Discussion of 400GbE DMT level diagram for realistic implementation

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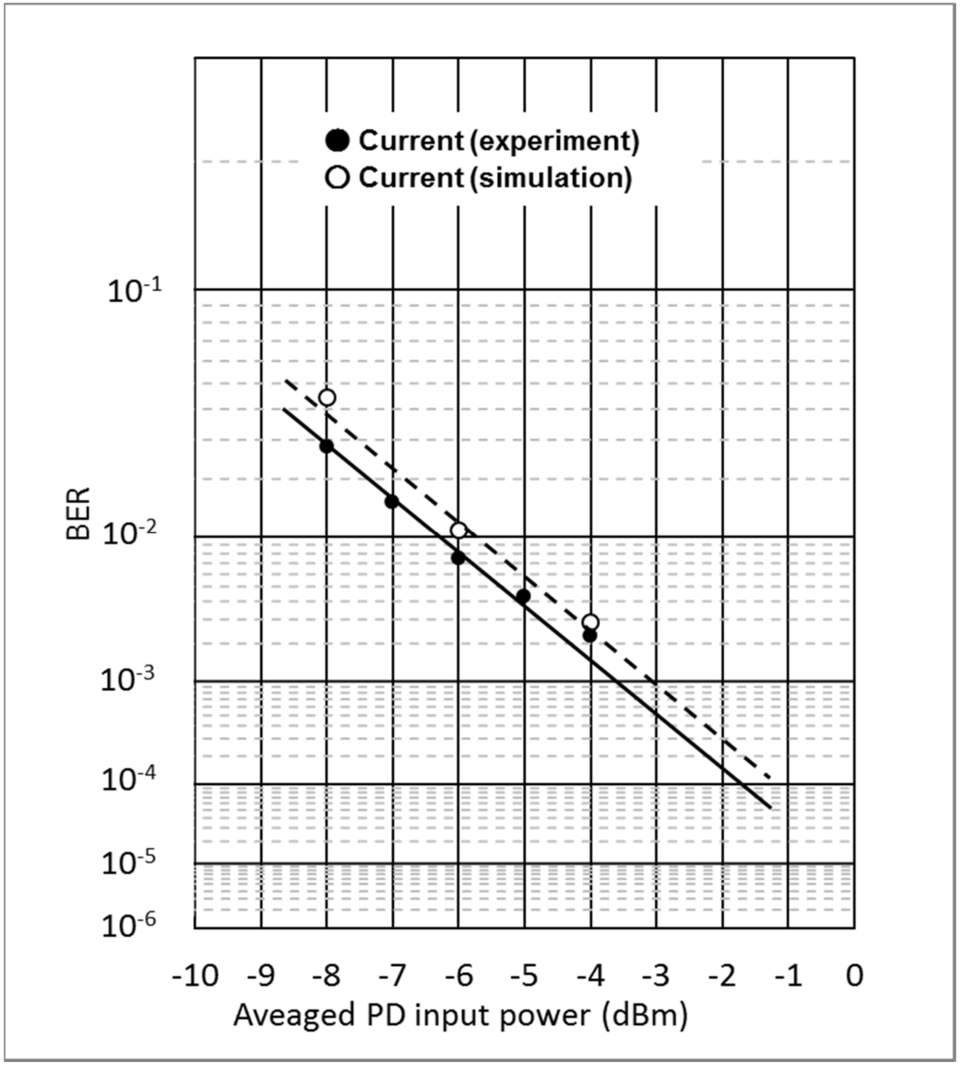
Introduction

- Design tool for DMT was established based on VPItransmissionMaker and MATLAB.
- Accuracy of simulation model is demonstrated by feeding with real device parameters and compare with experiment.
- High sensitivity is demonstrated with production level device parameters.
- Reasonable level diagram is discussed based on the simulation.

