Refresh Rate Analysis of ASUS_ROG_SWIFT_PG259QNR

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About The Monitor

Up to 360Hz with Hardware support for NVIDIA G-SYNC. Read more on manufacter's website.

Setup and Methods

Photocell data acquired via LabJack with logData.c on the MK2 computer (Figure M1). The photocell circuit board features a jumper that controls the gain, i.e. the relationship between lumince and voltage. Jumper location for each data file is recorded in the **data table** in Data Collected section below.

The display was setup such that only the ASUS ROG SWIFT 360Hz PG259QNR was active, i.e. NOT dual display (Figure M2). Contrast and Brightness were typically set to max in the Nvidea software, but see **data table** in Data Collected for more info.

Photocell data was collected while the monitor flashed black-to-white for 4 s at the monitor's refresh rate as set in the Nvidia software. PTB-3 was used to control stimuls presentation, and stimuli where full screen rectangels of RGB of (0,0,0), i.e. black, or white (255, 255, 255).

- Copy of PTB-3 code: `Z:\Monitors\ASUS_ROG_SWIFT_PG259QNR\2021-December-03\setup\PTBPhotocellTest.m`

Additionally, Photocell data was collected in a few control conditions:

1. Dark Current - Black tape over the photocell and placed facedown on a black table.
2. Steady State - Photocell over a static black, i.e. RGB (0,0,0) or white, i.e. RGB 255, 255, 255) image.

