

**ANGA 100 002 v1.0 (2018-06)**  
**Specification for a passive**  
**Network Termination Point**  
**In DOCSIS 3.1 Environments**  
**Network and Provisioning requirements**  
Version 1.0

**ANGA**

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## Foreword

This interface specification is designed to describe the functioning of the interface at the passive Network Termination Point in DOCSIS 3.1 Environment according to Sec. 41c TKG (German Telecommunication Act, TKG).

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## Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be used.

The terms "**must**" and "**must not**" are not allowed in ANGA deliverables except when used in direct citation.

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# Introduction

Cable networks have advanced from a purely coaxial based distribution system. Incremental network changes made up of diverse technologies allow for bi-directional services while retaining most of the customer premises installation. Changes to the German Telecommunications Act (Telekommunikationsgesetz, TKG) allow customers to become part of the neighbourhoods' network backbone. They may establish connections to the Cable Modem Termination System (CMTS) and supporting systems as long as the customer devices are attached to the passive Network Termination Point in a technically correct manner. Hence, only cable modems conforming to the OPERATOR defined interface specification and operational values shall be attached to the pNTP.

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## 1 Scope

This interface specification describes and specifies the main characteristics of the dedicated data interface in the OPERATOR cable network at the user's coaxial passive network termination point. This interface specification describes the typical limits or values within which the network characteristics can be expected to remain for networks that are built according to OPERATOR specifications at installation time.

The interface specification does not apply under abnormal operating conditions such as:

- operating conditions arising as a result of operating services other than DOCSIS 3.1 over the dedicated data interface (see e.g. PHY, MULPI, OSSI, SEC and EN 60728-1, EN 60728-101).
- operating conditions arising as a result of a fault, maintenance and construction work or to minimize the extend of interruption of service.
- operating conditions arising as a result of force majeure or third-party interference.
- operating conditions arising as a result of test signal injection governed by regulation.
- non-compliance of a network user's installation or non-compliance of equipment with the relevant standards or non-compliance with the technical requirements for connection, established either by this interface specification or the public authorities including the relevant limits for electromagnetic compatibility.

The characteristics given in this interface specification are intended to be used to derive and specify requirements for equipment such as coaxial cables and cable modems to connect them to the dedicated data interface. The values in this interface specification take precedence over requirements in equipment product standards and installation standards. The given characteristics are not intended to be used as electromagnetic compatibility levels or user emission limits in the OPERATOR network.

This interface specification may be changed at any time to reflect changes made to the network as required by Sec. 41c Para. 2. Anyone using this specification is requested to regularly check for the newest version at the respective website as published by BNetzA. This standard may be superseded in total or in part by the terms of a contract between an individual user of this specification and the OPERATOR.

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## 2 References

### 2.1 Normative references

- [1] ETSI ETS 300 019-1-3 "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-3: Classification of environmental conditions; Stationary use at weather protected locations"
- [2] Deutsche Bundespost FTZ 1 R 8 – 15, Dezember 1985 "Technische und betriebliche Bedingungen für die Überlassung von Hauptanschlüssen, posteigenen Leitungen und Stromwegen sowie Direkt-Datenverbindungen (und für die Zulassung amtsberechtigter privater Leitungen) Teil 15: Breitbandanschlüsse"
- [3] IEC 61169-24:2001 "Radio-frequency connectors – Part 24: Sectional specification – Radio frequency coaxial connectors with screw coupling, typically for use in 75 ohm cable distribution systems (type F)"
- [4] IEC 61169-24:2009 "Radio-frequency connectors – Part 24: Sectional specification – Radio frequency coaxial connectors with screw coupling, typically for use in 75  $\Omega$  cable networks (type F)"
- [5] SCTE 02 2015 "Specification for "F" Port, Female, Indoor
- [6] DIN EN 60728-1:2008 "Cable networks for television signals, sound signals and interactive services - Part 1: System performance of forward paths; German version; EN 60728-1:2008"
- [7] DIN EN 60728-4 "Cable networks for television signals, sound signals and interactive services - Part 4: Passive wideband equipment for coaxial cable networks (IEC 60728-4); German version EN 60728-4"
- [8] DIN EN 60728-11:2005 "Cable networks for television signals, sound signals and interactive services - Part 11: Safety; German version EN 60728-11:2005"
- [9] DIN EN 60728-11:2011 "Cable networks for television signals, sound signals and interactive services - Part 11: Safety; German version EN 60728-11:2010"
- [10] CableLabs "Data Over Cable Service Interface Specifications, Data Over Cable Service Interface Specifications DOCSIS 3.1 Physical Layer Specification CM-SP-PHYv3.1-I14-180509"
- [11] CableLabs "Data Over Cable Service Interface Specifications, DOCSIS 3.1 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.1-I15-180509"
- [12] CableLabs "Data Over Cable Service Interface Specifications, DOCSIS 3.1 Operations Support System Interface Specification CM-SP-OSSIV3.1-I12-180509"
- [13] CableLabs "Data Over Cable Service Interface Specifications, DOCSIS 3.1 Security Specification CM-SP-SECv3.1-I07-170111"
- [14] CL-SP-CANN-DHCP-Reg "CableLabs' DHCP Options Registry"
- [15] EXCENTIS "EuroDOCSIS BPI+ Requirements: 2007"
- [16] DIN EN 60728-11:2017-11 "Cable networks for television signals, sound signals and interactive services - Part 101: System performance of forward paths loaded with digital channels only (IEC 60728-101:2016); German version EN 60728-101:2017 + AC:2017"

