EIC DIRC Laser Area Exit Light Study

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Contents

- Overview of problem
- Exit light behavior & hypotheses
- Test 1 – visual behavior
- Test 2 – oscilloscope test
- Conclusions

Overview of Problem

- OSHA requires exit lights in any area personnel will occupy
  - OSHA Standard Number 1910.37
- EIC DIRC quartz bar acceptance test require a dark environment
  - Laser area is being set up in EEL 108 for tests
- Exit light in area will be picked up by test station photodiodes, effecting their measurements
  - Light can not be treated as background noise and subtracted off of measurements due to its output varying due to the AC power
  - Conclusion reached in Monday, September 25, 2023 meeting

Red LED that photodiode was placed in front of (discussed in later slides)

Light emitted from green AC power status LED. LED is on bottom of sign and not visible in photo.

Right:
Photo of exit light in EIC DIRC laser test area with lights in room off. One of the red LEDs producing the light and the light emitted from the sign's green AC power status LED are boxed in blue.

Exit Light Behavior & Hypotheses

- Normal operation:
  - Red LEDs are on
  - Green LED indicating sign has AC power is on
- When sign's test button is pressed:
  - Red LEDs stay on
    - Assuming that LEDs stay on due to a battery backup
  - Side emergency lights turn on
  - Green LED turns off

- Hypotheses:
  - The green LED is AC powered
    - Light output will vary over time
  - The red LEDs are DC powered by the battery back-up circuit
    - Light output will be constant over time

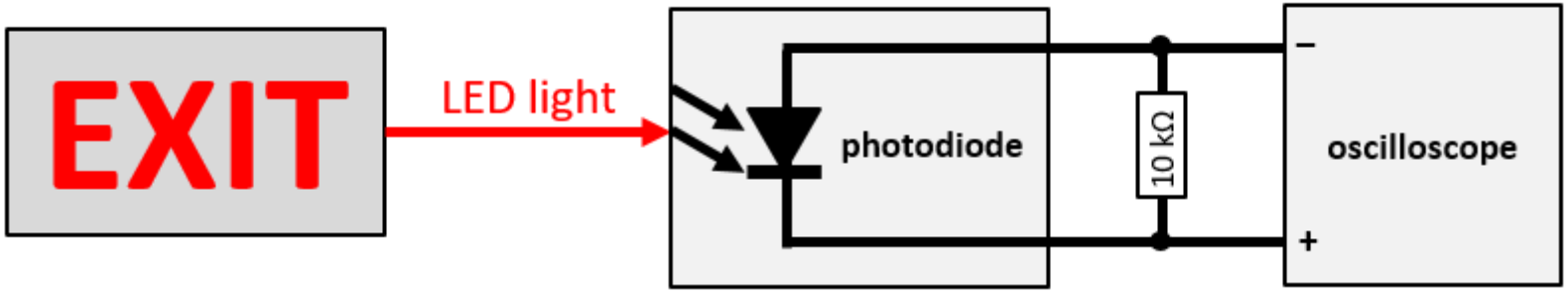
Test 1 – Visual Test

- Test procedure:
  - Record sign in slow motion using phone
    - Ten times slower than normal
- Expectations:
  - AC powered LEDs to flicker in video
    - Standard 60 Hz AC power gets rectified, causing flickering at about twice the frequency of the AC power
  - DC powered LEDs to stay at a constant output level
- Test results:
  - Visible flickering of green LED
  - No flickering seen of red LEDs

