

Overview Proposed Performance Specifications for ISO/IEC 11801 Class D, Class E and Class F Cabling

NEXT loss, Insertion Loss, ELFEXT, Return Loss Propagation Delay, Delay Skew, DC Loop Resistance, Longitudinal Conversion Loss, Coupling attenuation and Transfer Impedance

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**Changes in the tables relative to the previous summary are shown with a
yellow background.**

Notes:

1. This document is based on the May 5, 2000 (2000-05-08) draft of ISO/IEC 11801-2000+ and resolution of comments on ISO/IEC JTC 1/SC 25/SG 3 N598 during the June 12 to 17, 2000 ISO/IEC JTC1/SC 25/ WG 3 meeting in Tromso, Norway.
2. It was recognized during the Tromso meeting that Insertion Loss Deviation (ILD) can be significant at high frequencies. For a Class E channel, ILD is approx. 1 dB @ 250 MHz. For Class F cabling, ILD is approx. 2 dB @ 600 MHz. However, this will not affect the pass/fail limits for the channel. Under maximum length conditions of the horizontal cabling, the total length of flexible cabling must be reduced so that the channel limits are satisfied. Practically, the reduction of flexible cable is approx. 2 m.
3. Permanent link limits were changed and tightened to reflect the desire that addition of a

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compliant patch cable to a compliant permanent link should result a compliant channel configuration. This does not cover addition of a crossconnect, jumper cable and a patch cable. When this addition is made, the resulting channel must be re-tested for compliance.

4. Although the channel limits are generally rather definite, recently changed values for channel (Class E and F) and permanent link limits are considered "half frozen". This means that a simple majority will be sufficient for change. Other requirements will need a 2/3 majority for change.
5. In general, if the insertion loss is less than 4 dB pass/fail limits for insertion loss and all other parameters do not apply. For channel and permanent link return loss measurements, the minimum insertion loss is 3 dB. This was changed during the Tromso meeting (there could be a misunderstanding here). However, the same floor applicable to cable return loss remains 4 dB. This appears inconsistent, and is therefore likely to change.
6. A substantial amount of work remains to be done on LCL, LCTL, coupling attenuation requirements. It was agreed that channel and permanent link requirements would be by design and not be part of a field test requirement.
7. The table values for ISO/IEC 11801-2000 Class D insertion loss deviate slightly (up to 0.3 dB) from the computed values from cable and connector requirements, because the original ISO/IEC 11801-1995 specifications were only provided in table format. The ISO/IEC 11801-2000 Class D table values are shown, where different than computed values. All ISO/IEC 11801-2000+ pass/fail limits will be based on equations, which are identified in ISO/IEC 11801-2000+ Annex F.

Overview Requirement Specifications Insertion loss

Parameter	Class D-2000	Class D-2000+	Class E	Class F
Frequency Range	100 MHz	100 MHz	250 MHz	600 MHz
Cable insertion loss				
	$1.967\sqrt{f} + 0.02f + \frac{0.2}{\sqrt{f}}$ (±0.3 dB approx)	$1.9108\sqrt{f} + 0.0223f + \frac{0.0486}{\sqrt{f}}$	$1.82\sqrt{f} + 0.017f + \frac{0.2}{\sqrt{f}}$	$1.8\sqrt{f} + 0.01f + \frac{0.2}{\sqrt{f}}$
100 MHz	21.7 dB	21.3 dB	19.9 dB	19.0 dB
250 MHz			33.0 dB	31.0 dB
600 MHz				50.1 dB
Connector insertion loss				
	$0.04 * \sqrt{f}$ 0.1 dB min	$0.04 * \sqrt{f}$ 0.1 dB min	$0.02 * \sqrt{f}$ 0.1 dB min	$0.02 * \sqrt{f}$ 0.1 dB min
100 MHz	0.4 dB	0.4 dB	0.2 dB	0.2 dB
250 MHz			0.3 dB	0.3 dB
600 MHz				0.5 dB
Channel insertion loss	100 m	100 m	100 m	100 m
	$1.05 * att_{ca} + 3 * att_{co}$ (± 0.2 dB approx.)	$1.05 * att_{ca} + 3 * att_{co}$ 4 dB min	$1.05 * att_{ca} + 4 * att_{co} + ILD$ 4 dB min	$1.05 * att_{ca} + 4 * att_{co} + ILD$ 4 dB min
100 MHz	24.0 dB	24.0 dB	21.7 dB	20.8 dB
250 MHz			36.0 dB	33.8 dB
600 MHz				54.6 dB
Permanent Link insertion loss	90 m	90 m	90 m	90 m
	$0.9 * att_{ca} + 2 * att_{co}$ (± 0.3 dB approx.)	$0.9 * att_{ca} + 3 * att_{co}$ 4 dB min	$0.9 * att_{ca} + 3 * att_{co}$ 4 dB min	$0.9 * att_{ca} + 3 * att_{co}$ 4 dB min
100 MHz	20.6 dB	20.4 dB	18.5 dB	17.7 dB
250 MHz			30.7 dB	28.8 dB
600 MHz				46.6 dB

