MRJ21 10G System.

1. INTRODUCTION

1.1 Purpose

Testing was performed on MRJ21 10G System, to determine its conformance to the requirements of CommScope Product Specification 108-93046, Rev. F.

1.2 Scope

This report covers the electrical, mechanical, environmental and transmission performance of the MRJ21 10G System manufactured by CommScope.
The testing was performed between June 16th, 2012 and February 4th, 2014.

1.3 Conclusion

Tested MRJ21 10G System meet the electrical, mechanical, environmental and transmission performance requirements of CommScope Product Specification 108-93046, Rev. F.

1.4 Product Description

The MRJ21 10G System comprised of a fully shielded board mounted receptacle and a shielded cable assembly, is intended for use in networking applications where density and high performance is required.

1.5 Test Samples

Tested samples were randomly selected from pre-production and normal current production lots, and the following part numbers (PN) were used for tests:

6 samples of 24 ports MRJ21 10G panel MRJ21 10GbE	PN 2153041.
2 samples of 48 ports MRJ21 10G panel MRJ21 10GbE	PN 2153046.
12 samples of cable assembly MRJ21/MRJ21 10G LSZH	PN 2153052-X.
6 samples of cable assembly MRJ21/MRJ21 45º 10G LSZH	PN 2153078-X.
17 samples of cable assembly MRJ21/MRJ21 10G CMR	PN 2111521-X.
6 samples of cable assembly MRJ21/MRJ21 45º 10G CMR	PN 2111522-X.
5 samples of PCB assembly MRJ21 10G 8 port	PN 2153043.
Cable 16 pairs (4x4) Cat6A S/U/FTP 24AWG solid in the following configurations	PN 2153051.

- 1 cable (16 pairs)
- 7 cables (6 around 1) (112 pairs)
- 19 cables (12 around 6 around 1) (304 pairs)

1.6 Qualification Test Sequence

Test or Examination	Test group									
	1	2	3	4	5	6	7	8	9	10
	Test sequence (a)									
General examination	1,16	1,13	1,9	1,9	1,13	1,8	1,6	1,5	1,9	
Voltage proof	4	4,12	4,8	4,8		4			4,12	
Current carrying capacity / temperature derating							3			
Current carrying capacity (PoE+ 600mA pair) / temperature derating on cable										1
Contact resistance, plug/receptacle interface.							4		2,7, 10	
Input to output DC resistance (signal and shield)	2,7,9, 12,15	2,6,8, 10	2,6	2,6		2,6	2,5	2,4		
Insulation resistance	3,10	3,11	3,7	3,7		3,7			3,11	
Surge						5				
Plug to receptacle insertion/withdrawal force	5,13									
Cable to plug retention (perpendicular loading, bending)								3		
Effectiveness of connector coupling device (axial loading)	6,14									
Mechanical operations with electrical load									5,8	
Mechanical operation (durability)		5,9								
Vibration			5							
Rapid change of temperature	8									
Cyclic damp heat	11									
Flowing mixed gas corrosion		7							6	
Electrical load and temperature				5						
Insertion Loss (Channel configuration)					2					
Return Loss (Channel configuration)					3					
Delay parameter (Channel configuration)					4					
Next loss (Channel configuration)					5					
PSNext loss (Channel configuration)					6					
ACRF loss (Channel configuration)					7					
PSACRF loss (Channel configuration)					8					
PSANEXT loss (Channel configuration)					9					
PSANEXT average loss (Channel configuration)					10					
PSAACRF (Channel configuration)					11					
Coupling attenuation					12					

NOTE *(a) Numbers indicate sequence in which tests are performed.*

2. SUMMARY OF TESTING

2.1 General examination – All Groups.

All samples submitted for testing were selected from normal current production lots.

2.2 Contact Resistance, plug/receptacle interface – Group 7 and 9.

All contact resistance measured values with low level method were lower than 20 mOhm (maximum specified value).

2.3 Input to Output DC Resistance – Groups 1, 2, 3, 4, 6, 7 and 8.

All termination resistance measured values with low level method were lower than 200 mOhm (maximum specified value).
All shield termination resistance measured values with low level method were lower than 100 mOhm (maximum specified value).