## 2.2 Informative references

- [i.1] SchuTSEV, 13.05.2009 "Verordnung zum Schutz von öffentlichen Telekommunikationsnetzen und Sende- und Empfangsfunkanlagen, die in definierten Frequenzbereichen zu Sicherheitszwecken betrieben werden."
- [i.2] ETSI ES 201 488 "Data Over Cable Service Interface Specifications (DOCSIS); Radio Frequency Interface Specifications"
- [i.3] EN 60966-2-6:2009 "Radio frequency and coaxial cable assemblies - Part 2-6: Detail specification for cable assemblies for radio and TV receivers - Frequency range 0 MHz to 3000 MHz, IEC 61169-24 connectors (IEC 60966-2-6:2009)"
- [i.4] IEC 60966-2-7:2015 "Radio frequency and coaxial cable assemblies - Part 2-7: Detail specification for cable assemblies for radio and TV receivers - Frequency range 0 MHz to 3 000 MHz, IEC 61169-47 connectors"
- [i.5] EN 61169-47:2012 "Sectional specification for radio-frequency coaxial connectors with clamp coupling typically for use in 75  $\Omega$  cable networks (type F-Quick)"
- [i.6] DIN EN 60728-1-1:2010 „Cable networks for television signals, sound signals and interactive services – Part 1-1: RF cabling for two way home networks; German version EN 60728-1-1:2010“
- [i.7] EN 50289-3-9 "Communication cables - Specifications for test methods - Part 3-9: Mechanical test methods; Bending tests"

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## 3 Definitions, symbols and abbreviations

### 3.1 Definitions

**Cable Modem (CM):** modulator-demodulator at subscriber locations intended for use in conveying data Communications on a cable television system

**Cable Modem Termination System (CMTS):** cable modem termination system, located at the cable television system headend or distribution hub, which provides complementary functionality to the cable modem to enable data connectivity to a wide-area network

**Cable Network:** coaxial-based broadband access network in the form of either an all-coax or Hybrid-Fibre/Coax (HFC) network

**Carrier Hum Modulation:** peak-to-peak magnitude of the amplitude distortion relative to the RF carrier signal level due to the fundamental and low-order harmonics of the power-supply frequency

**Composite Second Order beat (CSO):** peak of the average level of distortion products due to second-order non-linearity's in cable system equipment

**Composite Triple Beat (CTB):** peak of the average level of distortion components due to third-order non-linearity's in cable system equipment

**customer:** human being or organization that accesses the network in order to communicate via the services provided by the network

**downstream:** in cable television, the direction of transmission from the headend to the subscriber

**dynamic range:** ratio between the greatest signal power that can be transmitted over a multichannel analogue transmission system without exceeding distortion or other performance limits, and the least signal power that can be utilized without exceeding noise, error rate or other performance limits

**group delay:** difference in transmission time between the highest and lowest of several frequencies through a device, circuit or system

**High Frequency (HF):** Used in the present document to refer to the entire subsplit (5 MHz to 30 MHz) and extended subsplit (5 MHz to 65 MHz) band used in return channel communications over the cable television network

**hum modulation:** undesired modulation of the television visual carrier by the fundamental or low-order harmonics of the power supply frequency, or other low-frequency disturbances

**Hybrid Fibre/Coax (HFC) system:** broadband bidirectional shared-media transmission system using fibre trunks between the headend and the fibre nodes, and coaxial distribution from the fibre nodes to the customer locations

**impulse noise:** noise characterized by non-overlapping transient disturbances

**layer:** subdivision of the Open System Interconnection (OSI) architecture, constituted by subsystems of the same rank

**micro-reflections:** echoes in the forward transmission path due to departures from ideal amplitude and phase characteristics

