ACIF C559:2003
PART 3

REQUIREMENTS FOR DEPLOYMENT CLASS SYSTEMS

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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 ULLS. 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 code obligation described in section 8.2 of Part 1. 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 is through satisfying the Deployment Classes and Deployment Rules as in Clause 8.3 of Part 1, and do not apply when the alternative method of compliance in Clause 8.4 of Part 1 is used.

1.3 The Deployment Classes and Deployment Rules:

(a) list the technologies that have been taken into account in determining the PSD mask(s) that systems must meet under the code;

(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) correspond to Equipment Classes used in the AS/ACIF S043.2 Customer Equipment standard;

(d) 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 Equipment Class in AS/ACIF S043.2.

1.4 Not all available technologies are represented in the Deployment Classes.

Note: A Carrier or Carriage 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.

1.5 The use of a Deployment Class for other technology types is not restricted, provided the operation of the system complies with the 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 The ACIF Approved Deployment Classes may be amended in the future as part of a code review. A party wishing to include a new Deployment Class or Basis System in the code must approach ACIF for a review of the Code.

2 DEPLOYMENT CLASSES AND ASSOCIATED DEPLOYMENT RULES

2.1 General

2.1.1 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;

(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 PIUT cable.

2.1.2 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 8.2 of Part 1 of this Code.

Note: Clause 8.2 prohibits a carrier or carriage 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 carrier or carriage 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.

2.1.3 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 'Group A' and 'Group B' requirements for each applicable Deployment Class.

2.1.4 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.

2.2 Group A and Group B Requirements

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) Group A which specifies the requirements for operation of the Deployment Class system; or

(b) Group B 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 Group A requirements or Group B 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 requirements contained in Group B 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 Group B requirements in this Industry Code. Group A requirements, which correspond to tighter (i.e. lower) PSD masks than the Group B requirements, are available as an alternative path for compliance of systems which cannot comply with the line code aspect of the Group B requirements.

2.3 Total Average Power

2.3.1 The total average power at the ULLS-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.

2.3.2 The methodology for the measurement of the total average power is as specified in Appendix B in Part 1.

2.4 Power Spectral Density (PSD)

2.4.1 The PSD at the ULLS-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.

2.4.2 The methodology for the measurement of the PSD is as specified in Appendix B in Part 1.

2.5 Line Code

2.5.1 For Group B, the system line code **shall** comply with the requirements of the applicable Deployment Class.

2.6 Longitudinal Balance

2.6.1 The longitudinal balance of the system towards the AS network, shall be greater than or equal to the longitudinal balance level specified for the applicable Deployment Class when the longitudinal termination is 1/4 of the termination impedance for the Deployment Class.

Longitudinal Balance is defined as

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.

2.6.2 The methodology for the measurement of the longitudinal balance is as specified in Clause B.3.3 of Appendix B of Part 1.

2.7 Longitudinal Output Voltage

2.7.1 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.

2.7.2 The methodology for the measurement of the longitudinal output voltage is as specified in Clause B.3.4 of Appendix B of Part 1.

2.8 Deployment Rules

2.8.1 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.

2.8.2 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.

2.8.3 The Calculated Attenuation of a ULLS shall be calculated using the formulae of Appendix A to Part 1.

2.8.4 A system belonging to a Spectrally Asymmetric Deployment Class shall not be fed from a ULLS-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 carrier or carriage service provider proposing to operate a system from a ULLS-NRP lower than the Deployment Reference Point for that Deployment Class must use the alternative means of compliance prescribed for Non-Deployment Class systems.

2.8.5 Any Pair Separation rules applicable to a ULLS shall only apply with respect to the NRP at which the ULLS originates.

2.8.6 Where Pair Separation is required under a Deployment Rule, the cable pair used for the ULLS 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).

2.9 Operation of Spectrally Asymmetric Systems in Reverse Mode

2.9.1 Reverse ADSL is a case where the network end (ATU-C) equipment as defined in the relevant Recommendations (ITU G.992.1 and G992.2) is used to transmit in the reverse direction, that is towards the network.

2.9.2 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 Code.