Figure M1: Photocell on Monitor

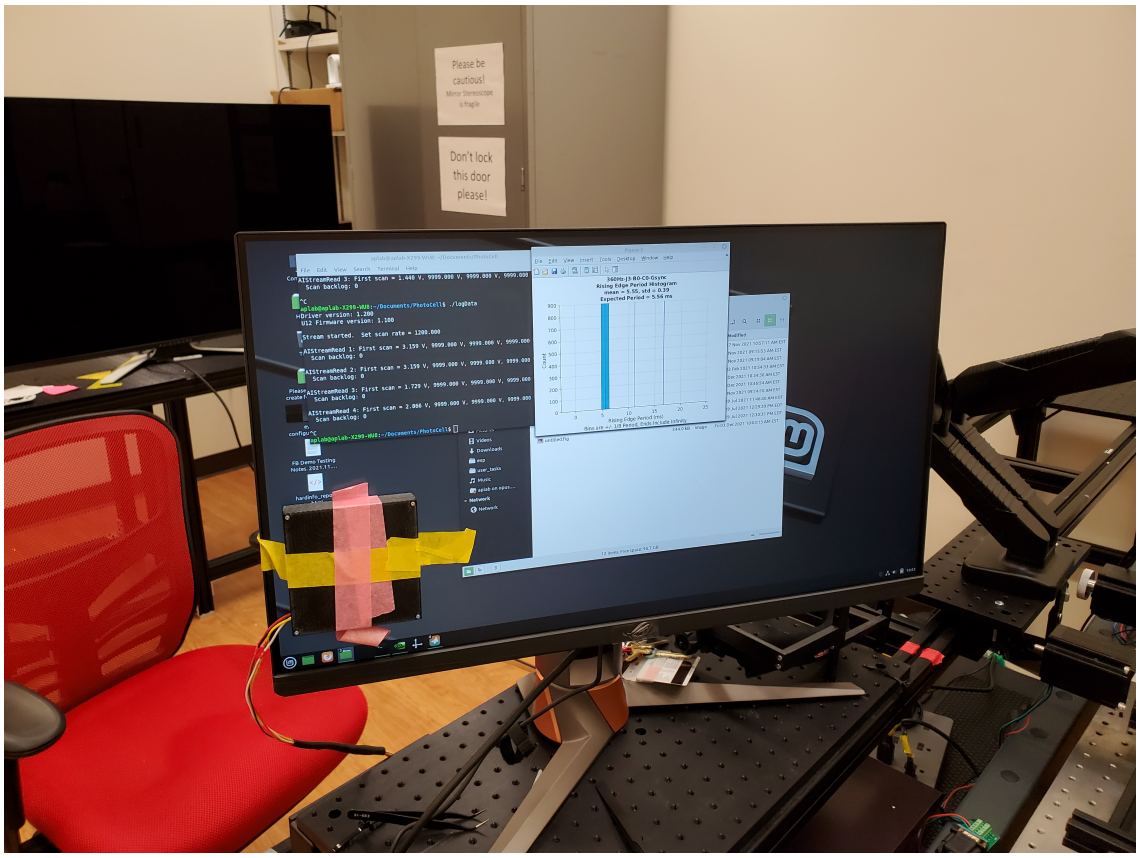
