

# Report on test methodologies from the February 11th and 12th lab work

**Objective: Test the tests**

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# Proposal to have an open laboratory prior to the February interim meeting

- Proposed procedures must be validated on several devices
- Follow up and refinement of “Raleigh” modifications through subsequent serial PMD teleconferences
- Test beds built during between Jan 18th and Feb 11th
- A “Public” lab (open to anyone)
- A “Private” lab (those who signed up were given 3 hours of private use on the test beds)
- Eight participants

# Some results from the January meeting in Raleigh

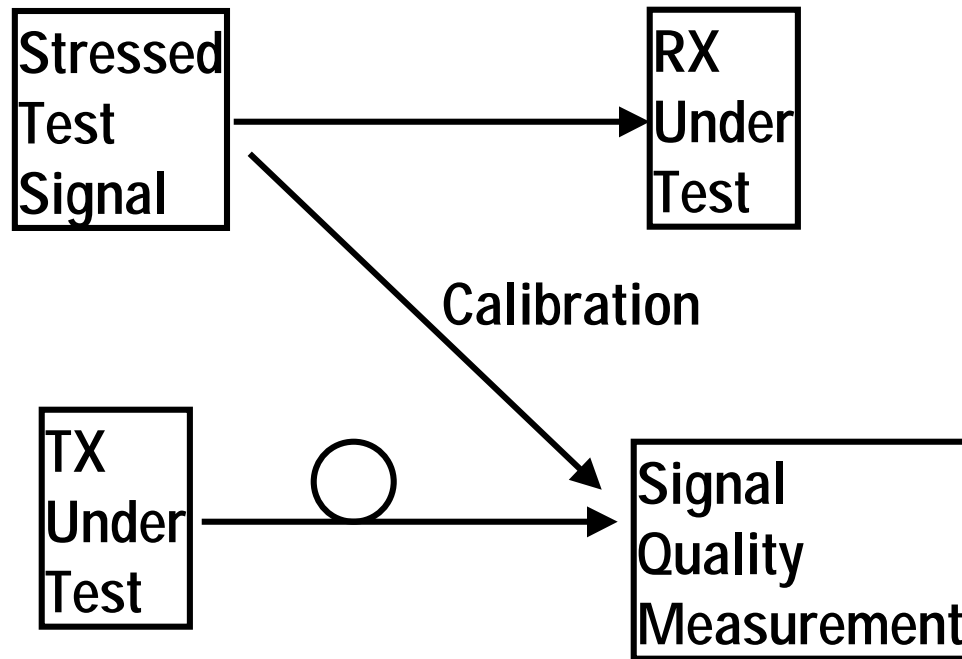
- New proposals for stressed eye receiver testing
- New proposals for transmitter jitter testing
- Report on root causes for difficulties in performing jitter bathtub stressed receiver test measurements
  - Verification needed on “real” devices

# Test system overview

- Transmitter test bed:
  - Jitter bathtub measurement
  - Transmitter Dispersion Penalty (TDP) measurement
- Receiver test bed:
  - "Old" stressed eye
  - "Simplified" Stress

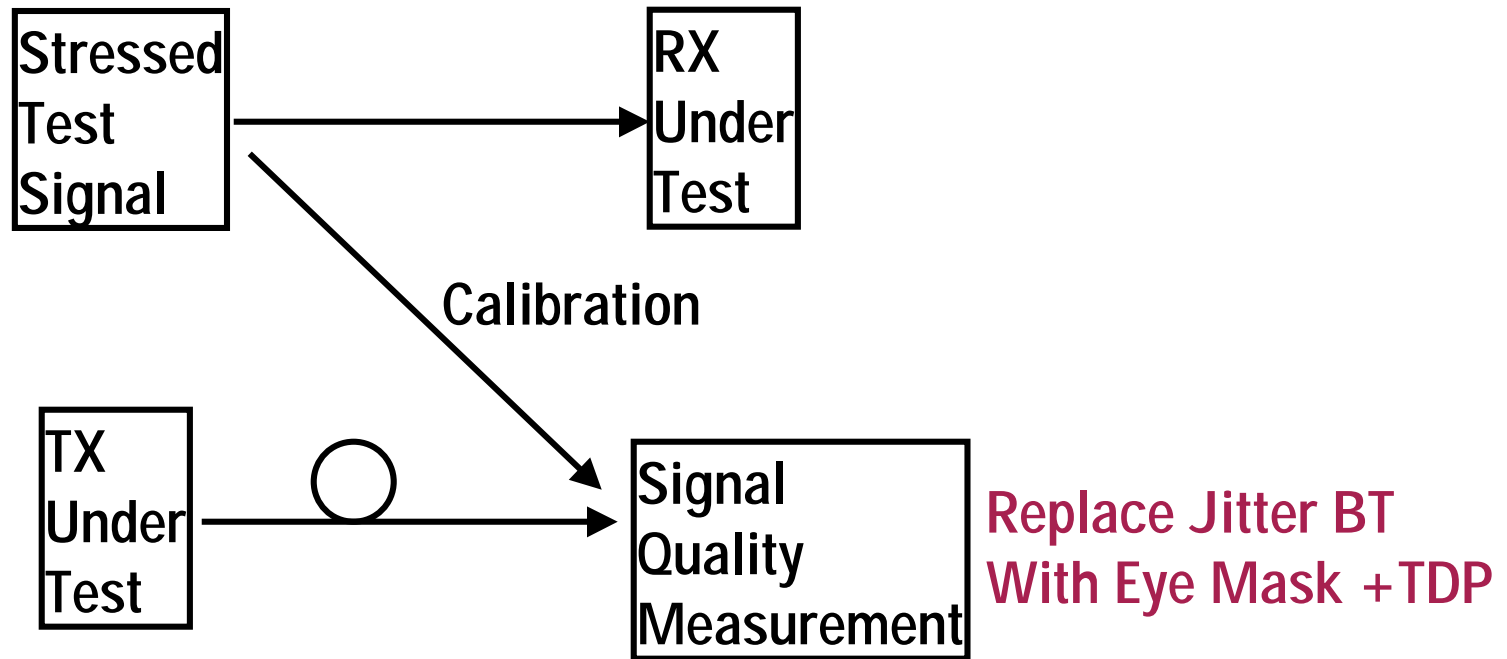


# D4.1 vs D4.0: What hasn't Changed:



# D4.1 vs D4.0: Two Major Changes:

**“Simplified” Stress:  
Additive Amplitude ISI**



# Contract Between TX and RX

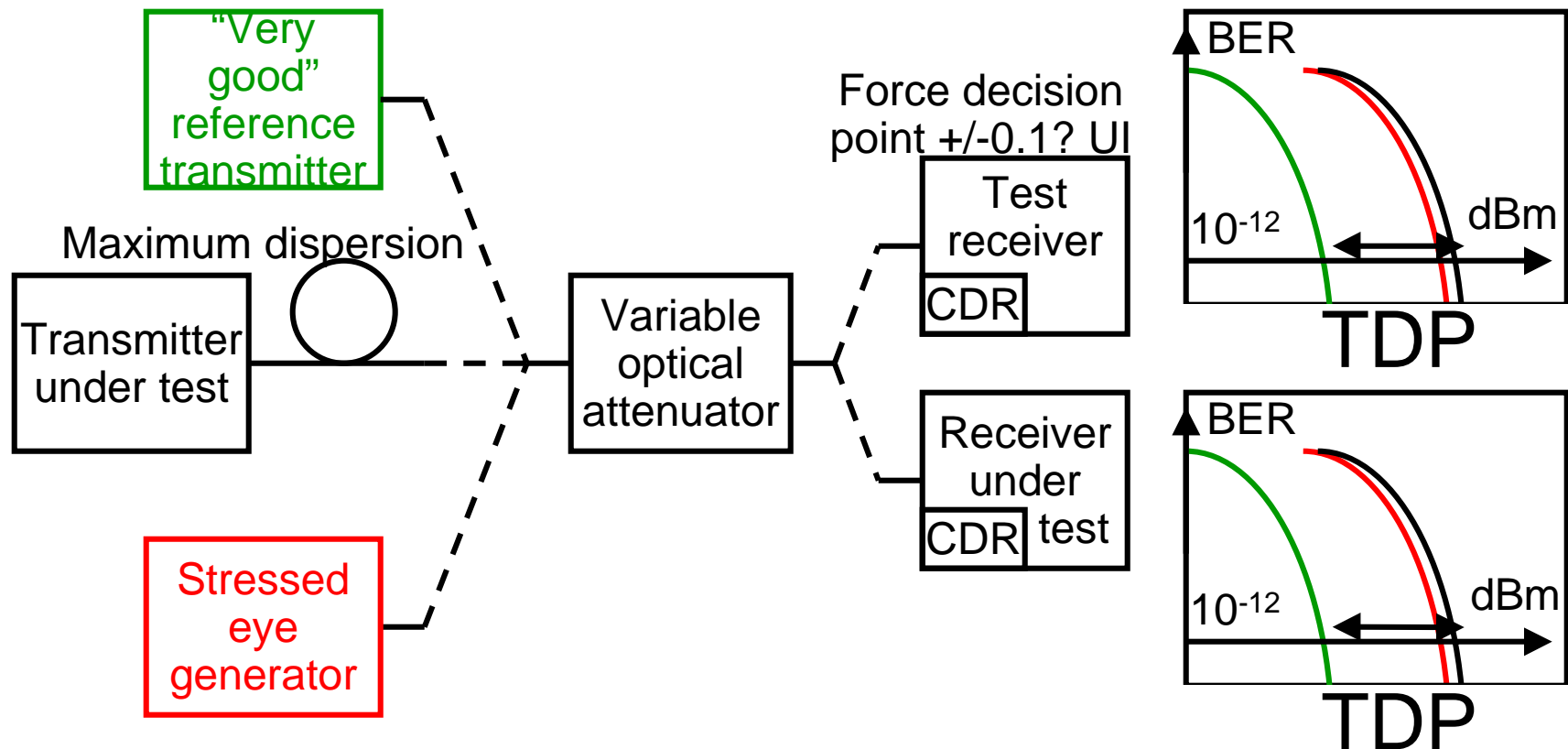
## Bathtub jitter

TX must produce less jitter than stressed eye

RX must successfully receive stressed eye

- TDP methodology
- TX must produce a smaller sensitivity penalty than stressed eye
- RX must successfully receive stressed eye

# Matrix of measured Penalties



Three transmitters

Two receivers

	Receiver	
Transmitter	Test Rx	Rx U.T.
V.good ref.	cal. for TDP	Inform. sens.
Tx U.T.	TDP	
Stressed eye	cal.for str.sens.	Norm. sens.