Note: Temperature effects of insertion loss in cable (0.4 %/°C up to 40 °C, 0.6 %/°C up to 60 °C) and ILD must be accounted for by reduced maximum length of horizontal cabling or maximum length of patch cords/jumpers.

Class E channels: ILD » 1 dB @ 250 MHz (approx. 3 m reduction of horizontal cabling or 2 m of patch cordage).

Class F channels: ILD » 2 dB @ 600 MHz (approx. 3 m reduction of horizontal cabling or 2 m of patch cordage).

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Overview Requirement Specifications NEXT loss

Parameter	Class D-2000	Class D-2000+	Class E	Class F
Frequency Range	100 MHz	100 MHz	250 MHz	600 MHz
Cable NEXT loss	100 m	100 m	100 m	100 m
Pair-to-pair	$64 - 15 \log\left(\frac{f}{0.772}\right)$	$65.3 - 15 \log(f)$	$74.3 - 15 \log(f)$	$102.4 - 15 \log(f)$ 80 dB max
100 MHz PP	32.3 dB	35.3 dB	44.3 dB	72.4 dB
250 MHz PP			38.3 dB	66.4 dB
600 MHz PP				60.7 dB
Power sum	$61 - 15 \log\left(\frac{f}{0.772}\right)$	$62.3 - 15 \log(f)$	$72.3 - 15 \log(f)$	$99.4 - 15 \log(f)$ 77 dB max
100 MHz PS	29.3 dB	32.3 dB	42.3 dB	69.4 dB
250 MHz PS			36.3 dB	63.4 dB
600 MHz PS				57.7 dB
Conn NEXT loss				
Pair-to-pair	$56 - 20 \log\left(\frac{f}{16}\right)$	$83 - 20 \log(f)$	$94 - 20 \log(f)$	$102.4 - 15 \log(f)$ 80 dB max
100 MHz PP	40.1 dB	43.0 dB	54.0 dB	72.4 dB
250 MHz PP			46.0 dB	66.4 dB
600 MHz PP				60.7 dB
Power sum	$53 - 20 \log\left(\frac{f}{16}\right)$	$80 - 20 \log(f)$	$90 - 20 \log(f)$	$99.4 - 15 \log(f)$ 77 dB max
100 MHz PS	37.1 dB	40.0 dB	50.0 dB	69.4 dB
250 MHz PS			42.0 dB	63.4 dB
600 MHz PS				57.7 dB

Note:

NEXT loss requirements for cable and connecting hardware over 60 dB for category 5E and 65 dB for category 6 and 7, and PS NEXT loss requirements for cable and connecting hardware over 57 dB for category 5E and 62 dB for category 6 and 7, are for information only (measurement cap).

