The Implications of Fiber Optic Transponder Testing

- Introduction
- Functions of a fiber optic transponder
- Typical tests and measurements
- Issues
- Solutions

Purpose of test

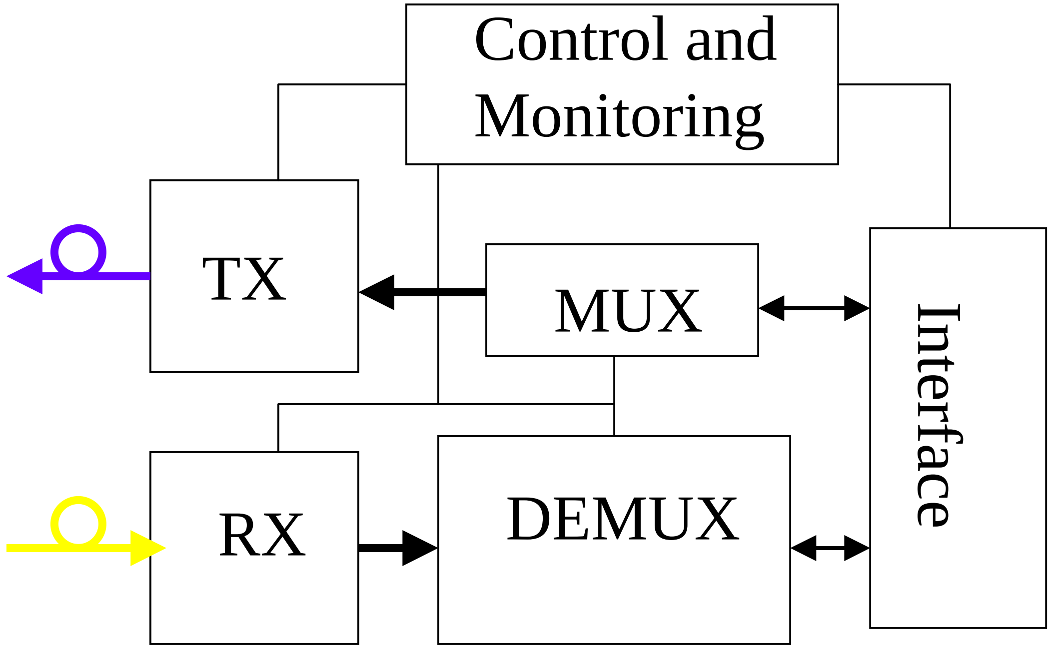
- Test for interoperability
- Test for compatibility

What is a Fiber Optic Transponder?

Functions of a Fiber Optic Transponder

- Electrical and optical signals conversions
- Serialization and deserialization
- Control and monitoring

