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ITU-T

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G.992.5

Amendment 1
(07/2005)

SERIES G: TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

Digital sections and digital line system – Access networks

Asymmetric Digital Subscriber Line (ADSL) transceivers – Extended bandwidth ADSL2 (ADSL2plus)

Amendment 1

ITU-T Recommendation G.992.5 (2005) – Amendment 1

ITU-T

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ITU-T Recommendation G.992.5

Asymmetric Digital Subscriber Line (ADSL) transceivers – Extended bandwidth ADSL2 (ADSL2plus)

Amendment 1

Summary

Amendment 1 to ITU-T Recommendation G.992.5 (2005) is the first amendment to the integrated ITU-T Rec. G.992.5 approved in January 2005. It specifies the following additions:

1) Addition to clause 7 of new optional valid S and D values in the PMS-TC framer configuration. This permits the achievement of higher net data rates while satisfying a configured minimum impulse noise protection (*INP_min*);
2) Addition to clause 8 of optional downstream spectrum shaping using time domain filtering only. This allows the transceiver to meet the PSD mask with filtering only in the time domain;
3) A new Annex C-based ADSL2plus system operating in the TCM-ISDN environment with a downstream bandwidth of 2208 kHz and an upstream bandwidth of 138 kHz (Annex C.A) or 276 kHz (Annex C.B).
4) Additions to Annex K to include net data rates corresponding to the new S and D values.
5) A new Appendix VI which gives examples of PSD masks for operation according to Annex C.

Revision marks are relative to the latest pre-published integrated 2005 version of ITU-T Rec. G.992.5.

Source

Amendment 1 to ITU-T Recommendation G.992.5 (2005) was approved on 14 July 2005 by ITU-T Study Group 15 (2005-2008) under the ITU-T Recommendation A.8 procedure.

FOREWORD

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In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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As of the date of approval of this Recommendation, ITU had received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

ITU-T Recommendation G.992.5

Asymmetric Digital Subscriber Line (ADSL) transceivers – Extended bandwidth ADSL2 (ADSL2plus)

Amendment 1

Modify clauses 7 and 8 as follows:

7.6.2 Valid framing configurations

Table 7-8/G.992.5 – Valid framing configurations

Parameter	Capability
...	...
D_p	1, 2, 4, 8, 16, 32, 64. For the downstream latency path #0, additional valid D_0 values are: 96, 128, 160, 192, 224, 256, 288, 320, 352, 384, 416, 448, 480, 511. If $R_p = 0$ then $D_p = 1$
Relationship of N_{FEC0} and D_0	Configurations that satisfy the following relationship are valid: $(N_{FEC0} - 1) \times (D_0 - 1) \leq 254 \times 63 = 16002$
Relation of S_p and M_p	Configurations that satisfy the following relationship are valid: $M_p/3 \leq S_p \leq 32 \times M_p$ (see Note 1). For the downstream latency path #0, additional valid configurations are: $M_0/16 \leq S_0 < M_0/3$
Delay Constraints	Configurations that satisfy the following relationship are valid: $1/3 \leq S_p \leq 64$ (see Note 3). For the downstream latency path #0, additional valid S_0 values are: $1/16 \leq S_0 < 1/3$

7.6.3 Mandatory framing configurations

See 7.6.3/G.992.3, with the following addition to Table 7-9/G.992.3:.

S_0	$1/3 \leq S_0 < 64$. Support of additional optional S_0 values is indicated during initialization, through $S_{0\ min}$, with $1/16 \leq S_{0\ min} \leq 1/3$. All values of S_0, with $S_{0\ min} \leq S_0 < 1/3$, shall be supported.

7.10 Initialization procedures

See 7.10/G.992.3, with the following paragraph after Table 7-18c/G.992.3 as follows:.

The $S_{0\ min}$ value shall be less than or equal to 1/3 (i.e., n ≥ 2). If the $S_{0\ min}$ octet (see Table 7-18c/G.992.3) is not included in the CL or CLR message, the $S_{0\ min}$ value shall be set equal to 1/3 (implicit indication). The S_0 value selected during the exchange phase (see 7.10.3/G.992.3 and Table 7-7/G.992.3) shall be equal to or higher than the highest of the $S_{0\ min}$ values indicated in the CL and CLR message.

For use in this Recommendation, the unsigned 12-bit net_max value in Table 7-18/G.992.3 is the data rate divided by 8000 (rather than 4000 for use in ITU-T Rec. G.992.3).

8.13.2.1 Handshake – ATU-C

See 8.13.2.1/G.992.3.

The G.992.5 handshake codepoints are defined in ITU-T Rec. G.994.1 [2].

For operation in Annex A mode, the following additional Npar(2) codepoint is defined:

Npar(2)	**Definition for CL message**
Downstream spectrum shaping using time domain filtering only	When set to 1, the ATU-C indicates that only time domain filtering is used to shape the downstream in-band spectrum.

If the ATU-C sets the "downstream spectrum shaping using time domain filtering only" bit to ONE in the CL message, the downstream tss_i values shall all be set to ONE and the ATU-C shall shape the in-band transmit PSD only in the time domain, with a shape identical to the shape of the downstream Annex A PSD mask. If the ATU-C sets this bit to ZERO in the CL message, it indicates that the ATU-R shall use the downstream tss_i values as indicated in the CL message for all calculations.

The ATU-C shall set the "downstream spectrum shaping using time domain filtering only" bit to ONE in the MS message if, and only if, both the previous CL and CLR messages have this bit set to ONE.

8.13.2.2 Handshake – ATU-R

See 8.13.2.2/G.992.3.

For operation in Annex A mode, the following additional Npar(2) codepoint is defined:

Npar(2)	**Definition for CLR message**
Downstream spectrum shaping using time domain filtering only	When set to 1, the ATU-R indicates that it can support processing of received signals generated with time domain only filtering of the downstream in-band spectrum.

The ATU-R shall set the "downstream spectrum shaping using time domain filtering only" bit to ONE in the MS message if, and only if, both the previous CL and CLR messages have this bit set to ONE.

If the "downstream spectrum shaping using time domain filtering only" bit is set to ONE in the MS message, the ATU-R shall assume that the downstream tss_i values are all set to ONE and the ATU-R shall compute the NOMATP using a set of downstream tss_i values derived from the Annex A downstream PSD mask. If the bit is set to ZERO in the MS message, the ATU-R shall use the downstream *tssi* values as indicated in the previous CL message for all calculations.

Modify Annex C as follows:

Annex C

Specific requirements for an ADSL system operating in the same cable as ISDN as defined in ITU-T Rec. G.961, Appendix III

This annex is a delta to the main body of this Recommendation. For clauses where no supplements or amendments are made, the clause heading is repeated to maintain the numbering of clause headings aligned with the main body.

C.1 Scope

This annex defines those parameters of the ADSL system that have been left undefined in the body of this Recommendation because they are unique to an ADSL service that coexists in the same binder as TCM-ISDN as defined in Appendix III/G.961. The clauses in this annex provide supplementary and replacement material to the clauses in the main body. The modifications described in this annex allow a performance improvement from the ADSL system specified in Annex A in an environment where ADSL and TCM-ISDN operate in the same cable. It is recommended that an ADSL system which implements Annex C also implements Annex A.

For this annex, support of STM-TC, as defined in K.1, remains for further study.

C.2 References

This annex does not define any additional references.

C.3 Definitions

C.3/G.992.3 defines terms applicable to this annex.