2.4 Insulation Resistance – Groups 1, 2, 3, 4, 6 and 9.

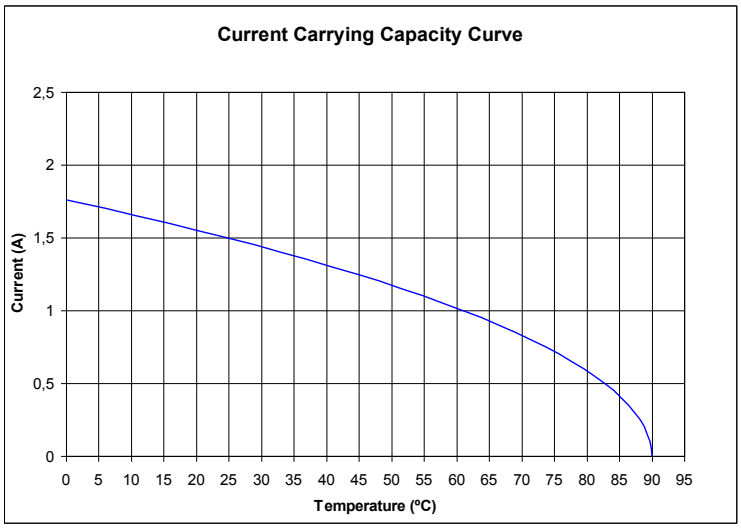
All insulation resistance measured values were higher than $5 \cdot 10^8$ Ω (minimum specified value):

2.5 Voltage proof – Groups 1, 2, 3, 4, 6 and 9.

No dielectric breakdown or flashover occurred during the test, having applied 1000 V_{AC} Peak between adjacent contacts and 1500 V_{AC} Peak between contacts and shield, 1 minute hold and 2mA max. leakage current.

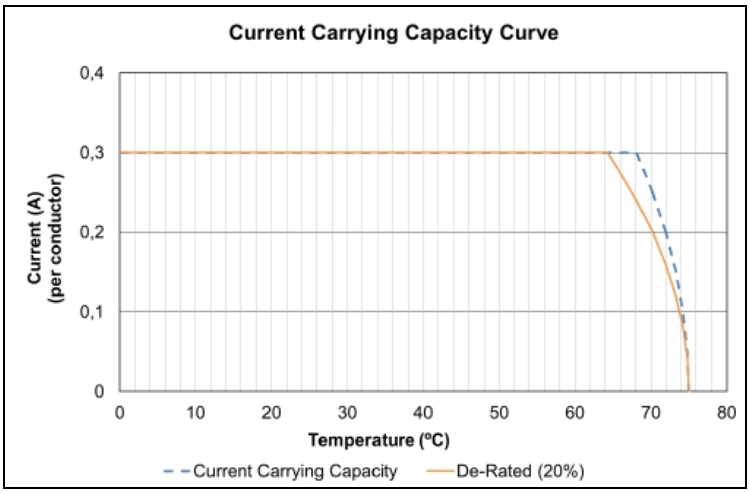
2.6 Current Carrying Capacity / temperature derating – Group 7.

Current carrying capacity exceeds the specified values given by:
$I(t) = 1.76\ (1-(t/90))^{0.5}$.



2.7 Current carrying capacity (PoE+ 600mA pair) / temperature derating on cable – Group 10

Current carrying capacity exceeds the specified values given by the following graph



2.8 Surge – Group 6.

All tested samples meet the requirements for the performed test.
All samples meet visual requirements, show no physical damages and meet the requirements of additional tests specified in test sequence.

2.9 Plug to receptacle insertion/withdrawal force – Group 1.

Insertion force measured on all tested samples was lower than 66.7 N.
Withdrawal force measured on all tested samples was lower than 20.0 N.
Samples tested show no physical damages and meet the requirements of additional tests specified in test sequence.

2.10 Cable to plug retention (perpendicular loading, bending) – Group 8.

No discontinuities equal or greater than 2 microseconds were detected.
All tested samples meet visual requirements, show no physical damages and meet the requirements of additional tests specified in test sequence.

2.11 Effectiveness of connector coupling device (axial loading) – Group 1.

All tested samples remain engaged after applying 178 N for 60 seconds, show no physical damages and meet the requirements of additional tests specified in test sequence.

2.12 Mechanical operations with electrical load – Group 9.

All tested samples meet visual requirements, show no physical damages and meet the requirements of additional tests specified in test sequence.

2.13 Mechanical operation (durability) – Group 2.

Samples were submitted to 100 mating/unmating cycles. Samples tested show no physical damages and meet the requirements of additional tests specified in test sequence.

