SUMITOMO ELECTRIC

SOA + PIN-PD receiver performance

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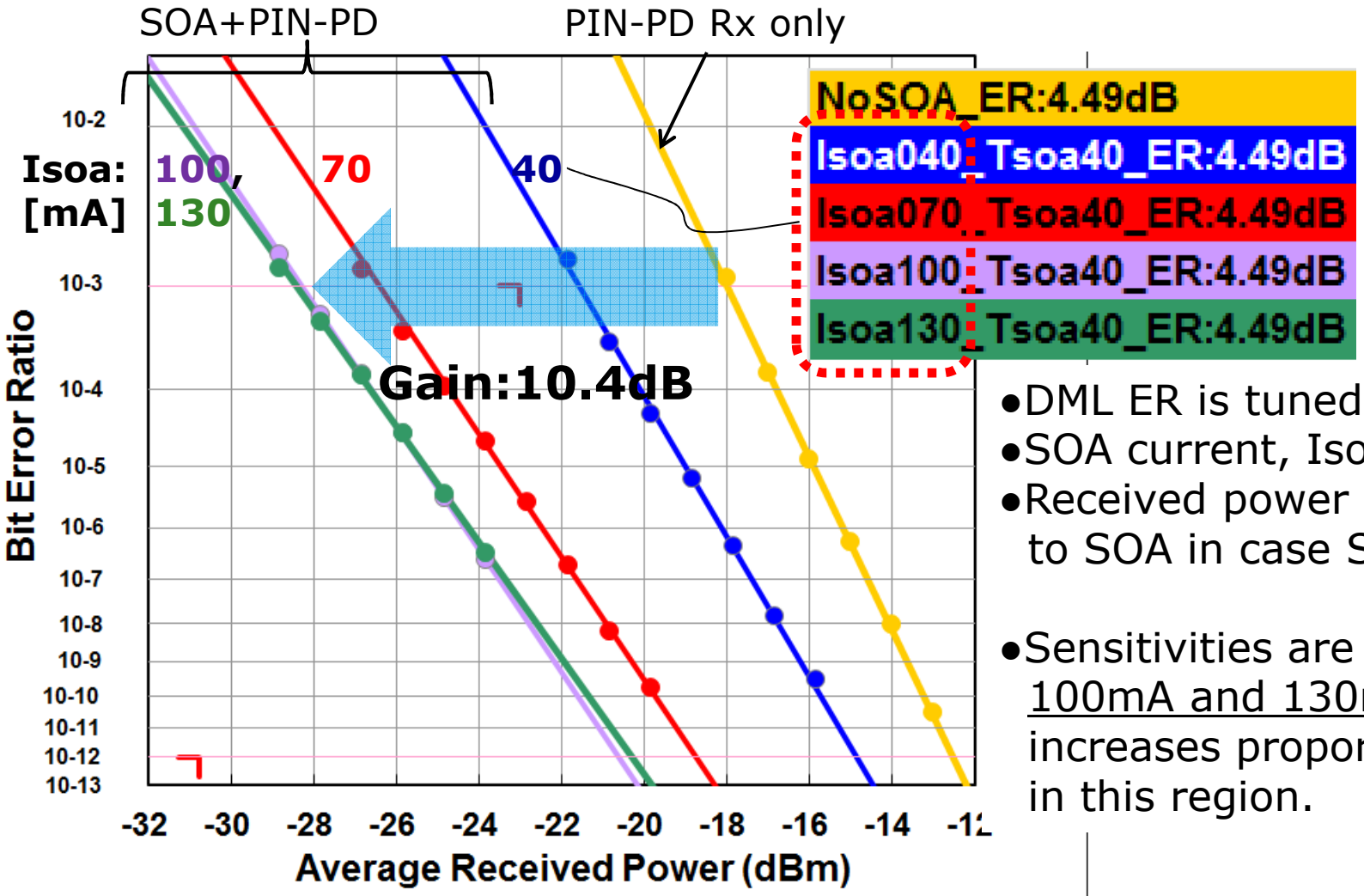
Introduction

- 25G APD receiver sensitivity was discussed in previous meeting. We showed the investigation about OMA sensitivity degradation of it.
- 25G receiver sensitivity in OLT side is still problem to overcome PR30 power budget and SOA pre-amplifier is desired to be applied for 100G-EPON with PIN-PD Rx.

- Sensitivities of SOA + PIN-PD Rx are evaluated.
  - Those are evaluated with multiple WDM filters.
  - ER dependency of OMA sensitivities is also checked.

Sensitivities of SOA + PIN-PD Rx

- PIN-PD ROSA and DML TOSA are the same samples used in tanaka_3ca_1116.
- SOA gain of sensitivity is 10.4dB@BER:1e-3 under Isoa:130mA and Tsoa:40degC with LAN-WDM filter of LR4/ER4.

