Eye Opening Monitor Detailed Operation

Background and overview

- Eye Monitor Description
- Eye Monitor

Eye Monitor Description

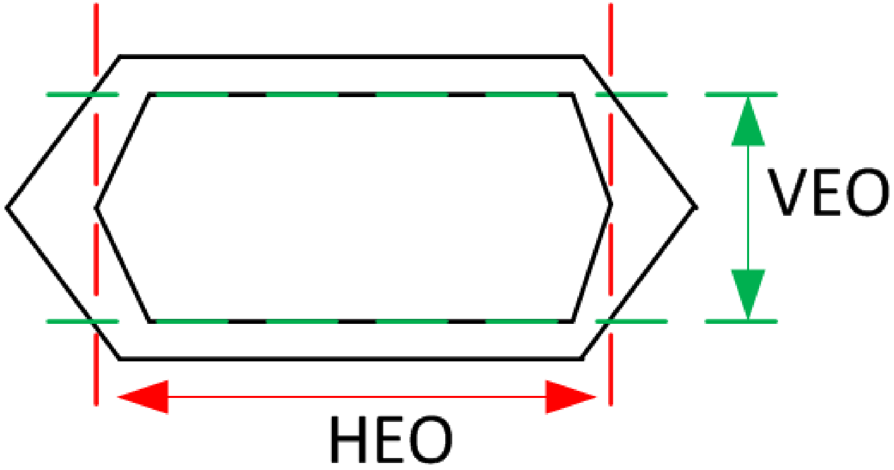
- The LMH12XX on-chip Eye Opening Monitor (EOM) is used to analyze and diagnose the post-equalized waveform
- The post-equalized waveform is sampled both in phase and voltage domain across one unit interval
- The phase and voltage range each is divided into 64 steps, so the result of the eye capture is a 64 × 64 cells
- Each cell specifies a specific voltage and phase that indicates number of hits relative to the main reference incoming eye diagram.
- The number of hits registered at each point needs to be taken in context with the total number of bits observed at that voltage and phase offset to determine the corresponding probability for that point.

Post Equalization Signal Integrity Check

- There are two ways to check post equalization signal integrity:
  - Reading Horizontal and Vertical Eye Opening(HEO/VEO)
    - HEO/VEO Reading can be used to interrupt if certain threshold is reached
  - Capture incoming signal eye waveform and visually inspecting the eye diagram

HEO/VEO Description

- HEO Specifies horizontal eye opening:
  - Value reported by LMH12XX should be converted to decimal and divided by 64
  - Example, reg 0x27 HEO register content is 0x20 then 32/64=0.5UI eye opening
- VEO is specified in terms of vertical eye opening
  - Value reported by LMH12XX should be converted to decimal and then multiplied by 3.125mV
  - For example, reg 0x28 VEO register content is 0x30 then 48*3.125=150mV eye opening
- As long as we have at least 45% to 50% eye opening with 100-150mV VEO device will operate error