Confirmation of design tool

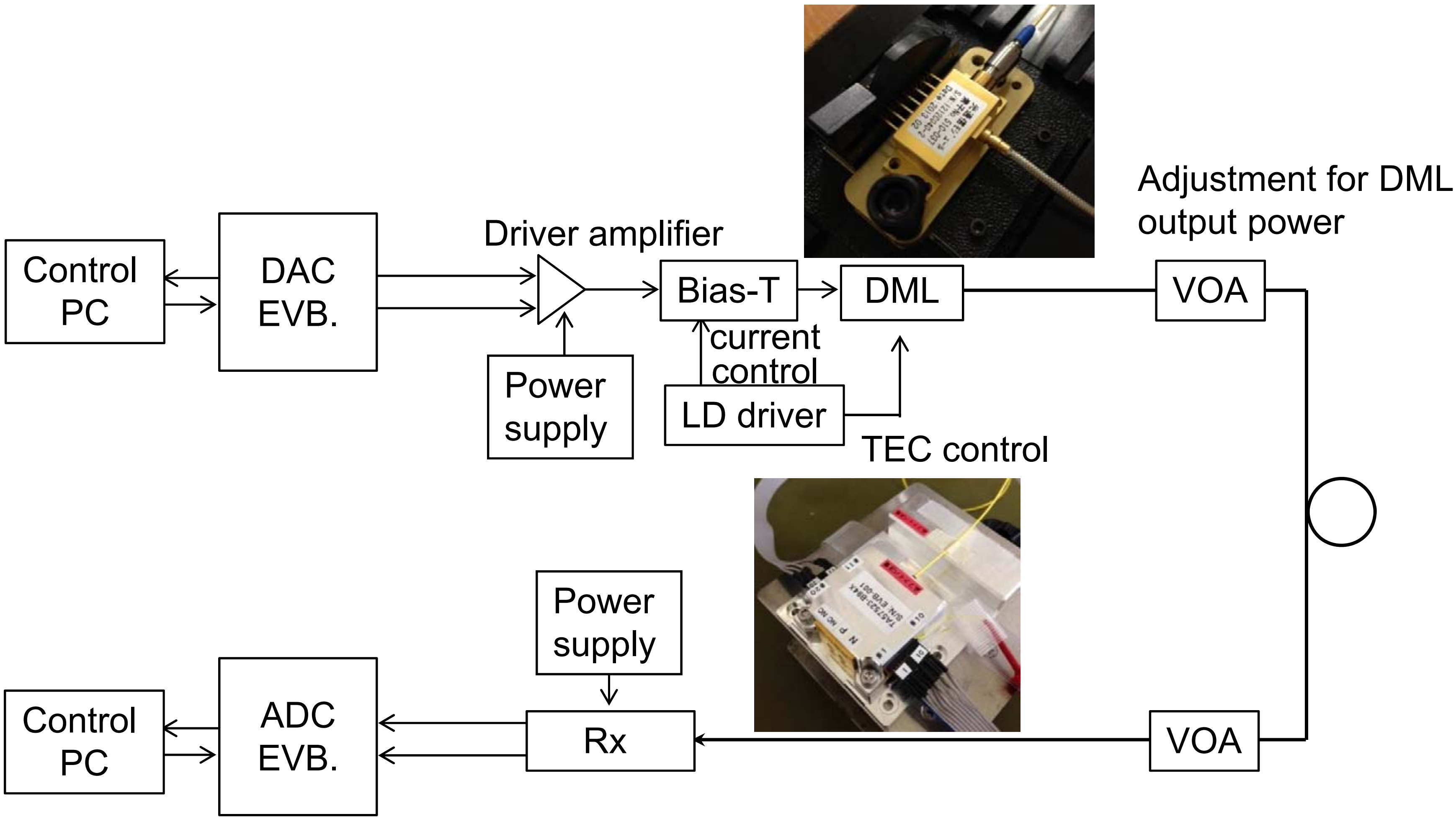


Bitrate	116 Gbps
SC	256

Good agreement was confirmed.

Experimental set up

The confirmation of design tool was done by sensitivity comparison between experiment and simulation.
Accuracy is demonstrated by feeding with real device parameters and compare with the experimental result.



