

**NEW ZEALAND**

**COPPER LOCAL LOOP**

**PRELIMINARY**

**INTERFERENCE MANAGEMENT PLAN**

**PART 3**

**REQUIREMENTS FOR DEPLOYMENT CLASS SYSTEMS**

**NOVEMBER 2007**

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# 1 DEPLOYMENT CLASSES

- 1.1 This Part sets out the Deployment Classes and Deployment Rules for operation of Deployment Class Systems using the MPF. Deployment Classes are based on technologies that are common or expected to be used in the network. The Deployment Rules are the requirements and constraints on the operation of systems that correspond to a Deployment Class. A system that corresponds to a Deployment Class is referred to as a Deployment Class System.
- 1.2 This Part provides only one of the two ways of demonstrating compliance with the obligation described in section 8.2 of Part 1 of this IMP. Throughout this Part the requirements expressed as “shall” or “must” apply only to the case in which compliance with the performance requirements of Part 1 of this IMP is through satisfying the Deployment Classes and Deployment Rules as in Clause 8.3 of Part 1 of this IMP, and do not apply when the alternative method of compliance in Clause 8.4 of Part 1 of this IMP is used.
- 1.3 The Deployment Classes and Deployment Rules:
- (a) list the technologies that have been taken into account in determining deployment class characteristics that systems must meet under the IMP;
  - (b) specify requirements for operation of particular systems that are intended to ensure that systems corresponding to Basis Systems are afforded some measure of protection;
  - (c) will only have the desired effect of limiting interference to an acceptable level and will only be complied with if the customer equipment used in the supply of the system meets the requirements of the corresponding international standards.
- 1.4 Not all available technologies are represented in the Deployment Classes.
- NOTE: A Service Provider that proposes to operate a system that does not fall within a Deployment Class is subject to the requirements in Clause 8.4 of Part 1 of this IMP.*
- 1.5 The use of a Deployment Class for other technology types is not restricted, provided the operation of the system complies with the aggregate transmit power and PSD requirements for the Deployment Class.
- 1.6 Table A-1 sets out the required reference frequencies and attenuation limits (including equivalent distances) for each Deployment Class.
- 1.7 A Service Provider wishing to deploy a Rate Adaptive system shall use service qualification and deployment limits appropriate to the maximum possible rate of the system on that MPF.

# DEPLOYMENT CLASSES AND ASSOCIATED DEPLOYMENT RULES

## 1.2 General

1.2.1 The requirements for operation of Deployment Class Systems comprises three broad categories of requirements:

- (a) requirements that apply to the operation of network equipment;
- (b) requirements that apply to the operation of customer equipment; and
- (c) Deployment Limits for the Deployment Class system and rules for pair separation.

*NOTE: The requirements in (c) above are collectively referred to as Deployment Rules. The Deployment Limit is expressed as an attenuation limit with a corresponding cable length limit for 0.4 PEFUT cable.*

1.2.2 The operation of Deployment Class Systems shall comply with the requirements for the applicable Deployment Class in respect of network equipment, customer equipment and attenuation limit and pair separation in order to comply with the obligation in Clause 8.2 of Part 1 of this IMP.

*NOTE: Clause 8.2 prohibits a Service Provider from operating a system that would cause Unacceptable Interference to a Basis System or Unacceptable Excess Power. Clause 8.3 provides that a Service Provider that operates a Deployment Class System in accordance with the requirements for the applicable Deployment Class is taken to comply with the obligation in Clause 8.2.*

1.2.3 The performance requirements for network equipment, customer equipment and attenuation limits and pair separation are described in Clauses 2.2 through 2.8 of this Part. The substantive requirements for each Deployment Class are contained in the document(s) corresponding to the applicable Deployment Class. The Deployment Rules for each Deployment Class are contained in Table A-1.

*Note: See Clause 2.2 below for a description of 'Nominal' and 'Compliance' requirements for each applicable Deployment Class.*

1.2.4 For Spectrally Symmetric Systems the performance requirements for network equipment and customer equipment are identical. For Spectrally Asymmetric Systems the requirements for network equipment are set out in appendices to this Part, which in turn may reference the respective international standard.

## 1.3 Nominal and Compliance Requirements

1.3.1 2.2.1 For each Deployment Class, there are two alternative means of operating a system in accordance with the Deployment Class requirements. The operation of a Deployment Class System shall comply with the requirements of either:

- (a) Nominal requirements, which specifies the requirements for operation of the Deployment Class system;
- (b) Compliance requirements, which specifies either the requirements for the operation of the Deployment Class system or the references to the referenced documents of the applicable Deployment Class.

*Note 1: A carrier or carriage service provider that operates a Deployment Class System in accordance with either Nominal requirements or Compliance requirements and complies with the Deployment Rules for that Deployment Class is taken to comply with the obligation in Part 1 of this Code.*

*Note 2: The Compliance requirements are taken from the ITU-T standard that corresponds to the indicative technology for the relevant Deployment Class.*

*Note 3: It is expected that most Deployment Class Systems that comply with international standards will comply under the relevant Compliance requirements in this Industry Code. Nominal requirements, which correspond to tighter (i.e. lower) PSD masks than the Compliance requirements, are available as an alternative path for compliance of systems which cannot comply with the line code aspect of the Compliance requirements.*

## **1.4 Total Aggregate Transmit Power**

- 1.4.1 The total aggregate transmit power at the MPF-NRP shall be less than or equal to the limit for the applicable Deployment Class, measured while the equipment is transmitting maximum power, excluding any transient startup or initialisation phases.
- 1.4.2 The methodology for the measurement of the total aggregate transmit power is as specified in Appendix B in Part 1 of this IMP.

## **1.5 Power Spectral Density (PSD)**

- 1.5.1 The PSD at the MPF-NRP shall be less than or equal to the PSD mask for the applicable Deployment Class over the nominated frequency range when the equipment is transmitting maximum power, excluding any transient startup or initialisation phases.
- 1.5.2 The methodology for the measurement of the PSD is as specified in Appendix B in Part 1 of this IMP.

## **1.6 Line Code**

- 1.6.1 The system line code shall comply with the Compliance requirements of the applicable Deployment Class. Systems utilising different line codes from that defined in the class standard meets the requirements provided the system fully complies with both PSD spectral mask and the maximum aggregate power as specified for that class.

## **1.7 Longitudinal Balance**

- 1.7.1 The longitudinal balance of the system towards the Service Provider network, shall be greater than or equal to the longitudinal balance level specified for the applicable Deployment Class when the longitudinal termination is one quarter (1/4) of the termination impedance for the Deployment Class.

Longitudinal Balance is defined as

$$\text{Longitudinal Balance (dB)} = 20\log |V_l/V_m|$$

where:  $V_m$  is the metallic or differential voltage

$V_l$  is the longitudinal or common mode voltage.

- 1.7.2 The methodology for the measurement of the longitudinal balance is as specified in Clause B.3.3 of Appendix B of Part 1 of this IMP.

## 1.8 Longitudinal Output Voltage

- 1.8.1 The Power Spectral Density of the longitudinal output voltage shall be less than or equal to the level for the applicable Deployment Class over the frequency range specified. The longitudinal output voltage is measured across a load (consisting of 100Ω in series with 0.15µF) when the equipment under test is transmitting maximum power, excluding any transient startup or initialisation phases.
- 1.8.2 The methodology for the measurement of the longitudinal output voltage is as specified in Clause B.3.4 of Appendix B of Part 1 of this IMP.

## 1.9 Deployment Rules

- 1.9.1 A Deployment Class System is only taken to be operated in accordance with the Deployment Rules for the applicable Deployment Class if the operation of the system complies with the Deployment Rules in Table A-1 for the applicable Deployment Class.
- 1.9.2 The Calculated Attenuation shall be less than or equal to the Deployment Limit, specified at the reference frequency for the Deployment Class, calculated with respect to the Deployment Reference Point for the applicable Deployment Class.
- 1.9.3 The Calculated Attenuation of an MPF shall be calculated using the formulae of Appendix A to Part 1 of this IMP.
- 1.9.4 A system belonging to a Spectrally Asymmetric Deployment Class shall not be fed from an MPF-NRP which is lower than the Deployment Reference Point for that Deployment Class.

*NOTE 1: In Deployment State A the Deployment Reference Point for all Deployment Classes is at the Highest NRP. Deployment Reference Points for Deployment State B are given in Table 1 as Highest if at the Highest NRP or Lower if at the Nominated Lower NRP.*

*NOTE 2: A Service Provider proposing to operate a system from an MPF-NRP lower than the Deployment Reference Point for that Deployment Class must use the alternative means of compliance prescribed for Non-Deployment Class systems.*

- 1.9.5 Any Pair Separation rules applicable to an MPF shall only apply with respect to the NRP at which the MPF originates.
- 1.9.6 Where Pair Separation is required under a Deployment Rule, the cable pair used for the MPF shall be in a different Cable Unit from the pair used by a system or part of a system of a Deployment Class which requires the separation (e.g. a Deployment Class 1b, E1 customer to exchange pair).

## 1.10 Operation of Spectrally Asymmetric Systems in Reverse Mode

- 1.10.1 Reverse ADSL is a case where the network end (ATU-C) equipment as defined in the relevant ITU G992 series Recommendations is used to transmit in the reverse direction, that is towards the network.

- 1.10.2 The operation of any of the Spectrally Asymmetric systems listed in Table A-1 in reverse mode will cause Unacceptable Interference into a Basis System in contravention of this IMP.

## **1.11 Use of Two System Types on a single MPF**

- 1.11.1 This IMP does not provide any protection from interference between the operation of two types of system that use the same ULLS (i.e. as part of a composite service). This is a design issue for the Service Provider.
- 1.11.2 Where two types of system use the same MPF, the operation of the systems is taken to comply with the obligation in Clause 8.2 in Part 1 of this IMP if the two systems operate only in separate time intervals (e.g. a transmission system and a testing system which only tests when the transmission is off) and each system complies separately with the obligations of Clause 8.2 in Part 1 of this IMP (i.e. with the other turned off).

