



# New proposal for PMD specifications - PHY types and terminology

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- 3 different PHY types ➤ 3 different PMD

(PMD names are given just an example; final name is not critical for rational behind this proposal)

- 1000BASE-RHA

- Oriented to cover all the specifications for Home/Consumer
- Connection of PMD to the medium (i.e. SI-POF) is not typically connectorized; bare fiber is attached to PMD in a clamp

- 1000BASE-RHB

- Oriented to cover all the specifications for Industrial applications
- Connection of PMD to the medium (i.e. SI-POF) is connectorized and harsh environment is expected (extended temperature range, dust, connector terminated in the field to facilitate flexible equipment interconnection layout, ...)

- 1000BASE-RHC

- Oriented to catch all the specifications for Automotive applications
- Connector has to support specific requirements for installation in a car: kojiri criteria, dust protection, vibration robustness, tensile strength, etc. These specific requirements have to be considered in the TP2 and TP3 specifications

# Link segments



- 3 different link segment types are specified
- Link segment type I: 50 m
  - Link segment using duplex cable of plastic optical fiber according to standard IEC 60793-2-40 sub-category A4a.2 of at least 50 m length
  - Maximum permitted link segment insertion loss: 9.5 dB
  - Channel impulse response specified by MPD per EAF lower bound limit at TP3 under launching condition at TP2 also specified per EAF lower bound limit
- Link segment type II: 40 m
  - Link segment using duplex cable of plastic optical fiber according to standard IEC 60793-2-40 sub-category A4a.2 of at least 40 m length
  - Maximum permitted link segment insertion loss: 8 dB
  - Channel impulse response specified by MPD per EAF lower bound limit at TP3 under launching condition at TP2 also specified per EAF lower bound limit
- Link segment type III: 15 m
  - Link segment using duplex cable of plastic optical fiber according to standard IEC 60793-2-40 sub-category A4a.2 of at least 15 m length
  - Maximum permitted link segment insertion loss: 3 dB
  - Channel impulse response specified by MPD per EAF lower bound limit at TP3 under launching condition at TP2 also specified per EAF lower bound limit
- 1000BASE-RHA and 1000BASE-RHB PHYs have to be able to operate in a link segment type I
- A 1000BASE-RHC PHY has to be able to operate in the link segment types II and III
- Inline connections implemented for 1mm SI-POF does not produce modifications of modal distribution, therefore MPD at TP3 is not affected. The only effect of inline connection is attenuation. Because of that, the number of supported inline connections is not normative and it finally depends on the implementation of the inline connection and the specification of the PHY does not relay on it.

# Specifications at TP2



Parameter	Symbol	Units	Value/Criteria					
			Min			Max		
			1000BASE-RHA	1000BASE-RHB	1000BASE-RHC	1000BASE-RHA	1000BASE-RHB	1000BASE-RHC
Average optical power	AOP	dBm	-6	-7	-9	1		
Average optical power of transmitter OFF	AOP <sub>OFF</sub>	dBm	—			-35		
Optical return loss tolerance	ORLT	dB	14			—		
Extinction ratio	ER	dB	11			—		
Center wavelength	$\lambda_c$	nm	635			665		
Spectral width	$\lambda_w$	nm	—			20		
Rise time (10% – 90%)	$t_r$	ns	—			3		
Fall time (10% – 90%)	$t_f$	ns	—			3		
Transmitter timing jitter	$t_j$	ps	—			20		
2 <sup>nd</sup> order harmonic distortion	HD <sub>2</sub>	dBc	—			-21		
3 <sup>rd</sup> order harmonic distortion	HD <sub>3</sub>	dBc	—			-29		
Relative intensity noise	RIN	dB/Hz	—			-137		
Off transition time (from tx_pwr = OFF to AOP <sub>OFF</sub> )	$t_{off}$	ns	—			100		
On transition time (from tx_pwr = ON to active operation)	$t_{on}$	ns	—			1500		

# Specifications at TP2 - MPD per EAF



Angle (°)	EAF lower bound limit		
	1000BASE-RHA	1000BASE-RHB	1000BASE-RHC
0	0.00		
5	0.07		
10	0.26		
15	0.50		
20	0.72		
25	0.87		
30	0.95		
35	0.98		
40	1.00		

# Specifications at TP3



Parameter	Symbol	Units	Value/Criteria							
			Min				Max			
			1000BASE-RHA	1000BASE-RHB	1000BASE-RHC		1000BASE-RHA	1000BASE-RHB	1000BASE-RHC	
			Type I	Type I	Type II	Type III	Type I	Type I	Type II	Type III
Average optical power for reliable link establishment	AOP <sup>a</sup>	dBm	-17	-17	-17	-18.5	1			
Wavelength range	$\lambda$	nm	600				700			
Off transition time (from rx_pwr = OFF to quiet mode)	toff	ns	—				200			
On transition time (from rx_pwr = ON to active operation)	ton	ns	—				400			

<sup>a</sup> The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having a power level equal to the average receive optical power (max) plus at least 1 dB.

- Change D1.2, 115.4.2, P110, L49:
- Sensitivity term is eliminated from C/115 to avoid confusion, and min AOP at TP3 for reliable link is used instead of that
- “A complete 1000BASE-RHx PHY shall be able to establish a reliable link throughout the average optical power (AOP) range between the minimum and maximum limit defined in Table 115–x. For that specification it is assumed that a 1000BASE-RHx PMD is not tested standalone, but is always considered as part of a complete PHY (i.e. PCS and PMA sublayers are also included).”

# Specifications at TP3 - MPD per EAF



Angle (°)	EAF lower bound limit			
	1000BASE-RHA	1000BASE-RHB	1000BASE-RHC	
	Type I	Type I	Type II	Type III
0	0.00		0.00	
5	0.04		0.04	
10	0.16		0.18	
15	0.35		0.39	
20	0.57		0.62	
25	0.77		0.81	
30	0.90		0.93	
35	0.97		0.98	
40	1.00		1.00	

# Worst case link power budget (informative)



Parameter	Units	1000BASE-RHA	1000BASE-RHB	1000BASE-RHC	
		Type I	Type I	Type II	Type III
Link power budget	dB	11	10	8	9.5
Channel insertion loss	dB	9.5	9.5	8	3
Unallocated link margin	dB	1.5	0.5	0	6.5

- Note — Unallocated link margin may be used for inline connections (connectors). Maximum 1.5 dB attenuation per inline connection is assumed.

# Environment: ambient temperature classes



- 3 temperature range classes are defined

Class	Low temperature (°C)	High temperature (°C)
Regular	0	+70
Extended I	-40	+85
Extended A	-40	+105

(class names are given just an example; final name is not critical for rational behind this proposal)

- Implementations shall be declared as compliant over one of three complete ranges