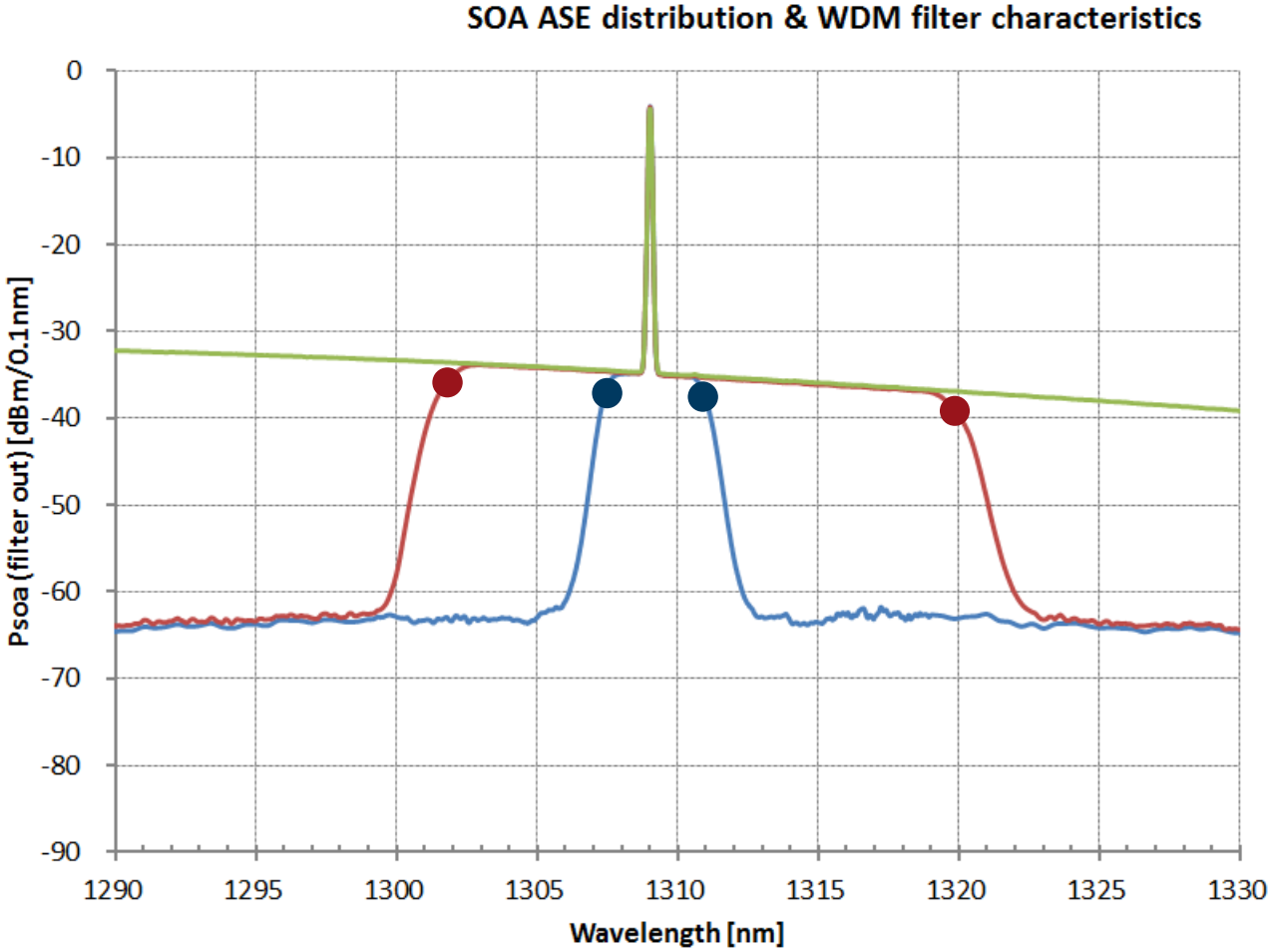


- DML ER is tuned to 4.5dB in this result.
- SOA current, Isoa is biased 40 to 130mA
- Received power are defined as the input to SOA in case SOA pre-amp is applied.

- Sensitivities are almost same at Isoa 100mA and 130mA because ASE power increases proportionally to gain increase in this region.

Pass bandwidth of WDM filters

- ASE spectrum passed through WDM filters.
  - Isoa:130mA, Tsoa:40degC, SOA input power:-20dBm as average
- FWHM (Full width of -3dB magnitude)
  - LAN-WDM BPF Lane3: 3.66nm, CWDM BPF 1311nm port: 18.4nm



ASE spectrum through BPF
(Filter loss is shifted for visibility)