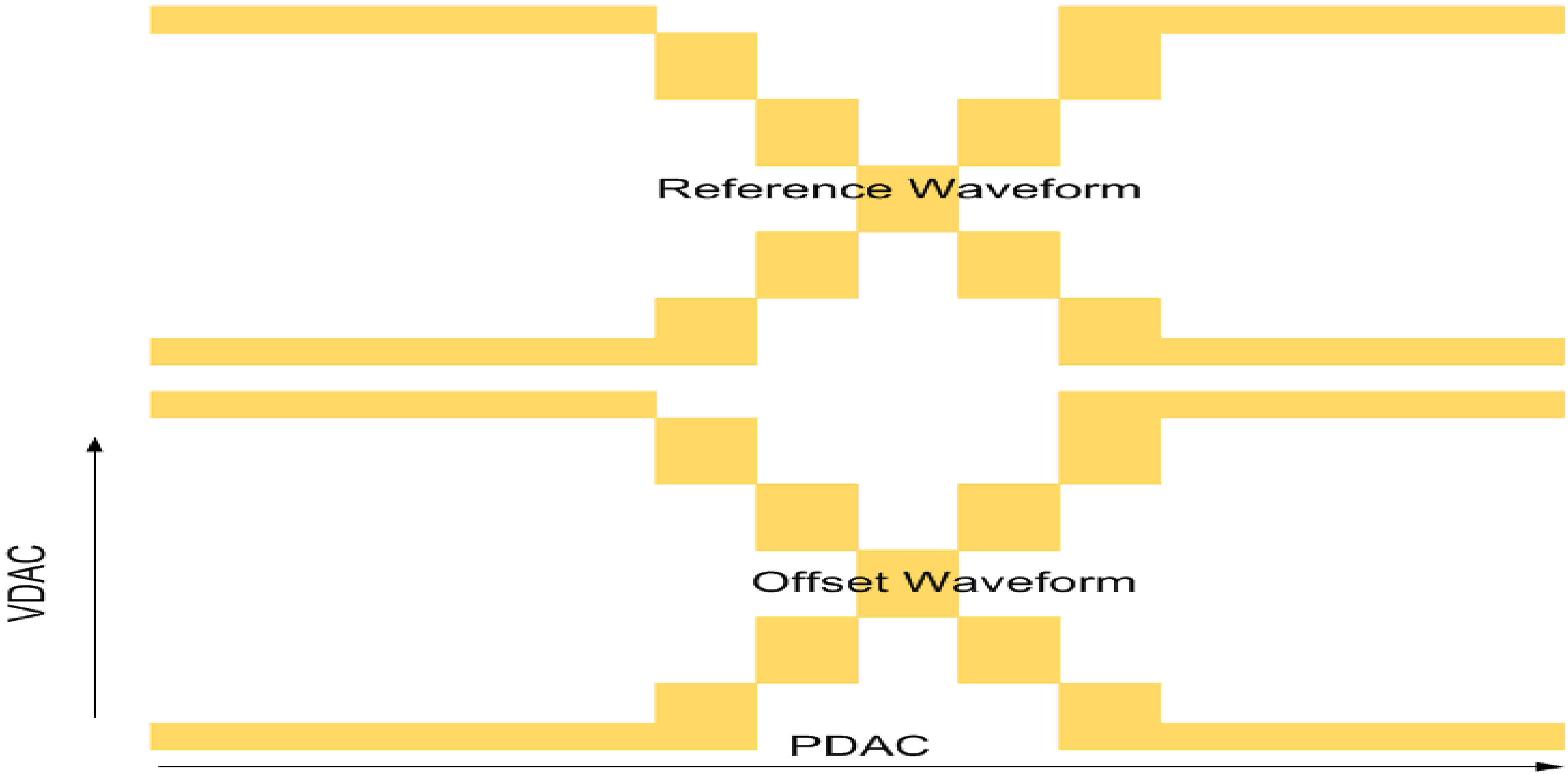
How to Capture Incoming Eye Diagram

- Refer to the LMH12XX programming guide for detailed register settings
- Incoming signal waveform hit count is checked with 64 steps vertically (VDAC) and 64 steps horizontally (PDAC)
- Reference waveform is compared against reference signal that is offset by 64 steps VDAC and 64 steps PDAC
- Number of hits where this two waveform is overlapped is counted as hits

