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INTERNET PROTOCOL (IP) NETWORK TELECOMMUNICATION DEVICE TECHNICAL REQUIREMENTS

Based on PERMEN KOMINFO NO 10 TAHUN 2019

Internet protocol network telecommunications equipment is a telecommunication tool and / or device that has the function of passing information from one network address to another network address. The configuration is as followed:

Picture 1 IP Network Device Configuration

A. GENERAL REQUIREMENTS

1. Power Supply

The device can be supplied with AC or DC power. For devices supplied by AC power, it must operate normally with 220 V ± 10% supply and 50 Hz ± 6% frequencies. In case the device uses an external supply, for example an AC adapter, the supply must not affect device's operating capability.

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2. EMC Requirements

a. Emission

The following emissions measurements must be taken on the device if possible:

1) Devices used in residential areas
   a) The device radiation emissions must meet Class B requirements specified in Table A.4 and Table A.5 in accordance with clause 4 of SNI ISO / IEC CISPR 32;
   b) Conduction emissions at the DC power port of the device must meet the Class B requirements specified in Table A.10 in accordance with clause 4 of SNI ISO / IEC CISPR 32;
   c) Conduction emissions at the AC supply port of a device with certain AC / DC power converter must meet the Class B requirements specified in Table A.10 in accordance with clause 4 of SNI ISO / IEC CISPR 32 (devices with DC power ports that are supplied with adapters or converters special AC / DC power is considered as a device with AC power supply (clause 3.1.1 SNI ISO / IEC CISPR 32)); and
   d) Conduction emissions at the cable network port must meet the Class B requirements specified in Table A.12 in accordance with clause 4 of SNI ISO / IEC CISPR 32.
2) Devices used in non-residential areas
   a) Device radiation emissions must meet Class A requirements specified in Table A.2 and Table A.3 in accordance with clause 4 of SNI ISO / IEC CISPR 32;
   b) Conduction emissions at the DC power port of the device must meet the Class A requirements specified in Table A.9 in accordance with clause 4 of SNI ISO / IEC CISPR 32;
   c) Conduction emissions at the AC supply port of the device with a special AC / DC power converter must meet Class A requirements specified in Table A.9 in accordance with clause 4 of SNI ISO / IEC CISPR 32 (devices with DC power ports that are supplied with adapters or special AC / DC power converters are considered devices with AC power supplies (clause 3.1.1 SNI ISO / IEC CISPR 32)).
   d) Conduction emissions at the cable network port must meet the Class A requirements specified in Table A.11 in accordance with clause 4 of SNI ISO / IEC CISPR 32.

b. Immunity

The following immunity measurements should be carried out on the device if possible and must meet the provisions in SNI ISO / IEC CISPR 35:

1) RF electromagnetic fields (80 MHz to 1 GHz) on the device
2) Electromagnetic discharges on the device closing;
3) Fast transients (common mode) on DC and AC power supply ports that have cables longer than 3 m;
4) RF common mode 0.15 MHz to 80 MHz on DC and AC power supply ports that have cables longer than 3 m;

5) Voltage dips and interruption on the device's AC power supply port with a special AC / DC power converter; and
6) Power surge, common mode and differential mode on device power supply port with a special AC / DC converter.

3. Electrical Safety Requirements

a. Electrical safety assessment of the device must meet the requirements specified in IEC 60950-1 or IEC 62368-1 based on the following assumptions:
1) The device is supplied with a special external power supply continuously (AC / DC converter or adapter / charger); and
2) The device operates with SELV in an environment where excess voltage from the telecommunications network is not possible. SELV refers to voltages not exceeding 42.4 V peak or 60 V DC.
3) For device safety assessments carried out using a risk-based approach, the process specified in the following 62368-1 must be used:
a) Identification of energy sources in the device;
b) Classification of energy sources (impact on the body or combustible material, such as the possibility of injury or ignition);
c) Identification of efforts to protect energy sources; and
d) Consider the effectiveness of the protection effort by considering the fulfillment criteria or requirements specified in IEC 62368-1.