2.10 Use of Two System Types on a single ULLS

2.10.1 This Code 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 AS.

2.10.2 Where two types of system use the same ULLS, the operation of the systems is taken to comply with the obligation in Clause 8.2 in Part 1 of this Code 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 Code (i.e. with the other turned off)

APPENDIX A Summary of Network Deployment Classes

Table A-1

Table 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)	Deployment Rules	Reference frequency for class (kHz)
	Network equipment	Customer equipment (Note 2)				
1a	Appendix B	Appendix B	Symmetric Highest	E1 HDB3 ≤18.2 dB	Deployment Limit 18.2 dB (equivalent to 0.7km 0.4 mm PIUT)	1024
1b	Appendix B	Appendix B	Symmetric Highest	E1 HDB3 > 18.2 dB	Unlimited. Only for pair rearrangement and deployment of Deployment Class 1b systems on existing routes, provided there is no incursion of "return" pairs into cable units or quad cable layers not previously containing "return" pairs of Deployment Class 1b systems	1024
2a	Not For Use In This Code					

Deploy-ment 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)	Deployment Rules	Reference frequency for class (kHz)
	Network equipment	Customer equipment (Note 2)				
3a	Customer Equipment used in connected with Class 3a systems is subject to labelling and compliance requirements contained in the Telecommunications Labelling Notice.		N/A	Low Band	Unlimited	
4a	AS/ACIF S043.2 Appendix A	AS/ACIF S043.2 Appendix A	Symmetric Lower	ISDN BR 2B1Q	Unlimited	40
5a	AS/ACIF S043.2 Appendix B	AS/ACIF S043.2 Appendix B	Symmetric Lower	Similar to SHDSL with modified roll-off (up to 576 kbit/s)	Unlimited	96
5b	AS/ACIF S043.2 Appendix C	AS/ACIF S043.2 Appendix C	Symmetric Lower	Similar to SHDSL with modified roll-off (up to 784 kbit/s, reduced power)	Unlimited	131

Deploy-ment 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)	Deployment Rules	Reference frequency for class (kHz)
	Network equipment	Customer equipment (Note 2)				
6a	Appendix C	AS/ACIF S043.2 Appendix D	Asymmetric Lower	ADSL FD with Reduced NEXT	Unlimited. Pair Separation from the customer to exchange pair of Deployment Class 1b is required. Deployment Class 3a systems may be used in conjunction with this Deployment Class.	300
6b	Appendix D	AS/ACIF S043.2 Appendix E	Asymmetric Lower	ADSL Lite	Unlimited. Deployment Class 3a systems may be used in conjunction with this Deployment Class.	300
6c	Appendix E	AS/ACIF S043.2 Appendix F	Asymmetric Lower	ADSL over ISDN	Pair Separation from the customer to exchange pair of Deployment Class 1b is required. Deployment limit 21.0 dB (equivalent to 1.5km 0.4 mm PIUT) Deployment Class 3a systems may be used in conjunction with this Deployment Class. Deployment Class 4a systems may be used in conjunction with this Deployment Class.	300

Deploy-ment 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)	Deployment Rules	Reference frequency for class (kHz)
	Network equipment	Customer equipment (Note 2)				
6d	Appendix F	AS/ACIF S043.2 Appendix D	Asymmetric Lower	ADSL EC	Pair Separation from the customer to exchange pair of Deployment Class 1b is required. Deployment limit 30.8 dB (equivalent to 2.2 km 0.4 mm PIUT). Deployment Class 3a systems may be used in conjunction with this Deployment Class.	300
6e	Appendix G	AS/ACIF S043.2 Appendix D	Asymmetric Lower	ADSL FD Low Power	Unlimited Deployment Class 3a systems may be used in conjunction with this Deployment Class.	300
6f	Appendix H	AS/ACIF S043.2 Appendix D	Asymmetric Lower	ADSL FD Limited carriers	Unlimited Deployment Class 3a systems may be used in conjunction with this Deployment Class.	300

