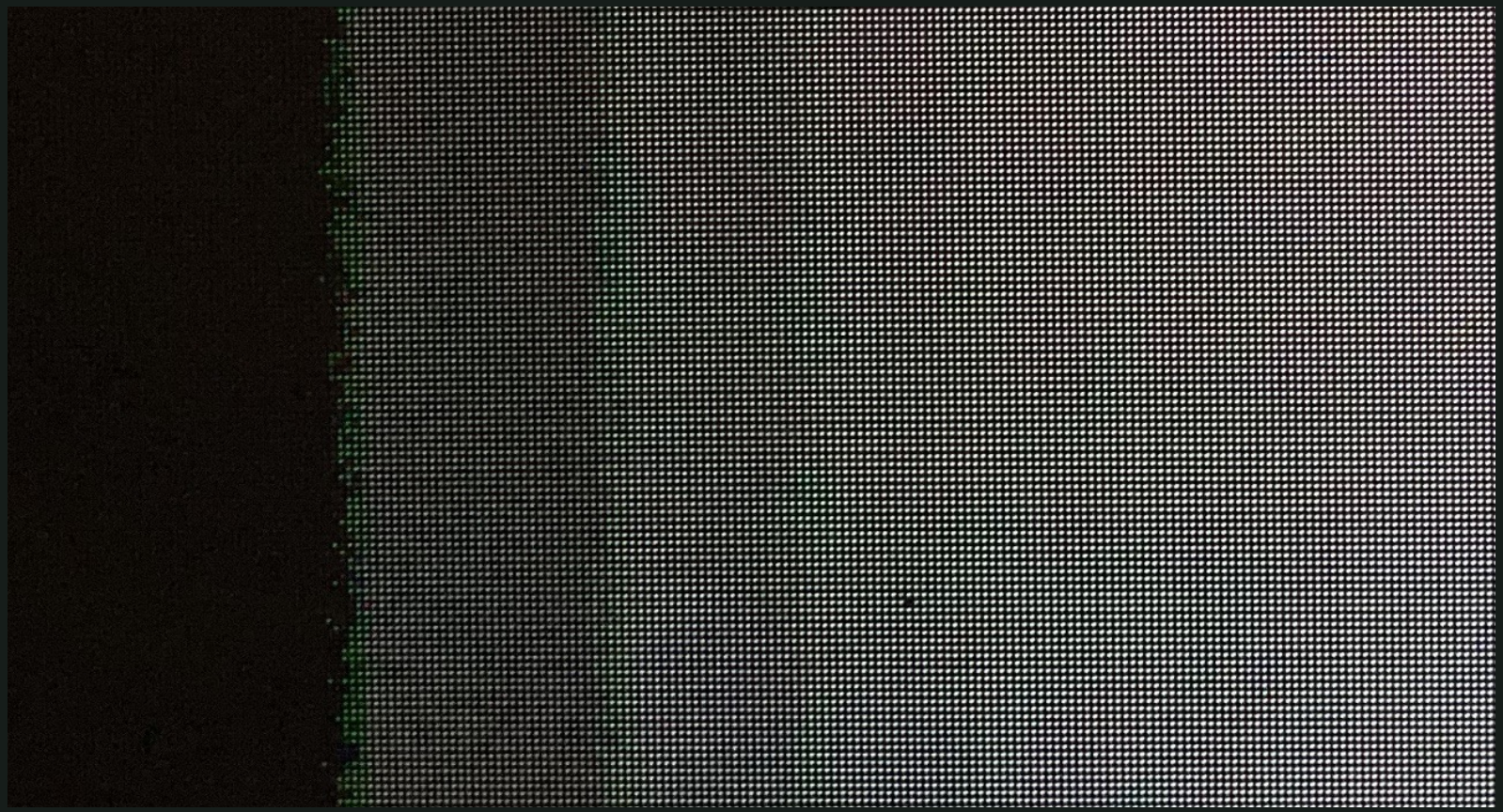


IMAGE TRANSMISSION

Banding



Dithering
Reflections

IMAGE TRANSMISSION

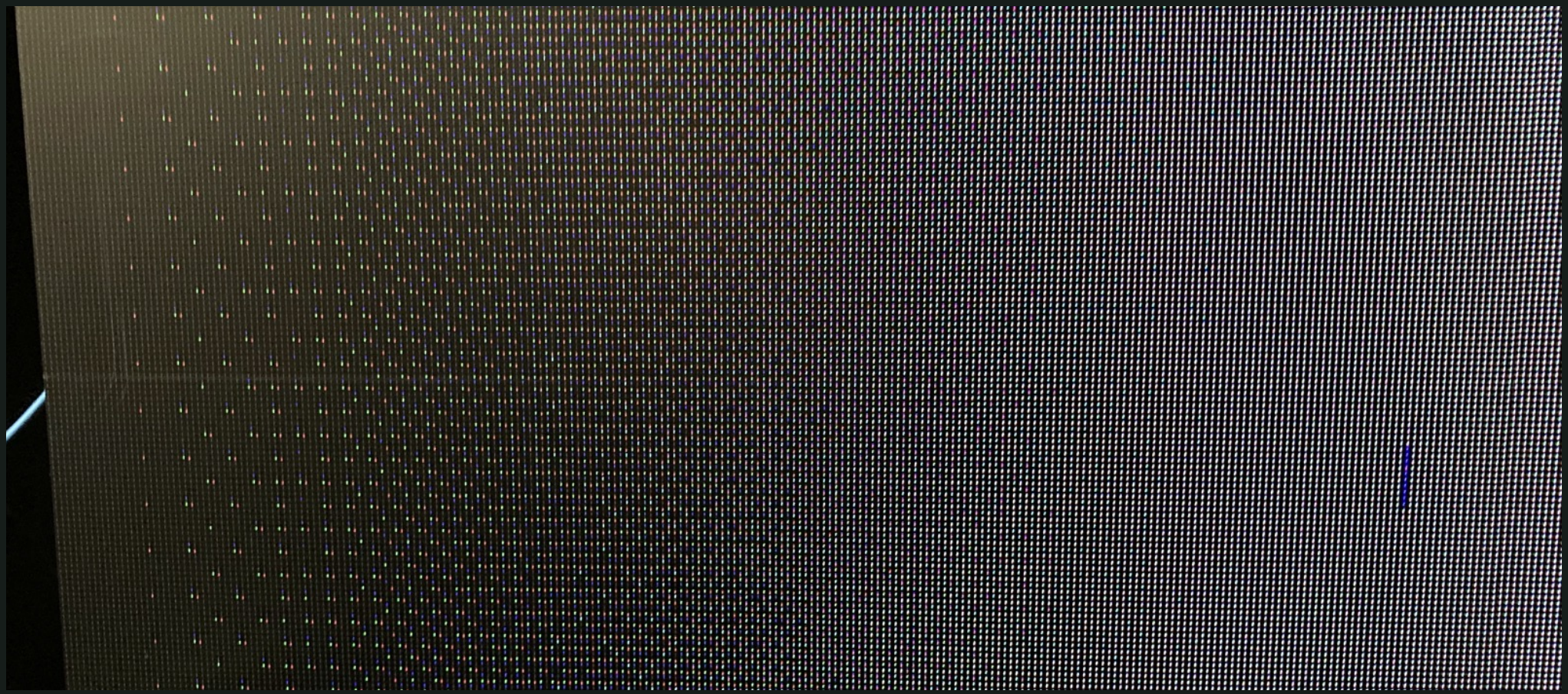


IMAGE TRANSMISSION

Dithering

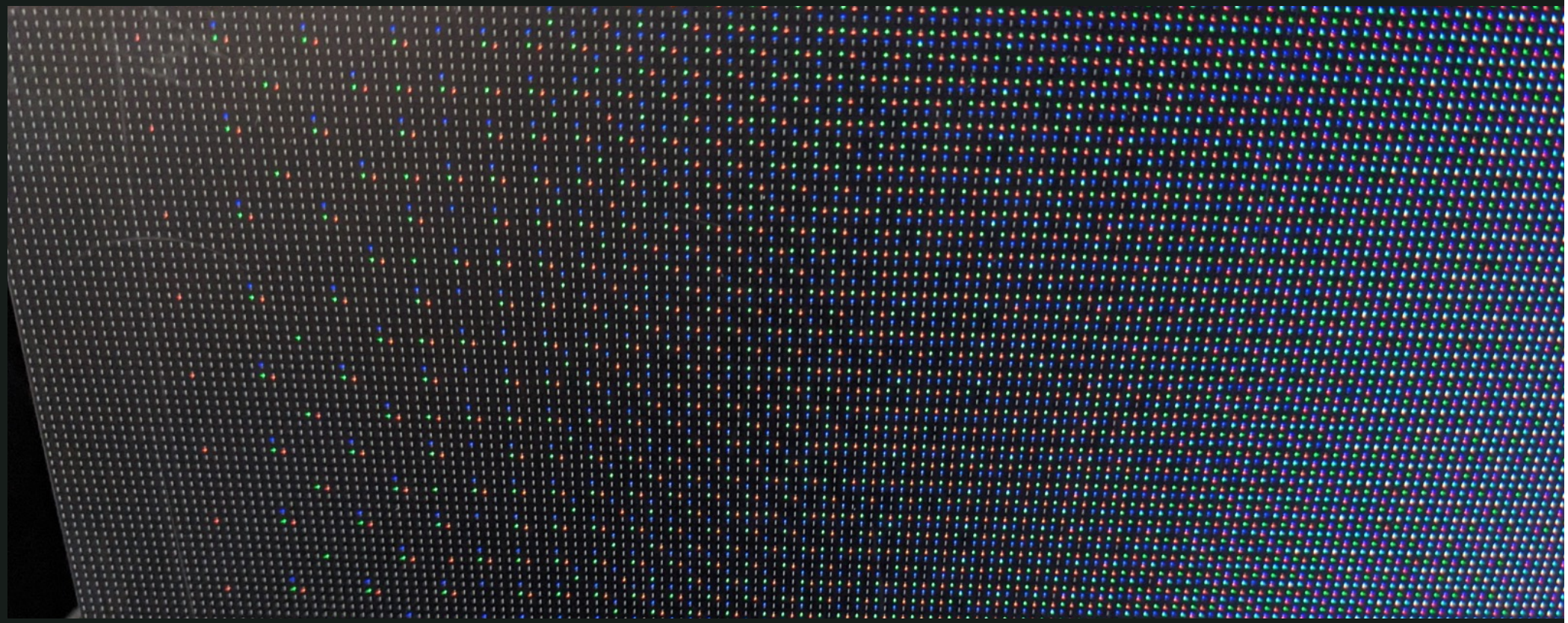


IMAGE TRANSMISSION

Nonlinearity

Temporal artifacts

IMAGE TRANSMISSION

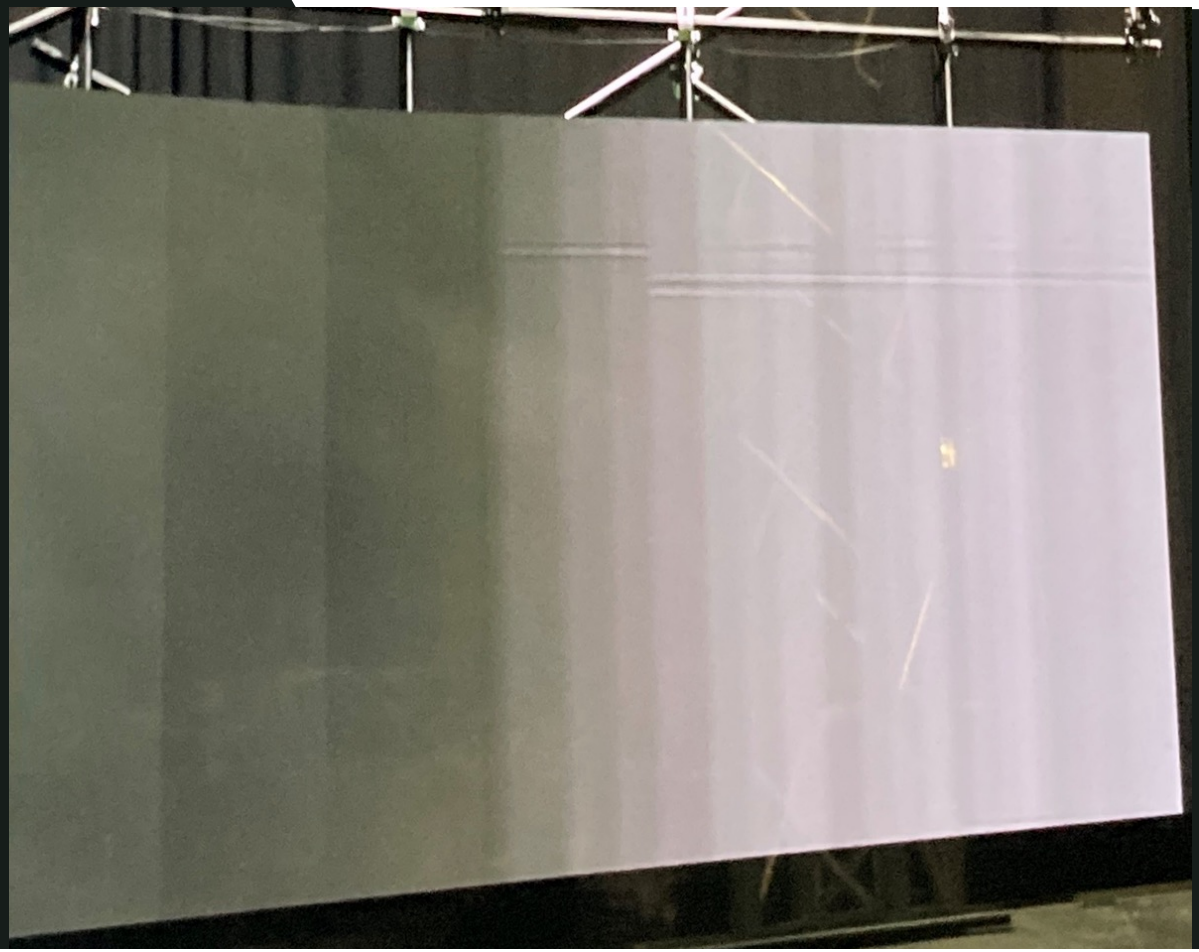
Nonlinearity

Temporal artifacts

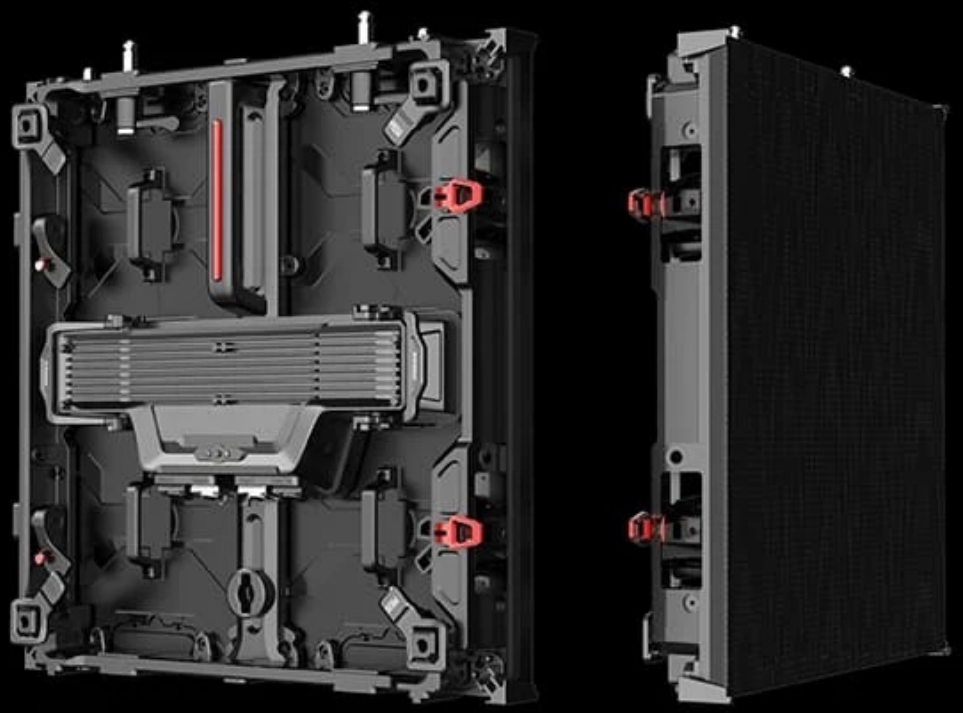
IMAGE TRANSMISSION

Nonlinearity

Temporal artifacts



LED WALL PARAMETERS



https://www.led-display-manufacturer.com/de/led-video-wall-virtual-production-in-film-making/

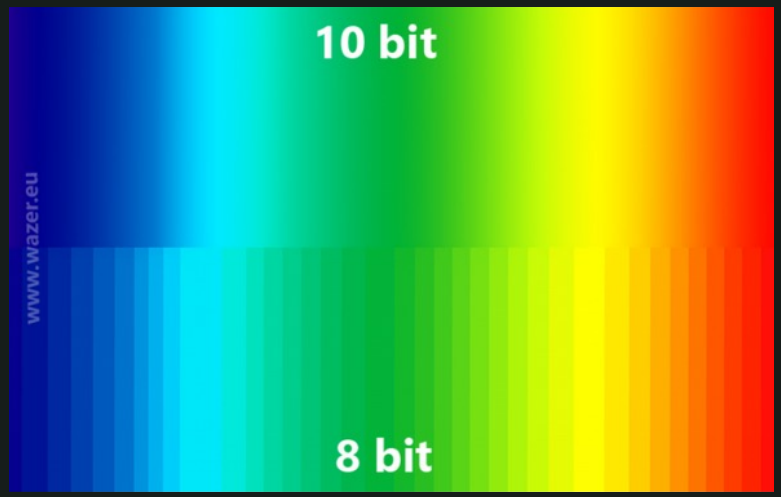
- Gamut
- Bit depth
- Contrast range
- Maximum brightness
- Temporal behavior
  - Refresh rate
  - Scanlines / Multiplexing