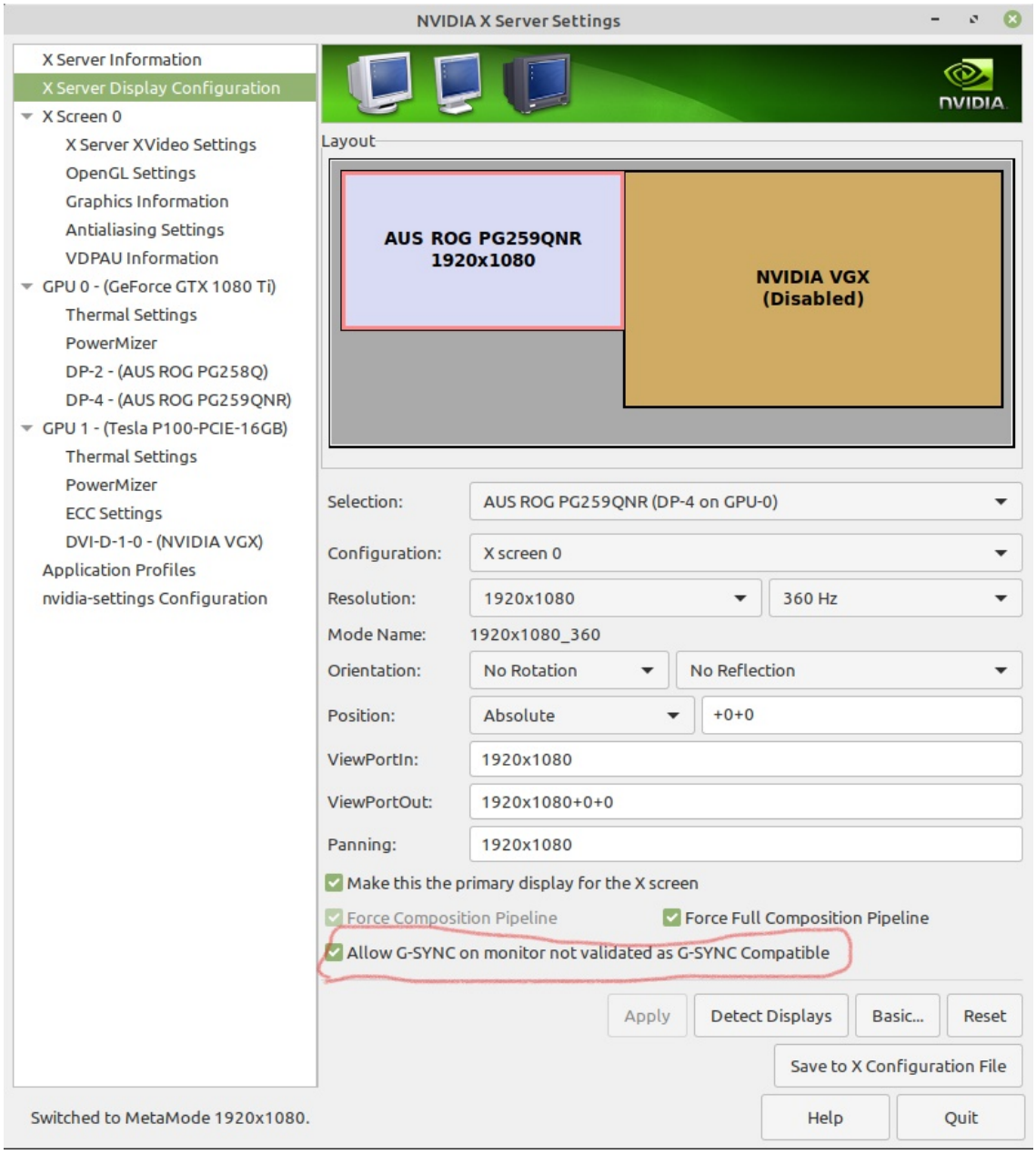
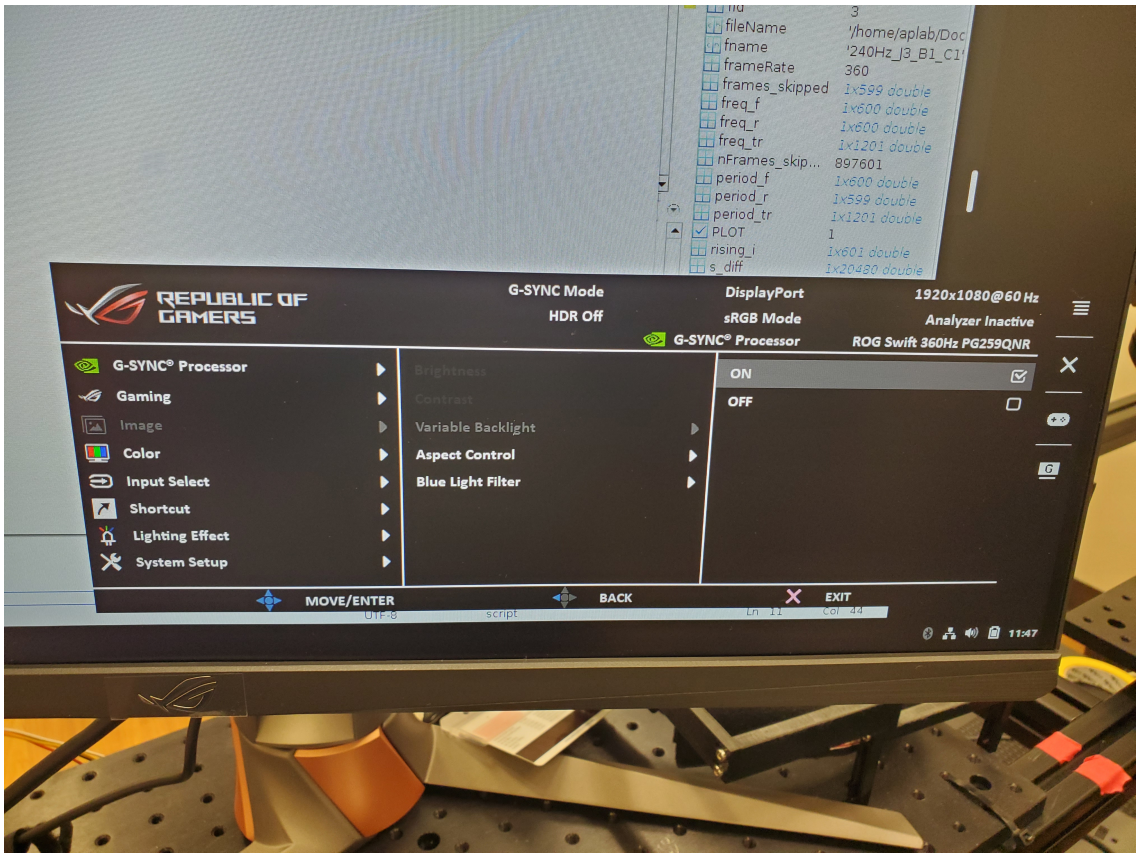