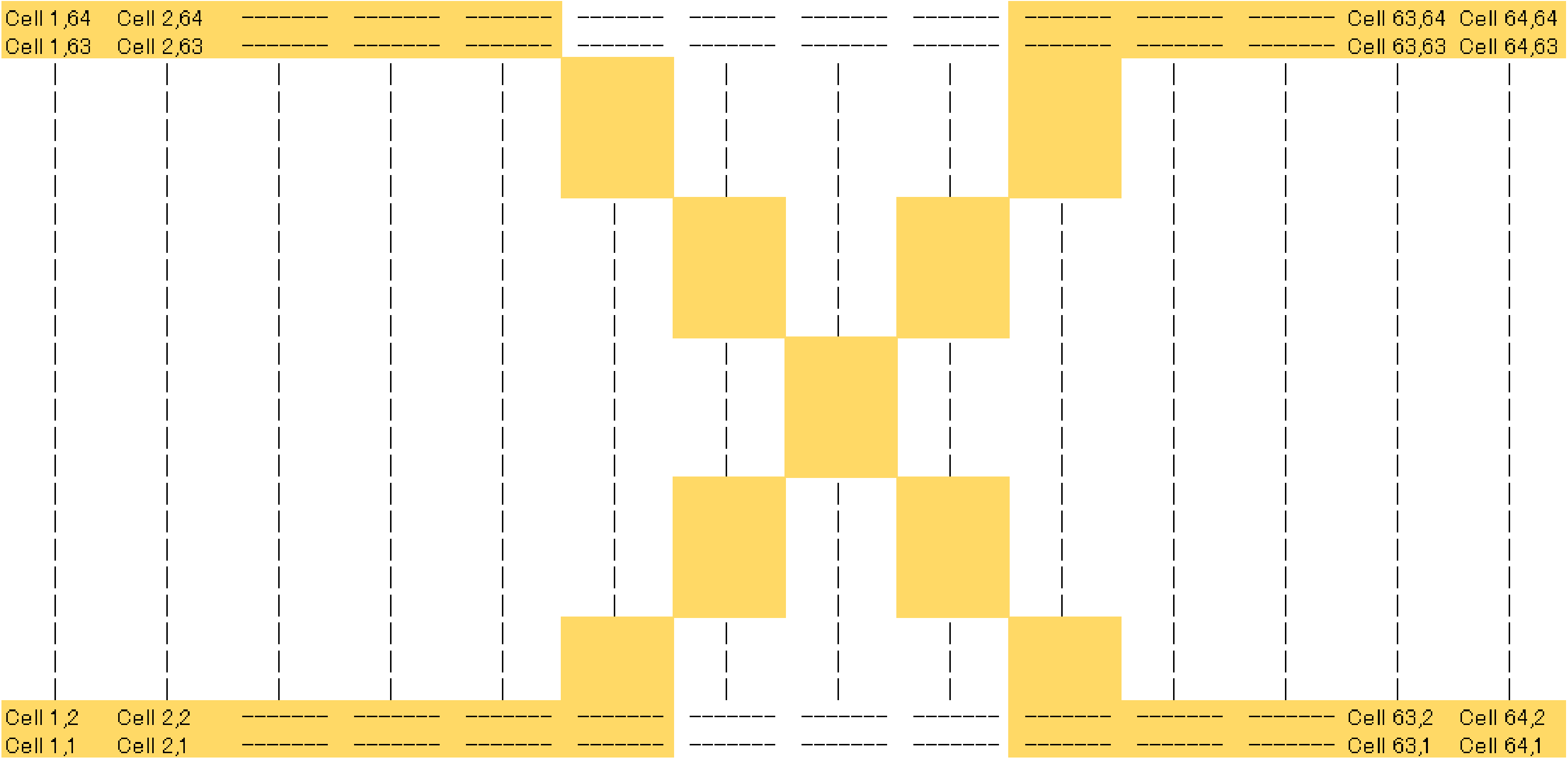
64X64 Cells Fast Eye Data Format

- PDAC is hold constant while VDAC is swept from lowest to highest value
- Next PDAC is increased by one step and again VDAC is swept across it’s range
- This continues until 64X64 cells or 4096 eye hits are reported

Hit Count Measurement

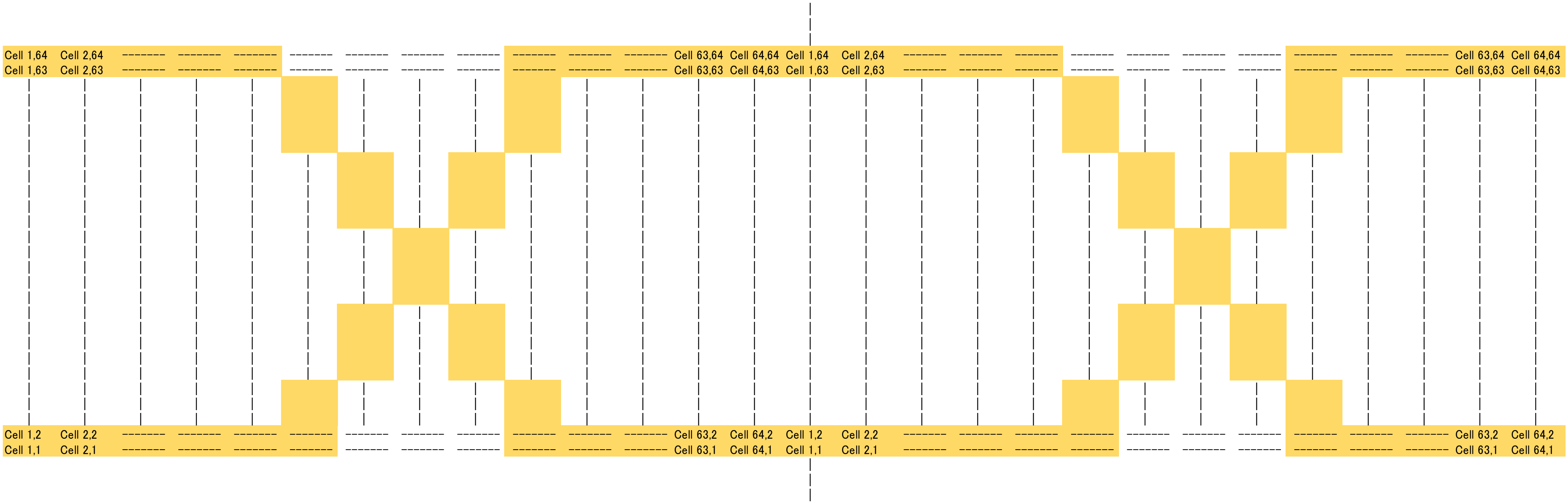


Eye Hit Counts Fast Eye Format Data Stream



- Device first streams out Column 1: (Cell 1,1), (Cell1,2), through (Cell 1,64)
- Followed by column 2: (Cell 2,1), (Cell 2,2), through (Cell 2,64)
- This is continued through column 64 and to Cell 64,64

Overall Eye Diagram



- Cells 1,1 through Cell 64,64 is duplicated externally to build the above eye diagram

Eye Diagram Hit Count Processing

- For visual observation, hit count can be normalized and scaled
- Reg 0x2A content indicates length of time hit counts are captured
  - Duration = 256*reg 0x2A(decimal)*(32/data rate)
  - Example: 11.88Gbps, reg 0x2A = 0x30
    - Duration = 256*48*(32/11.88E9)=33uS
    - For 33uS per cell we capture hit counts
    - 4096*33uS = 135mS to capture 64X64 cells

Summary

- The LMH12XX on-chip EOM is used to analyze the post-equalized waveform
- Further processing can be done to calculate peak to peak jitter and rise/fallLMH12XX
- HEO/VEO Automatically interrupt when certain threshold is reached