## APPENDIX A: SUMMARY OF NETWORK DEPLOYMENT CLASSES

Deployment Class	Appendix or Reference document specifying the Deployment Class requirements (Note 1)		Symmetric or Asymmetric & State B DRP (Note 3)	Typical Technology (informative) (Note 5) (Note 6)	Deployment Rules (Note 11)	Reference frequency for class (kHz) (Note 10)
	Network equipment	Customer equipment (Note 2)				
1b	Appendix B		Appendix B	Sym-metric Highest	E1 HDB3	1024
4a	Appendix C	Appendix C	Symmetric Lower	ISDN BR 2B1Q	Unlimited	40
6a	Appendix D1	Appendix D2 PTC 270	Asymmetric Lower	ADSL FD with Reduced NEXT	Unlimited. Pair Separation at the Highest NRP from Deployment Class 1b is required.	160
6e	Appendix E	Appendix D2 PTC 273	Asymmetric Lower	ADSL FD Low Power	Unlimited	160
6g	Appendix F1	Appendix F2 PTC 273	Asymmetric Lower	Reach Extended ADSL2 non overlapped spectrum	MIMINUM deployment limit 28.5 dB (equivalent to 3.0 km 0.4 mm PEFUT) – not to be deployed on shorter loops. Pair Separation at the Highest NRP from Deployment Class 1b is required.	160
6h	Appendix G1	Appendix G2 PTC 273	Asymmetric Lower	ADSL2 or ADSL2+ non overlapped spectrum	Unlimited Pair Separation at the Highest NRP from Deployment Class 1b is required.	160
6i	Appendix H1	Appendix H2 PTC 273	Asymmetric Lower	All Digital Mode ADSL2+ non overlapped spectrum	Unlimited Pair Separation at the Highest NRP from Deployment Class 1b is required.	160
6j	Appendix G1	Appendix G3 PTC 273	Asymmetric Lower	ADSL2 or ADSL2+ non overlapped spectrum with extended upstream bandwidth (Annex M) Mask EU-44	Unlimited Pair Separation from the Highest NRP of Deployment Class 1b is required.	160

Deployment Class	Appendix or Reference document specifying the Deployment Class requirements (Note 1)		Symmetric or Asymmetric & State B DRP (Note 3)	Typical Technology (informative) (Note 5) (Note 6)	Deployment Rules (Note 11)	Reference frequency for class (kHz) (Note 10)
	Network equipment	Customer equipment (Note 2)				
6k	Appendix G1	Appendix G3 PTC 273	Asymmetric Lower	ADSL2 or ADSL2+ non overlapped spectrum with extended upstream bandwidth (Annex M) Mask EU-52	Deployment Limit 36.1 dB (equivalent to 3.8 km 0.4 mm PEFUT). Pair Separation from the Highest NRP of Deployment Class 1b is required.	160
6l	Appendix G1	Appendix G3 PTC 273	Asymmetric Lower	ADSL2 or ADSL2+ non overlapped spectrum with extended upstream bandwidth (Annex M) Mask EU-56	Deployment Limit 33.3 dB (equivalent to 3.5 km 0.4 mm PEFUT). Pair Separation from the Highest NRP of Deployment Class 1b is required.	160
6m	Appendix G1	Appendix G3 PTC 273	Asymmetric Lower	ADSL2 or ADSL2+ non overlapped spectrum with extended upstream bandwidth (Annex M) Mask EU-60	Deployment Limit 29.5 dB (equivalent to 3.1 km 0.4 mm PEFUT). Pair Separation from the Highest NRP of Deployment Class 1b is required.	160
6n	Appendix G1	Appendix G3 PTC 273	Asymmetric Lower	ADSL2 or ADSL2+ non overlapped spectrum with extended upstream bandwidth (Annex M) Mask EU-64	Deployment Limit 24.7 dB (equivalent to 2.6 km 0.4 mm PEFUT). Pair Separation from the Highest NRP of Deployment Class 1b is required.	160
8b	Appendix I	Appendix I	Symmetric Highest	HDSL 2B1Q 1168 kbit/s	Deployment Limit 21.9 dB (equivalent to 2.3 km 0.4 mm PEFUT).	160
9d	Appendix J	Appendix J	Symmetric Highest	SHDSL (192 to 1160 kbit/s)	Deployment Limit 39.9 dB (equivalent to 4.2 km 0.4 mm PEFUT).	160
9e	Appendix J	Appendix J	Symmetric Highest	SHDSL (192 to 1544 kbit/s)	Deployment Limit 30.4 dB (equivalent to 3.2 km 0.4 mm PEFUT).	160
9h	Appendix J	Appendix J	Symmetric Highest	SHDSL (192 to 1800 kbit/s)	Deployment Limit 26.6 dB (equivalent to 2.8 km 0.4 mm PEFUT).	160
9f	Appendix J	Appendix J	Symmetric Highest	SHDSL (192 to 2056 kbit/s)	Deployment Limit 22.8 dB (equivalent to 2.4 km 0.4 mm PEFUT).	160

Deployment Class	Appendix or Reference document specifying the Deployment Class requirements (Note 1)		Symmetric or Asymmetric & State B DRP (Note 3)	Typical Technology (informative) (Note 5) (Note 6)	Deployment Rules (Note 11)	Reference frequency for class (kHz) (Note 10)
	Network equipment	Customer equipment (Note 2)				
9g	Appendix J	Appendix J	Symmetric Highest	SHDSL (192 to 2312 kbit/s)	Deployment Limit 20.9 dB (equivalent to 2.2 km 0.4 mm PEFUT).	160
9i	Appendix K	Appendix K	Symmetric Highest	ESHDSL (192(C-16) to 2624(C-16) kbit/s) or (768(C-32) to 3496(C-32) kbit/s)	Deployment Limit 19.0 dB (equivalent to 2.0 km 0.4 mm PEFUT).	160
9j	Appendix K	Appendix K	Symmetric Highest	ESHDSL (192(C-16) to 2880(C-16) kbit/s) or (768(C-32) to 3840(C-32) kbit/s)	Deployment Limit 18.1 dB (equivalent to 1.9 km 0.4 mm PEFUT).	160
9k	Appendix K	Appendix K	Symmetric Highest	ESHDSL (192(C-16) to 3072(C-16) kbit/s) or (768(C-32) to 4096(C-32) kbit/s)	Deployment Limit 17.1 dB (equivalent to 1.8 km 0.4 mm PEFUT).	160
9l	Appendix K	Appendix K	Symmetric Highest	ESHDSL (192(C-16) to 3264(C-16) kbit/s) or (768(C-32) to 4352(C-32) kbit/s)	Deployment Limit 16.2 dB (equivalent to 1.7 km 0.4 mm PEFUT).	160
9m	Appendix K	Appendix K	Symmetric Highest	ESHDSL (192(C-16) to 3456(C-16) kbit/s) or (768(C-32) to 4608(C-32) kbit/s)	Deployment Limit 15.2 dB (equivalent to 1.6 km 0.4 mm PEFUT).	160
9n	Appendix K	Appendix K	Symmetric Highest	ESHDSL (192(C-16) to 3648(C-16) kbit/s) or (768(C-32) to 4864(C-32) kbit/s)	Deployment Limit 14.3 dB (equivalent to 1.5 km 0.4 mm PIUT).	160
9o	Appendix K	Appendix K	Symmetric Highest	ESHDSL (192(C-16) to 3840(C-16) kbit/s) or (768(C-32) to 5120(C-32) kbit/s)	Deployment Limit 14.3 dB (equivalent to 1.5 km 0.4 mm PEFUT).	160
9p	Appendix K	Appendix K	Symmetric Highest	ESHDSL (768(C-32) to 5376(C-32) kbit/s)	Deployment Limit 14.3 dB (equivalent to 1.5 km 0.4 mm PEFUT).	160

Deployment Class	Appendix or Reference document specifying the Deployment Class requirements (Note 1)		Symmetric or Asymmetric & State B DRP (Note 3)	Typical Technology (informative) (Note 5) (Note 6)	Deployment Rules (Note 11)	Reference frequency for class (kHz) (Note 10)
	Network equipment	Customer equipment (Note 2)				
9q	Appendix K	Appendix K	Symmetric Highest	ESHDSL (768(C-32) to 5696(C-32) kbit/s)	Deployment Limit 13.3 dB (equivalent to 1.4 km 0.4 mm PEFUT).	160

**TABLE A-1**

**Table of Network Deployment Classes**

*NOTE 1: Unless otherwise indicated, the appendices referred to under 'Network Equipment' and 'Customer Equipment' are contained in Part 3 of this IMP.*

*NOTE 2: Deleted*

*NOTE 3: 'Highest' and Lower' refer to the Highest NRP and Nominated Lower NRP respectively.*

*NOTE 4: For Deployment Class Systems the Deployment Reference Point in Deployment State B may be at the Highest NRP (designated Highest) or at the Nominated Lower NRP (designated Lower). Note that for Deployment Class Systems, Spectrally the Lowest Asymmetric System Feed Point is the Deployment Reference Point.*

*NOTE 5: The bit rate upper limits under the column titled "Typical Technology" represent line rates (total payload plus overhead bits carried), except for SHDSL and ESHDSL where they represent payload rates only, without the 8kbps line overhead. For Classes 9a to 9h the SHDSL system maximum payload rates shown are based on 3 bits per symbol (C-16 line-code) as per the default in G.991.2. For these Classes systems that operate at the same symbol rates using the alternative option of 4 bits per symbol (C-32) have maximum payload rates corresponding to the 32-TCPAM column of Table Q 2. Classes 9i to 9o are for ESHDSL systems for which G.991.2 specifies two line-code options (C-16 or C-32). Maximum payload rates are shown for both options for these Classes. Classes 9p and 9q show maximum payload rates for the C-32 line-code only, because G.991.2 specifies no C-16 alternatives for these cases.*

*NOTE 6: SHDSL and ESHDSL system Deployment Class is determined by the Symbol Rate – which may correspond to different system bit-rates depending on whether 16-TCPAM (3 bits per symbol) or 32-TCPAM (4 bits/symbol) coding is being used, as defined in G.991.2 Annex K. Example payload bitrates are denoted with a suffix (C-16) for 16-TCPAM (3 bits/symbol) values, and (C-32) for 32-TCPAM (4 bits/symbol) values. .*

*NOTE 7: Deleted*

*NOTE 8: The typical technology ADSL2 overlapped is not included because of the risk of interference into other systems. A Service Provider may propose it as a Non-Deployment Class System.*

*NOTE 9: If a Service Provider is intending to deploy a Rate Adaptive system, the service qualification for that technology must be performed at the maximum line rate of the system.*

*NOTE 10: The Reference Frequency is always 160Khz unless otherwise stated*

*NOTE 11: As per clause 2.8.5, where Pair Separation is required this is located at the Lowest NRP.*

## APPENDIX B: DEPLOYMENT CLASS 1b

Table B-1 provides the test criteria and referenced documents for Deployment Class 1b. The termination impedance for Deployment Class 1b is 120 Ω. A typical technology is E1 HDB3.