Figure M2: Screen Shot of Nvidea Settings
"Allow G-SYNC on monitor not validated as G-SYNC Compatible"



M3: Variable Backlight Setting on Monitor



Data Collected

See `Z:\Monitors\ASUS_ROG_SWIFT_PG259QNR\2021-December-03\data\`

Filename	Refresh Rate (Hz)	Photocell Jumper	Nvidia Brightness	Nvidia Contrast	Nvidia Gamma	Variable Backlight	Allow G-SYNC on monitor not validated as G-SYNC Compatible
60Hz_J3_B1_C1	60	3	1	1	1	Off	Yes
144Hz_J3_B1_C1	144	3	1	1	1	Off	Yes
240Hz_J3_B1_C1	240	3	1	1	1	Off	Yes
360Hz_J3_B1_C1	360	3	1	1	1	Off	Yes
J3_darkcurrent	n/a - steady state darkness	3	n/a	n/a	n/a	n/a	n/a
J3_000_B1_C1	n/a - steady state BLACK (0,0,0)	3	1	1	1	Off	Yes
J3_255_B1_C1	n/a - steady state WHITE (255,255,255)	3	1	1	1	Off	Yes
60Hz_J3_B1_C1-BacklightON	60	3	1	1	1	On	Yes
240Hz_J3_B1_C1-BacklightON	240	3	1	1	1	On	Yes
360Hz_J3_B1_C1-BacklightON	360	3	1	1	1	On	Yes
360Hz_J3_B0_C0_Gsync	360	3	0	0	1	Off	Yes
360Hz_J3_B0_C0_NoGsync	360	3	0	0	1	Off	No
360Hz_J3_Bn1_Cp1_Gsync	360	3	-1	1	1	Off	Yes
J1_darkcurrent	n/a - steady state darkness	1	n/a	n/a	n/a	Off	n/a
J5_darkcurrent	n/a - steady state darkness	5	n/a	n/a	n/a	Off	n/a