B. INTEROPERABILITY REQUIREMENTS

1. Interface

a. Ethernet
1) Twisted-pair
In the case that the device has an ethernet interface that uses a twisted-pair cable, one or more of the provisions in Table 1 apply according to the type of protocol used.
2) Optical fiber
In the case that the device has an ethernet interface that uses a fiber optic cable, one or more of the provisions in Table 2 will be applied according to the type of protocol used.
3) Copper
In the case that the device has an ethernet interface that uses a copper cable, the provisions in Table 3 apply.
4) Wireless
a) IEEE 802.11 or WiFi
In the case that the device has WiFi interface, interface characteristics must be tested in accordance with applied regulation.

b) IEEE 802.16 or WiMAX
In the case that the device has a WiMAX interface, interface characteristics must be tested in accordance with applied regulation.

b. Hybrid Fiber-Coax (HFC)
In the case that the device has a Hybrid Fiber Coax (HFC) interface, the interface characteristics must be tested in accordance with applied regulation.

c. Broadband over Power Line (BPL) and Power Line Communication (PLC)
If the device has a BPL and / or PLC interface, the interface characteristics must be tested in accordance with applied regulation.

d. Long Term Evolution (LTE)
In the case that the device has an LTE interface, the characteristics of the interface must be tested according to applied regulation

e. Wideband Code Division Multiple Access (WCDMA)
If the device has a WCDMA interface, interface characteristics must be tested according to applied regulation.

f. Global System for Mobile Communication (GSM)
If the device has a GSM interface, the interface characteristics must be tested in accordance with applied regulation.

2. Addressing system

IP network devices must implement the following addressing systems:

a. Routed protocol
The device must support IPv4 addressing systems according to IETF RFC 791 and / or IPv6 according to IETF RFC 2460.

b. Routing protocol
The device must support routing using the Network Address Translation, IP Masquerading, and / or Static Routing methods.

Table 1. Interface Requirements with *twisted-pair medium*

Protocol	Standard	Interface Requirements
100BASE-TX	IEEE 802.3u	Table 4
1000BASE-T	IEEE 802.3ab	Table 5
2.5GBASE-T, 5GBASE-T	IEEE 802.3bz	Table 6
10GBASE-T	IEEE 802.3an	Table 7
25G/40GBASE-T	IEEE 802.3bq	Table 8

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Table 2. Interface Requirements with *optical fiber medium*

Protocol	Standard	Interface Requirements
1000BASE-X	IEEE 802.3z	Table 9
10GBASE-S	IEEE 802.3ae	Table 10
10GBASE-L	IEEE 802.3ae	Table 12
10GBASE-E	IEEE 802.3ae	Table 13
10GBASE-LX4	IEEE 802.3	Table 14
10GBASE-LRM	IEEE 802.3aq	Table 15
40GBASE-R	IEEE 802.3ba	Table 17

Protocol	Standard	Interface Requirements
100GBASE-R	IEEE 802.3ba	Table 18

Table 3. Interface Requirements with *cooper wire medium*

Protocol	Standard	Interface Requirements
10GBASE-CX4	IEEE 802.3ak	Table 19

Table 4. Interface Characteristics of 100BASE-TX (IEEE 802.3-2015)

Parameter	Unit	Value
Channel coding		4B5B MLT-3

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Table 5. Interface Characteristics of 1000BASE-T (IEEE 802.3-2015)

Parameter	Unit	Value
Signal strength		See Figure 2. Transmitter: 1. The absolute value of the wave peaks at points A and B, as in figure 40-22, must be in the range of 0.67 V to 0.82 V (0.75 V ± 0.83 dB) 2. The absolute value of the peak of the waves at points A and B, as in figure 40-22, has a difference of less than 1% of the average value of the absolute peak of the waves at points A and B 3. The absolute value of the peak of the waves at points C and D, as in figure 40-22, has a difference of less than 2% of 0.5 times the average value of the absolute peak of the waves at points A and B *Receiver*: *Bit error rate* ≤ 10^{-10}
Channel coding		4D-PAM5