LED WALL PARAMETERS

Gamut

Brompton Technology – Dynamic Calibration - 2024

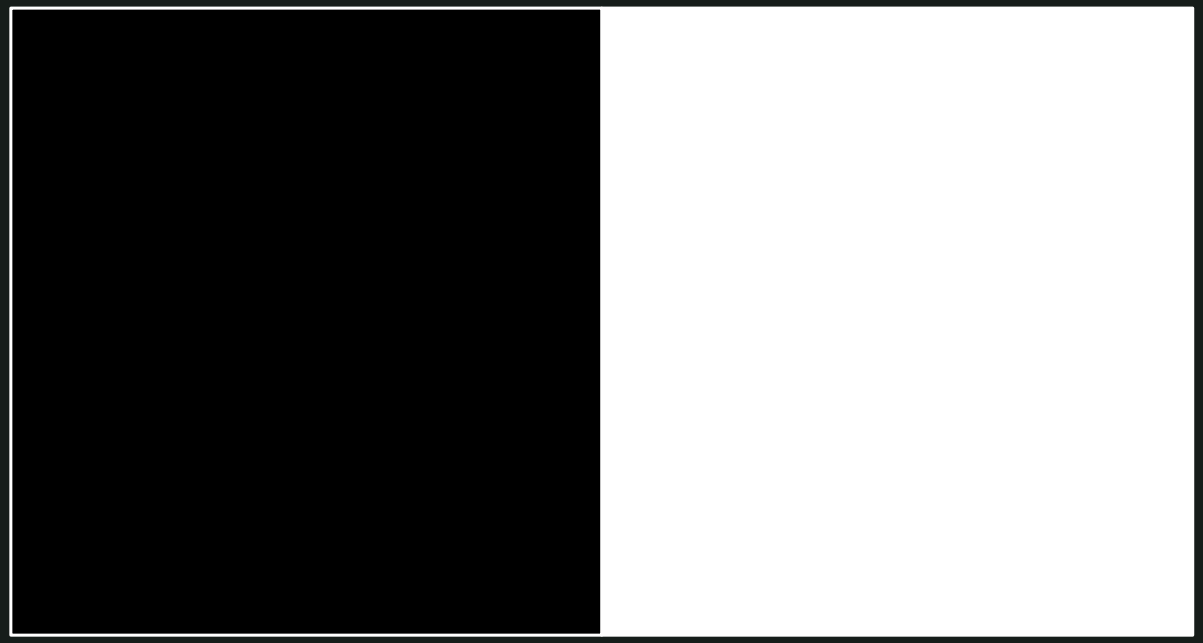
Farbtiefe



https://www.computerbase.de/forum/threads/8-bit-oder-10-bit-einstellen.2039968/

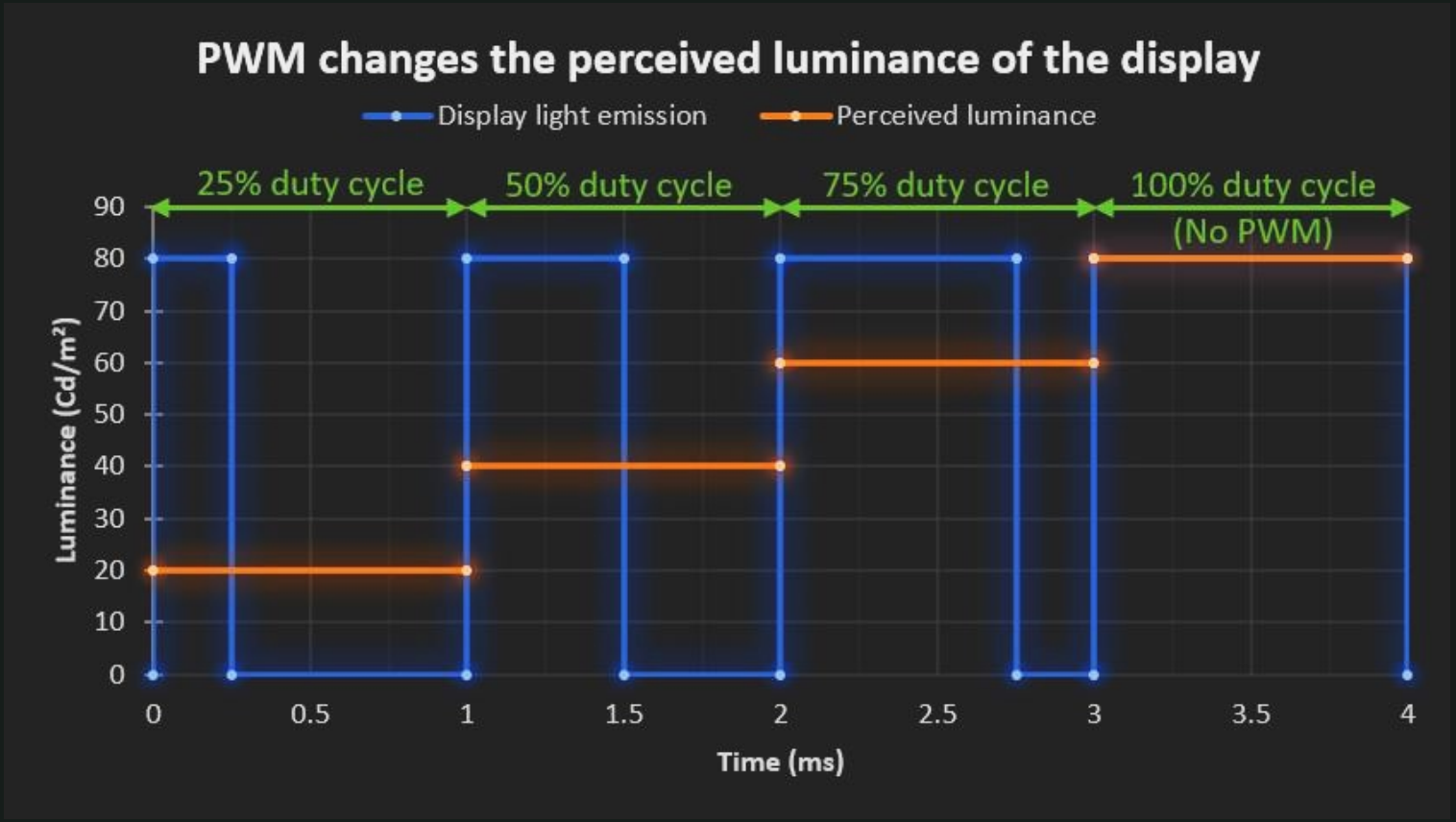
LED WALL PARAMETERS

Contrast range
Maximum brightness



LED WALL PARAMETERS

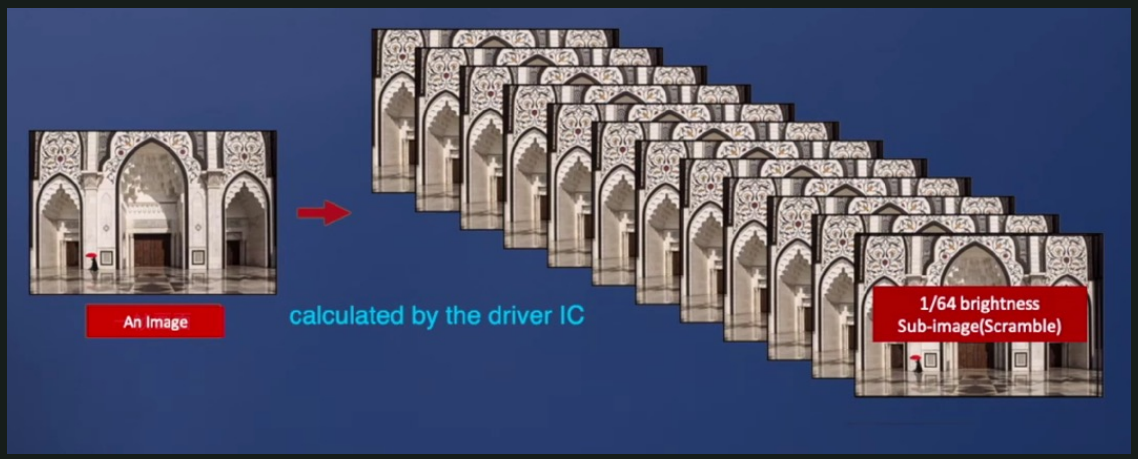
Temporal behavior

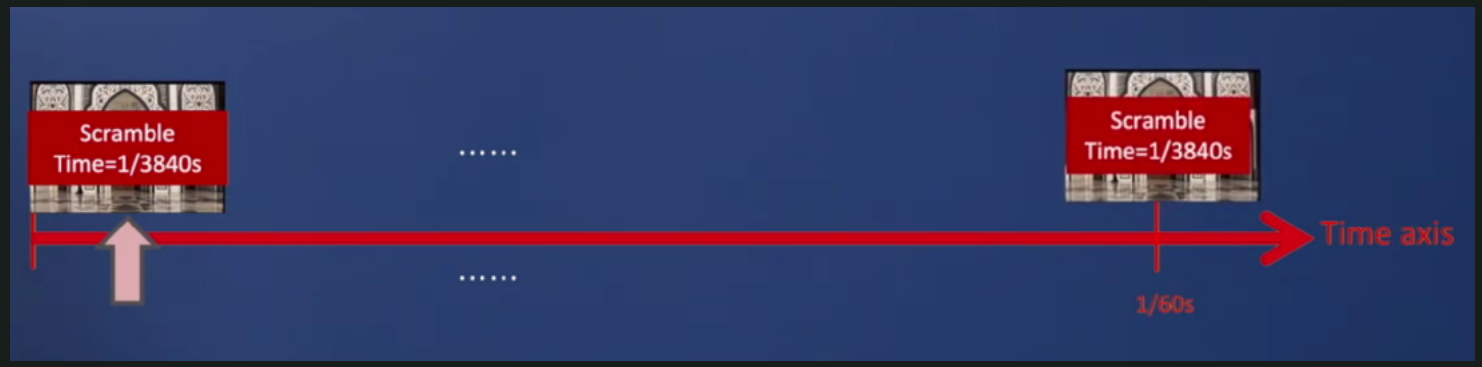


https://corp.dxomark.com/flicker-the-display-afflictiono-draft/

LED WALL PARAMETERS

Temporal behavior





https://www.youtube.com/watch?v=5pxxDEs8IMw

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Temporal behavior

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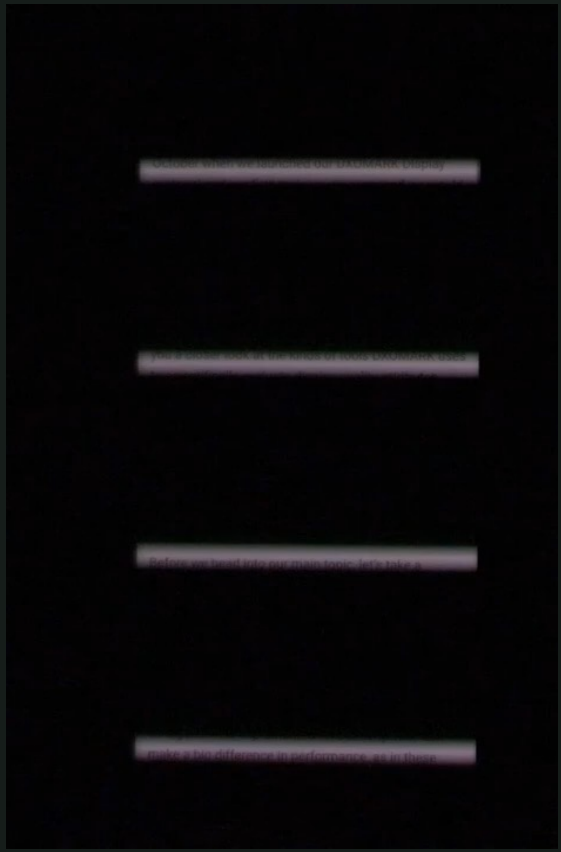
Temporal behavior



