R5 Control of NeoPixel
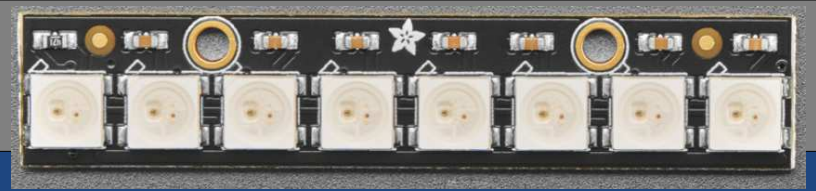
Topics

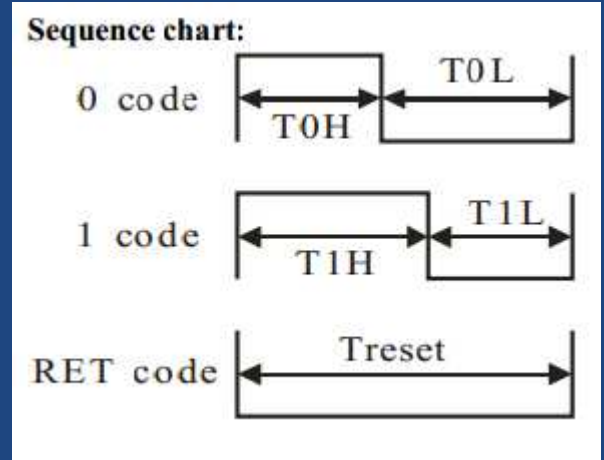1) How can we drive RGBW LEDs (NeoPixel) from the BeagleY-AI?

- Adafruit makes RGB LEDs called NeoPixel
  - Uses a 1-wire protocol
    (Features WS2812B or SK6812 LED driver)
  - Pixels have D_{in} and D_{out} daisy chained:
    As data is shifted into a pixel,
    it simultaneously shifts old data.
  - Designed for 5V, but works on 3.3V!
    D_{in} signal can be $0.7V_{DD} = 0.7*5 = 3.5V$ (but it works!)