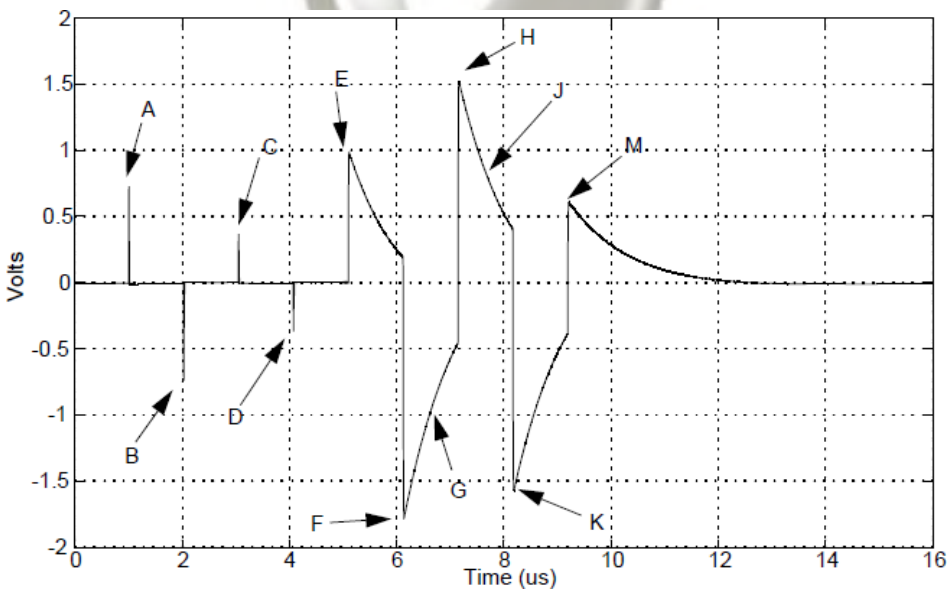

Figure 2. Example of *Transmitter* Mode Wave sample (1 cycle)

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Table 6. Interface Characteristics of 2.5G/5GBASE-T (IEEE 802.3bz-2016)

Parameter	Unit	Value
Signal strength	dBm/ Hz	See Figure 3 *Transmitter:* $\text{PSD1}(f) \le \begin{cases} -77.7 - 10 \times log_{10}(S) & 0 < 2\frac{f}{S} \le 70 \\ -77.7 - 10 \times log_{10}(S) - \left(\frac{2\frac{f}{S}-70}{80}\right) & 70 < 2\frac{f}{S} \le 150 \\ -78.7 - 10 \times log_{10}(S) - \left(\frac{2\frac{f}{S}-150}{58}\right) & 150 < 2\frac{f}{S} \le 730 \\ -78.7 - 10 \times log_{10}(S) - \left(\frac{2\frac{f}{S}-330}{40}\right) & 730 < 2\frac{f}{S} \le 1822 - 400 \times log_{10}(S) \\ -116 & S \times (911 - 200 \times log_{10}(S)) < f \le 3000 \end{cases}$ *Upper* $\text{PSD}(f) \le \text{maxPSD1}(f)$ $\textit{Upper PSD}\ (f) \le \begin{cases} -78.5 - 6\ \text{dB} & 0 < f \le 70 \\ -78.5 - \left(\frac{f-70}{80}\right) - 6\ \text{dB} & 70 < f \le 150 \\ -79.5 - \left(\frac{f-150}{58}\right) - 6\ \text{dB} & 150 < f \le 730 \\ -79.5 - \left(\frac{f-330}{40}\right) - 6\ \text{dB} & 730 < f \le 1790 \\ -116 - 6\ \text{dB} & 1790 < f \le 3000 \end{cases}$ $\textit{Lower PSD}\ (f) \ge \begin{cases} -82.3 - 10 \times log_{10}(S) & 5 \le 2\frac{f}{S} \le 50 \\ -83 - 10 \times log_{10}(S) - \left(\frac{2\frac{f}{S}-50}{50}\right) & 50 < 2\frac{f}{S} \le 200 \\ -86 - 10 \times log_{10}(S) - \left(\frac{2\frac{f}{S}-200}{25}\right) & 200 < 2\frac{f}{S} \le 400 \end{cases}$ f dalam MHz *Receiver:* *Bit error rate* $\le 10^{-12}$
Channel coding		PAM16 – LDPC