Overview Requirement Specifications NEXT loss (continued)

Parameter	Class D-2000	Class D-2000+	Class E	Class F
Frequency Range	100 MHz	100 MHz	250 MHz	600 MHz
Channel NEXT loss	100 m	100 m	100 m	100 m (4 conn model)
Pair-to-pair	$-20\log\left(10^{\frac{-N_{ps}}{20}} + 2 * 10^{\frac{-N_{ps}}{20}}\right)$ 60 dB max	$-20\log\left(10^{\frac{-N_{ps}}{20}} + 2 * 10^{\frac{-N_{ps}}{20}}\right)$ 60 dB max	$-20\log\left(10^{\frac{-N_{ps}}{20}} + 2 * 10^{\frac{-N_{ps}}{20}}\right)$ 65 dB max	$-20\log\left(10^{\frac{-N_{ps}}{20}} + 2 * 10^{\frac{-N_{ps}}{20}}\right)$ 65 dB max
100 MHz PP	27.1 dB	30.1 dB	39.9 dB	62.9 dB
250 MHz PP			33.1 dB	56.9 dB
600 MHz PP				51.2 dB
Power sum	57 dB max	57 dB max	62 dB max	62 dB max
100 MHz PS	24.1 dB	27.1 dB	37.1 dB	59.9 dB
250 MHz PS			30.2 dB	53.9 dB
600 MHz PS				48.2 dB
Permanent Link NEXT loss	90 m	90 m	90 m	90 m (3 conn model)
Pair-to-pair	$-20\log\left(10^{\frac{-N_{ps}}{20}} + 10^{\frac{-N_{ps}}{20}}\right)$ 60 dB max	$-20\log\left(10^{\frac{-N_{ps}}{20}} + 10^{\frac{-N_{ps}}{20}}\right)$ 60 dB max	$-20\log\left(10^{\frac{-N_{ps}}{20}} + 10^{\frac{-N_{ps}}{20}}\right)$ 65 dB max	$-20\log\left(10^{\frac{-N_{ps}}{20}} + 10^{\frac{-N_{ps}}{20}}\right)$ 65 dB max
100 MHz PP	29.3 dB	32.3 dB	41.8 dB	65.0 dB
250 MHz PP			35.3 dB	60.4 dB
600 MHz PP				54.7 dB
Power sum	$-20\log\left(10^{\frac{-N_{ps}}{20}} + 10^{\frac{-N_{ps}}{20}}\right)$ 57 dB max	$-20\log\left(10^{\frac{-N_{ps}}{20}} + 10^{\frac{-N_{ps}}{20}}\right)$ 57 dB max	$-20\log\left(10^{\frac{-N_{ps}}{20}} + 10^{\frac{-N_{ps}}{20}}\right)$ 62 dB max	$-20\log\left(10^{\frac{-N_{ps}}{20}} + 10^{\frac{-N_{ps}}{20}}\right)$ 62 dB max
100 MHz PS	26.3 dB	29.3 dB	39.3 dB	62.0 dB
250 MHz PS			32.7 dB	57.4 dB
600 MHz PS				51.7 dB

Note: If the insertion loss in the channel or permanent link is less than 4 dB, the pass/fail limits for NEXT/PS NEXT loss shall not apply. Instead the ACR/PS ACR pass/fail limits shall apply.

Overview ACR

Parameter	Class D-2000	Class D-2000+	Class E	Class F
Frequency Range	100 MHz	100 MHz	250 MHz	600 MHz
ACR Channel PP				
100 MHz PP	3.1 dB	6.1 dB	18.2 dB	42.1 dB
250 MHz PP			-2.8 dB (@250 MHz) 3.0 dB (@200 MHz)	23.1 dB
600 MHz PP				-3.4 dB
ACR Channel PS				
100 MHz PS	0.1 dB	3.1 dB	15.4 dB	39.1 dB
250 MHz PS			-5.8 dB (250 MHz) 0.1 dB (@200 MHz)	20.1 dB
600 MHz PS				-6.4 dB

For Class F, also the ACR values for a two-connector model are shown in the draft standard. In this case assume for the channel and permanent link formulas:

- Insertion loss: 2 connectors are present.
- NEXT and PS NEXT loss: 1 connector is present (at each end).
- The Power Sum ACR value is then 0 dB @ 570MHz.
- The insertion loss limits at 100 MHz, 250 MHz and 600 MHz are respectively 20.4 dB, 33.2 dB, and 53.6 dB.
- The PP NEXT loss limits at 100 MHz, 250 MHz and 600 MHz are respectively 65.0 dB, 60.4 dB, and 54.7 dB.
- The PS NEXT loss limits at 100 MHz, 250 MHz and 600 MHz are respectively 62.0 dB, 57.4 dB, and 51.7 dB.
- The PP ACR limits at 100 MHz, 250 MHz and 600 MHz are respectively 44.6 dB, 27.3 dB, and 1.1 dB.
- The PS ACR limits at 100 MHz, 250 MHz and 600 MHz are respectively 41.6 dB, 24.3 dB, and -1.9 dB.

Overview Requirement Specifications ELFEXT

Parameter	Class D-2000	Class D-2000+	Class E	Class F
Frequency Range	100 MHz	100 MHz	250 MHz	600 MHz
Cable ELFEXT	100 m	100 m	100 m	100 m
Pair-to-pair	$67 - 20 \log\left(\frac{f}{0.772}\right)$	$63.8 - 20 \log(f)$	$67.8 - 20 \log(f)$	$94 - 20 \log(f)$ 75 dB max
100 MHz PP	24.8 dB	23.8 dB	27.8 dB	54.0 dB
250 MHz PP			19.8 dB	46.0 dB
600 MHz PP				38.4 dB
Power sum	$64 - 20 \log\left(\frac{f}{0.772}\right)$ 75 dB max	$60.8 - 20 \log(f)$	$64.8 - 20 \log(f)$	$91 - 20 \log(f)$
100 MHz PS	21.8 dB	20.8 dB	24.8 dB	51.0 dB
250 MHz PS			16.8 dB	43.0 dB
600 MHz PS				35.4 dB
Connector FEXT loss Pair-to-pair	$75.1 - 20 \log(f)$ 75 dB max	$75.1 - 20 \log(f)$ 75 dB max	$83.1 - 20 \log(f)$ 75 dB max	$90 - 15 \log(f)$
100 MHz PP	35.1 dB	35.1 dB	43.1 dB	60.0 dB
250 MHz PP			35.1 dB	55.0 dB
600 MHz PP				48.3 dB
Power sum	$72.1 - 20 \log(f)$ 72 dB max	$72.1 - 20 \log(f)$ 72 dB max	$80.1 - 20 \log(f)$ 72 dB max	$87 - 20 \log(f)$ 72 dB max
100 MHz PS	32.1 dB	32.1 dB	40.1 dB	57.0 dB
250 MHz PS			32.1 dB	51.0 dB
600 MHz PS				45.3 dB

Note:

ELFEXT and FEXT loss requirements for cable and connecting hardware over 60 dB for category 5E and 65 dB for category 6 and 7, and PS ELFEXT and PS FEXT loss requirements for cable and connecting hardware over 57 dB for category 5E and 62 dB for category 6 and 7, are for information only (measurement cap).

Overview Requirement Specifications ELFEXT (continued)