> **Photocell Jumper** = Location of jumper of photocell circuit board. Gain increases with location, i.e. Postion 5 is a greater gain than postion 1. The gain controls how monitor luminace is converted to voltage by the photocell.
>
> **Nvidia Brigntness, Contrast, Gamma** = The setting make in the Nvidia software under color correction. Controls the overall brighness and darkness of the monitor. We typically run experiments at Brightness = 0 and Contrast = 0 and Gamma ~ 2.
>
> **Variable Backlight** = This monitor has the option to have a Variable Backlight. Not toally sure what this does, but reviewers of monitors online says it makes the blacks blacker, e.g. see this review
>
> **Allow G-SYNC on monitor not validated as G-SYNC Compatible** = This is a setting in the Nvidea software, and I though that maybe it would turn off G-SYNC, but I don't think it did as this monitor is explicilty G-SYNC capable.

Results for Brightness 1, Contrast 1, and Jumper 3

All data below as collected using the same Nvidia software settings (Brightens 1, Contrast 1, Gamma 1) with the photocell jumper in position 3. By default, the Variable Backlight setting on the monitor was turned off except where indicated (i.e., the 2nd column of the 2 column figures below).

CODE: `Z:\Monitors\ASUS_ROG_SWIFT_PG259QNR\2021-December-03\runDataLogOfPhotoCellDataForReport.m`

