TECHNICAL REPORT

TR-114
VDSL2 Performance Test Plan

Issue: **3 Amendment 2**
Approval Date: **March 2018**

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Issue History

Issue Number	Approval Date	Publication Date	Issue Editor	Changes
1	November 2009	November 2009	Arlynn Wilson, ADTRAN	Original
2	26 November 2012	17 December 2012	Aleksandra Kozarev, Lantiq	See Executive Summary
3	13 March 2017	13 March 2017	Aleksandra Kozarev, Intel	See Executive Summary
3 Amendment 1	8 May 2017	9 June 2017	Aleksandra Kozarev, Intel	See Executive Summary
3 Amendment 2	16 March 2018	10 May 2018	Aleksandra Kozarev, Intel	See Executive Summary

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Executive Summary

See *Executive Summary/TR-114 Issue* 3.

Content changes in TR-114 Issue 3 Amendment 2 are the following:

1.Added:

a) ANNEX F for ALIEN NOISE DISTURBERS FOR ANNEX Q TESTING

b) ANNEX Q for G.993.2 ANNEX Q PHYSICAL LAYER TEST CASES

c) APPENDIX on CROSSTALK IMPAIRMENT FOR ANNEX Q PERFORMANCE TESTS

2. Updated:

a)SECTION 5.1 EUT INFORMATION

b) SECTION 6.1 TEST CONFIGURATIONS

c) SECTION 6.2.1 BAND PROFILES

d) SECTION 6.2.2.2 GENERAL LINE SETTINGS

e) SECTION 6.2.2.3 GENERAL LINE SETTINGS

f) SECTION 6.2.3 PROFILE LINE COMBIANTIONS

g) SECTION 6.3 TEST SETUP

h) SECTION 7.1 ACCURACY OF LOOP SIMULATORS AND NOISE SOURCES

i) SECTION 8.1 VERIFICATION OF ERROR REPORTING

j) SECTION 8.2 MARGIN VERIFICATION TEST

k) SECTION 9.1 PTM THROUGHPUT TEST

l) APPENDIX III SUMMARY OF PROFILE AND LINE COMBINATIONS

1 Purpose and Scope

1.1 Purpose

See *Purpose/TR-114 Issue* 3.

1.2 Scope

See *Scope/TR-114 Issue* 3.

Tests applicable to VDSL2 Band-profile QA35b and QM35b refer only to Class 2 implementations.

2 References and Terminology

2.1 Conventions

In this Technical Report, several words are used to signify the requirements of the specification. These words are always capitalized. More information can be found be in RFC 2119 [3].

SHALL	This word, or the term “REQUIRED”, means that the definition is an absolute requirement of the specification.
SHALL NOT	This phrase means that the definition is an absolute prohibition of the specification.
SHOULD	This word, or the adjective “RECOMMENDED”, means that there could exist valid reasons in particular circumstances to ignore this item, but the full implications need to be understood and carefully weighed before choosing a different course.
SHOULD NOT	This phrase, or the phrase "NOT RECOMMENDED" means that there could exist valid reasons in particular circumstances when the particular behavior is acceptable or even useful, but the full implications need to be understood and the case carefully weighed before implementing any behavior described with this label.
MAY	This word, or the adjective “OPTIONAL”, means that this item is one of an allowed set of alternatives. An implementation that does not include this option SHALL be prepared to inter-operate with another implementation that does include the option.

2.2 References

The following references are of relevance to this Technical Report. At the time of publication, the editions indicated were valid. All references are subject to revision; users of this Technical Report are therefore encouraged to investigate the possibility of applying the most recent edition of the references listed below.
A list of currently valid Broadband Forum Technical Reports is published at www.broadband-forum.org.

See *References/TR-114 Issue*3.

Document		Title	Source	Year
[1]	TR-114 Issue 3	*VDSL2 Performance Test Plan*	BBF	2017
[2]	G.993.2 (2015) Amendment 2	*Very high speed subscriber line transceivers 2 (VDSL2): Amendment 2*	ITU-T	2016
[3]	RFC 2119	*Key words for use in RFCs to Indicate Requirement*	IETF	1997

Levels

2.3 Definitions

See *Definitions/TR-114 Issue* 3.

2.4 Abbreviations

See *Abbreviations/TR-114 Issue* 3.

3 Technical Report Impact

3.1 Energy Efficiency

TR-114 Issue 3 Amendment 2 has no impact on Energy Efficiency.

3.2 Security

TR-114 Issue 3 Amendment 2 has no impact on Security.

3.3 Privacy

Any issues regarding privacy are not affected by TR-114 Issue 3 Amendment 2.

4 Updates to the TR-114 Issue 3 related to G.993.2 Annex Q

4.1 Updates to Section 5.1 EUT Information

Amend the text of Table 1 DSLAM information with Annex Q band profiles QA35b and QM35b (revision marks relative to the TR-114 Issue 3 text).

Table 1: DSLAM information

……..	
VDSL2 Band-Profiles supported: – AA8d, AA8a, AA12a – BA8b, BA17a0, BA17ade – BB8b, BB12a, BB17a – CG8d, CG12a, CG17a, CG30a – QA35b, QM35b	

Amend the text of Table 2 CPE information with Annex Q band profiles QA35b and QM35b (revision marks relative to the TR-114 Issue 3 text).

Table 2: CPE information

……..	
VDSL2 Band-Profiles supported: – AA8d, AA8a, AA12a – BA8b, BA17a0, BA17ade – BB8b, BB12a, BB17a – CG8d, CG12a, CG17a, CG30a – QA35b, QM35b	

4.2 Updates to Section 6.1 Test Configurations

Revise Figure 1 in Section 6.1 Test Configurations to reflect Annex Q (revision marks relative to the TR-114 Issue 3 text).

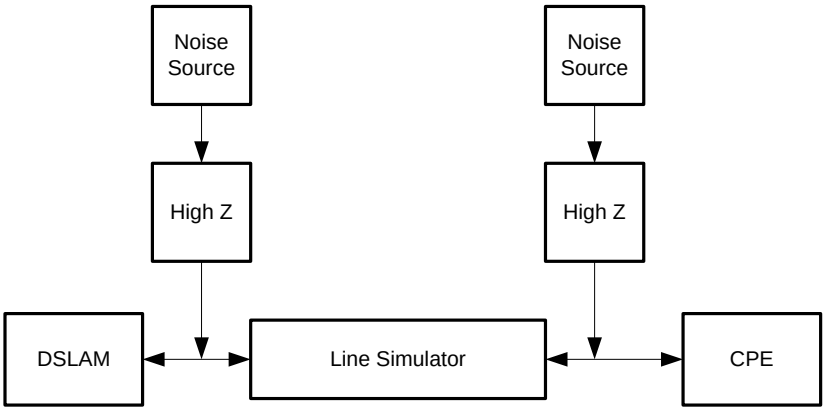

Figure 1: Test configuration for Annex A over POTS, Annex B over POTS and Annex Q over POTS testing

4.3 Updates to Section 6.2.1 Band Profiles

Amend the text of Section 6.2.1 Band Profiles to reflect Annex Q (revision marks relative to the TR-114 Issue 3 text).