Parameter	Class D-2000	Class D-2000+	Class E	Class F
Channel ELFEXT	100 m	100 m	100 m	100 m 4 connectors
Pair-to-pair	$17.0 - 20 \log \left(\frac{f}{100} \right)$	60 dB max	$-20 \log_{10} \left(\frac{-N_{ca}}{20} + 4 * 10 \frac{-N_{co}}{20} \right)$ 65 dB max	$-20 \log_{10} \left(\frac{-N_{ca}}{20} + 4 * 10 \frac{-N_{co}}{20} \right)$ 65 dB max
100 MHz PP	17.0 dB	17.4 dB	23.3 dB	44.4 dB
250 MHz PP			15.3 dB	37.8 dB
600 MHz PP				31.3 dB
Power sum	$14.4 - 20 \log \left(\frac{f}{100} \right)$	$-20 \log_{10} \left(\frac{-N_{ca}}{20} + 4 * 10 \frac{-N_{co}}{20} \right)$ 57 dB max	$-20 \log_{10} \left(\frac{-N_{ca}}{20} + 4 * 10 \frac{-N_{co}}{20} \right)$ 62 dB max	$-20 \log_{10} \left(\frac{-N_{ca}}{20} + 4 * 10 \frac{-N_{co}}{20} \right)$ 62 dB max
100 MHz PS	14.4 dB	14.4 dB	20.3 dB	41.4 dB
250 MHz PS			12.3 dB	34.8 dB
600 MHz PS				28.3 dB
Channel ELFEXT	100 m 2 connectors	100 m 2 connectors	100 m 2 connectors	100 m 2 connectors
Pair-to-pair	not specified	not specified	not specified	$-20 \log_{10} \left(\frac{-N_{ca}}{20} + 2 * 10 \frac{-N_{co}}{20} \right)$ 65 dB max
100 MHz PP				48.0 dB
250 MHz PP				40.9 dB
600 MHz PP				34.1 dB
Power sum	not specified	not specified	not specified	$-20 \log_{10} \left(\frac{-N_{ca}}{20} + 2 * 10 \frac{-N_{co}}{20} \right)$ 62 dB max
100 MHz PS				45.0 dB
250 MHz PS				37.9 dB
600 MHz PS				31.1 dB

Note: If the insertion loss in the channel or permanent link is less than 4 dB, the pass/fail limits for ELFEXT/PS ELFEXT shall not apply.

Overview Requirement Specifications ELFEXT (continued)

Parameter	Class D-2000	Class D-2000+	Class E	Class F
Permanent Link ELFEXT	90 m	90 m	90 m	90 m
Pair-to-pair	$19.6 - 20 \log \left(\frac{f}{100} \right)$	$-20 \log \left(10^{\frac{-N_{ca}}{20}} + 3 * 10^{\frac{-N_{co}}{20}} \right)$ 60 dB max	$-20 \log \left(10^{\frac{-N_{ca}}{20}} + 3 * 10^{\frac{-N_{co}}{20}} \right)$ 65 dB max	$-20 \log \left(10^{\frac{-N_{ca}}{20}} + 3 * 10^{\frac{-N_{co}}{20}} \right)$ 65 dB max
100 MHz PP	19.6 dB	18.6 dB	24.2 dB	46.0 dB
250 MHz PP			16.2 dB	39.2 dB
600 MHz PP				32.6 dB
Power sum	$17.0 - 20 \log \left(\frac{f}{100} \right)$	$-20 \log \left(10^{\frac{-N_{ca}}{20}} + 3 * 10^{\frac{-N_{co}}{20}} \right)$ 57 dB max	$-20 \log \left(10^{\frac{-N_{ca}}{20}} + 3 * 10^{\frac{-N_{co}}{20}} \right)$ 62 dB max	$-20 \log \left(10^{\frac{-N_{ca}}{20}} + 3 * 10^{\frac{-N_{co}}{20}} \right)$ 62 dB max
100 MHz PS	17.0 dB	15.6 dB	21.2 dB	43.0 dB
250 MHz PS			13.2 dB	36.2 dB
600 MHz PS				29.6 dB

Note: If the insertion loss in the channel or permanent link is less than 4 dB, the pass/fail limits for ELFEXT/PS ELFEXT shall not apply.

Overview Requirement Specifications Return Loss

Note: the following proposal for cable return loss was adopted by ISO/IEC JTC1/SC 25/WG 3, but will be subject of further discussions.