Simulation parameters

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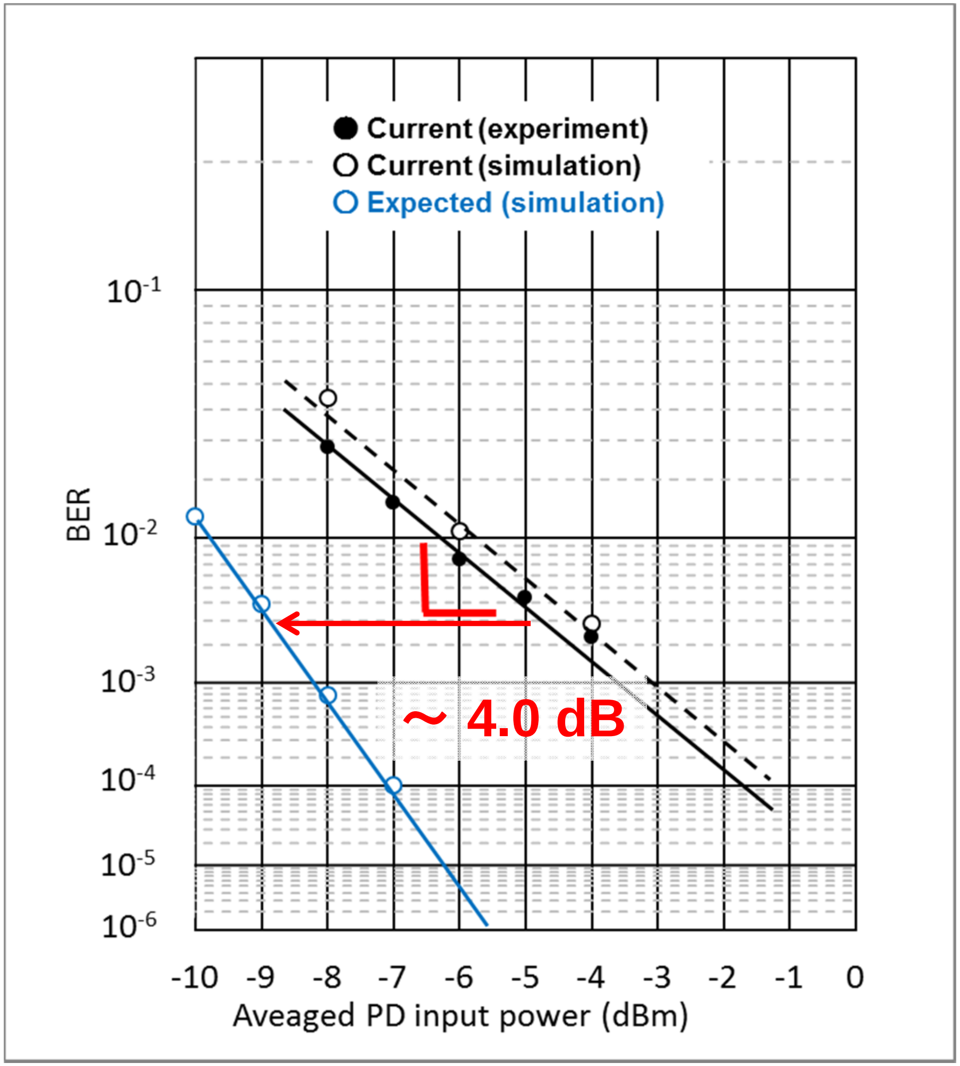
Parameter	Experiment	Target	Unit	
FEC OH	12.5	←	%	
FEC	BCH(9193,8192)	←		
Bit rate	116.015625	←	Gbps	
Subcarrier number	256	←		
Cyclic prefix	16	←		
Clipping ratio	3.16	←		
Sampling rate	64	←	GS/s	
TX bandwidth	12	18	GHz	EVB. Impairment was included
RX bandwidth	16	21	GHz	EVB. Impairment was included
Optical modulation index	0.42	0.45		
DML RIN	-148	←	dB/Hz	
Input referred noise	20	12	pA/√Hz	Linear new TIA will be selected