6.2.1 Band Profiles

Band Profiles are used to describe the VDSL2 profile under test. The structure of the abbreviation used throughout the document for Band Profiles is as follows.

The abbreviation begins with a letter designating the G.993.2 Annex to which the profile refers. The next letter refers to the US0 type of the profile, hence indicating profiles for

- AA: G.993.2 Annex A with US0 corresponding to Annex A of G.992.5 (VDSL2 over POTS).
- BA: G.993.2 Annex B with US0 corresponding to Annex A of G.992.5 (VDSL2 over POTS). Note that the same abbreviation is used for profile 17a where US0 is not available.
- BB: G.993.2 Annex B with US0 corresponding to Annex B of G.992.5 (VDSL2 over ISDN).
- CG: G.993.2 Annex C (VDSL2 over TCM-ISDN). Note that US0 is not available.
- QA: G.993.2 Annex Q with US0 corresponding to Annex A of G.992.5 (VDSL2 over POTS with Downstream starting at 138 kHz).
- QM: G.993.2 Annex Q with US0 corresponding to Annex M of G.992.5 (VDSL2 over POTS with Downstream starting at 276 kHz).

……..

Amend the text of Table 6 Common Band Profiles with Annex Q band profiles QA35b and QM35b (revision marks relative to the TR-114 Issue 3 text).

Table 6: Common Band Profiles

Annex Q		
VDSL2 Band-profile	QA35b	QM35b
Profile	35b	35b
Annex	Q	Q
Limit PSD Mask (short name)	998E35-M2x-A (B8-19)	998ADE35-M2x-M (B8-22)
US0 type	A	M
MAXNOMATPds	+17 dBm	+17 dBm

4.4 Updates to Section 6.2.2.2 General Line Settings

Amend the text of Table 8 General line settings to reflect Annex Q (revision marks relative to the TR-114 Issue 3 text).

Table 8: General line settings

General line-setting	Parameter	Setting	Description
R-17/2/41 *(applicable for retransmission enabled profiles, including QA35b)*	RTX_MODE	2	RTX_FORCED
	IAT_REIN_RTX	0	REIN at 100Hz
	INPMIN_REIN_RTX	2	DMT symbols protection against REIN
	INPMIN_SHINE_RTX	41	DMT symbols protection against PEIN/SHINE
	SHINERATIO_RTX	2	Worst case PEIN retransmission overhead (in %)
	LEFTR_THRESH	0.78	Low rate defect threshold
	DELAYMAX_RTX	17	ms
	DELAYMIN_RTX	0	Outlet shaper off
R-12/2/8 *(applicable for QM35b)*	RTX_MODE	2	RTX_FORCED
	IAT_REIN_RTX	0	REIN at 100Hz
	INPMIN_REIN_RTX	2	DMT symbols protection against REIN
	INPMIN_SHINE_RTX	8	DMT symbols protection against PEIN/SHINE
	SHINERATIO_RTX	1	Worst case PEIN retransmission overhead (in %)
	LEFTR_THRESH	0.90	Low rate defect threshold
	DELAYMAX_RTX	12	ms
	DELAYMIN_RTX	0	Outlet shaper off

4.5 Updates to Section 6.2.2.3 General Line Settings

Amend the text of Table 10 Specific line settings to reflect Annex Q (revision marks relative to the TR-114 Issue 3 text).

Table 10: Specific line settings for Retransmission enabled tests

Specific line-setting	DS General line-setting	US General line-setting	RA-Mode	DS Expected throughput and net data rate (kbps) (ETR_RTX) (max-min) (NDR)(kbps) (max)	US Expected throughput and net data rate (kbps) (ETR_RTX) (max-min) (NDR)(kbps) (max)
RA_R-17/2/41_400_150	R-17/2/41	R-17/2/41	AT_INIT	MAXETR_RTX= 400000 MAXNDR_RTX= 400000 MINETR_RTX= 518	MAXETR_RTX= 150000 MAXNDR_RTX= 150000 MINETR_RTX= 518
RA_R-12/2/8_400_150	R-12/2/8	R-12/2/8	AT_INIT	MAXETR_RTX= 400000 MAXNDR_RTX= 400000 MINETR_RTX= 518	MAXETR_RTX= 150000 MAXNDR_RTX= 150000 MINETR_RTX= 518
FX_R-17/2/41_090_023	R-17/2/41	R-17/2/41	Manual	MAXETR_RTX= 89600 MAXNDR_RTX= 89600 MINETR_RTX= 89600	MAXETR_RTX= 22700 MAXNDR_RTX= 22700 MINETR_RTX= 22700
FX_R-12/2/8_096_019	R-12/2/8	R-12/2/8	Manual	MAXETR_RTX= 95800 MAXNDR_RTX= 95800 MINETR_RTX= 95800	MAXETR_RTX= 18700 MAXNDR_RTX= 18700 MINETR_RTX= 18700

4.6 Updates to Section 6.2.3 Profile Line Combiantions

Amend the text of Table 11 Concatenated common settings, testing combination description with Annex Q band profiles QA35b and QM35b (revision marks relative to the TR-114 Issue 3 text).

Table 11: Concatenated common settings, testing combination description

Band-profile	Specific line-setting	Profile-line combination
AA8d	RA_I_096_056	AA8d_UPBO_RA_I_096_056
AA12a	RA_I_098_058	AA12a_UPBO_RA_I_098_058
AA17a	RA_I_150_096	AA17a_UPBO_RA_I_150_096
BB17a	RA_F_150_150	BB17a_RA_F_150_150
BA17a0	RA_R-17/2/41_150_150	BA17a0_RA_R-17/2/41_150_150
QA35b	RA_R-17/2/41_400_150	QA35b_RA_R-17/2/41_400_150
QM35b	RA_R-12/2/8_400_150	QM35b_RA_R-12/2/8_400_150
etc.	etc.	etc.

4.7 Updates to Section 6.3 Test Setup

Amend the text of Section 6.3 Test Setup to reflect Annex Q (revision marks relative to the TR-114 Issue 3 text).

6.3.1.1 Splitter Requirements for Annex B and Annex Q Testing

Splitter requirements for Annex B and Annex Q are as defined in TS 101 952-2.

6.3.2.2 Loop Models for Annex B and Annex Q testing

For test cases applicable to systems using G.993.2 Annex B (Europe) and Annex Q, the loop types are straight homogeneous loops PE04 and TP100 defined in TS 101 271 Annex ZA.3. Loop type PE04 SHALL be used for all Annex B and Annex Q band profiles (Table 6), except the BA17ade, for which the loop TP100 SHALL apply.

6.3.3.2 Noise Models for Annex B and Annex Q testing

Noise models for Annex B testing of the 8b, 12a and 17a VDSL2 over POTS and VDSL2 over ISDN systems, and for Annex Q testing of 35b VDSL2 over POTS consist of two components, self crosstalk and alien crosstalk. This excludes the noise model n_BA17ade_D&UPBO that is purely self crosstalk. The noise models represent medium density scenarios MD_EX and MD_CAB27 where the SUT is deployed:

- from the local exchange (MD_EX);
- from a street cabinet located at 27 dB attenuation(at 1 MHz) from the local exchange MD_CAB27);

For each of the noise models the number of self disturbers and a link to the equivalent alien noise PSD profiles is provided together with the associated VDSL2 band-profile in Table 19. Noise models for the band-profiles with the activated DPBO and UPBO are defined in appropriate performance sections. In general, the self-disturber PSD SHALL always be associated to the band-profile.