Link to slow motion video of exit sign uploaded to JLab userweb space

Test 2 – Oscilloscope Test

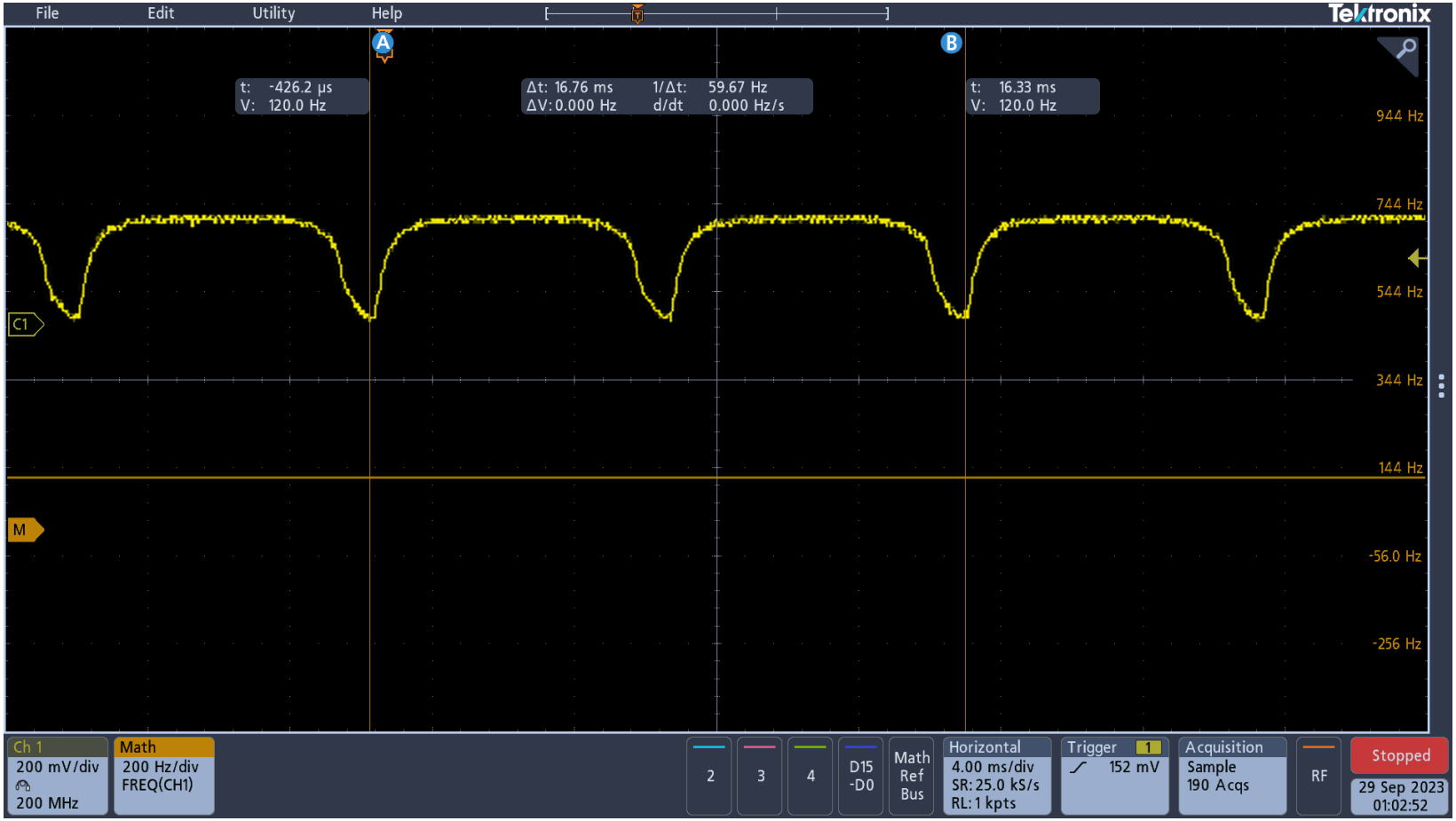
- Test procedure:
  - Use one of the photodiodes for quartz bar tests with 10-kΩ resistor in series with photodiode and measure voltage drop across resistor with oscilloscope
  - Any oscillations in voltage caused by changes in light levels can be seen using the oscilloscope
- Expectations:
  - Green LED will induce an oscillating signal
    - Estimate 120 Hz because of rectified, 60-Hz AC power
  - Red LEDs will induce a constant signal



Simplified system diagram of test set up.