**TABLE B-1**

### Test criteria for Deployment Class 1b

Parameter	Sub-parameter	Nominal Requirements	Compliance Requirements
Total aggregate power	Level	Not Available	+14 dBm
	Frequency range	Not Available	0 to 4 MHz
	Averaging time	Not Available	≥ 10 s
PSD mask		Not Available	Table B-2
Line code		Not Available	G.703 Clause 9.1, 9.2, Annex A

*NOTE 1: Because Deployment Class 1b systems are not directly deployable in this IMP, the Compliance PSD Mask is only used for spectral compatibility assessment of the E1 Basis System.*

**TABLE B-2**

### PSD mask for Deployment Class 1b

Frequency (kHz)	PSD (dBm/Hz)
$0 < f \leq 1024$	-44.5
$1024 < f \leq 30000$	$-44.5 - 20 \times \log_{10} (f / 1024)$

## APPENDIX C: DEPLOYMENT CLASS 4a

Table A-11 provides the Nominal and Compliance test criteria and Referenced Documents for Deployment Class 4a. The test termination impedance for Deployment Class 4a is 135 Ω. A typical technology is ISDN BR 2B1Q.

**Table C-1**

**Test criteria and Referenced Documents for  
Deployment class 4a**

Parameter	Sub-parameter	Nominal Requirements	Compliance Requirements
Total aggregate power	Level	14 dBm	ITU-T G.961 Appendix II Clause II.12
	Frequency Range	0 Hz to 160 kHz	ITU-T G.961 Appendix II Clause II.12
	Averaging Time	≥ 10 s	≥ 10 s
PSD Mask		Table C-2	ITU-T G.961 Appendix II Clause II.12.4
Line Code		Not Applicable	ITU-T G.961 Appendix II Clause II.1
Longitudinal balance	Level	55 dB from 281.2 Hz to 40 kHz, with a slope of 20 dB/decade below 281.2 Hz and -20 dB/decade above 40 kHz	ITU-T G.961 Appendix II Clause II.13.3.1
	Frequency range	5 Hz to 1 MHz	ITU-T G.961 Appendix II Clause II.13.3.1
Longitudinal output voltage	Level	-50 dBV in any 4 kHz band	-50 dBV in any 4 kHz band
	Frequency range	As per longitudinal balance	As per longitudinal balance

**Table C-2**

**PSD mask for Deployment class 4a (Nominal PSD)**

Frequency Range, f (kHz)	PSD (dBm/Hz)
$0 < f \leq 25$	-32.5
$25 < f \leq 76$	$-32.5 - 10.35 \times \log_{10}\left(\frac{f}{25}\right)$
$76 < f \leq 79$	$-37.5 - 0.5 \times \left(\frac{f - 76}{3}\right)$
$79 < f \leq 85$	$-38 - 19.6 \times \log_{10}\left(\frac{f - 69}{10}\right)$
$85 < f \leq 100$	$-42 - 4 \times \frac{f - 85}{15}$
$100 < f \leq 115$	$-46 - 7 \times \frac{f - 100}{15}$
$115 < f \leq 120$	-53
$120 < f \leq 225$	$-53 - 55 \times \log_{10}\left(\frac{f}{120}\right)$
$225 < f \leq 635$	$-68 - 70 \times \log_{10}\left(\frac{f}{225}\right)$
$635 < f \leq 30000$	$-143 - 10 \times \log_{10}\left(\frac{(10^3 \times f)^{1.5}}{1.134 \times 10^{13}}\right)$

## APPENDIX D1: DEPLOYMENT CLASS 6a Network Equipment

Table D-1 provides the Nominal and Compliance test criteria and referenced documents for Deployment class 6a Network Equipment. The test termination impedance for Deployment class 6a is 100  $\Omega$ . A typical technology is ADSL FD with reduced NEXT.

**TABLE D-1**

### Test criteria for Deployment Class 6a Network Equipment

Parameter	Sub-parameter	Nominal Requirements	Compliance Requirements
Total aggregate power	Level	19.9 dBm with Power Cutback in accordance with Table D-2	G.992.1 Clause.A.1.2.3.3 and Power Cutback in accordance with G.992.1 Clause 10.4.5.1 and A.3.1
	Frequency Range	25.875 to 1104 kHz	G.992.1 Clause.A.1.2.3.3
	Averaging Time	$\geq 10$ s	$\geq 10$ s
PSD Mask		<b>Table D-3</b> with a flat power cutback in accordance with <b>Table D-2</b> .	G.992.1 Clause A.1.3. Maximum power in the 0 to 4kHz band is relaxed to $-10\text{dBm}_{600\text{ohms}}$
Line Code		Not applicable	G.992.1 Clause 7.7, 7.8 or 7.9, 7.10, 7.11
Longitudinal balance	Level	40dB	G.992.1 Clause A 4.3.1
	Frequency range	30kHz to 1104kHz	G.992.1 Clause A 4.3.1
Longitudinal output voltage	Level	-50dBv in any 4kHz band	-50dBv in any 4kHz band
	Frequency range	As per longitudinal balance	As per longitudinal balance

**TABLE D-2**

**Power Cutback for downstream signal of Classes 6a, 6g ,6h ,6i as a function of loop attenuation at 50 kHz.**

Equivalent km of 0.4 mm PEFUT	Attenuation of loop (dB at 50 kHz)	Minimum Power Cut-back(dB)
< 0.154	< 1.13	12
< 0.290	< 2.13	10
< 0.425	< 3.13	8
< 0.561	< 4.13	6
< 0.696	< 5.13	4
< 0.832	< 6.13	2

**TABLE D-3**

**PSD Mask for Deployment Class 6a.**

Frequency band f (kHz)	PSD	Frequency band f (kHz)
0 < f < 4	-97.5	-10dBm <sub>600</sub> Note 1
4 < f < 80	-96 + 4.63 × log <sub>2</sub> (f / 4)	Not applicable
80 < f < 138	-76 + 36 × log <sub>2</sub> (f / 80)	Not applicable
138 < f < 1 104	-40	Not applicable
1 104 < f < 3093	-40 – 36 × log <sub>2</sub> (f / 1 104)	Not applicable
3093 < f < 4 545	-93.5 peak	Max power in the [f, f + 1 MHz] window of (-36.5 – 36 × log <sub>2</sub> (f / 1 104) + 60) dBm <sub>100</sub> Note 3
4 545 < f < 11 040	-93.5 peak	Max power in the [f, f + 1 MHz] window of -50 dBm <sub>100</sub> Note 3

NOTE 1: The 0 to 4kHz band total power measurement is in 600 Ω.

NOTE 2: Above 25.875 kHz, the peak PSD shall be measured with a 10 kHz resolution bandwidth.

NOTE 3: The power in a 1 MHz sliding window is measured in a 1 MHz bandwidth, starting at the measurement frequency.

## APPENDIX D2: Deployment Class 6a and 6e Customer Equipment

Table D-4 provides the Nominal and Compliance test criteria and Referenced Documents for Deployment classes 6a and 6e Customer Equipment. The test termination impedance for Deployment Classes 6a and 6e is 100  $\Omega$ .

Typical technologies are ADSL FD and ADSL FD with reduced power.

**Table D-4**

**Test criteria for Deployment Class 6a and 6e Customer Equipment**

Parameter		Group A	Group B
Total Average Power	Level	12.5 dBm	G.992.1 Clause A.2.4.3.3 [7]
	Frequency range	25.875 kHz to 138 kHz	G.992.1 Clause A.2.4.3.3 [7]
	Averaging time	$\geq 10$ s	$\geq 10$ s
PSD Mask	–	Table D-5	G.992.1 Clause A.2.4 [5] The maximum power in the 0 to 4 kHz band is to be -65 dBm in place of the -75 dBm (+15 dBm) in G.992.1 [7] (See Note)
Line Code	–	Not applicable	G.992.1 Clauses 8.7, 8.10, 8.11 and either Clause 8.8 or 8.9 [7]
Longitudinal Balance	Level	40 dB	G.992.1 Clause A 4.3.1 [7]
	Frequency Range	30 kHz to 1104 kHz	G.992.1 Clause A 4.3.1 [7]
Longitudinal Output Voltage	Level	-50 dBV in any 4 kHz band	-50 dBV in any 4 kHz band
	Frequency Range	As per longitudinal balance	As per longitudinal balance

*Note: The limit for the maximum power in the 0 to 4 kHz band assumes that the high pass filter is included in CE. If an external splitter or filter is required to meet this requirement, the specification and installation of such a filter is to be detailed in the CE manual.*

**Table D-5**

**PSD mask and testing requirements for  
Deployment Classes 6a and 6e Customer Equipment**

<b>Frequency band f (kHz)</b>	<b>PSD (dBm/Hz) (See Note 2)</b>	<b>Testing Requirements</b>
$0 < f \leq 4$	-97.5	PSD and Wideband power -65 dBm (See Note 1)
$4 < f \leq 25.875$	$-96 + 21.533 \times \log_2(f/4)$	PSD
$25.875 < f \leq 138$	-38	PSD
$138 < f \leq 307$	$-38 + 48.112 \times \log_2(f/138)$	PSD
$307 < f \leq 1221$	-93.5	PSD
$1221 < f \leq 1630$	$-93.5 - 39.587 \times \log_2(f/1221)$	-93.5 dBm/Hz peak and in the [f, f + 1 MHz] window:  $-90 - 48 \times \log_2\left(\frac{f}{1221}\right) + 60$ dBm  (See Note 3)
$1630 < f \leq 11040$	-110	-93.5 dBm/Hz peak and in the [f, f + 1 MHz] window: -50 dBm (See Note 3)
$11040 < f < 30000$	-110	-93.5 dBm/Hz peak

Note 1: The 0 to 4 kHz band total power measurement is in 600 Ω. The limit for the maximum power in the 0 to 4 kHz band assumes that the high pass filter is included in CE. If an external splitter or filter is required to meet this requirement, the specification and installation of such a filter is to be detailed in the CE manual.