Deploy-ment 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)	Deployment Rules	Reference frequency for class (kHz)
	Network equipment	Customer equipment (Note 2)				
7a	AS/ACIF S043.2 Appendix G	AS/ACIF S043.2 Appendix G	Symmetric Highest	SDSL (≤ 272 kbit/s)	Unlimited	68
7b	Appendix I	AS/ACIF S043.2 Appendix H	Symmetric Highest	SDSL (≤ 528 kbit/s, reduced power)	Unlimited	132
7c	AS/ACIF S043.2 Appendix H	AS/ACIF S043.2 Appendix H	Symmetric Highest	SDSL (≤ 528 kbit/s)	Deployment Limit 27.0 dB (equivalent to 2.5km 0.4 mm PIUT).	132
7d	AS/ACIF S043.2 Appendix I	AS/ACIF S043.2 Appendix I	Symmetric Highest	SDSL (≤ 784 kbit/s)	Deployment Limit 30.1 dB (equivalent to 2.5km 0.4 mm PIUT).	196
7e	AS/ACIF S043.2 Appendix J	AS/ACIF S043.2 Appendix J	Symmetric Highest	SDSL (≤ 1168 kbit/s)	Deployment Limit 22.2 dB (equivalent to 1.6 km 0.4 mm PIUT).	292

Deploy-ment 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)	Deployment Rules	Reference frequency for class (kHz)
	Network equipment	Customer equipment (Note 2)				
7f	AS/ACIF S043.2 Appendix K	AS/ACIF S043.2 Appendix K	Symmetric Highest	SDSL (≤ 1552 kbit/s)	Deployment Limit 15.7 dB (equivalent to 1.0 km 0.4 mm PIUT).	388
7g	AS/ACIF S043.2 Appendix L	AS/ACIF S043.2 Appendix L	Symmetric Highest	SDSL (≤ 2064 kbit/s)	Pair Separation from the customer to exchange pair of Deployment Class 1b is required. Deployment Limit 12.7 dB (equivalent to 0.7 km 0.4 mm PIUT).	516
7h	AS/ACIF S043.2 Appendix M	AS/ACIF S043.2 Appendix M	Symmetric Highest	SDSL (≤ 2320 kbit/s)	Pair Separation from the customer to exchange pair of Deployment Class 1b is required. Deployment Limit 13.5dB (equivalent to 0.7 km 0.4 mm PIUT).	580
7i	AS/ACIF S043.2 Appendix L	AS/ACIF S043.2 Appendix L	Symmetric Highest	SDSL (≤ 2064 kbit/s)	Pair Separation from the customer to exchange pair of Deployment Class 1b is required. Attenuation shall be between 12.7 dB and Deployment Limit of 18.1 dB (equivalent to 0.7 km to 1.0 km of 0.4 mm PIUT).	516

Deploy-ment 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)	Deployment Rules	Reference frequency for class (kHz)
	Network equipment	Customer equipment (Note 2)				
					Systems may be deployed under Deployment Class 7i up to 30 September 2001 and may be operated under Deployment Class 7i up to 30 September 2002. After 30 September 2001 new services shall not be deployed using Deployment Class 7i. After 30 September 2002 services shall not operate using Deployment Class 7i, and shall either operate using equipment under an alternative Deployment Class or be withdrawn.	
7j	AS/ACIF S043.2 Appendix M	AS/ACIF S043.2 Appendix M	Symmetric Highest	SDSL (≤ 2320 kbit/s)	Pair Separation from the customer to exchange pair of Deployment Class 1b is required. Attenuation shall be between 13.5 dB and Deployment Limit of 19.3dB (equivalent to 0.7 km to 1.0 km of 0.4 mm PIUT). Systems may be deployed under Deployment Class 7j up to 30 September 2001 and may be operated under Deployment Class 7j up to 30 September 2002. After 30 September 2001 new services shall not be deployed using Deployment Class 7j. After 30 September 2002 services shall not operate using Deployment Class 7j, and shall either operate using equipment under an alternative Deployment Class or be withdrawn.	580