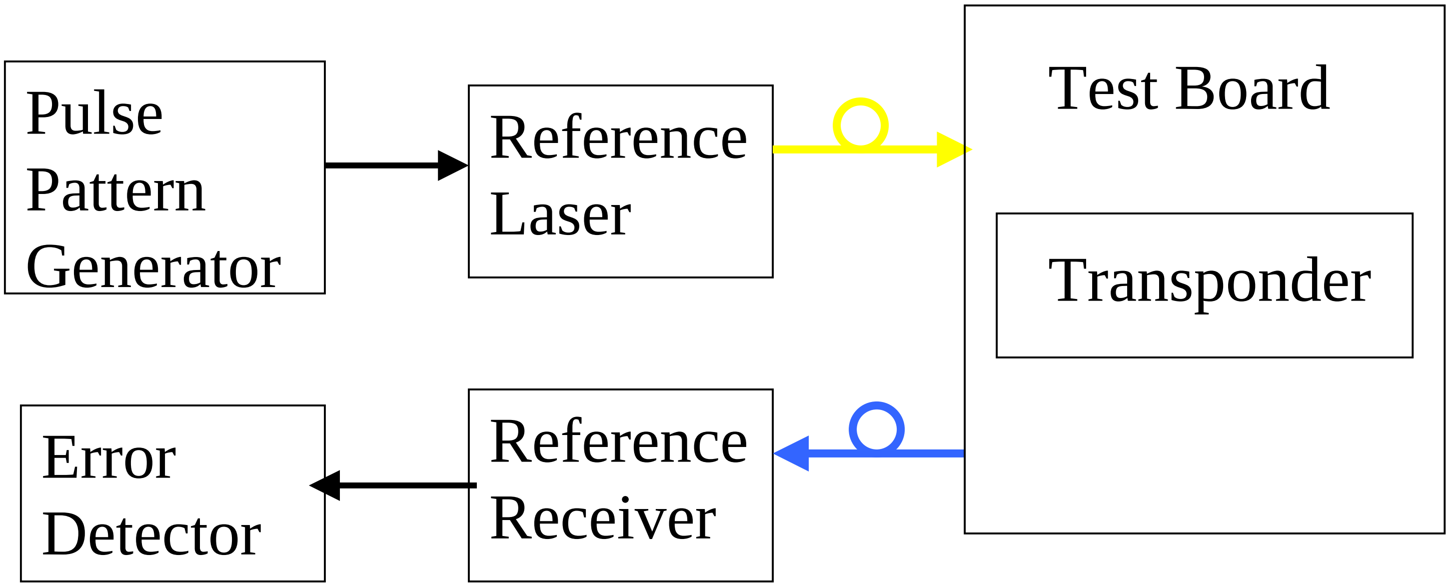
10 Gb/s Transponder Block Diagram

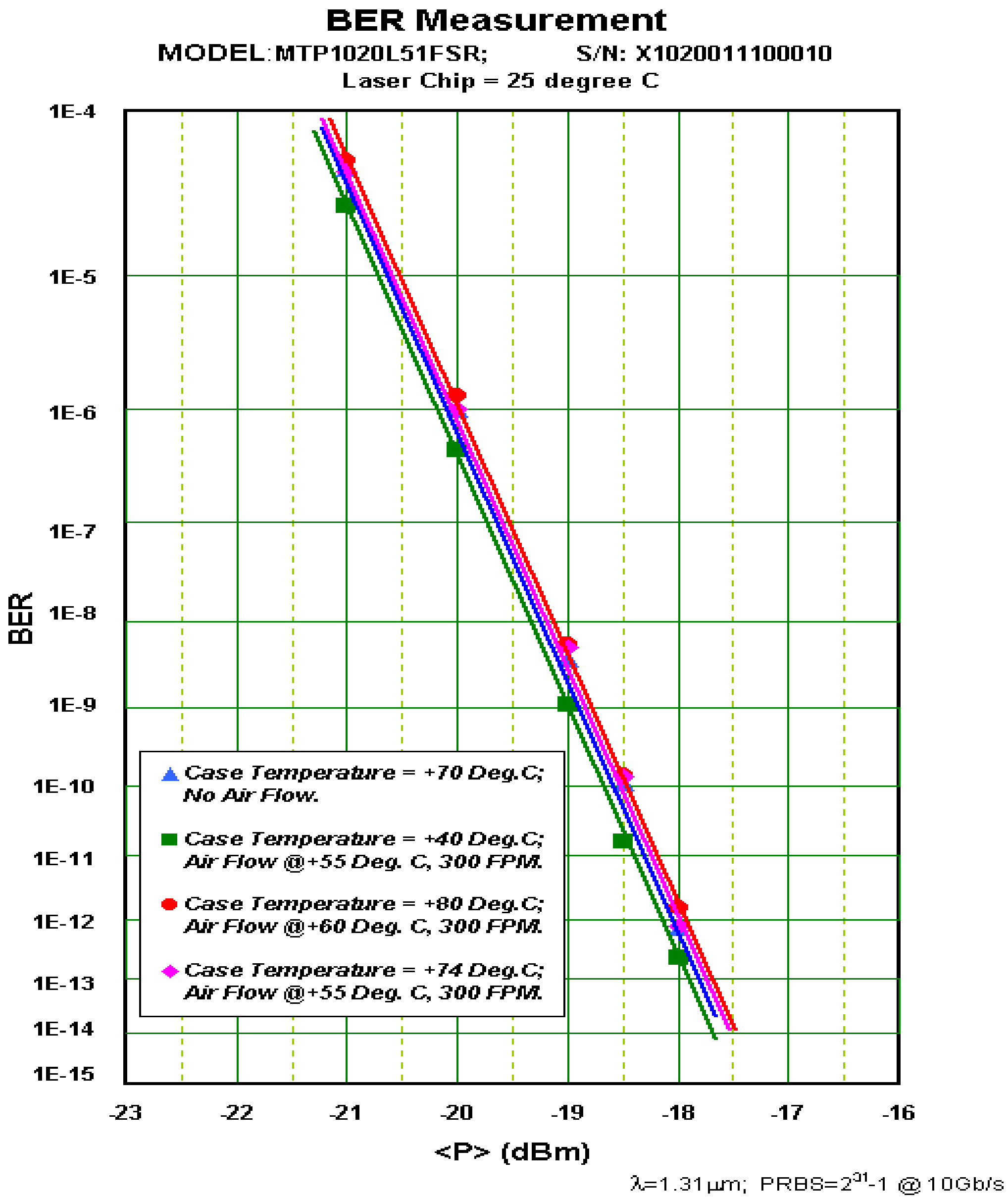


Typical Tests and Measurements

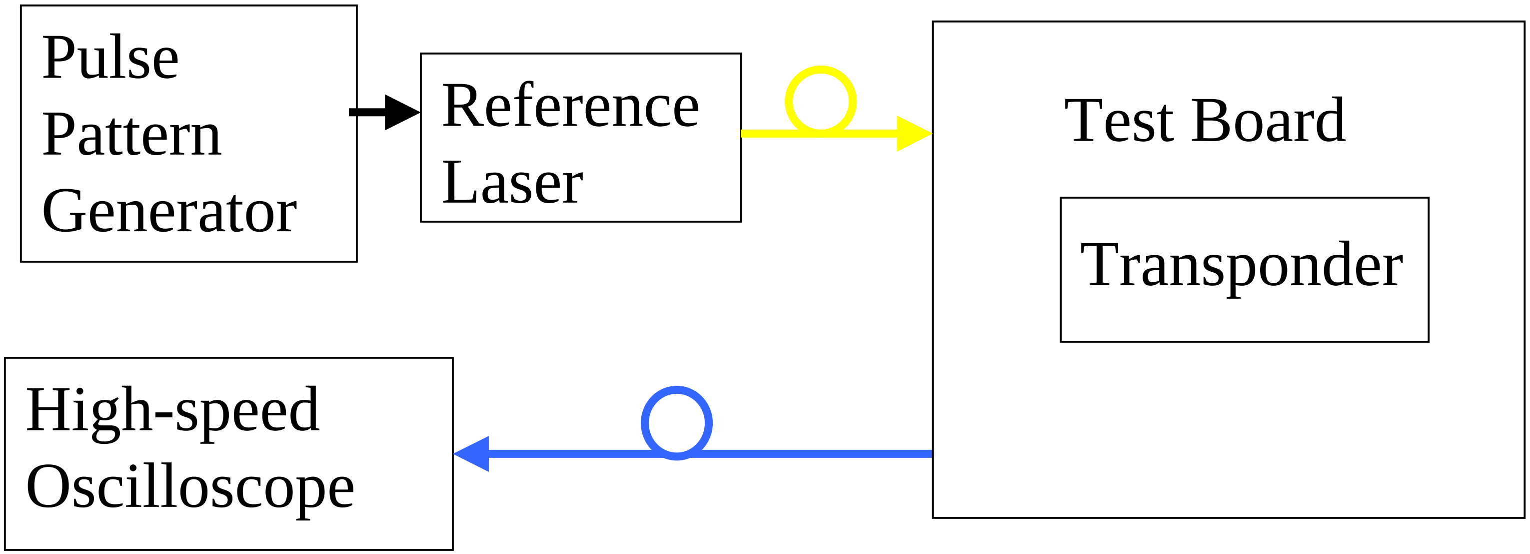
- Receiver sensitivity based on BER (Bit Error Rate)
- Transmitter eye measurements
- Jitter performance of the module
- Transmission performance based on path penalty