C.4 Abbreviations

C.4/G.992.3 defines abbreviations applicable to this annex.

C.5 Reference models

See C.5/G.992.3.

C.6 Transport protocol specific transmission convergence (TPS-TC) function

C.6.1 Transport capabilities

C.6.2 Interface signals and primitives

C.6.3 Control parameters

C.6.4 Data plane procedures

C.6.5 Management plane procedures

C.6.6 Initialization procedure

C.6.6.1 G.994.1 phase

This clause supplements 6.6.1/G.992.3.

C.6.6.1.1 G.994.1 capabilities list message

Replace Table 6-2/G.992.3 with Table C.6-1 as follows:

Table C.6-1/G.992.5 – Format for TPS-TC capabilities information

Spar(2) bits	Definition of Npar(3) bits
Maxtype Upstream (Note)	Parameter block of 2 octets that describes the *maxtype* values for upstream, using an unsigned 3-bit value in the 0 to 4 range for each of the TPS-TC types 2 (ATM) and 3 (PTM).
Maxtype Downstream (Note)	Parameter block of 2 octets that describes the *maxtype* values for downstream, using an unsigned 3-bit value in the 0 to 4 range for each of the TPS-TC types 2 (ATM) and 3 (PTM).
NOTE – TPS-TC type 1 (STM) is left for further study.	

C.6.6.1.2 G.994.1 Mode select message

C.6.6.2 Channel analysis phase

C.6.6.3 Exchange phase

C.6.7 On-line reconfiguration

C.6.8 Power management mode

C.7 Physical media specific transmission convergence (PMS-TC) function

See C.7/G.992.3.

C.8 Physical media-dependent function

C.8.1 ATU-C/R transmitter timing model (new)

See C.8.1/G.992.3.

C.8.2 Operating modes (new)

See C.8.2/G.992.3.

Example PSDs for profiles 3, 5, and 6 are found in Appendix VI.

The handshake codepoints to support these profiles are contained in ITU-T Rec. G.994.1.

C.8.3 Block interface signals and primitives

C.8.4 Block diagram and internal reference point signals

See C.8.4/G.992.3.

C.8.5 Control parameters

C.8.5.1 Definition of control parameters

C.8.5.2 Mandatory and optional settings of control parameters

C.8.5.3 Setting control parameters during initialization

This clause supplements 8.5.3.

C.8.5.3.1 During the G.994.1 phase

C.8.5.3.2 During the channel analysis phase

C.8.5.3.3 During the exchange phase

Replace Table 8-15 with Table C.8-1 below. Table C.8-1 shows the PMD function control parameters included in C-PARAMS.

Table C.8-1/G.992.5 – PMD function control parameters included in C-PARAMS

Octet Nr [i]	Parameter	Format PMD bits [8 × i + 7 to 8 × i + 0]
0	*LATNus* (LSB)	[xxxx xxxx], bit 7 to 0
1	*LATNus* (MSB)	[0000 00xx], bit 9 and 8
2	*SATNus* (LSB)	[xxxx xxxx], bit 7 to 0
3	*SATNus* (MSB)	[0000 00xx], bit 9 and 8
4	*FEXT SNRMus* (LSB)	[xxxx xxxx], bit 7 to 0
5	*FEXT SNRMus* (MSB)	[ssss sxxx], bit 10 to 8
6	*FEXT ATTNDRus* (LSB)	[xxxx xxxx], bit 7 to 0
7	*FEXT ATTNDRus*	[xxxx xxxx], bit 15 to 8
8	*FEXT ATTNDRus*	[xxxx xxxx], bit 23 to 16
9	*FEXT ATTNDRus* (MSB)	[xxxx xxxx], bit 31 to 24
10	*FEXT ACTATPus* (LSB)	[xxxx xxxx], bit 7 to 0
11	*FEXT ACTATPus* (MSB)	[ssss ssxx], bit 9 and 8
12	*NEXT SNRMus* (LSB)	[xxxx xxxx], bit 7 to 0
13	*NEXT SNRMus* (MSB)	[ssss sxxx], bit 10 to 8
14	*NEXT ATTNDRus* (LSB)	[xxxx xxxx], bit 7 to 0
15	*NEXT ATTNDRus*	[xxxx xxxx], bit 15 to 8
16	*NEXT ATTNDRus*	[xxxx xxxx], bit 23 to 16
17	*NEXT ATTNDRus* (MSB)	[xxxx xxxx], bit 31 to 24
18	*NEXT ACTATPus* (LSB)	[xxxx xxxx], bit 7 to 0
19	*NEXT ACTATPus* (MSB)	[ssss ssxx], bit 9 and 8
20	*TRELLISus*	[0000 000x], bit 0
21	Reserved	[0000 0000]
22	FEXT upstream bits and gains for subcarrier 1 (LSB)	[gggg bbbb], bit 7 to 0
23	FEXT upstream bits and gains for subcarrier 1 (MSB)	[gggg gggg], bit 15 to 8
…	…	…
18 + 2 × *NSCus*	FEXT upstream bits and gains for subcarrier *NSCus* – 1 (LSB)	[gggg bbbb], bit 7 to 0
19 + 2 × *NSCus*	FEXT upstream bits and gains for subcarrier *NSCus* – 1 (MSB)	[gggg gggg], bit 15 to 8
20 + 2 × *NSCus*	NEXT upstream bits and gains for subcarrier 1 (LSB)	[gggg bbbb], bit 7 to 0

Table C.8-1/G.992.5 – PMD function control parameters included in C-PARAMS

Octet Nr [i]	Parameter	Format PMD bits [8 × i + 7 to 8 × i + 0]
21 + 2 × *NSCus*	NEXT upstream bits and gains for subcarrier 1 (MSB)	[gggg gggg], bit 15 to 8
…	…	…
16 + 4 × *NSCus*	NEXT upstream bits and gains for subcarrier *NSCus* – 1 (LSB)	[gggg bbbb], bit 7 to 0
17 + 4 × *NSCus*	NEXT upstream bits and gains for subcarrier *NSCus* – 1 (MSB)	[gggg gggg], bit 15 to 8
18 + 4 × *NSCus*	Reserved	[0000 0000]
19 + 4 × *NSCus*	Upstream tone ordering first subcarrier to map	[xxxx xxxx], bit 7 to 0
…	…	…
17 + 5 × *NSCus*	Upstream tone ordering last subcarrier to map	[xxxx xxxx], bit 7 to 0

Replace Table 8-16 with Table C.8-2 below. Table C.8-2 shows the PMD function control parameters included in R-PARAMS.