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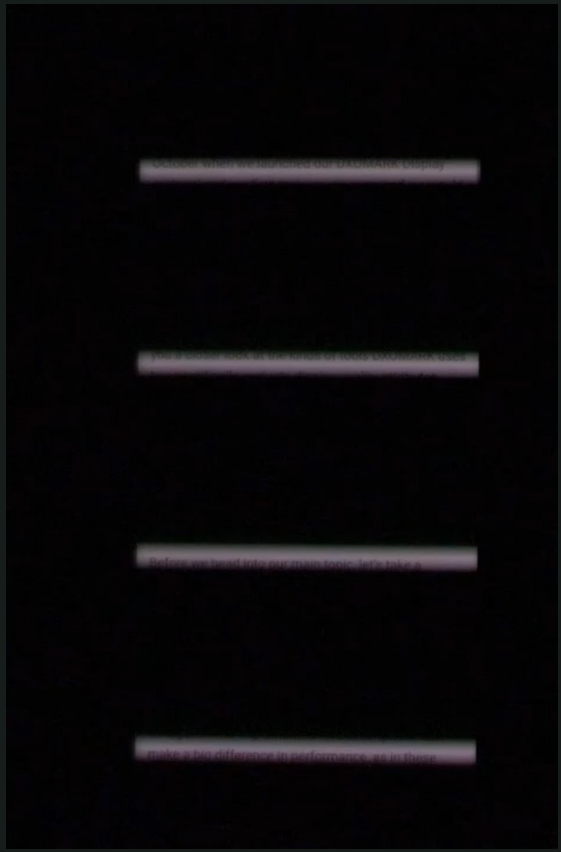

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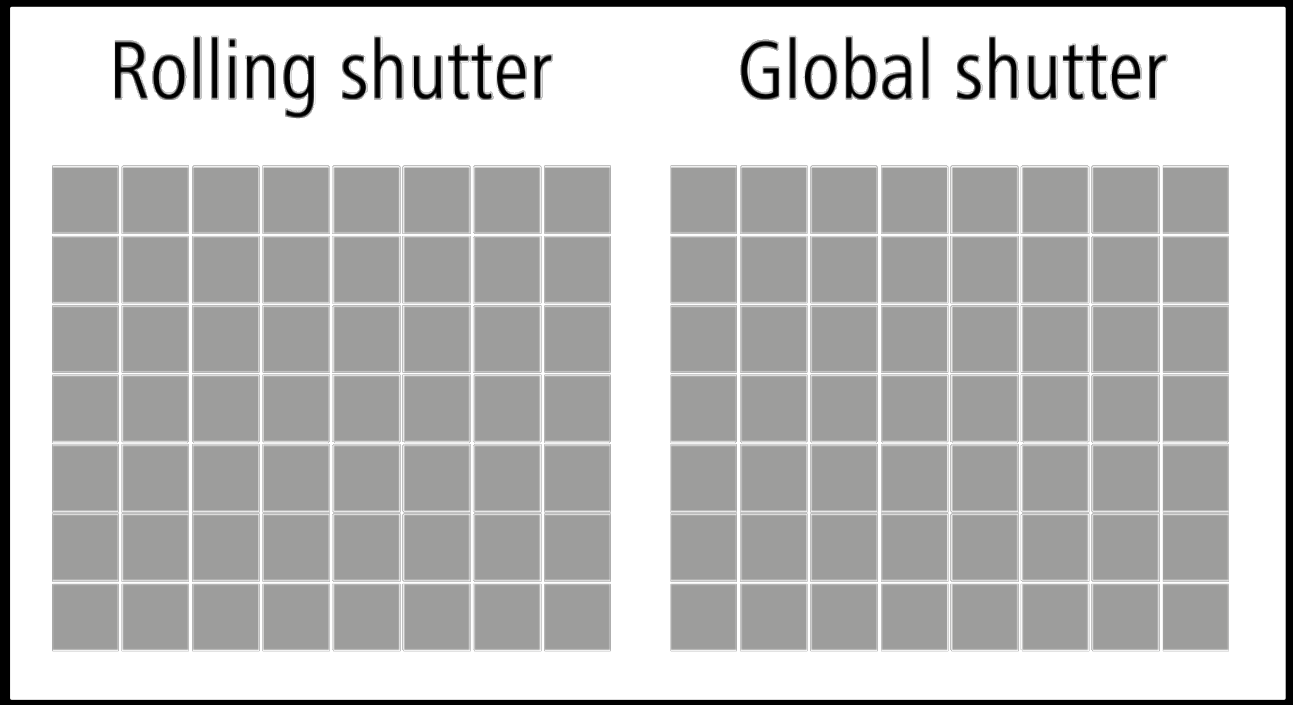


https://www.baumer.com/de/en/service-support/function-principle/function-principle-and-applications-of-rolling-shutter-cmos-cameras/a/CMOS-rolling-shutter-cameras

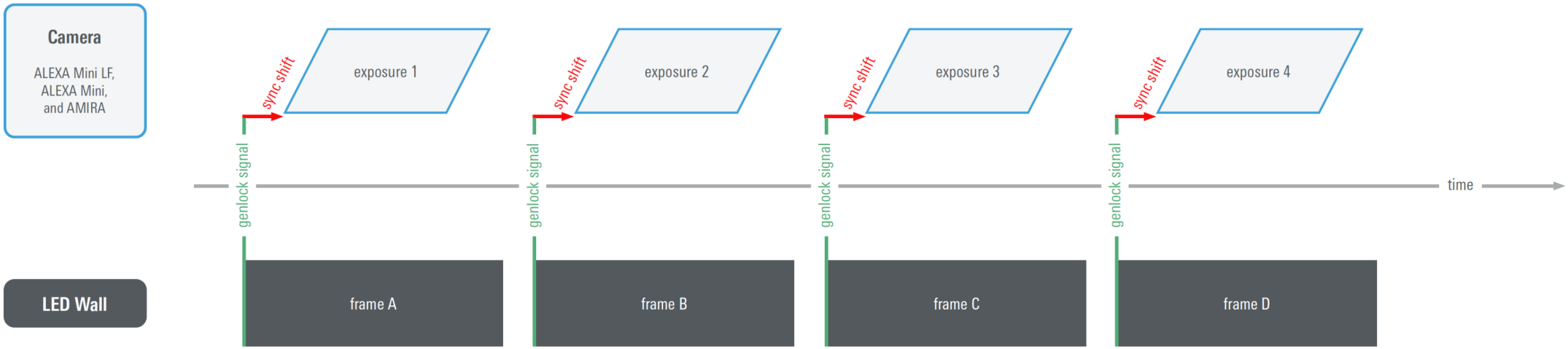
LED WALL PARAMETERS

Temporal artifacts

LED WALL PARAMETERS

LED WALL PARAMETERS

Rolling Shutter



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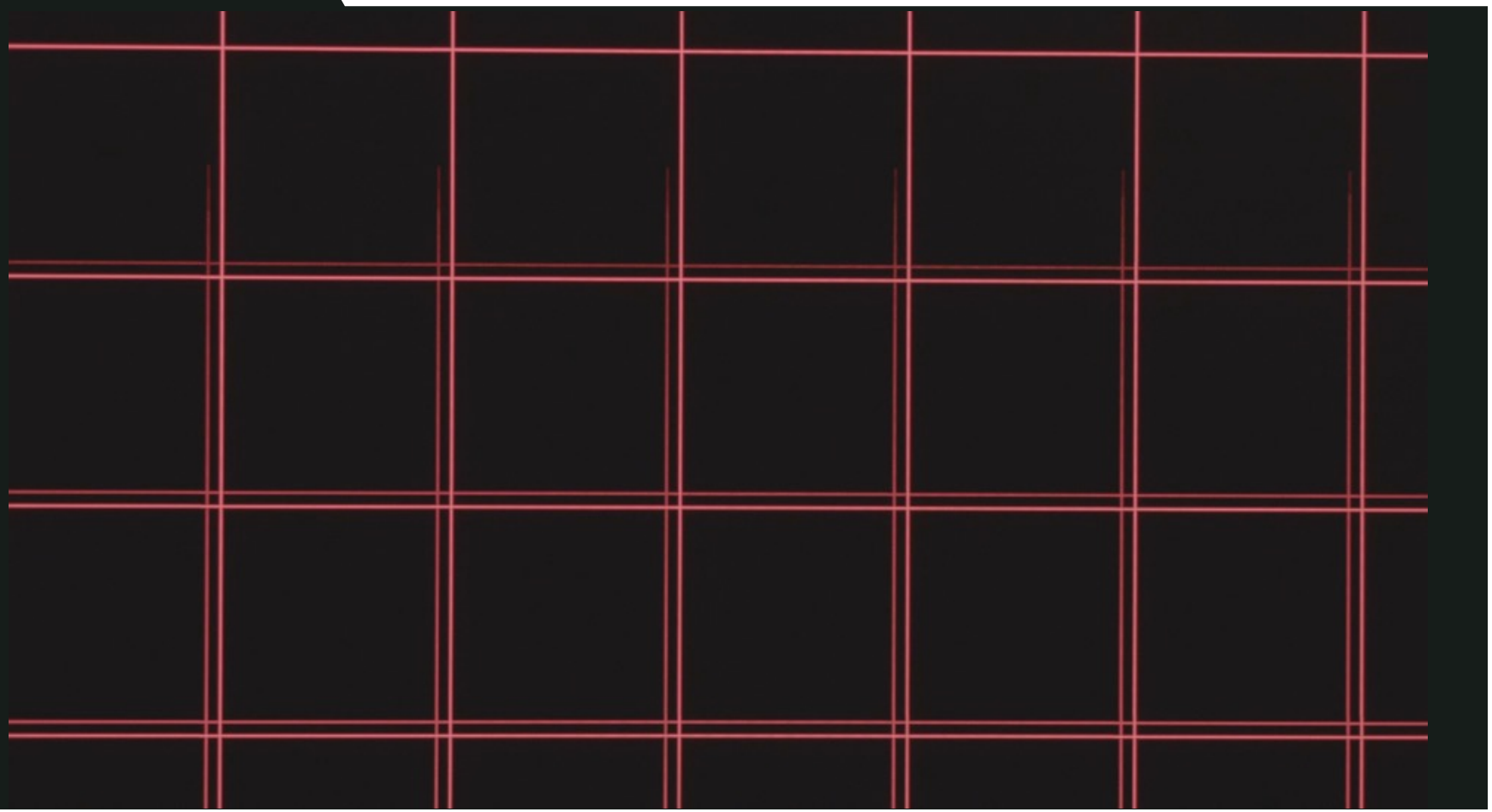