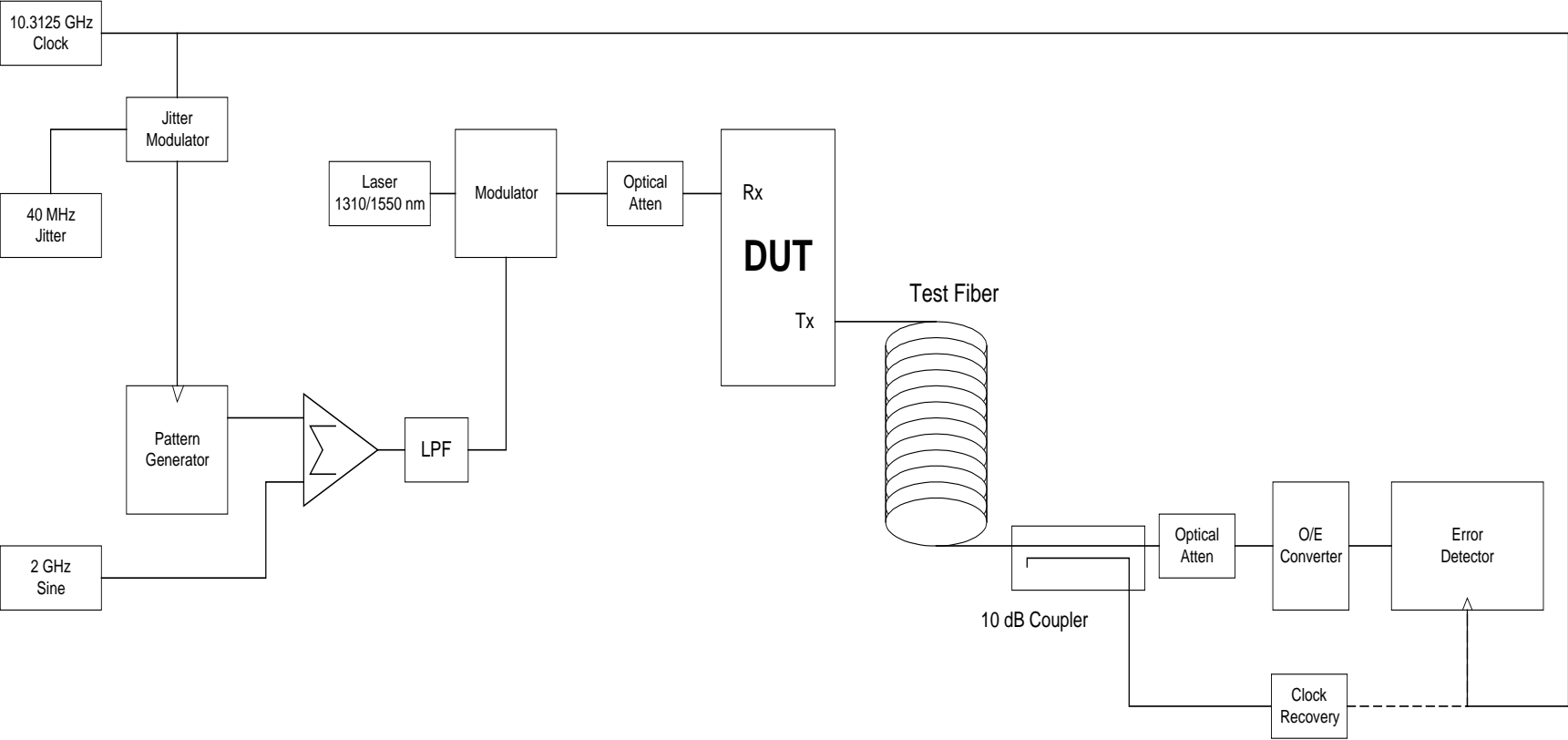
# Effect of Test Equipment non-ideality

## Jitter Bathtub method

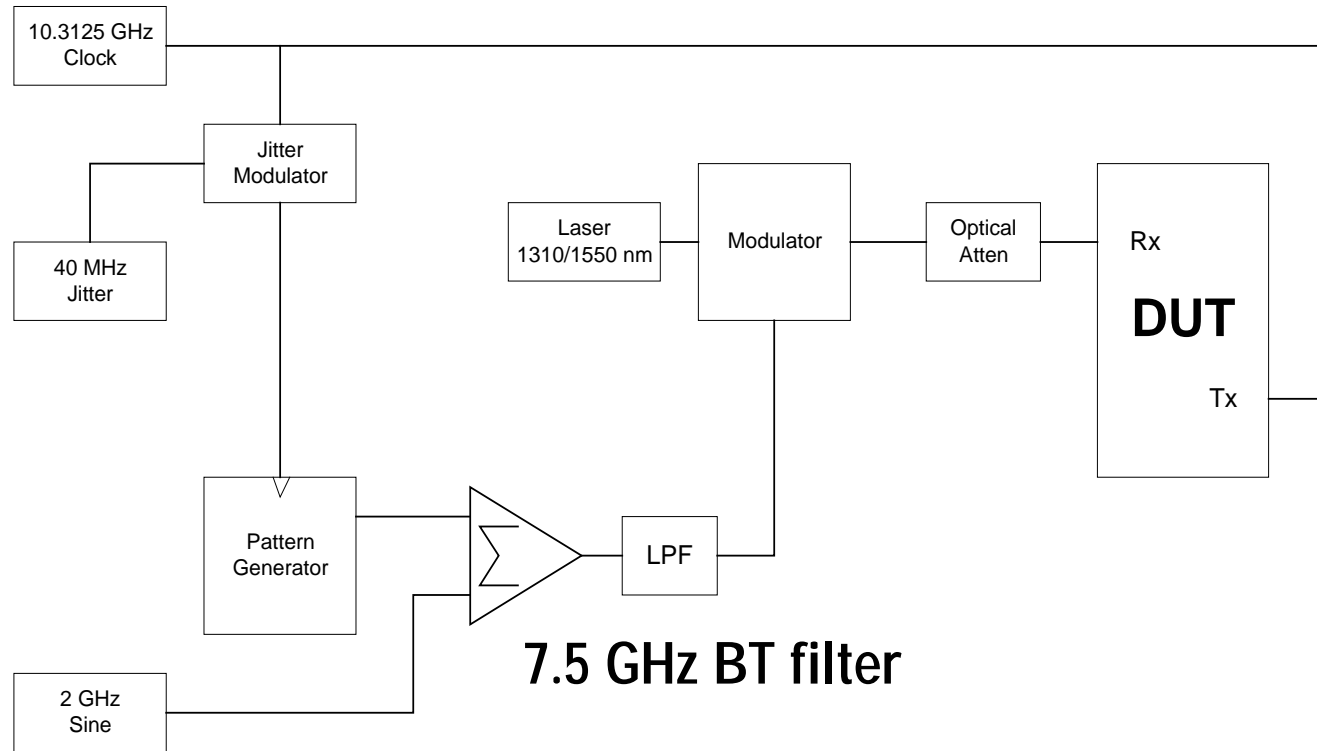
- Tend to over-estimate jitter of TX
- Tend to over-estimate jitter in stressed RX test signal
- These two effects tend to partially cancel out
- But, not all test equipment has equal non-ideality
- How does jitter combine?

- TDP method
- Substitutional method:
  - first order compensation for jitter in measurement RX
- But what about differences between reference RX?

# Test System Block Diagram



# Receiver Test



- Unstressed
- Simplified Stress
- PRBS31

# Original Stress vs Simplified Stress

## Original Stress:

Emphasis on LPF

Added RJ

- Hard to Adjust Filter
- Need BT measurement to Calibrate
- Non-ideal Frequency Response:
  - larger pattern dependence
  - larger Sigma, smaller W

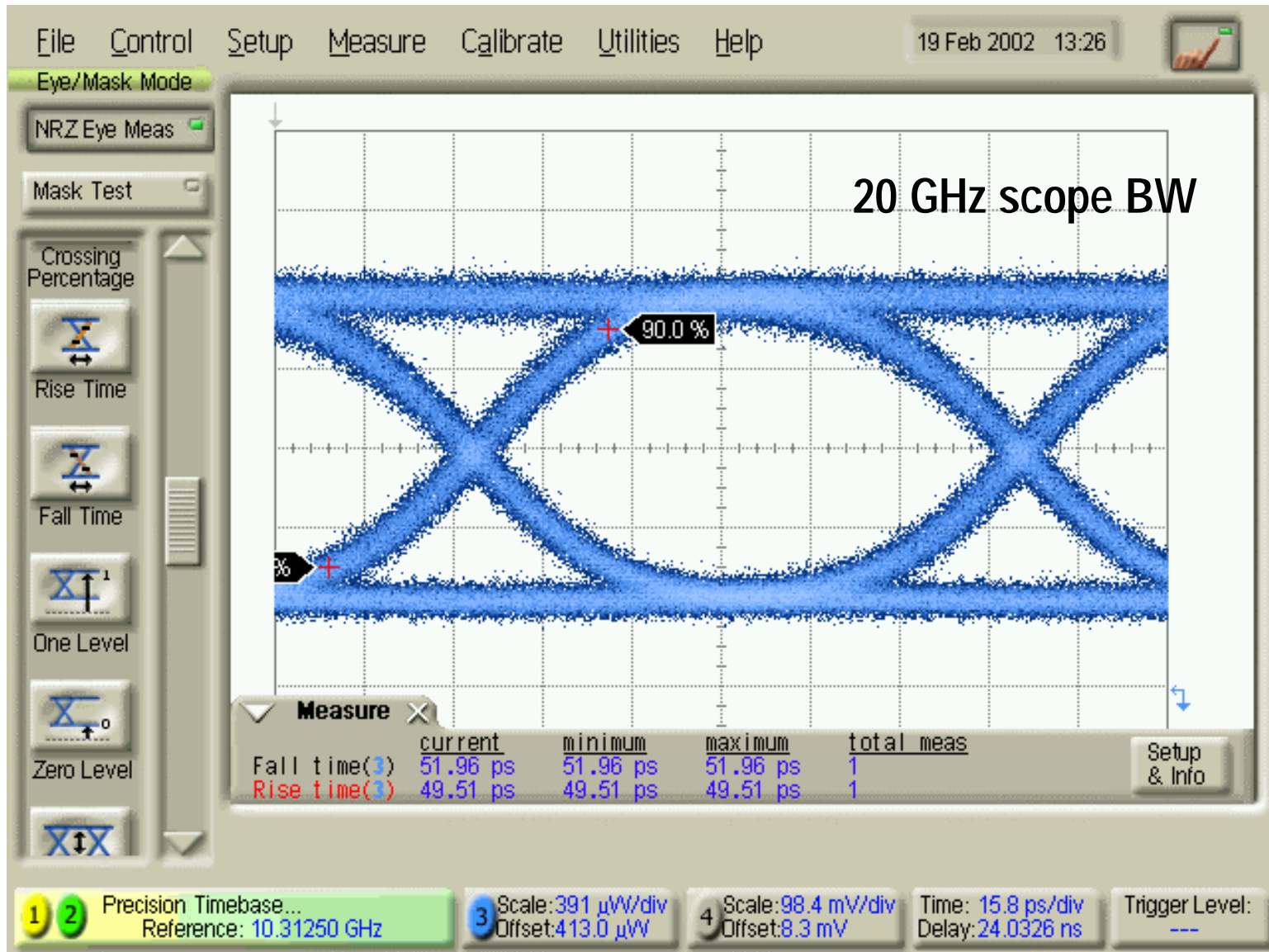
## Simplified Stress:

Additive Amplitude ISI

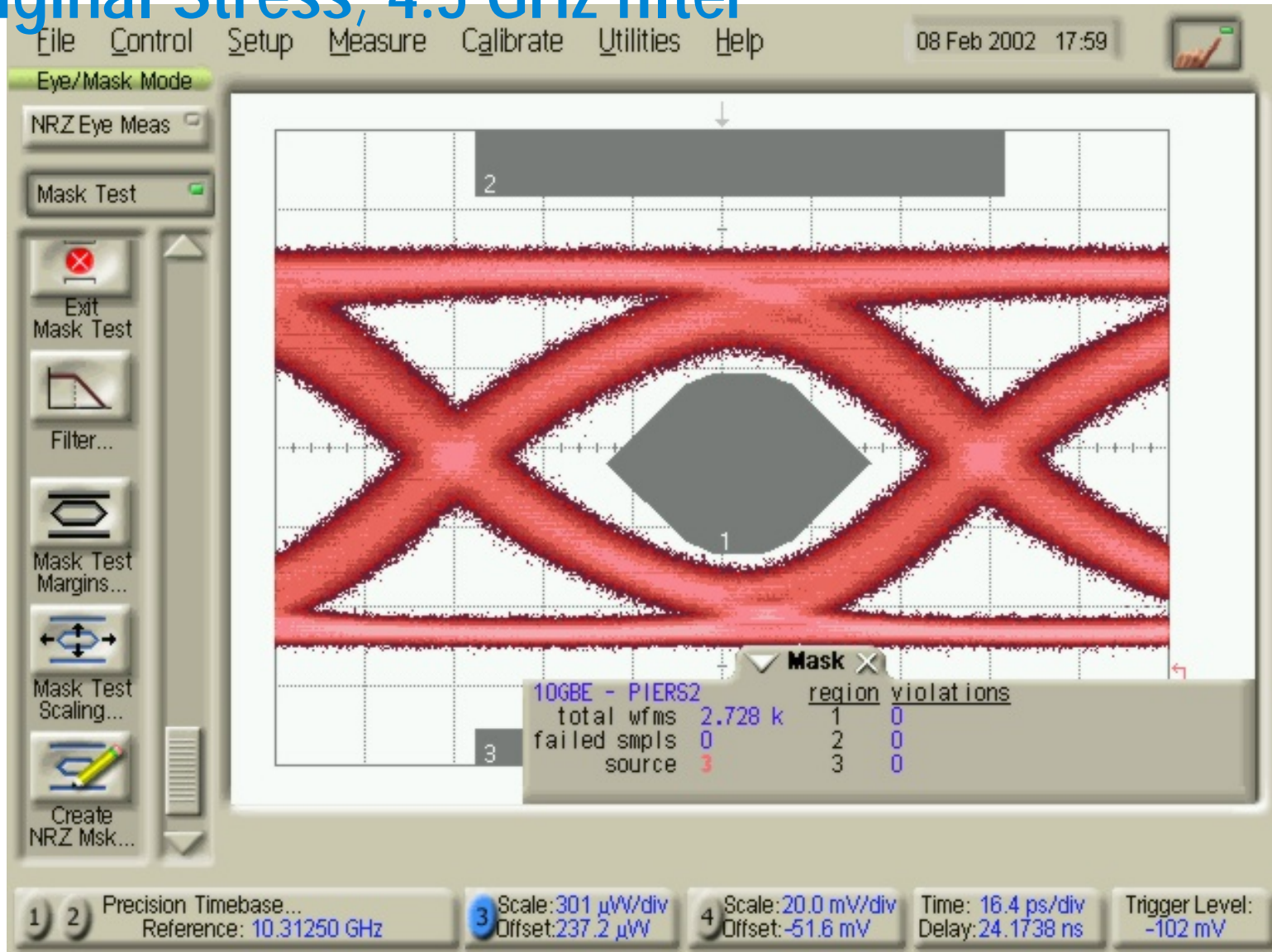
Sinusoidal Jitter

- Easier to Adjust ISI, SJ
- Measure with Oscilloscope
- More ideal frequency response
- Smaller pattern dependence
- W larger, Sigma is smaller