Parameter	Class D-2000	Class D-2000+	Class E	Class F
	100 MHz	100 MHz	250 MHz	600 MHz
Mean characteristic impedance	± 15 W	± 5 W	± 5 W	± 5 W
Cable RL (solid core)	100 m	100 m	100 m	100 m
Return loss	no change	1 – 100 MHz: 23 dB	1 – 100 MHz: 23 dB 100 – 250 MHz: $23 - 10 \log \left(\frac{f}{100} \right)$	1 – 300 MHz: 23 dB 300 – 600 MHz: $23 - 10 \log \left(\frac{f}{300} \right)$

Overview Requirement Specifications Return Loss

Previous return loss requirements for cable are still shown in this overview

Parameter	Class D-2000	Class D-2000+	Class E	Class F
	100 MHz	100 MHz	250 MHz	600 MHz
Cable RL (solid core)	100 m	100 m	100 m	100 m
Z_{100MHz}	100 Ω ± 6 Ω for information only	100 Ω ± 6 Ω for information only	100 Ω ± 6 Ω for information only	100 Ω ± 6 Ω for information only
1 - 10 MHz	not specified	20 + 5 * log(<i>f</i>)	20 + 5 * log(<i>f</i>)	20 + 5 * log(<i>f</i>)
10 - 20 MHz		25 dB	25 dB	25 dB
20 MHz – 250 MHz		34.1 – 7 * log(<i>f</i>)	34.1 – 7 * log(<i>f</i>)	34.1 – 7 * log(<i>f</i>)
250 MHz – 600 MHz				ffs
100 MHz	not specified	20.1 dB	20.1 dB	20.1 dB
250 MHz			15.6 dB	15.6 dB
600 MHz				ffs
Cable RL (stranded)	100 m	100 m	100 m	100 m
1 - 10 MHz	not specified	20 + 5 * log(<i>f</i>)	20 + 5 * log(<i>f</i>)	20 + 5 * log(<i>f</i>)
20 MHz – 100 MHz	not specified	25 dB	25 dB	25 dB
100 MHz–250 MHz	not specified	36.2 – 8.6 * log(<i>f</i>)	36.2 – 8.6 * log(<i>f</i>)	36.2 – 8.6 * log(<i>f</i>)
100 MHz	not specified	19.0 dB	19.0 dB	19.0 dB
250 MHz			16.0 dB	19.0 dB
600 MHz				11.4 dB
RL patch cord assy				
1 - 10 MHz	not specified	20 + 5 * log(<i>f</i>)	20 + 5 * log(<i>f</i>)	20 + 5 * log(<i>f</i>)
20 MHz – 100 MHz	not specified	25 dB	25 dB	25 dB
100 MHz–250 MHz	not specified	38 – 10 * log(<i>f</i>)	38 – 10 * log(<i>f</i>)	38 – 10 * log(<i>f</i>)
100 MHz	not specified	18.0 dB	18.0 dB	18.0 dB
250 MHz			14.0 dB	14.0 dB
600 MHz				ffs
Conn RL				
1 - 10 MHz	26 dB	26 dB	30 dB	30 dB
20 MHz – 100 MHz	$26 - 20 * \log\left(\frac{f}{20}\right)$	60 – 20 * log(<i>f</i>)	64 – 20 * log(<i>f</i>) 30 dB max	64 – 20 * log(<i>f</i>) 30 dB max
100 MHz–250 MHz			64 – 20 * log(<i>f</i>)	64 – 20 * log(<i>f</i>)
100 MHz	12.0 dB	20.0 dB	24.0 dB	24.0 dB
250 MHz			16.0 dB	16.0 dB
600 MHz				8.4 dB

Overview Requirement Specifications Return Loss (continued)