Note 2: Above 25.875 kHz, the peak PSD is measured with a 10 kHz resolution bandwidth.

Note 3: The power in a 1 MHz sliding window is measured in a 1 MHz bandwidth, starting at the measurement frequency.

## APPENDIX E: DEPLOYMENT CLASS 6e Network Equipment

Table E-1 provides the Nominal and Compliance test criteria and Referenced Documents for Deployment class 6e Network Equipment. The test termination impedance for Deployment class 6e is 100  $\Omega$ . A typical technology is ADSL FD with reduced power.

**TABLE E-1**

### Test criteria for Deployment Class 6e Network Equipment

Parameter	Sub-parameter	Nominal Requirements	Compliance Requirements
Total average power	Level	9.9 dBm (has 10dB attenuation)	G.992.1 Clause .A.1.2.3.3 reduced by 10dB
	Frequency range	25.875 to 1104 kHz	G.992.1 Clause .A.1.2.3.3
	Averaging time	$\geq 10$ s	$\geq 10$ s
PSD mask		<b>Table E-2</b>	G.992.1 Clause . A.1.3 reduced by 10 dB Maximum power in the 0 to 4kHz band is relaxed to -10dBm <sub>600ohms</sub>
Line code		Not applicable	G.992.1 Clause 7.7, 7.8 or 7.9, 7.10, 7.11
Longitudinal balance	Level	40dB	G.992.1 Clause A 4.3.1
	Frequency range	30kHz to 1104kHz	G.992.1 Clause A 4.3.1
Longitudinal output voltage	Level	-50 dBV in any 4 kHz band	-50dBV in any 4 kHz band
	Frequency range	As per longitudinal balance	As per longitudinal balance

TABLE E-2

### PSD mask for Deployment Class 6e Network Equipment

Frequency band $f$ (kHz)	PSD (dBm/Hz) Note 2	Wideband power
$0 < f < 4$	-97.5	-10 dBm <sub>600</sub> Note 1
$4 < f < 100$	$-96 + 4.63 \times \log_2(f/4)$	Not applicable
$100 < f < 138$	$-86 + 36 \times \log_2(f/80)$	Not applicable
$138 < f < 1\ 104$	-50	Not applicable
$1\ 104 < f < 2551$	$-50 - 36 \times \log_2(f/1\ 104)$	Not applicable
$2551 < f < 4\ 545$	-93.5 peak	max power in the $[f, f + 1\ \text{MHz}]$ window of $(-36.5 - 36 \times \log_2(f/1\ 104) + 60)$ dBm <sub>100</sub> Note 3
$4\ 545 < f < 11\ 040$	-93.5 peak	max power in the $[f, f + 1\ \text{MHz}]$ window of -50 dBm <sub>100</sub> Note 3
$11\ 040 < f < 12\ 040$	-93.5 peak	Not applicable

Note 1: The 0 to 4 kHz band total power measurement is in 600  $\Omega$

Note 2: Above 25.875 kHz, the peak PSD shall be measured with a 10 kHz resolution bandwidth.

Note 3: The power in a 1 MHz sliding window is measured in a 1 MHz bandwidth, starting at the measurement frequency.

## APPENDIX F1: DEPLOYMENT CLASS 6g Network Equipment

Table F-1 provides the Nominal and Compliance test criteria and referenced documents for Deployment Class 6g network systems. The termination impedance for Deployment Class 6g is 100  $\Omega$ . A typical technology is Reach Extended ADSL2.

**TABLE F-1**

### Test criteria for Deployment Class 6g Network Equipment

Parameter	Sub-parameter	Nominal Requirements	Compliance Requirements
Total average power	Level	19.9 dBm with Power Cutback in accordance with Table D-2.	G.992.3 Clause.L.1.3.2 and Power Cutback in accordance with G.992.1 Clause 10.4.5.1 and A.3.1
	Frequency range	138 to 552 kHz	G.992.3 Clause.L.1.3
	Averaging time	$\geq 10$ s	$\geq 10$ s
PSD mask		Table F-2	G.992.3 Clause L.1.3. Maximum power in the 0 to 4kHz band is relaxed to -10dBm <sub>600ohms</sub>
Line code		Not applicable	G.992.3 Clause 8.6.
Longitudinal balance	Level	40dB	G.992.3 Clause A 4.3.3.1
	Frequency range	30kHz to 1104kHz	G.992.3 Clause A 4.3.3.1
Longitudinal output voltage	Level	-50dBv in any 4kHz band	-50dBv in any 4kHz band
	Frequency range	As per longitudinal balance	As per longitudinal balance

TABLE F-2

## PSD mask for Deployment Class 6g

Frequency band f (kHz)	PSD (dBm/Hz) Note 2	Wideband power
$0 < f < 4$	-97.5	-10 dBm <sub>600</sub> Note 1
$4 < f < 80$	$-96 + 4.63 \times \log_2 ( f / 4 )$	Not applicable
$80 < f < 138$	$-76 + 36 \times \log_2 ( f / 80 )$	Not applicable
$138 < f \leq 276$	$-40 + 0.0214 \times ( f - 138 )$	Not applicable
$276 < f \leq 552$	-37	Not applicable
$552 < f \leq 1012$	$-37 - 36 \times \log_2 ( f / 552 )$	Not applicable
$1012 < f \leq 1800$	-68.5	Not applicable
$1800 < f \leq 2290$	$-68.5 - 72 \times \log_2 ( f / 1800 )$	Not applicable
$2290 < f \leq 3093$	-93.5 peak	Not applicable
$3093 < f \leq 4\,545$	-93.5 peak	Max power in the [f, f + 1 MHz] window of $(-36.5 - 36 \times \log_2 ( f / 1\,104 ) + 60)$ dBm <sub>100</sub> (Note 3)
$4\,545 < f < 11\,040$	-93.5 peak	Max power in the [f, f + 1 MHz] window of -50 dBm <sub>100</sub> (Note 3)
$11\,040 < f < 12\,000$	-93.5 peak	Not applicable

Note 1: The 0 to 4 kHz band total power measurement is in 600 Ω.

Note 2: Above 25.875 kHz, the peak PSD shall be measured with a 10 kHz resolution bandwidth.

Note 3: The power in a 1 MHz sliding window is measured in a 1 MHz bandwidth, starting at the measurement frequency

## APPENDIX F2: DEPLOYMENT CLASS 6g Customer Equipment

Table F-3 provides the Nominal and Compliance test criteria and referenced documents for Deployment Class 6g customer equipment. The termination impedance for Deployment Class 6g is 100  $\Omega$ . A typical technology is Reach Extended ADSL2.

**TABLE F-3**

### Test criteria and Reference Documents for Deployment class 6g Customer Equipment

Parameter	Sub-parameter	Nominal Requirements	Compliance Requirements
Total average power	Level	12.5 dBm	G.992.3 Clause.L.2.2.2 [8]
	Frequency range	25.875 kHz to 103.5 kHz	G.992.3 Clause.L.2.2 [8]
	Averaging time	$\geq 10$ s	$\geq 10$ s
PSD mask		Table F-4	G.992.3 mask 1 Clause L.2.2.[8]
Line code		Not applicable	G.992.3 Clause 8.8 [8].
Longitudinal balance	Level	40dB	G.992.3 Clause A 4.3.3.1 [8]
	Frequency range	30kHz to 1104kHz	G.992.3 Clause A 4.3.3.1 [8]
Longitudinal output voltage	Level	-50dBV in any 4kHz band	-50dBV in any 4kHz band
	Frequency range	As per longitudinal balance	As per longitudinal balance

**TABLE F-4**

**PSD mask and testing requirements for  
Deployment Class 6g Customer Equipment**

Frequency band f (kHz)	PSD (dBm/Hz) Note 2	Testing requirements
$0 < f \leq 4.0$	-101.5	PSD. Also wideband power < -65 dBm (See Note 1)
$4 < f \leq 25.875$	$-96 + 22.127 \times \log_2\left(\frac{f}{4}\right)$	PSD
$25.875 < f \leq 103.5$	-36.4	PSD
$103.5 < f \leq 400.9$	$\begin{aligned} & -36.4 - 72 \times \log_2\left(\frac{f}{103.5}\right) \\ \text{Max}\{ & 10 \times \log_{10}\left[0.05683 \times (1000f)^{-1.5}\right] - 3.5 \} \end{aligned}$	PSD
$400.9 < f \leq 1411$	-100	PSD
$1411 < f \leq 1630$	$-100 - 48.041 \times \log_2\left(\frac{f}{1411}\right)$	-100 dBm/Hz peak and in the [f, f + 1 MHz] window:  $-40 - 48 \times \log_2\left(\frac{f}{1411}\right)$ dBm  (See Note 2)
$1630 < f \leq 5275$	$-110 - 1.1804 \times \log_2\left(\frac{f}{1630}\right)$	-100 dBm/Hz peak and  $-50 - 1.18 \times \log_2\left(\frac{f}{1630}\right)$ dBm in the [f, f + 1 MHz] window:  (See Note 2)
$5275 < f \leq 30000$	-112	-100 dBm/Hz peak and in the [f, f + 1 MHz] window:  -52 dBm (See Note 2)

*Note 1: The 0 to 4 kHz band total power measurement is in 600  $\Omega$ . The limit for the maximum power in the 0 to 4 kHz band assumes that the high pass filter is included in CE. If an external splitter or filter is required to meet this requirement, the specification and installation of such a filter is to be detailed in the CE manual.*

*Note 2: The power in a 1MHz sliding window is measured in a 1 MHz bandwidth, starting at the measurement frequency.*

## APPENDIX G1: DEPLOYMENT CLASSES 6h, 6j to 6n Network Equipment

Table G-1 provides the Nominal and Compliance test criteria and referenced documents for Deployment Classes 6h, 6j, 6k, 6l, 6m and 6n network systems. The termination impedance for Deployment Classes 6h, 6j, 6k, 6l, 6m and 6n is 100  $\Omega$ . A typical technology for Deployment Class 6h is ADSL2 or ADSL2+ non overlapped spectrum. A typical technology for Deployment Classes 6j to 6n is ADSL2 or ADSL2+ non overlapped spectrum with extended upstream bandwidth (also known as Annex M to ADSL2/2+).