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)	Deployment Rules	Reference frequency for class (kHz)
	Network equipment	Customer equipment (Note 2)				
8a	AS/ACIF S043.2 Appendix N	AS/ACIF S043.2 Appendix N	Symmetric Highest	HDSL 2B1Q 784 kbit/s	Deployment Limit 30.1 dB (equivalent to 2.5 km 0.4 mm PIUT)	196
8b	AS/ACIF S043.2 Appendix O	AS/ACIF S043.2 Appendix O	Symmetric Highest	HDSL 2B1Q 1168 kbit/s	Deployment Limit 22.2 dB (equivalent to 1.6 km 0.4 mm PIUT).	292
8c	AS/ACIF S043.2 Appendix P	AS/ACIF S043.2 Appendix P	Symmetric Highest	HDSL 2B1Q 2320 kbit/s	Pair Separation from the customer to exchange pair of Deployment Class 1b is required. Deployment Limit 13.5 dB (equivalent to 0.7 km 0.4 mm PIUT).	580
8d	AS/ACIF S043.2 Appendix P	AS/ACIF S043.2 Appendix P	Symmetric Highest	HDSL 2B1Q 2320 kbit/s	Pair Separation from the customer to exchange pair of Deployment Class 1b is required. Attenuation shall be between 13.5 dB and Deployment Limit of 19.3dB (equivalent to 0.7 km to 1.0 km of 0.4 mm PIUT). Systems may be deployed under Deployment Class 8d up to 30 September 2001 and may be operated under Deployment Class 8d up to 30 September 2002. After 30 September 2001 new services shall not be deployed using Deployment Class 8d. After 30 September 2002 services shall not operate using Deployment Class 8d, and shall either operate using equipment under an alternative Deployment Class or be withdrawn.	580

Deploy-ment 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)	Deployment Rules	Reference frequency for class (kHz)
	Network equipment	Customer equipment (Note 2)				
9a	AS/ACIF S043.2 Appendix Q where the PSD shall be measured with a resolution bandwidth less than or equal to 10kHz	AS/ACIF S043.2 Appendix Q where the PSD shall be measured with a resolution bandwidth less than or equal to 10kHz	Symmetric Lower	SHDSL (200 to 584 kbit/s)	Unlimited.	96
9b	Appendix J	AS/ACIF S043.2 Appendix R	Symmetric Lower	SHDSL (200 to 784 kbit/s, reduced power)	Unlimited.	131
9c	AS/ACIF S043.2 Appendix R	AS/ACIF S043.2 Appendix R	Symmetric Lower	SHDSL (200 to 784 kbit/s)	Deployment Limit 28.0 dB (equivalent to 2. 6 km 0.4 mm PIUT).	131
9d	AS/ACIF S043.2 Appendix S	AS/ACIF S043.2 Appendix S	Symmetric Lower	SHDSL (200 to 1168 kbit/s)	Deployment Limit 31.2 dB (equivalent to 2.6 km 0.4 mm PIUT).	195
9e	AS/ACIF S043.2 Appendix T	AS/ACIF S043.2 Appendix T	Symmetric Lower	SHDSL (200 to 1552 kbit/s)	Deployment Limit 31.8 dB (equivalent to 2.4 km 0.4 mm PIUT).	259
9f	AS/ACIF S043.2 Appendix U	AS/ACIF S043.2 Appendix U	Symmetric Lower	SHDSL (200 to 2064 kbit/s)	Deployment Limit 26.8 dB (equivalent to 1.8 km 0.4 mm PIUT).	344

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)	Deployment Rules	Reference frequency for class (kHz)
	Network equipment	Customer equipment (Note 2)				
9g	AS/ACIF S043.2 Appendix V	AS/ACIF S043.2 Appendix V	Symmetric Lower	SHDSL (200 to 2320 kbit/s)	Deployment Limit 26.7 dB (equivalent to 1.7 km 0.4 mm PIUT).	387

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

Note 2: Customer Equipment used in connection with Deployment Class Systems may also be subject to additional compliance and labelling requirements contained in the Telecommunications Labelling Notice.

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 limits under the column titled "Typical Technology" represent total payload plus overhead bits carried. In Table 11-1 SHDSL system bit rates are based on 3 bits per symbol as the default in G.991.2. Systems using the option of 4 bits per symbol are classified at the equivalent baud rate. For systems with 4 bits/symbol, use 3/4 of the system bit rate to determine the Deployment Class in Table 11-1.

APPENDIX B DEPLOYMENT CLASS 1a and DEPLOYMENT CLASS 1b

Table B-1 provides the Group A and Group B test criteria and referenced documents for Deployment Classes 1a and 1b. The termination impedance for Deployment Classes 1a and 1b is 120 Ω.

TABLE B-1

Test criteria for Deployment Classes 1a and 1b

Parameter	**Sub-parameter**	**Group A (Value)**	**Group B**
Total average 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

TABLE B-2

PSD mask for Deployment Class 1b

Frequency (kHz)	PSD (dBm/Hz)
0 < f < 1024	-44.5
1024 $\leq$ f < 30000	$-44.5 - 20 \times \log_{10} (f / 1\,024)$

APPENDIX C DEPLOYMENT CLASS 6a

Table C-1 provides the Group A and Group B test criteria and referenced documents for Deployment Class 6a network systems. The termination impedance for Deployment Class 6a is 100 Ω.