**mid split:** frequency division scheme that allows bi-directional traffic on a single coaxial cable

**passive network termination point (pNTP):** customer terminal with minimum optical/electrical spacing to the CMTS

**PHysical (PHY) layer:** layer 1 in the Open System Interconnection (OSI) architecture; the layer that provides services to transmit bits or groups of bits over a transmission link between open systems and which entails electrical, mechanical and handshaking procedures

**Quadrature Amplitude Modulation (QAM):** method of modulating digital signals onto a radio-frequency carrier signal involving both amplitude and phase coding

**Radio Frequency (RF):** in cable television systems, this refers to electromagnetic signals in the range 5 MHz to 1 GHz

**return loss (RL):** parameter describing the attenuation of a guided wave signal (e.g. via a coaxial cable) returned to a source by a device or medium resulting from reflections of the signal generated by the source

**terminal:** equipment connected to a telecommunication network to provide access to one or more specific services

## 3.2 Abbreviations

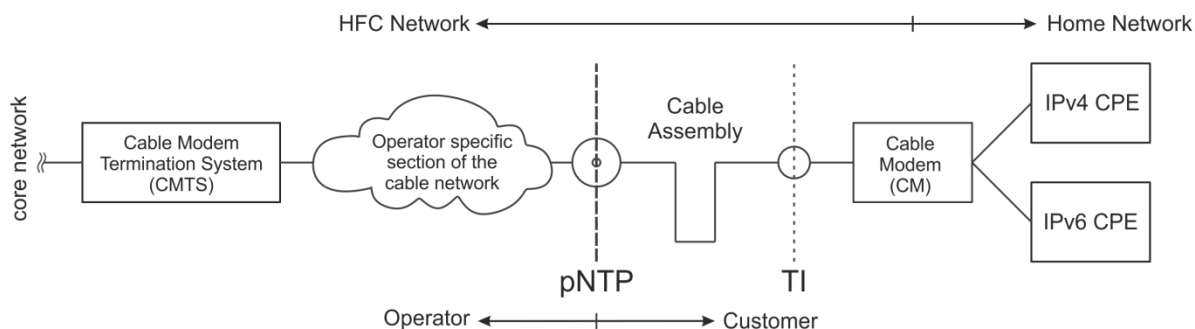
BER	Bit Error Rate
C/N or CNR	Carrier-to-Noise Ratio
CENELEC	European Committee for Electrotechnical Standardization
CM	Cable Modem
CPE	Customer Premise Equipment
CSO	Composite Second Order beat
CTB	Composite Triple Beat
DIN	Deutsches Institut für Normung
DOCSIS	Data Over Cable Service Interface Specifications
ETSI	European Telecommunications Standards Institute
FM	Frequency Modulation
HF	High Frequency
HFC	Hybrid-Fibre/Coax
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
MER	Modulation Error Ratio
PER	Packet Error Rate
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase-Shift Keying
RF	Radio Frequency
RMCD	Ready Made Connecting Device
pNTP	passive Network Termination Point
TI	Terminal Input
SNR	Signal to Noise Ratio



## 4 RF Interface Connector

### 4.1 General

Clause 4 describes and defines the mechanical coaxial connector and connection requirements at the customers pNTP.



**Figure 1: Location of the pNTP within the HFC network.**

*NOTE: The terminal connection to the pNTP requires an appropriate coaxial cable assembly (RMCD). Implementation examples for such assemblies are given in Annex 1.*

### 4.2 Environmental Profile

The technical requirements of the present document apply under the environmental profiles in [1] assuming accordance with [8] or [9]. If not stated otherwise Class 3.1 typically applies for pNTP inside customer homes.

The technical specification of the present document applies under the environmental class  $E_0$ :

**Table 1:  $E_0$  environmental classification (MICE)**

Electromagnetic Environment	$E_0$
Radiated radio frequency, RF-AM	106 dB $\mu$ V/m at (30 to 470 MHz) 100 dB $\mu$ V/m at (470 to 862 MHz)
Conducted radio frequency	3 V at (150 kHz to 30 MHz)
Electrical fast transients (signal/data/control)	N/A
Surge (transient ground potential difference – signal, line to earth)	N/A
Magnetic Field (50 Hz)	3 A/m

### 4.3 Mechanical interface description for coaxial connector with socket centre contact

The pNTP mechanical interface consists of a type F connector with socket centre contact conforming to either [3] or [4] that interfaces with corresponding type F male connectors whose diameters of the centre conductor shall be between 0.74 mm and 1.13 mm. The minimum maintained retention force shall be 0.3 N.

