Curing the Video Playout Nightmare

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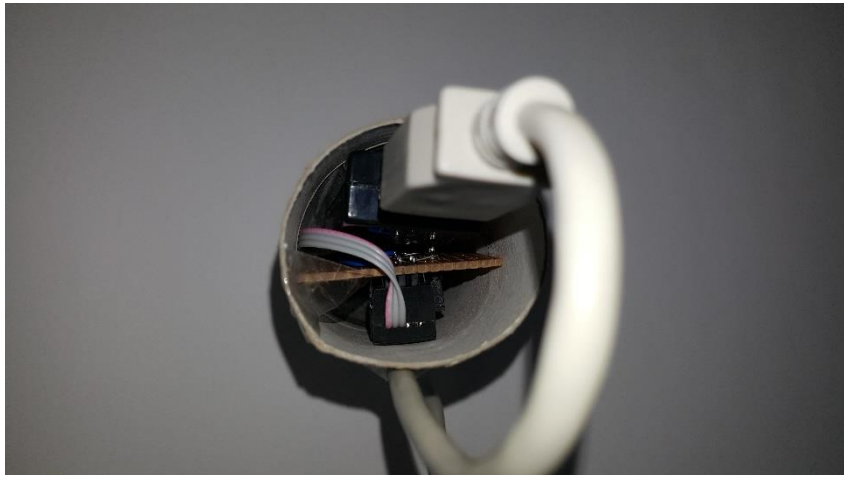
Motivation

- Some subjects reported flicker in videos
- Was the flicker in the videos (e.g. fast panning) or or due to the test setup (e.g. VLC player)?
- Need for a measurement device to measure flicker
- Optimize test setup with this device

… we went for lunch.

Monday Morning…



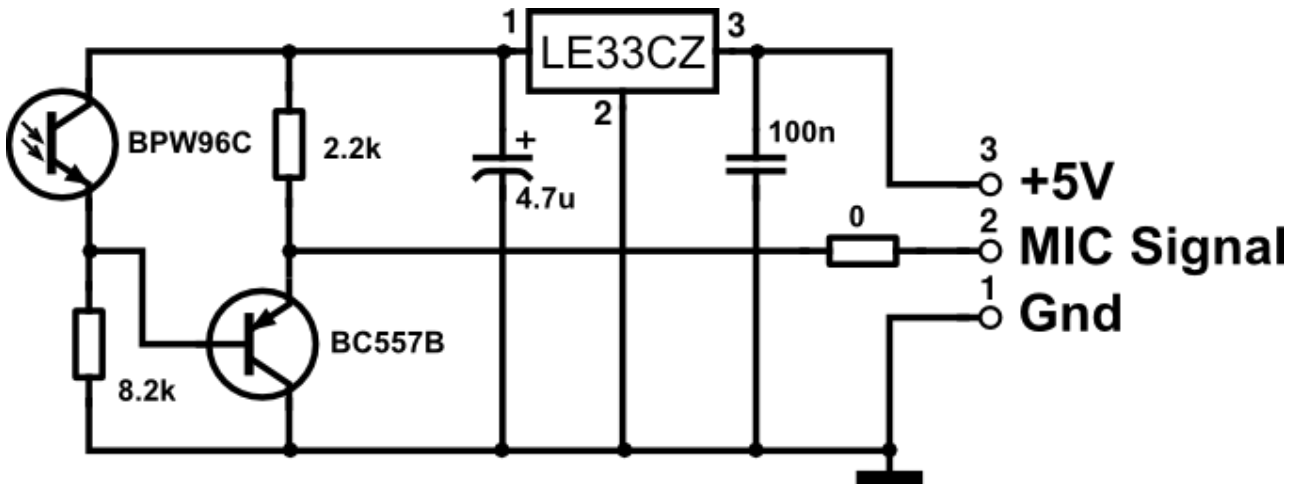
Flicker Sensor

- The video needs to be prepared
  - Square in one corner of the video
  - White square in frame 1
  - Black square in frame 2, etc.
- Flicker sensor measures this square
  - Phototransistor, simple circuit, modified USB soundcard
  - Record signal on PC with every DAW (e.g. Audacity)