Table C.8-2/G.992.5 – PMD function control parameters included in R-PARAMS

Octet Nr [i]	Parameter	Format PMD bits [8 × i + 7 to 8 × i + 0]
0	*LATNds* (LSB)	[xxxx xxxx], bit 7 to 0
1	*LATNds* (MSB)	[0000 00xx], bit 9 and 8
2	*SATNds* (LSB)	[xxxx xxxx], bit 7 to 0
3	*SATNds* (MSB)	[0000 00xx], bit 9 and 8
4	*FEXT SNRMds* (LSB)	[xxxx xxxx], bit 7 to 0
5	*FEXT SNRMds* (MSB)	[ssss sxxx], bit 10 to 8
6	*FEXT ATTNDRds* (LSB)	[xxxx xxxx], bit 7 to 0
7	*FEXT ATTNDRds*	[xxxx xxxx], bit 15 to 8
8	*FEXT ATTNDRds*	[xxxx xxxx], bit 23 to 16
9	*FEXT ATTNDRds* (MSB)	[xxxx xxxx], bit 31 to 24
10	*FEXT ACTATPds* (LSB)	[xxxx xxxx], bit 7 to 0
11	*FEXT ACTATPds* (MSB)	[ssss ssxx], bit 9 and 8
12	*NEXT SNRMds* (LSB)	[xxxx xxxx], bit 7 to 0
13	*NEXT SNRMds* (MSB)	[ssss sxxx], bit 10 to 8
14	*NEXT ATTNDRds* (LSB)	[xxxx xxxx], bit 7 to 0
15	*NEXT ATTNDRds*	[xxxx xxxx], bit 15 to 8
16	*NEXT ATTNDRds*	[xxxx xxxx], bit 23 to 16
17	*NEXT ATTNDRds* (MSB)	[xxxx xxxx], bit 31 to 24
18	*NEXT ACTATPds* (LSB)	[xxxx xxxx], bit 7 to 0
19	*NEXT ACTATPds* (MSB)	[ssss ssxx], bit 9 and 8

Table C.8-2/G.992.5 – PMD function control parameters included in R-PARAMS

Octet Nr [i]	Parameter	Format PMD bits [8 × i + 7 to 8 × i + 0]
20	*TRELLISds*	[0000 000x], bit 0
21	Reserved	[0000 0000]
22	FEXT downstream bits and gains for subcarrier 1 (LSB)	[gggg bbbb], bit 7 to 0
23	FEXT downstream bits and gains for subcarrier 1 (MSB)	[gggg gggg], bit 15 to 8
…	…	…
18 + 2 × *NSCds*	FEXT downstream bits and gains for subcarrier *NSCds* – 1 (LSB)	[gggg bbbb], bit 7 to 0
19 + 2 × *NSCds*	FEXT downstream bits and gains for subcarrier *NSCds* – 1 (MSB)	[gggg gggg], bit 15 to 8
20 + 2 × *NSCds*	NEXT downstream bits and gains for subcarrier 1 (LSB)	[gggg bbbb], bit 7 to 0
21 + 2 × *NSCds*	NEXT downstream bits and gains for subcarrier 1 (MSB)	[gggg gggg], bit 15 to 8
…	…	…
16 + 4 × *NSCds*	NEXT downstream bits and gains for subcarrier *NSCds* – 1 (LSB)	[gggg bbbb], bit 7 to 0
17 + 4 × *NSCds*	NEXT downstream bits and gains for subcarrier *NSCds* – 1 (MSB)	[gggg gggg], bit 15 to 8
18 + 4 × *NSCds*	Reserved	[0000 0000]
19 + 4 × *NSCds*	Downstream tone ordering first subcarrier to map	[xxxx xxxx], bit 7 to 0
…	…	…
17 + 5 × *NSCds*	Downstream tone ordering last subcarrier to map	[xxxx xxxx], bit 7 to 0

C.8.6 Constellation encoder for data symbols

See C.8.6/G.992.3.

C.8.7 Constellation encoder for synchronization and L2 exit symbols

See C.8.7/G.992.3.

C.8.8 Modulation

C.8.9 Transmitter dynamic range

C.8.10 Transmitter spectral masks

This clause supplements 8.10.

Spectral masks for the different service options are defined in Annexes C.A and C.B. The spectral mask defines the maximum passband PSD, maximum stopband PSD and maximum aggregate transmit power.

C.8.11 Control plane procedures

C.8.12 Management plane procedures

See C.8.12/G.992.3.

C.8.13 Initialization

C.8.13.1 Initialization with hyperframe (new)

See C.8.13.1/G.992.3.

C.8.13.2 G.994.1 phase

C.8.13.2.1 Handshake – ATU-C

See C.8.13.2.1/G.992.3.

The G.992.5 handshake codepoints are defined in ITU-T Rec. G.994.1.

C.8.13.2.2 Handshake – ATU-R

See C.8.13.2.2/G.992.3.

The G.992.5 handshake codepoints are defined in ITU-T Rec. G.994.1.

C.8.13.2.3 G.994.1 transmit PSD levels

C.8.13.2.4 Spectral bounds and shaping parameters

C.8.13.3 Channel discovery phase

See C.8.13.3/G.992.3.

C.8.13.4 Transceiver training phase

See C.8.13.4/G.992.3.

C.8.13.5 Channel analysis phase

This clause supplements C.8.13.5/G.992.3.

C.8.13.5.1 ATU-C channel analysis

This clause supplements C.8.13.5.1/G.992.3.

C.8.13.5.1.1 C-MSG1

This clause supplements C.8.13.5.1.1/G.992.3.

The C-MSG1 state is of fixed length with 2 possible lengths, depending on whether the windowing parameters are included. In this state, the ATU-C shall transmit the C-MSG1 symbols only during the $FEXT_R$ symbols. During the $NEXT_R$ symbols, the ATU-C shall transmit the C-TREF pilot tone, except for profile 3 where C-QUIET is transmitted during $NEXT_R$ symbols. The ATU-C shall transmit LEN_C-MSG1 C-REVERB or C-SEGUE symbols to modulate the C-MSG1 prefix, message and crc. The C-MSGS1 state shall be the first state in which the ATU-C transmits the cyclic prefix. There are LEN_C-MSG1 = 240 or 240 + NSCds/4 C-MSG1 $FEXT_R$ symbols which correspond to 690 or 690 + (NSCds/512) × 345 symbols depending, respectively, on whether or not windowing is applied.

The C-MSG1 state shall have a minimum duration of 690 symbols (i.e., two hyperframes, each consisting of 128 $FEXT_R$ symbols). The 240 C-MSG1 symbols shall be transmitted in the first 240 $FEXT_R$ symbols of the C-MSG1 state. For the remaining 256 – 240 = 16 $FEXT_R$ symbols the ATU-C shall transmit the C-TREF pilot tone.

C.8.13.5.1.2 C-REVERB5

See C.8.13.5.1.2/G.992.3.

C.8.13.5.1.3 C-SEGUE2

See C.8.13.5.1.3/G.992.3.

C.8.13.5.1.4 C-MEDLEY

See C.8.13.5.1.4/G.992.3.

C.8.13.5.1.5 C-EXCHMARKER

See C.8.13.5.1.5/G.992.3.

C.8.13.5.2 ATU-R Channel Analysis

This clause supplements C.8.13.5.2/G.992.3.

C.8.13.5.2.1 R-REVERB5

This clause supplements C.8.13.5.2.1/G.992.3.

The R-REVERB5 state is of fixed length with 2 possible lengths, depending on whether the windowing parameters are included. In the R-REVERB5 state, the ATU-R shall transmit during both $FEXT_C$ and $NEXT_C$ symbols when bitmap-N_C is enabled (DBM). The ATU-R shall transmit R-REVERB symbols only during $FEXT_C$ symbols when bitmap-N_C is disabled (FBM).

In the R-REVERB5 state, the ATU-R shall transmit 1035-23 or $\{3 + (NSCds/512)\} \times 345$-23 depending on whether or not windowing is applied to the R-REVERB symbols. The R-REVERB5 state shall be the first state in which the ATU-R transmits the cyclic prefix.

C.8.13.5.2.2 R-SEGUE2

See C.8.13.5.2.2/G.992.3.