Table 19: Noise models for Annex B testing

Noise model	Band-profile	ETSI noise scenario	Number of self disturbers	Alien noise disturber frequency profiles
n_BA8b	BA8b	MD_EX	13	see Annex D.1
n_BB8b	BB8b	MD_EX		
n_BB12a	BB12a	MD_CAB27	15	See Annex D.2
n_BA17a0	BA17a0	MD_CAB27		
n_BB17a	BB17a	MD_CAB27		
n_QA35b	QA35b	MD_CAB27	15	See Annex F
n_QM35b	QM35b	MD_CAB27		

4.8 Updates to Section 7.1 Accuracy of loop simulators and noise sources

Amend the text of Section 7.1 Accuracy of loop simulators and noise sources to reflect Annex Q (revision marks relative to the TR-114 Issue 3 text).

7.1.1.1.2 European Annex B testing and Annex Q Testing

Loop Attenuation, which corresponds to the insertion loss, is expressed in dB and SHALL be calculated from RLCG parameters using two-port ABCD modeling methodology as specified in Section B.3.1/ATIS 0600417. The line constants for PE04 and TP100 cables are specified in Table ZA.13/Annex ZA.2 of TS 101 271.

7.1.1.1.4 Calibration Related Information

Frequency boundaries used for defining test calibration are provided in Table 20.

Table 20: Loop calibration frequency boundaries for VDSL2

Profile	Band Plan	f1 (kHz) over POTS	f1 (kHz) over ISDN	f1 (kHz) over TCM-ISDN	f2 (MHz)	fdelta (kHz)
8a, b, d	998	24	120	640	8.520	12
	997	24	120	N/A	8.844	12
12a	998	20	120	640	12.000	20
	997	20	120	N/A	12.000	20
12b	998	120	120	N/A	12.000	20
	997	120	120	N/A	12.000	20
17a	998	120	120	640	17.670	30
	997	120	120	N/A	17.670	30
30a	998	150	250	640	30.000	50
	997	150	250	N/A	30.000	50
35b	998	150	250	N/A	35.350	50

NOTE: Other loop calibration frequency boundaries MAY be required for testing band profiles beyond those specified in this document.

The maximum attenuation A_{max} for use in estimating MAE and ME for the loop simulator SHALL be used from the frequency dependent Table 21.

Table 21: Maximum attenuation for loop simulator calibration

Frequency (MHz)	A_{max} (dB) (NOTE)
0.025	90
1.104	90
1.622	85
3.750	82
5.200	82

7.500	80
15.00	80
15.05	70
30.00	70
35.35	70
NOTE: Values of Amax in between the frequency points SHALL be interpolated using a log frequency scale.	

7.1.1.3.2 Input impedance for European Annex B and Annex Q testing

Input impedances SHALL be calculated from RLCG parameters using two-port ABCD modeling methodology as specified in Section B.3.1/ATIS 0600417. The line constants for PE04 and TP100 cables are specified in Table ZA.13/Annex ZA.2 (normative) of TS101271.

4.9 Updates to Section 8.1 Verification of error reporting

Amend the text of Table 23 Test procedure for verification of uncorrected DTUs reporting to reflect Annex Q (revision marks relative to the TR-114 Issue 3 text).

Table 23: Test procedure for verification of uncorrected DTUs reporting

Test Configuration	(1) Configure the SUT according to the settings of the profile-line combination under test defined in Annex B and Annex Q. (2) Test configuration (test loops, noise impairment) SHALL be according to Section B.10 and Section Q.3. (3) The test mode shall be selected with setting RTX_ENABLE = RTX_TESTMODE.
……..	

4.10 Updates to Section 8.2 Margin Verification Test

Amend the text of Table 26 Test procedure for margin verification with Retransmission enabled to reflect Annex Q (revision marks relative to the TR-114 Issue 3 text).

Table 26: Test procedure for margin verification with Retransmission enabled

Test Configuration	(1) Configure the SUT according to the settings of the profile-line combination under test defined in Annex B and Annex Q. (2) Test configuration (test loops, noise conditions) SHALL be according to Section B.11, Section B.12, Section Q.4 and Section Q.5. (3) The test mode shall be selected with setting RTX_ENABLE = RTX_TESTMODE.
……..	

4.11 Updates to Section 9.1 PTM Throughput Test

Amend the text of Section 9.1 PTM Throughput Test with Annex Q band profiles QA35b and QM35b (revision marks relative to the TR-114 Issue 3 text).

……..

Table 33: Packet throughput test bitrates

Profile-line combination	DS Expected throughput (ETR) (Mbps)	US Expected throughput (ETR) (Mbps)	Loop Length	Crosstalk
QA35b_D&UPBO_FX_R-17/2/41_090_023	89.6	22.7	50m	n_QA35b_D&UPBO
QM35b_D&UPBO_FX_R-12/2/8_096_019	95.8	18.7	50m	n_QM35b_D&UPBO

A mix of Ethernet frame sizes SHALL be used during testing, with the mix of frames being evenly distributed according to the probabilities listed in Table 33.1.

Table 33.1: Frame Size Distribution within Ethernet Traffic

Frame Size (bytes)	Probability
1566	0.050
1500	0.673
1024	0.088
256	0.014
64	0.175
NOTE: All Ethernet frame sizes being on the first byte of the Destination MAC Address and end on the last byte of the Frame Check Sequence (FCS).	

To calculate the total number of frames per second to transmit through a connection of a given bit-rate, the following calculations SHALL be used.

$$\text{Average\_Frame\_Size\_of\_Mix}\left(\frac{bytes}{frame}\right) = \left\lceil \sum_{i=1}^{M} \text{frame\_probability}(i) \times \text{frame\_size}(i) \right\rceil .$$

For the Frame Size Distribution in Table 33.1, the Average_Frame_Size_of_Mix (MIX) is 1193 bytes.

$$\text{Required\_Frame\_Rate}\left(\frac{frames}{\text{sec}}\right) = \left\lfloor \frac{\text{Required\_Throughput} \times \frac{1}{8}}{\text{Average\_Frame\_Size\_of\_Mix}} \right\rfloor ,$$

where Required_Throughput is in units of bits per second, and specified in Table 33 for each Profile-line combination.

Table 33.2: Throughput Test Results for profile QA35b_D&UPBO_FX_R-17/2/41_090_023

Analyzer Recorded Ethernet FPS			Max FPS		% of Max		Pass/Fail	
Packet Size	DS	US	DS	US	DS	US	DS	US
MIX			9388	2378				

Table 33.3: Throughput Test Results for profile QM35b_D&UPBO_FX_R-12/2/8_096_019

Analyzer Recorded Ethernet FPS			Max FPS		% of Max		Pass/Fail	
Packet Size	DS	US	DS	US	DS	US	DS	US
MIX			10037	1959				

4.12 New Annex F Alien noise disturbers for Annex Q testing

Annex F Alien noise disturbers for Annex Q testing

Linear interpolation of the PSD in dBm/Hz against log(f) SHALL be used to calculate the values between the breakpoints.