Parameter	Class D-2000	Class D-2000+	Class E	Class F
	100 MHz	100 MHz	250 MHz	600 MHz
Channel RL	10 m - 100 m	10 m - 100 m	10 m - 100 m	10 m - 100 m
	(17 dB max)	(17 dB max)	(19 dB max)	(19 dB max)
1 - 10 MHz	17	17	19	19
10 - 20 MHz	17	17	$24 - 5\log(f)$	$24 - 5\log(f)$
20 MHz - 40 MHz	$17 - 10\log\left(\frac{f}{20}\right)$	$30 - 10\log(f)$	$24 - 5\log(f)$	$24 - 5\log(f)$
40 - 100 MHz	$17 - 10\log\left(\frac{f}{20}\right)$	$30 - 10\log(f)$	$32 - 10\log(f)$	$32 - 10\log(f)$
100 - 250 MHz			$32 - 10\log(f)$	$32 - 10\log(f)$
250 - 600 MHz				8 dB
100 MHz	10.0 dB	10.0 dB	12.0 dB	12.0 dB
250 MHz			8.0 dB	8.0 dB
600 MHz				8.0 dB
Permanent Link RL	10 m - 90 m	10 m - 90 m	10 m - 90 m	10 m - 100 m
	(17 dB max)	(19 dB max)	(21 dB max)	(21 dB max)
1 - 10 MHz	19 dB	19 dB	21 dB	21 dB
10 - 20 MHz	19 dB	19 dB	$26 - 5\log(f)$	$26 - 5\log(f)$
20 MHz - 40 MHz	$19 - 10\log\left(\frac{f}{20}\right)$	$32 - 10\log(f)$	$26 - 5\log(f)$	$26 - 5\log(f)$
40 - 100 MHz	$19 - 10\log\left(\frac{f}{20}\right)$	$32 - 10\log(f)$	$34 - 10\log(f)$	$34 - 10\log(f)$
100 - 250 MHz			$34 - 10\log(f)$	$34 - 10\log(f)$
250 - 600 MHz				10 dB
100 MHz	12.0 dB	12.0 dB	14.0 dB	14.0 dB
250 MHz			10.0 dB	10.0 dB
600 MHz				10.0 dB

Note: return loss pass/fail limits for the channel and permanent link do not apply when the insertion loss is below 3 dB.

Overview Requirement Specifications Propagation Delay

Parameter	Class D-2000	Class D-2000+	Class E	Class F
	100 MHz	100 MHz	250 MHz	600 MHz
Cable PD	Prop. Delay	Prop. Delay	Prop. Delay	Prop. Delay
	$534 + \frac{36}{\sqrt{f}}$	$534 + \frac{36}{\sqrt{f}}$	$534 + \frac{36}{\sqrt{f}}$	$534 + \frac{36}{\sqrt{f}}$
1 MHz	570 ns	570 ns	570 ns	570 ns
2 MHz	559 ns	559 ns	559 ns	559 ns
10 MHz	545 ns	545 ns	545 ns	545 ns
100 MHz	538 ns	538 ns	538 ns	538 ns
200 MHz			537 ns	537 ns
600 MHz				535 ns
Conn PD				
1 MHz and up	2.5 ns	2.5 ns	2.5 ns	2.5 ns
Channel PD				
	$0.544 + \frac{0.036}{\sqrt{f}}$	$0.544 + \frac{0.036}{\sqrt{f}}$	$0.544 + \frac{0.036}{\sqrt{f}}$	$0.544 + \frac{0.036}{\sqrt{f}}$
1 MHz	580	580	580	580
2 MHz	569	569	569	569
10 MHz	555	555	555	555
100 MHz	548	548	548	548
125 MHz			547	547
200 MHz			547	547
250 MHz			546	546
600 MHz				545
Permanent Link PD				
	$0.486 + \frac{0.036}{\sqrt{f}}$	$0.486 + \frac{0.036}{\sqrt{f}}$	$0.486 + \frac{0.036}{\sqrt{f}}$	$0.486 + \frac{0.036}{\sqrt{f}}$
1 MHz	521	521	521	521
2 MHz	511	511	511	511
10 MHz	498	498	498	498
100 MHz	491	491	491	491
125 MHz			491	491
200 MHz			490	490
250 MHz			490	490
600 MHz				489

