

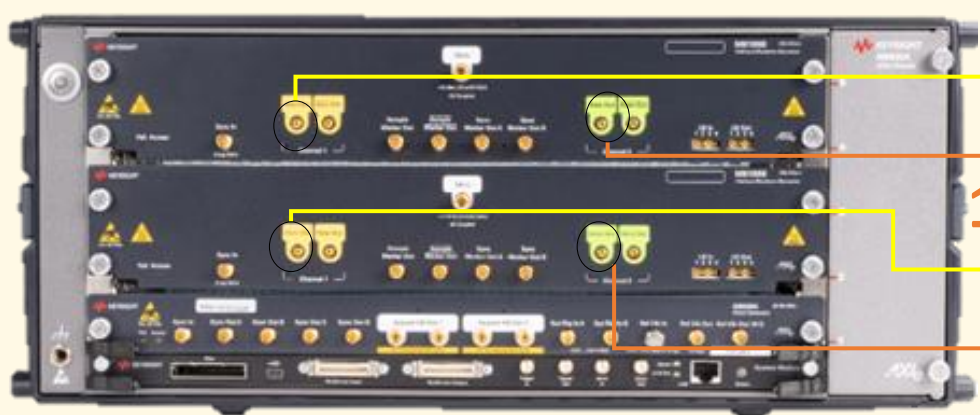


Beyond 400Gbps Lane Rate Transmission

Enabling 448G Pathfinding with today's T&M equipment

Electrical Signal Generation

Arbitrary Waveform Generator
(256Gs, 80GHz)