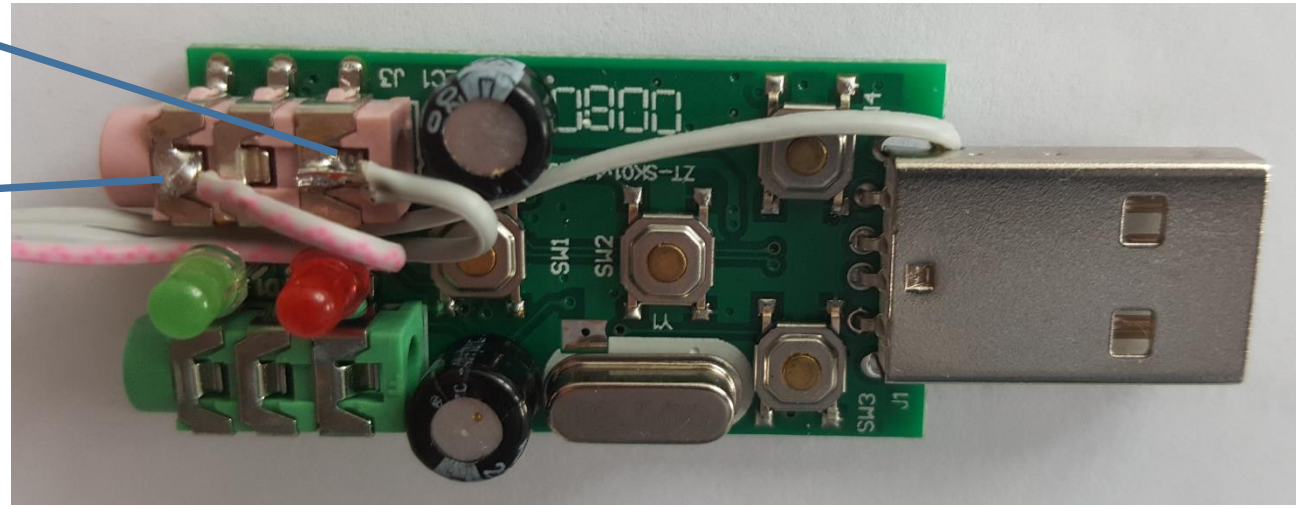
Flicker Sensor: Video

Flicker Sensor: Video

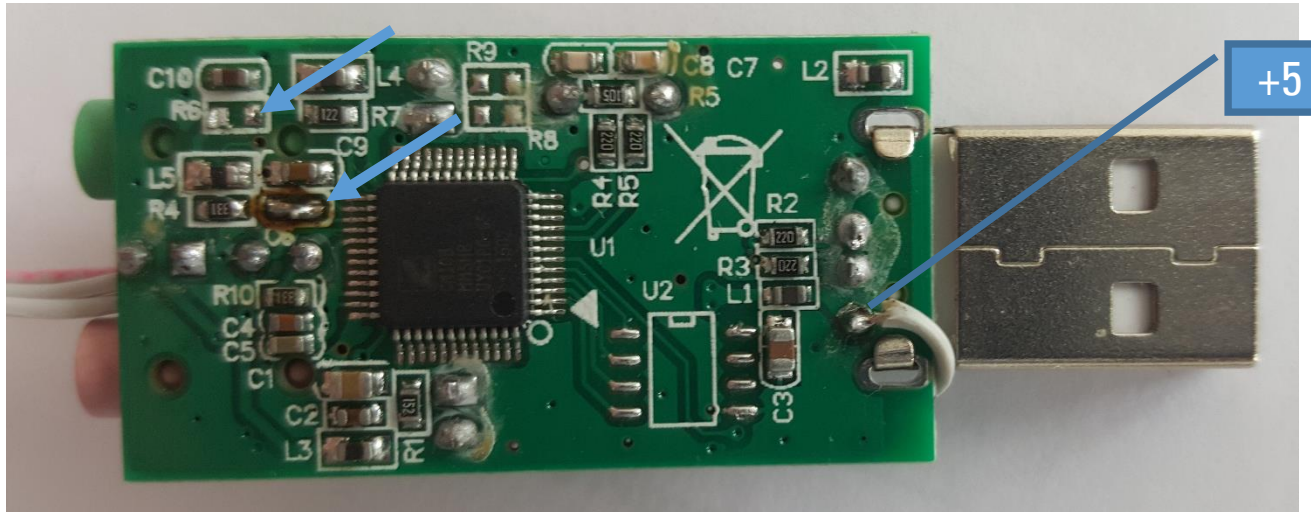
Flicker Sensor: Schematic



Flicker Sensor: Soundcard Modification



- Why:
  AC coupling => DC coupling
- Short circuit C6
- Remove R6
- Beware: some soundcards filter out DC not with a capacitor but with a digital filter