**TABLE G-1**

**Test criteria and Reference Documents for Deployment Classes 6h, 6j to 6n Network Equipment**

Parameter	Sub-parameter	Nominal Requirements	Compliance Requirements
Total average power	Level	19.9 dBm with power cutback in accordance with Table D-2	G.992.5 Clause A.1.3.2 and power cutback in accordance with G.992.1 Clauses 10.4.5.1 and A.3.1
	Frequency range	25.875 to 2208 kHz	G.992.5 Clause.A.1.3
	Averaging time	$\geq 10$ s	$\geq 10$ s
PSD mask		Table G-2 with a flat power cutback in accordance with Table D-2	G.992.5 Clause. A.1.3 Maximum power in the 0 to 4kHz band is relaxed to -10dBm/600 $\Omega$
Line code		Not applicable	G.992.5 Clauses 7 & 8
Longitudinal balance	Level	40dB	G.992.5 Clause A 4 and G.992.3 Clause A 4.3.3.1
	Frequency range	30kHz to 2208kHz	G.992.5 Clause A 4
Longitudinal output voltage	Level	-50 dBV in any 4 kHz band	-50 dBV in any 4 kHz band
	Frequency range	As per longitudinal balance	As per longitudinal balance

**TABLE G-2**

**PSD mask and Testing Requirements for Deployment Classes 6h, 6j to 6n (Nominal Requirements)**

Frequency band <i>f</i> (kHz)	PSD (dBm/Hz in Narrow Resolution Bandwidth) Note 1	Testing Requirements
$0 < f \leq 4$	- 101	PSD
$4 < f \leq 80$	$- 96 + 4.6276 \times \log_2 ( f / 4 )$	PSD
$80 < f \leq 138$	$- 76 + 35.978 \times \log_2 ( f / 80 )$	PSD
$138 < f \leq 1104$	- 40	PSD
$1104 < f \leq 1622$	$- 40 - 18.017 \times \log_2 ( f / 1104 )$	PSD
$1622 < f \leq 2208$	$- 50 - 2.9216 \times \log_2 ( f / 1622 )$	PSD
$2208 < f \leq 2500$	$- 51.3 - 64.737 \times \log_2 ( f / 2208 )$	PSD
$2500 < f \leq 3001.5$	$- 62.9 - 78.103 \times \log_2 ( f / 2500 )$	PSD
$3001.5 < f \leq 3175$	$- 83.5 - 203.52 \times \log_2 ( f / 3001.5 )$	PSD
$3175 < f < 3750$	-100	PSD
$3750 < f \leq 4\ 545$	$- 100 - 36.018 \times \log_2 ( f / 3750 )$	-100 dBm/Hz peak and Max power in the [f, f + 1 MHz] window of $- 40 - 36 \times \log_2 ( f / 3750 )$ ) dBm <sub>100</sub> Note 3
$4\ 545 < f \leq 7225$	$-110 - 2.9908 \times \log_2 ( f / 4545 )$	-100 dBm/Hz peak and Max power in the [f, f + 1 MHz] window of $-110 - 3 \times \log_2 ( f / 4545 )$ dBm <sub>100</sub> Note 3
$7225 < f \leq 30000$	-112	-100 dBm/Hz peak and Max power in the [f, f + 1 MHz] window of -112 dBm <sub>100</sub> Note 3

*NOTE 1: Below 25.875 kHz the peak PSD shall be measured with a 100 Hz resolution bandwidth. Above 25.875 kHz the peak PSD shall be measured with a 10 kHz resolution bandwidth.*

## APPENDIX G2: DEPLOYMENT CLASS 6h Customer Equipment

Table G-31 provides the Nominal and Compliance test criteria and referenced documents for Deployment Class 6h customer equipment. The termination impedance for Deployment class 6h is 100  $\Omega$ .

Typical technology is ADSL2 non-overlapped spectrum or ADSL2+ non-overlapped spectrum.

**Table G-3**

**Test criteria and Reference Documents for Deployment Class 6h Customer Equipment**

Parameter	Sub-parameter	Nominal Requirements	Compliance Requirements
Total average power	Level	12.5 dBm.	G.992.5 Clause A.2.2.2 [9]
	Frequency range	25.875 to 138 kHz	G.992.5 Clause A.2.2 [9]
	Averaging time	$\geq 10$ s	$\geq 10$ s
PSD mask		Table G-4	G.992.5 Clause. A.2.2 [9] Maximum power in the 0 to 4kHz band is relaxed to <b>-65dBm</b> <sub>600</sub>
Line code		Not applicable	G.992.5 Clauses 7 & 8 [9]
Longitudinal balance	Level	40dB	G.992.5 Clause A 4 [9] and G.992.3 Clause A 4.3.3.1 [8]
	Frequency range	30kHz to 2208kHz	G.992.5 Clause A 4 [9]
Longitudinal output voltage	Level	-50 dBV in any 4 kHz band	-50 dBV in any 4 kHz band
	Frequency range	As per longitudinal balance	As per longitudinal balance

Table G-4

**PSD mask and testing requirements for Deployment Class 6h Customer Equipment**

Frequency band f (kHz)	PSD (dBm/Hz in Narrow Resolution Bandwidth) Note 1	Testing requirements
$0 < f \leq 4$	- 101	PSD
$4 < f \leq 25.875$	$- 96 + 21.533 \times \log_2 ( f / 4 )$	PSD
$25.875 < f \leq 138$	- 38	PSD
$138 < f \leq 229.6$	$- 38 - 74.749 \times \log_2 ( f / 138 )$	PSD
$229.6 < f \leq 686$	$- 92.9 - 4.4963 \times \log_2( f / 229.6 )$	PSD
$686 < f \leq 1411$	- 100	PSD
$1411 < f \leq 1630$	$- 100 - 48.041 \times \log_2( f / 1411 )$	-100 dBm/Hz peak and in the [f, f + 1 MHz] window: - 40 - 48 × log <sub>2</sub> ( f / 1411 ) dBm
$1630 < f \leq 5275$	$- 110 - 1.1804 \times \log_2( f / 1630 )$	-100 dBm/Hz peak and in the [f, f + 1 MHz] window: - 50 - 1.18 × log <sub>2</sub> ( f / 1630 ) dBm
$5275 < f \leq 30000$	-112	-100 dBm/Hz peak and in the [f, f + 1 MHz] window: -52 dBm

Note 1: Below 25.875 kHz the peak PSD shall be measured with a 100 Hz resolution bandwidth. Above 25.875 kHz the peak PSD shall be measured with a 10 kHz resolution bandwidth.

## APPENDIX G3: Deployment Class 6j to 6n Customer Equipment

Table G-5 provides the Nominal and Compliance test criteria and referenced documents for Deployment Class 6j, 6k, 6l, 6m and 6n customer equipment. The termination impedance for Deployment Classes 6j to 6n is 100  $\Omega$ .

Typical technologies are the transmission masks EU-44, EU-52, EU-56, EU-60 and EU-64, providing extended ADSL upstream bandwidth in Annex M for ADSL2 or ADSL2+.

**Table G-5**

### Test criteria and Reference Documents for Deployment Classes 6j to 6n customer equipment

Parameter	Sub-parameter	Nominal Requirements	Compliance Requirements
Total average power	Level	12.5 dBm	G.992.5 Clause M.2.2.2 [9]
	Frequency range	see Table <b>G-6</b>	G.992.5 Clause M.2.2 [9]
	Averaging time	$\geq 10$ s	$\geq 10$ s
PSD mask		Table <b>G-7</b> and Table <b>G-8</b>	G.992.5 Clause. M.2.2.1 [9] Maximum power in the 0 to 4kHz band is relaxed to -65dBm <sub>600</sub> □
Line code		Not applicable	G.992.5 Clauses 7 & 8 [9]
Longitudinal balance	Level	40dB	G.992.5 Clause A 4 [9] and G.992.3 Clause A 4.3.3.1 [8]
	Frequency range	30kHz to 2208kHz	G.992.5 Clause A 4 [9]
Longitudinal output voltage	Level	-50 dBV in any 4 kHz band	-50 dBV in any 4 kHz band
	Frequency range	As per longitudinal balance	As per longitudinal balance

**Table G-6**

**Total Average Power frequency ranges for Deployment Class 6j to 6n Customer Equipment**

<b>Deployment class</b>	<b>Frequency Range for Total Average Power (kHz)</b>
6j	25.875 to 172.50 kHz
6k	25.875 to 224.25 kHz
6l	25.875 to 241.50 kHz
6m	25.875 to 258.75 kHz
6n	25.875 to 276.00 kHz

**Table G-7**

**Nominal PSD mask and testing requirements for Deployment Class 6j to 6n Customer Equipment**

Frequency band f (kHz)	PSD (dBm/Hz in Narrow Resolution Bandwidth) Note 1	Testing requirements
$0 < f \leq 4$	- 101	PSD
$4 < f \leq 25.875$	$- 96 + s1 \times \log_2 ( f / 4 )$	PSD
$25.875 < f \leq f1$	Nominal_PSD	PSD
$f1 < f \leq f1\_int\_templ$	$Nominal\_PSD - s2 \times \log_2 ( f / f1 )$	PSD
$f1\_int\_templ < f \leq 686$	$PSD\_int\_templ - s3 \times \log_2( f / f1\_int\_templ )$	PSD
$686 < f \leq 1411$	- 100	PSD
$1411 < f \leq 1630$	$- 100 - 48 .041 \times \log_2( f / 1411 )$	-100 dBm/Hz peak and in the [f, f+1 MHz] window: - $40 - 48 \times \log_2( f / 1411 )$ dBm
$1630 < f \leq 5275$	$- 110 - 1.1804 \times \log_2( f / 1630 )$	-100 dBm/Hz peak and in the [f, f+1 MHz] window: - $50 - 1.18 \times \log_2( f / 1630 )$ dBm
$5275 < f \leq 30000$	-112	-100 dBm/Hz peak and in the [f, f+1 MHz] window: -52 dBm

Note 1: Below 25.875 kHz the peak PSD shall be measured with a 100 Hz resolution bandwidth. Above 25.875 kHz the peak PSD shall be measured with a 10 kHz resolution bandwidth.