Example Setup for Bit Error Rate Measurement

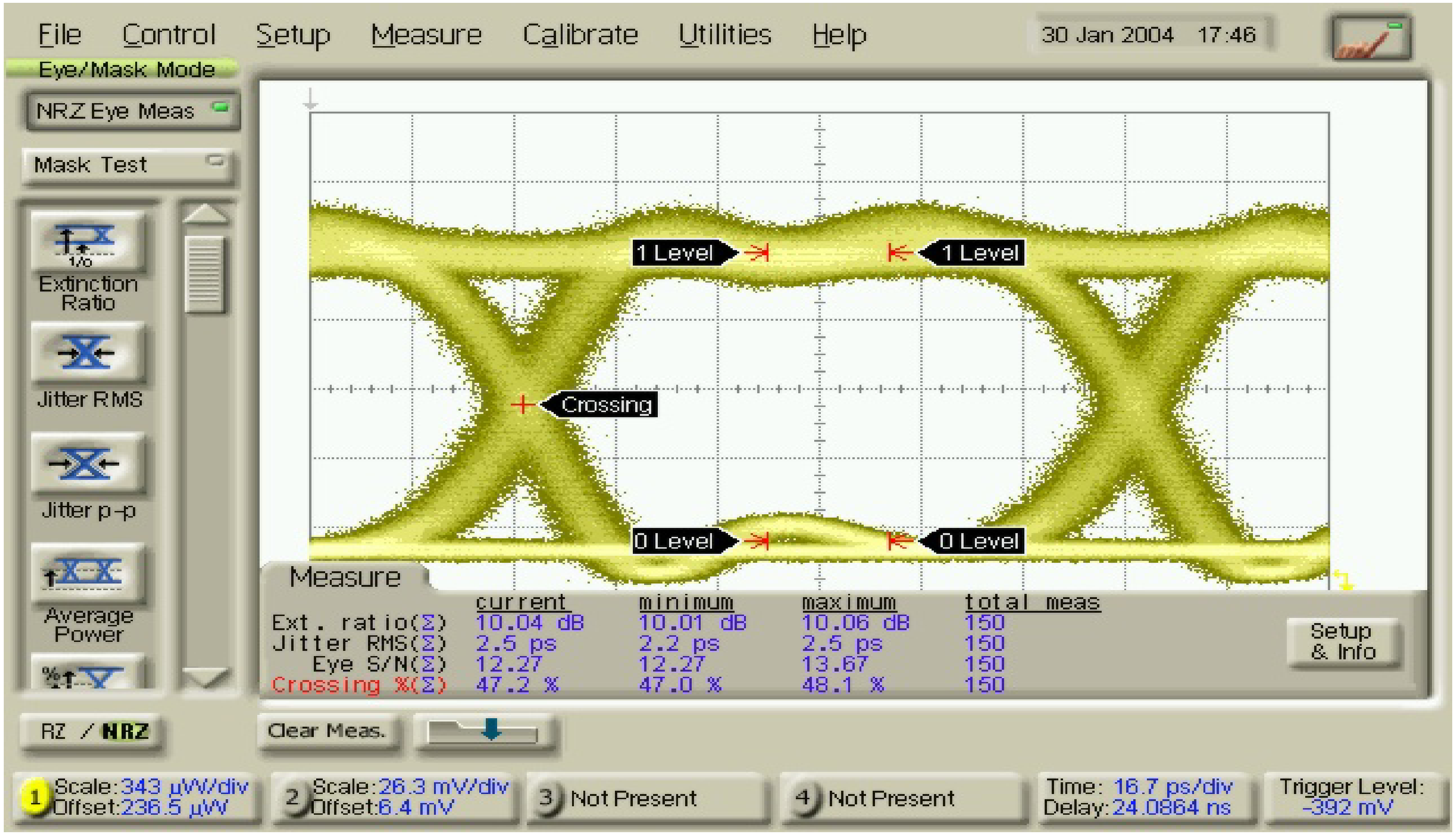



BER Measurement
MODEL:MTP1020L51FSR; S/N: X1020011100010
Laser Chip = 25 degree C
BER
1E-4
1E-5
1E-6
1E-7
1E-8
1E-9
1E-10
1E-11
1E-12
1E-13
1E-14
1E-15
-23
-22
-21
-20
-19
-18
-17
-16
<P> (dBm)
Case Temperature = +70 Deg.C; No Air Flow.
Case Temperature = +40 Deg.C; Air Flow @+55 Deg. C, 300 FPM.
Case Temperature = +80 Deg.C; Air Flow @+60 Deg. C, 300 FPM.
Case Temperature = +74 Deg.C; Air Flow @+55 Deg. C, 300 FPM.
λ=1.31μm; PRBS=2^31-1 @10Gb/s