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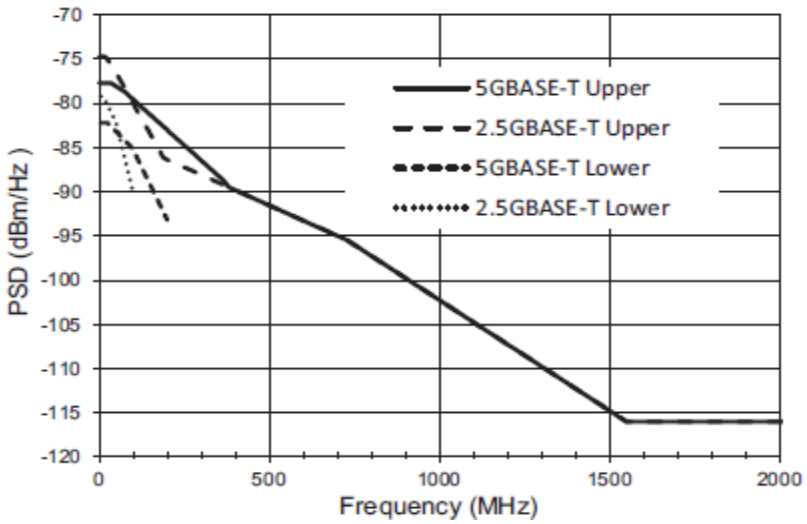

Figure 3. Power Spectral Transmitter Density

Table 7. Interface Characteristics of 10 GBASE-T (IEEE 802.3-2015)

Parameter	Unit	Value
Signal strength	dBm/ Hz	See Figure 4 *Transmitter:* $\text{Upper PSD}(f) \leq \begin{cases} -78.5 & 0 < f \leq 70 \\ -78.5 - \left(\frac{f-70}{80}\right) & 70 < f \leq 150 \\ -79.5 - \left(\frac{f-150}{58}\right) & 150 < f \leq 730 \\ -79.5 - \left(\frac{f-330}{40}\right) & 730 < f \leq 1790 \\ -116 & 1790 < f \leq 3000 \end{cases}$ $\text{Lower PSD}(f) \geq \begin{cases} -83 & 5 \leq f \leq 50 \\ -83 - \left(\frac{f-50}{50}\right) & 50 < f \leq 200 \\ -86 - \left(\frac{f-200}{25}\right) & 200 < f \leq 400 \end{cases}$ f dalam MHz *Receiver:* *Bit error rate* $\leq 10^{-12}$
Channel coding		DSQ128-PAM-16

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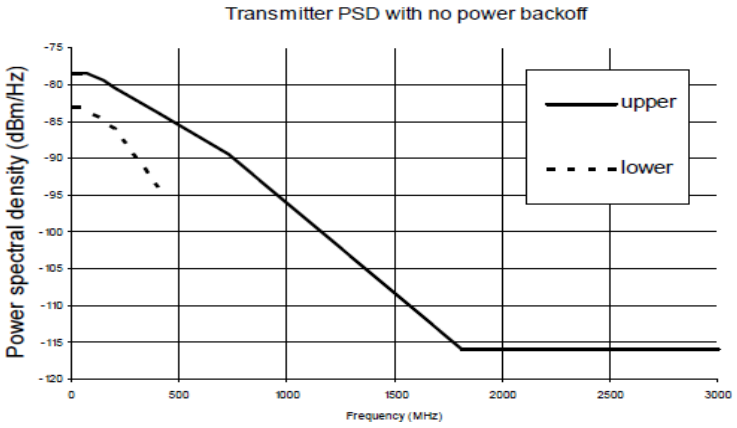

Figure 4. *Transmitter Power Spectral Density*

Table 8. Interface Characteristics of 25G/40GBASE-T (IEEE 802.3bq-2016)