Overview Requirement Specifications Delay Skew

Parameter	Class D-2000	Class D-2000+	Class E	Class F
Cable DS	100 m	100 m	100 m	100 m
1 MHz and up	45 ns	45 ns	45 ns	45 ns
Conn DS				
Delay Skew	1.25 ns	1.25 ns	1.25 ns	1.25 ns
Channel DS	100 m	100 m	100 m	100 m
Delay Skew	$ds_{ca} + 4 ds_{conn}$	$ds_{ca} + 4 ds_{conn}$	$ds_{ca} + 4 ds_{conn}$	$ds_{ca} + 4 ds_{conn}$
1 MHz and up	50 ns	50 ns	50 ns	50 ns
Permanent Link DS	90 m	90 m	90 m	90 m
Delay Skew	$0.9 ds_{ca} + 2 ds_{conn}$	$0.9 ds_{ca} + 3 ds_{conn}$	$0.9 ds_{ca} + 3 ds_{conn}$	$0.9 ds_{ca} + 3 ds_{conn}$
1 MHz and up	43 ns	44 ns	44 ns	44 ns

Overview Requirement Specifications DC Loop Resistance

Parameter	Class D-2000	Class D-2000+	Class E	Class F
Cable (100 m)	30 W	30 W	30 W	30 W
Connectors	0.3 W	0.2 W	0.2 W	0.2 W
Channel	40 W	40 W	40 W	40 W
Permanent link	34 W	34 W	34 W	34 W

Coupling attenuation

Parameter	Class D-2000	Class D-2000+	Class E	Class F
	100 MHz	100 MHz	250 MHz	600 MHz
Cable	Coupling Att	Coupling Att	Coupling Att	Coupling Att
30 - 100 MHz	not specified	55 dB (ffs)	55 dB (ffs)	80 dB (ffs)
100 - 1000 MHz		$95 - 20 \log(f)$ (ffs)	$95 - 20 \log(f)$ (ffs)	$120 - 20 \log(f)$ (ffs)
100 MHz		55.0 dB	55.0 dB	80.0 dB
250 MHz			47.0 dB	72.0 dB
600 MHz				64.4 dB

Longitudinal to differential conversion loss (unbalance attenuation)

Parameter	Class D-2000	Class D-2000+	Class E	Class F
	100 MHz	100 MHz	250 MHz	600 MHz
Cable	LCL	LCL	LCL	LCL
1 – 100 MHz	not specified	$40 - 10 \log(f)$ (ffs)	$40 - 10 \log(f)$ (ffs)	$40 - 10 \log(f)$ (ffs)
100 MHz – 600 MHz			$40 - 10 \log(f)$ (ffs)	$40 - 10 \log(f)$ (ffs)
100 MHz		20.0 dB	20.0 dB	20.0 dB
250 MHz			16.0 dB	16.0 dB
600 MHz				12.2 dB
Connectors	LCL	LCL	LCL	LCL
1 – 100 MHz	not specified	$46 - 10 \log(f)$ (ffs)	$46 - 10 \log(f)$ (ffs)	$46 - 10 \log(f)$ (ffs)
100 - 250 MHz			$46 - 10 \log(f)$ (ffs)	$46 - 10 \log(f)$ (ffs)
250 – 600 MHz				$46 - 10 \log(f)$ (ffs)
100 MHz		26.0 dB	26.0 dB	26.0 dB
250 MHz			22.0 dB	22.0 dB
600 MHz				18.2 dB
Channel	LCL	LCL	LCL	LCL
Unbalance attenuation	not specified	$40 - 10 \log(f)$ (ffs)	$40 - 10 \log(f)$ (ffs)	$40 - 10 \log(f)$ (ffs)
100 MHz		20.0 dB	20.0 dB	20.0 dB
250 MHz			16.0 dB	16.0 dB
600 MHz				12.2 dB

Transfer Impedance (shielded connectors only)

Parameter	Class D-2000	Class D-2000+	Class E	Class F
Connectors	100 MHz	100 MHz	250 MHz	600 MHz
1 – 10 MHz	not specified	$0.1 f^{0.301}$ (ffs)	$0.1 f^{0.301}$ (ffs)	$0.05 f^{0.301}$ (ffs)
10 - 80 MHz		$0.02 f$ (ffs)	$0.02 f$ (ffs)	$0.01 f$ (ffs)
1 MHz		0.1 W	0.1 W	0.05 W
10 MHz		0.2 W	0.2 W	0.1 W
80 MHz		1.6 W	1.6 W	0.8 W