2.14 Vibration – Group 3.

No discontinuities equal or greater than 10 microseconds were detected.
All tested samples meet visual requirements, show no physical damages and meet the requirements of additional tests specified in test sequence.

2.15 Rapid change of temperature – Group 1.

All tested samples meet visual requirements, show no physical damages and meet the requirements of additional tests specified in test sequence.

2.16 Cyclic damp heat – Group 1.

All tested samples meet visual requirements, show no physical damages and meet the requirements of additional tests specified in test sequence.

2.17 Flowing mixed gas corrosion – Group 2 and 9.

All tested samples meet visual requirements, show no physical damages and meet the requirements of additional tests specified in test sequence.

2.18 Electrical load and temperature – Group 4.

All tested samples meet visual requirements, show no physical damages and meet the requirements of additional tests specified in test sequence.

2.19 Transmission Tests – Insertion Loss (Channel configuration) – Group 5.

Samples tested meet the requirements of Transmission tests for 10GBASE-T IEEE 802.03an (ISO/IEC TR-24750 / TIA/EIA TSB-155) and related standards.

2.20 Transmission Tests – Return Loss (Channel configuration) – Group 5.

Samples tested meet the requirements of Transmission tests for 10GBASE-T IEEE 802.03an (ISO/IEC TR-24750 / TIA/EIA TSB-155) and related standards.

2.21 Transmission Tests – Delay parameter (Channel configuration) – Group 5.

Samples tested meet the requirements of Transmission tests for 10GBASE-T IEEE 802.03an (ISO/IEC TR-24750 / TIA/EIA TSB-155) and related standards.

2.22 Transmission Tests – NEXT Loss (Channel configuration) – Group 5.

Samples tested meet the requirements of Transmission tests for 10GBASE-T IEEE 802.03an (ISO/IEC TR-24750 / TIA/EIA TSB-155) and related standards.

2.23 Transmission Tests – PSNext loss (Channel configuration) – Group 5.

Samples tested meet the requirements of Transmission tests for 10GBASE-T IEEE 802.03an (ISO/IEC TR-24750 / TIA/EIA TSB-155) and related standards.

2.24 Transmission Tests – ACR-F Loss (Channel configuration) – Group 5.

Samples tested meet the requirements of Transmission tests for 10GBASE-T IEEE 802.03an (ISO/IEC TR-24750 / TIA/EIA TSB-155) and related standards.

2.25 Transmission Tests – PSACRF loss (Channel configuration) – Group 5.

Samples tested meet the requirements of Transmission tests for 10GBASE-T IEEE 802.03an (ISO/IEC TR-24750 / TIA/EIA TSB-155) and related standards.

2.26 Transmission Tests – PSANEXT loss (Channel configuration) – Group 5.

Samples tested meet the requirements of Transmission tests for 10GBASE-T IEEE 802.03an (ISO/IEC TR-24750 / TIA/EIA TSB-155) and related standards.

2.27 Transmission Tests – PSANEXT average loss (Channel configuration) – Group 5.

Samples tested meet the requirements of Transmission tests for 10GBASE-T IEEE 802.03an (ISO/IEC TR-24750 / TIA/EIA TSB-155) and related standards.

2.28 Transmission Tests – PSAACRF (Channel configuration) – Group 5.

Samples tested meet the requirements of Transmission tests for 10GBASE-T IEEE 802.03an (ISO/IEC TR-24750 / TIA/EIA TSB-155) and related standards.

2.29 Transmission Tests – Coupling attenuation – Group 5.

Samples tested meet the requirements of Transmission tests for ClassE_A according to ISO 11801 2nd edition Amd1 and related standards.

3. TEST METHODS

3.1 General examination. (Reference Standard: IEC 60512-1-1, Ed. 1 Feb 02).

Product drawings and inspections plans were used to examine the samples. They were examined visually and functionally.