C.8.13.5.2.3 R-MSG1

See C.8.13.5.2.3/G.992.3.

C.8.13.5.2.4 R-MEDLEY

See C.8.13.5.2.4/G.992.3.

C.8.13.5.2.5 R-EXCHMARKER

See C.8.13.5.2.5/G.992.3.

C.8.13.6 Exchange phase

See C.8.13.6/G.992.3.

C.8.13.7 Timing diagram of the initialization procedures

See C.8.13.7/G.992.3.

C.8.14 Short initialization procedures (supplements 8.14)

The short initialization procedure defined in 8.14 is not applicable to, and therefore shall not be used for this annex.

C.8.15 Loop diagnostics mode procedures (supplements 8.15)

C.8.15.1 Overview

C.8.15.2 Channel discovery phase

See C.8.15.2/G.992.3.

C.8.15.3 Transceiver training phase

C.8.15.4 Channel analysis phase

See C.8.15.4/G.992.3.

C.8.15.5 Exchange phase

C.8.15.5.1 ATU-C exchange phase

See C.8.15.5.1/G.992.3.

C.8.15.5.2 ATU-R exchange phase

This clause supplements C.8.15.5.2/G.992.3.

C.8.15.5.2.1 Channel information bearing messages

This clause supplements C.8.15.5.2.1/G.992.3.

Replace Table C.8-17/G.992.3 with the following Table C.8-3.

Table C.8-3/G.992.5 – Format of the R-MSG1-LD message

Octet Nr [i]	Information	Format message bits [8 × i + 7 to 8 × i + 0]
0	Sequence number	[0000 0001]
1	Reserved	[0000 0000]
2	Hlin scale (LSB)	[xxxx xxxx], bit 7 to 0
3	Hlin scale (MSB)	[xxxx xxxx], bit 15 to 8
4	LATN (LSB)	[xxxx xxxx], bit 7 to 0
5	LATN (MSB)	[0000 00xx], bit 9 and 8
6	SATN (LSB)	[xxxx xxxx], bit 7 to 0
7	SATN (MSB)	[0000 00xx], bit 9 and 8
8	FEXT SNRM (LSB)	[xxxx xxxx], bit 7 to 0
9	FEXT SNRM (MSB)	[0000 00xx], bit 9 and 8
10	FEXT ATTNDR (LSB)	[xxxx xxxx], bit 7 to 0
11	FEXT ATTNDR	[xxxx xxxx], bit 15 to 8
12	FEXT ATTNDR	[xxxx xxxx], bit 23 to 16
13	FEXT ATTNDR (MSB)	[xxxx xxxx], bit 31 to 24
14	FEXT Far-end ACTATP (LSB)	[xxxx xxxx], bit 7 to 0
15	FEXT Far-end ACTATP (MSB)	[ssss ssxx], bit 9 to 8
16	NEXT SNRM (LSB)	[xxxx xxxx], bit 7 to 0
17	NEXT SNRM (MSB)	[0000 00xx], bit 9 and 8
18	NEXT ATTNDR (LSB)	[xxxx xxxx], bit 7 to 0
19	NEXT ATTNDR	[xxxx xxxx], bit 15 to 8

Table C.8-3/G.992.5 – Format of the R-MSG1-LD message

Octet Nr [i]	Information	Format message bits [8 × i + 7 to 8 × i + 0]
20	NEXT ATTNDR	[xxxx xxxx], bit 23 to 16
21	NEXT ATTNDR (MSB)	[xxxx xxxx], bit 31 to 24
22	NEXT Far-end ACTATP (LSB)	[xxxx xxxx], bit 7 to 0
23	NEXT Far-end ACTATP (MSB)	[ssss ssxx], bit 9 to 8

Replace Table C.8-18/G.992.3 with the following Table C.8-4.

Table C.8-4/G.992.5 – Format of the FEXT QLN(i) R-MSGx-LD message

Octet Nr [i]	Information	Format message bits [8 × i + 7 to 8 × i + 0]
0	Sequence number	[xxxx xxxx] (as 8-bit unsigned integer)
1	Reserved	[0000 0000]
2	FEXT QLN(256 × k)	[xxxx xxxx], bit 7 to 0
…	...	...
257	FEXT QLN(256 × k + 255)	[xxxx xxxx], bit 7 to 0
NOTE – For each of the values k = 0 to *NSCds*/256 – 1, a single R-MSGx-LD message shall be transmitted, with sequence number x = 3 × *NSCds*/128 + 2 + k.		

Replace Table C.8-19/G.992.3 with the following Table C.8-5.

Table C.8-5/G.992.5 – Format of the FEXT SNR(i) R-MSGx-LD message

Octet Nr [i]	Information	Format message bits [8 × i + 7 to 8 × i + 0]
0	Sequence number	[xxxx xxxx] (as 8-bit unsigned integer)
1	Reserved	[0000 0000]
2	FEXT SNR(256 × k)	[xxxx xxxx], bit 7 to 0
...	…	…
257	FEXT SNR(256 × k + 255)	[xxxx xxxx], bit 7 to 0
NOTE – For each of the values k = 0 to *NSCds*/256 – 1, a single R-MSGx-LD message shall be transmitted, with sequence number x = 7 × *NSCds*/256 + 2 + k.		

Replace Table C.8-20/G.992.3 with the following Table C.8-6.

Table C.8-6/G.992.5 – Format of the NEXT QLN(i) R-MSGx-LD message

Octet Nr [i]	Information	Format message bits [8 × i + 7 to 8 × i + 0]
0	Sequence number	[xxxx xxxx] (as 8-bit unsigned integer)
1	Reserved	[0000 0000]
2	NEXT QLN(256 × k)	[xxxx xxxx], bit 7 to 0
…	…	…
257	NEXT QLN(256 × k + 255)	[xxxx xxxx], bit 7 to 0
NOTE – For each of the values k = 0 to *NSCds*/256 – 1, a single R-MSGx-LD message shall be transmitted, with sequence number x = 4 × *NSCds*/128 + 2 + k.		

Replace Table C.8-21/G.992.3 with the following Table C.8-7.

Table C.8-7/G.992.5 – Format of the NEXT SNR(i) R-MSGx-LD message

Octet Nr [i]	Information	Format message bits [8 × i + 7 to 8 × i + 0]
0	Sequence number	[xxxx xxxx] (as 8-bit unsigned integer)
1	Reserved	[0000 0000]
2	NEXT SNR(256 × k)	[xxxx xxxx], bit 7 to 0
…	…	…
257	NEXT SNR(256 × k + 255)	[xxxx xxxx], bit 7 to 0
NOTE – For each of the values k = 0 to *NSCds*/256 – 1, a single R-MSGx-LD message shall be transmitted, with sequence number x = 9 × *NSCds*/256 + 2 + k.		

Replace Table C.8-22/G.992.3 with the following Table C.8-8.

Table C.8-8/G.992.5 – ATU-R loop diagnostics state durations

State	Duration (round up in hyperframes)
R-MSG1-LD	[24 × 8 + 16]/34 = 7
R-MSGx-LD (x = 2 to 10 × *NSCds*/256 + 1)	[258 × 8 + 16]/34 = 62

C.8.15.5.2.2 Message flow, acknowledgement and retransmission

See C.8.15.5.2.2/G.992.3.