R5

D_i D_{out} D_i D_{out} D_i D_{out} D_i D_{out} ...
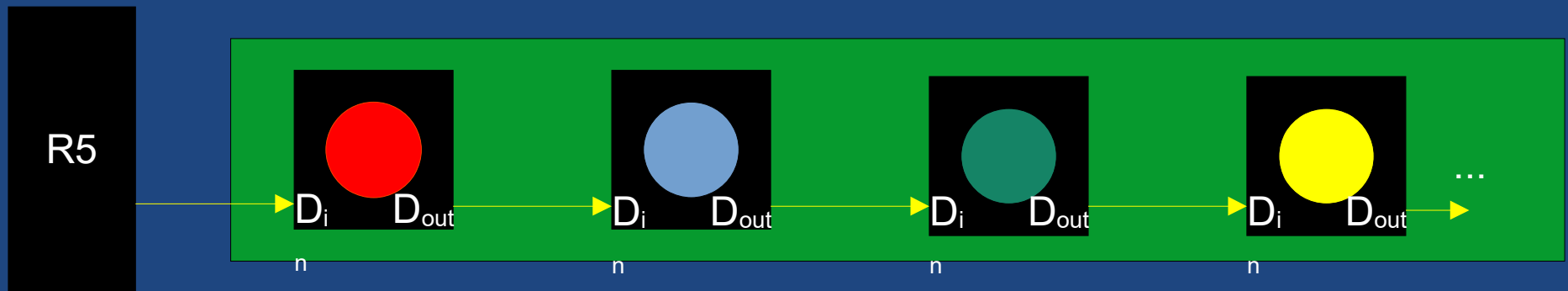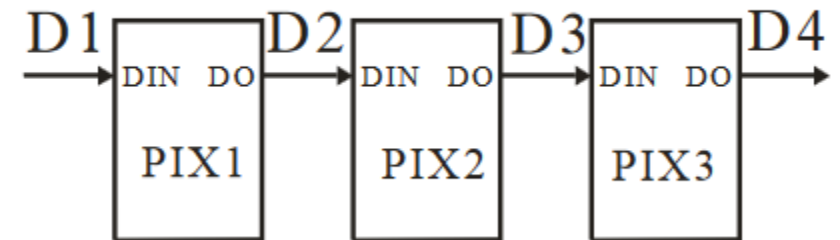
1-Wire Protocol
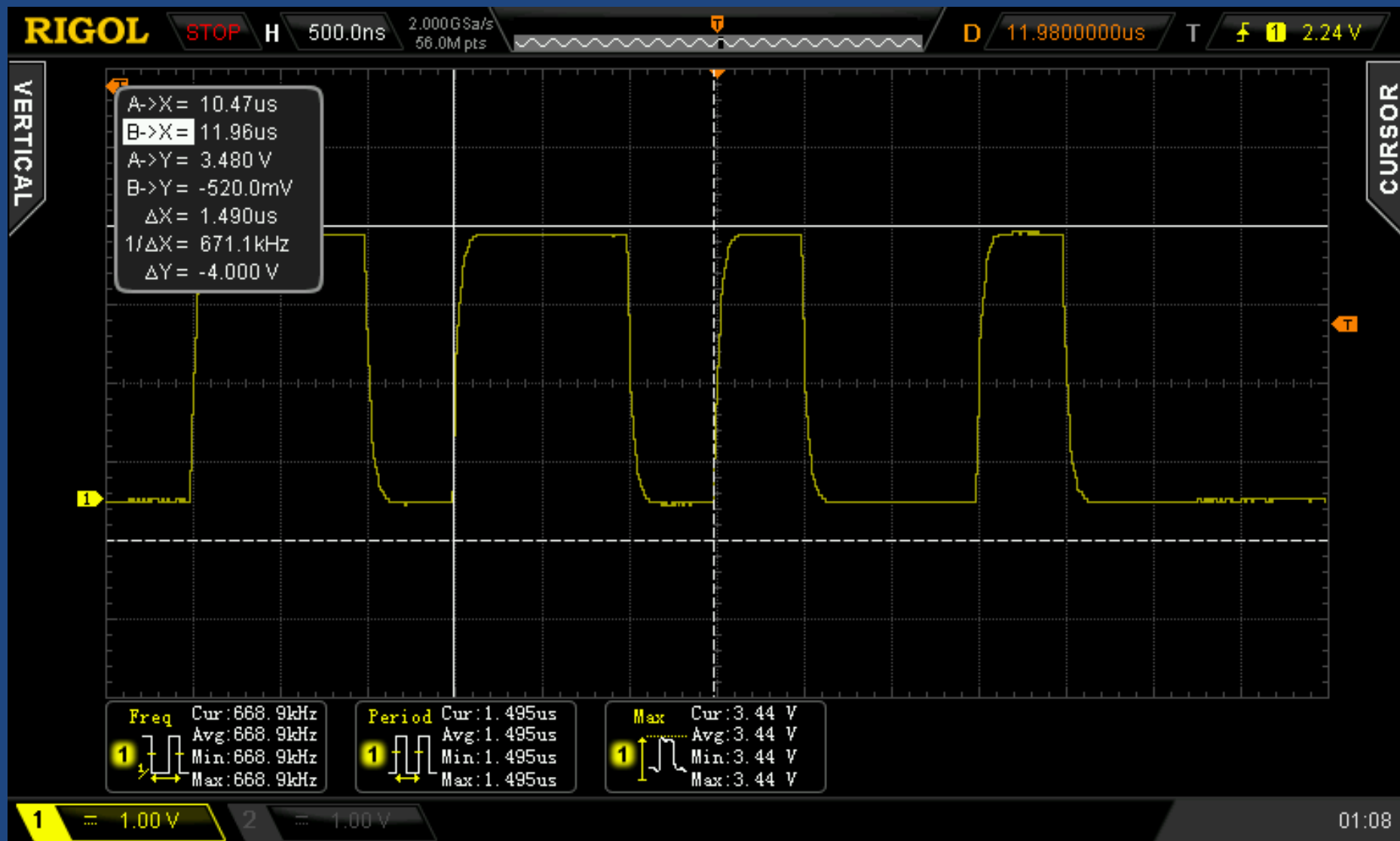
- The Data wire signal is a square wave
  - 0: ..
    (0.35us = 350ns)
  - 1: ..
    (0.7us = 700ns)