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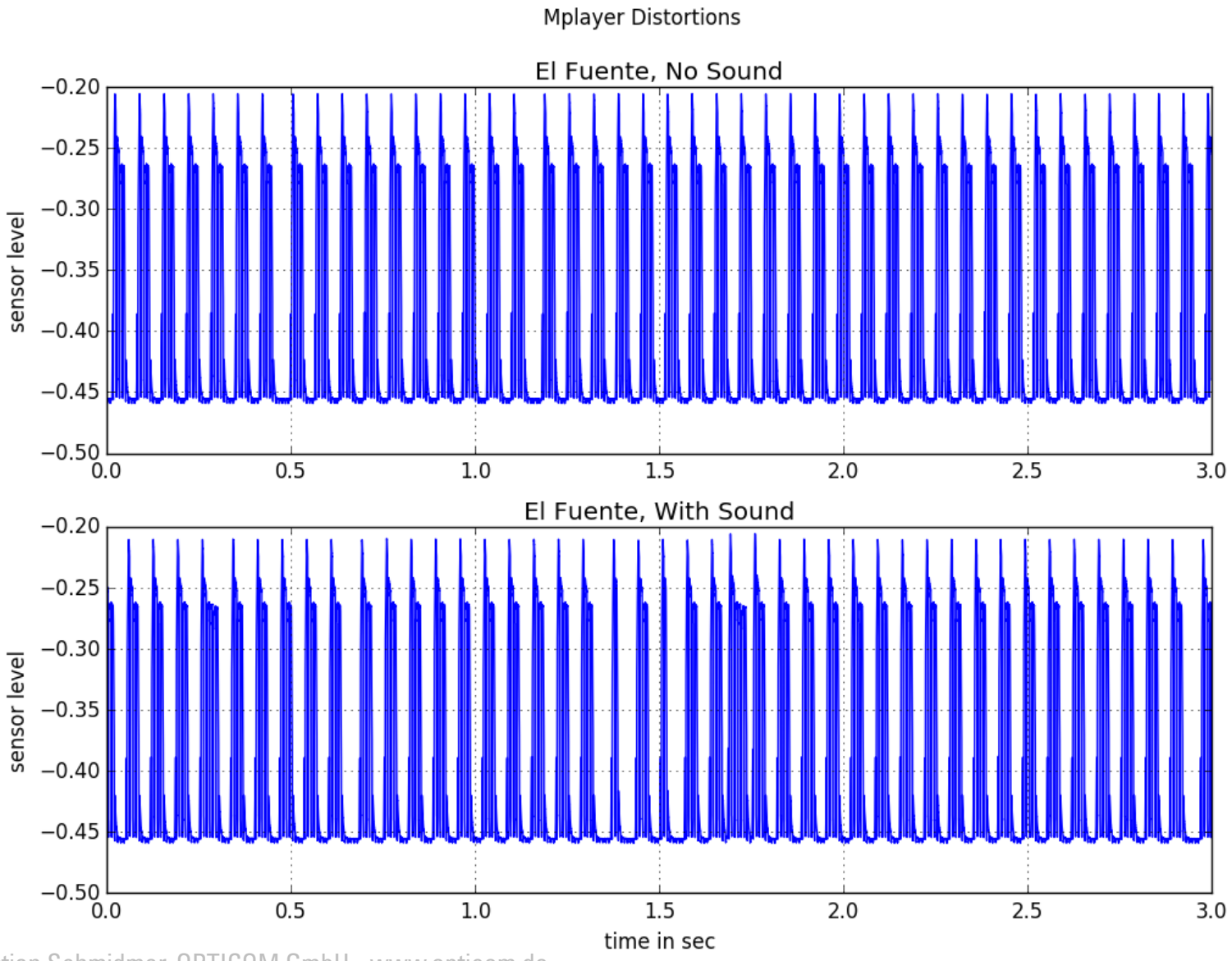
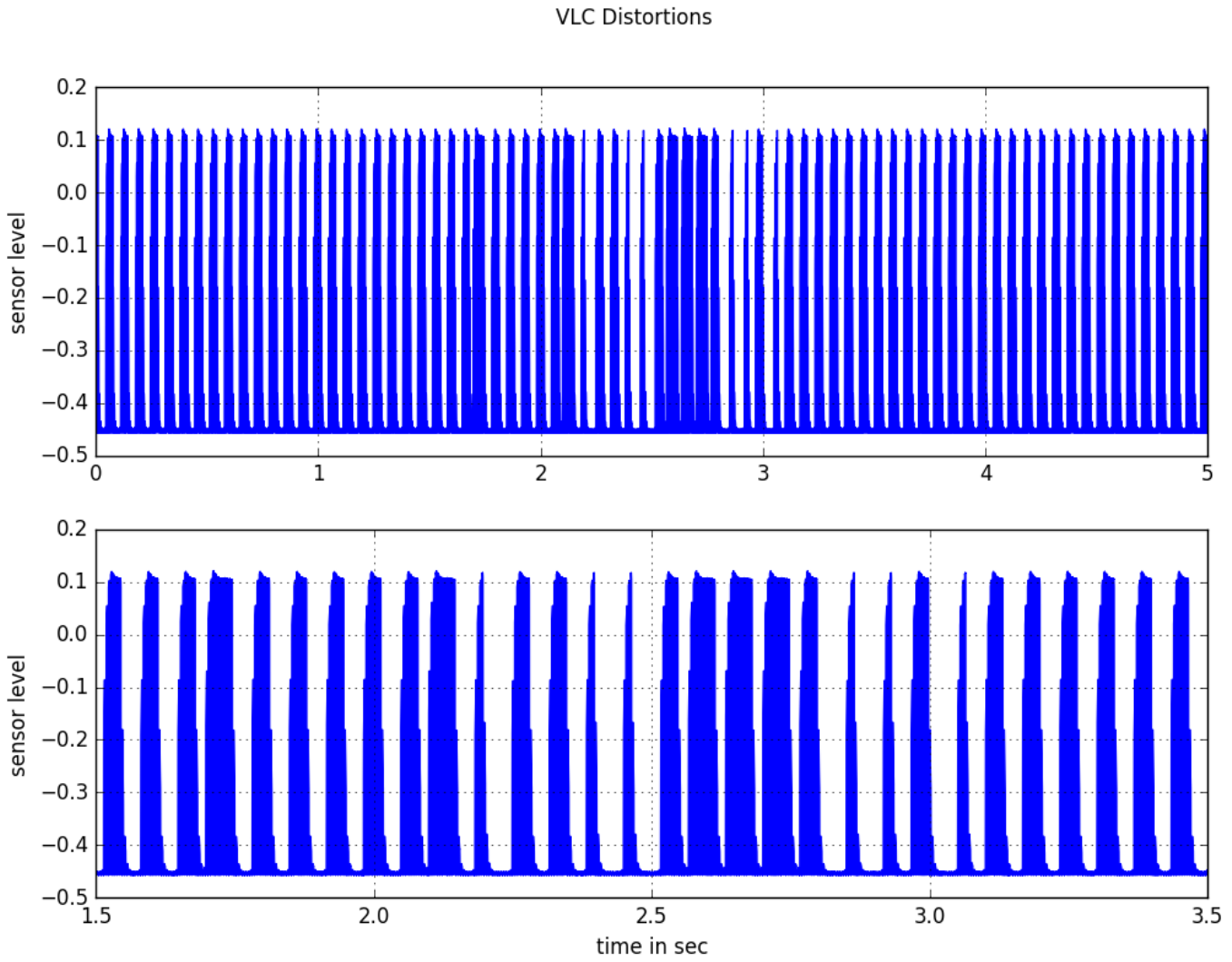
Mplayer

- Windows PC
- Playback to Monitor
- Graphics card set to 60 fps
- Video
  - El Fuente 1920x1080
  - 30 fps
  - Encoded with H.264
- Sporadic flicker without sound
- Regular flicker with sound



VLC

- Windows PC
- Playback to Monitor
- Graphics card set to 60 fps
- Video
  - El Fuente 1920x1080
  - 30 fps
  - Encoded with H.264
- Sporadic flicker about every 10 seconds



Requierments for New Setup

- Full control of the signal path
- Simple to use SDK
- Playback of raw 10 bit 4kp60 (1.3GB/s continuous..)
- Storage for at least 30min of video