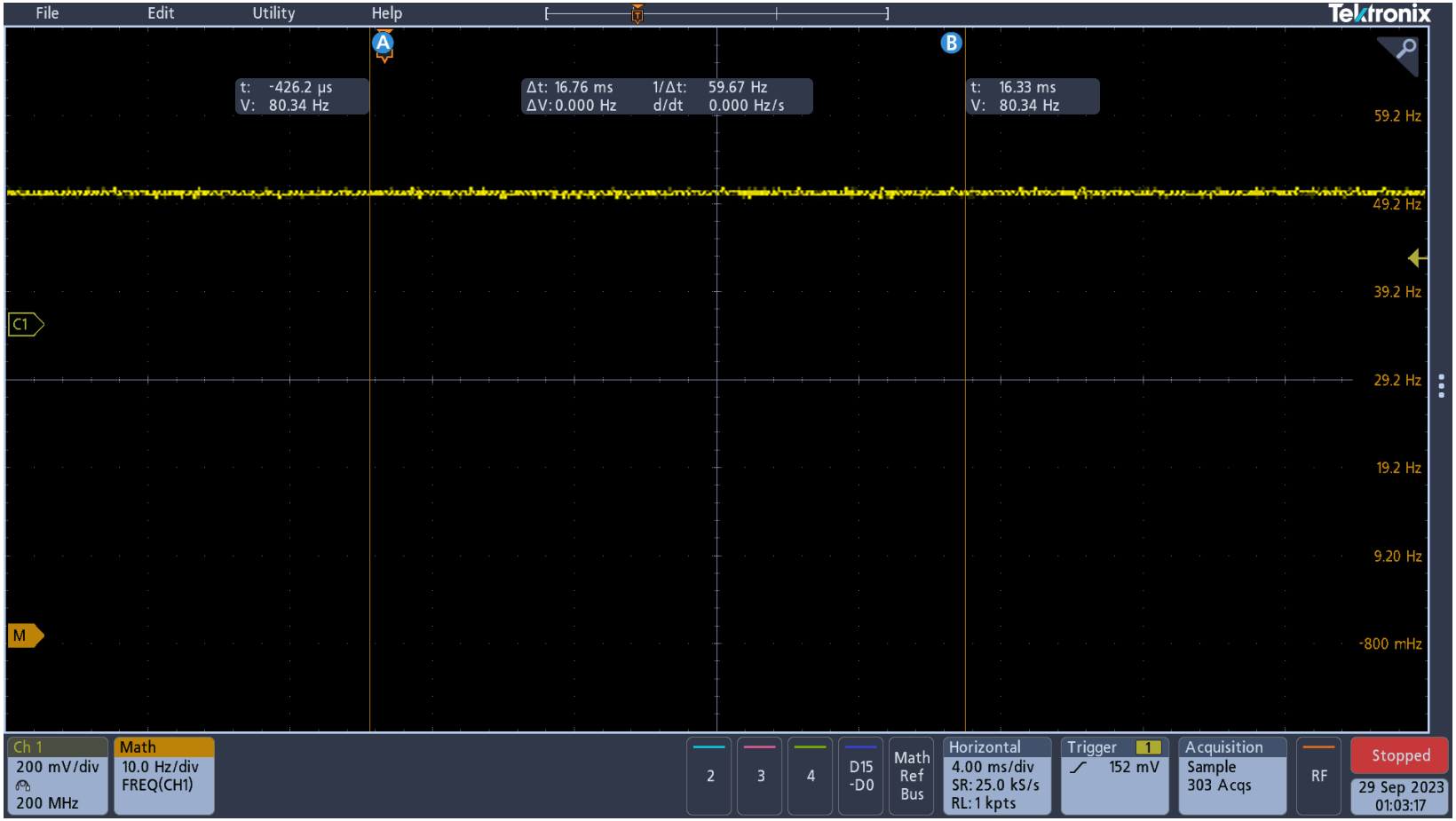
Test 2 – Oscilloscope Test – Green LED Results

- Measurable 120-Hz oscillation



Test 2 – Oscilloscope Test – Red LEDs Results

- No measurable signal changes or oscillations
  - Any result measured by oscilloscope is from noise



Conclusions

- Red LEDs in EIC DIRC laser area's exit sign are DC-powered
  - No changes in light output over time
- Green LED on sign is AC-powered
  - Measurable 120-Hz oscillation in photodiode signal seen
  - LED can be covered with aluminum, light-blocking tape (on-hand)

- **Red light from the exit sign during normal operation can be treated as background noise**

- Next:
  - Waiting on response from ESH and Facilities Management on model number of exit light to look up circuit diagram to 100% confirm that the red LEDs are DC powered