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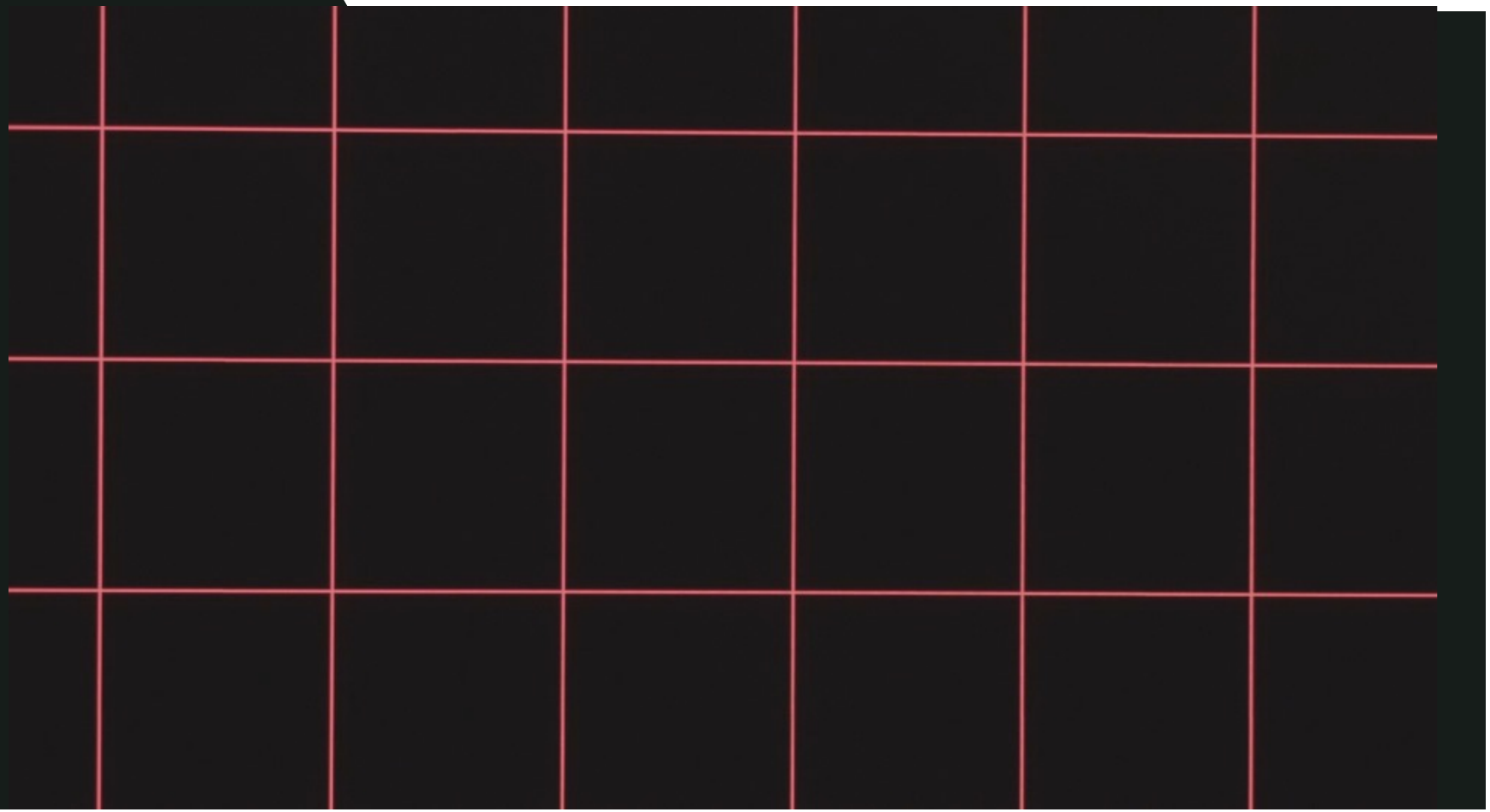

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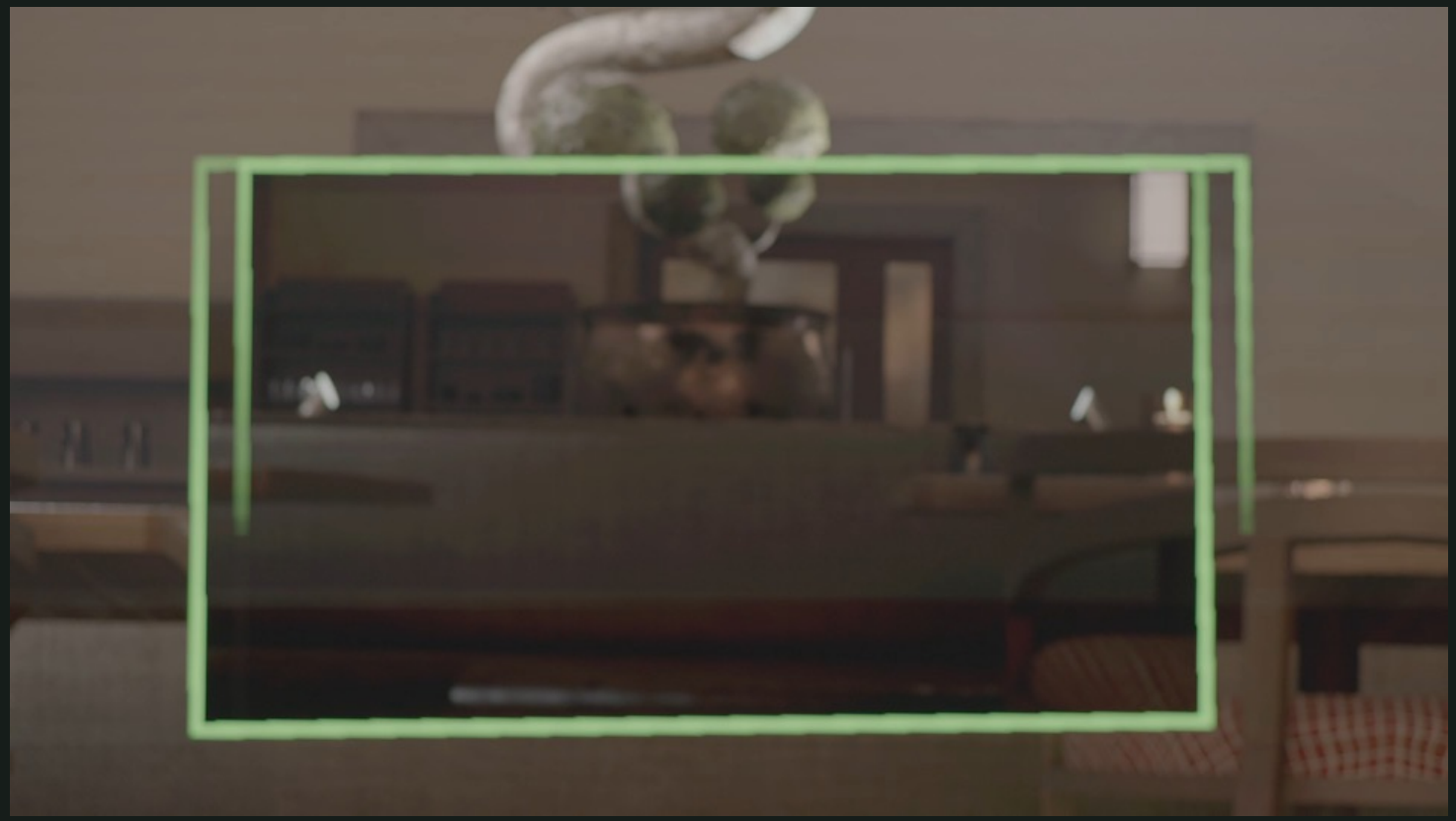
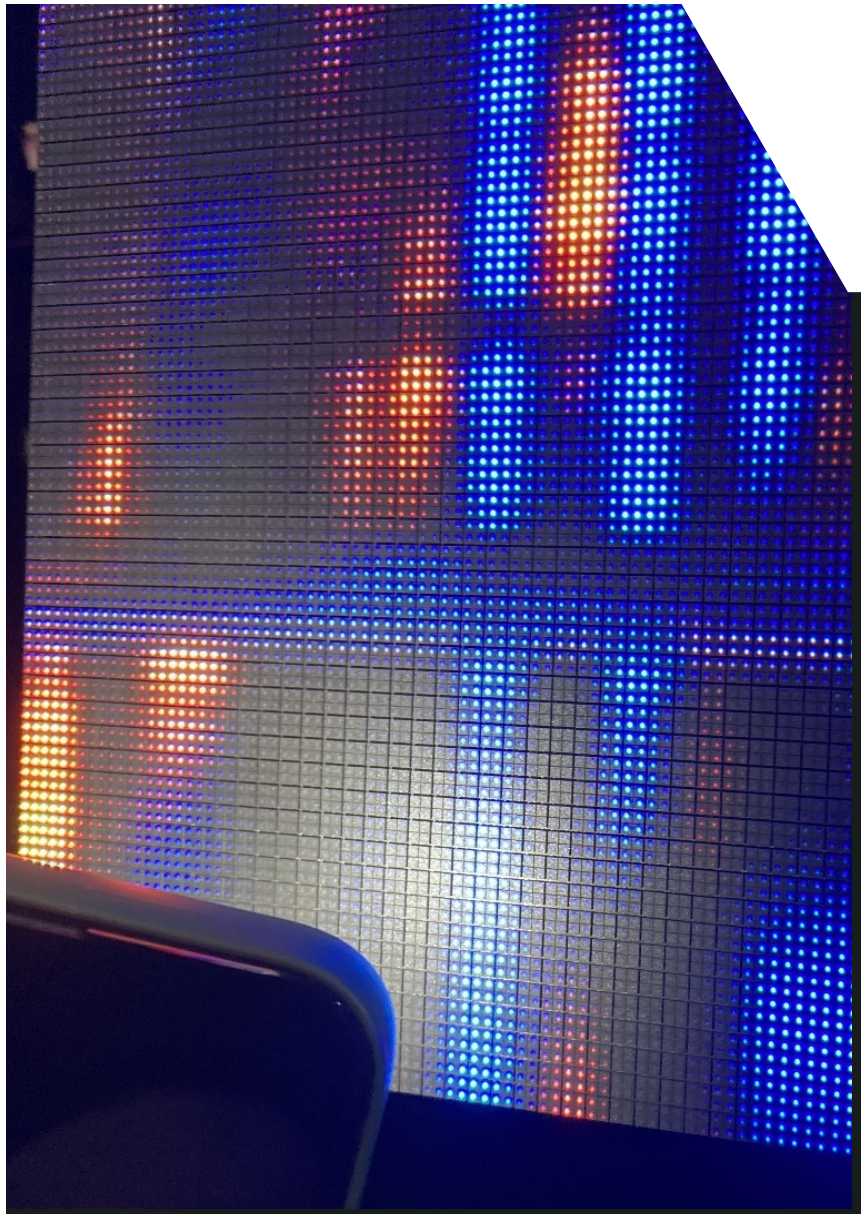




LED WALL PARAMETERS

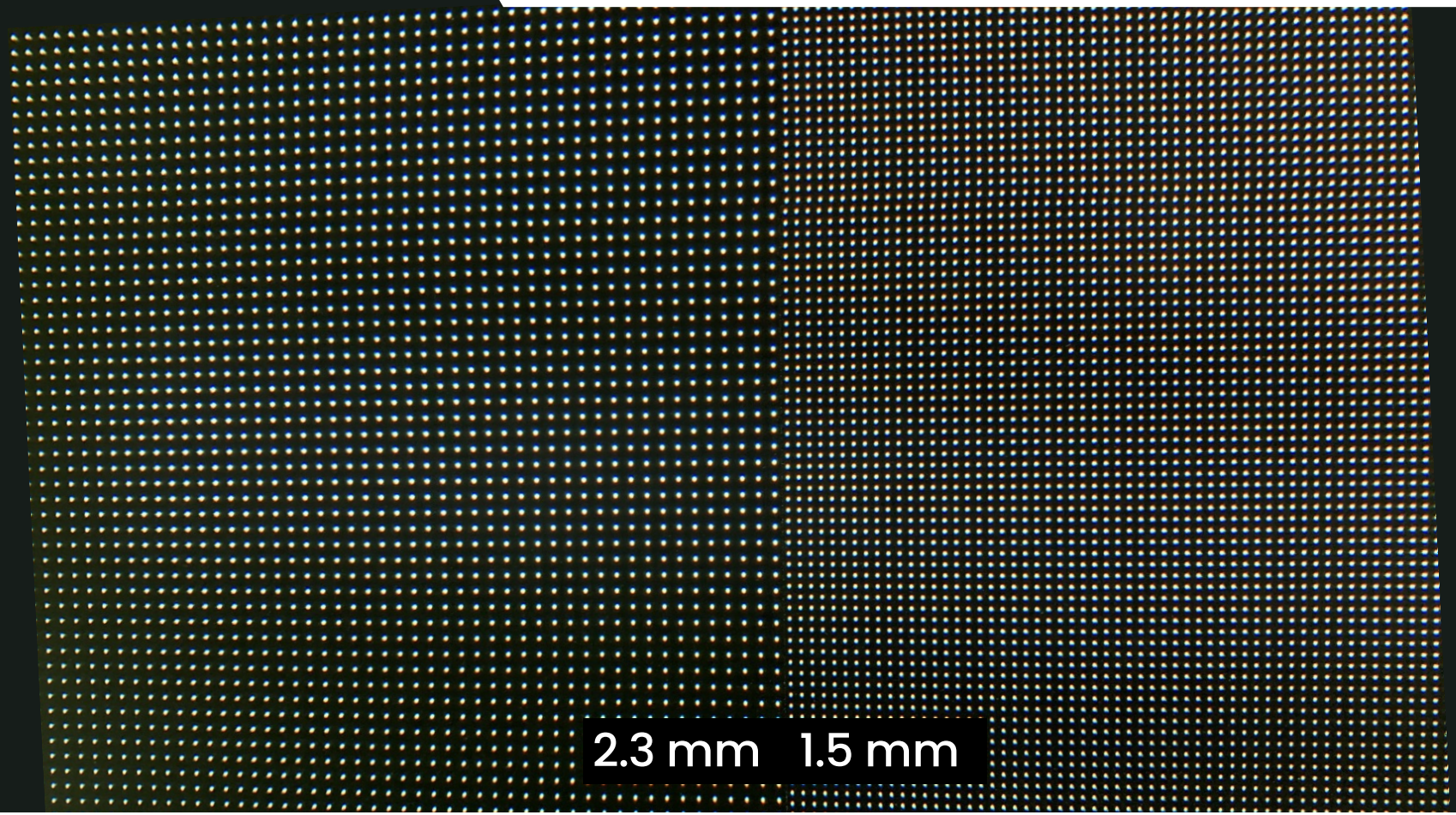
- LED processor options
- Reflection behavior / light spill sensitivity
- Pixel pitch
- Pixel size
- Color channels RGB, RGBW or similar