New Subjective Test Setup

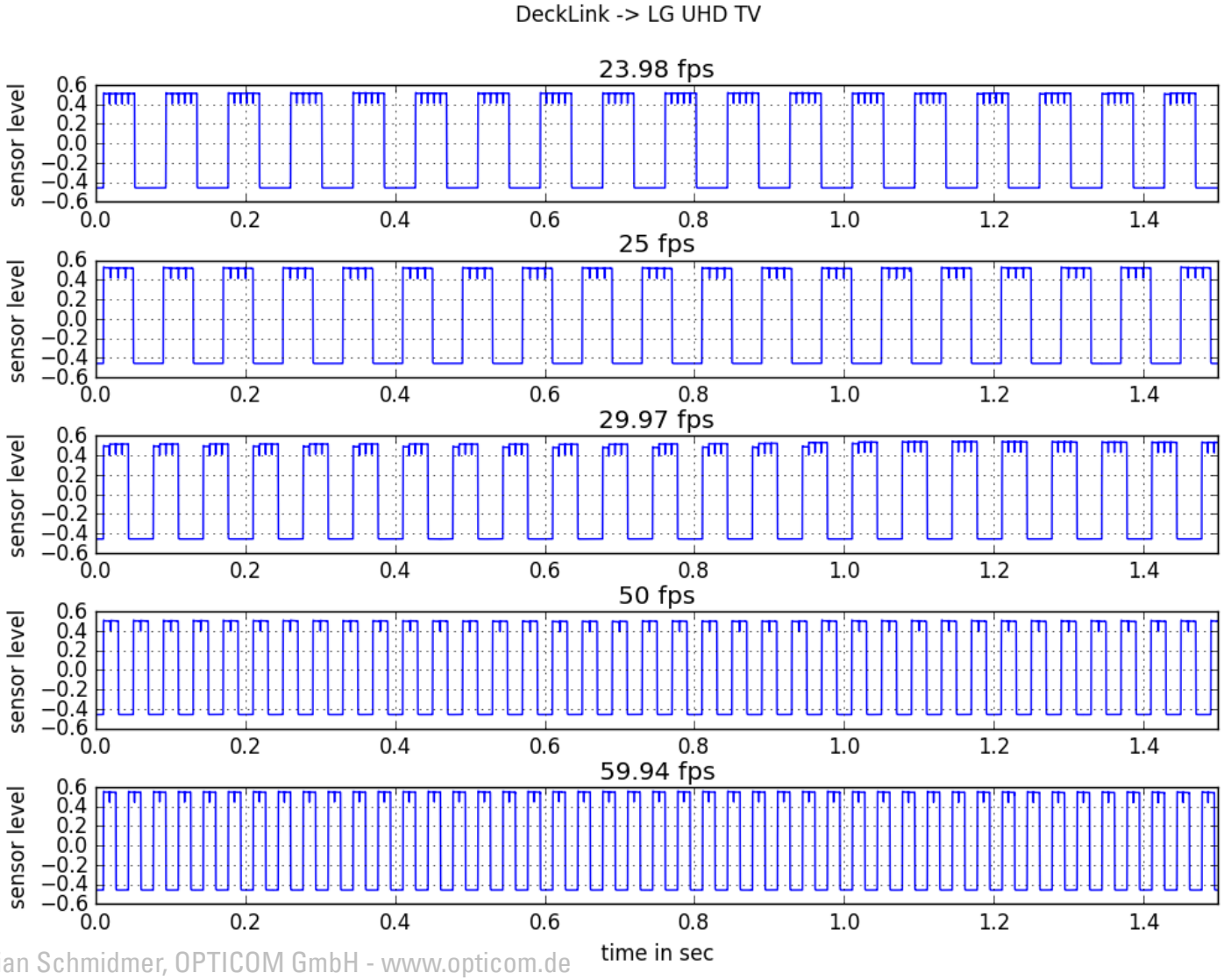
- Hardware
  - Workstation with Windows 10 x64
  - Video playback card
    - Blackmagic Design DeckLink 4K Extreme 12G
    - HDMI output
    - Video Format:
      - Framerates: 23.98, 24, 25, 29.97, 30, 50, 59.94, 60 fps
      - Resolutions: 3840x2160, 1920x1080
      - Pixel formats: uyvy422, v210
    - Audio format: pcm_s16le, 2 channels, samplerate 48 kHz
    - SDK for Windows available
    - Needs a PCIe slot Gen. 2, 8 lanes
  - SSDs
    - two Samsung NVMe SSD 960 PRO M.2
    - Total storage of 4 TB
    - One or two adapter boards M.2 to PCIe; needs either
      - one PCIe slot, Gen. 3, 8 lanes (one adapter)
      - or two PCIe slots, Gen. 3, 4 lanes (two adapters)
    - If a Gen. 2 PCIe slot is used it limits the read speed of the SSD to about 1600 MB/sec which is still enough to play 4K@60 video

New Subjective Test Software

- MMTesting (thanks NTIA!)
  - Second screen
  - Control of the test sessions
  - Scoring
  - Randomization
  - …
- OptiPlay (based on Blackmagic SDK)
  - Actual video playback
  - Source available on request