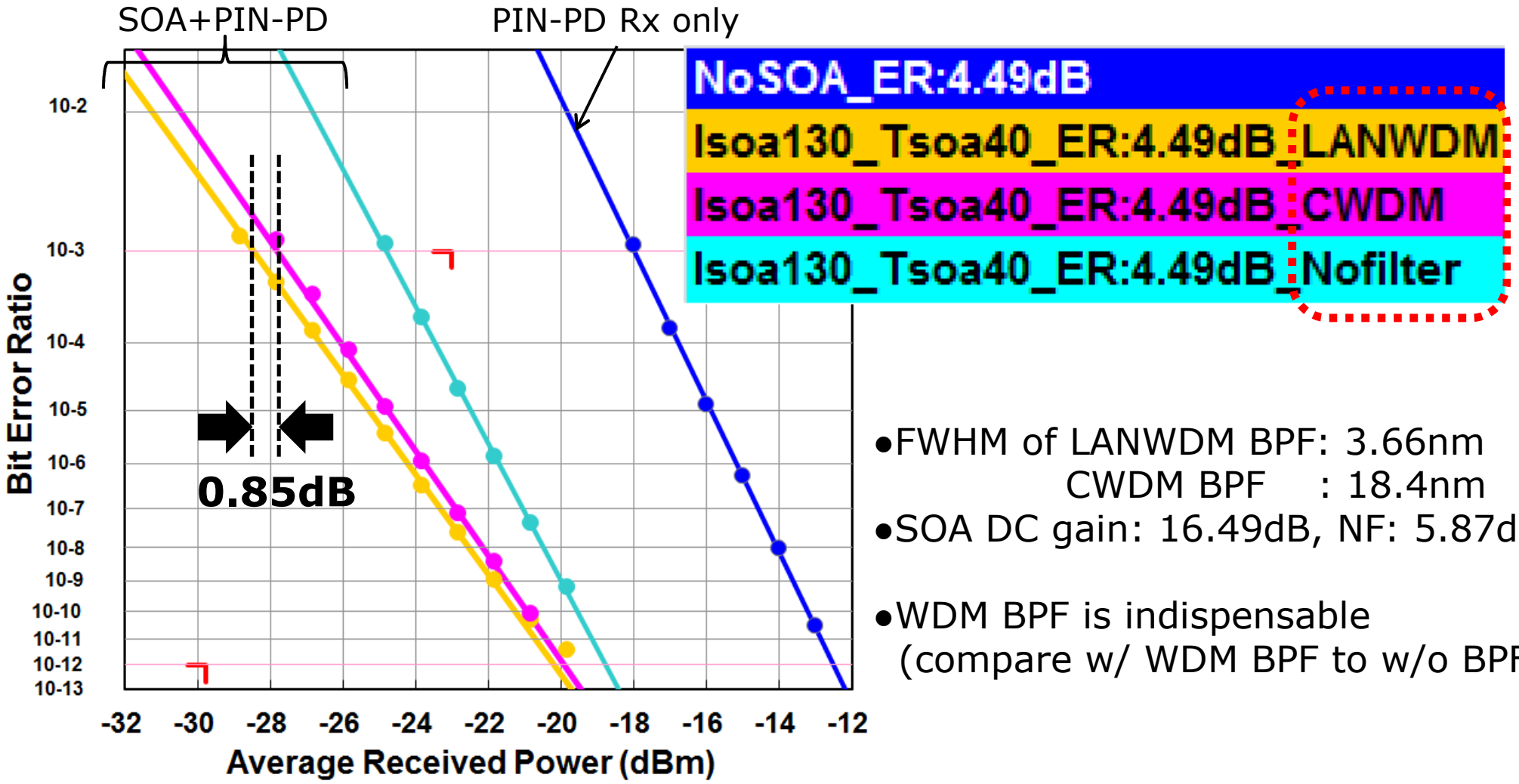
- LANWDM L3 [dBm/0.1nm]
- CWDM [dBm/0.1nm]
- Nofilter [dBm/0.1nm]

Wavelength at -3dB magnitude [nm]
(ASE level w/o filter [dBm])

	Left	Right	BW
CWDM	1301.61 (-33.54)	1320.01 (-36.91)	18.4
LANWDM	1307.37 (-34.47)	1311.03 (-35.19)	3.66