Note 2:  $f1$ ,  $f1\_int\_templ$ ,  $Nominal\_PSD$ ,  $PSD\_int\_templ$ ,  $s1$ ,  $s2$  and  $s3$  are given in Table G-8.

**Table G-8**

**Nominal PSD Template Parameters for Deployment Classes 6j to 6n Customer Equipment**

Deployment Class	Nominal Designator	f1	Slope s1 (Note 1)	Template Peak PSD level Nominal_PSD (dBm/Hz)	Template intercept frequency f1_int_templ (kHz)	Slope s2 (note 1)	Template intercept PSD level PSD_int_templ (dBm/Hz)	Slope s3 (Note 1)
6j	EU-44	174.5	21.1622	-39.0	294.39	71.9721	-94.5	4.5064
6k	EU-52	224.25	20.7538	-40.1	384.95	71.9634	-96.2	4.5589
6l	EU-56	241.5	20.6424	-40.4	415.25	71.9988	-96.7	4.5566
6m	EU-60	258.75	20.5310	-40.7	445.59	72.0518	-97.2	4.4981
6n	EU-64	276	20.4196	-41.0	475.99	71.9861	-97.6	4.5517

Note 1: The breakpoint frequencies and PSD values are exact. The breakpoints in the tables shall be connected by linear straight lines on a dB/log(f) plot

## APPENDIX H1: DEPLOYMENT CLASS 6i Network Equipment

Table H-1 provides the Nominal and Compliance test criteria and referenced documents for Deployment Class 6i network systems. The termination impedance for Deployment Class 6i is 100  $\Omega$ . A typical technology is All digital Mode ADSL2+.

**TABLE H-1**

### Test criteria and Reference Documents for Deployment Class 6i

Parameter	Sub-parameter	Nominal Requirements	Compliance Requirements
Total average power	Level	19.9 dBm	G.992.5 Clauses I.1.3 and A.1.3.2.
	Frequency range	138 to 2208 kHz	G.992.5 Clause.I.1.3
	Averaging time	$\geq 10$ s	$\geq 10$ s
PSD mask		Table H-2	G.992.5 Clauses I.1.3 and A.1.3
Line code		Not applicable	G.992.5 Clause 8.8.
Longitudinal balance	Level	40dB	G.992.5 Clause A.4 and G.992.3 Clause A 4.3.3.1
	Frequency range	30kHz to 2208kHz	G.992.5 Clause A 4
Longitudinal output voltage	Level	-50dBv in any 4kHz band	-50dBv in any 4kHz band
	Frequency range	As per longitudinal balance	As per longitudinal balance

**TABLE H-2**

**Nominal PSD mask and Testing Requirements for Deployment Class 6i**

Frequency band <i>f</i> (kHz)	PSD (dBm/Hz in Narrow Resolution Bandwidth) Note 1	Testing Requirements
$0 < f \leq 4$	-97.5	PSD
$4 < f \leq 80$	$-96 + 4.6276 \times \log_2 ( f / 4 )$	PSD
$80 < f \leq 138$	$-76 + 35.978 \times \log_2 ( f / 80 )$	PSD
$138 < f \leq 1104$	-40	PSD
$1104 < f \leq 1622$	$-40 - 18.017 \times \log_2( f / 1104 )$	PSD
$1622 < f \leq 2208$	$-50 - 2.9216 \times \log_2( f / 1622 )$	PSD
$2208 < f \leq 2500$	$-51.3 - 64.737 \times \log_2( f / 2208 )$	PSD
$2500 < f \leq 3001.5$	$-62.9 - 78.103 \times \log_2( f / 2500 )$	PSD
$3001.5 < f \leq 3175$	$-83.5 - 203.52 \times \log_2( f / 3001.5 )$	PSD
$3175 < f < 3750$	-100	PSD
$3750 < f \leq 4\ 545$	$-100 - 36.018 \times \log_2( f / 3750 )$	-100 dBm/Hz peak and Max power in the [f, f + 1 MHz] window of $-40 - 36 \times \log_2( f / 3750 )$ dBm <sub>100</sub> Note 3
$4\ 545 < f \leq 7225$	$-110 - 2.9908 \times \log_2( f / 4545 )$	-100 dBm/Hz peak and Max power in the [f, f + 1 MHz] window of $-50 - 3 \times \log_2( f / 4545 )$ dBm <sub>100</sub> Note 3
$7225 < f < 30000$	-112	-100 dBm/Hz peak and Max power in the [f, f + 1 MHz] window of -52 dBm <sub>100</sub> Note 3

*NOTE 1: Below 25.875 kHz the peak PSD shall be measured with a 100 Hz resolution bandwidth. Above 25.875 kHz the peak PSD shall be measured with a 10 kHz resolution bandwidth.*

## APPENDIX H2: Deployment Class 6i Customer Equipment

Table H-3 provides the Nominal and Compliance test criteria and referenced documents for Deployment Class 6i. The termination impedance for Deployment class 6i is 100  $\Omega$ . A typical technology is All Digital Mode ADSL2+ non overlapped spectrum.

**Table H-3**

### Test criteria and Reference Documents for Deployment Class 6i Customer Equipment

Parameter	Sub-parameter	Nominal Requirements	Compliance Requirements
Total average power	Level	13.3 dBm	G.992.5 Clause 1.2.2.2 [9]
	Frequency range	3 kHz to 138 kHz	G.992.5 Clause 1.2.2 [9]
	Averaging time	$\geq 10$ s	$\geq 10$ s
PSD mask		Table H-4	G.992.5 Clauses 1.2.2 [9]
Line code		Not applicable	G.992.5 Clause 8.8 and 8.9 [9]
Longitudinal balance	Level	40dB	G.992.3 Clause A 4.3.3.1 [8]
	Frequency range	30kHz to 2208kHz	G.992.5 Clause A 1.4 [9]
Longitudinal output voltage	Level	-50dBV in any 4kHz band	-50dBV in any 4kHz band
	Frequency range	As per longitudinal balance	As per longitudinal balance

Table H-4

Nominal PSD mask and testing requirements for Deployment Class 6i Customer Equipment

Frequency band f (kHz)	PSD (dBm/Hz in Narrow Resolution Bandwidth) Note 1	Testing requirements
$0 < f \leq 1.5$	-50	PSD
$1.5 < f \leq 3$	$-50 + 12 \times \log_2\left(\frac{f}{1.5}\right)$	PSD
$3 < f \leq 138$	-38	PSD
$138 < f \leq 229.6$	$-38 - 74.749 \times \log_2\left(\frac{f}{138}\right)$	PSD
$229.6 < f \leq 686$	$-92.9 - 4.4963 \times \log_2\left(\frac{f}{229.6}\right)$	PSD
$686 < f \leq 1411$	-100	PSD
$1411 < f \leq 1630$	$-100 - 48.041 \times \log_2\left(\frac{f}{1411}\right)$	-100 dBm/Hz peak and in the [f, f + 1 MHz] window: $-40 - 48 \times \log_2\left(\frac{f}{1411}\right)$ dBm (See Note 2)
$1630 < f \leq 5275$	$-110 - 1.1804 \times \log_2\left(\frac{f}{1630}\right)$	-100 dBm/Hz peak and in the [f, f + 1 MHz] window: $-50 - 1.18 \times \log_2\left(\frac{f}{1630}\right)$ dBm (See Note 2)
$5275 < f \leq 30000$	-112	-100 dBm/Hz peak and in the [f, f + 1 MHz] window: -52 dBm (See Note 2)

Note 1: The 0 to 4 kHz band total power measurement is in 600 Ω. The limit for the maximum power in the 0 to 4 kHz band assumes that the high pass filter is included in CE. If an external splitter or filter is required to meet this requirement, the specification and installation of such a filter is to be detailed in the CE manual.

Note 2: The power in a 1MHz sliding window is measured in a 1 MHz bandwidth, starting at the measurement frequency.

## APPENDIX I: Deployment Class 8b

Table I-1 provides the Nominal and Compliance test criteria and referenced documents for Deployment Class 8b. The test termination impedance for Deployment class 8b is 135  $\Omega$ .

*Note: Telecom to reference appropriate table entries to T1.418-2000 if required*

A typical technology is HDSL 2B1Q (1168 kbit/s).