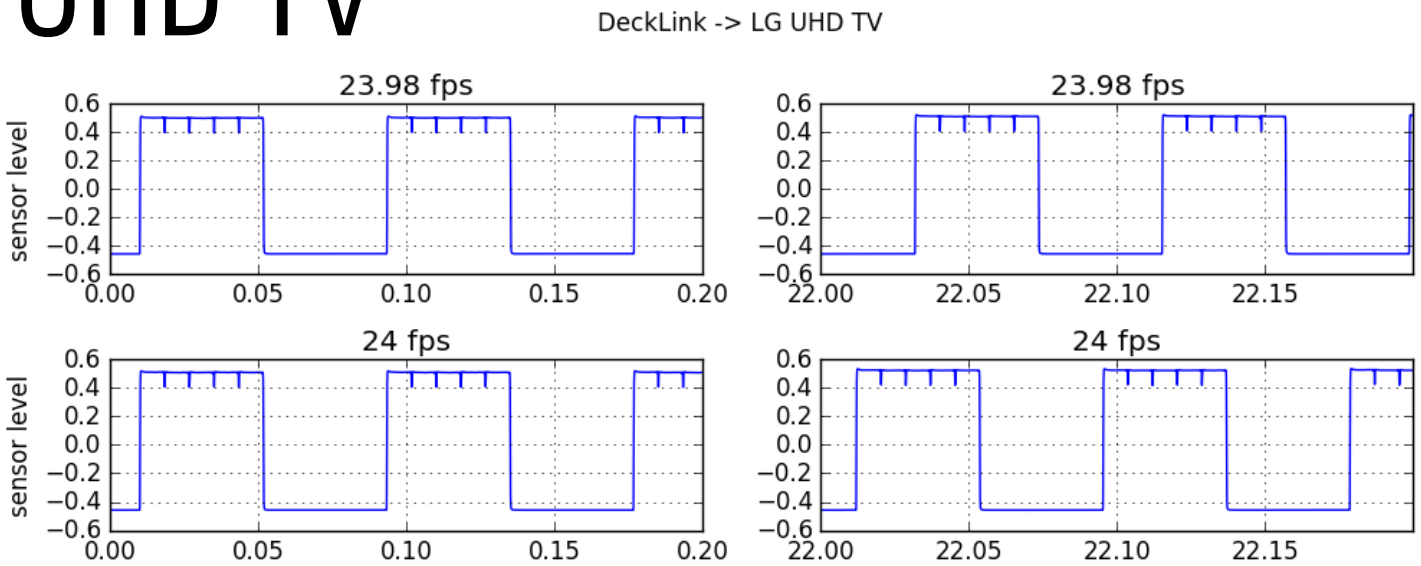
Measurements: LG UHD TV (OLED65C6D)

- Windows PC
- Playback via OptiPlay and DeckLink card
- LG UHD TV
- Video
  - El Fuente 3840x2160
  - Originally 59.94 fps
  - Uncompressed video
  - Played back with various framerates
- No stutter



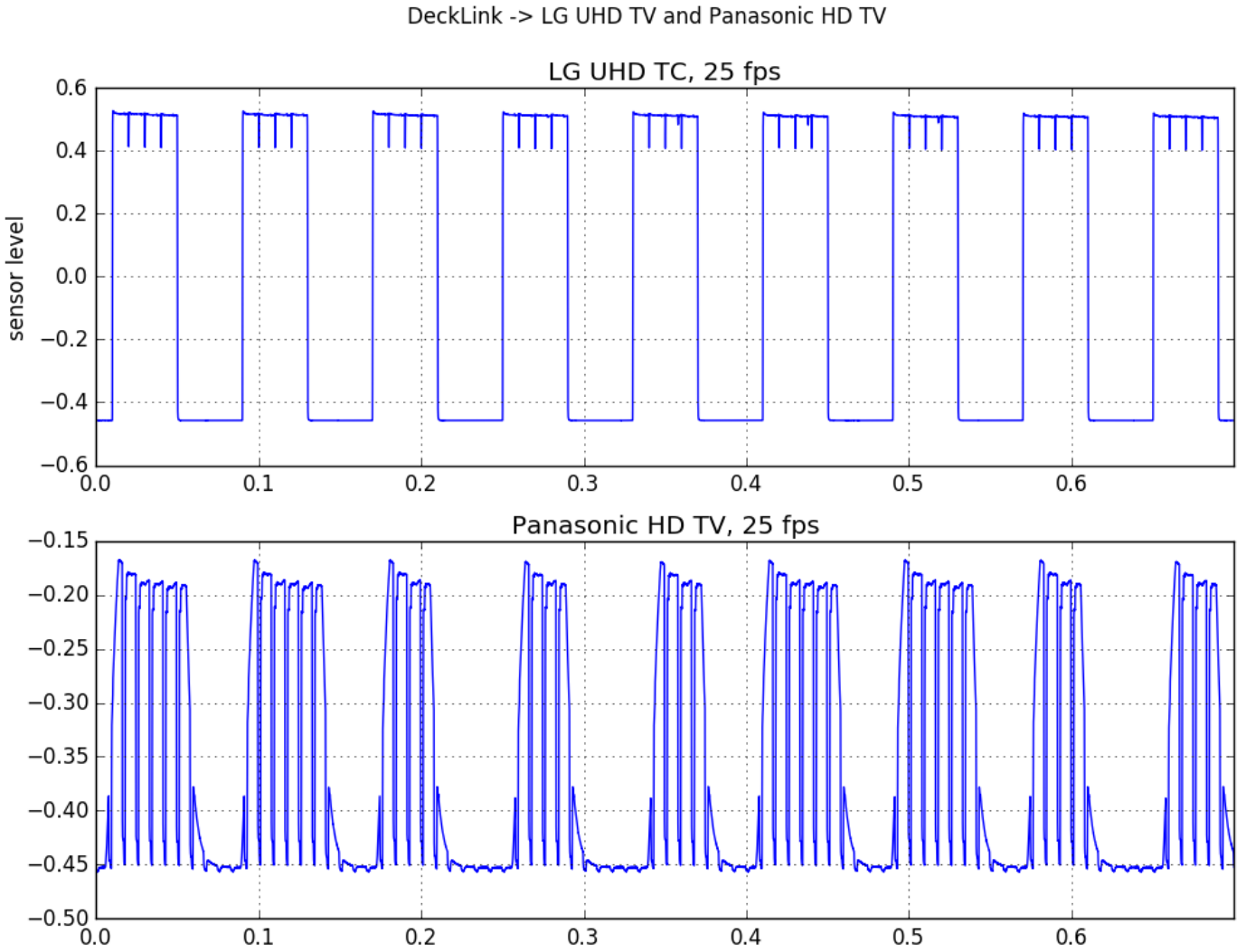
Measurements: LG UHD TV

- Same setup
- Comparison
  - 23.98 and 24 fps
  - 29.97 and 30 fps
- Frame duration is a tiny bit longer for 23.98 than for 24
- Same holds for 29.97 and 30
- No fixed framerate in this setup