# Clean signal- 7.5 GHz BT filter

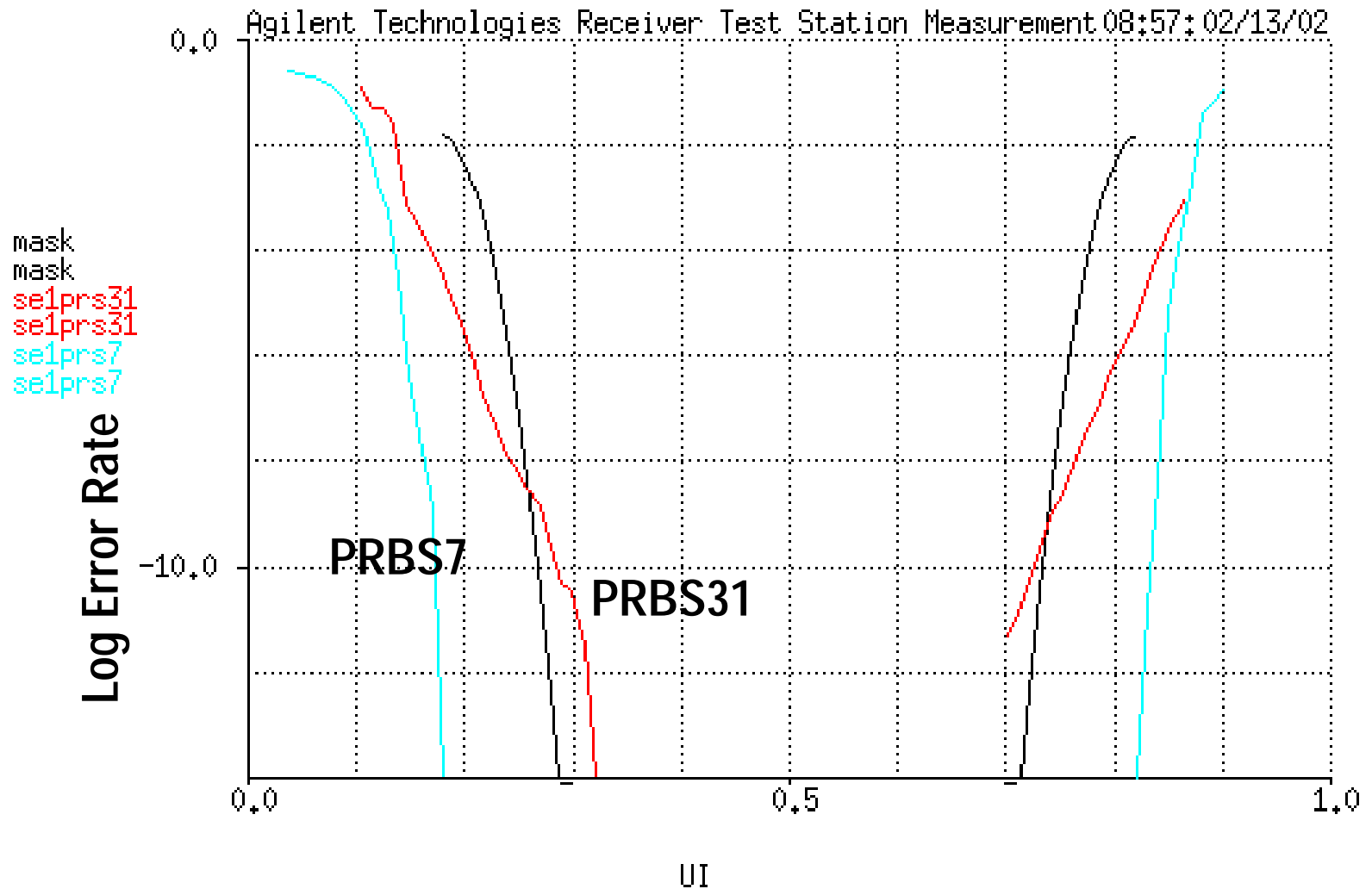


# Original Stress; 4.5 GHz filter



# Original stress-Pattern dependence

10GBE Bathtub Curve with Limit Mask

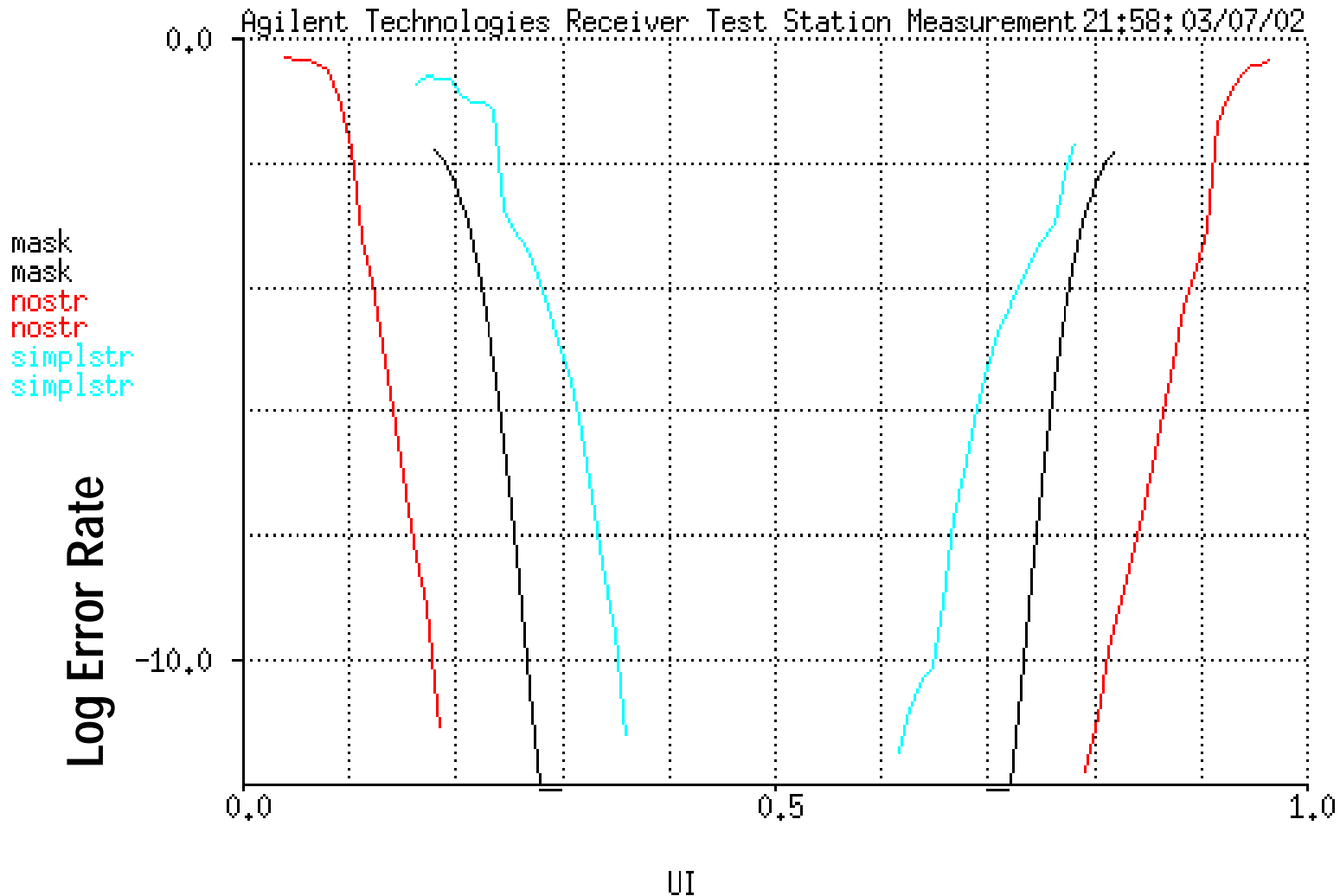


# Simplified Stress- 7.5 BT filter

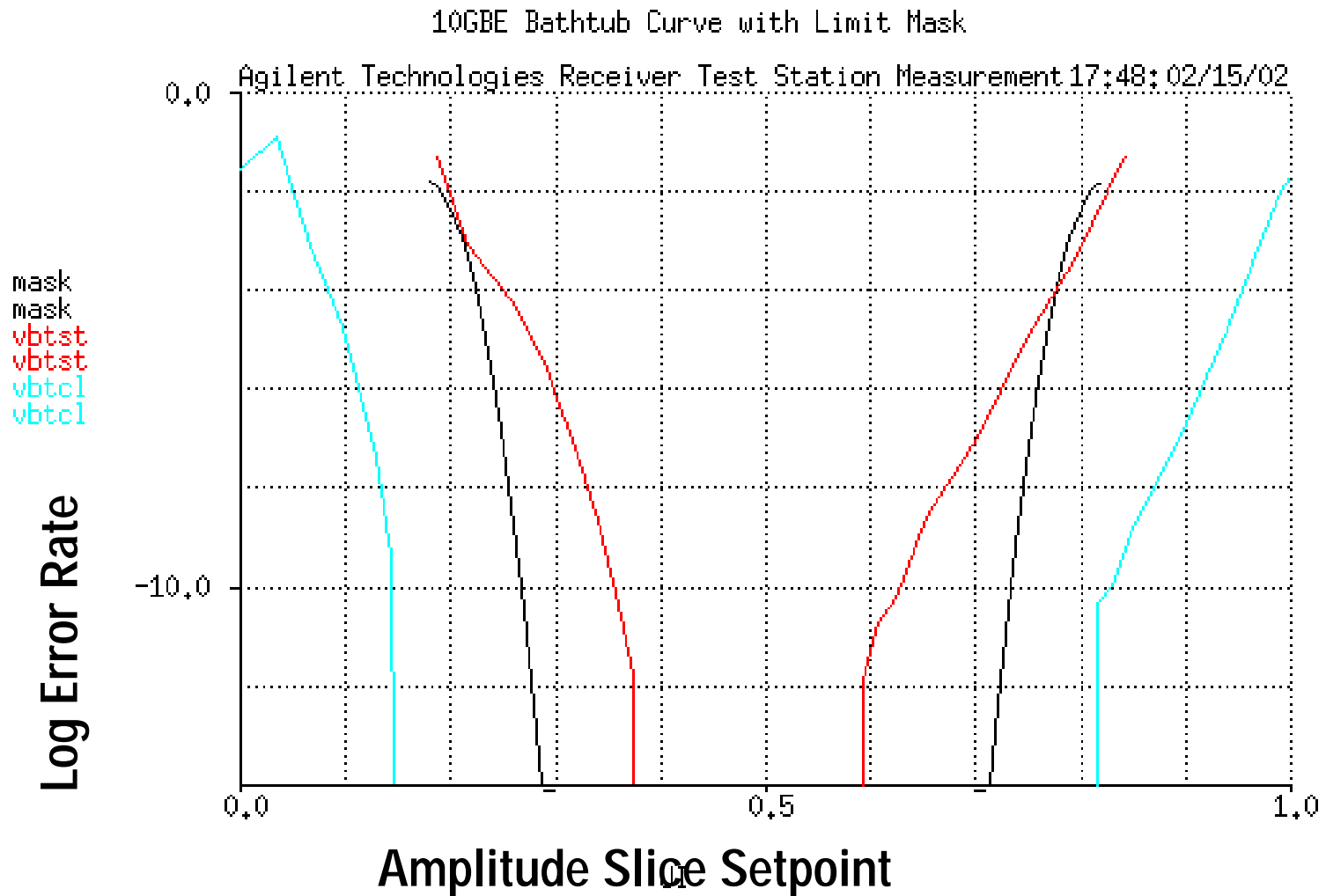


# PRBS 31 – Nostress vs Simplified Stress

10GBE Bathtub Curve with Limit Mask

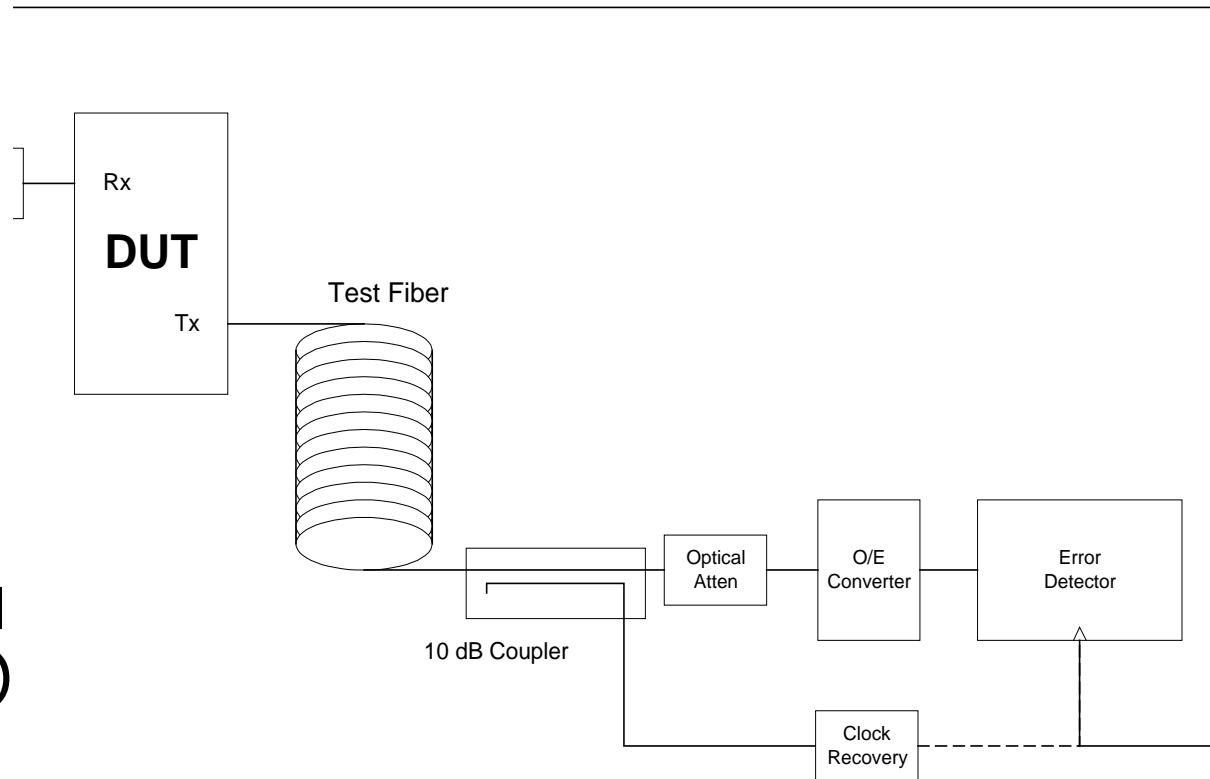


# PRBS 31 – Nostress vs Simplified Stress Vertical “Q” Plot



# Transmitter Test

- Eye Mask
- Bathtub Jitter
- TDP ( $\pm 0.1$  UI decision point)
- PRBS31



# Bathtub Curve vs TDP

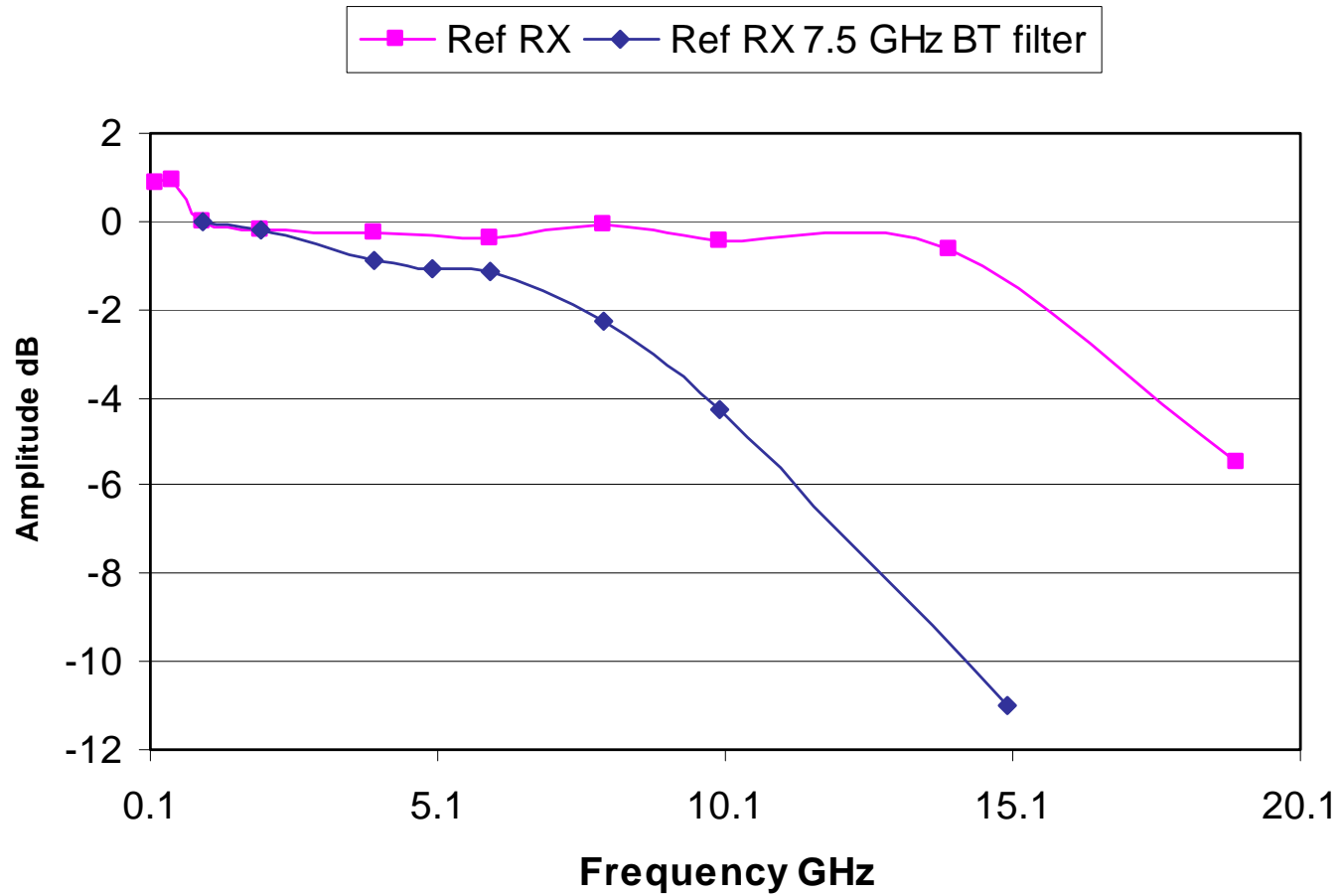
## Bathtub Jitter Measurement

- Tests Low and High Probability Jitter
- Does not test Vertical Eye Closure
  - Left to eye mask