**Table I-1**

### Test criteria and Referenced Documents for Deployment class 8b

Parameter		Nominal Requirements	Compliance Requirements
Total Average Power	Level	14 dBm	G.991.1 Clause 5.8.4.4 [5]
	Frequency range	0 Hz to 584 kHz	G.991.1 Clause 5.8.4.4 [5]
	Averaging time	$\geq 10$ s	$\geq 10$ s
PSD Mask	–	Table I-2	G.991.1 Clause 5.8.4.3.2 [5] to 12040 kHz
Line Code	–	Not applicable	G.991.1 Clause 5.3.6 [5]
Longitudinal Balance	Level	40 dB from 20 kHz to 292 kHz, with a slope of 20 dB/decade below 20 kHz and -20 dB/decade above 292 kHz	G.991.1 Clause 5.8.5.1 [5]
	Frequency Range	500 Hz to 1168 kHz	G.991.1 Clause 5.8.5.1 [5]
Longitudinal Output Voltage	Level	-50 dBV in any 4 kHz band	G.991.1 Clause 5.8.5.2 [5]
	Frequency Range	As per longitudinal balance	G.991.1 Clause 5.8.5.2 [5]

**Table I-2**

**Nominal PSD mask for Deployment Class 8b**

Frequency f (kHz)	PSD (dBm/Hz)
0	-38.7
74	-38.7
186	-39.7
313	-42.7
462	-58.7
551	-74.7
819	-76.7
998	-86.7
1117	-98.7
1460	-99.7
1585	-105.5
$1585 < f \leq 30000$	$-143 - 10 \times \log_{10} \left( \frac{(10^3 \times f)^{1.5}}{1.134 \times 10^{13}} \right)$

Note: The values between the specified points are derived by linear interpolation of frequency and PSD limit in dBm/Hz.

## APPENDIX J: Deployment Classes 9c to 9h

Table J-1 provides the Nominal and Compliance test criteria and reference documents for Deployment Classes 9c, 9d, 9e, 9f, 9g and 9h. The test termination impedance for Deployment Class 9 is 135  $\Omega$ .

A typical technology is SHDSL for the 16-TCPAM rates up to 2312 kbps and eSHDSL for the 32-TCPAM rates up to 3080 kbps.

**Table J-1**

### Test criteria and Reference Documents for Deployment classes 9c to 9h

Parameter	Sub-parameter	Nominal Requirement	Compliance Requirement
Total average power	Level	see Table J-2.	see Table J-2.
	Frequency range	0 Hz to 1.5 MHz	0 Hz to 1.5 MHz
	Averaging time	$\geq 10$ s	$\geq 10$ s
PSD mask		Table J-3 for 16-TCPAM Table K-3 for 32-TCPAM.	G.991.2 Clause B4.1 [6] (Table J-4 lists the testing requirements)
Line code		Not applicable	Trellis Coded Pulse Amplitude Modulation
Longitudinal balance	Level	40 dB from 20 kHz to $f_{\text{sym}}/2$ kHz, with a slope of 20 dB/decade below 20 kHz and -20dB/decade above $f_{\text{sym}}/2$ .	40 dB from 20 kHz to $f_{\text{sym}}/2$ kHz, with a slope of 20 dB/decade below 20 kHz and -20 dB/decade above $f_{\text{sym}}/2$ kHz. Note: $f_{\text{sym}}$ is the symbol rate or baud rate on the line.
	Frequency Range	20 kHz to 2000 kHz	20 kHz to 2000 kHz
Longitudinal output voltage	Level	-50 dBV in any 4 kHz band	-50 dBV in any 4 kHz band
	Frequency Range	20 kHz to 450 kHz	20 kHz to 450 kHz

**Table J-2**

**List of Parameters for Deployment Classes 9a to 9h**

<b>Class</b>	<b><math>f_{sym}</math> (k symbols/sec)</b>	<b>Power (dBm)</b>	<b>K</b>	<b>16-TCPAM Payload Rate (kbps)</b>	<b>32-TCPAM Payload Rate (kbps) see Note 1</b>
9c	$66.6 < f_{sym} < 261.4$	14.0	7.86	$192 \leq PR \leq 776$	$768 \leq PR \leq 1032$
9d	$66.6 < f_{sym} < 389.4$	14.0	7.86	$192 \leq PR \leq 1160$	$768 \leq PR \leq 1544$
9e	$66.6 < f_{sym} < 517.4$	14.0	7.86	$192 \leq PR \leq 1544$	$768 \leq PR \leq 2056$
9f	$66.6 < f_{sym} < 685.4$	14.0	7.86	$192 \leq PR \leq 2048$	$768 \leq PR \leq 2728$
	$685.4 < f_{sym} \leq 688$	15.0	9.9	$2048 < PR \leq 2056$	$2728 < PR \leq 2744$
9g	$66.6 < f_{sym} < 685.4$	14.0	7.86	$192 \leq PR \leq 2048$	$768 \leq PR \leq 2728$
	$685.4 < f_{sym} < 773.4$	15.0	9.9	$2048 < PR \leq 2312$	$2728 < PR \leq 3080$
9h	$66.6 < f_{sym} < 602.6$	14.0	7.86	$192 \leq PR \leq 1800$	$768 \leq PR \leq 2400$

Note 1: For Nominal testing requirements for equipment using 32-TCPAM line code refer to Table K-3.

**Table J-3**

**Nominal PSD mask and testing requirements for Deployment Classes 9a to 9h using 16-TCPAM**

Frequency	PSDMASK (f) in dBm/Hz	Testing Requirements
$f < f_{\text{int}}$	$10 \times \log_{10} \left[ \frac{K}{135} \times \frac{1}{f_{\text{sym}}} \times \frac{\left[ \sin \left( \frac{\partial f}{N f_{\text{sym}}} \right) \right]^2}{\left( \frac{\partial f}{N f_{\text{sym}}} \right)^2} \times \frac{1}{1 + \left( \frac{f}{f_{3\text{dB}}} \right)^{2 \times \text{Order}}} \right]$	PSD
$f_{\text{int}} \leq f \leq 1500 \text{ kHz}$	$10 \times \log_{10} \left[ 1.7971 \times 10^{-6} \times f^{-1.5} \right]$	PSD
$1500 \text{ kHz} < f \leq 11040 \text{ kHz}$	-110	-90 dBm/Hz peak; and Maximum power in the [f, f + 1 MHz] window of -50 dBm
$11040 \text{ kHz} < f \leq 30000 \text{ kHz}$	-110	-90 dBm/Hz peak

where:

K and  $f_{\text{sym}}$  are defined in Table J-2      Order = 6       $f_{3\text{dB}} = f_{\text{sym}}/2$       PSDMASK(f) is in dBm/Hz      f is in kHz.

$f_{\text{int}}$  is the frequency where the two equations governing PSDMASK(f) intersect, in kHz.

For each data rate at which the equipment can operate,  $f_{\text{sym}}$  shall not exceed the PSDMASK generated by choosing a value of  $f_{\text{sym}}$  which need not be related to the actual CE parameters but may be any value in the range listed in Table J-2 for the relevant Deployment Class. Because the Nominal requirement permits such wide freedom to choose any  $f_{\text{sym}}$  value in the prescribed range, a party submitting equipment for test under the Nominal requirements should provide to the test laboratory a detailed list of operating modes and corresponding  $f_{\text{sym}}$  values to use in generating the compliance masks.

The PSD shall be measured with a resolution bandwidth less than or equal to 10kHz. Large PSD variations over narrow frequency intervals (for example near the junction of the main lobe with the noise floor) might require a smaller resolution bandwidth (RBW) to be used. An appropriate way would be to choose RBW such that there is no more than 1 dB change in the signal PSD across the RBW.

The power in the 1 MHz sliding window is measured in a 1 MHz bandwidth, starting at the measurement frequency.

Table J-4

Compliance PSD mask and testing requirements for Deployment Classes 9a to 9h using 16-TCPAM

$$\text{PSDMASK}(f) = 10 \times \log_{10} \left\{ \begin{array}{l} \frac{K}{135} \times \frac{1}{f_{\text{sym}}} \times \frac{\left[ \sin\left(\frac{\partial f}{Nf_{\text{sym}}}\right) \right]^2}{\left(\frac{\partial f}{Nf_{\text{sym}}}\right)^2} \times \frac{1}{1 + \left(\frac{f}{f_{3\text{dB}}}\right)^{2 \times \text{Order}}} \times 10^{\frac{\text{MaskOffsetdB}(f)}{10}} \quad , \quad f < f_{\text{int}} \\ 1.7971 \times 10^{-6} \times f^{-1.5} \quad , \quad f_{\text{int}} \leq f \leq 1500 \text{ kHz} \end{array} \right.$$

PSDMASK (f) = -90 peak (Max power in the [f, f + 1 MHz] window of -50 dBm) , 1500 kHz < f ≤ 11040 kHz

PSDMASK (f) = -90 peak, 11040 kHz < f ≤ 12040 kHz

where:

$$\text{MaskOffsetdB}(f) = \begin{cases} 1 + 0.4 \times \frac{f_{3\text{dB}} - f}{f_{3\text{dB}}} & , \quad f < f_{3\text{dB}} \\ 1 & , \quad f \geq f_{3\text{dB}} \end{cases}$$

Order = 6

$f_{3\text{dB}} = f_{\text{sym}}/2$

PSDMASK(f) is in dBm/Hz, f is in kHz.

$f_{\text{int}}$  is the frequency where the two equations governing PSDMASK(f) intersect, in kHz.

$f_{\text{sym}} = (\text{payload kbit rate} + \text{overhead kbit rate}) / (\text{number of bits per symbol})$

The 16-TCPAM constellation has 3 bits per symbol while the 32-TCPAM constellation has 4 bits per symbol.

The PSD shall be measured with a resolution bandwidth less than or equal to 10kHz. Large PSD variations over narrow frequency intervals (for example near the junction of the main lobe with the noise floor) might require a smaller resolution bandwidth (RBW) to be used. An appropriate way would be to choose RBW such that there is no more than 1 dB change in the signal PSD across the RBW.

The power in the 1 MHz sliding window is measured in a 1 MHz bandwidth, starting at the measurement frequency.

## APPENDIX K: Deployment Classes 9i to 9q

Table K-1 provides the Nominal and Compliance test criteria and reference documents for Deployment Classes 9i, 9j, 9k, 9l, 9m, 9n, 9o, 9p and 9q. The test termination impedance for Deployment class 9 is 135  $\Omega$ .

A typical technology is ESHDSL.