FIG FILES: `Z:\Monitors\ASUS_ROG_SWIFT_PG259QNR\2021-December-03\plots`

Increasing Refresh Rate Decreases Max and Min Luminance

Figure R1: Range

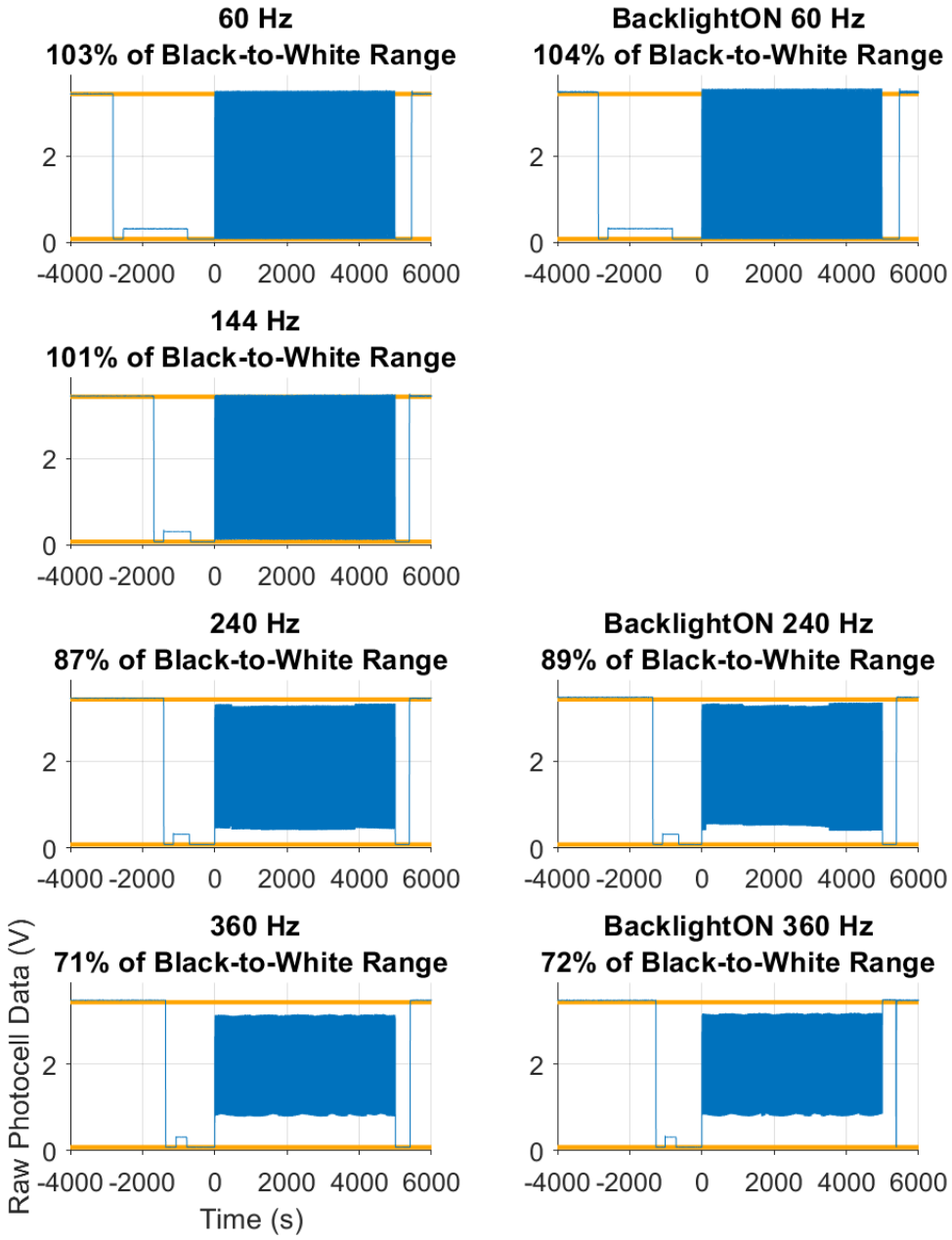


Figure R1: Photocell voltage (y-axis) during presentation of black-to-white images (blue lines) at varying refresh rates (subplots, each row is a different refresh rate, see title). Stimulus presentation starts at time 0 on the x-axis. Voltage data appears as a block given scaling of x-axis (see Figure R2 for zoomed data). Orange lines indicate the average voltage measured with a steady state white image (higher value) and black image (lower value). Title reports that percentage of this range that is covered by the time-varying data. Note how at higher refresh rates, the blue lines do not reach the orange lines. Turning on the monitor's Variable Backlight (left column) slightly increases the range covered.

Figure R2: Temporal Dynamics

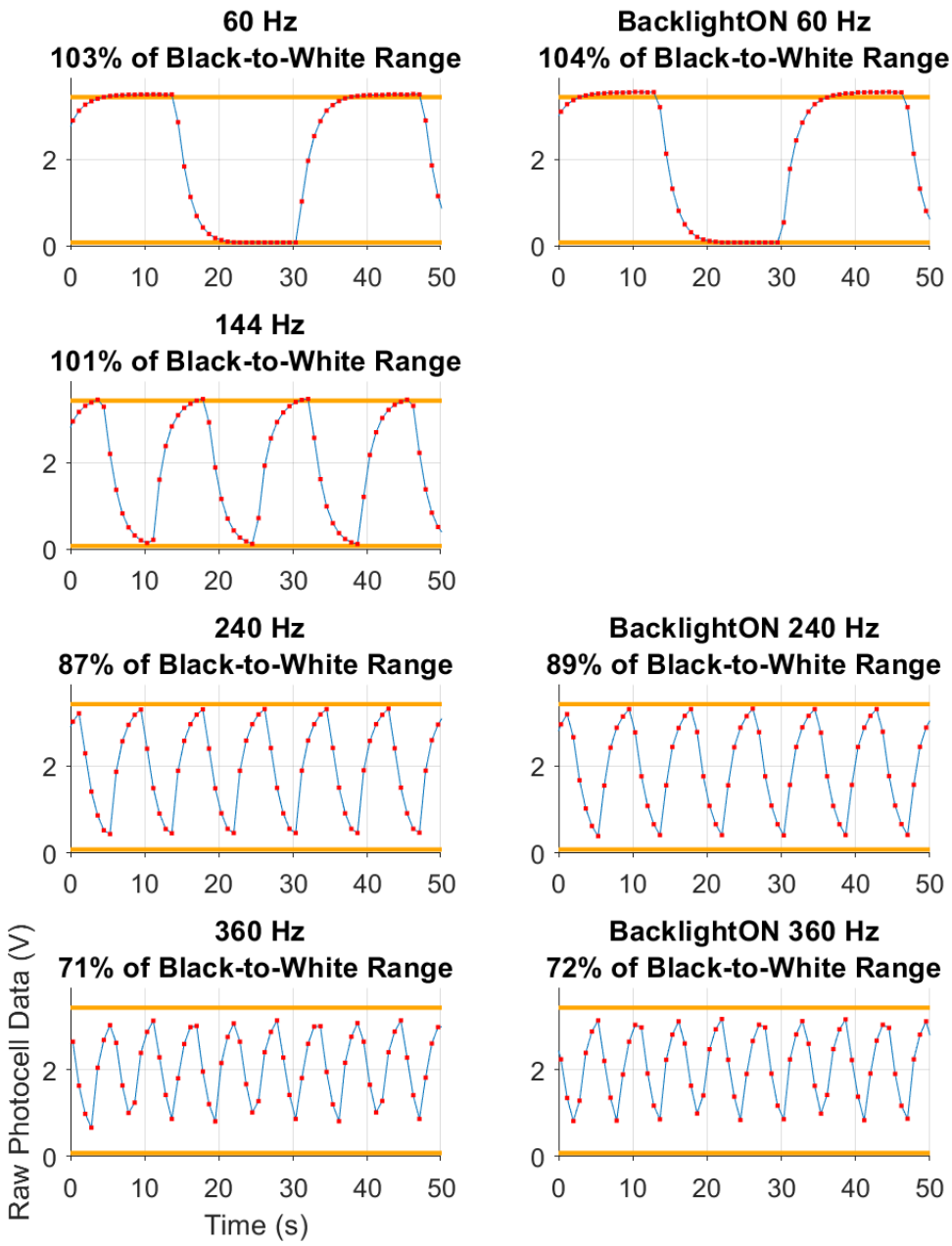
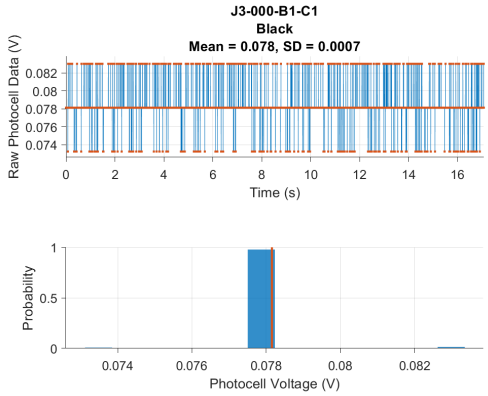
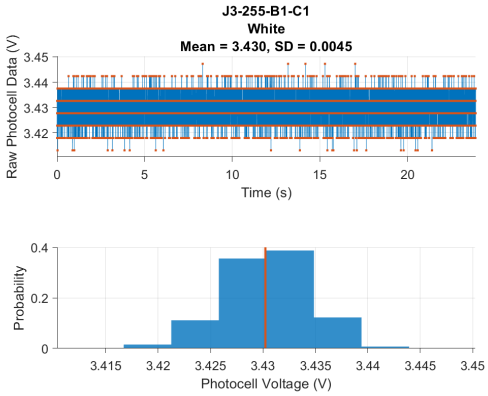