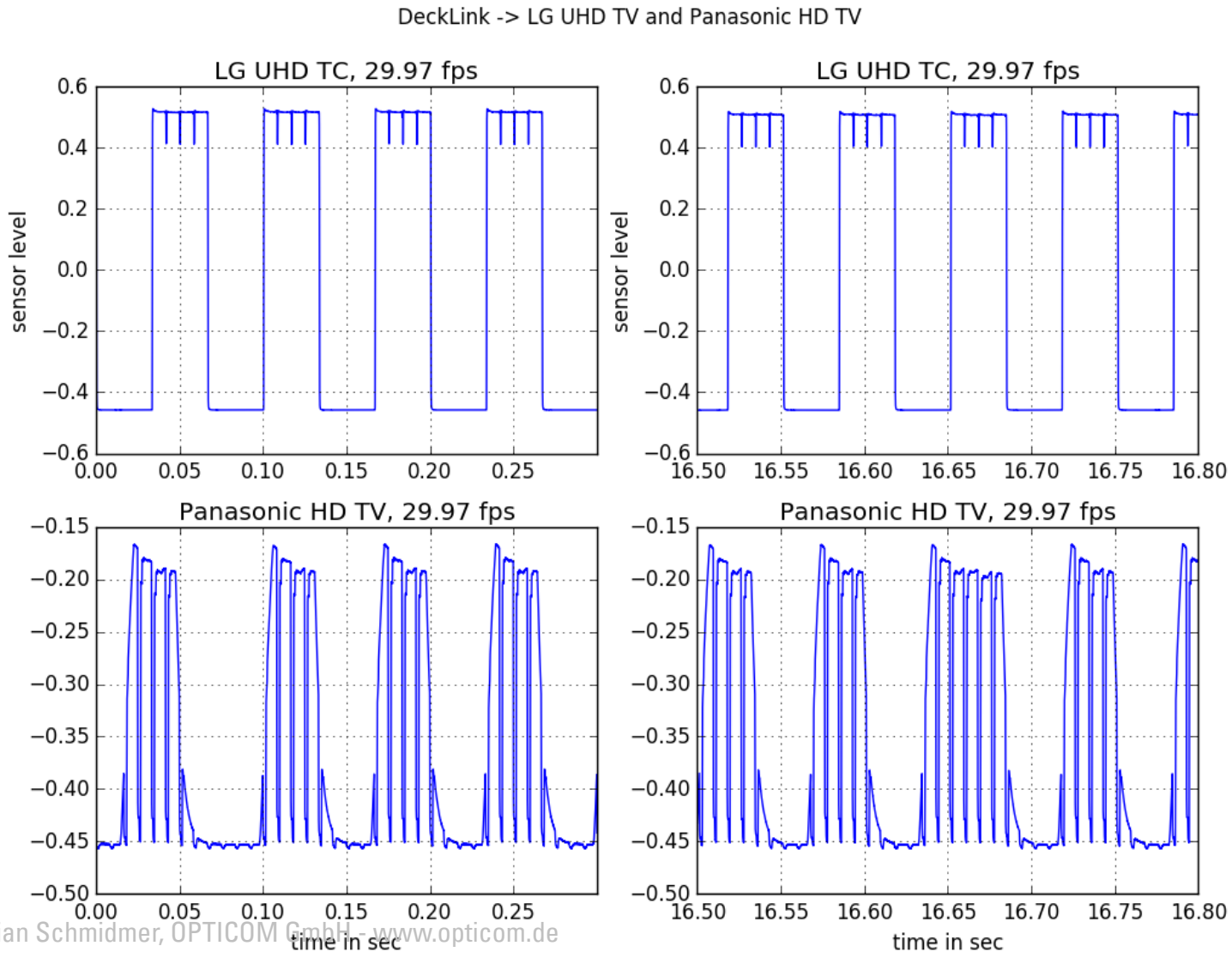
Measurements: Panasonic HD TV

- Comparison
  - 25 fps
  - LG UHD TV with Panasonic HD TV
- LG TV playback is fine
- Panasonic TV
  - plays back in a 3:2:3:2:2 pattern
  - All the other framerates => no pattern
  - You would get the same pattern if you would upsample to 60 fps with ffmpeg