TABLE C-1

Test criteria for Deployment Class 6a

Parameter	Sub-parameter	Group A (Value)	Group B
Total average power	Level	19.9 dBm with Power Cutback in accordance with Table C-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	≥ 10 s	≥ 10 s
PSD mask		Table C-3 with a flat power cutback in accordance with Table C-2.	G.992.1 Clause A.1.3. Maximum power in the 0 to 4kHz band is relaxed to -10dBm$_{600ohms}$
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 C-2

Power Cutback for downstream signal of Classes 6a, 6b, 6c, 6d, 6f as a function of measured upstream attenuation at 50 kHz.

Equivalent km of 0.4 mm PIUT	Attenuation of loop (dB at 50 kHz)	Power Cut-back (dB)
< 0.131	< 1.13	12
< 0.246	< 2.13	10
< 0.361	< 3.13	8
< 0.476	< 4.13	6
< 0.592	< 5.13	4
< 0.707	< 6.13	2

TABLE C-3

PSD mask for Deployment Class 6a

Frequency band *f* (kHz)	**PSD (dBm/Hz) (Note 2)**	**Wideband power**
0 < f < 4	–97.5	-10dBm$_{600}$ 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 < 1 104	–40	Not applicable
1 104 < f < 3093	$-40 - 36 \times \log_2(f / 1\,104)$	Not applicable
3093 < f < 4 545	–93.5 peak	Max power in the [f, f + 1 MHz] window of $(-36.5 - 36 \times \log_2(f / 1\,104) + 60)$ dBm$_{100}$ Note 3
4 545 < f < 11 040	–93.5 peak	Max power in the [f, f + 1 MHz] window of –50 dBm$_{100}$ Note 3
11 040 < f < 12040	–93.5 peak	Not applicable

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 D DEPLOYMENT CLASS 6b

Table D-1 provides the Group A and Group B test criteria and referenced documents for Deployment Class 6b network systems.

The termination impedance for Deployment Class 6b is 100 Ω.

TABLE D-1

Test criteria for Deployment Class 6b

Parameter	Sub-parameter	Group A (Value)	Group B
Total average power	Level	16.2 dBm with power cutback in accordance with Table C-2	G.992.2 Clause A.2.2.3 and power cutback in accordance with G.992.2 Clause 11.7.5
	Frequency range	138 - 552 kHz	G.992.2 Clause A.2.2.3
	Averaging time	≥ 10 s	≥ 10 s
PSD mask		Table D-2 with a flat power cutback in accordance with Table C-2	G.992.2 Clause A.2 Maximum power in the 0 to 4kHz band is relaxed to -10dBm$_{600ohms}$
Line code		Not applicable	G.991.2 Clause 7.7, 7.8, 7.9 7.10
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 and 4 kHz band	-50 dBV in and 4 kHz band
	Frequency range	As per longitudinal balance	As per longitudinal balance

TABLE D-2

PSD mask for Deployment Class 6b

Frequency band *f* (kHz)	PSD (dBm/Hz) Note 2	Wideband Power
0 < f < 4	–97.5	-10dBm$_{600}$ 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 < 552	-40	Not applicable
552 < f < 893	$-40 - 36 \times \log(f / 552)/\log(2)$	Not applicable
893 < f < 1 800	-65	Not applicable
1 800 < f < 2 368	$-65 - 72 \times \log(f / 1800)/\log(2)$	Not applicable
2 368 < f < 3 093	–93.5	Not applicable
3 093 < f < 4 545	< - 93.5 peak	max power in the [f, f + 1 MHz] window of $(-36.5 - 36 \times \log_2(f / 1104)/\log(2) + 60)$ dBm$_{100}$ Note 3
4 545 ≤ f < 11 040	< - 93.5 peak	max power in the [f, f + 1 MHz] window of –50 dBm$_{100}$ Note 3
11 040 < f < 12040	–93.5 peak	Not applicable

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 E DEPLOYMENT CLASS 6c

Table E-1 provides the Group A and Group B test criteria and referenced documents for Deployment Class 6c network systems. The termination impedance for Deployment Class 6c is 100 Ω.