- At 800 MHz, how many clock cycles is 0.35us?
  - 1s / 800 Million Cycles/s
    = 0.00125 us / Cycle
    = 1 R5 CPU cycle takes 1.25ns
  - Note 0.35us = 350ns
  - # cycles in 350ns
    = 350 ns / 1.25 ns/cycle
    = 280 cycles

Sequence chart:

0 code — T0H, T0L

1 code — T1H, T1L

RET code — Treset

Cascade method:

D1 → DIN DO (PIX1) → D2 → DIN DO (PIX2) → D3 → DIN DO (PIX3) → D4

Actual Wave

image source: https://hackaday.com/2014/09/10/driving-ws2812b-pixels-with-dma-based-spi/
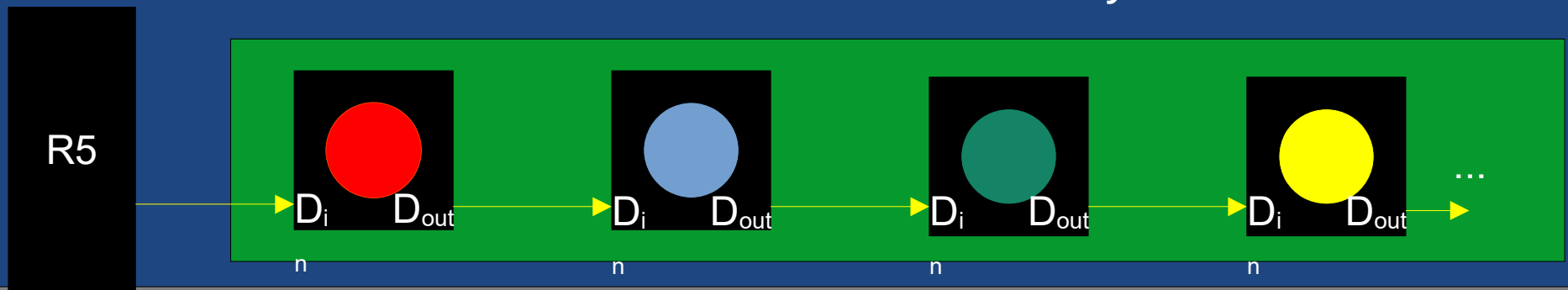
- Send a single "frame" to show on the LEDs
(RGBW values for all pixels)
    - Shift in all bits, for all pixels, one at a time.
    - Send the last LED's values first (shifts through all)
    - Send data in the sequence R, G, B, W (8-bit each)
    - Send the high-bit first

- After sent whole frame, signal a RESET
    - Pull data line low for >= 50us
    - LEDs don't show their new colour until they see RESET
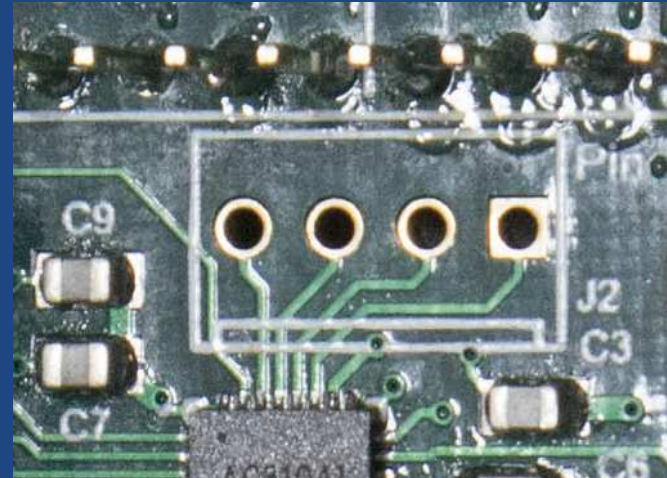
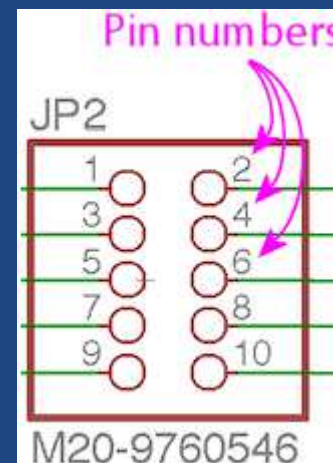# Wiring Up