Influence of pass bandwidth of WDM filter

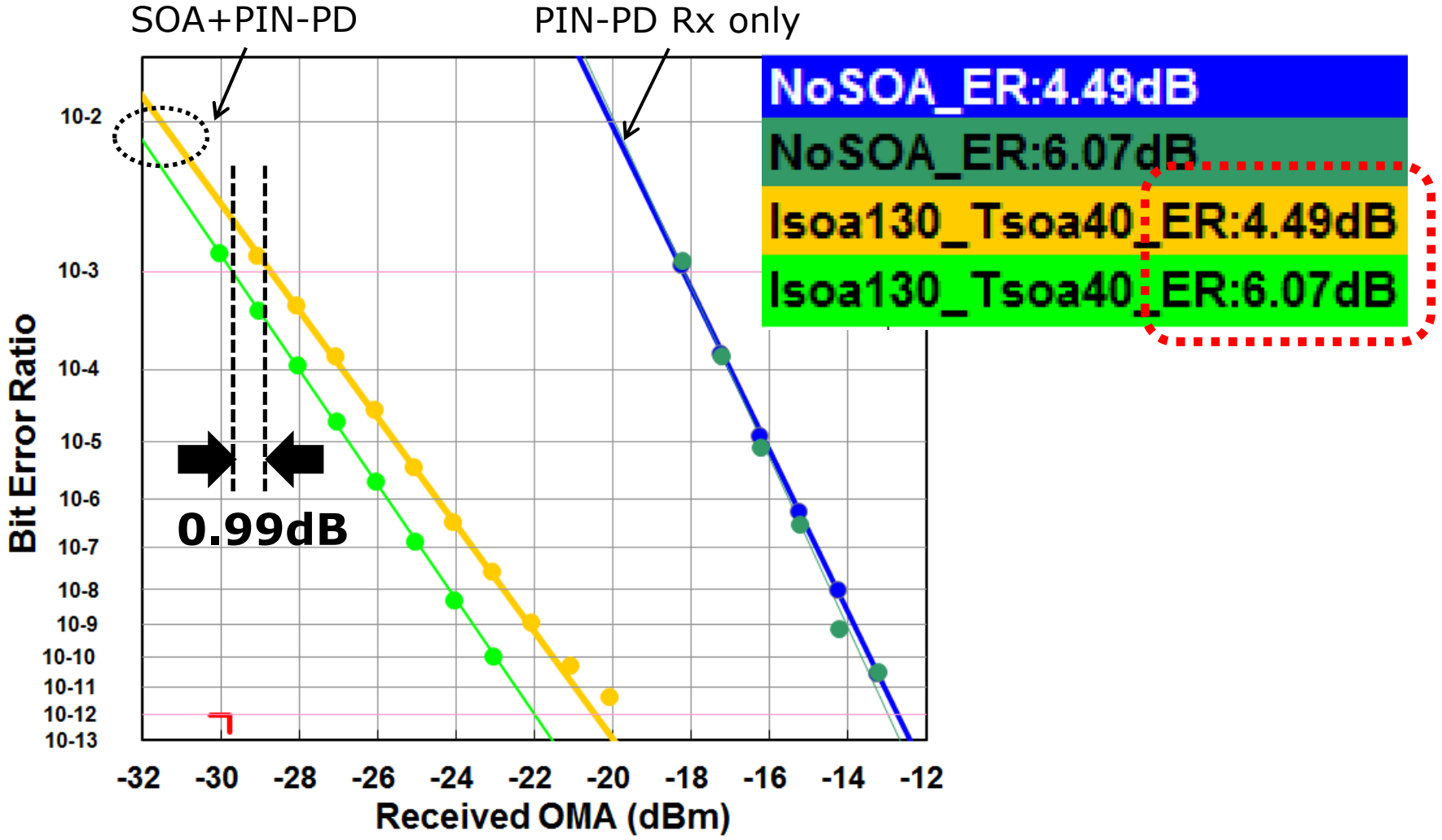
- Sensitivities are also compared to those with CWDM filter.
- Sensitivity is 0.85dB worse with CWDM filter @BER:1e-3. FWHM of this CWDM filter is 18.4nm.



- FWHM of LANWDM BPF: 3.66nm
  CWDM BPF : 18.4nm
- SOA DC gain: 16.49dB, NF: 5.87dB
- WDM BPF is indispensable
  (compare w/ WDM BPF to w/o BPF)

ER dependency of SOA + PIN-PD Rx

- OMA sensitivities are measured with 2 ER of DML TOSA.
  - Those are 4.5dB and 6.1dB.
- OMA sensitivity is 0.99dB@BER:1e-3 better with 6.1dB ER than with 4.5dB.



Summary

- SOA + PIN-PD performances are simply shown with the measured data.
- Its sensitivity depends on the pass bandwidth of WDM BPF and ER of transmitter.
  - 0.85dB worse w/ 5x wider bandwidth BPF in this measurement.
  - ER dependency is observed and is caused by SOA ASE.

- Further considerations are needed if SOA pre-amp are applied on OLT side, for example receiving overload.

Thank you

Back Up

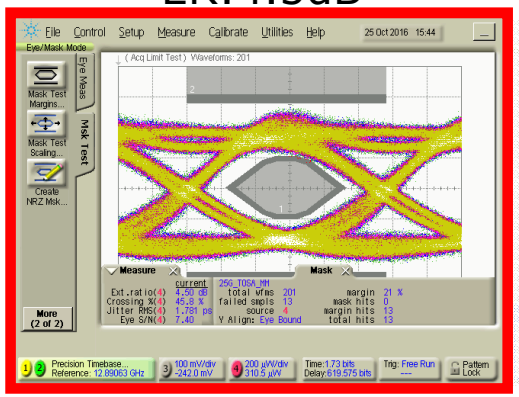
Transmitters' waveforms

- Transmitters' waveforms for receiver evaluation
  - Tx ER is tuned to 4.5, 6.1dB for DML.