**Table K-1**

**Test criteria and Reference Documents for Deployment Classes 9i to 9q**

Parameter	Sub-parameter	Nominal Requirements	Compliance Requirements
Total average power	Level	see Table K-2.	see Table K-2.
	Frequency range	0 Hz to 2.0 MHz	0 Hz to 2.0 MHz
	Averaging time	$\geq 10$ s	$\geq 10$ s
PSD mask		Table K-3	Table K-4 For test requirements for 16-TCPAM line code at payload rate(s) $\leq 2312$ kbps refer to Table J-4
Line code		Not applicable	Trellis Coded Pulse Amplitude Modulation
Longitudinal balance	Level	40 dB from 20 kHz to $f_{\text{sym}}/2$ kHz, with a slope of 20 dB/decade below 20 kHz and -20 dB/decade above $f_{\text{sym}}/2$ .	40 dB from 20 kHz to $f_{\text{sym}}/2$ kHz, with a slope of 20 dB/decade below 20 kHz and -20 dB/decade above $f_{\text{sym}}/2$ kHz. Note: $f_{\text{sym}}$ is the symbol rate on the line.
	Frequency Range	20 kHz to 2000 kHz	20 kHz to 2000 kHz
Longitudinal output voltage	Level	-50 dBV in any 4 kHz band	-50 dBV in any 4 kHz band
	Frequency Range	20 kHz to 450 kHz	20 kHz to 450 kHz

**Table K-2**

**List of Parameters for Deployment classes 9i to 9q**

<b>Class</b>	<b>f<sub>sym</sub> (k symbols/sec)</b>	<b>Power (dBm)</b>	<b>KSHDSL</b>	<b>16-TCPAM Payload Rate (kbps) see Note 1</b>	<b>32-TCPAM Payload Rate (kbps) see Note 2</b>
9i	66.6 < f <sub>sym</sub> < 685.4	14.0	7.86	192 ≤ PR ≤ 2048	768 ≤ PR ≤ 2728
	685.4 < f <sub>sym</sub> < 877.3	15.0	9.9	2048 < PR ≤ 2624	2728 < PR ≤ 3496
9j	66.6 < f <sub>sym</sub> < 685.4	14.0	7.86	192 ≤ PR ≤ 2048	768 ≤ PR ≤ 2728
	685.4 < f <sub>sym</sub> < 962.7	15.0	9.9	2048 < PR ≤ 2880	2728 < PR ≤ 3840
9k	66.6 < f <sub>sym</sub> < 685.4	14.0	7.86	192 ≤ PR ≤ 2048	768 ≤ PR ≤ 2728
	685.4 < f <sub>sym</sub> < 1026.7	15.0	9.9	2048 < PR ≤ 3072	2728 < PR ≤ 4096
9l	66.6 < f <sub>sym</sub> < 685.4	14.0	7.86	192 ≤ PR ≤ 2048	768 ≤ PR ≤ 2728
	685.4 < f <sub>sym</sub> < 1090.7	15.0	9.9	2048 < PR ≤ 3264	2728 < PR ≤ 4352
9m	66.6 < f <sub>sym</sub> < 685.4	14.0	7.86	192 ≤ PR ≤ 2048	768 ≤ PR ≤ 2728
	685.4 < f <sub>sym</sub> < 1154.7	15.0	9.9	2048 < PR ≤ 3456	2728 < PR ≤ 4608
9n	66.6 < f <sub>sym</sub> < 685.4	14.0	7.86	192 ≤ PR ≤ 2048	768 ≤ PR ≤ 2728
	685.4 < f <sub>sym</sub> < 1218.7	15.0	9.9	2048 < PR ≤ 3648	2728 < PR ≤ 4864
9o	66.6 < f <sub>sym</sub> < 685.4	14.0	7.86	192 ≤ PR ≤ 2048	768 ≤ PR ≤ 2728
	685.4 < f <sub>sym</sub> < 1282.7	15.0	9.9	2048 < PR ≤ 3840	2728 < PR ≤ 5120
9p	194 ≤ f <sub>sym</sub> ≤ 684	14.0	7.86	N/A	768 ≤ PR ≤ 2728
	684 < f <sub>sym</sub> ≤ 1346	15.0	9.9	N/A	2728 < PR ≤ 5376
9q	194 ≤ f <sub>sym</sub> ≤ 684	14.0	7.86	N/A	768 ≤ PR ≤ 2728
	684 < f <sub>sym</sub> ≤ 1426	15.0	9.9	N/A	2728 < PR ≤ 5696

Note 1: For Nominal testing requirements for equipment using 16-TCPAM line code at payload rates less than or equal to 2312 kbps refer to Table J-3.

Note 2: For Nominal testing requirements for equipment using

(i) 16-TCPAM line code at payload rate(s) greater than 2312 kbps or

(ii) 32-TCPAM line code refer to Table K-3.

Table K-3

Nominal PSD mask and testing requirements for:  
Deployment classes 9i to 9q; and  
Deployment classes 9c to 9h using 32-TCPAM

Frequency	PSDMASK (f) in dBm/Hz	Testing Requirements
$f < f_{int}$	$10 \times \log_{10} \left[ \frac{K_{SHDSL}}{R_s} \times \frac{1}{f_{sym}} \times \frac{\left[ \sin\left(\frac{\partial f}{f_{sym}}\right) \right]^2}{\left(\frac{\partial f}{f_{sym}}\right)^2} \times \frac{1}{1 + \left(\frac{f}{f_{3dB}}\right)^{2 \times Order}} \times \frac{f^2}{f^2 + f_c^2} \right]$	PSD
$f_{int} \leq f \leq 3184 \text{ kHz}$	$10 \times \log_{10} [1.7971 \times 10^{-6} \times f^{-1.5}]$	PSD
$3184 \text{ kHz} < f \leq 11040 \text{ kHz}$	-110	-90 dBm/Hz peak; and Maximum power in the [f, f + 1 MHz] window of -50 dBm
$11040 \text{ kHz} < f \leq 30000 \text{ kHz}$	-110	-90 dBm/Hz peak

where:

$K_{shdsl}$  and  $f_{sym}$  are defined in Table K-2  $f$  = frequency in kHz  $R_s = 135 \Omega$   $f_c$  is the transformer cut-off frequency, assumed to be 5 kHz

$f_{int}$  = lowest frequency above  $f_{3dB}$  where the expressions for  $P_1(f)$  and  $P_2(f)$  intersect

$f_{max} = 11,040 \text{ MHz}$   $Order = 6$   $N = 1$   $f_{3dB} = f_{sym}/2$

For each data rate at which the equipment can operate,  $f_{sym}$  shall not exceed the PSDMASK generated by choosing a value of  $f_{sym}$  which need not be related to the actual CE parameters but may be any value in the range listed in Table L2 for the relevant Equipment Class. Because the Group A requirement permits such wide freedom to choose any  $f_{sym}$  value in the prescribed range, a party submitting equipment for test under Group A should provide to the test laboratory a detailed list of operating modes and corresponding  $f_{sym}$  values to use in generating the compliance masks.

The PSD shall be measured with a resolution bandwidth less than or equal to 10kHz. Large PSD variations over narrow frequency intervals (for example near the junction of the main lobe with the noise floor) might require a smaller resolution bandwidth (RBW) to be used. An appropriate way would be to choose RBW such that there is no more than 1 dB change in the signal PSD across the RBW.

Note 1: Refer to Table J-3 for Nominal testing requirements at 16-TCPAM line rates below 2312kbps.

Compliance PSD mask and testing requirements for:  
 Deployment Classes 9i to 9q and  
 Deployment classes 9c to 9h using 32-TCPAM

PSDMASK(f) =

$$P_1(f) = 10 \log_{10} \left[ \frac{K_{SDSL}}{R_s} \times \frac{1}{f_{sym}} \times \frac{\left[ \sin\left(\frac{\partial f}{f_{sym}}\right) \right]^2}{\left(\frac{\partial f}{f_{sym}}\right)^2} \times \frac{1}{1 + \left(\frac{f}{f_{3dB}}\right)^{2 \times Order}} \times 10^{\frac{MaskOffsetdB(f)}{10}} \right] \text{ [dBm/Hz]} \quad f < f_{int}$$

$P_2(f)$  = -90 dBm/Hz peak with maximum power in a [f, f + 1 MHz] window of  $[10 * \log_{10}(0,5683 \times 10^{-4} \times f^{-1,5}) + 90]$  dBm  $f_{int} \leq f \leq 3184$  MHz

$P_3(f)$  = -90 dBm/Hz peak with maximum power in a [f, f + 1 MHz] window of - 50 dBm  $3184 \text{ MHz} < f \leq f_{max}$

$P_4(f)$  = -90 dBm/Hz peak  $11040 \text{ kHz} < f \leq 30000 \text{ kHz}$

where:

$K_{SDSL}$  and  $f_{sym}$  are defined in Table K-2

f = frequency in kHz

$R_s = 135 \Omega$

$$MaskOffsetdB(f) = \begin{cases} 1 + 0,4 \times \frac{f_{3dB} - f}{f_{3dB}} \text{ [dB]}, & f < f_{3dB} \\ 1 \text{ [dB]}, & f \geq f_{3dB} \end{cases}$$

$f_{int}$  = lowest frequency above  $f_{3dB}$  where the expressions for  $P_1(f)$  and  $P_2(f)$  intersect

$f_{max} = 11.040$  MHz

Order = 6; N = 1;  $f_{3dB} = f_{sym}/2$

PSDMASK(f) is in dBm/Hz.

$f_{sym} = (\text{payload kbit rate} + \text{overhead kbit rate}) / (\text{number of bits per symbol})$

The 16-TCPAM constellation has 3 bits per symbol while the 32-TCPAM constellation has 4 bits per symbol.

The PSD shall be measured with a resolution bandwidth less than or equal to 10kHz. Large PSD variations over narrow frequency intervals (for example near the junction of the main lobe with the noise floor) might require a smaller resolution bandwidth (RBW) to be used. An appropriate way would be to choose RBW such that there is no more than 1 dB change in the signal PSD across the RBW.

The power in the 1 MHz sliding window is measured in a 1 MHz bandwidth, starting at the measurement frequency.

*Note 1: Refer to Table L4 for Group A testing requirements at 16-TCPAM line rates below 2312kbps.*