- Channel de-embedding

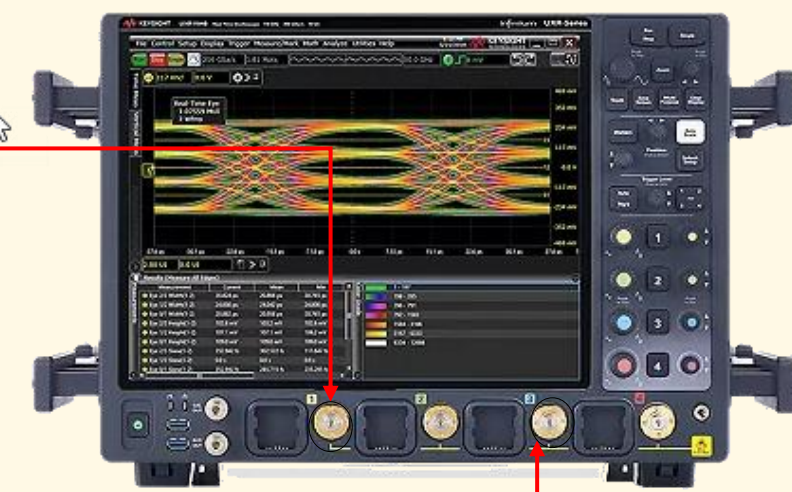
Broadband Balun

15 cm RF cables

30 cm RF cables

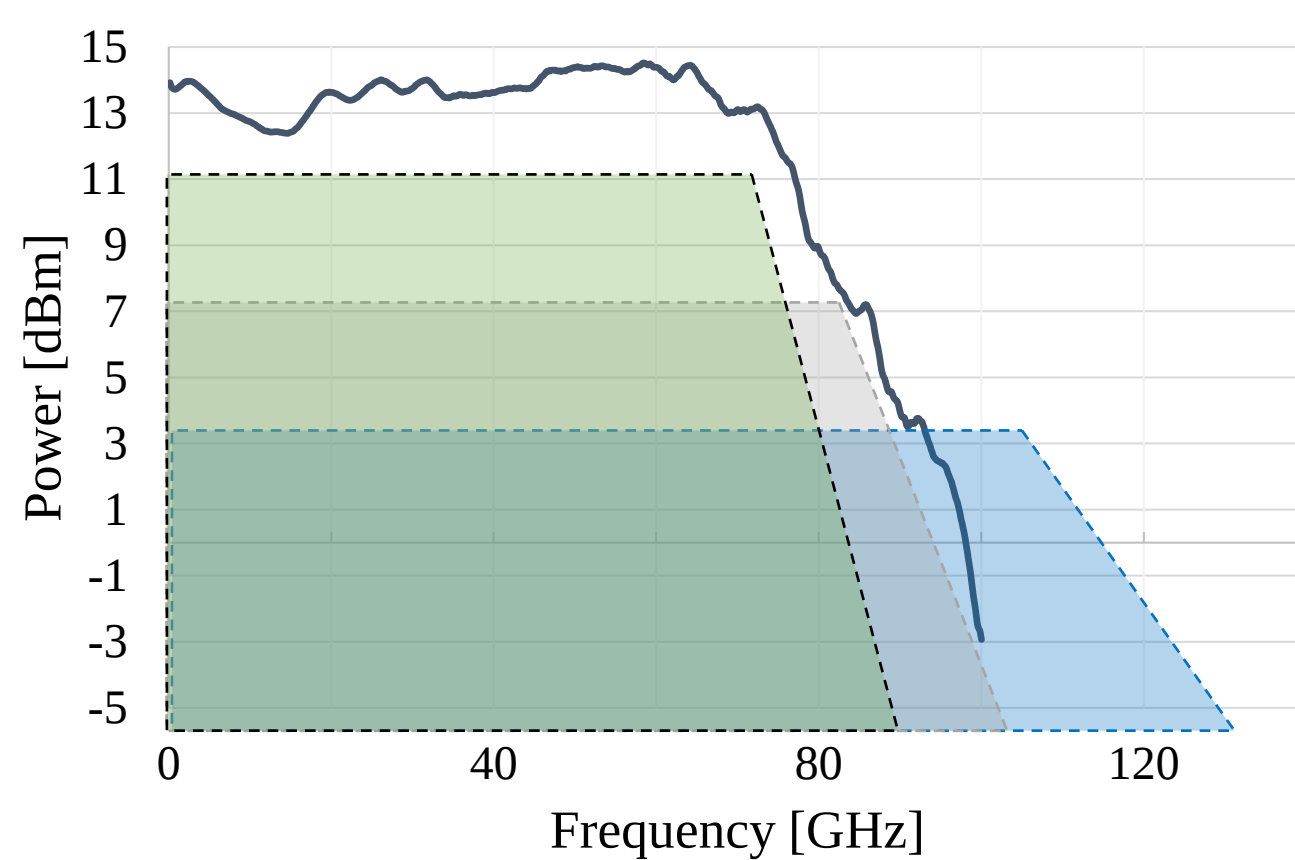
Electrical Signal Detection

Real-time Oscilloscope
(256Gs, 113GHz brick-Wall)



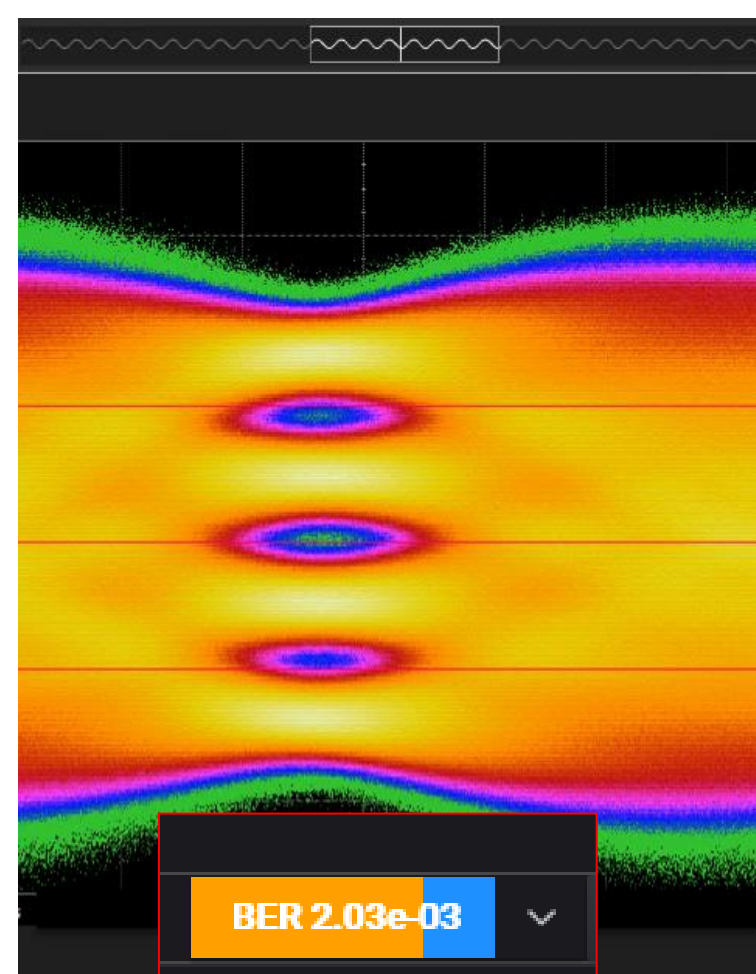
- LP filter
- CDR
- FFE equalizer
- Error counting