Figure R2: Same data as R1 with an x-axis showing 50ms. Photocell voltage (y-axis) during presentation of black-to-white images (blue lines) at varying refresh rates (subplots, each row is a different refresh rate, see title). Red data points are individual photocell measurements (Fs = 1200). Stimulus presentation starts at time 0 on the x-axis. Orange lines indicate the average voltage measured with a steady state white image (higher value) and black image (lower value). Title reports that percentage of this range that is covered by the time-varying data. Note how at higher refresh rates, the blue lines do not reach the orange lines. Turning on the monitor's Variable Backlight (left column) does not seem to change the temporal dynamics of the data.

Figure R3: Steady-State Black	Figure R3: Steady-State White
	

> R2 & R3: Photocell voltage (y-axis) during presentation of steady-state images. Top plot shows data over time, bottom plot is distribution of data above. Mean and standard deviation of voltage in reported in title. Mean value is plotted as orange lines in Figure R1 and R2.

Refresh Rate Seems to be Reliable

Figure R4: Period Analysis

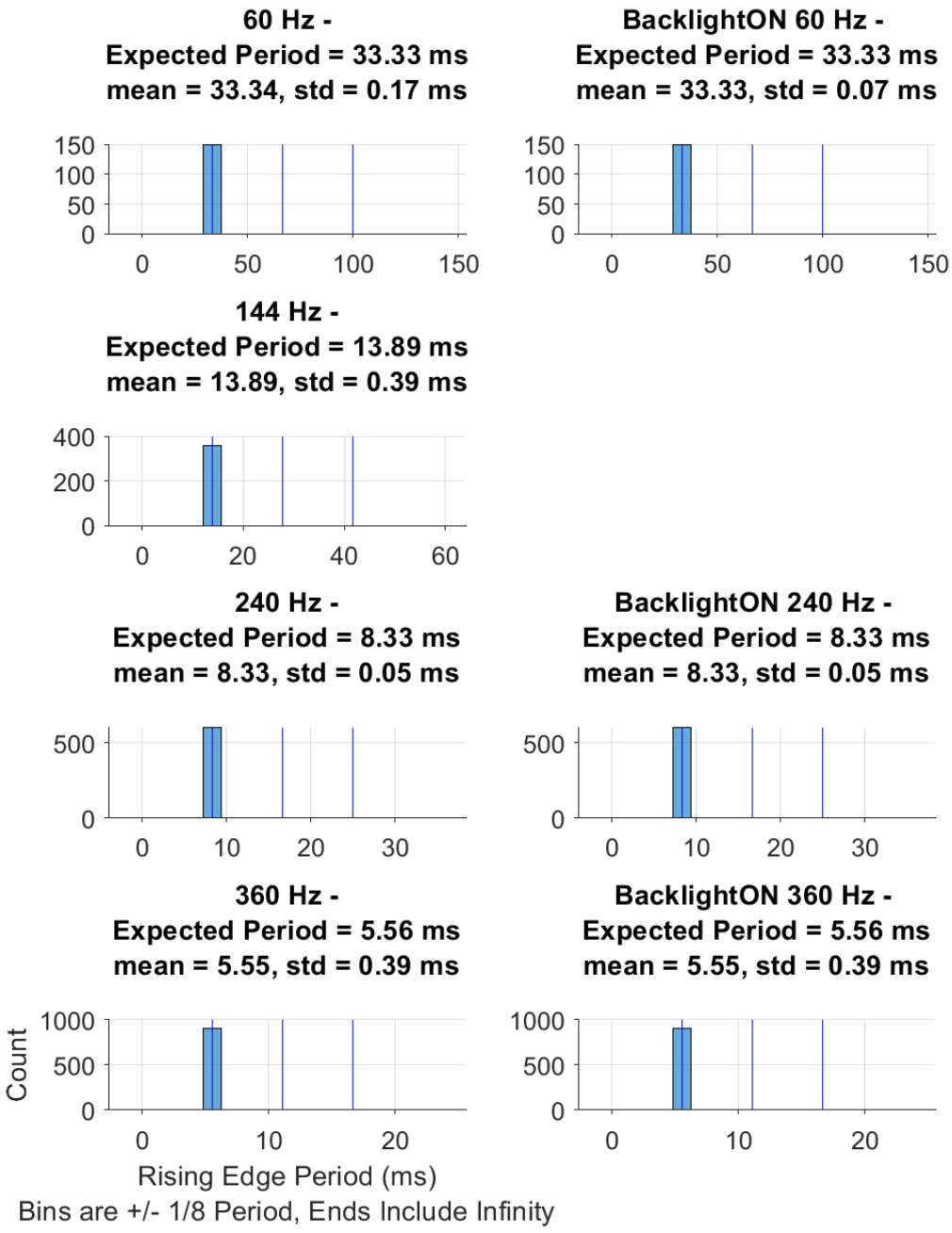
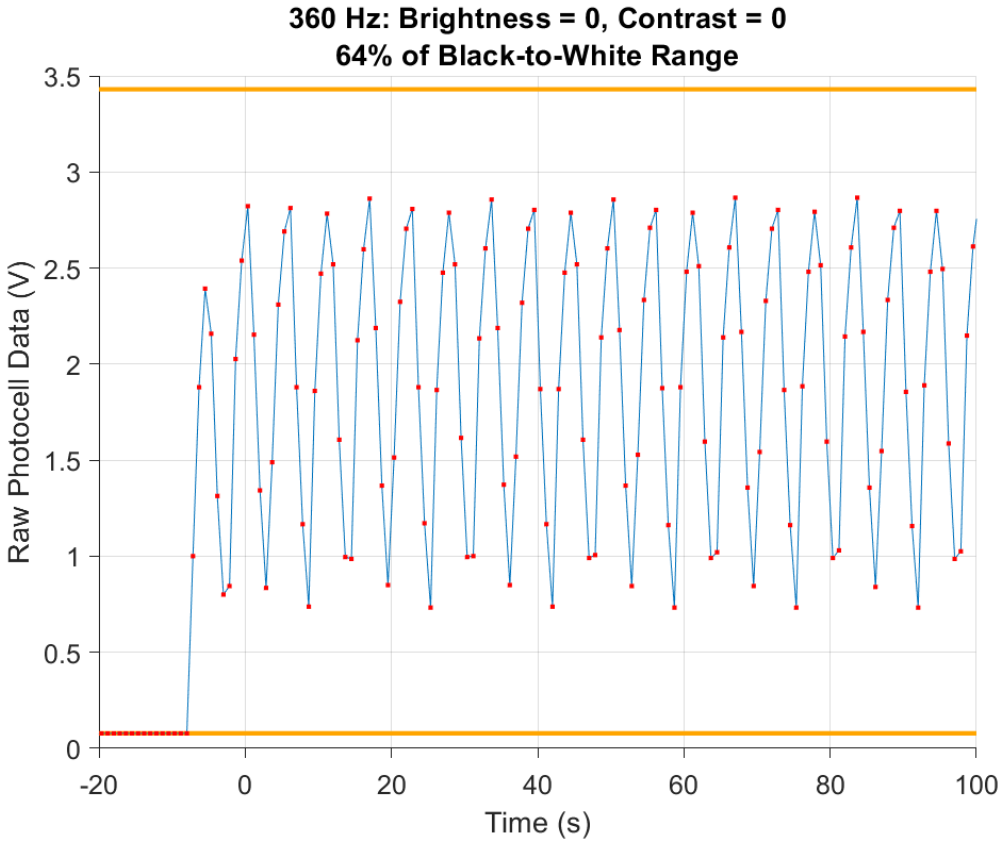