C.8.15.6 Timing diagram of the loop diagnostics procedures

C.8.16 On-line reconfiguration of the PMD function

C.8.17 Power management in the PMD function

C.9 Management protocol specific transmission convergence (MPS-TC) functions (supplements clause 9)

C.9.1 Transport functions

C.9.2 Additional functions

C.9.3 Block interface signals and primitives

C.9.4 Management plane procedures

This clause supplements 9.4.

C.9.4.1 Commands

This clause supplements 9.4.1.

C.9.4.1.1 On-line reconfiguration command (supplements 9.4.1.1)

This clause supplements C.9.1.1.1/G.992.3.

Replace Table C.9-1/G.992.3 with the following Table C.9-1.

Table C.9-1/G.992.5 – On-line reconfiguration commands transmitted by the initiating receiver

Message length (Octets)	Element name (Command)
$4 + 4 \times N_f$	01_{16} FEXT bitmap request type 1 followed by:
	2 octets for the number of subcarriers N_f
	$4 \times N_f$ octets describing FEXT bitmap subcarrier parameter field for each subcarrier
$4 + 8 \times N_{LP} + 4 \times N_f$	08_{16} FEXT bitmap request type 3 followed by:
	$2 \times N_{LP}$ octets containing new $Lf3_P$ values for the N_{LP} enabled latency paths
	$2 \times N_{LP}$ octets containing new $Ln3_P$ values for the N_{LP} enabled latency paths
	$2 \times N_{LP}$ octets containing new $Lf4_P$ values for the N_{LP} enabled latency paths
	$2 \times N_{LP}$ octets containing new $Ln4_P$ values for the N_{LP} enabled latency paths
	2 octets for the number of carriers N_f
	$4 \times N_f$ octets describing FEXT bitmap subcarrier parameter field for each subcarrier
$4 + 4 \times N_f$	09_{16} NEXT bitmap request type 1 followed by:
	2 octets for the number of subcarriers N_f
	$4 \times N_f$ octets describing NEXT bitmap subcarrier parameter field for each subcarrier

Table C.9-1/G.992.5 – On-line reconfiguration commands transmitted by the initiating receiver

Message length (Octets)	Element name (Command)
$4 + 8 \times N_{LP} + 4 \times N_f$	$0A_{16}$ NEXT bitmap request type 3 followed by: $2 \times N_{LP}$ octets containing new $Lf3_P$ values for the N_{LP} enabled latency paths $2 \times N_{LP}$ octets containing new $Ln3_P$ values for the N_{LP} enabled latency paths $2 \times N_{LP}$ octets containing new $Lf4_P$ values for the N_{LP} enabled latency paths $2 \times N_{LP}$ octets containing new $Ln4_P$ values for the N_{LP} enabled latency paths 2 octets for the number of carriers N_f $4 \times N_f$ octets describing NEXT bitmap subcarrier parameter field for each subcarrier
	All other octet values are reserved by ITU-T.

C.9.4.1.2 eoc commands

C.9.4.1.3 Time commands

C.9.4.1.4 Inventory command

C.9.4.1.5 Control value read commands

C.9.4.1.6 Management counter read commands

C.9.4.1.7 Power management commands (supplements 9.4.1.7)

This clause supplements C.9.1.1.2/G.992.3.

Replace Table C.9-3/G.992.3 with the following Table C.9-2.

Table C.9-2/G.992.5 – Change in L2 grant command

Message length (Octets)	Element name (Command)
$5 + 2 \times N_{LP} + 3 \times N_f$	82_{16} L2 grant followed by: $2 \times N_{LP}$ octets containing new Lf_p values for the N_{LP} enabled latency paths (Note) 1 octet containing the actual PCBds value 1 octet containing the exit symbol PCBds value 1 octet containing the exit symbol b_i/g_i table flag 1 octet for the number of carriers N_f $3 \times N_f$ octets describing subcarrier parameter field for each subcarrier
NOTE – Since L2 state is not meant for data transmission, jitter requirements shall be ignored in this state for simplicity. The following relation shall be used during L2 state: $Lf3_p = Lf4_p = Lf_p$	

A subcarrier parameter field contains 3 octets formatted as [0000 0ccc cccc cccc 0000 bbbb]. The carrier index i (11 bits) and the b_i (4 bits). The carrier index shall be the three least significant bits of the first octet and the second octet of the subcarrier field. The b_i shall be the least significant 4 bits of the second octet.

C.9.4.1.8 Clear eoc messages

C.9.4.1.9 Non-standard facility overhead commands

C.9.4.1.10 Test parameter messages (supplements 9.4.1.10)

This clause supplements C.9.1.1.3/G.992.3.

Replace Table C.9-4/G.992.3 with the following Table C.9-3.

Table C.9-3/G.992.5 – PMD test parameter ID values

Test parameter ID	Test parameter name	Length for single read	Length for multiple read	Length for block read
01_{16}	Channel Transfer Function *Hlog(f)* per subcarrier	2 + *NSC* × 2 octets	5 octets	2 + (stop subcarrier – start subcarrier + 1) × 2 octets
02_{16}	Reserved by ITU-T			
03_{16}	FEXT quiet line noise PSD *QLN(f)* per subcarrier	2 + *NSC* octets	4 octets	2 + (stop subcarrier – start subcarrier + 1) octets
04_{16}	FEXT signal-to-noise ratio *SNR(f)* per subcarrier	2 + *NSC* octets	4 octets	2 + (stop subcarrier – start subcarrier + 1) octets
05_{16}	Reserved by ITU-T			
21_{16}	Line Attenuation *LATN*	2 octets	N/a	N/a
22_{16}	Signal Attenuation *SATN*	2 octets	N/a	N/a
23_{16}	FEXT signal-to-noise margin *SNRM*	2 octets	N/a	N/a
24_{16}	FEXT attainable net data rate *ATTNDR*	4 octets	N/a	N/a
25_{16}	FEXT near-end actual aggregate transmit power *ACTATP*	2 octets	N/a	N/a
26_{16}	FEXT far-end actual aggregate transmit power *ACTATP*	2 octets	N/a	N/a
83_{16}	NEXT quiet line noise PSD *QLN(f)* per subcarrier	2 + *NSC* octets	4 octets	2 + (stop subcarrier – start subcarrier + 1) octets
84_{16}	NEXT signal to noise ratio *SNR(f)* per subcarrier	2 + *NSC* octets	4 octets	2 + (stop subcarrier – start subcarrier + 1) octets
$A3_{16}$	NEXT signal-to-noise margin *SNRM*	2 octets	N/a	N/a
$A4_{16}$	NEXT attainable net data rate *ATTNDR*	4 octets	N/a	N/a
$A5_{16}$	NEXT near-end actual aggregate transmit power *ACTATP*	2 octets	N/a	N/a
$A6_{16}$	NEXT far-end actual aggregate transmit power *ACTATP*	2 octets	N/a	N/a

C.9.5 Power management

C.10 Dynamic behaviour

C.K TPS-TC functional description

NOTE – This clause includes Annex C – Specific supplements and replacements relative to Annex K.

See Annex C.K/G.992.3, with the following change:

The ATU shall support a net data rate of at least 16 Mbit/s. The net_min_n, net_max_n and $net\_reserve_n$ entries in Table C.K.2-3/G.992.3 shall show "16 Mbit/s" instead of "8 Mbit/s".