→ **Extended generator**
bandwidth required for PAM4



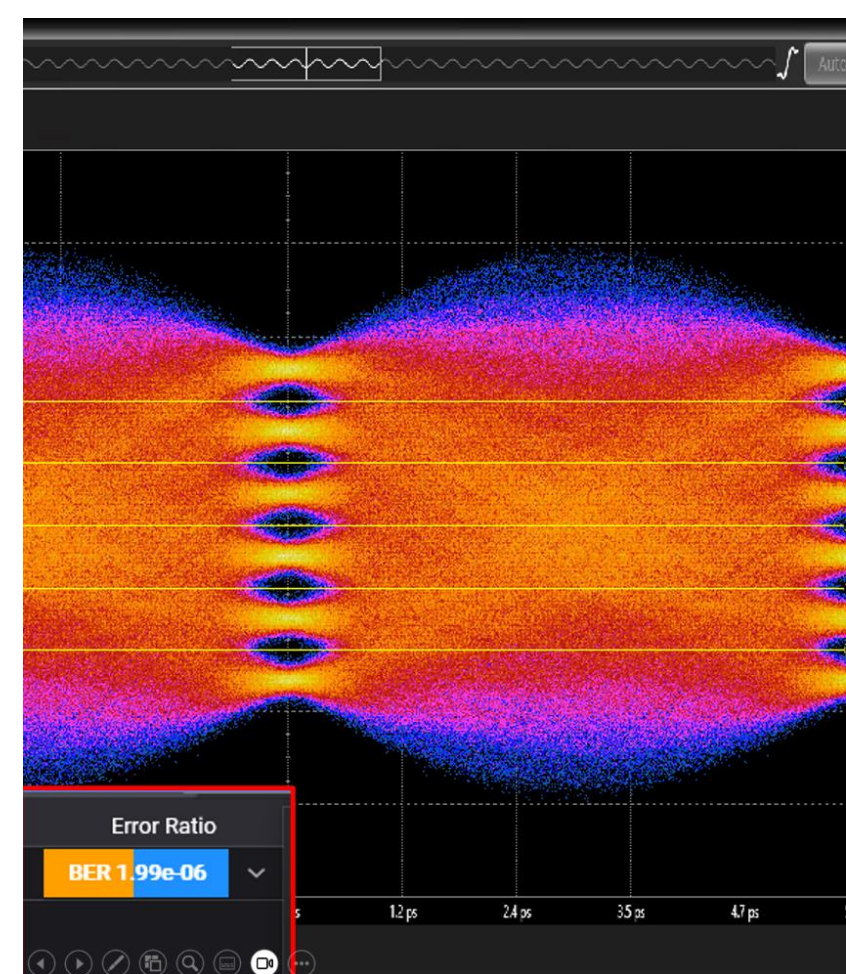
220GBd PAM4 (440Gb/s)