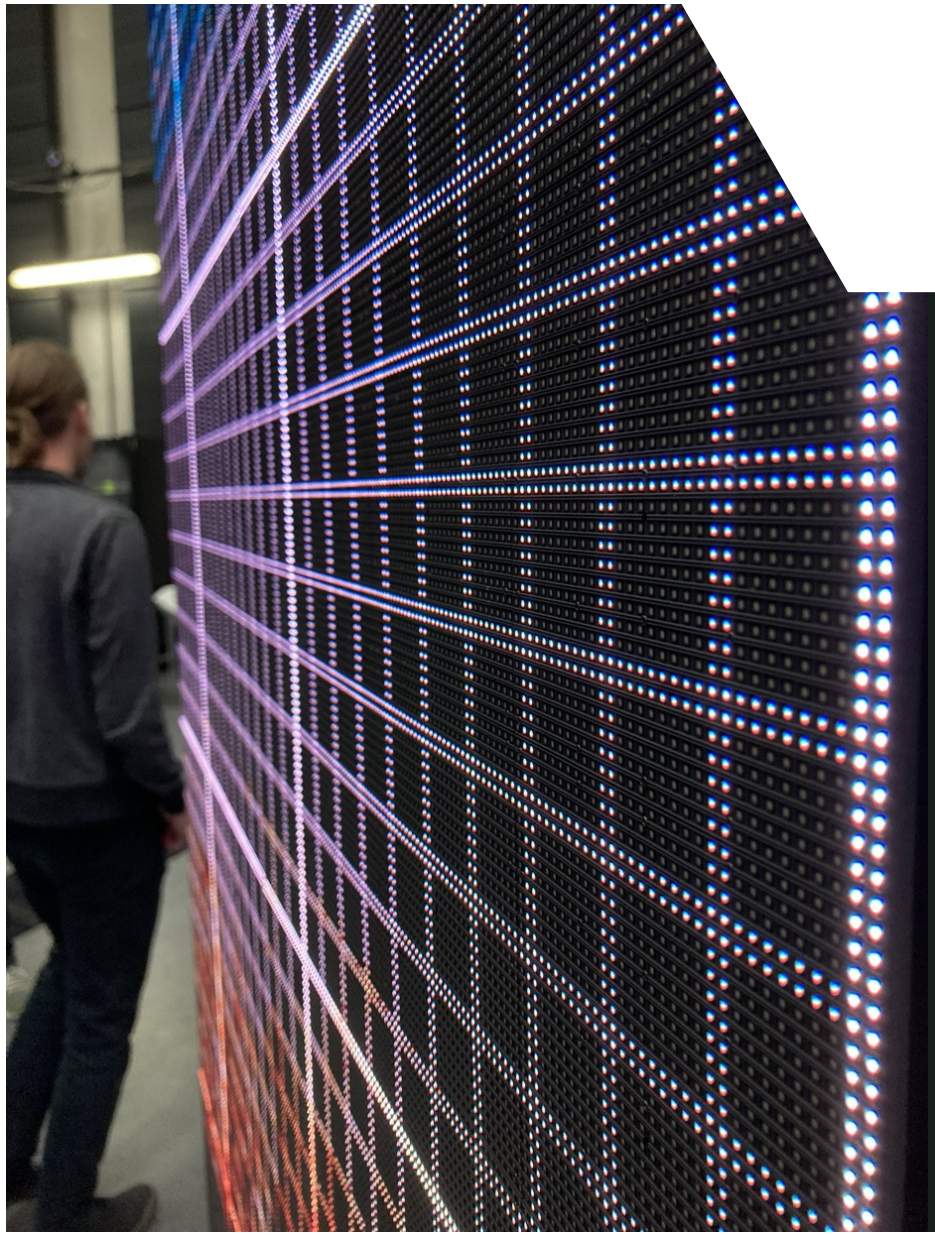
PARAMETER LED-WAND

Reflection behavior

LED WALL PARAMETERS

Pixel Pitch



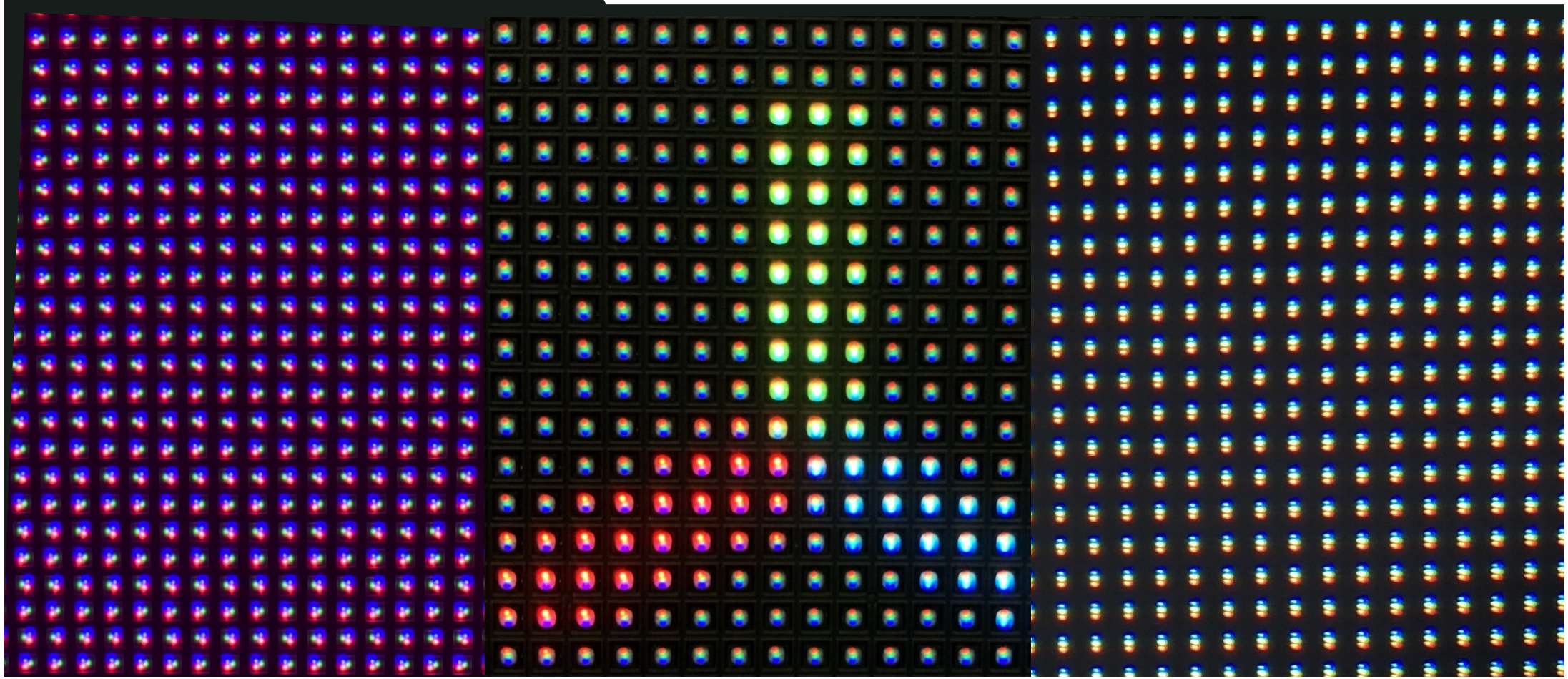


LED WALL PARAMETERS

- Viewing angle stability
  - Obscured sub-pixels
  - Color arrangement of pixels
- Robustness / mechanics
- Thermal properties
- Panel maintenance
- Repairability
- Scalability -> Batches