The nominal tightening torque for screw type F connectors is typical 3.4 Nm  $\pm$  10% (Absolute maximum tightening torque as per [5]). Networks conforming to [2] which are not supplied with type F pNTP may be supported by OPERATOR provided interface adapters.

NOTE: The use of screw type F connectors is discouraged.

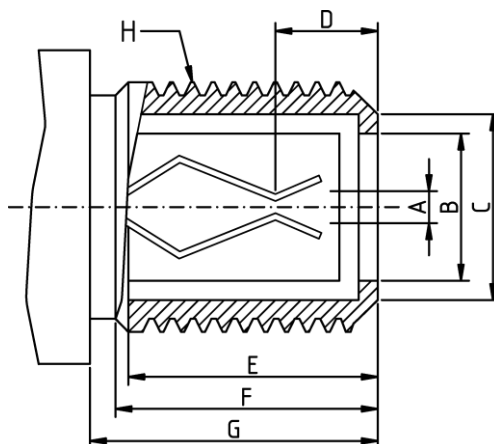


Figure 2: Type F connector with socket centre contact

Table 1: Mechanical Interface Dimensions

Dimension	Nominal
A	accepts 0.74 – 1.13 mm
B-H	according to [3] or [4]
NOTE: The mechanical Interface is compatible with [i.5]	

## 4.4 Electrical Performance Characteristics

This clause describes the nominal electrical performance characteristics in the frequency range from DC to 1218 MHz.

The nominal system impedance is 75  $\Omega$ . This impedance is the reference impedance for all passive coaxial components such as cables, connectors and wall outlets in the specified frequency range. Impedance mismatch results in a lower return loss.

The DC contact resistance of the centre conductor junction of the type F connector with socket centre contact to male F centre conductor shall be less than 25 m $\Omega$  and the DC contact resistance shall be less than 10 m $\Omega$ .

NOTE: The resulting contact resistance when using copper-clad steel conductors is typically greater than 10 m $\Omega$ .

The minimum nominal return loss of the pNTP is given in the table below.

Table 2: Minimum Return Loss

Frequency Range [MHz]	Nominal <sup>1</sup>
5 to 47	$\geq 14$ dB
47 to 1218	14 dB – 1.5 dB/octave, $\geq 10$ dB
<sup>1</sup> see [6], [16]	

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## 5 Network RF Characteristics

This clause describes and defines the RF parameters and requirements at the customer's pNTP.

### 5.1 Downstream RF characteristics

#### 5.1.1 Downstream Frequency Range

Downstream lower band edges other than those specified in [10] are not supported at the pNTP and MAY NOT be used.

See provider specific documentation.

#### 5.1.2 Downstream RF performance

See provider specific documentation.

### 5.2 Upstream RF characteristics

#### 5.2.1 Upstream Frequency Range

Upstream upper band edges other than those specified in [10] are not supported at the pNTP and MAY NOT be used.

See provider specific documentation.

#### 5.2.2 Upstream RF performance

See provider specific documentation.

## 6 DOCSIS 3.1 Physical Interface Requirements

The following table describes the DOCSIS physical interface requirements at the pNTP based on and in line with [10].

TABLE 7

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VIII.5		Engineering Changes for CM-SP-PHYv3.1-I06-150611	x	x		
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## 7 DOCSIS 3.1 MULPI Interface Requirements

The following table describes the DOCSIS MULPI interface requirements at the pNTP based on and in line with [11].

TABLE 8

Index		Description	relevant for IF Spec	informative	mandatory	optional
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	1.2	Background	x	x		
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	1.2.2	DOCSIS Network and System Architecture	x	x		
	1.2.3	Service Goals	x	x		
	1.2.4	Statement of Compatibility	x	x		
	1.2.5	Reference Architecture	x	x		
	1.2.6	DOCSIS 3.1 Documents	x	x		
	1.3	Requirements	x		x	
	1.4	Conventions	x		x	
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<b>2</b>		<b>REFERENCES</b>				
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	2.3	Reference Acquisition	x	x		
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	5.2	Technical Overview	x	x		
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Index		Description	relevant for IF Spec	informative	mandatory	optional
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	1.2	Background	x	x		
	1.2.1	Broadband Access Network	x	x		
	1.2.2	DOCSIS Network and System Architecture	x	x		
	1.2.3	Service Goals	x	x		
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Index		Description	relevant for IF Spec	informative	mandatory	optional
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	1.2	Background	x	x		
	1.2.1	Broadband Access Network	x	x		
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Index		Description	relevant for IF Spec	informative	mandatory	optional
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Index		Description	relevant for IF Spec	informative	mandatory	optional
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Index		Description	relevant for IF Spec	informative	mandatory	optional
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Index		Description	relevant for IF Spec	informative	mandatory	optional
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Index		Description	relevant for IF Spec	informative	mandatory	optional
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	1.2.1	Broadband Access Network	x	x		
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Index		Description	relevant for IF Spec	informative	mandatory	optional
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	1.2	Background	x	x		
	1.2.1	Broadband Access Network	x	x		
	1.2.2	DOCSIS Network and System Architecture	x	x		
	1.2.3	Service Goals	x	x		
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## 8 DOCSIS 3.1 OSSI Interface Requirements