## TDP

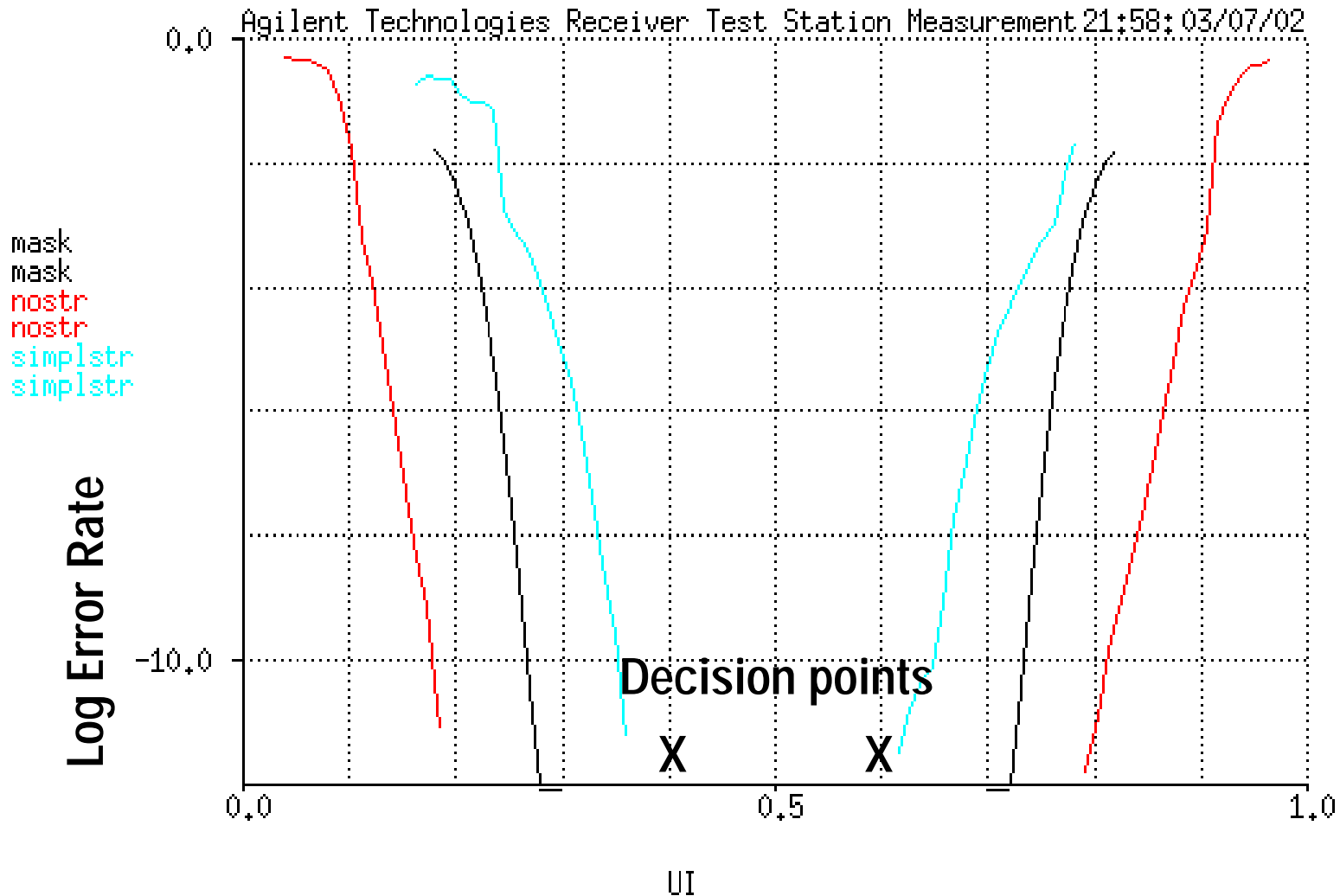
- Classical TDP tests Vertical Eye Closure
- TDP with Offset sampling point tests Vertical Eye Closure and Jitter
- Sensitivity to Jitter depends on choice of Sampling Point Offset

## RX Frequency response



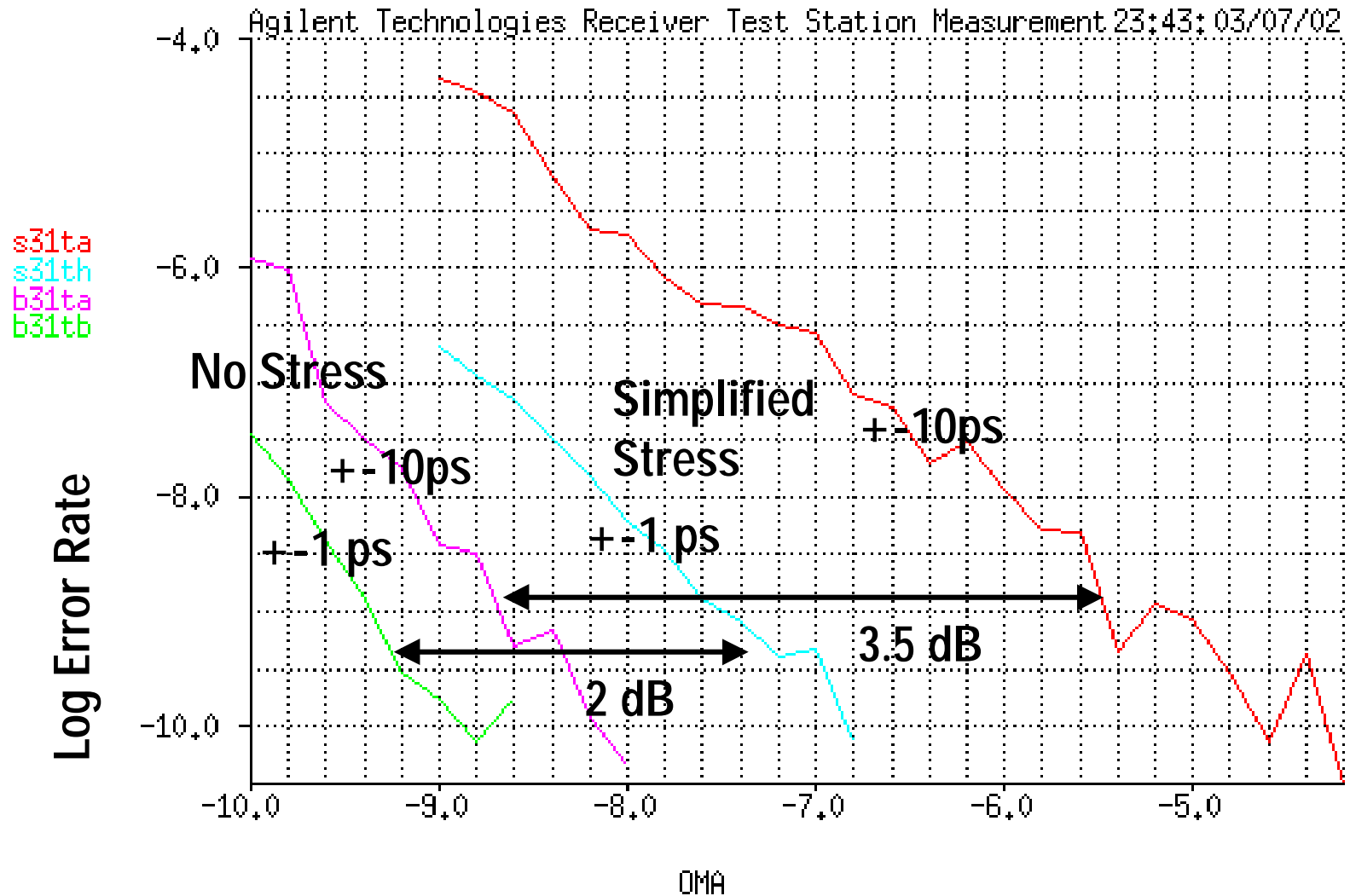
# TDP Meas and BT measurement on Simpl stress