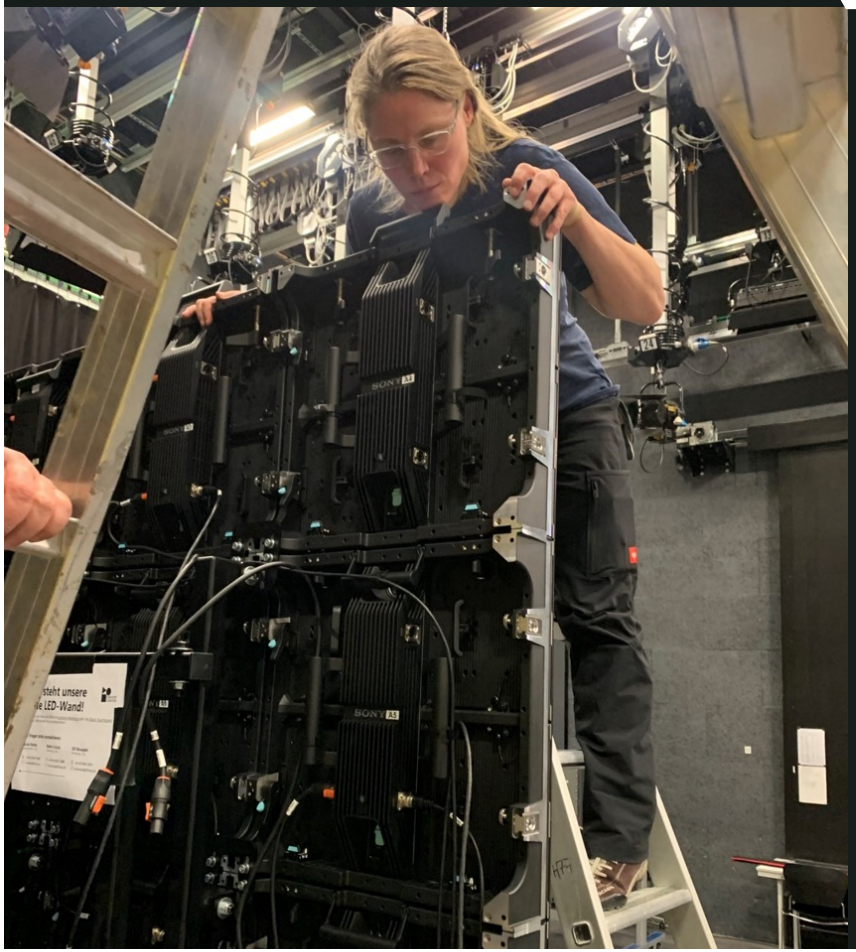
Color configuration of the pixels

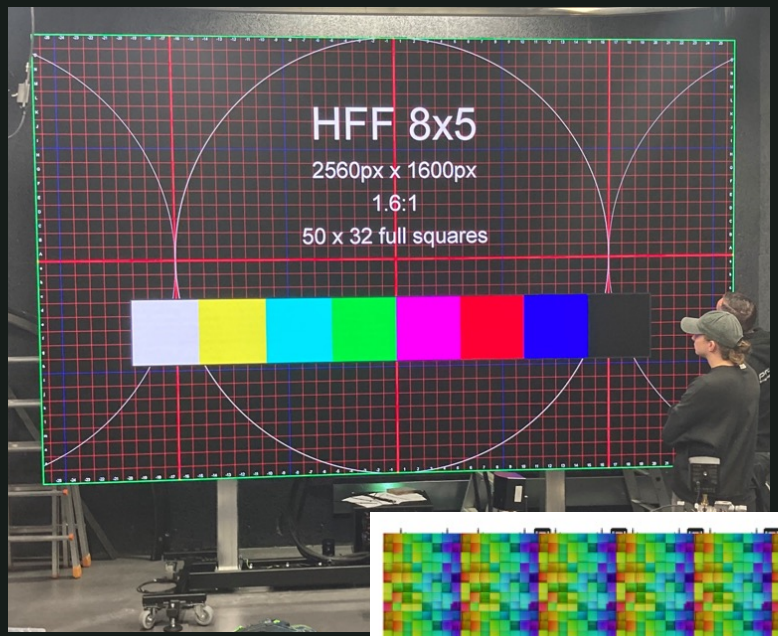
LED WALL PARAMETERS



LED WALL PARAMETERS

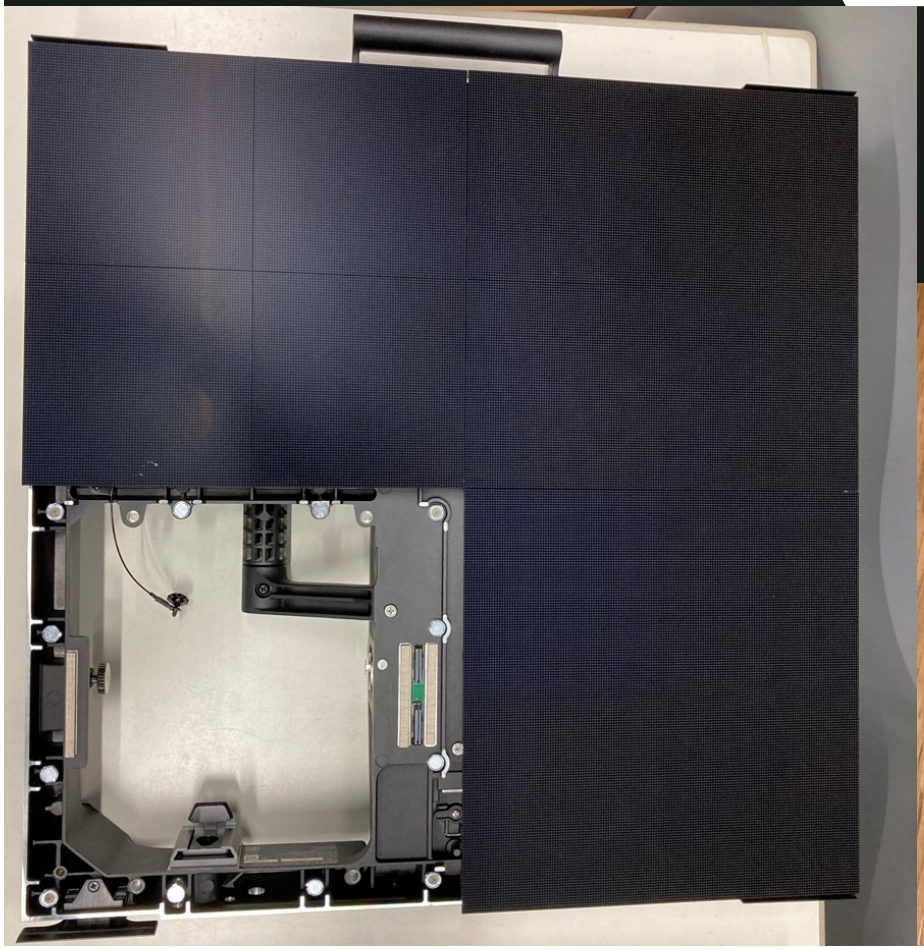
Robustness / mechanics





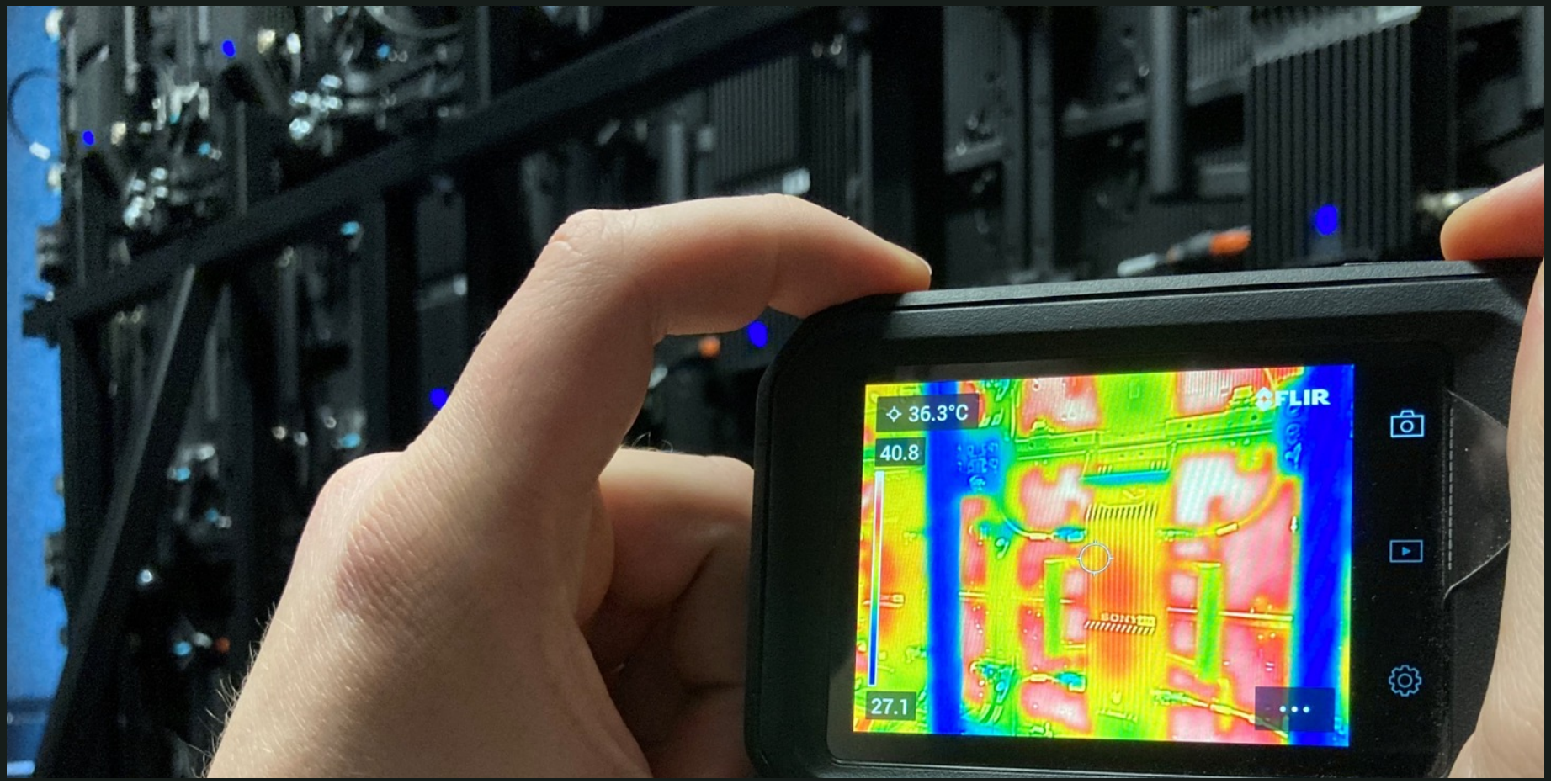
LED WALL PARAMETERS

Repairability



LED WALL PARAMETERS

Thermal properties



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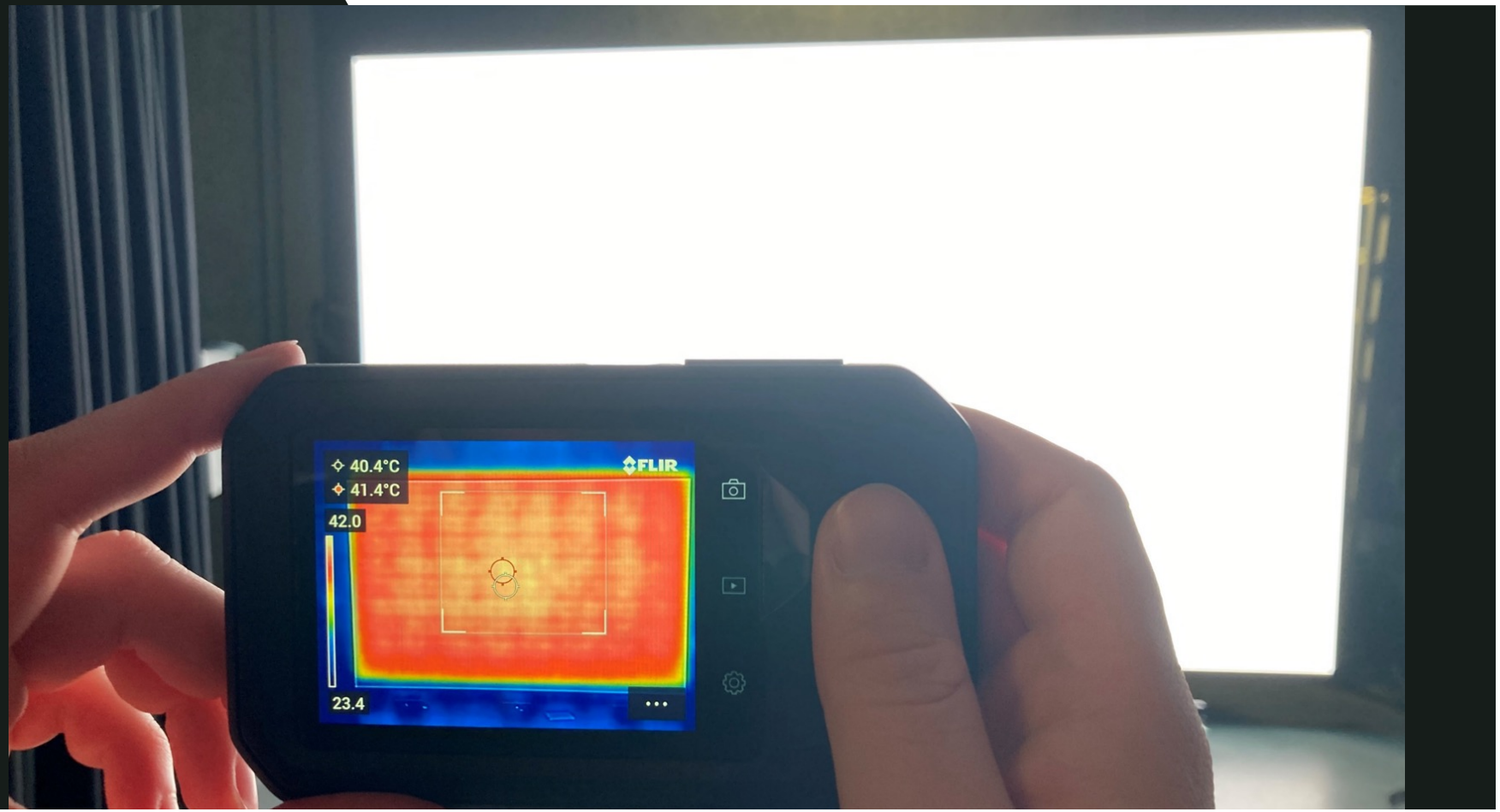
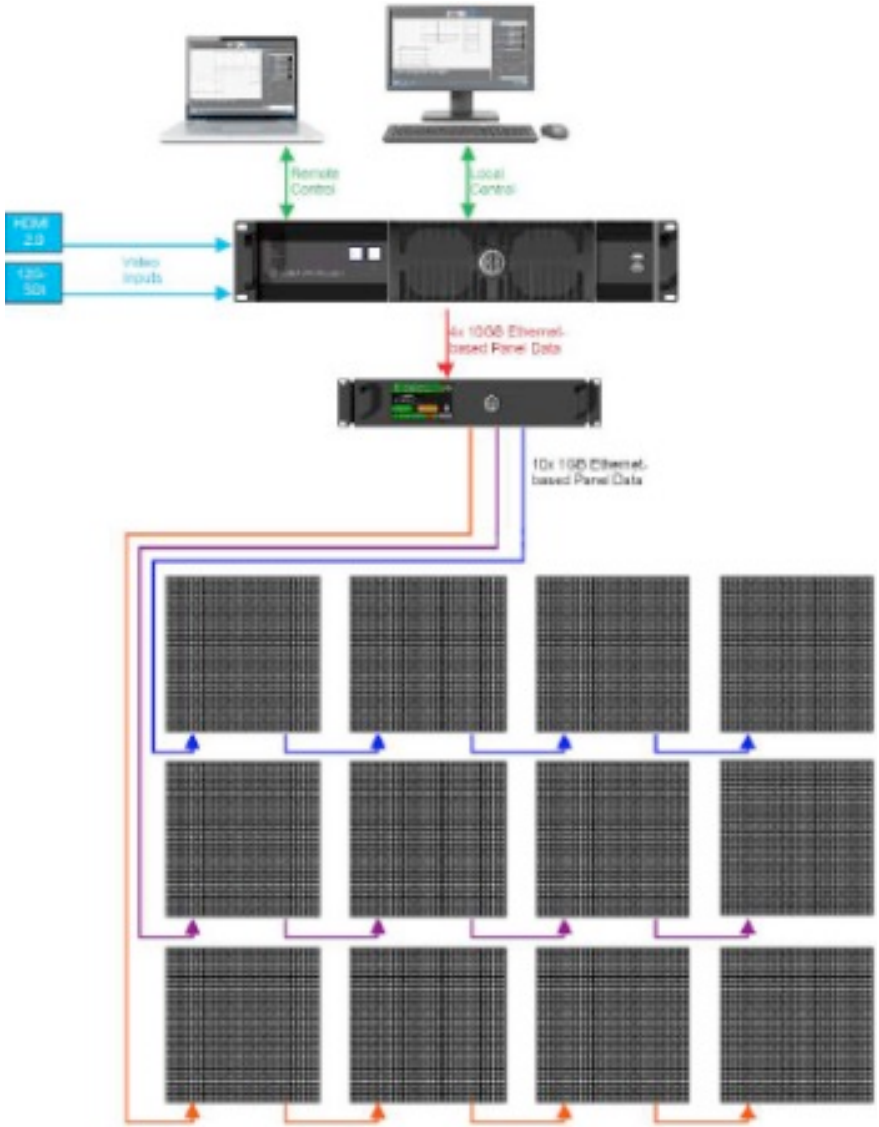


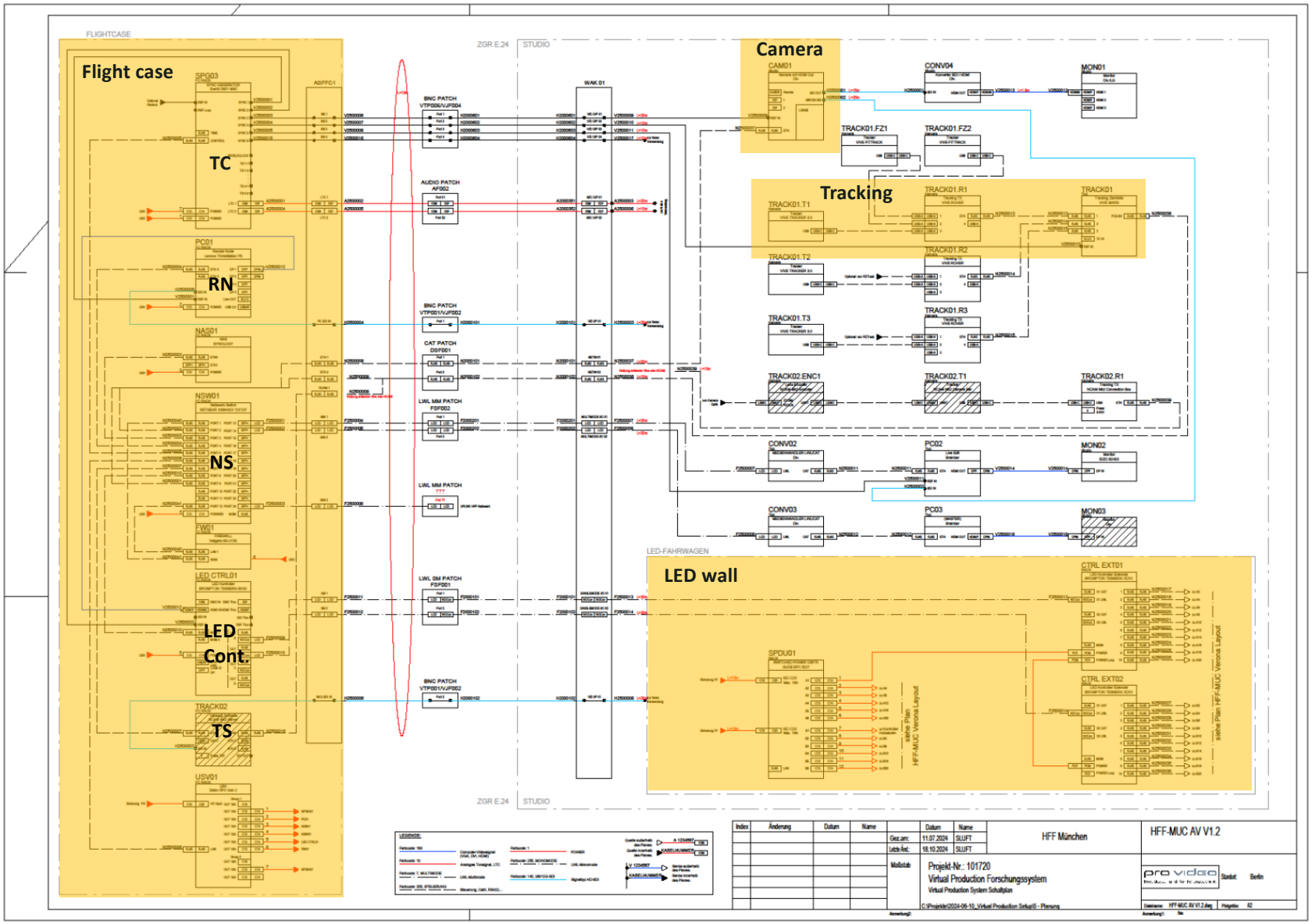


LED PROCESSOR

Driving the LED wall

- Processor communicates with a proprietary protocol to the receiver card of the LED panels