Expected improvement of receiver sensitivity



116 Gbps

SC: 256

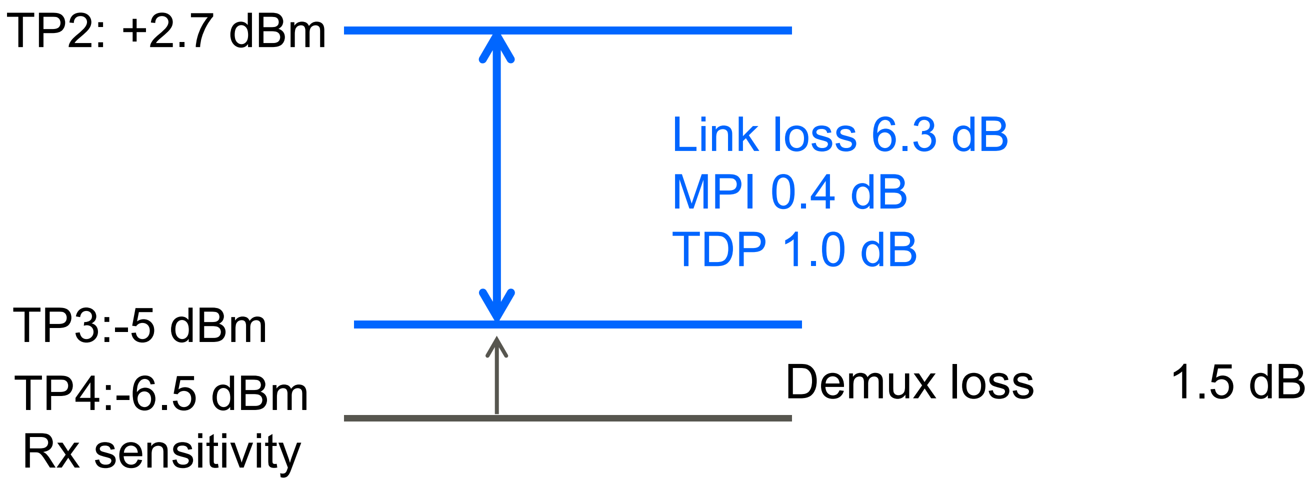
Target BER 3.3E-3

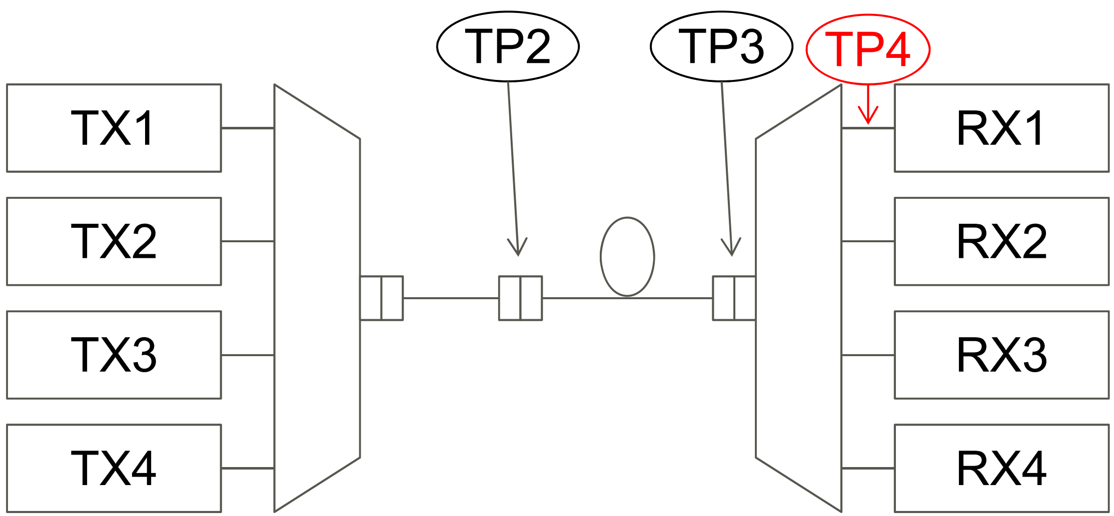
BCH(9193,8192)

Loss budget consideration

Average output power

Maximum power is below allowable power of +14.1dBm for laser safety.