Table F.1: XA.LT and XA.NT component for MD_CAB27 noise scenario

Alien LT component for MD_CAB27 scenario			**Alien NT component for MD_CAB27 scenario**	
[Hz]	[dBm/Hz]		[Hz]	[dBm/Hz]
0.01	-30.2		0.01	-30.2
6900	-30.3		7000	-30.2
15000	-30.5		15000	-30.5
29000	-32		22000	-31
45000	-35.5		24000	-31
74000	-47.4		25000	-30.9
86000	-48		28000	-30.9
102000	-47.5		55000	-33.3
137000	-49.8		69000	-33.6
138000	-48.2		112000	-33.7
139000	-48		119000	-32.9
140000	-47.2		129000	-33
254000	-50.3		136000	-32.8
255000	-49.3		139000	-33.3
272000	-49.7		140000	-33.3
273000	-49		148000	-33.9
560000	-54.7		168000	-34.1
1104000	-63		274000	-34.3
1250000	-68.9		283000	-38.1
1622000	-81.2		301000	-42.4
2208000	-88.8		362000	-48.8
2696000	-113.1		512000	-71
2830000	-117.2		644000	-93.3
3040000	-118.2		676000	-93.3
30000000	-118.2		759000	-94
35328000	-130.0		918000	-94.5
			1030000	-94.6
			1411000	-94.6
			1630000	-104.6
			5274000	-106.5
			30000000	-106.5
			35328000	-120.0

4.13 New Annex Q for G.993.2 Annex Q Physical Layer Test Cases

Q Annex Q Physical Layer Test Cases for G.993.2 Annex Q

Q.1 Annex Q-specific Test Setup Information

Test configurations associated with the VDSL2 over POTS (VDSL2oPOTS) deployments with Annex Q band profiles are defined in Table 1**.**

Table 1: Annex Q test configurations

Type of VDSL2 deployment	Band-profile	Test configuration
VDSL2oPOTS	QA35b	Figure 1
	QA35b_D&UPBO	
	QM35b	
	QM35b_D&UPBO	

The specific SUT's settings as defined in Section 6.2 SHALL be used.

Q.1.1 Pass/fail criteria for Annex Q testing

Tests SHALL be performed according to the general procedure described in Section 8. Testing is defaulted to no PBO unless specified in specific test procedure.

- For sections with more than 3 test loops, if more than 10% of the data rates are less than the data rate requirements in a section, then the DSLAM/CPE pair fails the data rate requirements of that section.
- For sections with less than 4 test loops, the data rate requirement is indicated per table.

In addition to achieving the required rate, both downstream and upstream noise margin values are to be considered in determining the result of an individual section. It is acknowledged that achieving a desired noise margin is primarily the responsibility of the receiver. That is, the DSLAM is primarily responsible for achieving desired upstream noise margins, while the CPE is primarily responsible for achieving desired downstream noise margins. Table 2 outlines the pass/fail criteria on the reported noise margin.

Table 2: Noise margin pass/fail requirements

Reported Noise Margin (dB)	Requirement
< 5	On no test point
≥ 5 and < 5.8	On at most 10% of the test points
≥ 5.8	On at least 90% of the test points

All values SHALL be collected at the DSLAM.

Overall pass/fail criteria for each rate adaptive test are as follows:

- If any reported noise margin is less than 5 dB, then the DSLAM/CPE pair fails the noise margin requirements of that section.
- If more than 10% of the reported noise margins are less than 5.8 dB in a section, then the DSLAM/CPE pair fails the noise margin requirements of that section.

- If more than 10% of the data rates are less than the data rate requirements in a section, then the DSLAM/CPE pair fails the data rate requirements of that section.
- If the DSLAM/CPE pair passes both the data rate and noise margin requirements, it passes the section; otherwise, it fails the section.

Table 3 lists the number of test points per section or table corresponding to the 10% limit mentioned above.

Table 3: Data rate pass/fail requirements for rate adaptive testing

Section number	Number of test cases	10% limit
Q.6	8	7
Q.7	8	7
Q.8	8	7
Q.9	8	7

Q.1.2 Noise impairments

The noise is specified in TS 101 271 and includes the crosstalk noise and the white noise (NEXT noise generator G1, FEXT noise generator G2 and the white noise generator G4).

Noise generators G1 and G2 are injected on one side at a time.

The white noise generator G4 SHALL be set to –140 dBm/Hz at both ends of the loop.

Q.1.2.1 Crosstalk Impairment G1 and G2

Crosstalk impairment includes the NEXT noise generator G1 and FEXT noise generator G2. It is defined as follows.

The crosstalk coupling functions NEXT and FEXT SHALL be calculated using the transfer function equations from Section ZA.1.3.3/TS 101 271.

For the generic n_XYZ noise the following applies:

- the alien noise disturber frequency domain profiles are associated with the ETSI noise scenario (MD_CAB27) as described in section 6.3.3.2, in a unique way and SHALL be as defined in Annex D.2; these are given in dBm/Hz.
- the self noise disturber frequency domain profile depends on the number (N) of self disturbers and is associated with the VDSL2 Band-profile (XYZ) which implicitly defines the single self-disturber PSD template for the LT side (US bands) and the NT side (DS bands).

Let $P_{Alien\text{-}XYZ,SS}$ be the alien PSD for the generic n_XYZ noise at the SS side (SS=LT, NT) in W/Hz. Let $P_{Self\text{-}XYZ,SS}$ be the self-disturber PSD for the generic n_XYZ noise at the SS side (SS=LT, NT) in W/Hz.

The PSD of the noise generators G1 and G2 for the generic n_XYZ noise is a weighted sum of the self-crosstalk and alien crosstalk profiles, as specified in Section 9.3.3/TS 101 271.

At DSLAM side:

- G1 = (XA.LT.n_XYZ ∗ XS.LT.n_XYZ), with NEXT coupling function

- G2 = (XA.NT.n_XYZ ∗ XS.NT.n_XYZ), with FEXT coupling function

At CPE side:

- G1 = (XA.NT.n_XYZ ∗ XS.NT.n_XYZ), with NEXT coupling function
- G2 = (XA.LT.n_XYZ ∗ XS.LT.n_XYZ), with FEXT coupling function

Symbol "∗" refers to the FSAN crosstalk sum $P_{XYZ,SS}$ of two PSDs in W/Hz, the alien $P_{Alien-XYZ,SS}$ and self-crosstalk $P_{Self-XYZ,SS}$ PSD:

Formula Q-1

$$P_{XYZ,SS}=\left[P_{Alien-XYZ,SS}^{1/0.6}+P_{Self-XYZ,SS}^{1/0.6}\right]^{0.6}$$

The alien crosstalk (XA) profiles (XA.LT.n_XYZ, XA.NT.n_XYZ) are defined in Annex D. Self-crosstalk (XS) profiles (XS.LT.n_XYZ, XS.NT.n_XYZ) are specified in Table 4 and describe the self-crosstalk portion of an equivalent disturber co-located at the LT and NT end of the loop.