Parameter	Unit	Value
Signal strength	dBm/ Hz	See figure 5. *Transmitter:* $\text{Upper PSD}\ (f) \leq \begin{cases} -88.5 - 10 \times log_{10}(S) & 0 < \frac{f}{S} \leq 280 \\ -88.5 - 10 \times log_{10}(S) - \left(\frac{\frac{f}{S}-280}{320}\right) & 280 < \frac{f}{S} \leq 600 \\ -89.5 - 10 \times log_{10}(S) - \left(\frac{\frac{f}{S}-600}{232}\right) & 600 < \frac{f}{S} \leq 2920 \\ -89.5 - 10 \times log_{10}(S) - \left(\frac{\frac{f}{S}-1320}{160}\right) & 2920 < \frac{f}{S} \leq 7160 \\ -126 & 7160 < \frac{f}{S} \leq \frac{12000}{S} \end{cases}$ $\text{Lower PSD}\ (f) \geq \begin{cases} -93 & 20 \leq f \leq 200 \\ -93 - \left(\frac{\frac{f}{S}-200}{200}\right) & 200 < \frac{f}{S} \leq 800 \\ -96 - \left(\frac{\frac{f}{S}-800}{100}\right) & 800 < \frac{f}{S} \leq \frac{1600}{S} \end{cases}$ f dalam MHz *Receiver:* *Bit error rate* ≤ 10^{-12}
Channel coding		DSQ128 – *Combination of* RS-FEC *and* LDPC

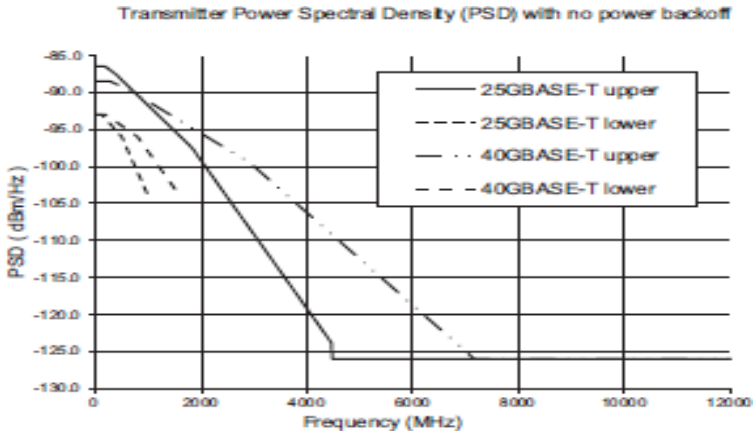

Figure 5. *Transmitter Power Spectral Density*

Table 9. Interface Characteristics of 1000BASE-X (IEEE 802.3-2008)

Parameter	Unit	Value				
Application code		1000BASE-SX		1000BASE-LX		
Fiber Type		62.5 µm MMF	50 µm MMF	62.5 µm MMF	50 µm MMF	10 µm SMF
Operating wavelength range	Nm	770-860	770-860	1270-1355	1270-1355	1270-1355
RMS *spectral width*	Nm	0.85	0.85	4	4	4
Mean launched power: - *maximum* - *minimum*	dBm dBm	*Class* 1M -9.5	*Class* 1M -9.5	-3 -11.5	-3 -11.5	-3 -11
Minimum receiver sensitivity	dBm	-17	-17	-19	-19	-19

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Table 10. Interface Characteristics of 10GBASE-S (IEEE 802.3-2008)

Parameter	Unit	Value			
Application code		10GBASE-SW		10GBASE-SR	
Nominal signaling speed	GBd	9.95328		10.3125	
Fiber Type		62.5 µm MMF	50 µm MMF	62.5 µm MMF	50 µm MMF
Operating wavelength range	Nm	840-860	840-860	840-860	840-860
RMS *spectral width*	Nm	Lihat Table 11	Lihat Table 11	Lihat Table 11	Lihat Table 11
Mean launched power: - *maximum* - *minimum*	dBm dBm	*Class* 1M Gambar 6	*Class* 1M Gambar 6	*Class* 1M Gambar 6	*Class* 1M Gambar 6
Minimum receiver sensitivity	dBm	-11.1	-11.1	-11.1	-11.1

Table 11. 10 GBASE-S RMS *spectral width* (IEEE 802.3-2008)