The following table describes the DOCSIS OSSI interface requirements at the pNTP based on and in line with [12].

TABLE 9

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	8.2.2	System Configuration	x		x	
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	D.4	Bulk Data Transfer		x		

Index		Description	relevant for IF Spec	informative	mandatory	optional
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	1.2.5	Reference Architecture	x	x		
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## 9 DOCSIS 3.1 SEC Interface Requirements

The following table describes the DOCSIS SEC interface requirements at the pNTP based on and in line with [13].

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	V.5	Engineering Change for CM-SP-SECv3.1-I06-160202	x	x		
	V.6	Engineering Changes for CM-SP-SECv3.1-I07-170111	x	x		

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## Annex 1 (informative): Implementation Advice

### 1.1 Coaxial cable assemblies

Successful operation of cable modems attached to the cable network requires the consideration of environmental conditions such as electromagnetic fields and handling habits of the customer.

Examples of working coaxial cable assemblies no longer than 3 m operating in the transverse electromagnetic mode (TEM) are given in [i.3] with the following recommended parameters and exemptions:

Downstream signal levels at the cable modem RF port are reduced according to the frequency dependent attenuation of the cable assemblies. Other quality parameters could be affected by the length of the cable assembly if the total cable length of the cable assembly is greater than 300 cm [i.6, 5.3.2].

The cable assembly should be specified over the frequency range DC to 2400 MHz.

The use of type F screw connectors is discouraged as customers cannot be expected to adjust the required tightening torque of 3.4 Nm. Therefore, the use of connectors in accordance with [i.5] is strongly recommended.

The screening effectiveness requirements for cable assemblies are highly OPERATOR network specific. A typical calculation results in the following requirements:

**Table 12: OPERATOR specific Screening Effectiveness of coaxial cable assemblies (calculated)**

Frequency [MHz]	Value [dB]
30 to 80	75
108 to 790	75
790 to 862	83

**Table 13: OPERATOR specific Transfer Impedance of coaxial cable assemblies (calculated)**

Frequency [MHz]	Value [mΩ/m]
5 to 12	≤ 5.2
12 to 30	≤ 5.0

**Table 14: OPERATOR specific parameters for coaxial cable assemblies**

Parameter	Value
Cable length	≤ 300 cm
Frequency range	5 to 2400 MHz
Screening effectiveness	N/A
Connector	According to [i.4]
One end	90 degrees angled
Other end	Straight
Attenuation	
5 to 1006 MHz	≤ 0.6 dB/m
1006 to 2400 MHz	≤ 0.9 dB/m
Return Loss	
5 to 12 MHz	≥ 20 dB
12 to 30 MHz	≥ 25 dB
30 to 300 MHz	≥ 25 dB
300 to 470 MHz	≥ 23 dB
470 to 1006 MHz	≥ 18 dB
1006 to 1700 MHz	≥ 15 dB
1700 to 2400 MHz	≥ 12 dB
Cable bend radius	≤ 30 mm
Cable stress test	According to [i.7]
Pull off/ push on force	≥ 40 N
Inner conductor	0.74 to 1.13 mm
Color mark on the connector	Red

The cable assemblies shall comply to RoHS and WEEE environmental regulations as defined by the EU.

---

## 1.2 Cable Modem RF Port Characteristics

For successful operation at many compatible pNTPs the cable modem/cable assembly has to fulfil all requirements described in [10], [i.1] or later. OPERATOR supplied cable modems could be tested against more challenging parameters. The determination of suitable RF port characteristics for the cable modem is left to the manufacturer.

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## Annex 2 (informative): Change History

Date	Version	Information about changes

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## History

Document history		
<Version>	<Date>	<Milestone>
1	2018/06/15	Initial version V1.0 (2018-6)