3.2 Contact Resistance, plug/receptacle interface (Reference Standard: IEC 60512-2-1, Ed. 1 Feb 02).

Contact resistance was measured between MRJ21 jack and plug as it is shown in figure 1 with a micro-ohmmeter using the low level method: 20 mV max. open circuit and 100 mA max.

$$R = R_{13} - (R_{12} + R_{23})$$

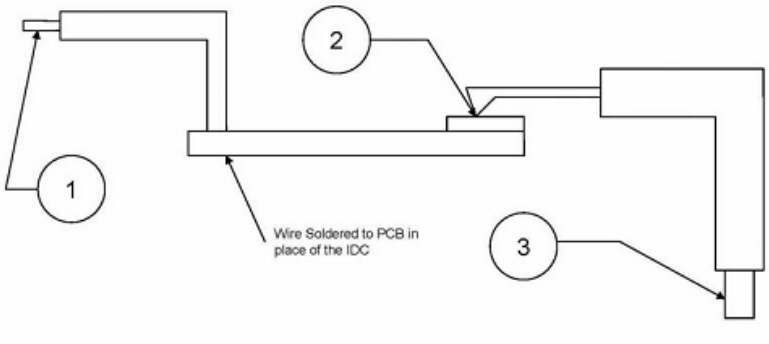


Figure 1.

3.3 Input to Output DC Resistance (Reference Standard: IEC 60512-2-1, Ed. 1 Feb 02).

Input output resistance was measured as it is shown in figure 2 with a micro-ohmmeter using the low level method: 20 mV max. and 100 mA max. open circuit.
Wires included in measurements were subtracted.

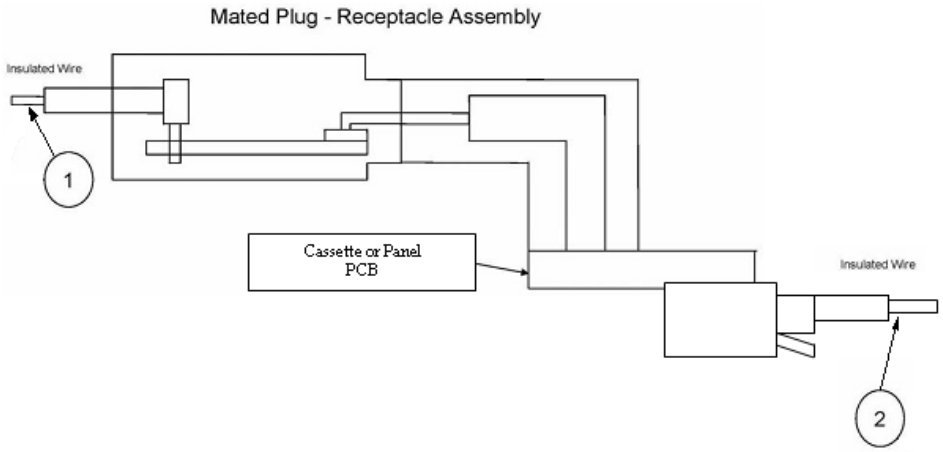


Figure 2.

3.4 Insulation Resistance (Reference Standard: IEC 60512-3-1, Ed. 1 Feb 02)

Insulation Resistance was measured between adjacent contacts and between contacts and shield using a megaohmmeter applying 100 V DC.

3.5 Voltage proof (Reference Standard: IEC 60512-4-1, Ed. 1 May 03).

1000 VAC peak voltage was applied between adjacent contacts grouped together during 60 s.
1500 VAC peak voltage was applied between all contacts and shield during 60 s.
Maximum leakage current limit was set to 2 mA.

3.6 Current Carrying Capacity / temperature derating (Reference Standard: IEC 60512-5-2, Ed.1 Feb 02).

The contact temperature at several current steps was measured. The maximum allowed temperature minus the measured temperature increase was plotted vs. current.

3.7 Current carrying capacity (PoE+ 600mA pair) / temperature derating on cable (Reference Standard ISO/IEC TR 29125,)

The contact temperature at several current steps was measured at 304 twisted pairs cable bundle. The maximum allowed temperature minus the measured temperature increase was plotted vs. current.

3.8 Surge (Reference Standard: IEC 60603-7, Ed. 3 Jul 08).

Samples were submitted to the tests according ITU-T K.20 (2000-02).
ITU-T K.20 conditions and criteria considered applicable are:
Contact/contact. Unexposed environments and the following:

Test 2.1.1.a.
Waveshape: 10/700 µs.
Uc(max) = 1.0 kV.
5 impulses of each polarity.

Test 2.1.1.b.
Waveshape: 10/700 µs.
Uc(max) = 1.0 kV.
5 impulses of each polarity.

Test 2.2.1.a.
Ua.c.(max) = 600 V.
t = 0.2 s.
5 times.

Test 2.3.1.a.
Ua.c. = 230 V.
t = 15 min.