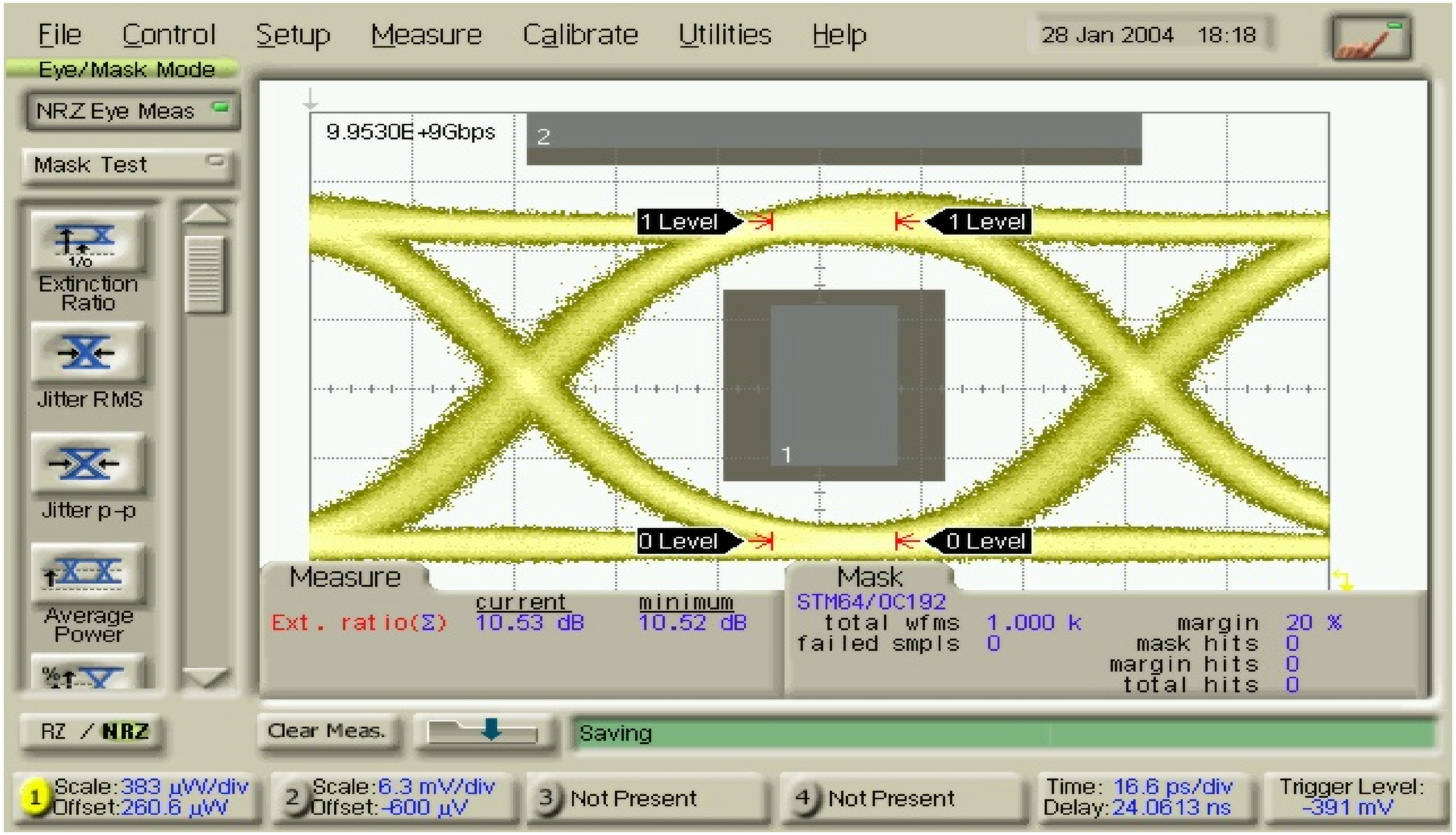
Example Setup for Transmitter Eye Measurement