Measurements: Panasonic HD TV

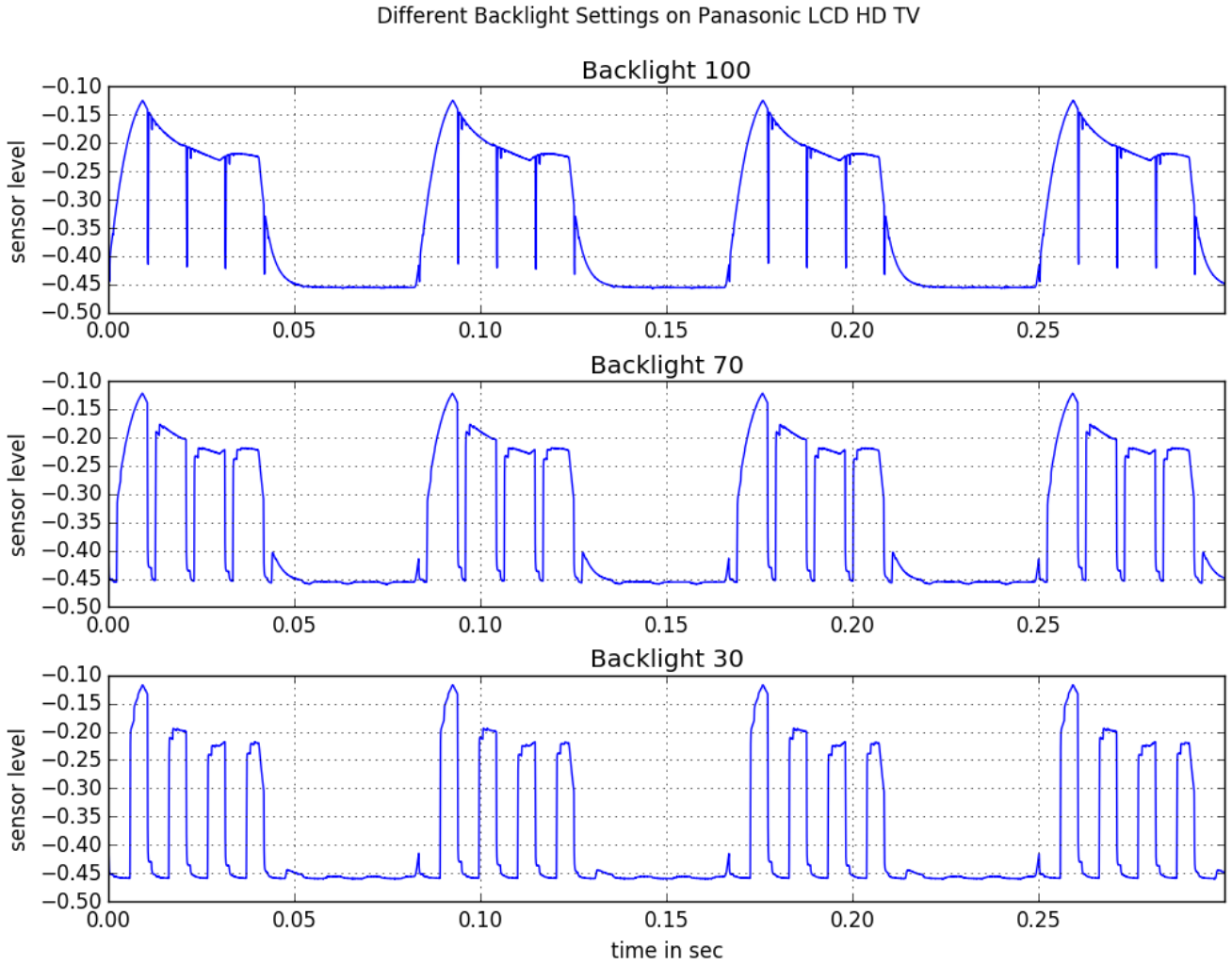
- Comparison
  - 29.97 fps
  - LG UHD TV with Panasonic HD TV
- LG TV playback is fine
- Panasonic TV
  - Longer frame every 16.6 seconds