- 2e-3 BER
- Mian limitation: BW



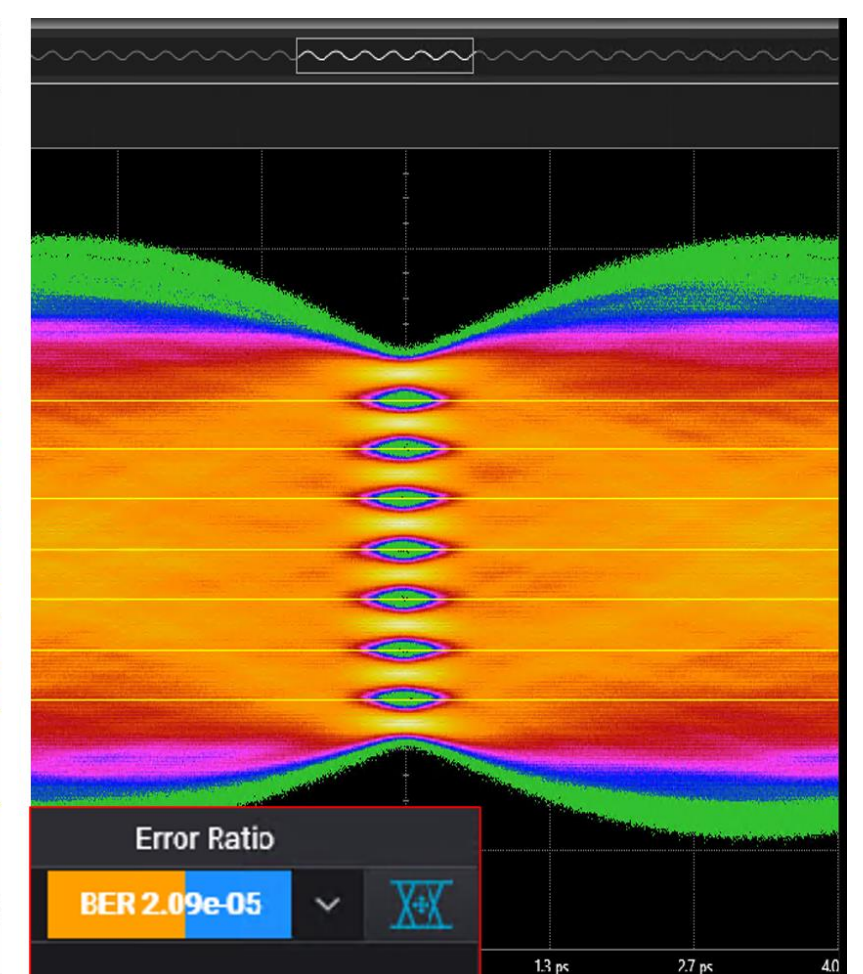
176GBd PAM6 (440Gb/s)

- 2e-6 BER
- Main limitation: SNR



150GBd PAM8 (450Gb/s)

- 2e-5 BER
- Main limitation: SNR



Optical Signal Generation

AWG

15 cm RF cables

Balun

TFLN modulator
(~1.2V V π , >100GHz 10dB BW)



1310nm laser

15 cm RF cables

Optical Signal Detection

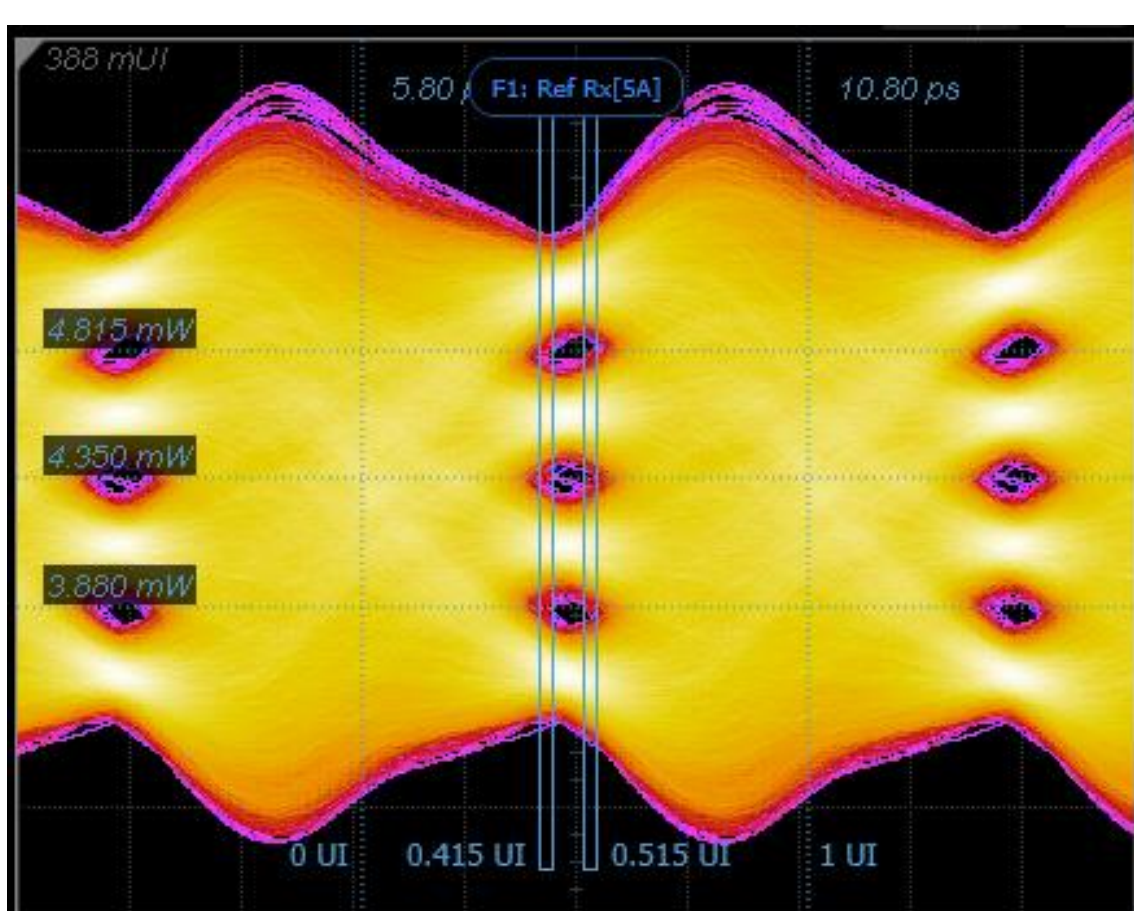
Optical Sampling Oscilloscope
(120GHz BW smooth roll-off)