Unfiltered Eye

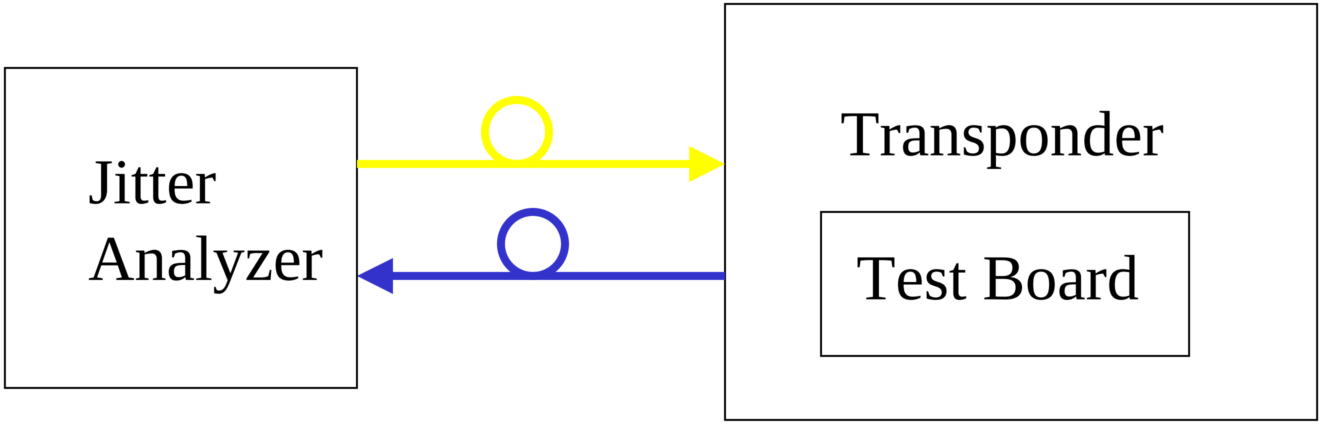


Filtered Eye



Example Setup for Jitter Measurements

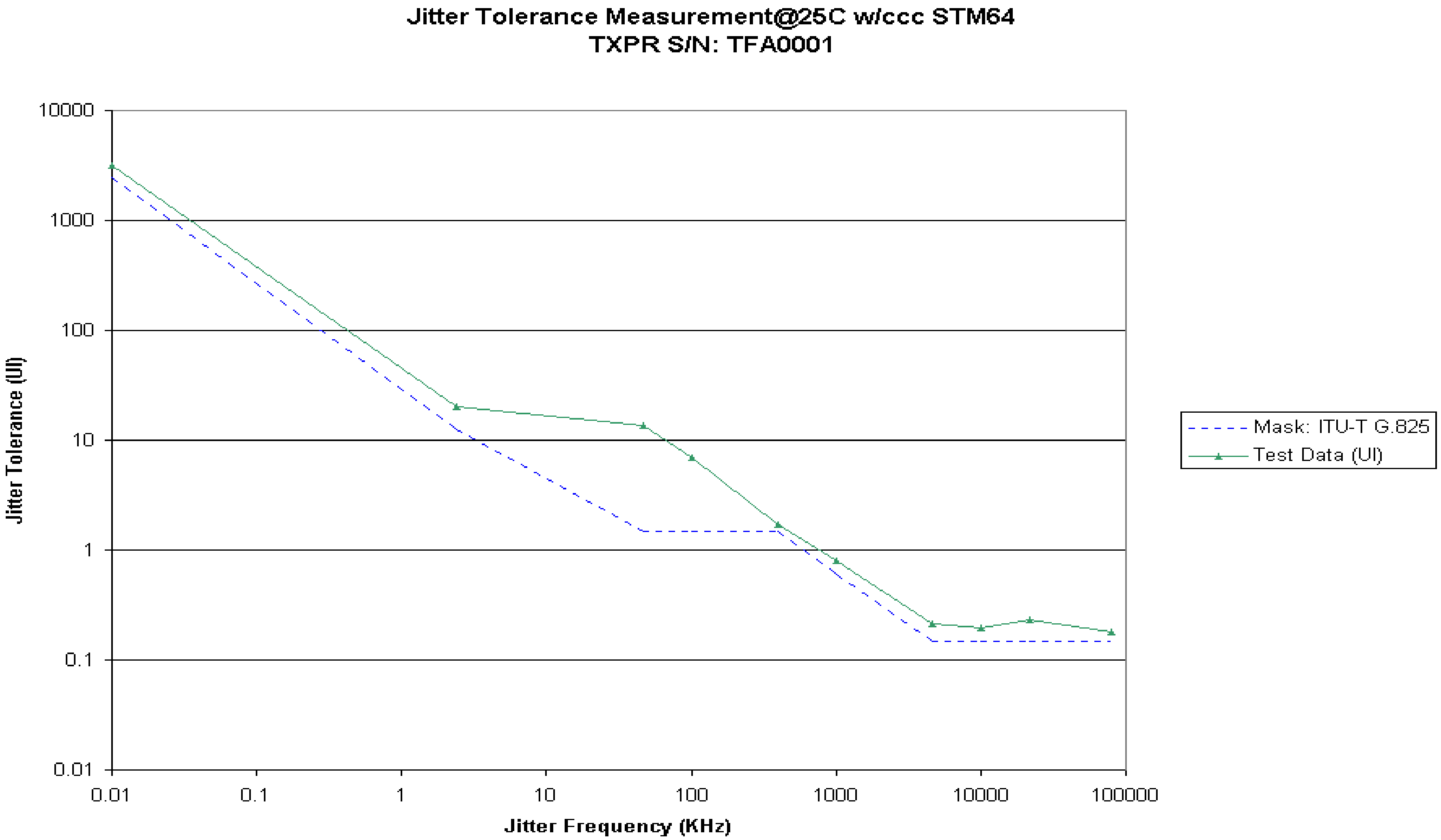
- Jitter Generation
- Jitter Tolerance
- Jitter Transfer