Annex C.A

Specific requirements for an Annex C-based ADSL system operating with a downstream bandwidth of 2208 kHz and an upstream bandwidth of 138 kHz

This annex defines those parameters of the ADSL system that have been left undefined in the body of Annex C because they are unique to an ADSL service that uses a downstream bandwidth up to 2208 kHz (subcarrier 512) and an upstream bandwidth up to 138 kHz (subcarrier 32).

C.A.1 ATU-C functional characteristics (pertains to clause 8)

C.A.1.1 ATU-C control parameter settings

As defined in A.1.1.

C.A.1.2 ATU-C downstream transmit spectral mask for overlapped spectrum operation (supplements 8.10)

As defined in A.1.2.

C.A.1.2.1 Passband PSD and response

As defined in A.1.2.1.

C.A.1.2.2 Aggregate transmit power

As defined in A.1.2.2.

C.A.1.3 ATU-C transmitter PSD mask for non-overlapped spectrum operation (supplements 8.10)

As defined in A.1.3.

C.A.1.3.1 Passband PSD and response

As defined in A.1.3.1.

C.A.1.3.2 Aggregate transmit power

As defined in A.1.3.2.

C.A.2 ATU-R functional characteristics (pertains to clause 8)

C.A.2.1 ATU-R control parameter settings

As defined in A.2.1.

C.A.2.2 ATU-R upstream transmit spectral mask (supplements 8.10)

As defined in A.2.2.

C.A.2.2.1 Passband PSD and response

As defined in A.2.2.1.

C.A.2.2.2 Aggregate transmit power

As defined in A.2.2.2.

C.A.3 Initialization

For this annex, no additional requirements apply (relative to Annex C).

Annex C.B

Specific requirements for an Annex C-based ADSL system operating with a downstream bandwidth of 2208 kHz and an upstream bandwidth of 276 kHz

This annex defines those parameters of the ADSL system that have been left undefined in the body of Annex C because they are unique to an ADSL service that uses a downstream bandwidth up to 2208 kHz (subcarrier 512) and an upstream bandwidth up to 276 kHz (subcarrier 64).

C.B.1 ATU-C functional characteristics (pertains to clause 8)

C.B.1.1 ATU-C control parameter settings

As defined in A.1.1.

C.B.1.2 ATU-C downstream transmit spectral mask for overlapped spectrum operation (supplements 8.10)

As defined in A.1.2.

C.B.1.2.1 Passband PSD and response

As defined in A.1.2.1.

C.B.1.2.2 Aggregate transmit power

As defined in A.1.2.2.

C.B.1.3 ATU-C transmitter PSD mask for non-overlapped spectrum operation (supplements 8.10)

As defined in A.1.3.

C.B.1.3.1 Passband PSD and response

As defined in A.1.3.1.

C.B.1.3.2 Aggregate transmit power

As defined in A.1.3.2.

C.B.2 ATU-R functional characteristics (pertains to clause 8)

C.B.2.1 ATU-R control parameter settings

As defined in M.2.1.

C.B.2.2 ATU-R upstream transmit spectral mask (supplements 8.10)

As defined in M.2.2, except that the ATU-R transmit PSD shall comply with EU-64.

C.B.2.2.1 Passband PSD and response

As defined in M.2.2.1 for EU-64.

C.B.2.2.2 Aggregate transmit power

As defined in M.2.2.2.

C.B.3 Initialization

C.B.3.1 Handshake – ATU-C

See C.B.3.1/G.992.3.

C.B.3.2 Handshake – ATU-R

See C.B.3.2/G.992.3.

Modifiy Annex K as follows:

Annex K

TPS-TC functional descriptions

See Annex K/G.992.3, with the following changes:

1) The G.994.1 codepoints shall represent the data rate divided by 8000 bit/s. The last row of Table K.6/G.992.3 shall show "8000 bit/s" instead of "4000 bit/s".

2) The ATU shall support a net data rate of at least 16 Mbit/s. net_min_n, net_max_n and $net\_reserve_n$ entry in Tables K.4/G.992.3, K.11/G.992.3 and K.20/G.992.3 shall show "16 Mbit/s" instead of "8 Mbit/s".

3) Replace Tables K.3a/G.992.3, K.3b/G.992.3 and K.3c/G.992.3 with Tables K.3a, K.3b, and K.3c/G.992.5. For Table K.3c/G.992.5, the number of subcarriers is 511 and all valid R, S, D and N_{FEC} values listed in Table 7-8 are allowed.

4) The referenced Appendix V is as contained in this Recommendation.

Add new Table K.3c:

Table K.3c/G.992.5 – INP_min and delay_max related downstream net data rates limits using the optional D_0 values for downstream latency path #0 (in kbit/s)

		INP_min						
		0	**½**	**1**	**2**	**4**	**8**	**16**
delay_max [ms]	**1 (Note)**	29556	0	0	0	0	0	0
	2	29556	25718	20928	7616	0	0	0
	4	29556	27613	25718	21093	7616	0	0
	8	29556	27809	26042	22244	14455	8112	0
	16	29556	27809	26042	22244	14455	8112	4024
	32	29556	27809	26042	22244	14455	8112	4024
	63	29556	27809	26042	22244	14455	8112	4024
NOTE – In ITU-T Rec. G.997.1, a 1 ms delay is reserved to mean that $S_p \leq 1$ and $D_p = 1$.								

Add new Appendix VI as follows:

Appendix VI

Example overlapped PSD masks for use in a TCM-ISDN crosstalk environment

This appendix defines examples of shaped overlapped downstream PSD masks for use in a TCM-ISDN crosstalk environment. These masks may be used with Annex C modes of operation that use overlapped PSDs.

VI.1 Example downstream PSD masks for use with profiles 5 and 6

In this appendix, two example downstream PSD masks are described. They may be used for downstream dual bitmap modes with overlapped spectrum. In general, using overlapped spectrum downstream may result in NEXT to the upstream channel. To meet spectrum compatibility requirements, the frequency components overlapping the upstream channel are shaped to reduce the crosstalk. The first example is a spectrally shaped mask used during the NEXT phase of the TTR clock. The second PSD mask has an alternative spectral shaping and is designed for use during the FEXT phase of the TTR clock.

VI.1.1 Downstream shaped overlapped PSD mask for use during NEXT periods

The shaped overlapped spectral mask for use during NEXT periods of the TTR clock is defined in Tables VI.1a and VI.1b and shown plotted in Figure VI.1. Spectral shaping is provided in the frequency band overlapping the ADSL upstream channel. Adherence to this mask will result in spectral compatibility with other systems deployed in an access network in a TCM-ISDN crosstalk environment.

NOTE – The definitions given in Tables VI.1a and VI.1b and in Figure VI.1 are those of a PSD mask. The corresponding PSD template is 3.5 dB below the mask at all frequencies.