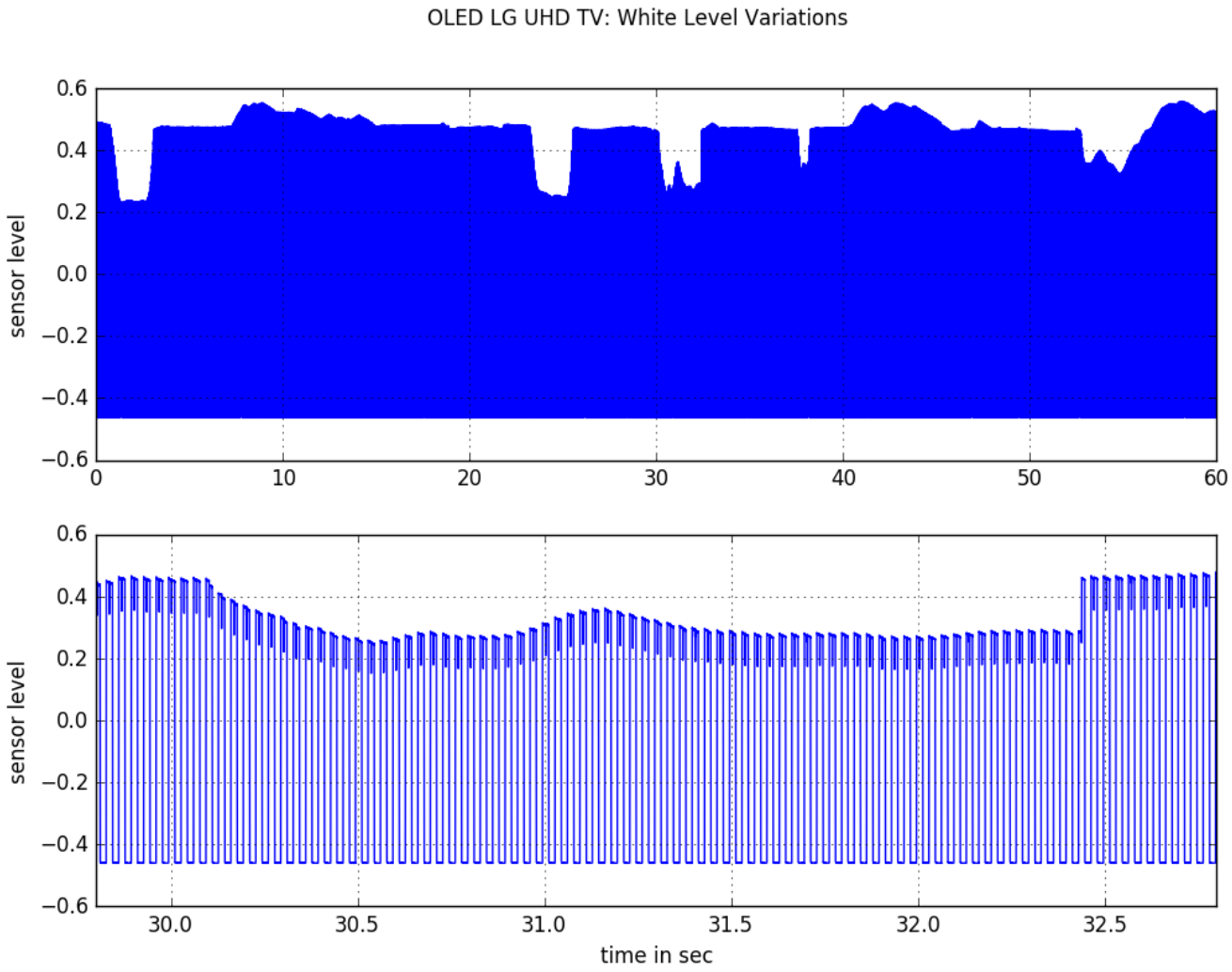
Conclusions

- Don‘t trust your subjective video setup, measure it!
- Don‘t trust your TV, it might introduce distortions!

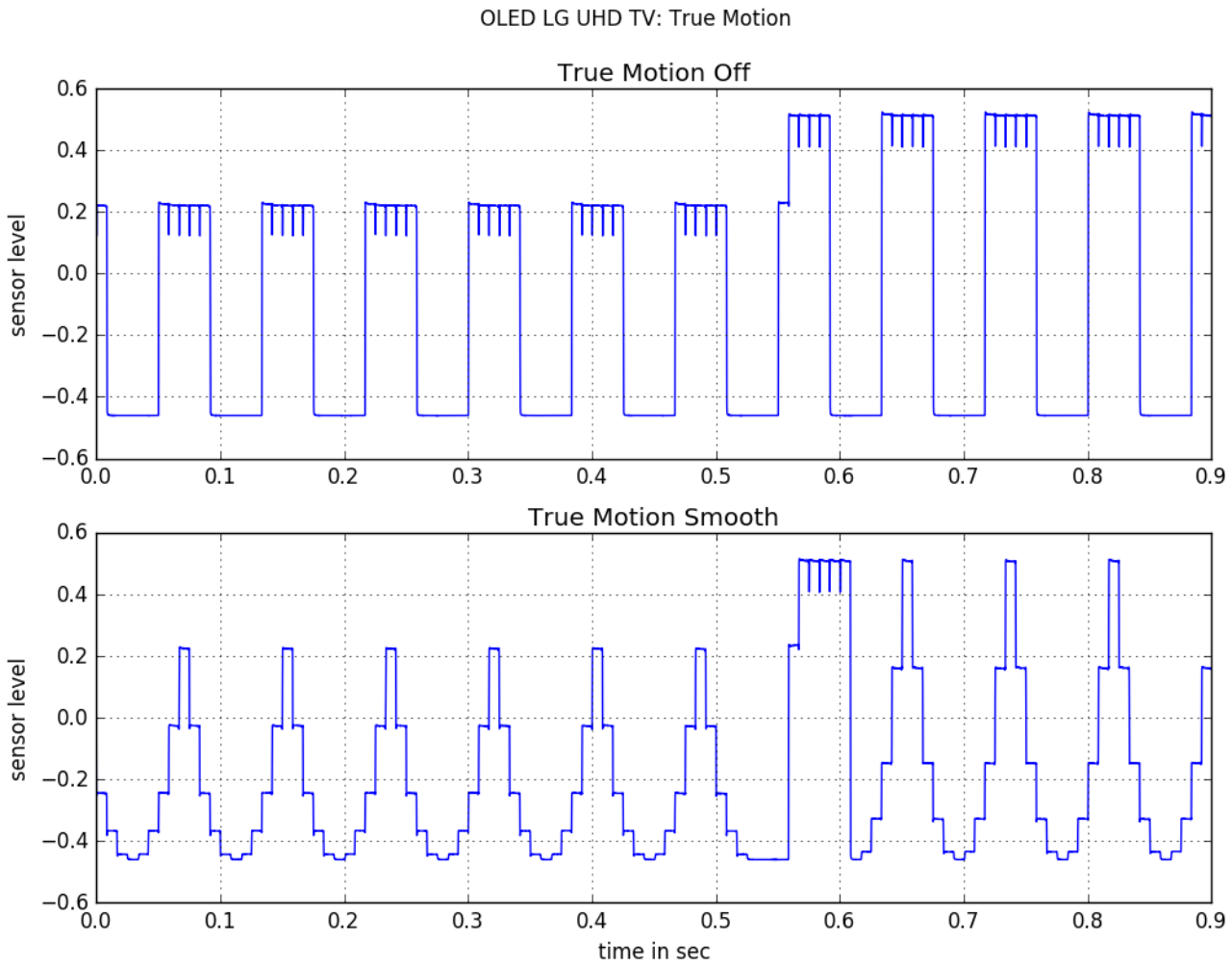
LCD TV: Backlight



OLED TV: White Level



LG TV: „True Motion“



PC Specification

- Fan, case, power supply 650W, Windows 10 Pro 64bit
- Fujitsu Mainboard D3348-B2, ATX, socket 2011 (v3/v4)
- Intel Xeon E5-1620V4, 3.5GHz, 4 cores / 8 threads, 10MB Cache, socket 2011 (v3)
- 32 GB of RAM (ECC)
- ZOTAC GeForce GT 710, 1GB, passiv, DVI-D / HDMI / VGA, PCIe x1
  The Xeon CPU does not have integrated graphic, so this card is needed.
- Samsung SSD 850 Evo 2,5" 500GB (SATA) for the OS
- Two Samsung SSD 960 PRO 2TB M.2 2280 NVMe for the videos
- Fujitsu M.2 Carrier Board D3352-A GS1 to hold the two NVMe SS