LED Strip header
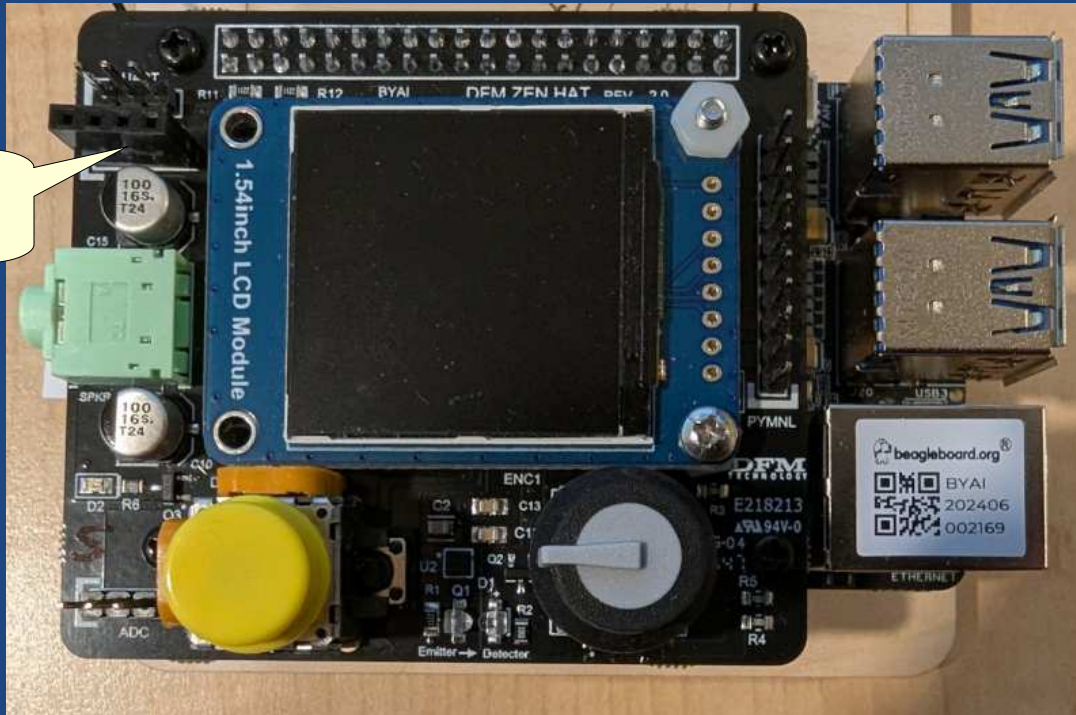
Demo

Pin Counting Aside

- Square pin indicates pin 1
  Or circle, or triangle or [
  on the printed circuit board
  (PCB)

- On headers with 2 rows,
  count across first

Header image source: http://mjrnet.org/pinscape/BuildGuideV2/BuildGuide.php?

Review Questions

- How is one wire used to send data?

- How many pulses are needed to drive 8 RGBW LEDs?

- What is the purpose of holding the data line low for >50us?

- Links
  - NeoPixel Parts
  - Data sheet
  - Info on using NeoPixel