TABLE E-1

Test criteria for Deployment Class 6c

Parameter	Sub-parameter	Group A	Group B
Total average power	Level	19.9 dBm with power cutback in accordance with Table C-2	G.992.1 Clause B.1.3.2.2 and power cutback in accordance with G.992.1 Clauses 10.4.5.1 and B3.3
	Frequency range	138 to 1104 kHz	G.992.1 Clause. B.1.3.2.2
	Averaging time	>= 10 s	>= 10 s
PSD mask		Table E-2 with a flat power cutback in accordance with Table C-2	G.992.1 Clause. B.1.3
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 E-2

PSD mask for Deployment Class 6c

Frequency band *f* (kHz)	PSD (dBm/Hz)	Wideband power
$0 \leq f < 50(70)$	–90	Not applicable
$50 \leq f < 80$	$-90 + 12 \times \log_2(f / f_1)$	Not applicable
$80 \leq f < 138$	$-82 + 54 \times \log(f / 80,2)$ where f is kHz	Not applicable
$138 \leq f < 1104$	–40	Not applicable
$1104 \leq f < 3093$	$-40 - 36 \times \log_2(f / 1\ 104)$	Not applicable
$3093 \leq f < 4545$	–93.5 peak	max power in the [f, f + 1 MHz] window of $(-36.5 - 36 \times \log_2(f / 1\ 104) + 60)$ dBm_{100}
$4545 \leq f < 11\ 040$	–93.5 peak	with max power in the [f, f + 1 MHz] window of -50 dBm_{100}
11 040 < f < 12040	–93.5 peak	Not applicable

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

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

APPENDIX F DEPLOYMENTCLASS 6d

Table F-1 provides the Group A and Group B test criteria and referenced documents for Deployment Class 6d network systems.

The termination impedance for Deployment Class 6d is 100 Ω.

TABLE F-1

Test criteria for Deployment Class 6d

Parameter	Sub-parameter	Group A (Value)	Group B
Total average power	Level	20.4 dBm with power cutback in accordance with Table C-2	G.992.1 Clause A.1.2.3.3 and power cutback in accordance with G.992.1 Clauses 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	≥ 10 s	≥ 10 s
PSD mask		Table F-2 with flat power cutback in accordance with Table C-2	G.992.1 Clause. A.1.2 Maximum power in the 0 to 4kHz band is relaxed to -10dBm$_{600ohms}$
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	-50 dBV in any 4 kHz band
	Frequency range	As per longitudinal balance	As per longitudinal balance

TABLE F-2

PSD mask for Deployment Class 6d

Frequency band *f* (kHz)	PSD (dBm/Hz) Note 2	Wideband power
0 < *f* < 4	–97.5	-10dBm$_{600}$ Note 1
4 < *f* < 25.875	–96+ 21 × $\log_2$ (*f* / 4)	Not applicable
25.875 < *f* < 1 104	–40	Not applicable
1104 < *f* < 3093	–40 – 36 × $\log_2$ (*f* / 1 104)	Not applicable
3093 < *f* < 4545	–93.5 peak	max power in the [*f*, *f* + 1 MHz] window of (-36.5 – 36 × $\log_2$ (*f* / 1 104) + 60) dBm$_{100}$ Note 3
4 545 < *f* < 11 040	–93.5 peak	max power in the [*f*, *f* + 1 MHz] window of -50 dBm$_{100}$ Note 3
11 040 < f < 12040	–93.5 peak	Not applicable

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

Note 1: 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 G DEPLOYMENT CLASS 6e

Table G-1 provides the Group A and Group B test criteria and referenced documents for Deployment Class 6e network systems. The termination impedance for Deployment Class 6e is 100 Ω.

