

PD CLC/TR 50083-10-1:2014



BSI Standards Publication

Cable networks for television signals, sound signals and interactive services

Part 10-1: Guidelines for the implementation of return paths in cable networks

bsi.

...making excellence a habit.™

National foreword

This Published Document is the UK implementation of CLC/TR 50083-10-1:2014. It supersedes PD CLC/TR 50083-10-1:2009 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee EPL/100, Audio, video and multimedia systems and equipment, to Subcommittee EPL/100/4, Cable distribution equipment and systems.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2014.
Published by BSI Standards Limited 2014

ISBN 978 0 580 85318 0
ICS 33.060.40

Compliance with a British Standard cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 30 June 2014.

Amendments/corrigenda issued since publication

Date	Text affected
------	---------------

TECHNICAL REPORT
RAPPORT TECHNIQUE
TECHNISCHER BERICHT

CLC/TR 50083-10-1

June 2014

ICS 33.060.40

Supersedes CLC/TR 50083-10-1:2009

English Version

**Cable networks for television signals, sound signals and
interactive services - Part 10-1: Guidelines for the
implementation of return paths in cable networks**

Réseaux de distribution par câbles pour signaux de
télévision, signaux de radiodiffusion sonore et services
interactifs - Partie 10-1: Lignes directrices relatives à la
mise en oeuvre de la voie de retour dans les réseaux
câblés

Kabelnetze für Fernsehsignale, Tonsignale und interaktive
Dienste - Teil 10-1: Leitfaden für die Einrichtung von
Rückkanälen in Kabelnetzen

This Technical Report was approved by CENELEC on 2014-06-02.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Contents

Foreword	5
1 Scope	6
1.1 General	6
1.2 Specific scope of this Technical Report	6
2 Normative references	6
3 Terms, definitions, symbols and abbreviations	7
3.1 Terms and definitions	7
3.2 Symbols	10
3.3 Abbreviations	11
4 Network architecture	13
4.1 HFC architecture	13
4.2 Upgrade alternatives	15
4.3 Active or passive return path	25
4.4 In building network	25
4.5 In home network	25
5 Network design	26
5.1 Considerations	26
5.2 Return path loss, path loss difference and return path slope	26
5.3 Noise and nonlinearity, optimizing signal levels	31
5.4 Isolation between outlets	33
5.5 Equalization and filtering in return paths	33
6 Channel planning	36
6.1 Purpose of this section	36
6.2 Introduction	36
6.3 Summary	36
6.4 Considerations for channel planning	37
6.5 Common path distortion products	41
6.6 European upstream bandwidths	41
6.7 Channel width	41
6.8 QPSK/16QAM operation and channel widths	41
6.9 Available return path spectrum (Table 8)	42
6.10 Channel plans	43
6.11 Network radiation	45
7 Equipment for return path implementation	45
7.1 General	45
7.2 Return path amplifiers	45
8 Installation and maintenance	48