- LP filter
- Ref. Equalizer (CTLE + FFE+DFE)
- OMA, TDECQ (PAM4)

200GBd PAM4 (400Gb/s)

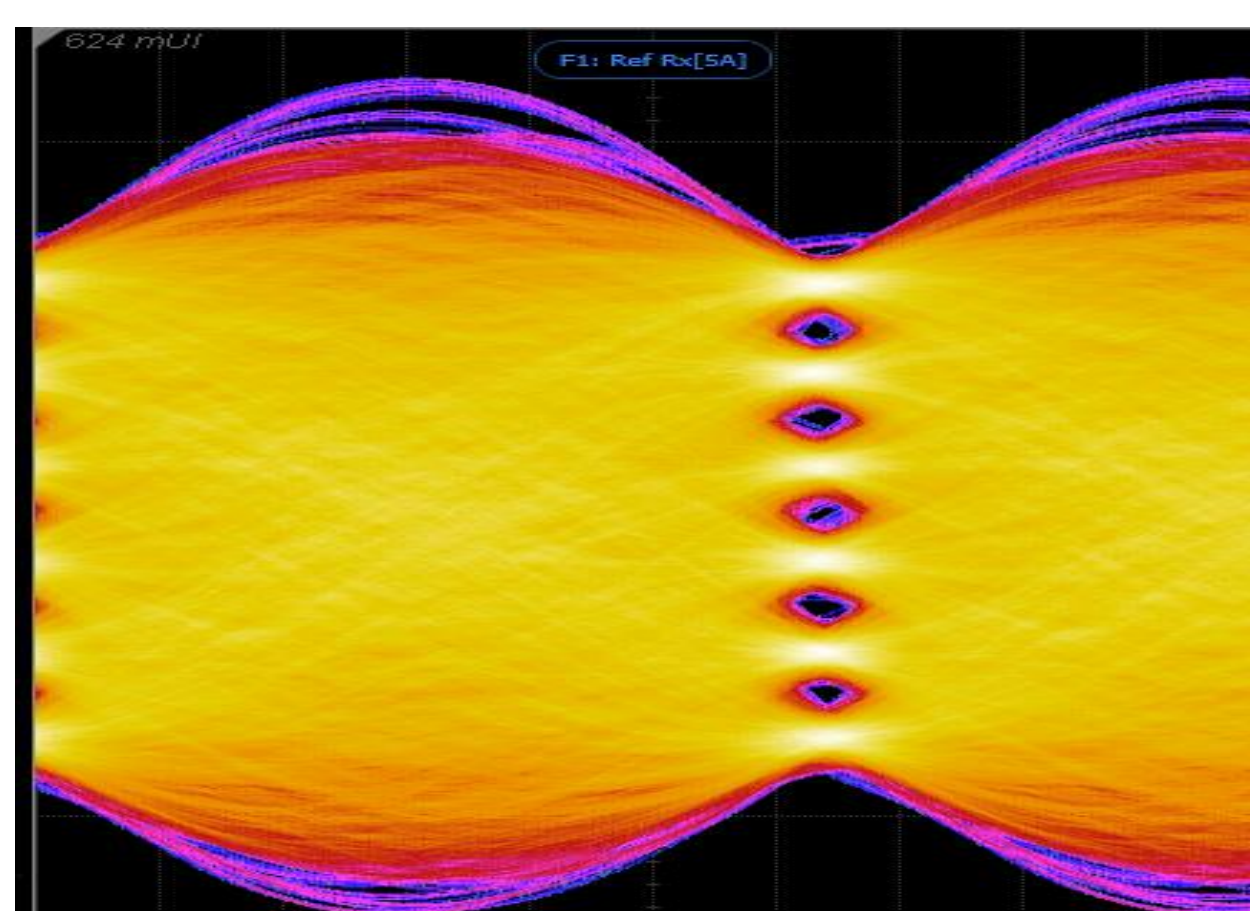
→ **PAM4 limited by ISI (AWG BW) and SNR (low ER)**