3.9 Plug to receptacle insertion/withdrawal force (Reference Standard: IEC 60512-13-2, Ed. 1 Feb 02).

Samples were placed in a tensile strength machine and the force required to mate and unmate plug and jack was measured with the screw-lock inoperative at a rate of 50 mm/min.

3.10 Cable to plug retention (perpendicular loading, bending) (Reference Standard: IEC 60512-8-1, Ed. 1 Jun 10).

A force of 90N has been applied perpendicular to the axial plane of the plug housing for 5 times in each 4 orthogonal directions for at least 1 second.
Contact disturbance of electromechanical components of the samples has been monitored during the test.
Samples have been connected to a DC source which has not exceeded 10V and it was not allowed any discontinuity equal or greater than 2 µs.

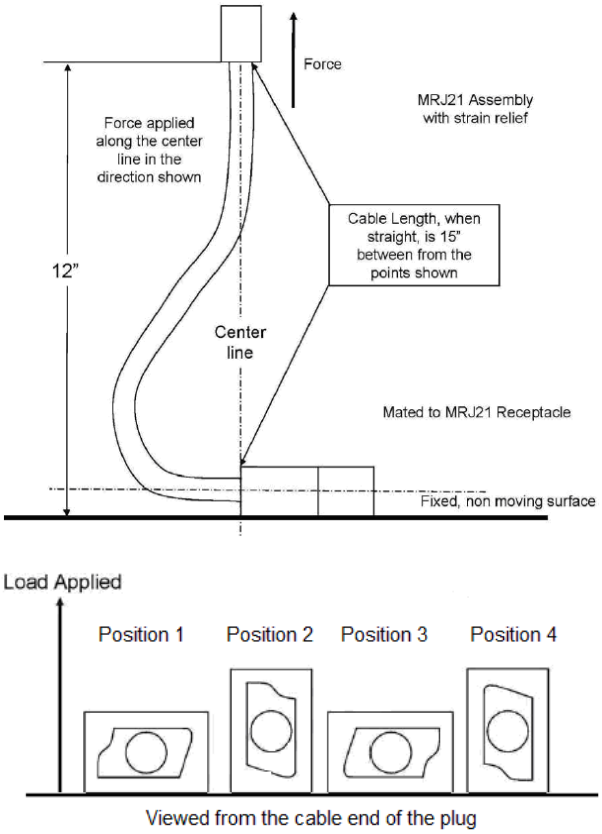


Figure 3.- Cable to plug retention test requirements.

3.11 Effectiveness of connector coupling device (axial loading) (Reference Standard: IEC 60512-15-6, Ed. 1 May 08).

Plug and jack were mated with the interface screw-lock engaged with 0.34 N·m torque. An axial force (178N) was applied during 60 seconds ± 5 seconds.

3.12 Mechanical operations with electrical load (Reference Standard: IEC 60512-99-001 ed. 1: Test group UEL 1).

Samples were submitted to 100 mating/unmating cycles with the plug's latch inoperative during insertion and extraction. 50 cycles were performed before corrosion test and 50 cycles after corrosion test.

3.13 Mechanical operation (durability) (Reference Standard: IEC 60512-9-1, Ed. 1 Mar 10.

Samples were submitted to 100 mating/unmating cycles with the screw-lock inoperative during insertion and extraction.
Cycles were performed manually by laboratory staff with 1 second rest when mated and when unmated.
NOTE: 50 cycles were performed before corrosion test and 50 cycles after corrosion test.

3.14 Vibration (Reference Standard: IEC 60512-6-4, Ed. 1 Feb 02).

Samples were subjected to frequency range of 10 to 500Hz with displacement amplitude of 0.35mm (0.70 mm peak to peak) and an acceleration of 5g (~50 m/s^2).
Were performed 10 sweep cycles per each direction on the 3 perpendicular axes at a rate of 1 octave per minute. Total duration: 2 hours per axis. It is not allowed any discontinuity greater than 10 microseconds. Samples shall remain mated and will not show evidence of physical damage.

3.15 Rapid change of temperature (Reference Standard: IEC 60068-2-14, Ed. 6 Jan 09).

Samples were submitted to 25 cycles of thermal shock as follows:
30 min at −40º C and 30 min at 70º C. 1 hour and a half of recovery time.