TABLE G-1

Test criteria for Deployment Class 6e

Parameter	Sub-parameter	Group A (Value)	Group B
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	≥ 10 s	≥ 10 s
PSD mask		Table G-2	G.992.1 Clause . A.1.3 reduced by 10 dB Maximum power in the 0 to 4kHz band is relaxed to -10dBm$_{600ohms}$
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 G-2

PSD mask for Deployment Class 6e

Frequency band *f* (kHz)	PSD (dBm/Hz) Note 2	Wideband power
0 < f < 4	–97.5	-10 dBm_{600} 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 MHz] window of $(–36.5 – 36 \times \log_2(f/1\ 104) + 60)$ dBm_{100} Note 3
4 545 < f < 11 040	–93.5 peak	max power in the [f, f + 1 MHz] window of – 50 dBm_{100} Note 3
11040 < f < 12040	–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 H DEPLOYMENT CLASS 6f

Table H-1 provides the Group A and Group B test criteria and referenced documents for Deployment Class 6f network systems. The termination impedance for Deployment Class 6f is 100 Ω.

TABLE H-1

Test criteria for Deployment Class 6f

Parameter	Sub-parameter	Group A (Value)	Group B
Total average power	Level	16.7 dBm with power cutback in accordance with Table C-2	G.992.1 Clause A.1.2.3.3 and power cutback in accordance with G.992.1 Clauses 10.4.5.1 and A.3.1
	Frequency range	25.875 to 610 kHz	G.992.1 Clause.A.1.2.3.3 Note1
	Averaging time	≥ 10 s	≥ 10 s
PSD mask		Table H-2 with a flat power cutback in accordance with Table C-2	G.992.1 Clause. A.1.3 with maximum tone of 140 (610kHz) Maximum power in the 0 to 4kHz band is relaxed to -10dBm$_{600ohms}$
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	-50 dBV in any 4 kHz band
	Frequency range	As per longitudinal balance	As per longitudinal balance

TABLE H-2

PSD mask for Deployment Class 6f

Frequency band *f* (kHz)	PSD (dBm/Hz) Note 2	Wideband power
0 < f < 4	–97.5	-10 dBm_{600} 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 < 610	–40	Not applicable
610 < f < 1709	$–40 – 36 \times \log_2(f /610)$	Not applicable
1709 ≤ f < 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_{100} Note 3
4 545 ≤ f < 11 040	–93.5 peak	max power in the [f, f + 1 MHz] window of –50 dBm_{100} Note 3
11040 < f < 12040	–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 I DEPLOYMENT CLASS 7b

Table I-1 provides the Group A and Group B test criteria for Deployment Class 7b. The termination impedance for Deployment Class 7b is 135 Ω.

TABLE I-1

Test criteria for Deployment Class 7b

Parameter	**Sub-parameter**	**Group A (Value)**	**Group B**
Total average power	Level	10.5 dBm	10.5 dBm
	Frequency range	0Hz to 264kHz	0 Hz to 264 kHz
	Averaging time	≥ 10 s	≥ 10 s
PSD mask		Table I-2	Table I-3
Line code		Not available	2B1Q
Longitudinal balance	Level	40dB from 20KHz to 132kHz, with a slope of 20dB/decade below 20kHz and -20dB/decade above 132kHz.	40 dB from 20 kHz to 132 kHz, with a slope of 20 dB/decade below 20 kHz and -20dB/decade above 132 kHz.
	Frequency range	500Hz to 528kHz	500 Hz to 528 kHz
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 I-2

PSD mask for Deployment Class 7b (Group A)

Frequency *f* (kHz) (Note 1)	PSD (dBm/Hz)
0	-39.2
37	-39.2
93	-40.2
156	-43.2
230	-59.2
275	-75.2
408	-77.2
497	-87.2
557	-99.2
729.6	-100.4
729.6 < f < 30000	$= -143-10 \times \log_{10}((f \times 1000)^{1.5} / (1.134 \times 10^{13}))$

Note 1: The values between these points are derived by linear interpolation of the frequency and PSD limit in dBm/Hz.

TABLE I-3

PSD mask for Deployment Class 7b (Group B)

Frequency *f* (kHz)	PSD (dBm/Hz)
0	–39.2
37	–39.2
93	–40.2
156	–43.2
230	–55.7
275	–71.7
408	–73.7
497	–83.7
557	–95.7
728	–96.7
779	–101.5
779 < $f \leq$ 30000	$-143-10\times\log_{10}\left(\frac{(10^3\times f)^{1.5}}{1.134\times10^{13}}\right)$

Note 1: The values between the points are derived by linear interpolation of frequency and PSD limit in dBm/Hz.

APPENDIX J DEPLOYMENT CLASS 9b

Table J-1 provides the Group A and Group B test criteria for Deployment Class 9b. The termination impedance for Deployment Class 9b is 135 Ω.