Figure R4: Distribution of differences in photocell rise time, after thresholding voltage data. In all cases, average period (white-to-white) matched the expected period given the monitor's refresh rate.

Results for Other Brightness / Contrast

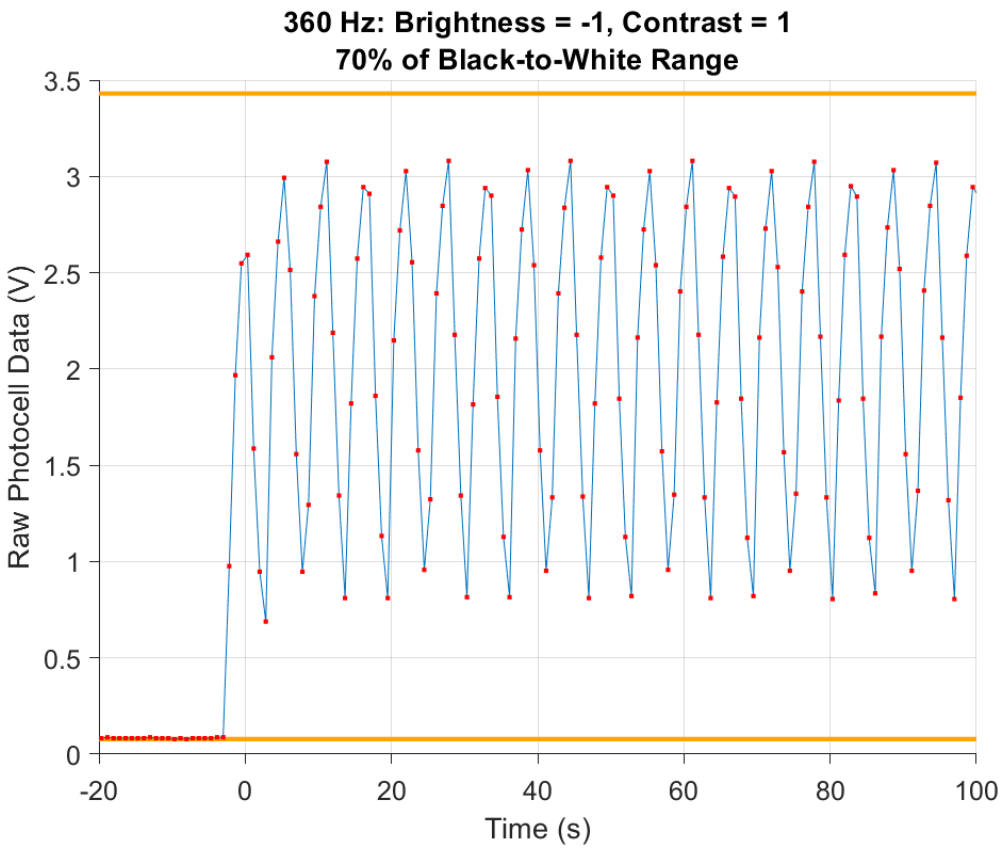
Brightness and Contrast Impact Max and Min Luminance, But do Not Bring 360Hz to Full Range

R5: Temporal Dynamics for Brightness = 0 and Contrast = 0



All conventions as in R2, though more time is show across the x-axis.

R6: Temporal Dynamics for Brightness = -1 and Contrast = 1



All conventions as in R2, though more time is show across the x-axis.