Summary

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- DMT design tool showed good agreement with experimental result.
- Simulation results based on reasonable improvement and relaxation of parameters demonstrated ～-6.5 dBm sensitivity.
  - Input referred noise 20 pA/√Hz → 12 pA/√Hz
  - TX bandwidth 12 GHz → 18 GHz
  - RX bandwidth 16 GHz → 21 GHz

Thank you

Appendix: Standard trend for Laser safety

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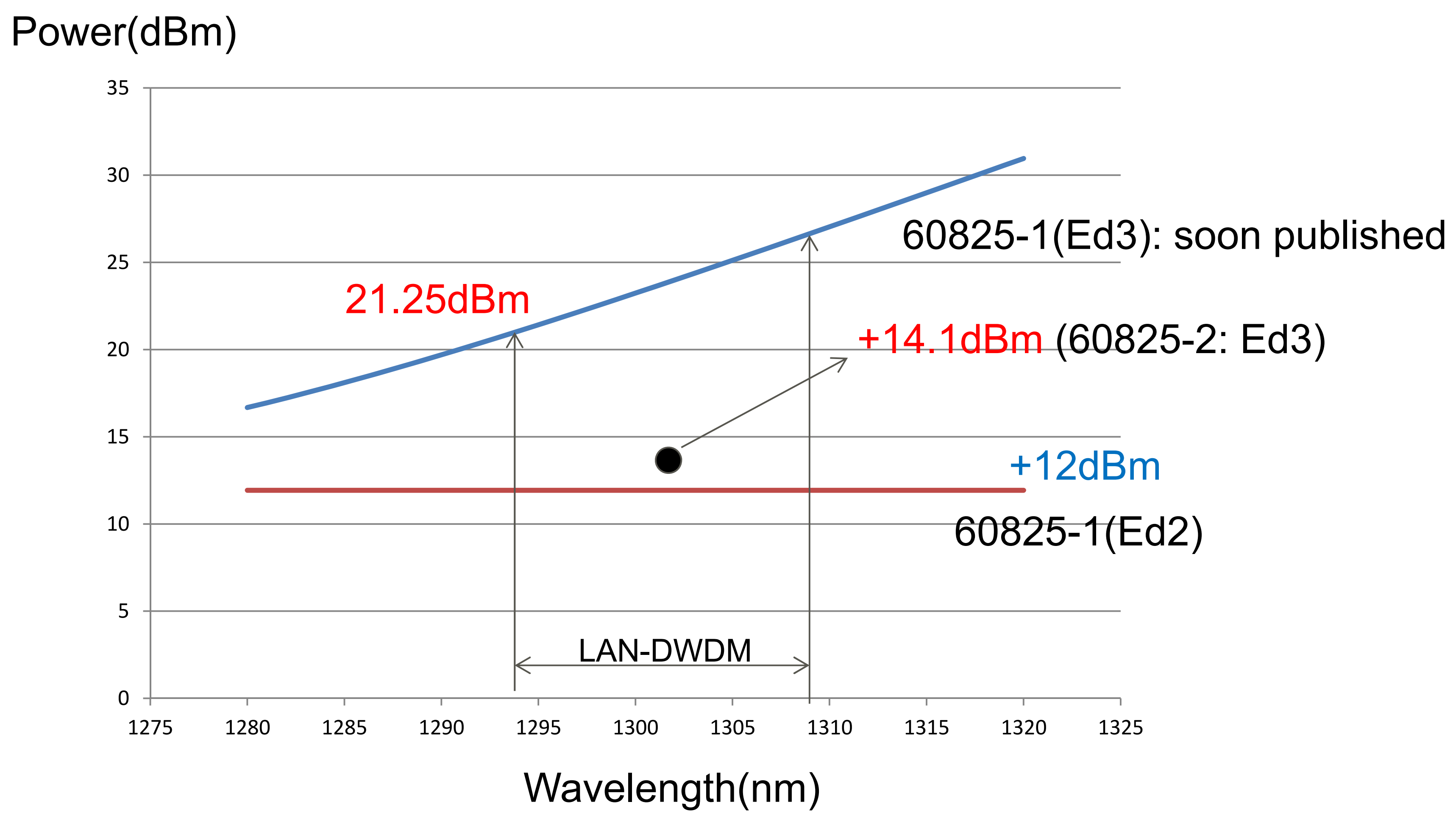
- ✓ Standard group: IEC TC76 WG5
- ✓ Related standards
  - IEC 62805-1(Part1):Equip classification & requirements
  - IEC 62805-2(Part2): Optical fiber communications