Center wavelength (nm)	RMS *Spectral width* (nm)								
	Up to 0.05	0.05 to 0.1	0.1 to 0.15	0.15 to 0.2	0.2 to 0.25	0.25 to 0.3	0.3 to 0.35	0.35 to 0.4	0.4 to 0.45
840 to 842	4.2	4.2	4.1	4.1	3.9	3.8	3.5	3.2	2.8
842 to 844	4.2	4.2	4.2	4.1	3.9	3.8	3.6	3.3	2.9
844 to 846	4.2	4.2	4.2	4.1	4.0	3.8	3.6	3.3	2.9
846 to 848	4.3	4.2	4.2	4.1	4.0	3.8	3.6	3.3	2.9
848 to 850	4.3	4.2	4.2	4.1	4.0	3.8	3.6	3.3	3.0

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Table 11. 10GBASE-S RMS spectral width (IEEE 802.3-2008)

Center wavelength (nm)	RMS *Spectral width* (nm)								
	Up to 0.05	0.05 to 0.1	0.1 to 0.15	0.15 to 0.2	0.2 to 0.25	0.25 to 0.3	0.3 to 0.35	0.35 to 0.4	0.4 to 0.45
850 to 852	4.3	4.2	4.2	4.1	4.0	3.8	3.6	3.4	3.0
852 to 854	4.3	4.2	4.2	4.1	4.0	3.9	3.7	3.4	3.1
854 to 856	4.3	4.3	4.2	4.1	4.0	3.9	3.7	3.4	3.1
856 to 858	4.3	4.3	4.2	4.1	4.0	3.9	3.7	3.5	3.1
858 to 860	4.3	4.3	4.2	4.2	4.1	3.9	3.7	3.5	3.2

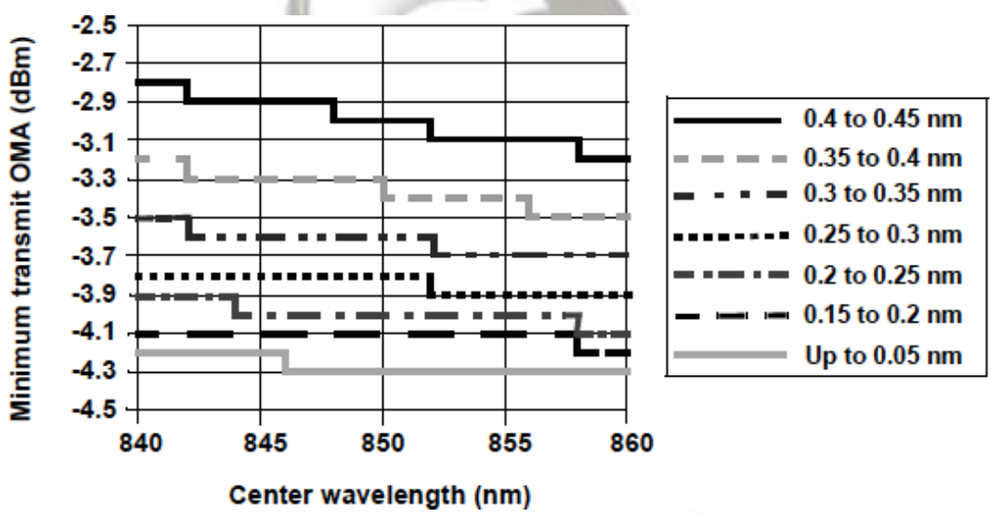

Figure 6. 10 GBASE-S *minimum transmit power* (IEEE 802.3-2008)

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Table 12. Interface Characteristics of 10GBASE-L (IEEE 802.3-2008)

Parameter	Unit	Value	
Application code		10GBASE-LW	10GBASE-LR
Nominal signaling speed	GBd	9.95328 ± 20 ppm	10.3125 ± 100 ppm
Fiber Type		B1.1 and B1.3 SMF	B1.1 and B1.3 SMF
Operating wavelength range	nm	1260-1355	1260-1355
Minimum Side Mode Suppression Ratio	dB	30	30
Mean launched power: *- maximum* *- minimum*	 dBm dBm	 0.5 -8.2	 0.5 -8.2
Minimum receiver sensitivity	dBm	-12.6	-12.6