8.1	Signal level adjustment	48
8.2	Monitoring and measurements	52
Annex A (informative) Interference on return path.....		54
A.1	Multiple interference.....	54
A.2	Impulse interference	63
A.3	Interference from home terminals — EMC standards of home terminals	65
A.4	Hum modulation.....	66
A.5	Common path distortion (CPD).....	66
Annex B (informative) Null packet and PRBS definitions.....		74
B.1	Null packet definition.....	74
B.2	PRBS definition	74
Annex C (informative) ITU DWDM grid.....		75
Bibliography.....		77
Figures		
Figure 1	— Typical HFC topology	14
Figure 2	— Regional network.....	15
Figure 3	— Trunk-and-distribution architecture using only coaxial equipment	15
Figure 4	— HFC system	16
Figure 5	— Generic diagram showing the mapping of nodes and CMTS(s) to segments.....	17
Figure 6	— Segment comprising a single CMTS to N optical nodes	17
Figure 7	— Spectrum allocation bandwidth.....	18
Figure 8	— Basic node architecture	19
Figure 9	— Re-arranged feeds (two CMTS serving four nodes).....	20
Figure 10	— Optical node with frequency stacking	21
Figure 11	— Divided node.....	21
Figure 12	— Return path segmentation	22
Figure 13	— Division of the node areas using additional fibres	22
Figure 14	— DWDM (CWDM) return path transmission	23
Figure 15	— Digital return technology basic concept.....	23
Figure 16	— Two return paths multiplexed to the transmission stream	24
Figure 17	— Optical node segmentation.....	25
Figure 18	— In house structures for transparent return path transmission.....	26
Figure 19	— Example of forward (862 MHz) and return path (65 MHz) network with operating levels for the drop and in home parts of the network	28
Figure 20	— Example of a block diagram of return path amplifier	46
Figure 21	— Commissioning of the forward path	48
Figure 22	— Commissioning of the return path amplifiers using the same method as on the forward path.....	49
Figure 23	— Problem when commissioning return path amplifiers following the method used for downstream amplifiers (standard output levels).....	49
Figure 24	— Unity gain method.....	50
Figure 25	— Optical reverse path	50

Figure 26 — Optical node with reverse transmitter 51

Figures in annexes

Figure A.1 — Typical spectrum of a return path..... 54
Figure A.2 — Noise funnelling 55
Figure A.3 — Average noise level vs. the number of subscribers and the return path frequency [19]..... 56
Figure A.4 — Simplified equivalent circuit of a drop cable 56
Figure A.5 — Screening effectiveness of a coaxial cable vs. frequency 58
Figure A.6 — Spectrogram of noise level vs. frequency and time (example) 60
Figure A.7 — Maximum, minimum and average noise levels vs. frequency (example) 61
Figure A.8 — Centile analysis of noise levels vs. frequency (example) 62
Figure A.9 — Temporal evolution of the -10 dB(mV) threshold crossing occurrence (example)..... 63
Figure A.10 — Frequency evolution of the -10 dB(mV) threshold crossing occurrence (example)..... 63
Figure A.11 — Illustration of impulse noise measurement according to the method described in EN 60728-10 65
Figure A.12 — Example for the use of the return path frequency range 66
Figure A.13 — Test set-up for CPD simulation 68
Figure A.14 — Intermodulation products with 8 MHz spacing 68
Figure A.15 — Contact resistance as function of contact pressure 69
Figure A.16 — Upstream pass-band characterization 70
Figure A.17 — Set-up of test signals..... 71
Figure A.18 — Test set-up for passive devices..... 71
Figure A.19 — Test set-up for power passing devices 72
Figure A.20 — Thermal cycle profile 72
Figure A.21 — Spectral response with CPD in the return path..... 73

Tables

Table 1 — Summary of in home return path losses 30
Table 2 — Calculation of return path versus temperature 31
Table 3 — Broadcasting allocations between 5 MHz and 42 MHz 38
Table 4 — Amateur and Citizens Band allocations between 5 MHz and 42 MHz 39
Table 5 — DOCSIS/EuroDOCSIS symbol rates and channel widths 39
Table 6 — Data carriers in the gaps between broadcasting bands 40
Table 7 — Data carriers in the gaps between broadcasting, amateur and CB bands..... 40
Table 8 — Available spectrum between 5 MHz and 65 MHz..... 42
Table 9 — Example of a 1,6 MHz wide channel plan up to 65 MHz (avoiding CPD products) 43
Table 10 — Example of a 3,2 MHz wide channel plan up to 65 MHz 44
Table 11 — Permitted radiation 0,3 MHz to 30 MHz (A-Deviation for Great Britain) 45
Table 12 — Permitted radiation 30 MHz to 68 MHz (A-Deviation for Great Britain) 45
Table 13 — Split frequencies used in Europe 47
Table 14 — Alarm thresholds for upstream monitoring (example)..... 53

Tables in Annexes

Table A.1 — European EMC standards applicable to home terminals 65
Table B.1 — Null transport stream packet definition 74
Table C.1 — ITU DWDM grid 75

Foreword

This document (CLC/TR 50083-10-1:2014) has been prepared by CLC/TC 209 "Cable networks for television signals, sound signals and interactive services".