Table 4: Power calculation of the XS profiles LT and NT

	MD_CAB27
XS.LT.n_XYZ	$P_{SingleSelf-XYZ,LT}$ + 7.06dB
XS.NT.n_XYZ	$P_{SingleSelf-XYZ,NT}$ + 7.06dB

The value of 7.06dB represents the power generated by the sum of 15 disturbers, which is added to the single self-disturber PSD $P_{SingleSelf-XYZ,SS}$ for the generic n_XYZ noise at the SS side (SS=LT, NT).

The following clause specifies the method of computation that applies for the single self-disturber PSD PSingleSelf-XYZ,SS. The basic PSD template corresponds to the associated VDSL2 Band-profile (XYZ) as per G.993.2 Amendment 2 [2]. This is considered constant regardless of the loop length corresponding to the specific test point. The single self-disturber PSD $P_{SingleSelf-XYZ,SS}$ is always defined for the complete frequency spectrum as given by the Band-profile configuration. No power reallocation to lower frequencies is taken into account as the loop length increases from one test point to the next.

The following steps SHALL be applied:

- identify the basic PSD template that corresponds to the associated VDSL2 Band-profile (XYZ). where required, apply to the above basic PSD template the DPBO and UPBO shaping of the associated VDSL2 Band-profile (XYZ) to calculate a shaped PSD template. NOTE: for upstream shaped PSD templates the kl_0 value varies with the test point.
- apply a flattening operation that consists in lowering all the highest levels of the above shaped PSD template to a single flattening level. This flattening level is determined on a PSD grid of 0.01dB such that the power under the resulting template up to a frequency of 35.328MHz (for all band plans up to 35MHz) is less or equal, and as close as possible, to the MAXNOMATP of the associated VDSL2 Band-profile (XYZ) (as per Table Q-1/ G.993.2 Amendment 2 [2]), both for upstream and downstream. The calculated flattened PSD template corresponds to the $P_{SingleSelf-XYZ,SS}$.

Q.1.3 Verification of bits, gains and NOMATP values

Downstream and upstream bits, gains and NOMATPds values SHALL be verified prior to collecting the performance measurements. The procedure and expected results are provided in Table 5.

Table 5: Verification of bits, gains and NOMATP values

Test Configuration	(1)Configure the SUT in the RA_R-17/2/41 for QA35b and RA_R-12/2/8 for QM35b band profiles. If for the specific band-profile the profile-line combinations are defined with UPBO and/or DPBO enabled, apply the related PBO configuration parameters defined in the Annex Q performance sections. (2)The DSLAM and CPE are connected in turn through the following test loops: • QA35b: 150m, 450m • QM35b: 150m, 450m
Method of Procedure	(1)Train the modem in the chosen test loop and band-profile. (2)Not sooner than two minutes after entering steady state operation (a.k.a. Showtime), record the reported downstream bi (bits) and gi (gains) values (BITSpsds and GAINSpsds) and upstream bi (bits) and gi (gains) values (BITSpsus and GAINSpsus).

Expected Result	1. In downstream, the g_i settings (in the bits-and-gains table) SHALL comply with the following requirements: (1)If $b_i > 0$, then g_i SHALL be in the [−14.5 to +2.5] (dB) range. (2)If $b_i > 0$, then the linear average of the g_i^2's in any band (as specified during the initialization procedure, see G.993.2 [2] §12.3.2) SHALL be ≤ 1. (3)If $b_i = 0$, then g_i SHALL be equal to 0 (linear) or in the [−14.5 to 0] (dB) range. (4)The NOMATP value calculated as: $$\text{NOMATP} = 10\log_{10}\Delta f + 10\log_{10}\left(\sum_{i\in\text{MEDLEY set}}\left(10^{\frac{\text{MREFPSD}[i]}{10}} g_i^2\right)\right)$$ SHALL NOT exceed the configured MAXNOMATPds and SHALL NOT exceed the maximum power specified for the VDSL2 profile under test. 2. In upstream, the g_i settings (in the bits-and-gains table) SHALL comply with the following requirements: (1)If $b_i > 0$, then g_i SHALL be in the [−14.5 to +2.5] (dB) range. (2)If $b_i > 0$, then the linear average of the g_i^2's in any band (as specified during the initialization procedure, see G.993.2 [2] §12.3.2) SHALL be ≤ 1. (3)If $b_i = 0$, then g_i SHALL be equal to 0 (linear) or in the [−14.5 to 0] (dB) range. (4)The NOMATP value calculated as: $$\text{NOMATP} = 10\log_{10}\Delta f + 10\log_{10}\left(\sum_{i\in\text{MEDLEY set}}\left(10^{\frac{\text{MREFPSD}[i]}{10}} g_i^2\right)\right)$$ SHALL NOT exceed the configured MAXNOMATPus and SHALL NOT exceed the maximum power specified for the VDSL2 profile under test.

Q.2 Long Term Stability Testing for Annex Q

Table 6: Long term stability test procedure

<table>
<tr><td>Test Configuration</td><td>(1)Depending on the band-profile under test, select the appropriate profile-line combination and loop length from the below table:
<table>
<tr><th>Band-profile</th><th>Loop Length (m, PE04 or TP100)</th></tr>
<tr><td>QA35b_RA_R-17/2/41_400_150</td><td>150</td></tr>
<tr><td>QM35b_RA_R-12/2/8_400_150</td><td>150</td></tr>
<tr><td>QA35b_D&UPBO_RA_R-17/2/41_400_150</td><td>150</td></tr>
<tr><td>QM35b_D&UPBO_RA_R-12/2/8_400_150</td><td>150</td></tr>
</table>
(2) Configure the SUT for PTM transport.
(3) The following parameters SHALL be indicated as follows:
• TARSNMRds = 9 dB
• MAXSNRMds = 18 dB
• packet size: 1500 bytes
(4) The loop simulator SHALL be configured to the value chosen above.
(5) Inject -140 dBm/Hz white noise at both ends of the loop.</td></tr>
<tr><td>Method of Procedure</td><td>(1)Train the CPE with the DSLAM.
(2)Wait for 1 minute after initialization.
(3)Check the reported margin and document as the initial reported margin.
(4)Adjust the noise level at the CPE side until the reported CPE-side margin is approximately 9 dB.
(5)Configure the traffic generator/analyzer to provide MAC frames, both upstream and downstream, at 85% of the net data rate.
(6)Run for four hours with constant noise level.
(7)If there are more than 2 ES, then the measurement SHALL be extended for up to an additional four-hour period (for a maximum of 8 hours).</td></tr>
<tr><td>Expected Result</td><td>(1)The customer end modem SHALL NOT lose synchronization at any time during the test.
(2)If during any 4 hour sliding window there are fewer than 3 ES and no SES then the CPE passes the test.</td></tr>
</table>

Q.3 VDSL2oPOTS test cases for error reporting verification test

Q.3.1 Test cases for uncorrected DTUs reporting verification test

Uncorrected DTUs reporting tests SHALL be performed according to Section 8.1.2. Testing consists of two test conditions randomly selected from the 3 described in the tables for any given profile-line combination. Test loops and noise impairment are listed in Table 7.