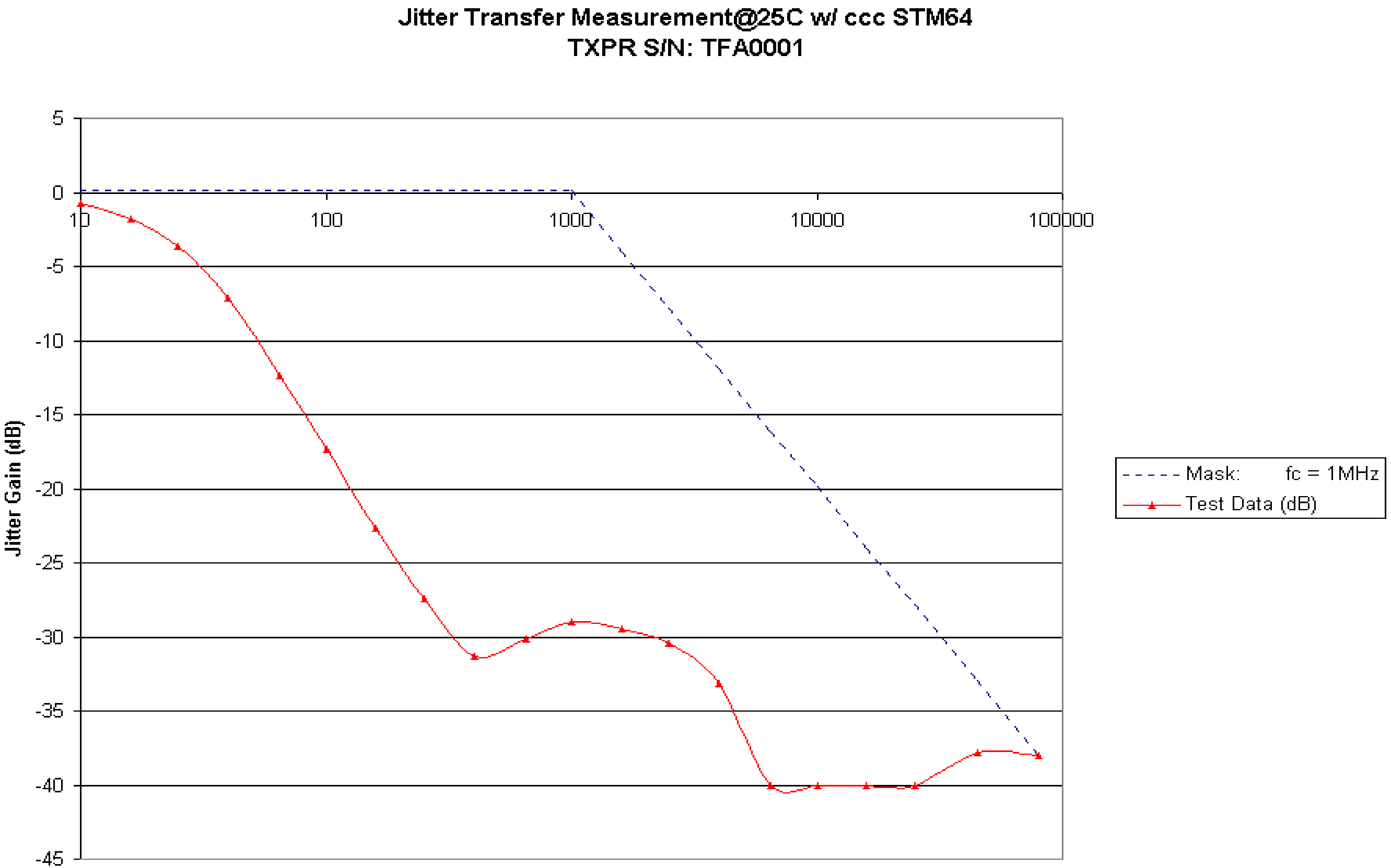
Jitter Generation Data

	Current Values	Max. Values
Jitter peak-peak	0.008 UIpp	0.062 UIpp
Jitter +peak	0.003 UIp	0.027 UIp
Jitter -peak	0.005 UIp	0.035 UIp
Jitter RMS	0.007 UI	