10GBE Bathtub Curve with Limit Mask

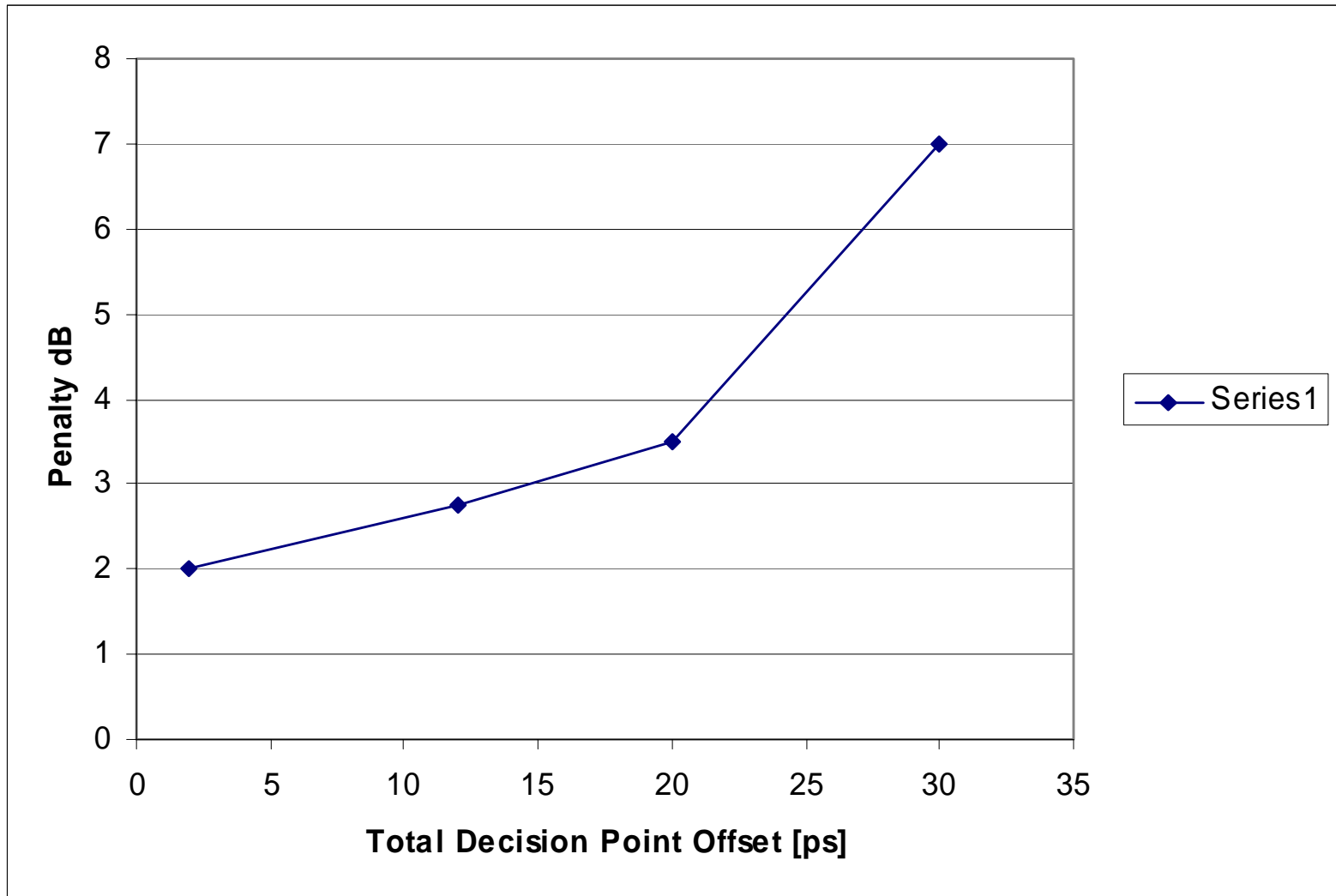


# Reference RX penalties; 7.5 GHz RX BT filter

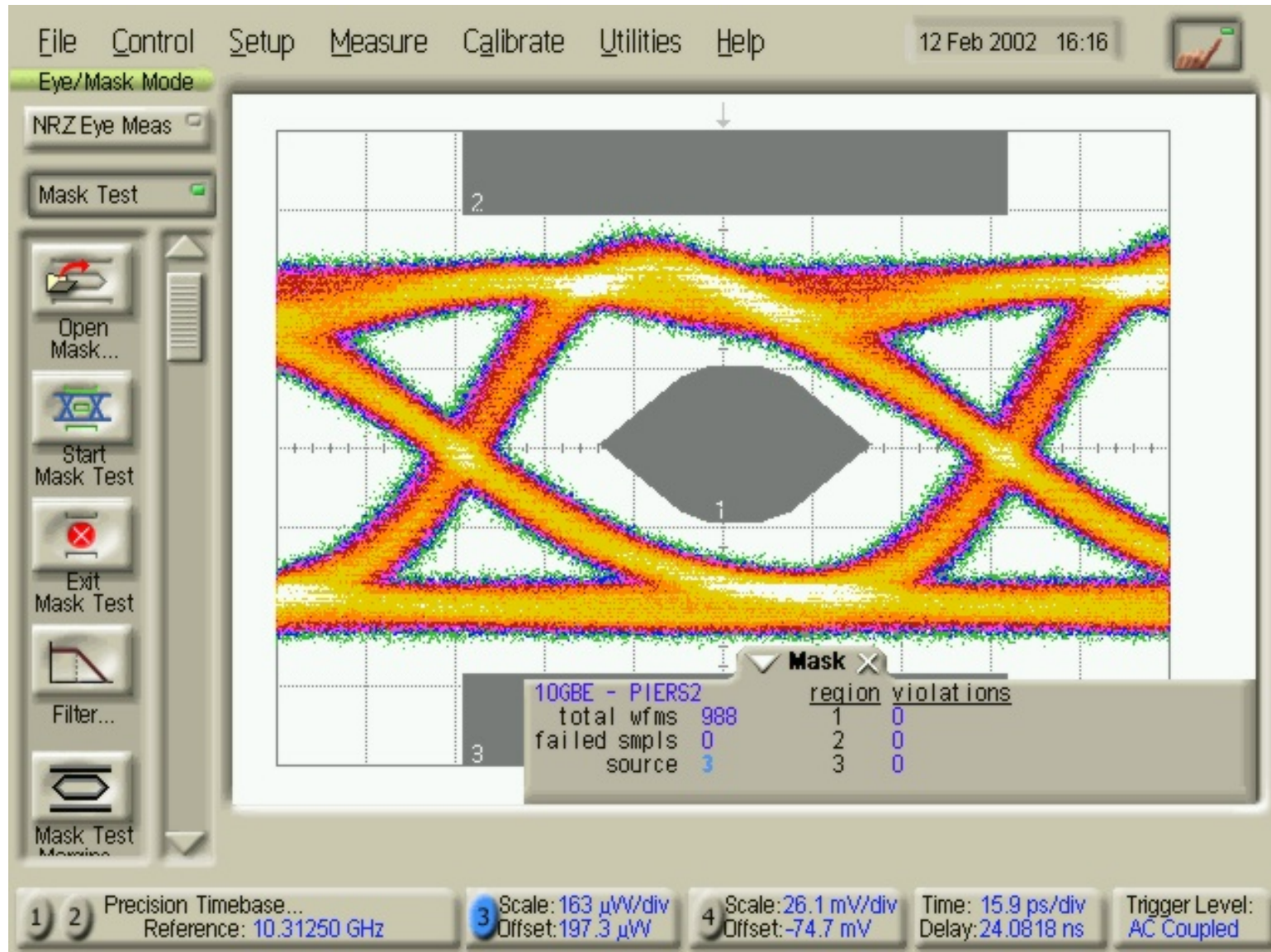
Sensitivity Plot



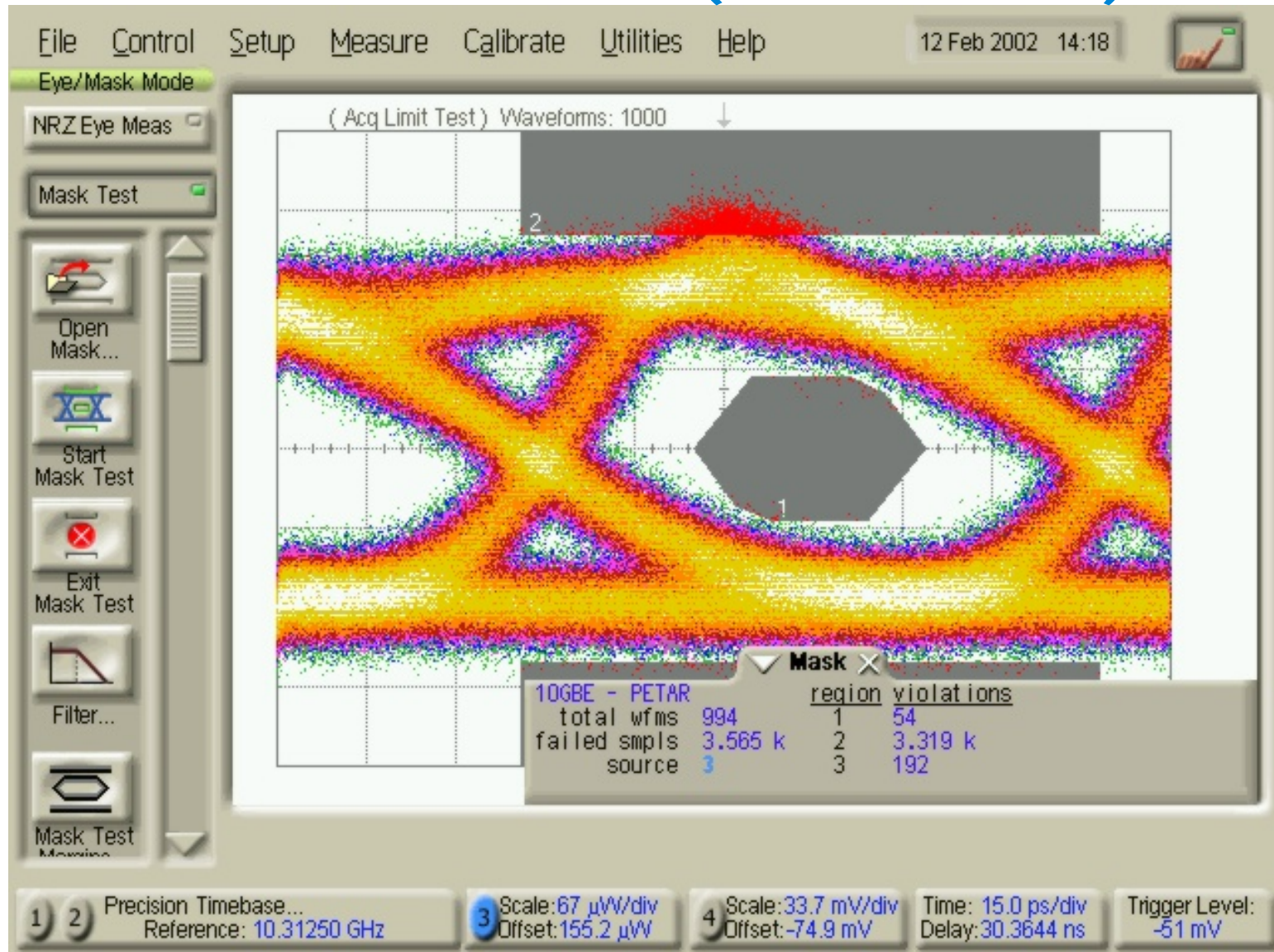
# Effect of Decision Point Offset- ref RX