3.16 Cyclic damp heat (Reference Standard: IEC 60068-2-38 Test Z/AD, Ed. 2 Ene 09).

Samples were placed in a climatic chamber and they performed 21 cycles (cycle time 24 hours) of humidity temperature between 25º C and 65º C with 93% RH. Five cold sub cycles (-10º C) were performed during the 9 first cycles.

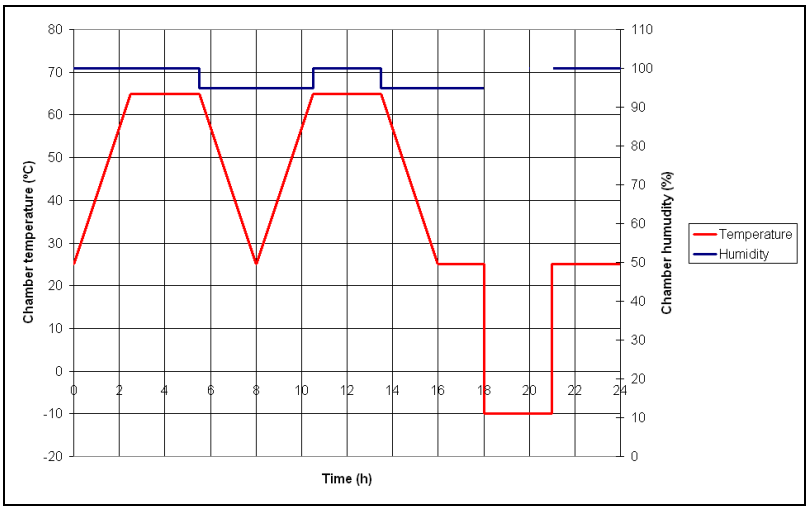


Figure 4. Humidity/Temperature Cycling profile.

3.17 Flowing mixed gas corrosion (Reference Standard: IEC 60512-11-7, Ed. 2 May 05).

Samples were placed during 4 days in a chamber with:
SO_2 = 0.5 ppm (Volume).
H_2S = 0.1ppm (Volume).
T = 25º C +/-2º C, HR = 75 % +/-3 %.
Half of samples mated. Half of the samples unmated.

3.18 Electrical load and temperature (Reference Standard: IEC 60068-2-2, Ed. 5 Jul 07).

Samples were placed into a climatic chamber at 70º C for 500 h.
All samples were mated. Half of the ports were series connected and a DC current of 0.8A was supplied during the test.

3.19 Transmission Tests – Insertion Loss (Reference Standard: IEC 61935-1).

Insertion Loss was measured according to the standard IEC 61935-1, Ed3.0, Jul-09.

3.20 Transmission Tests – Return Loss (Reference Standard: IEC 61935-1).

Return Loss was measured according to the standard IEC 61935-1, Ed3.0, Jul-09.

3.21 Transmission Tests – Delay parameter (Reference Standard: IEC 61935-1).

Delay parameter was measured according to the standard IEC 61935-1, Ed3.0, Jul-09.

3.22 Transmission Tests – NEXT Loss (Reference Standard: IEC 61935-1).

NEXT loss was measured according to the standard IEC 61935-1, Ed3.0, Jul-09.

3.23 Transmission Tests – PSNEXT loss (Reference Standard: IEC 61935-1).

PSNEXT loss was measured according to the standard IEC 61935-1, Ed3.0, Jul-09.

3.24 Transmission Tests – ACR-F Loss (Reference Standard: IEC 61935-1).

ACR-F Loss was measured according to the standard IEC 61935-1, Ed3.0, Jul-09.

3.25 Transmission Tests – PSACRF Loss (Reference Standard: IEC 61935-1).

PSACRF Loss was measured according to the standard IEC 61935-1, Ed3.0, Jul-09.

3.26 Transmission Tests – PSANEXT Loss (Reference Standard: IEC 61935-1).

PSANEXT loss was measured according to the standard IEC 61935-1, Ed3.0, Jul-09.

3.27 Transmission Tests – PSANEXT Average Loss (Reference Standard: IEC 61935-1).

PSANEXT Average Loss was measured according to the standard IEC 61935-1, Ed3.0, Jul-09.

3.28 Transmission Tests – PSAACRF (Reference Standard: IEC 61935-1).

PSAACRF was measured according to the standard IEC 61935-1, Ed3.0, Jul-09.

3.29 Transmission Tests – Coupling attenuation (Reference Standard: EN 50289-1-15)

Coupling Attenuation was measured according to the EN 50289-1-15.