Table 7: VDSL2oPOTS test cases for uncorrected DTUs reporting verification test

Profile-line combination	Loop length and type		Noise impairment	RTXUC Count	ES Count	Pass/ Fail
QA35b_RA_R-17/2/41_400_150	50 m	PE04	n_QA35b			
	150 m					
	450 m					
QA35b_D&UPBO_RA_R-17/2/41_400_150	50 m	PE04	n_QA35b_D&UPBO			
	150 m					
	450 m					
QM35b_RA_R-12/2/8_400_150	50 m	PE04	n_QM35b			
	150 m					
	450 m					
QM35b_D&UPBO_RA_R-12/2/8_400_150	50 m	PE04	n_QM35b_D&UPBO			
	150 m					
	450 m					

Q.4 VDSL2oPOTS test cases for downstream margin verification test

Q.4.1 Test cases for downstream margin verification test with Retransmission enabled

Downstream margin verification testing SHALL be performed according to Section 8.2.2 and Table 8. Testing consists of two test conditions randomly selected from the 3 described in the tables for any given profile-line combination.

Table 8: **Downstream margin verification for VDSL2oPOTS (PE04) with Retransmission enabled**

Profile-line combination	Length (m)	Crosstalk	Test Time (minutes)	SES Count	RTXUC Count	Estimated P_{DTU}	Pass/Fail
QA35b_RA_R-17/2/41_400_150	50	n_QA35b	10				
	150		10				
	450		10				
QA35b_D&UPBO_RA_R-17/2/41_400_150	50	n_QA35b_D&UPBO	10				
	150		10				
	450		10				
QM35b_RA_R-12/2/8_400_150	50	n_QM35b	10				
	150		10				

	450		10				
QM35b_D&UPBO_RA_R-12/2/8_400_150	50	n_QM35b_D&UPBO	10				
	150		10				
	450		10				

Q.5 VDSL2oPOTS test cases for upstream margin verification test

Q.5.1 Test cases for upstream margin verification test with Retransmission enabled

Upstream margin verification testing SHALL be performed according to Section 8.2.2 and Table 9. Testing consists of two test conditions randomly selected from the 3 described in the tables for any given profile-line combination.

Table 9: **Upstream margin verification for VDSL2oPOTS (PE04) with Retransmission enabled**

Profile-line combination	Length (m)	Crosstalk	Test Time (minutes)	SES Count	RTXUC Count	Estimated P_{DTU}	Pass/Fail
QA35b_RA_R-17/2/41_400_150	50	n_QA35b	10				
	150		10				
	450		10				
QA35b_D&UPBO_RA_R-17/2/41_400_150	50	n_QA35b_D&UPBO	10				
	150		10				
	450		10				
QM35b_RA_R-12/2/8_400_150	50	n_QM35b	10				
	150		10				
	450		10				
QM35b_D&UPBO_RA_R-12/2/8_400_150	50	n_QM35b_D&UPBO	10				
	150		10				
	450		10				

Q.6 Rate Adaptive Performance tests for QA35b

The tests with retransmission-enabled profiles are designed to be passed by implementations with a MAXDELAYOCTET-split parameter (MDOSPLIT) set to 80%.

Noise n_QA35b settings as defined in section 6.3.3.2.

8 individual tests – 7 tests SHALL be passed

Table 10: Performance tests with QA35b_RA_R-17/2/41_400_150

Loop Length (m, PE04 loop)	QA35b_RA_R-17/2/41_400_150							
	Downstream				Upstream			
	Actual net data rate (kbps)			Noise Margin, Reported (dB)	Actual net data rate (kbps)			Mar gin, Repo
	Expected	Measured	Pass/Fail		Expected	Measured	Pass/Fail	
50	96500				33700			
150	69000				26500			
300	56400				23400			
450	41300				18800			

Q.7 Rate Adaptive Performance tests for QM35b

The tests with retransmission-enabled profiles are designed to be passed by implementations with a MAXDELAYOCTET-split parameter (MDOSPLIT) set to 80%.

Noise n_QM35b settings as defined in section 6.3.3.2.

8 individual tests – 7 tests SHALL be passed

Table 11: Performance tests with QM35b_RA_R-12/2/8_400_150

Loop Length (m, PE04 loop)	QM35b_RA_R-12/2/8_400_150							
	Downstream				Upstream			
	Actual net data rate (kbps)			Noise Margin, Reported (dB)	Actual net data rate (kbps)			Noise Margin, Reported (dB)
	Expected	Measured	Pass/Fail		Expected	Measured	Pass/Fail	
50	102400				26900			
150	72100				21900			
300	60700				19200			
450	44400				16200			

Q.8 Rate adaptive performance tests for QA35b with DPBO and UPBO

The tests with retransmission-enabled profiles are designed to be passed by implementations with a MAXDELAYOCTET-split parameter (MDOSPLIT) set to 80%.

The basic QA35b Band Profile SHALL be applied with the following modifications to the "Common Line Settings" specified in Table 7 in [1] to define the shaped-PSD Band Profile QA35b_D&UPBO:

Table 12: Common Line Settings for QA35b_D&UPBO Band Profile

Parameter	Setting	Description
All parameters but those specified below	Value as specified in Table 7 in [1]	
DPBOEPSD	ADSL2plus Annex A	PSD mask that is assumed to be permitted at the exchange
DPBOESEL	27dB@1MHz	E-side electrical length
DPBOESCMA	0.1924	Model of the frequency dependent loss of E-side cable: scalars DPBOESCMA (NOTE)
DPBOESCMB	0.5960	Model of the frequency dependent loss of E-side cable: scalars DPBOESCMB (NOTE)
DPBOESCMC	0.2086	Model of the frequency dependent loss of E-side cable: scalars DPBOESCMC (NOTE)
DPBOMUS	-95 dBm/Hz	Minimum usable receive signal PSD mask
DPBOFMIN	138 kHz	Minimum frequency from which on the DPBO SHALL be applied
DPBOFMAX	2208 kHz	Maximum frequency up to which the DPBO SHALL be applied
UPBOKLF	0	Force CO-MIB electrical loop length (means that kl_0 is estimated during training)
UPBOKL	estimated during training	Upstream electrical loop length (kl_0)
UPBOA US0	40.00	A and B values US band 0 (these values imply no UPBO)
UPBOB US0	0	
UPBOA US1	47.30	A value US band 1
UPBOB US1	21.14	B value US band 1
UPBOA US2	54.00	A value US band 2
UPBOB US2	16.29	B value US band 2
UPBOA US3	54.00	A value US band 3
UPBOB US3	16.29	B value US band 3
NOTE: the values of DPBOESCMA, B and C are referred to a PE04 loop. Values that are configured according to G.997.1 SHALL be rounded to the nearest scalar value.		

The following profile-line combinations SHALL be configured on the equipment under test:

Table 13: Profile-line combination for QA35b_D&UPBO

Profile-line combination	Band-profile	Specific line-setting
QA35b_D&UPBO_RA_R-17/2/41_400_150	QA35b_D&UPBO	RA_R-17/2/41_400_150

The noise model n_QA35b_D&UPBO defined in Table 14 SHALL be used, which is coherent with the noise models framework specified in section 6.3.3.2:

Table 14: Noise model n_QA35b_D&UPBO

Noise model	Associated band-profile	Self noise disturbers	Alien noise disturbers
n_QA35b_D&UPBO	QA35b_D&UPBO	MD_CAB27	ETSI MD_CAB27 Annex F

For this Band Profile the value of kl_0 (UPBOKL) is estimated by the SUTs during training. The PSD of a single self-disturber SHALL be deterministically defined by the settings of Table 12 above using kl0 values for calculation of the single self-disturber PSD listed in Table 15.