    (Same sample shown in tanaka_3ca_1_1116.pdf)

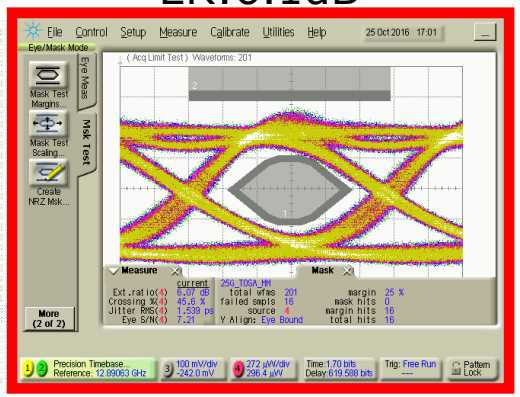
●DML

ER:4.5dB



ER:5.3dB

ER:6.1dB



●EML

ER:4.9dB

ER:5.8dB

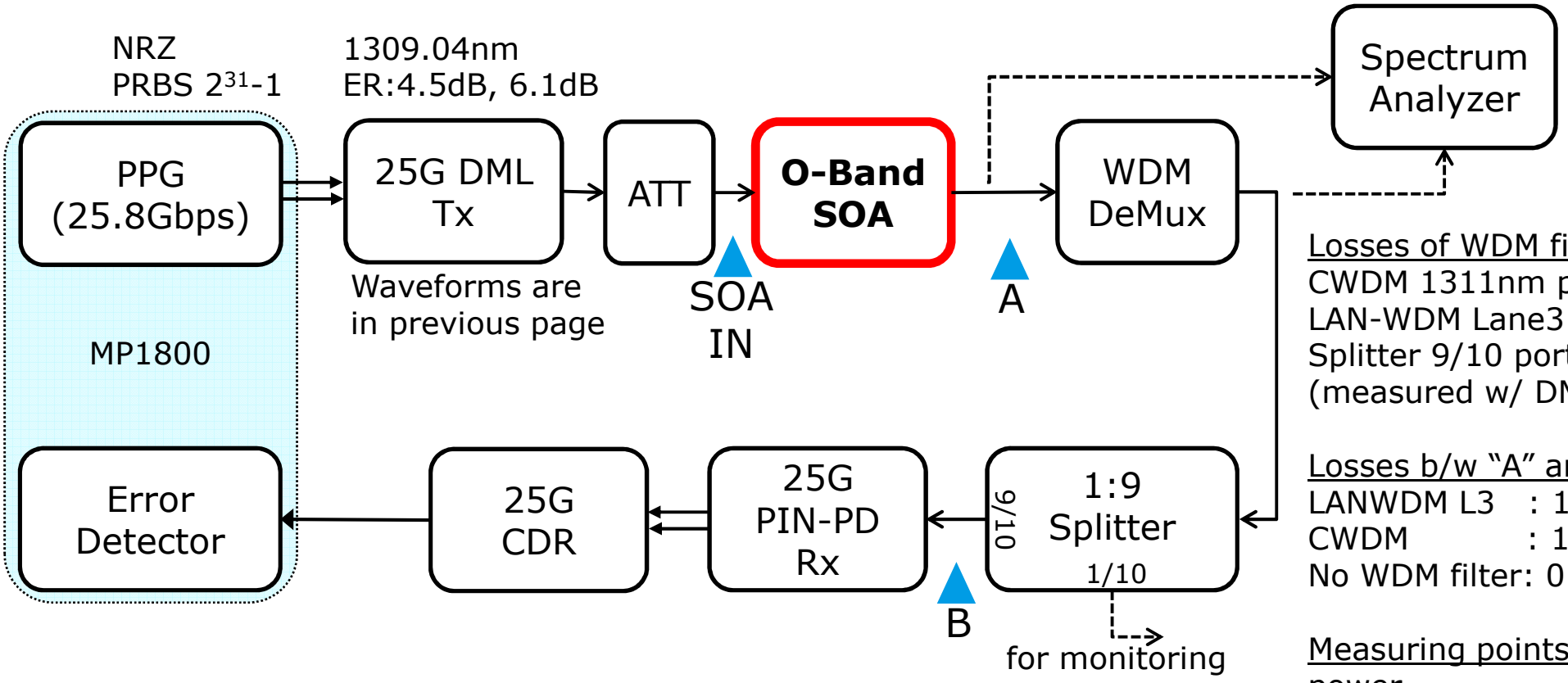
ER:9.5dB

ER:9.9dB

●0 level of low ER is noisy a little.

Measurement setup

- Measurement setup and losses of WDM filters are summarized.