Brompton Technology Usermanual 2.2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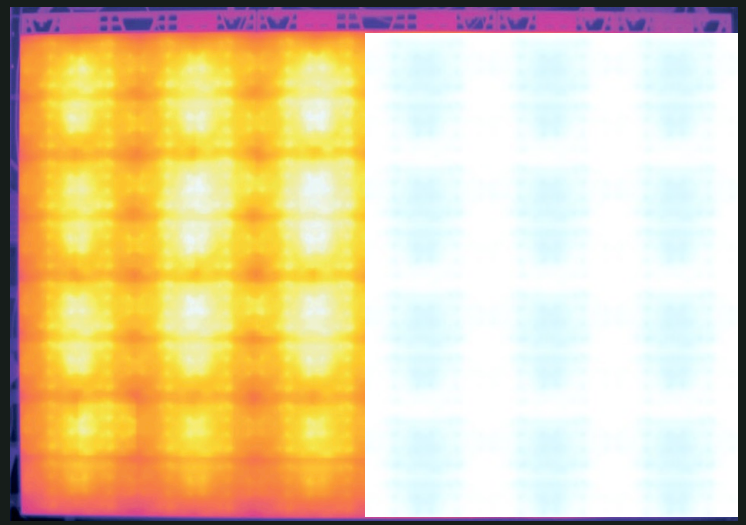
Projektbl.: A2

DISTRIBUTING THE SIGNAL



LED PROCESSOR

Driving the LED wall

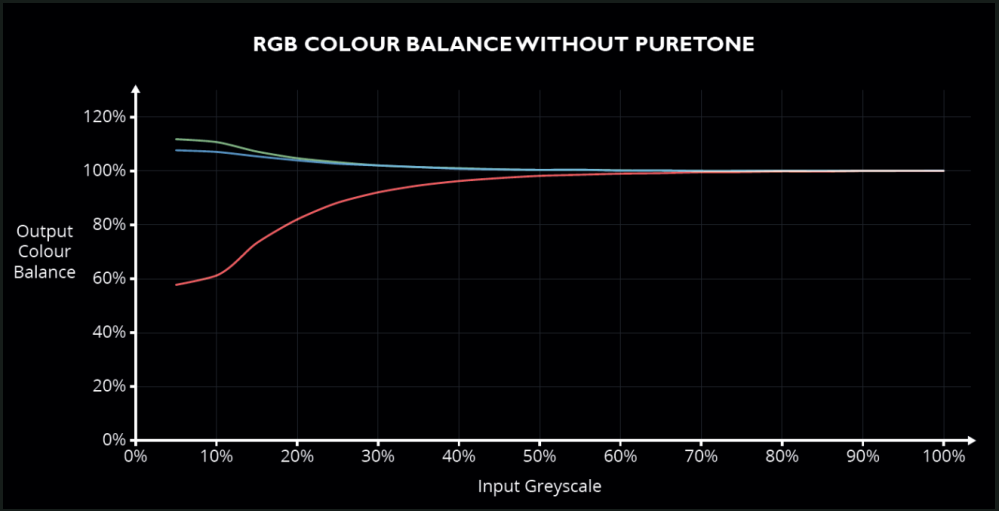
- Color (gamut) processing
- Panel calibration
- Linearity
- temporal behavior
  - PWM
  - Refresh rate

Brompton Technology – The HYDRA System + Brompton Technology Usermanual 2.2

Brompton Technology - Feature Spotlight Thermacal

LED PROCESSOR

Calibration example



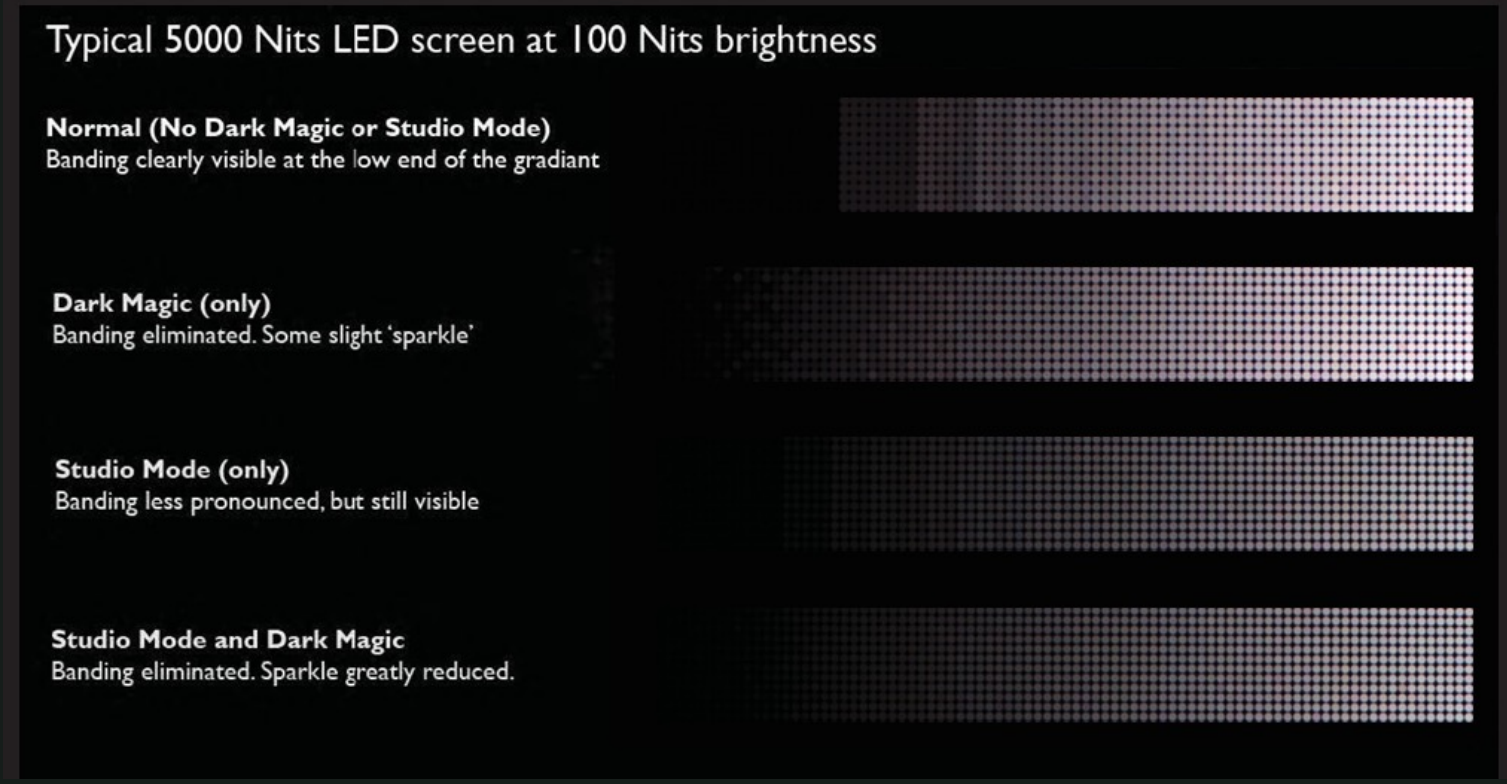
LED PROCESSOR

Driving the LED wall

- Dark image components
- Temporal behavior -> PWM
- Temporal multiplexing
- Gostframe, frame remapping
- Usability GUI / UI
- Frame rate