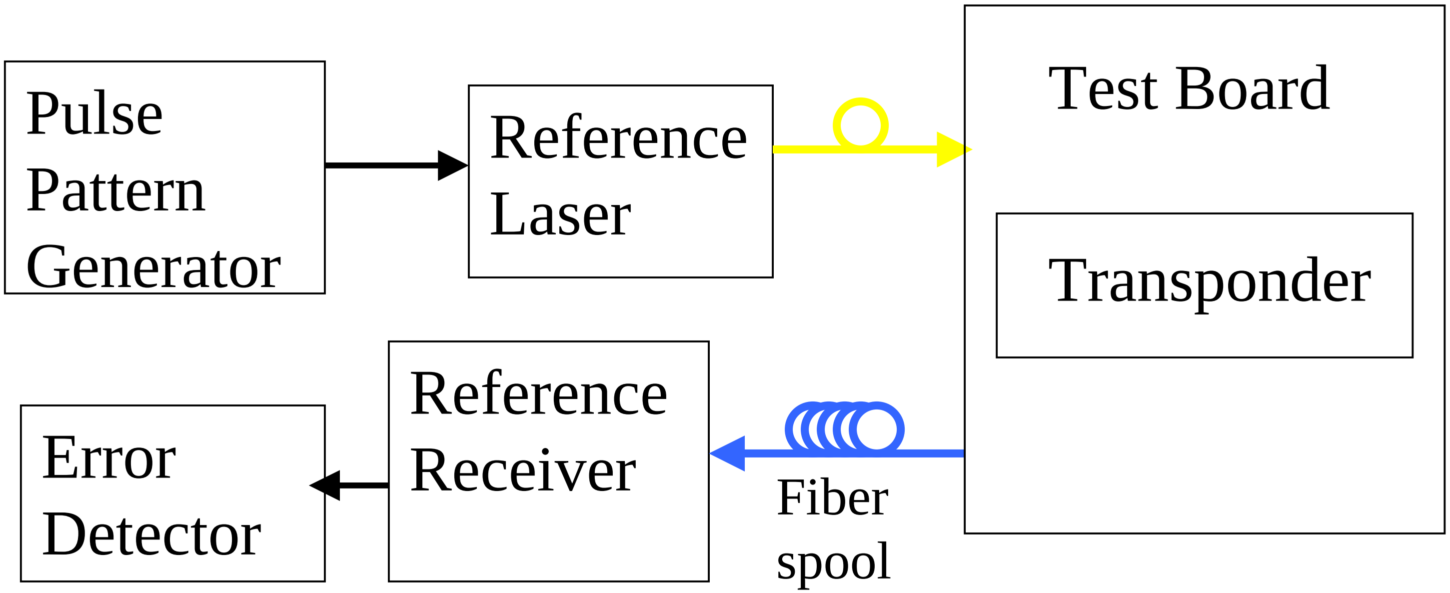
Jitter Tolerance Data



Jitter Transfer Data

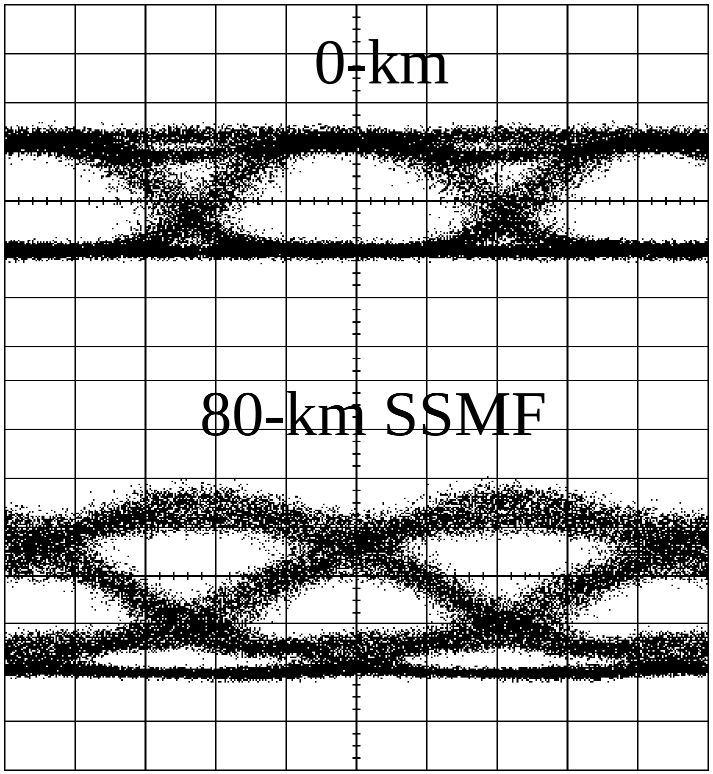


Example Setup for Path Penalty Measurements

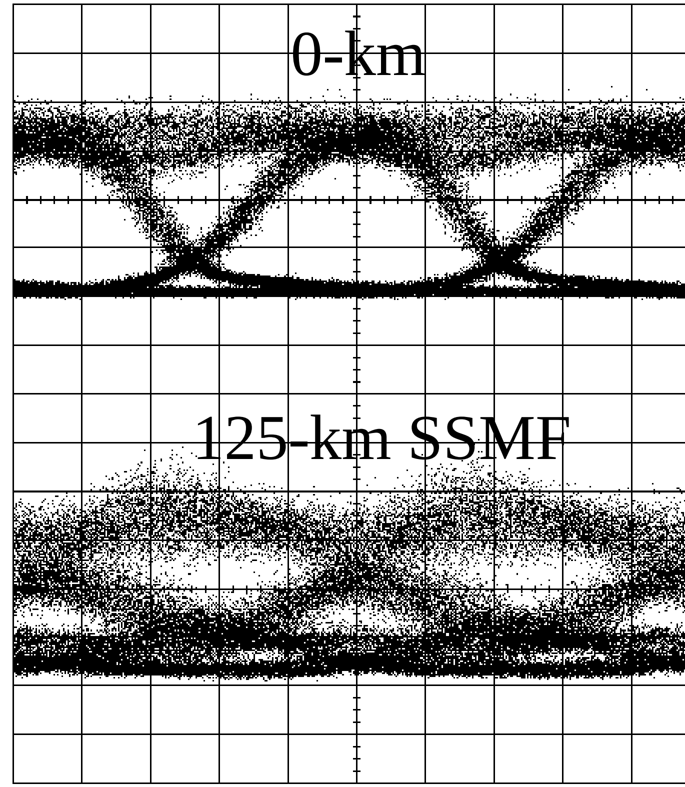


MULTIPLEX EML TRANSMITTER EYES

10.709 Gb/s 1553.0 nm

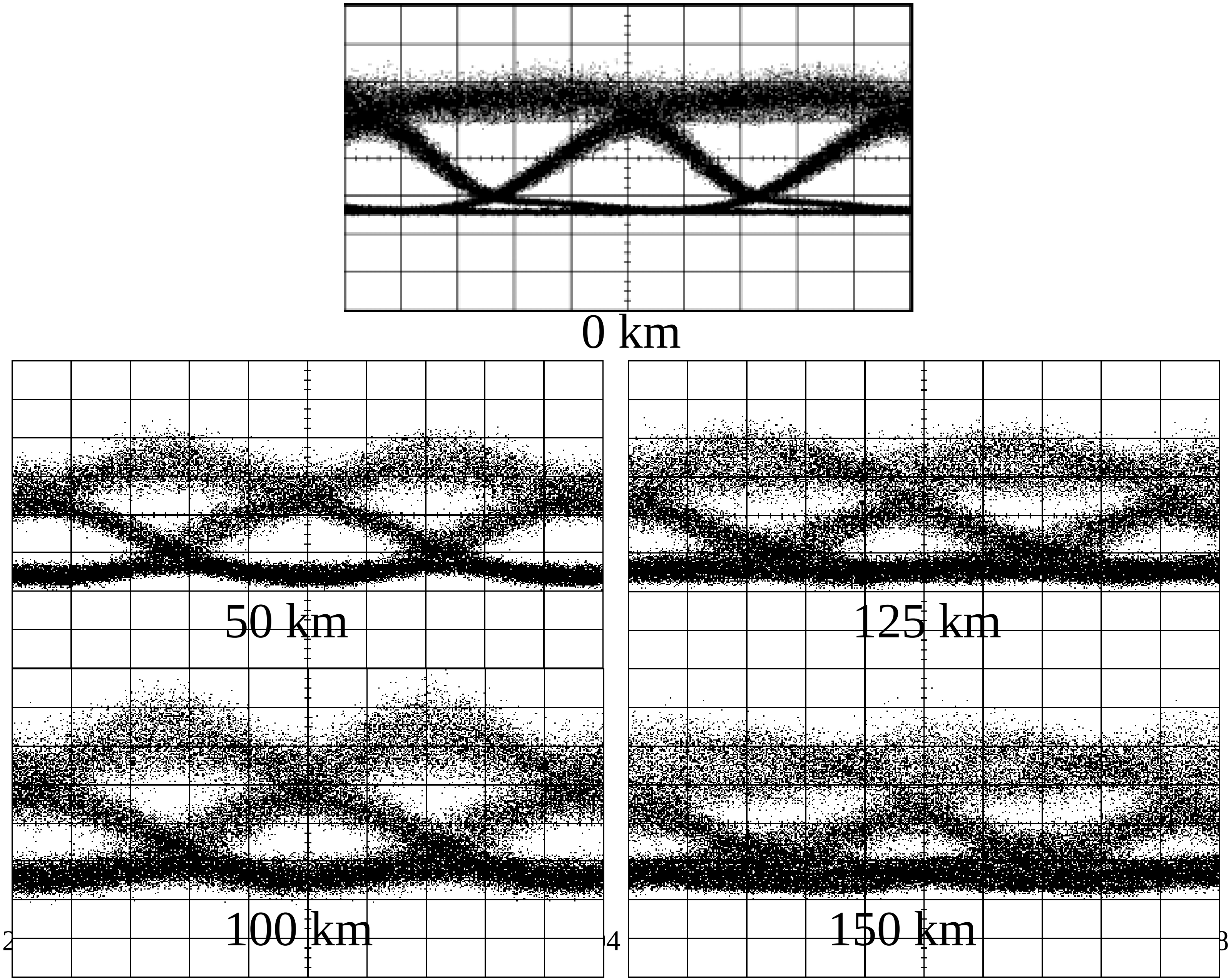


Original Chirp
Optimized for 80km
(1360 ps/nm)



Chirp Optimized for
125km (2125 ps/nm)

CHIRP OPTIMIZED FOR PERFORMANCE AT 150 km



Issues

Eye measurements

- SNR
  - Is it necessary?
  - How good is good enough?
  - Is it the same at different distances?
- ER
  - Should OMA (Optical Modulation Amplitude) be used instead?

Issues (Continued)

- Mask
  - How useful it is?
  - What does it guarantee?

Issues (Continued)

- BER measurement
  - Depending on type and characteristics of source

Issues (Continued)

Jitter Measurements

– The results often vary with instruments used
– The test setup has some effects, e.g., optical power settings, signal structures
– The test fixture could also cause errors or inaccuracy of the result, e.g., power supply noise, optical reflection from the interconnects

Issues (Continued)

- Path penalty measurement
  - Depending on eye adjustment and receiver threshold setting

Issues (Continued)

- Test environment
  - Power supply noise and tolerance
  - Temperature, air flow, humidity
  - Signal integrity, e.g., RefClk must be +-100ppm
  - Test configuration – line timing, source timing, optical loop back, electrical loop back
  - Selections of stimulation and test point

Solutions

- Improve MSA (Multi-Source Agreement)
- Understand physics and measurements
- Use same compliant test board

Summary: The implications

1. MSA is a good approach to improve interoperability but it is difficult to come up with a complete and unambiguous MSA due to various reasons.
2. Understand the physics relating to the parameters used in testing is paramount important.
3. Test instruments of different vendors need to be more coherent to produce consistent results.
4. The design margins should be big enough to reduce test time.
5. These implications should apply to similar products such as X2 and XFP as well.