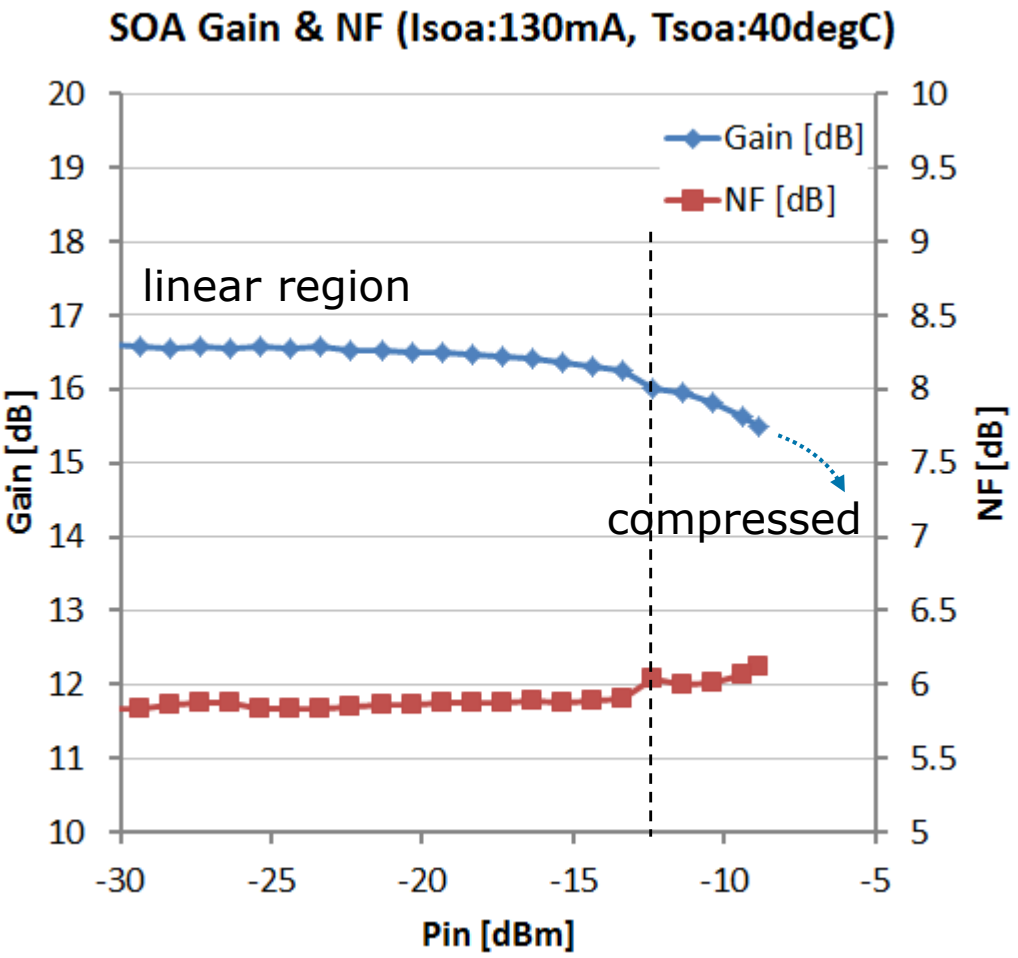
Losses of WDM filters & splitter
CWDM 1311nm port: 1.18dB
LAN-WDM Lane3 : 0.60dB
Splitter 9/10 port : 0.62dB
(measured w/ DML source)

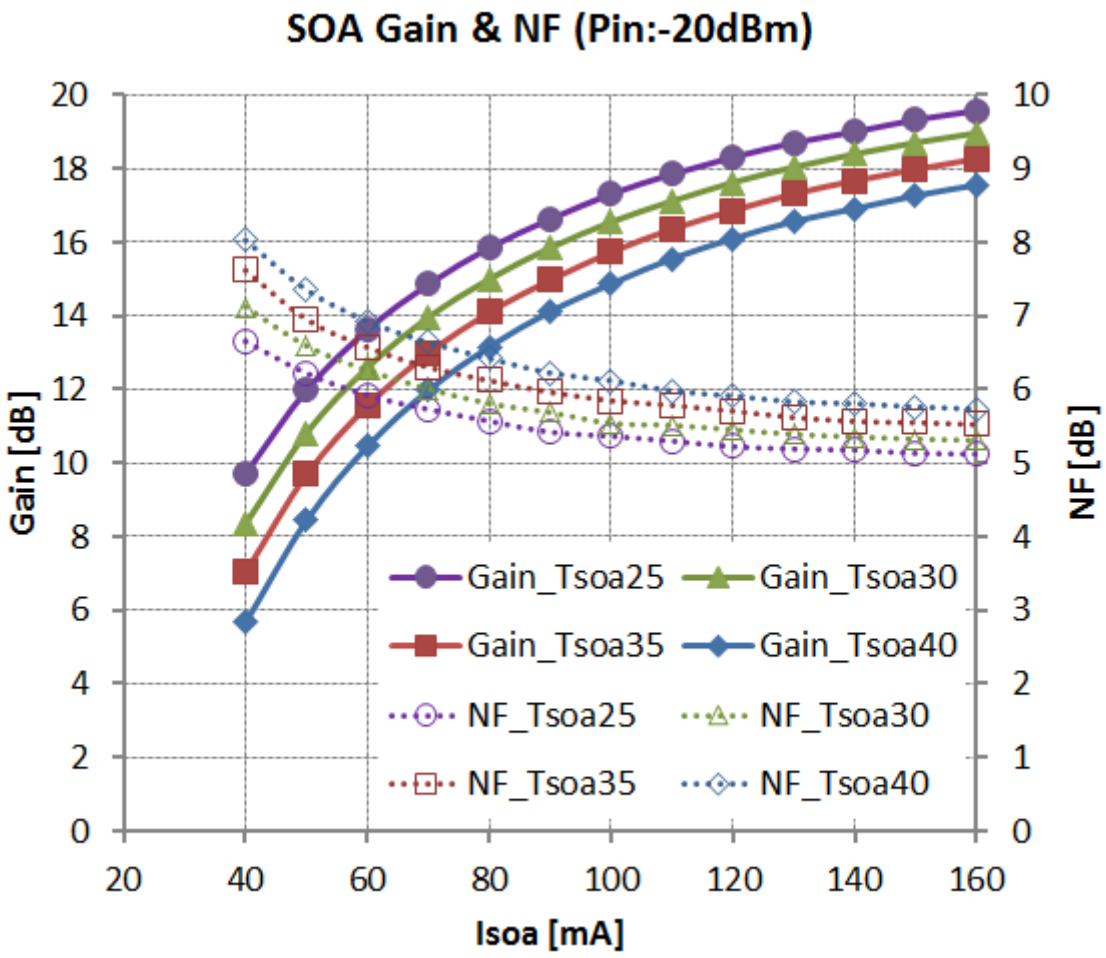
Losses b/w "A" and "B"
LANWDM L3 : 1.22dB
CWDM : 1.80dB
No WDM filter: 0.62dB