Table 13. Interface Characteristics of 10GBASE-E (IEEE 802.3-2008)

Parameter	Unit	Value	
Application code		10GBASE-EW	10GBASE-ER
Nominal signaling speed	GBd	9.95328 ± 20 ppm	10.3125 ± 100 ppm
Fiber Type		B1.1 and B1.3 SMF	B1.1 and B1.3 SMF
Operating wavelength range	nm	1530-1565	1530-1655
Minimum Side Mode Suppression Ratio	dB	30	30
Mean launched power: *- maximum* *- minimum*	 dBm dBm	 4.0 -4.7	 4.0 -4.7
Minimum receiver sensitivity	dBm	-14.1	-14.1

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Table 14. Interface Characteristics 10GBASE-LX4 (IEEE 802.3-2008)

Parameter	Unit	Value	
Nominal signaling speed	GBd	3.125 ± 100 ppm	
Fiber Type		62.5 and 50 μm MMF	10 μm SMF
Operating wavelength range	nm	1269.0-1282.4 1293.5-1306.9 1318.0-1331.4 1342.5-1355.9	1269.0-1282.4 1293.5-1306.9 1318.0-1331.4 1342.5-1355.9
Minimum Side Mode Suppression Ratio	dB	0	0
Mean launched power: - *maximum (four lanes)* - *minimum (per lane)*	dBm dBm	5.5 -0.5	5.5 -0.5
Minimum receiver sensitivity (per lane)	dBm	-14.25	-14.45

Table 15. Interface Characteristics of 10GBASE-LRM (IEEE 802.3-2015)

Parameter	Unit	Value
Nominal signaling speed	GBd	10.3125 ± 100 ppm
Fiber Type		Table 16
Operating wavelength range (Center wavelength)	nm	1260 to 1355
RMS Spectral Width at 1260 nm *RMS Spectral Width between 1260 nm and 1300* *RMS Spectral Width between 1300 nm and 1355 nm*	nm	2.4 See Figure 7. 4
Mean launched power: - *maximum* - *minimum*	dBm dBm	0.5 6.5
Minimum receiver sensitivity	dBm	6.5

Table 16.10GBASE-LRM *fiber types and operating ranges* (IEEE 802.3-2015)

Multimode fiber type	62.5 µm 160/500	62.5 µm 200/500	50 µm 500/500	50 µm 400/400	50 µm 1500/1500
ISO/IEC 11801:2002 *fiber type*		OM1	OM2		OM3
Operating range (m)	0.5 to 220				
Maximum channel insertion loss (dB)	1.9	1.9	1.9	1.7	1.9