TABLE J-1

Test criteria for Deployment Class 9b

Parameter	Sub-parameter	Group A	Group B
Total average power	Level	10.5 dBm	10.5 dBm
	Frequency range	0 Hz to 1.5 MHz	0 Hz to 1.5 MHz
	Averaging time	≥ 10 s	≥ 10 s
PSD mask		Table J-2	Table J-3
Line code		Not applicable	Trellis Coded Pulse Amplitude Modulation
Longitudinal balance	Level	40 dB from 20 kHz to 131 kHz, with a slope of 20 dB/decade below 20 kHz and -20dB/decade above 131 kHz.	40 dB from 40 kHz to $f_{sym}/2$ kHz, with a slope of 20 dB/decade below 20 kHz and -20 dB/decade above $f_{sym}/2$ kHz. Note: f_{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

PSD mask for Deployment Class 9b (Group A)

$$\mathrm{PSDMASK}(f) = 10 \times \log_{10} \begin{cases} \dfrac{K}{135} \times \dfrac{1}{f_{sym}} \times \dfrac{\left[\sin\left(\dfrac{\pi f}{N f_{sym}}\right)\right]^2}{\left(\dfrac{\pi f}{N f_{sym}}\right)^2} \times \dfrac{1}{1+\left(\dfrac{f}{f_{3dB}}\right)^{2\times \mathrm{Order}}} & , \quad f < f_{int} \\ 1.7971 \times 10^{-6} \times f^{-1.5} & , \quad f_{int} \le f \le 1500 \text{ kHz} \end{cases}$$

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:

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

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

f_{sym} need not be related to the actual CE parameters but may be any value between 66.6 kbaud and 261.3 kbaud. For each data rate at which the equipment can operate, it 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 between 66.6 kbaud and 773.4 kbaud. 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. In some circumstances, in addition to 10 kHz resolution bandwidth measurement, 1 kHz or 3 kHz resolution bandwidth may be used in order to optimize the result and reduce the uncertainty of the PSD measurement.

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

f_{sym} (kbaud)	K	Order	N	f_{3dB} (Hz)
66.6 to less than 192	7.86	6	1	1.0 × f_{sym}/2
192 to 261.3	3.51	6	1	1.0 × f_{sym}/2

TABLE J-3

PSD mask for Deployment Class 9b (Group B)

$$\mathrm{PSDMASK}(f) = 10 \times \log_{10} \begin{cases} \frac{\mathrm{K}}{135} \times \frac{1}{f_{\mathrm{sym}}} \times \frac{\left[\sin\left(\frac{\pi f}{\mathrm{N} f_{\mathrm{sym}}}\right)\right]^2}{\left(\frac{\pi f}{\mathrm{N} f_{\mathrm{sym}}}\right)^2} \times \frac{1}{1+\left(\frac{f}{f_{3\mathrm{dB}}}\right)^{2\times\mathrm{Order}}} \times 10^{\frac{\mathrm{MaskOffsetdB}(f)}{10}} & , \quad f < f_{\mathrm{int}} \\ 1.7971 \times 10^{-6} \times f^{-1.5} & , \quad f_{\mathrm{int}} \le f \le 1500\ \mathrm{kHz} \end{cases}$$

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:

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

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

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

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

The PSD shall be measured with a resolution bandwidth less than or equal to 10kHz. In some circumstances, in addition to 10 kHz resolution bandwidth measurement, 1 kHz or 3 kHz resolution bandwidth may be used in order to optimize the result and reduce the uncertainty of the PSD measurement.

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

f_{sym} (kbaud)	K	Order	N	$f_{3\mathrm{dB}}$ (kHz)
66.6 to less than 192	7.86	6	1	1.0 × f_{sym}/2
192 to 261.3	3.51	6	1	1.0 × f_{sym}/2

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Published by:

THE AUSTRALIAN COMMUNICATIONS INDUSTRY FORUM LTD

Level 9, 32 Walker Street
North Sydney NSW 2060

Correspondence: PO Box 444
Milsons Point NSW 1565

Telephone: (02) 9959 9111
Facsimile: (02) 9954 6136
TTY: (02) 9923 1911

E-mail: acif@acif.org.au

Web Site: http://www.acif.org.au/

ISBN 1 74000 266 0