- ✓ Part1 : under revision for Ed3 “C7 problem”
  - 1300nm SMF Class1:
    - L=3.9*10^(-4)*C4*C7(C4=5, C7=8)
    - =15.6mW (+12dBm)
  - C7=8+10^(0.04*(λ-1250nm)) [Revision point]
    - λ=1294.53nm(Worst) → L= +21.25dBm
  - It will be discussed in Tokyo meeting (Nov2014)

- ✓ Part2: 1300nm SMF Class1 → +14.1dBm (Be in mind)
  (Distance:70mm, Aperture 7mm)

IEC 60825 specifications



Appendix: Optical modulation index definition

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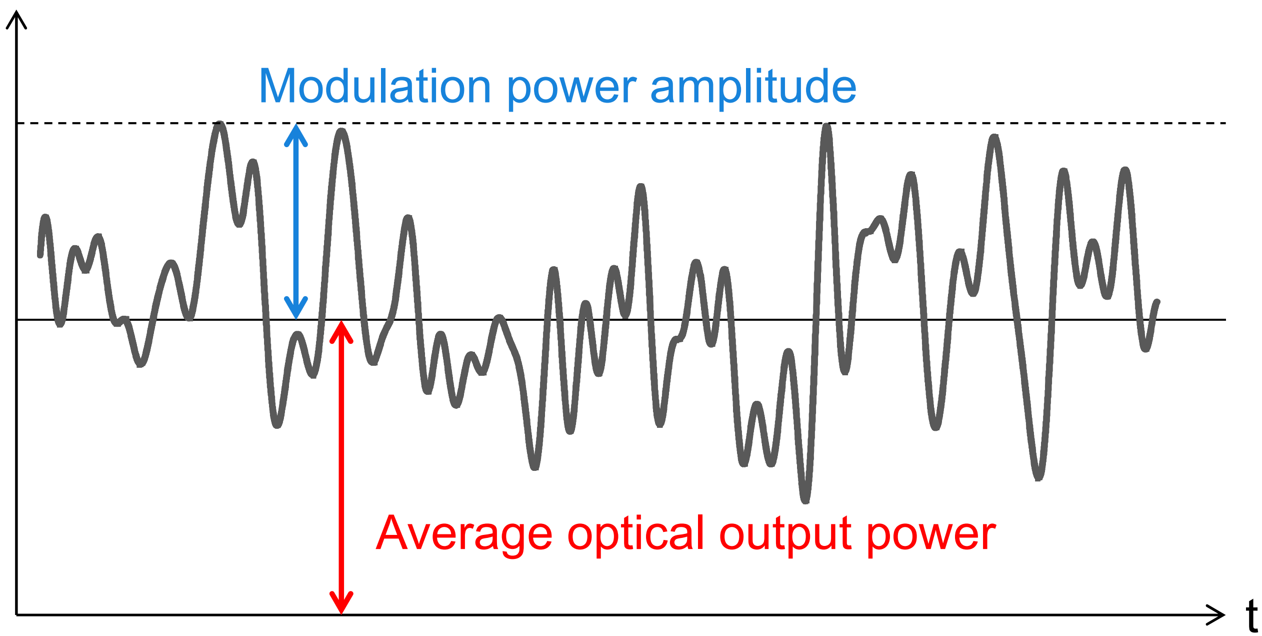
Optical modulation index is proposed instead of OMA.

- Optical modulation index
  Optical modulation index
  = Modulation power amplitude / Average optical output power



Appendix: Dispersion Penalty

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- Dispersion penalty: about 1 dB
  - Channel specification for dispersion from IEEE802.3ba
  - After 10-km SMF
  - 4ch. LAN-WDM configuration