Table 15: kl_0 for calculation of the single self-disturber PSD for QA35b_D&UPBO

Loop Length (m, PE04 loop)	kl_0 (UPBOKL) (dB @ 1MHz)
50	1.8
150	3.7
300	7.4
450	11.1

NOTE: Section 7.2.1.3.2.2/G993.2 [2] states: "If the estimated value of kl0 is smaller than 1.8, the modem shall be allowed to perform power back-off as if kl0 were equal to 1.8. The estimate of the electrical length should be sufficiently accurate to avoid spectrum management problems and additional performance loss." Therefore noise calculations SHALL assume kl0 value of 1.8dB which will simulate UPBO shaped disturbers at 50m line length in a more realistic way.

8 individual tests – 7 tests SHALL be passed

Table 16: Performance tests with QA35b_D&UPBO_RA_R-17/2/41_400_150

Loop Length (m, PE04 loop)	QA35b_D&UPBO_RA_R-17/2/41_400_150							
	Downstream				Upstream			
	Actual net data rate (kbps)			Noise Margin, Reported (dB)	Actual net data rate (kbps)			Noise Margin, Reported (dB)
	Expected	Measured	Pass/Fail		Expected	Measured	Pass/Fail	
50	99500				24100			
150	70800				21300			
300	59700				20500			
450	45800				19400			

Q.9 Rate adaptive performance tests for QM35b with DPBO and UPBO

The tests with retransmission-enabled profiles are designed to be passed by implementations with a MAXDELAYOCTET-split parameter (MDOSPLIT) set to 80%.

The basic QM35b Band Profile SHALL be applied with the following modifications to the "Common Line Settings" specified in Table 7 in [1] to define the shaped-PSD Band Profile QM35b_D&UPBO:

Table 17: Common Line Settings for QM35b_D&UPBO Band Profile

Parameter	Setting	Description
All parameters but those specified below	Value as specified in Table 7 in [1]	
DPBOEPSD	ADSL2plus Annex B	PSD mask that is assumed to be permitted at the exchange
DPBOESEL	27dB@1MHz	E-side electrical length
DPBOESCMA	0.1924	Model of the frequency dependent loss of E-side cable: scalars DPBOESCMA (NOTE)
DPBOESCMB	0.5960	Model of the frequency dependent loss of E-side cable: scalars DPBOESCMB (NOTE)
DPBOESCMC	0.2086	Model of the frequency dependent loss of E-side cable: scalars DPBOESCMC (NOTE)
DPBOMUS	-95 dBm/Hz	Minimum usable receive signal PSD mask
DPBOFMIN	254 kHz	Minimum frequency from which on the DPBO SHALL be applied
DPBOFMAX	2208 kHz	Maximum frequency up to which the DPBO SHALL be applied
UPBOKLF	0	Force CO-MIB electrical loop length (means that kl_0 is estimated during training)
UPBOKL	estimated during training	Upstream electrical loop length (kl_0)
UPBOA US0	40.00	A and B values US band 0 (these values imply no UPBO)
UPBOB US0	0	
UPBOA US1	47.30	A value US band 1
UPBOB US1	21.14	B value US band 1
UPBOA US2	54.00	A value US band 2
UPBOB US2	16.29	B value US band 2
NOTE: the values of DPBOESCMA, B and C are referred to a PE04 loop. Values that are configured according to G.997.1 SHALL be rounded to the nearest scalar value.		

The following profile-line combinations SHALL be configured on the equipment under test:

Table 18: Profile-line combination for QM35b_D&UPBO

Profile-line combination	Band-profile	Specific line-setting
QM35b_D&UPBO_RA_R-12/2/8_400_150	QM35b_D&UPBO	RA_R-12/2/8_400_150

The noise model n_QM35b_D&UPBO defined in Table 19 SHALL be used, which is coherent with the noise models framework specified in section 6.3.3.2:

Table 19: Noise model n_QM35b_D&UPBO

Noise model	Associated band-profile	Self noise disturbers	Alien noise disturbers
n_QM35b_D&UPBO	QM35b_D&UPBO	MD_CAB27	ETSI MD_CAB27 Annex F

For this Band Profile the value of kl_0 (UPBOKL) is estimated by the SUTs during training. The PSD of a single self-disturber SHALL be deterministically defined by the settings of Table 17 above using kl0 values for calculation of the single self-disturber PSD listed in Table 20.

Table 20: kl_0 for calculation of the single self-disturber PSD for QM35b_D&UPBO

Loop Length (m, PE04 loop)	kl_0 (UPBOKL) (dB @ 1MHz)
50	1.8
150	3.7
300	7.4
450	11.1

NOTE: Section 7.2.1.3.2/G993.2states: "If the estimated value of kl0 is smaller than 1.8, the modem SHALL be allowed to perform power back-off as if kl0 were equal to 1.8. The estimate of the electrical length should be sufficiently accurate to avoid spectrum management problems and additional performance loss." Therefore noise calculations SHALL assume kl0 value of 1.8dB which will simulate UPBO shaped disturbers at 50m line length in a more realistic way.

8 individual tests –7 tests SHALL be passed

Table 21: Performance tests with QM35b_D&UPBO_RA_R-12/2/8_400_150

Loop Length (m, PE04 loop)	QM35b_D&UPBO_RA_R-12/2/8_400_150							
	Downstream				Upstream			
	Actual net data rate (kbps)			Noise Margin, Reported (dB)	Actual net data rate (kbps)			Noise Margin, Reported (dB)
	Expected	Measured	Pass/Fail		Expected	Measured	Pass/Fail	
50	105400				20100			
150	75300				18100			
300	64300				17500			
450	45900				16600			

Q.10 REIN Testing for QA35b_D&UPBO and QM35b_D&UPBO profiles

Q.10.1 Common Line Setting Variations

The QA35b_D&UPBO and QM35b_D&UPBO Band Profiles SHALL be as defined in Table 12 and Table 17. The profile-line combination QA35b_D&UPBO_RA_R-17/2/41_400_150 and QM35b_D&UPBO_RA_R-12/2/8_400_150, as defined in Table 13 and Table 18, SHALL be configured on the SUT.

Q.10.2 Noise Models

The noise model n_QA35b_D&UPBO and n_QM35b_D&UPBO defined in Table 14 and Table 19 SHALL be used. The REIN noise SHALL be as defined for profile BA17ade (see Section B.20.2 [1]).

Q.10.3 REIN testing in rate adaptive mode

The test procedure is described in Table 22.