Measuring points of received power
Case w/ SOA : "SOA IN"
Case w/o SOA : "B"

SOA Gain and NF characteristics

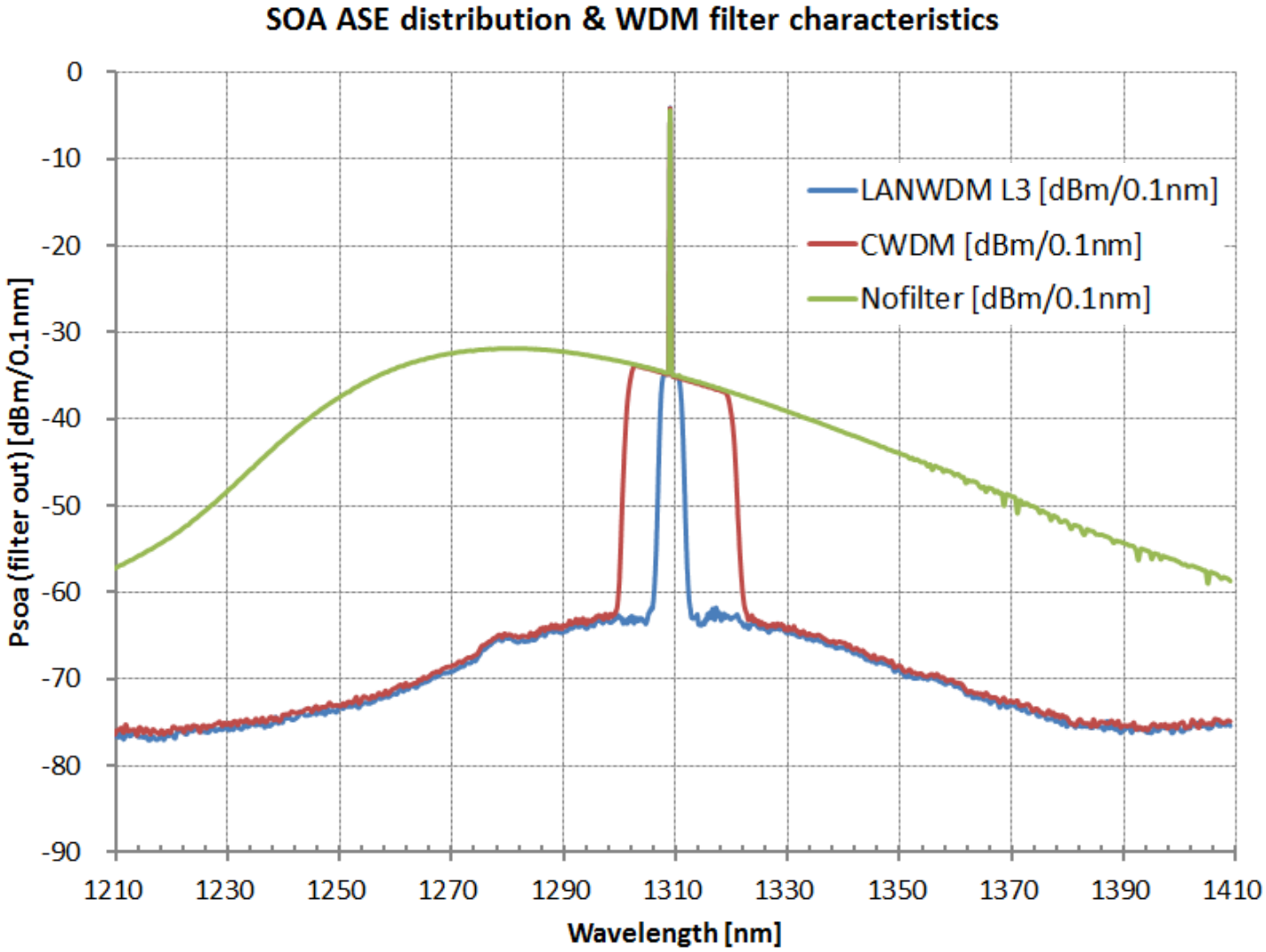
- Gain is compressed with high SOA input power. (left graph)
  - Data pattern effects will be observed in case of overload input.
- Wasting high SOA current is useless to get better NF. (right graph)





ASE spectrum

- Whole ASE spectrum passed WDM BPFs are plotted.