# Direct Tx No Fiber (Pier's Mask)

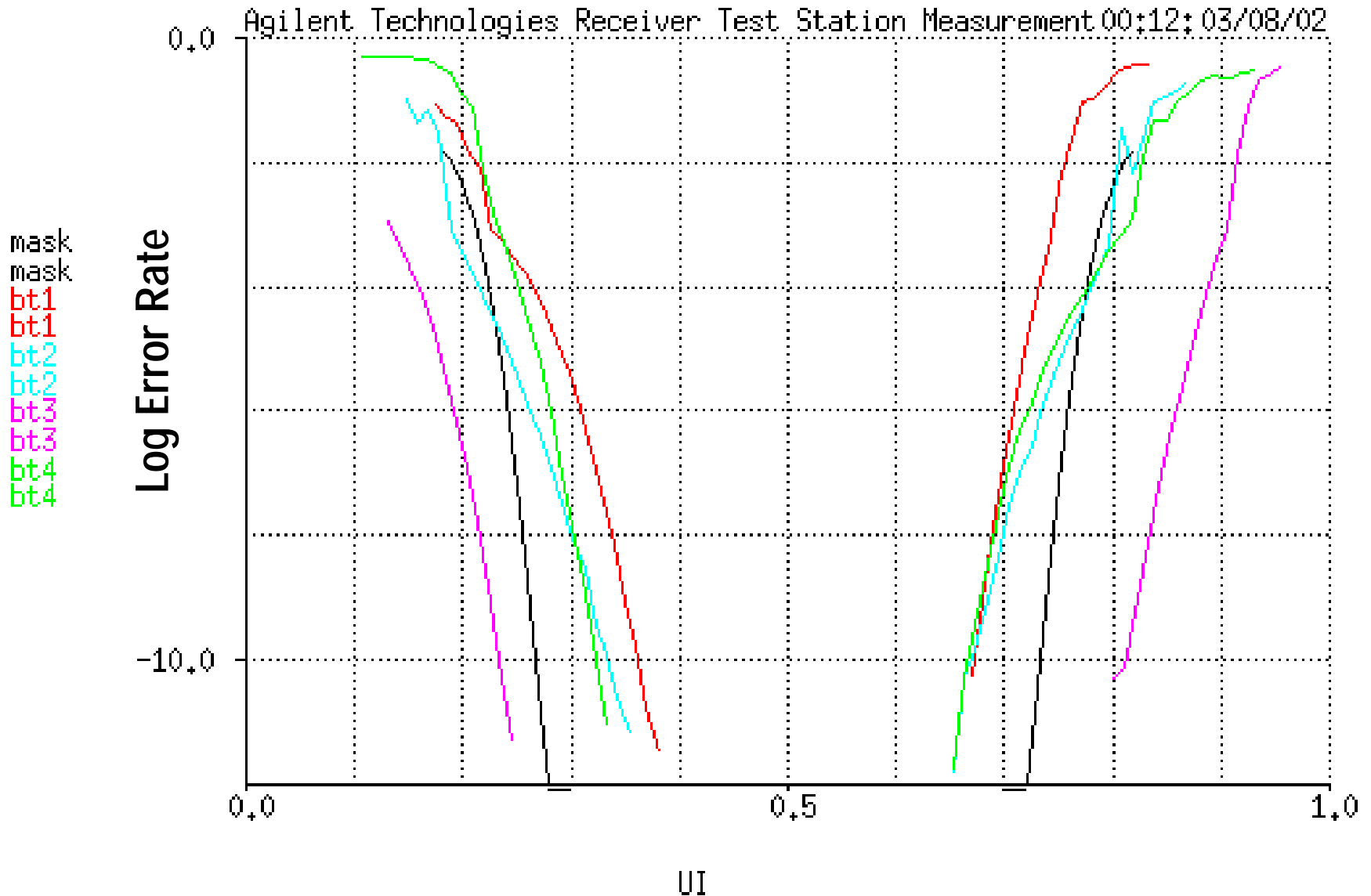


# Direct Laser Tx With Fiber (Petar's Mask)

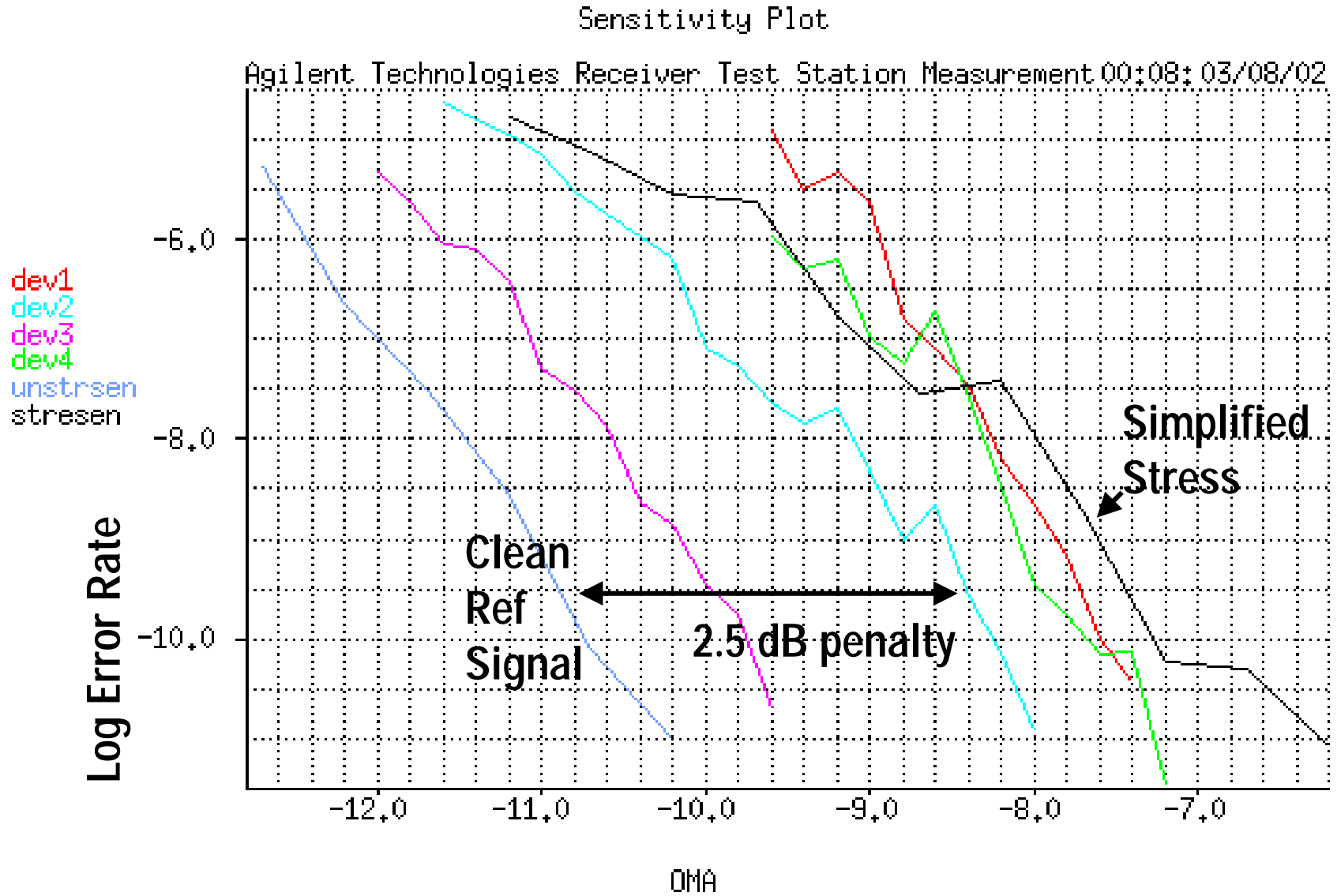


# Tx Test; PRBS31; No Stress; "10 km" fiber

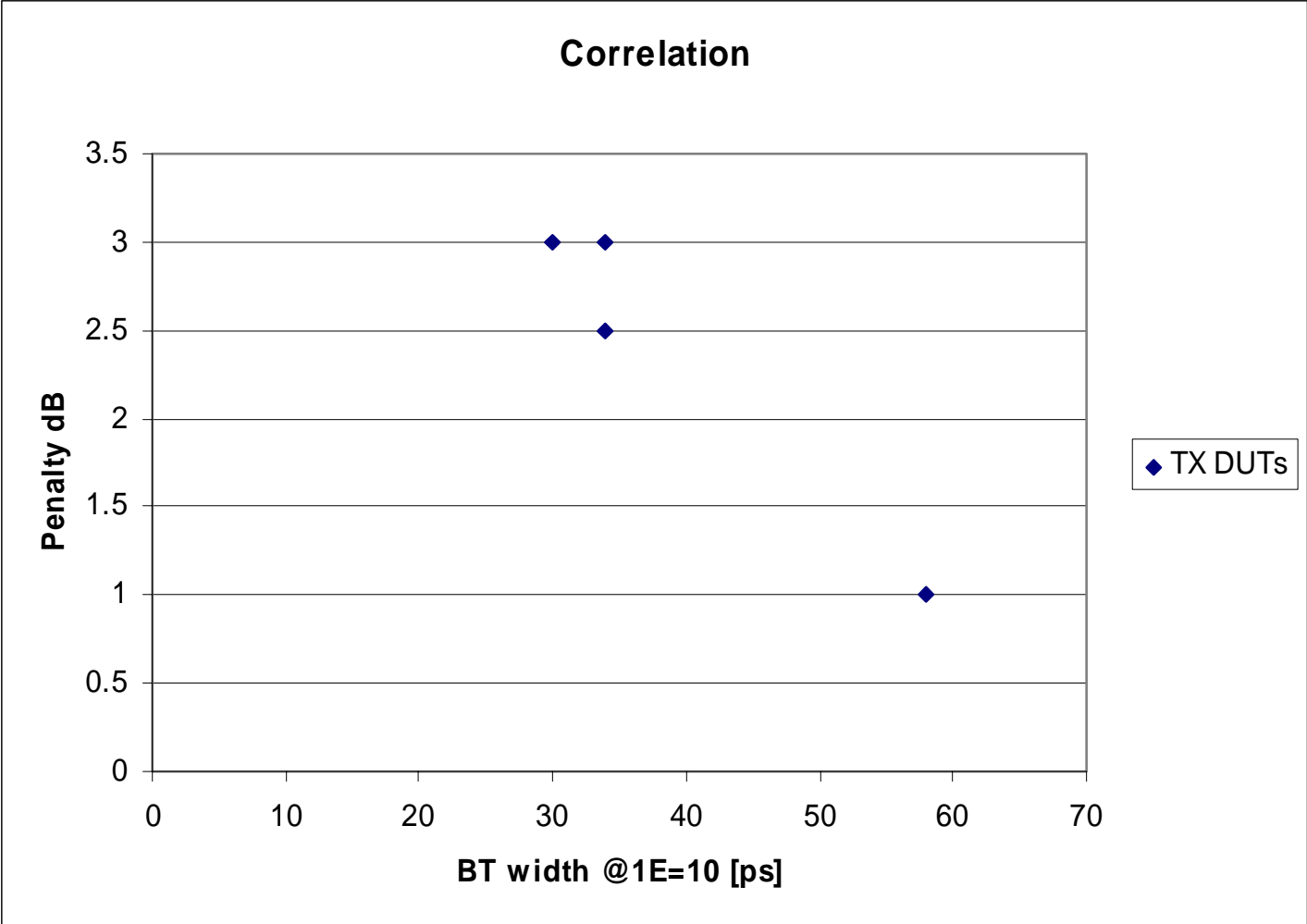
10GBE Bathtub Curve with Limit Mask



# TDP +/- 0.1 UI; TX through Fiber



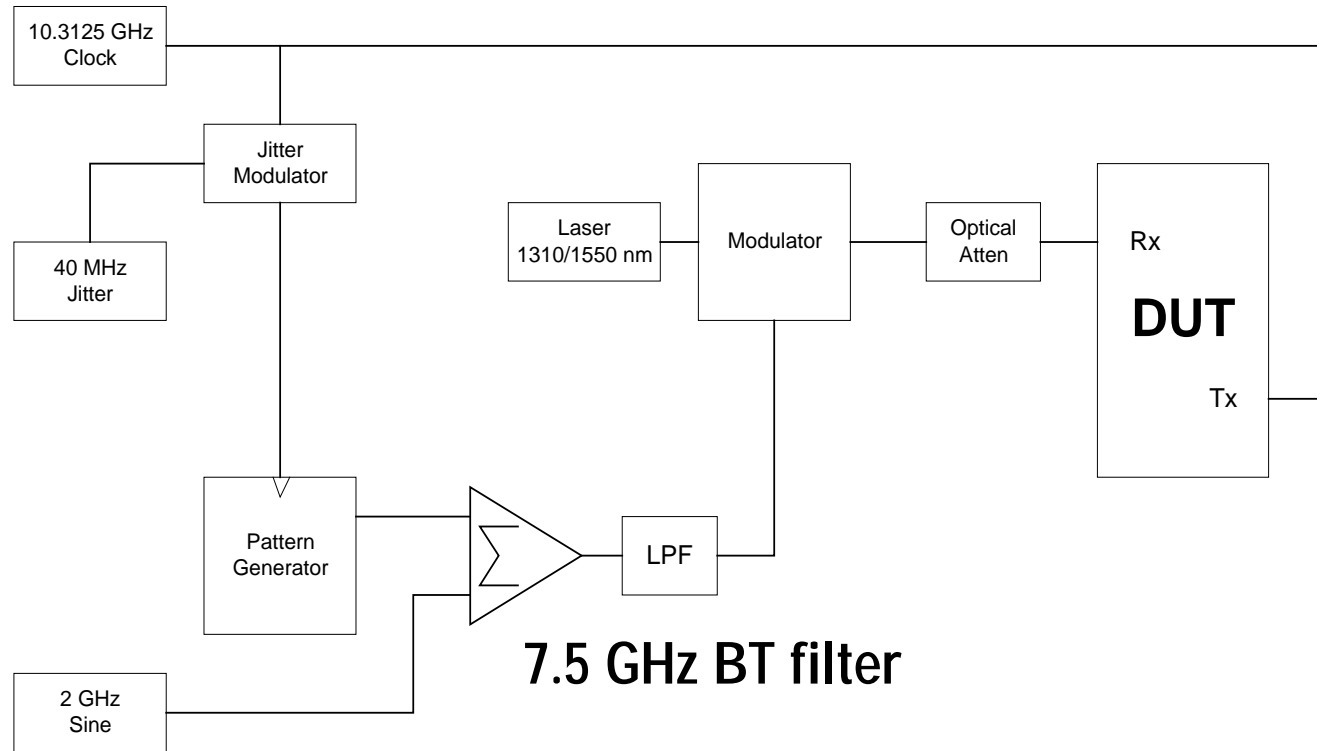
# TDP correlation to BT curves



# TDP Table- TX results

	Reference RX +/- 0.1 UI	RX DUT
Clean Source	calibration	
TX DUT	1 to 3 dB penalty	
Stressed Eye	3.5 dB penalty	

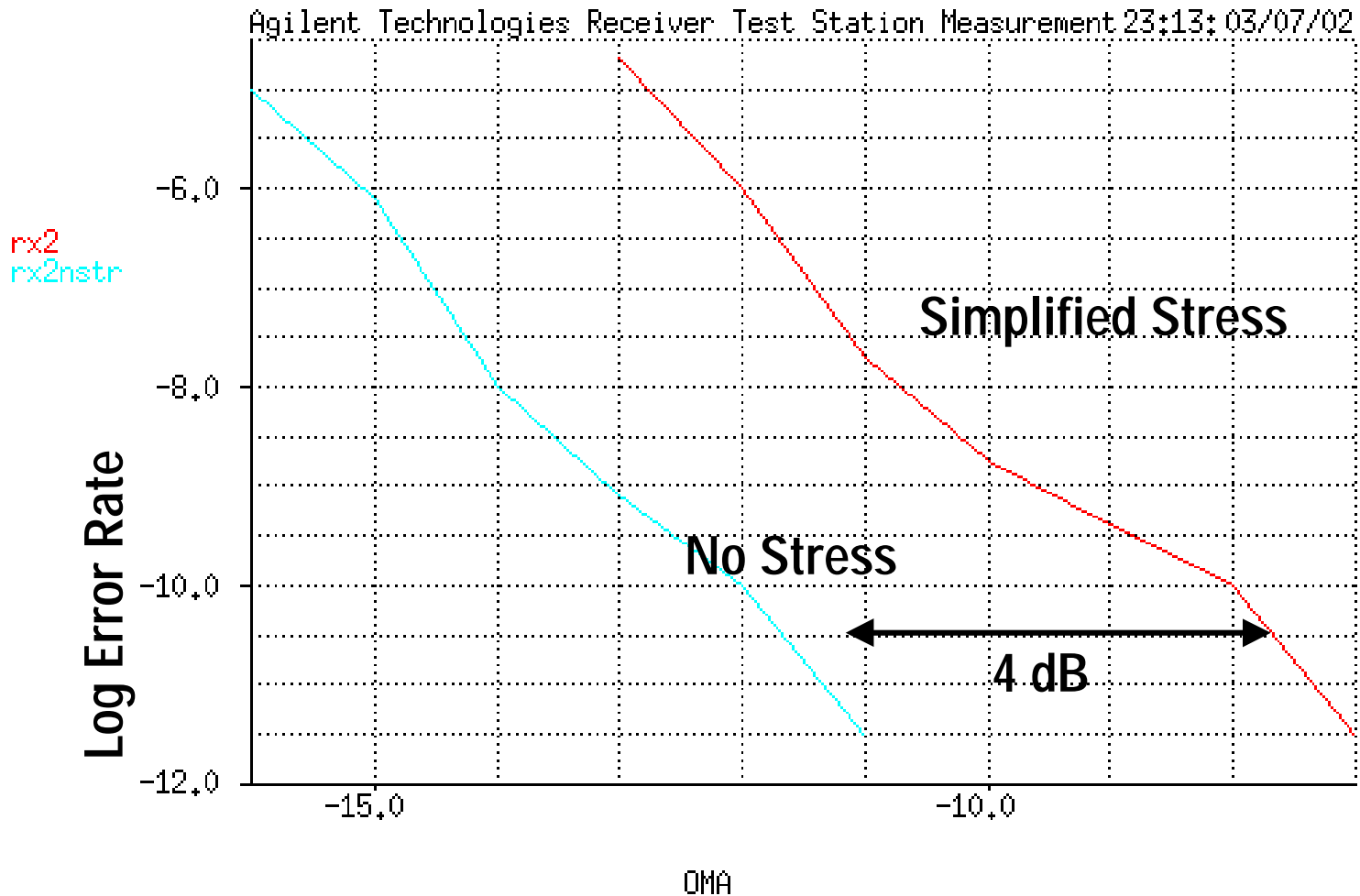
# Receiver Test



- Unstressed
- Simplified Stress
- PRBS31

# Rx BER vs OMA – Simplified Stress vs Nostress

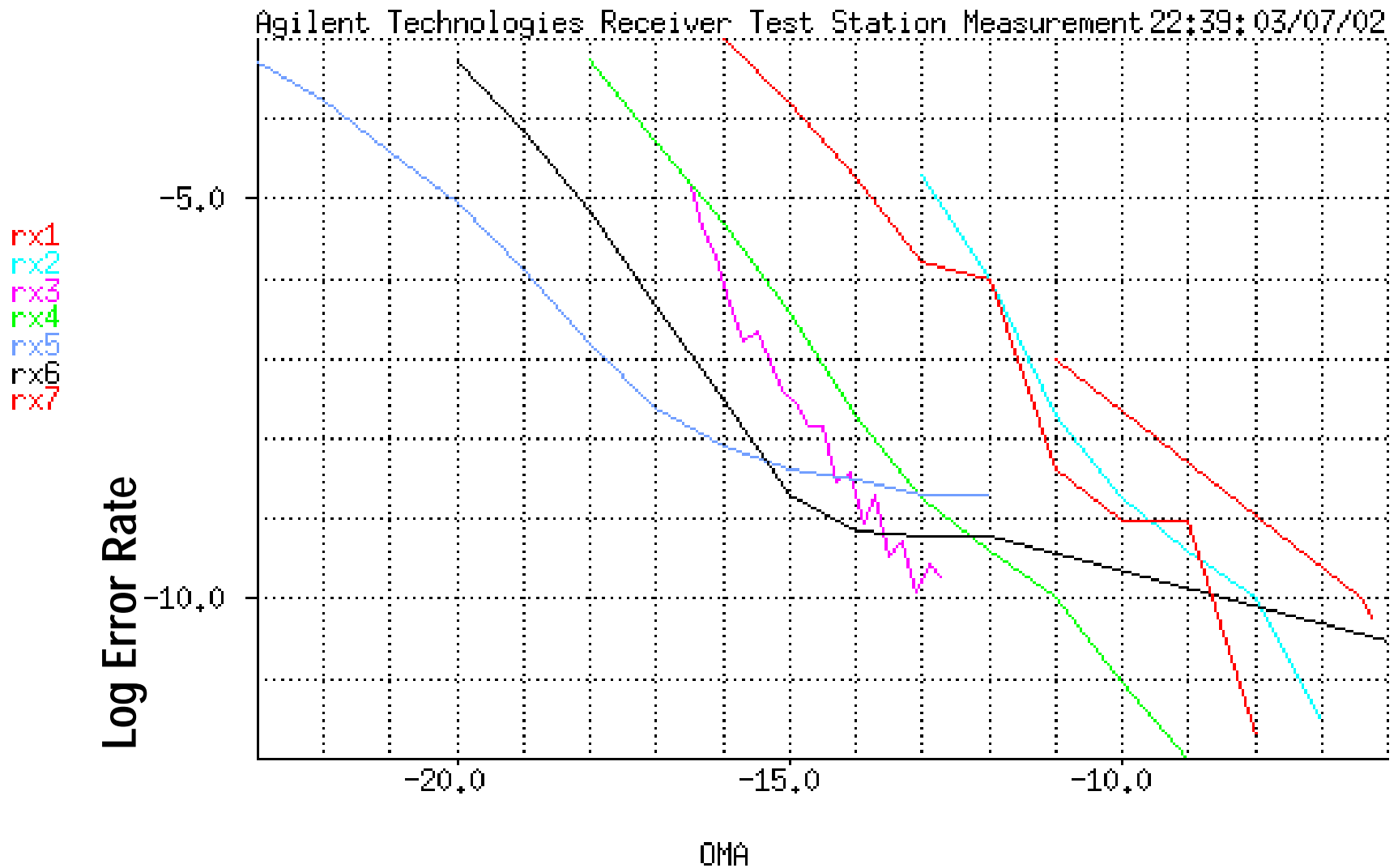
Sensitivity Plot



SJ ~.25UI

# Rx Sensitivity with Simplified Stress

Sensitivity Plot



# TDP Table

	Reference RX +/- 0.1 UI	RX DUT
Clean Source	calibration	Nominal sensitivity -18 to -11 dBm
TX DUT	1 to 3 dB penalty	
Stressed Eye	3.5 dB penalty	3.5-7 dB penalty OMA=-11 to -5 dBm

# Summary

- **Simplified Stress BT curves qualitatively similar to actual DML TX curves**
- **TDP measured with  $\pm 0.1$  UI decision point offset correlates with BT curve**
- **All TX DUTs measured smaller penalties than simplified stress**
- **Simplified stress induced moderate to large power penalties in RX DUTs**
- **Simplified Stress/TDP methodology seems to be workable using optimized test Receiver**