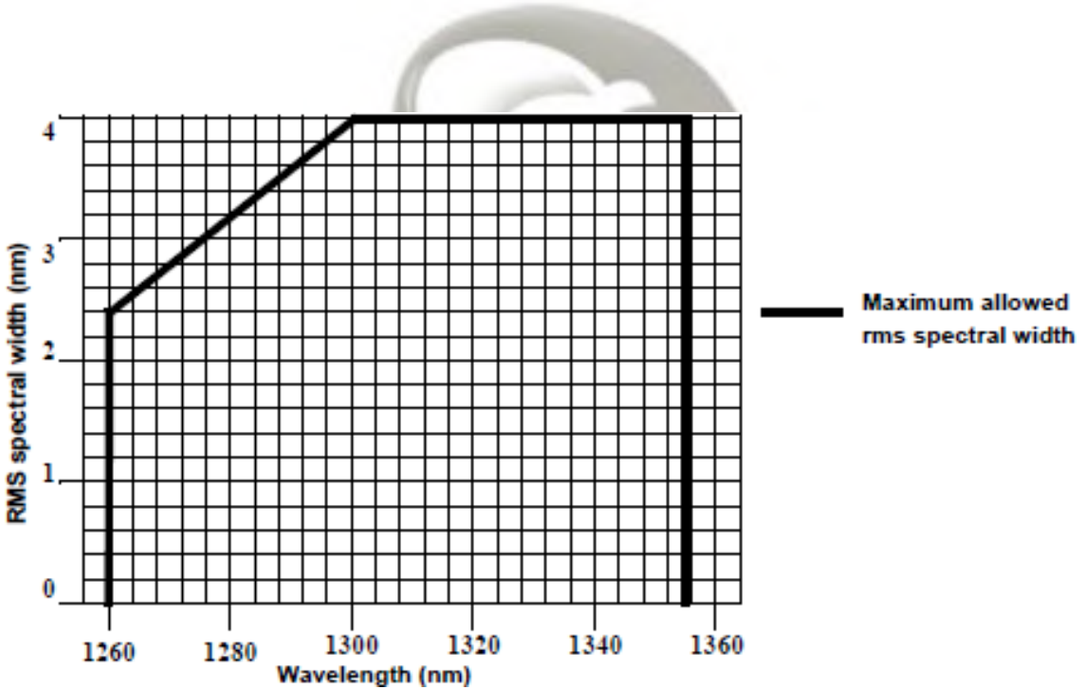

Figure 7. 10GBASE-LRM *Transmitter spectral limits*

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Table 17. Interface Characteristics 40GBASE-R (IEEE 802.3-2010)

Parameter	Unit	Value	
Application code		40GBASE-SR4	40GBASE-LR4
Nominal signaling speed	GBd	10.3125 ± 20 ppm	10.3125 ± 100 ppm
Fiber Type		50/125 µm MMF	B1.1, B1.3, and B6_A SMF
Operating wavelength range	nm	840-860	1264.5-1277.5 1284.5-1297.5 1304.5-1317.5 1324.5-1337.5
Minimum Side Mode Suppression Ratio	dB	30	30
Mean launched power: - *maximum* - *minimum*	 dBm dBm	 2.4 -7.6	 2.3 -7
Minimum receiver sensitivity	dBm	-9.5	-11.5

Table 18. Interface Characteristics 100GBASE-R (IEEE 802.3-2010)

Parameter	Unit	Value	
Application code		100GBASE-LR4	100GBASE-SR4
Nominal signaling speed	GBd	25.78125 ± 100 ppm	25.78125 ± 100 ppm
Fiber Type		B1.1, B1.3, and B6_A SMF	B1.1, B1.3, and B6_A SMF
Operating wavelength range	nm	1294.53-1296.59 1299.02-1301.09 1303.54-1305.63 1308.09-1310.19	1294.53-1296.59 1299.02-1301.09 1303.54-1305.63 1308.09-1310.19
Minimum Side Mode Suppression Ratio	dB	30	30
Mean launched power: - *maximum* - *minimum*	 dBm dBm	 4.5 -4.3	 2.9 -2.9
Minimum receiver sensitivity	dBm	-9.5	-11.5

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Table 19. Interface Characteristics 10GBASE-CX4 (IEEE 802.3-2015)

Parameter	Unit	Value
TRANSMITTER CHARACTERISTICS		
Nominal signaling speed	GBd	3.125 ± 100 ppm
Differential peak-to-peak output voltage *Maximum* *Minimum*	 mV mV	 1200 800
Differential peak-to-peak output voltage difference (maximum)	mV	150
Common-mode voltage lim its *Maximum* *Minimum*	 V V	 1.9 0.4
Differential output return loss minimum	dB	See Equation 1
Transition time *Maximum* *Minimum*	 ps ps	 130 60
Output jitter (peak-to-peak) *Random jitter* *Deterministic jitter* *Total jitter*	 UI UI UI	 0.27 0.17 0.35
RECEIVER CHARACTERISTICS		
Bit Error Rate		10^{-12}
Differential input peak-to-peak amplitude (maximum)	mV	1200
Return loss differential (minimum)*	dB	See Equation 1

**Relative to 100 Ω differential*

$$Return\ Loss\ (f) \begin{cases} \geq 10 & 100 \leq f \leq 625 \\ \geq 10 - 10 \times log\left(\frac{f}{625}\right) & 625 \leq f \leq 2000 \end{cases} \quad \text{.....(1)}$$