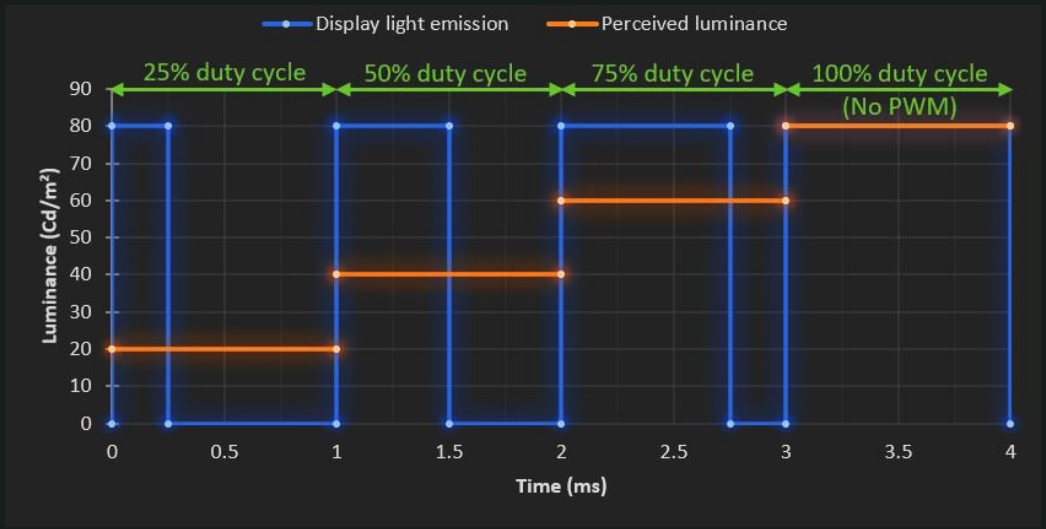
Dark image components

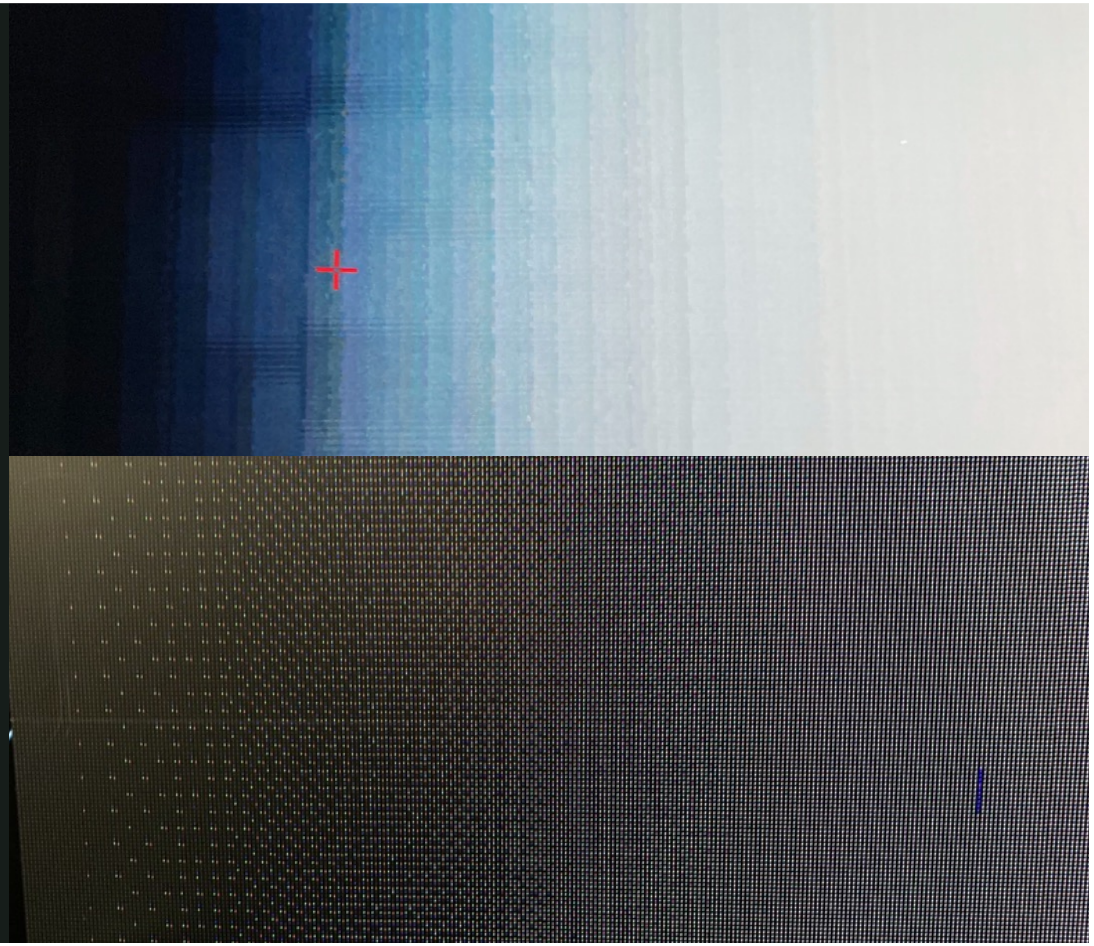
LED-PROZESSOR

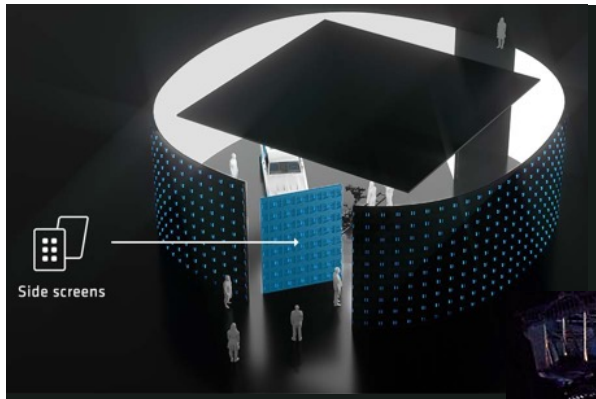


LED PROCESSOR

temporal artifacts







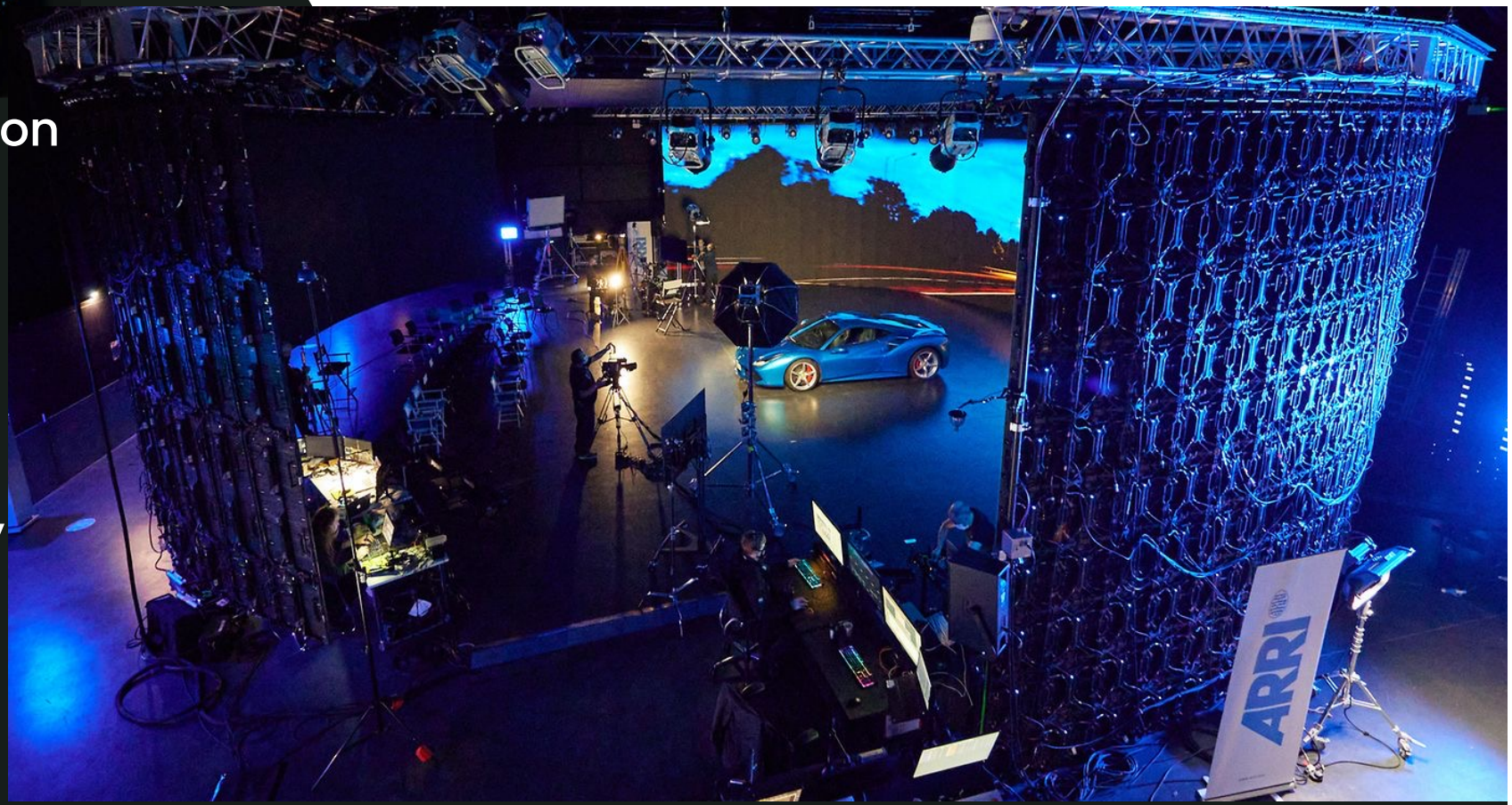
YOU CAN'T ALWAYS GET WHAT YOU WANT …

ARRI Studio London

In-vision wall:
30 m x 5 m

Side sections:
3 m x 4,2 m

We had money for 10 m²



https://www.arri.com/en/solutions/virtual-production/arri-stage-london

PREVIZ AS A PLANNING TOOL

PREVIZ AS A PLANNING TOOL

SIZE AND FLEXIBILITY

Quelle: Videofonika

Frequent modification

- Robustness of the system
- Easy to move (e.g. trolley)

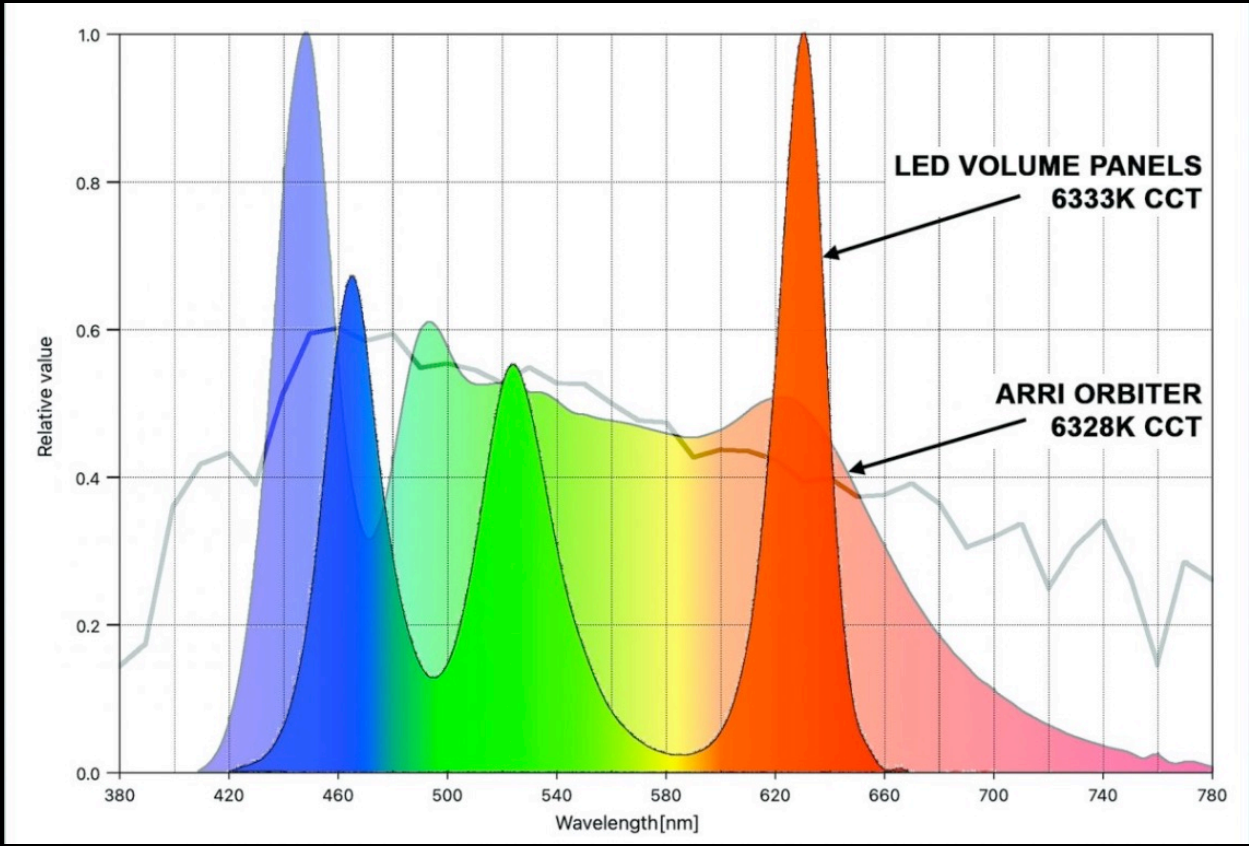
or fixed installation possible?

Let’s keep in touch!

s.rotter@hff-muc.de

m.schulz@hff-muc.de

THE LIMITATIONS OF RGB LEDS



https://theasc.com/articles/color-fidelity-in-led-volumes

THE LIMITATIONS OF RGB LEDS

https://theasc.com/articles/color-fidelity-in-led-volumes

RGBW / RGBCA PANEL

RGB	RGBW / RGBCA
- Wesentlich günstiger - Viele Anbieter - Bekanntes Processing	- Größere Pixel-Pitches (off camera, für Reflexionen) - Processing anspruchsvoller

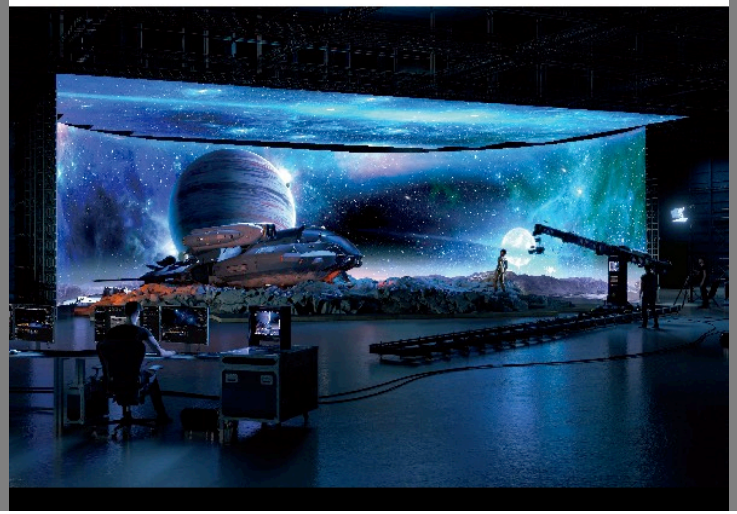
Sony Crystal LED Verona

SONY

Crystal LED VERONA

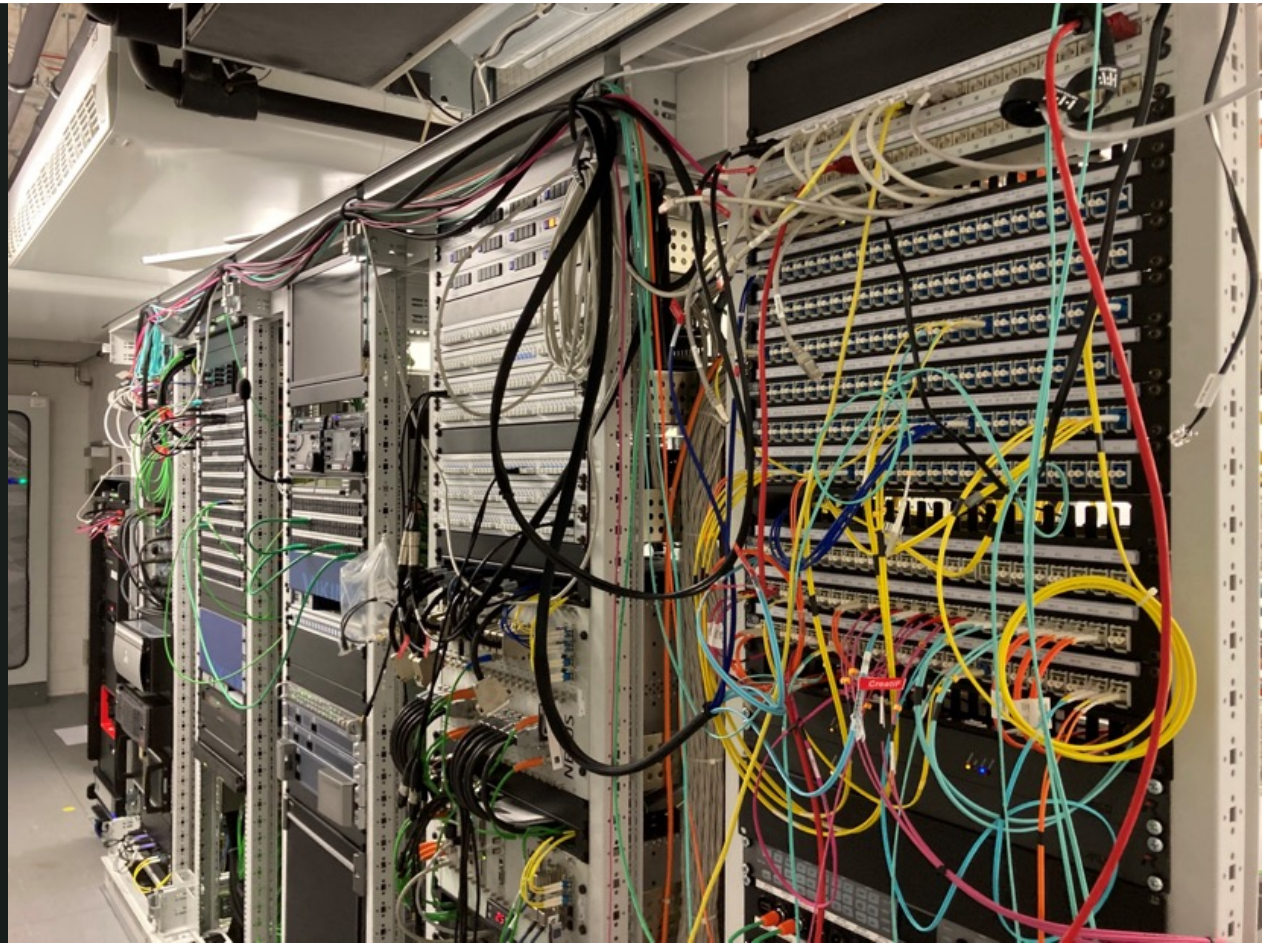
for Virtual Production

ZRD-VP15EB/ZRD-VP23EB
ZRD-VP15EM/ZRD-VP23EM



Brompton Tessera Manual

DISTRIBUTING THE SIGNAL



Creative Innovation Lab

CreatiF Center HFF Munich - Innovation and Transfer

EINE GEMEINSAME INITIATIVE VON
Innovative Hochschule
Bundesministerium für Bildung und Forschung
Gemeinsame Wissenschaftskonferenz GWK