Table 22: REIN test procedure – rate adaptive mode

Test Configuration	(1) The test set-up is to be configured according to Section 6.1 as appropriate for the modems under test. The test loop SHALL be PE04 straight homogeneous loop. (2) Configure the SUT in the selected rate adaptive profile-line combination. (3) The DSLAM and CPE are connected in turn through each loop length specified in Table 23 and Table 24. (4) The crosstalk noise impairment n_QA35b_D&UPBO or n_QM35b_D&UPBO, depending on the profile under test, SHALL be applied at both DSLAM and CPE. (5) Additive Gaussian White noise at -140 dBm/Hz is injected at both DSLAM and CPE. (6) The REIN noise impairment SHALL be applied at both DSLAM and CPE in addition to the crosstalk noise and the AWGN. The REIN sources SHALL be coming from a single source to ensure they are synchronous.
Method of Procedure	(1)Train the link in the presence of the crosstalk noise, AWGN and REIN impairments. (2)Wait for 1 minute after initialization for bitswaps to settle. (3)Record the actual net data rate R (kbps) and the number of SES and ES that occur during the following 2 minutes.
Expected Result	(1)The broadband link SHALL operate in the presence of the REIN. (2)If the link fails to train within 2 minutes or the connection is dropped before the end of the test, the result SHALL be declared a fail. (3)The number of reported ES SHALL be ≤ 1. (4)The number of reported SES SHALL be zero.

The following tables define a set of three tests. In each test, the crosstalk and REIN noise impairment is injected at both sides, DSLAM and CPE, and both downstream and upstream data rate, reported margin, SES and the ES count are recorded during the test. In total there are 6 test points (3 in downstream and 3 in upstream) and the SUT SHALL pass a minimum of five of these test points.

Table 23: REIN testing in rate adaptive mode for QA35b_D&UPBO

QA35b_D&UPBO											
				Downstream				**Upstream**			
Loop Length (m, PE04)	**Target Margin DS (dB)**	**Target Margin US (dB)**	**Link trained and did not loose sync?**	**ACTNDR (kbps)**	**Reported ES**	**Noise Margin, Reported (dB)**	**Pass/Fail**	**ACTNDR (kbps)**	**Reported ES**	**Noise Margin, Reported (dB)**	**Pass/Fail**
50	6	6									
150	6	6									
450	6	6									

Table 24: REIN testing in rate adaptive mode for QM35b_D&UPBO

QM35b_D&UPBO											
				Downstream				Upstream			
Loop Length (m, PE04)	Target Margin DS (dB)	Target Margin US (dB)	Link trained and did not loose sync?	ACTNDR (kbps)	Reported ES	Noise Margin, Reported (dB)	Pass/Fail	ACTNDR (kbps)	Reported ES	Noise Margin, Reported (dB)	Pass/Fail
50	6	6									
150	6	6									
450	6	6									

Q.11 Single High Impulse Noise (SHINE) Testing for QA35b_ D&UPBO and QM35b_ D&UPBO profiles

Q.11.1 Common Line Setting Variations

The QA35b_D&UPBO and QM35b_D&UPBO Band Profiles SHALL be as defined in Table 12 and Table 17. The profile-line combination QA35b_D&UPBO_RA_R-17/2/41_400_150 and QM35b_D&UPBO_RA_R-12/2/8_400_150, as defined in Table 13 and Table 18, SHALL be configured on the SUT.

Q.11.2 SHINE Noise Models

The noise model n_QA35b_D&UPBO and QM35b_D&UPBO_RA_I_150_150 defined in Table 14 and Table 19, SHALL be used. For QA35b_D&UPBO Band and QM35b_D&UPBO Band Profiles, the SHINE noise SHALL be as defined for profile BA17ade (see Section B.21.2) but from 138 kHz up to 35.0 MHz.

Q.11.3 SHINE testing in rate adaptive mode

The test procedure is described in Table 25.

Table 25: SHINE rate adaptive test procedure

Test Configuration	(1) The test set-up is to be configured according to Section 6.1 as appropriate for the modems under test. The test loop SHALL be straight homogeneous PE04 loop. (2) Configure the SUT in the selected rate adaptive profile-line combination. Target noise margin SHALL be set to 6dB. (3) The DSLAM and CPE are connected in turn through each loop specified in Table 26. (4) The crosstalk noise impairment n_QA35b_D&UPBO or n_QM35b_D&UPBO SHALL be applied at both DSLAM and CPE. (5) Additive Gaussian White noise at -140 dBm/Hz is injected at both DSLAM and CPE. (6) The SHINE noise impairment SHALL be applied at the CPE in addition to the crosstalk noise and the AWGN.

Method of Procedure	(1) The link is trained in the presence of the crosstalk noise and the AWGN impairments. (2) Wait for 60s after initialization for bitswaps to settle. (3) The SHINE is applied at the CPE. The duration of the SHINE is as specified in Table 26. (4) Wait for 10s after the end of the SHINE. (5) Record the SES and ES count that occurs during the following 60s.
Expected Result	(1) The modem SHALL NOT retrain during the application of the SHINE event and for 70s after the end of the SHINE event; (2) The number of reported ES that occur between 10s and 70s after the SHINE event SHALL be ≤ 1 (3) The number of reported SES that occur between 10s and 70s after the SHINE event SHALL be zero.

Table 26 defines a set of two tests for each Band Profile. Each test SHALL be repeated 3 times. The CPE SHALL pass all 3 tests for each burst length.

Table 26: SHINE test loop and burst lengths

Loop Length (m, PE04) for QA35b_D&UPBO and QM35b_D&UPBO Band Profiles	**Burst length[1] (ms)**
150	1000
150	100
NOTE: The burst length SHOULD be controllable with a resolution of 10 ms.	

4.14 Updates to Appendix III Summary of Profile and Line Combinations (informative)

Amend the text of Appendix III Summary of Profile and Line Combinations to reflect Annex Q (revision marks relative to the TR-114 Issue 3 text).

Table 205: Summary of profile-line combinations used in TR-114 Issue 3

VDSL2 Band-profile	Specific line-setting	Profile-line combination
……..		
Annex Q		
QA35b	RA_R_R-17/2/41_400_150	QA35b_RA_R-17/2/41_400_150
QA35b_D&UPBO	RA_R_R-17/2/41_400_150	QA35b_D&UPBO_RA_R-17/2/41_400_150
QA35b_D&UPBO	FX_R-17/2/41	QA35b_D&UPBO_FX_R-17/2/41_090_023
QM35b	RA_R_R-12/2/8_400_150	QA35b_RA_R-12/2/8_400_150
QM35b_D&UPBO	RA_R_R-12/2/8_400_150	QM35b_D&UPBO_RA_R-12/2/8_400_150
QM35b_D&UPBO	FX_R-12/2/8	QM35b_D&UPBO_FX_R-12/2/8_096_019

4.15 New Appendix on Crosstalk impairment for Annex Q performance tests (informative)

Appendix VIII Crosstalk impairment for Annex Q performance tests (informative)

QA35b_PE04_0150m.xlsx file contains the crosstalk impairment for QA35b performance tests, defined in Section Q.6, on 150m PE04 loop

QA35b_PE04_0150m_PBO.xlsx file contains the crosstalk impairment for QA35b performance tests, defined in Section Q.8, on 150m PE04 loop.

QM35b_PE04_0150m.xlsx file contains the crosstalk impairment for QM35b performance tests, defined in Section Q.7, on 150m PE04 loop.

QM35b_PE04_0150m_PBO.xlsx file contains the crosstalk impairment for QM35b performance tests, defined in Section Q.9, on 150m PE04 loop.

End of Broadband Forum Technical Report TR-114