Table VI.1a/G.992.5 – Tabulation of a shaped overlapped downstream PSD mask for use during NEXT periods of the TTR clock

Frequency f (kHz)	PSD (dBm/Hz) peak values
$0 \le f < 4$	–97.5, with max power in the 0-4 kHz band of +15 dBrn
$4 \le f < 32$	–94.5
$32 \le f < 109$	$-94.5 + 20.65 \log_2 (f/32)$
$109 \le f < 138$	$-58 + 58 \log_2 (f/109)$
$138 \le f < 200$	$-38.3 + 3.36 \log_2 (f/138)$
$200 \le f < 1104$	–36.5
$1104 \le f < 1622$	$-36.5 - 18 \log_2 (f/1104)$
$1622 \le f < 2208$	$-46.5 - 3 \log_2 (f/1622)$
$2208 \le f < 2500$	$-47.8 - 65 \log_2 (f/2208)$
$2500 \le f < 3001.5$	$-59.4 - 78 \log_2 (f/2500)$
$3001.5 \le f < 3175$	$-80 - 246.7 \log_2 (f/3001.5)$
$3175 \le f < 11040$	–100 dBm/Hz peak PSD in 10 kHz window

Table VI.1b/G.992.5 – Additional PSD requirements for use during NEXT periods of the TTR clock

Frequency *f* (kHz)	**Peak PSD (dBm/Hz) values in 1 MHz window above 3750 kHz**
$3750 \leq f < 4545$	$-100 - 36 \log_2 (f/3750)$
$4545 \leq f < 7225$	$-110 - 3.0 \log_2 (f/4545)$
$7225 \leq f < 11040$	-112

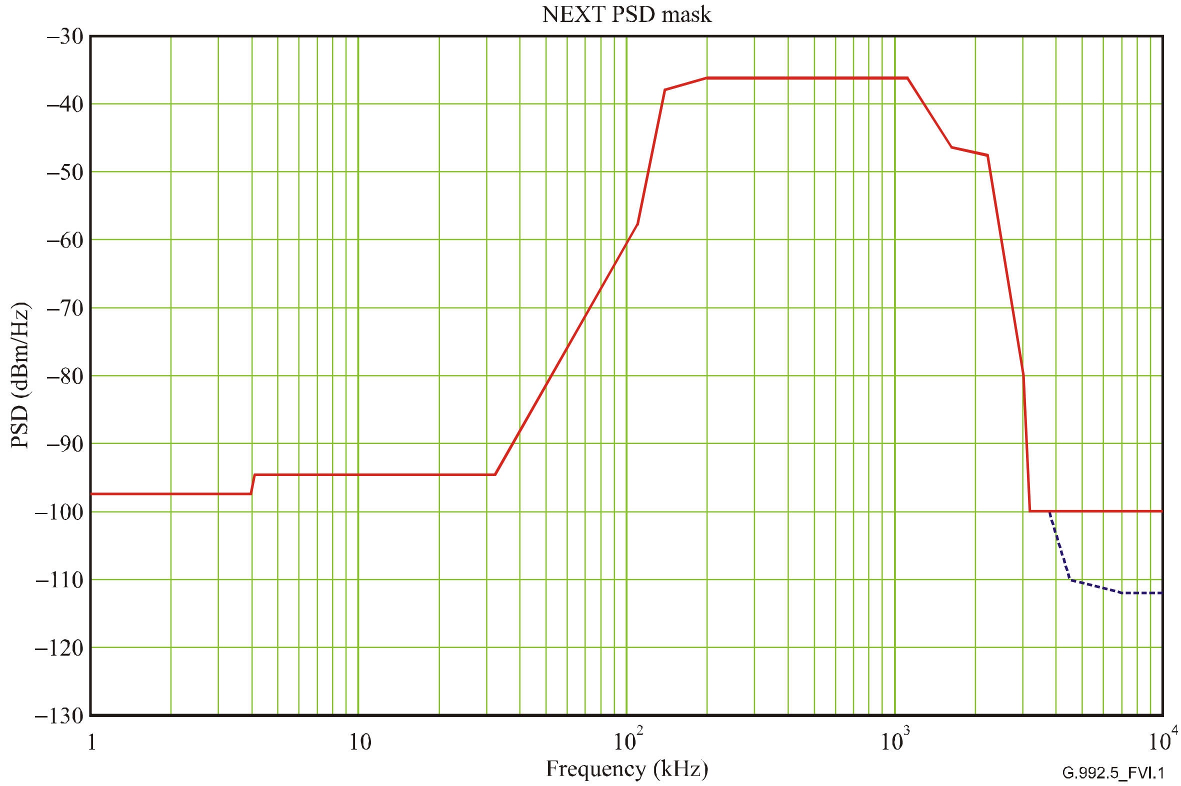

Figure VI.1/G.992.5 – A shaped overlapped downstream PSD mask for use during NEXT periods of the TTR clock

VI.1.2 Downstream shaped PSD mask for use during FEXT periods

The shaped overlapped spectral mask for use during FEXT periods of the TTR clock is defined in Tables VI.2a and VI.2b and shown plotted in Figure VI.2. Spectral shaping is provided in the frequency band overlapping the ADSL upstream channel. Adherence to this mask will result in spectral compatibility with other systems deployed in an access network in a TCM-ISDN crosstalk environment.

NOTE – The definitions given in Tables VI.2a and VI.2b and in Figure VI.2 are those of a PSD mask. The corresponding PSD template is 3.5 dB below the mask at all frequencies.

Table VI.2a/G.992.5 – Tabulation of a shaped overlapped downstream PSD mask for use during FEXT periods of the TTR clock

Frequency f (kHz)	PSD (dBm/Hz) peak values
$0 \leq f < 4$	–97.5, with max power in the 0-4 kHz band of +15 dBrn
$4 \leq f < 4.8$	–94.5
$4.8 \leq f < 50$	$-94.5 + 11.0 \log_2 (f/4.8)$
$50 \leq f < 126$	$-57.5 + 15.7 \log_2 (f/50)$
$126 \leq f < 1104$	–36.5
$1104 \leq f < 1622$	$-36.5 - 18 \log_2 (f/1104)$
$1622 \leq f < 2208$	$-46.5 - 3 \log_2 (f/1622)$
$2208 \leq f < 2500$	$-47.8 - 65 \log_2 (f/2208)$
$2500 \leq f < 3001.5$	$-59.4 - 78 \log_2 (f/2500)$
$3001.5 \leq f < 3175$	$-80 - 246.7 \log_2 (f/3001.5)$
$3175 \leq f < 11040$	–100 dBm/Hz peak PSD in 10 kHz window

Table VI.2b/G.992.5 – Additional PSD requirements for use during FEXT periods of the TTR clock

Frequency f (kHz)	Peak PSD (dBm/Hz) values in 1 MHz window above 3750 kHz
$3750 \leq f < 4545$	$-100 - 36 \log_2 (f/3750)$
$4545 \leq f < 7225$	$-110 - 3.0 \log_2 (f/4545)$
$7225 \leq f < 11040$	–112