CTLE + FFE + DFE

170GBd PAM6 (425Gb/s)

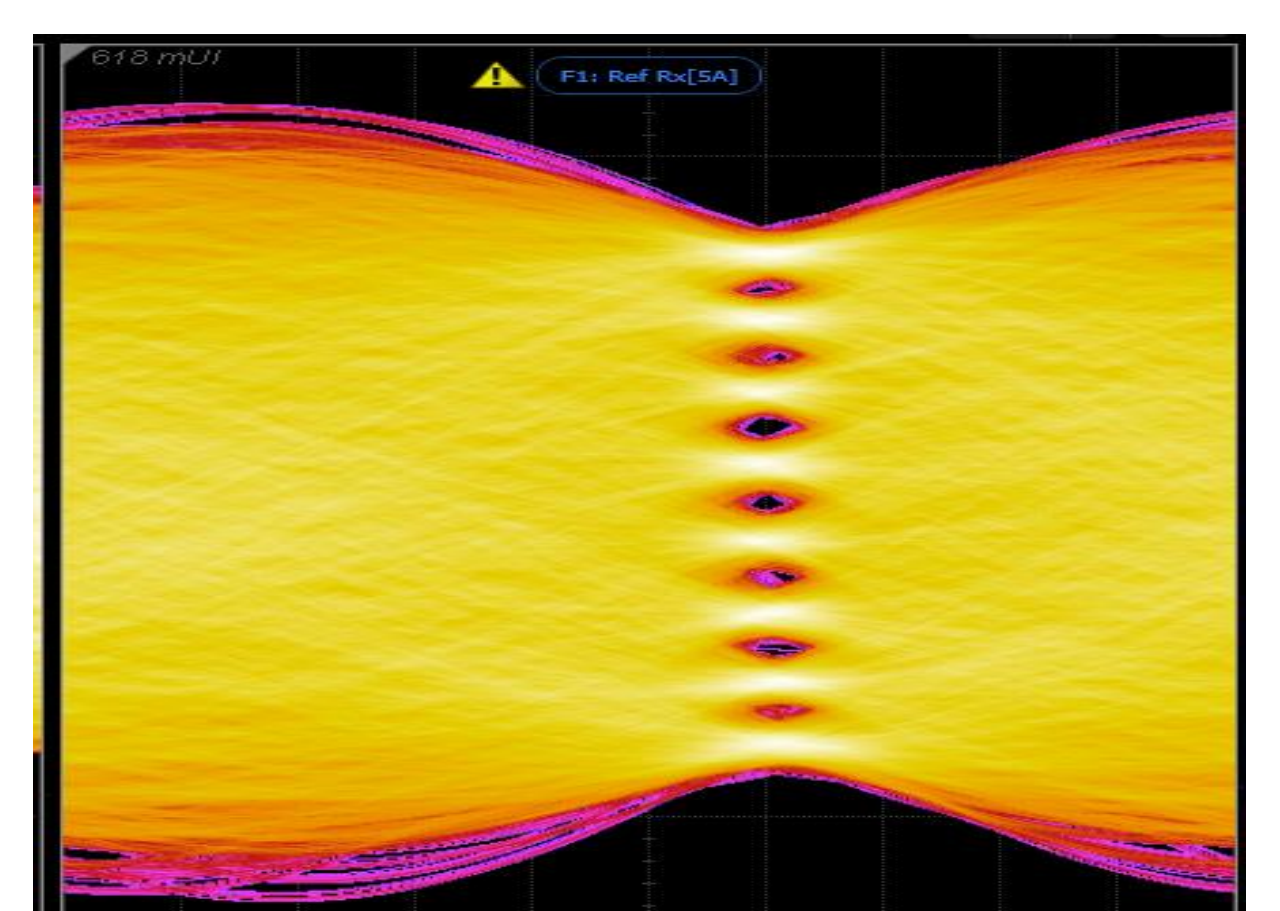
→ **PAM6 limited by SNR**



CTLE + FFE

150GBd PAM8 (450Gb/s)

→ **PAM8 limited by SNR**



CTLE + FFE