This document supersedes CLC/TR 50083-10-1:2009.

CLC/TR 50083-10-1:2014 includes the following significant technical changes with respect to CLC/TR 50083 10-1:2009:

- a) the introduction of a new "General Scope";
- b) the introduction of new upper frequency limit 85 MHz for return path as an option;
- c) the introduction of some new "Terms and definitions" due to the new general scope and due to the introduction of the extended return path frequency range to 85 MHz;
- d) the deletion of Clause B.1 on "Noise power ratio";
- e) the deletion of Clause B.2 on "10-tone measurement";
- f) the deletion of Clause B.3 on "MER measurement".

EN 50083 is currently composed of the following parts:

- EN 50083-2, *Cable networks for television signals, sound signals and interactive services — Part 2: Electromagnetic compatibility for equipment*;
- CLC/TR 50083-5-1, *Cable networks for television signals, sound signals and interactive services — Part 5-1: IP gateways and interfaces for headends*;
- EN 50083-8, *Cable networks for television signals, sound signals and interactive services — Part 8: Electromagnetic compatibility for networks*;
- EN 50083-9, *Cable networks for television signals, sound signals and interactive services — Part 9: Interfaces for CATV/SMATV headends and similar professional equipment for DVB/MPEG-2 transport streams*;
- EN 50083-10, *Cable networks for television signals, sound signals and interactive services — Part 10: System performance for return paths*;
- CLC/TR 50083-10-1, *Cable networks for television signals, sound signals and interactive services — Part 10-1: Guidelines for the implementation of return paths in cable networks* [the present document].

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

1 Scope

1.1 General

Standards and other deliverables of the EN 50083 and EN 60728 series deal with cable networks including equipment and associated methods of measurement for headend reception, processing and distribution of television and sound signals and for processing, interfacing and transmitting all kinds of data signals for interactive services using all applicable transmission media. These signals are typically transmitted in networks by frequency-multiplexing techniques.

This includes for instance:

- regional and local broadband cable networks,
- extended satellite and terrestrial television distribution networks and systems,
- individual satellite and terrestrial television receiving systems
- and all kinds of equipment, systems and installations used in such cable networks, distribution and receiving systems.

The extent of this standardization work is from the antennas and/or special signal source inputs to the headend or other interface points to the network up to the terminal input of the customer premises equipment.

The standardization work will consider coexistence with users of the RF spectrum in wired and wireless transmission systems.

The standardization of any user terminals (i.e. tuners, receivers, decoders, multimedia terminals etc.) as well as of any coaxial, balanced and optical cables and accessories thereof is excluded.

1.2 Specific scope of this Technical Report

This document is intended to provide guidance to network designers on the issues which should be addressed when considering the design of return paths for regional or local broadband networks.

Items such as return path architecture & design, channel performance, channel planning and sources of interference, measurements, segmentation and re-segmentation, in home networks, distortion and commissioning are included. This document is not intended as a design reference but provides details which need to be addressed on individual issues relating to the design of the return path for a regional or local broadband network.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 60728-1:2008, *Cable networks for television signals, sound signals and interactive services — Part 1: System performance of forward paths (IEC 60728-1:2007)*

EN 60728-3, *Cable networks for television signals, sound signals and interactive services — Part 3: Active wideband equipment for cable networks (IEC 60728-3)*

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)*

EN 60728-5, *Cable networks for television signals, sound signals and interactive services — Part 5: Headend equipment (IEC 60728-5)*

EN 60728-6, *Cable networks for television signals, sound signals and interactive services — Part 6: Optical equipment (IEC 60728-6)*