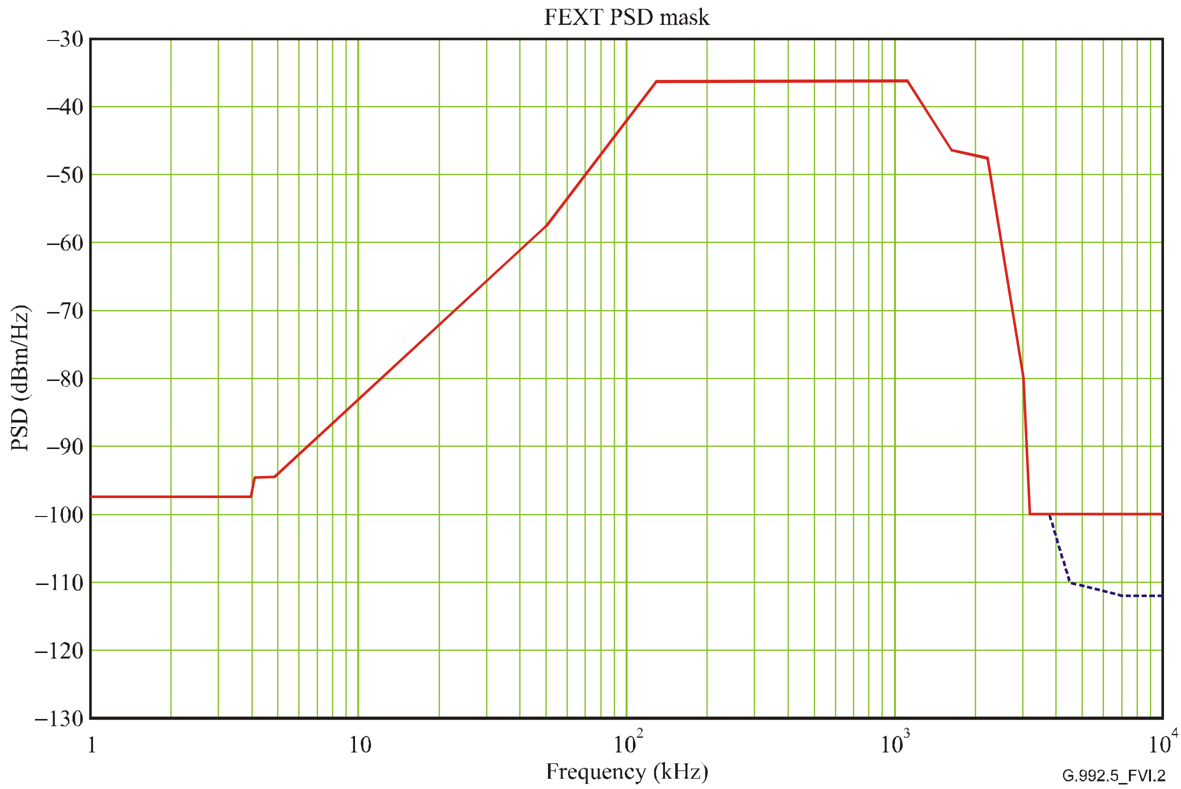

Figure VI.2/G.992.5 – A shaped overlapped downstream PSD mask for use during FEXT periods of the TTR clock

VI.2 Example downstream PSD mask for use with profile 3

An example shaped overlapped spectral mask for use with profile 3 is defined in Tables VI.3a and VI.3b and shown in Figure VI.3. Spectral shaping is provided in the frequency band overlapping the ADSL upstream channel. Adherence to this mask will result in spectral compatibility with other systems deployed in an access network in a TCM-ISDN crosstalk environment.

NOTE – The definitions given in Tables VI.3a and VI.3b and in Figure VI.3 are those of a PSD mask. The corresponding PSD template is 3.5 dB below the mask at all frequencies.

Table VI.3a/G.992.5 – Tabulation of a shaped downstream PSD mask for profile 3

Frequency *f* (kHz)	PSD (dBm/Hz) peak values
$0 \le f < 4$	–97.5, with max power in the in 0-4 kHz band of +15 dBrn
$4 \le f < 5$	$-92.5 + 18.64 \log_2(f/4)$
$5 \le f < 5.25$	–86.5
$5.25 \le f < 16$	$-86.5 + 15.25 \log_2 (f/5.25)$
$16 \le f < 32$	$-62 + 25.5 \log_2 (f/16)$
$32 \le f < 1104$	–36.5
$1104 \le f < 1622$	$-36.5 - 18 \log_2 (f/1104)$
$1622 \le f < 2208$	$-46.5 - 3 \log_2 (f/1622)$
$2208 \le f < 2500$	$-47.8 - 65 \log_2 (f/2208)$
$2500 \le f < 3001.5$	$-59.4 - 78 \log_2 (f/2500)$
$3001.5 \le f < 3175$	$-80 - 246.7 \log_2 (f/3001.5)$
$3175 \le f < 11040$	–100 dBm/Hz peak PSD in 10 kHz window

Table VI.3b/G.992.5 – Additional PSD requirements for profile 3

Frequency *f* (kHz)	Peak PSD (dBm/Hz) values in 1 MHz window above 3750 kHz
$3750 \le f < 4545$	$-100 - 36 \log_2 (f/3750)$
$4545 \le f < 7225$	$-110 - 3.0 \log_2 (f/4545)$
$7225 \le f < 11040$	–112

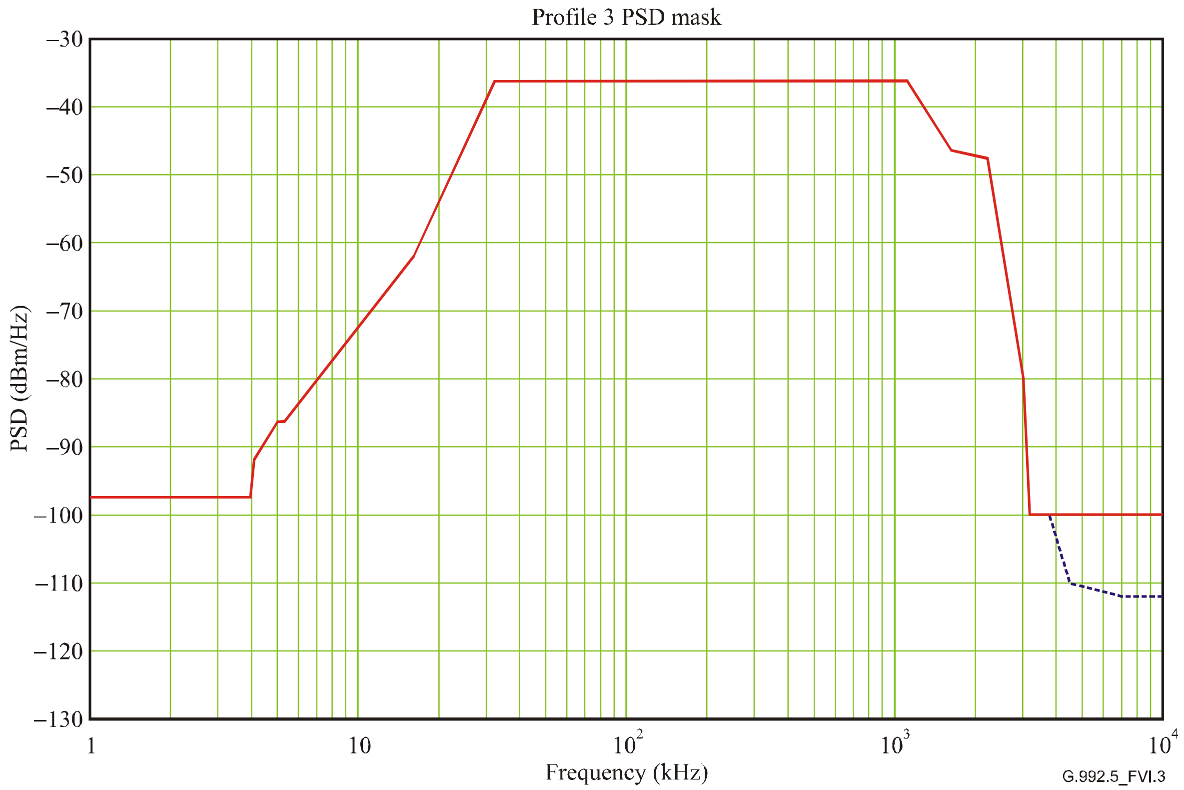

Figure VI.3/G.992.5 – A shaped downstream PSD mask for profile 3

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