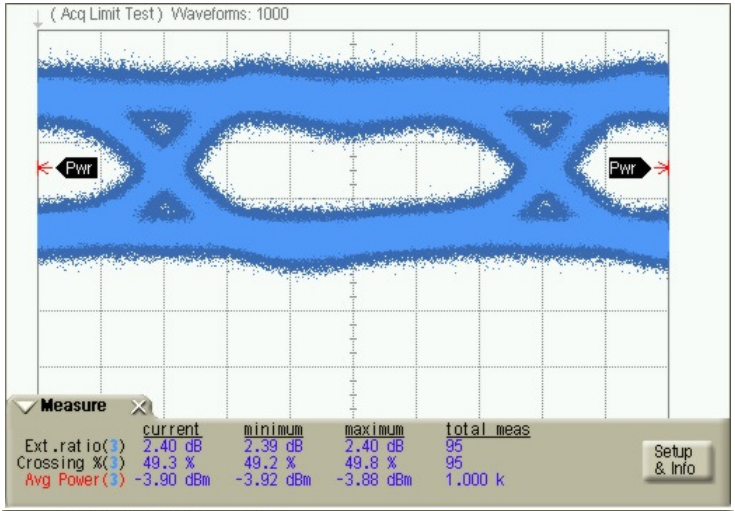


Amplified waveforms (10G)

- Amplified waveforms are observed with WDM filters.
  - Isoa:130mA, Tsoa:40degC, Pin:-20dBm, 4dB ATT for SOA output to protect DCA port (10G waveforms are shown because we can't prepare 25G DCA for this measurement.)
- Waveforms are opened w/o filter and ASE biases their DC level.

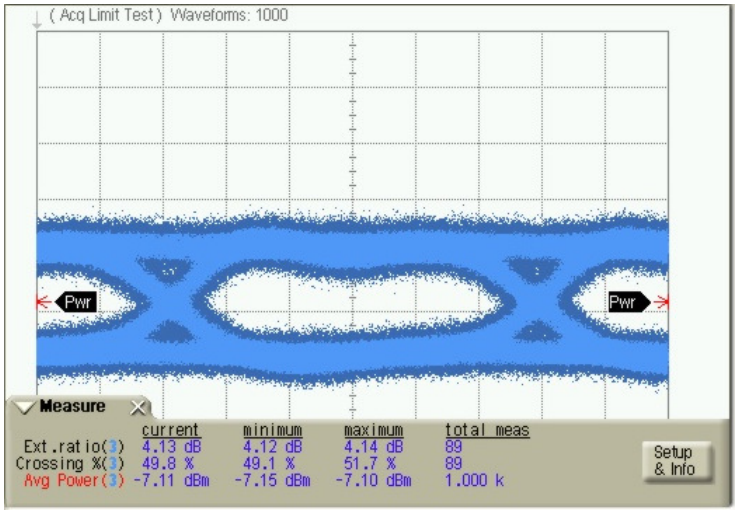
No WDM BPF
Pave :-3.9dBm

ER :2.40dB
OMA :-6.6dBm



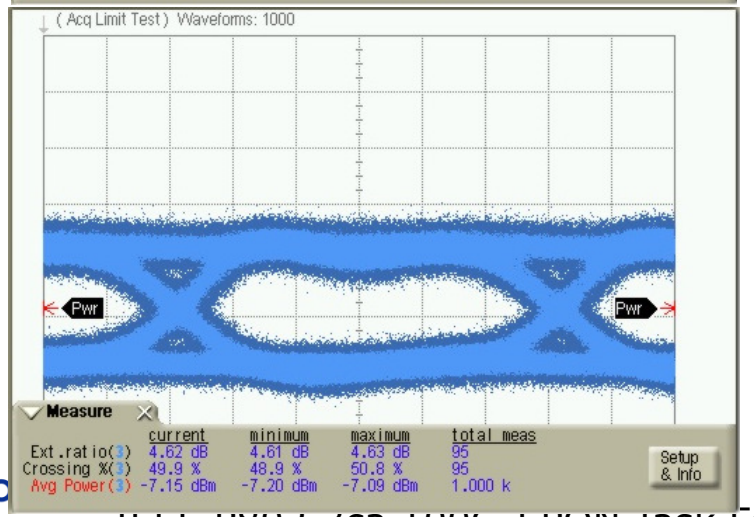
CWDM BPF
Pave :-7.1dBm
+filter Loss =>
Pave' :-5.9dBm

ER :4.13dB
OMA :-6.5dBm



LANWDM BPF
Pave :-7.2dBm
+filter Loss =>
Pave' :-6.5dBm

ER :4.62dB
OMA :-6.7dBm



- Same vertical scale and offset are applied in all figures.
- Pave increases w/ wide pass band filter and ER decreases.

⇒ OMA is almost same without regard to the pass band width.