IEC 61196-4

Edition 4.0 2022-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Coaxial communication cables –
Part 4: Sectional specification for radiating cables

Câbles coaxiaux de communication –
Partie 4: Spécification intermédiaire pour câbles rayonnants

IEC 61196-4:2022-09(en-fr)

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FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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IEC 61196-4 has been prepared by subcommittee 46A: Coaxial cables, of IEC technical committee 46: Cables, wires, waveguides, RF connectors, RF and microwave passive components and accessories. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 2015. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) rewrote "1 Scope" to be consistent with other blank detail specifications of coaxial cables;
b) updated different standards in "Clause 2 Normative references";
c) added the definitions of uniformly radiating type cable, stop frequency band and link loss;
d) added different materials and constructions in 4.2 to 4.5;
e) added "Clause 5 IEC type designation";

f) added a detailed rated temperature range of different materials in "6.2 Rated temperature range";

g) added detailed frequencies in "6.3 Operating frequency range";

h) added "6.4 Stop frequency band" and "6.5 Radiating characteristics";

i) added different detail requirements or typical values in 8.2.4, 8.2.7, 8.2.8, 8.4.3 to 8.4.8;

j) deleted "7.4.4 Ovality of outer conductor";

k) added "8.2.11 Link loss", "8.4.9 Adhesion of dielectric", "8.4.10 Shrinkage for insulations", "8.4.11 Maximum pulling force of cable";

l) used IEC 61196-1-123 and IEC 61196-1-124 in the electrical requirements to replace Annex A and Annex B respectively and deleted Annex A and Annex B;

m) added "Figure A.1 Example of testing coupling loss around circumferential orientation of radiating cable (Y-Z)" in Annex A.

The text of this International Standard is based on the following documents:

Draft	Report on voting
46A/1583/FDIS	46A/1598/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

This part of IEC 61196 is to be read in conjunction with IEC 61196-1:2005.

A list of all parts in the IEC 61196 series, published under the general title *Coaxial communication cables*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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COAXIAL COMMUNICATION CABLES –

Part 4: Sectional specification for radiating cables

1 Scope

This part of IEC 61196 applies to radiating coaxial communication cables, and specifies the terms and definitions, material and construction, IEC type designation, standard rating and characteristics, identification, marking and labelling, requirements of finished cables, quality assessment, delivery and storage, etc. Radiating coaxial communication cables are widely used in wireless communication systems for long, narrow, semi-enclosed and indoor environments, such as high-speed railways, subways, tunnels, and indoor environments.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-1:2013, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-61, *Environmental testing – Part 2-61: Test methods: Test Z/ABDM: Climatic sequence*

IEC 60332-1-2, *Tests on electric and optical fibre cables under fire conditions – Part 1-2: Test for vertical flame propagation for a single insulated wire or cable – Procedure for 1 kW pre-mixed flame*

IEC 60754-1, *Test on gases evolved during combustion of materials from cables – Part 1: Determination of the halogen acid gas content*

IEC TS 60695-7-50[1], *Fire hazard testing – Part 7-50: Toxicity of fire effluent – Estimation of toxic potency – Apparatus and test method*

IEC TS 60695-7-51[2], *Fire hazard testing – Part 7-51: Toxicity of fire effluent – Estimation of toxic potency – Calculation and interpretation of test results*

IEC 60811-406, *Electric optical fibre cables – Test methods for non-metallic materials – Part 406: Miscellaneous tests – Resistance to stress cracking of polyethylene and polypropylene compounds*

IEC 60811-502, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 502: Mechanical tests − Shrinkage test for insulations*

IEC 61034-2, *Measurement of smoke density of cables burning under defined conditions – Part 2: Test procedure and requirements*

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1 Withdrawn.

2 Withdrawn.

IEC 61196-1:2005, *Coaxial communication cables – Part 1: Generic specification – General, definitions and requirements*

IEC 61196-1-1, *Coaxial communication cables – Part 1-1: Capability approval for coaxial cables*

IEC 61196-1-100, *Coaxial communication cables – Part 1-100: Electrical test methods – General requirements*

IEC 61196-1-101, *Coaxial communication cables – Part 1-101: Electrical test methods – Test for conductor d.c. resistance of cable*

IEC 61196-1-102, *Coaxial communication cables – Part 1-102: Electrical test methods – Test for insulation resistance of cable dielectric*

IEC 61196-1-103, *Coaxial communication cables – Part 1-103: Electrical test methods – Test for capacitance of cable*

IEC 61196-1-105, *Coaxial communication cables – Part 1-105: Electrical test methods – Test for withstand voltage of cable dielectric*

IEC 61196-1-108, *Coaxial communication cables – Part 1-108: Electrical test methods – Test for characteristic impedance, phase and group delay, electrical length and propagation velocity*

IEC 61196-1-110, *Coaxial communication cables – Part 1-110: Electrical test methods – Test for continuity*

IEC 61196-1-112, *Coaxial communication cables – Part 1-112: Electrical test methods – Test for return loss (uniformity of impedance)*

IEC 61196-1-123[3], *Coaxial communication cables – Part 1-123: Electrical test methods – Test for attenuation constant of radiating cable*

IEC 61196-1-124, *Coaxial communication cables – Part 1-124: Electrical test methods – Test for coupling loss of radiating cable*

IEC 61196-1-200, *Coaxial communication cables – Part 1-200: Environmental test methods – General requirements*

IEC 61196-1-201, *Coaxial communication cables – Part 1-201: Environmental test methods – Test for cold bend performance of cable*

IEC 61196-1-215, *Coaxial communication cables – Part 1-215: Environmental test methods – High temperature cable ageing*

IEC 61196-1-300, *Coaxial communication cables – Part 1-300: Mechanical test methods – General requirements*

IEC 61196-1-301, *Coaxial communication cables – Part 1-301: Mechanical test methods – Test for ovality*

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[3] Under preparation. Stage at the time of publication: IEC/CDV 61196-1-123:2022.

IEC 61196-1-302, *Coaxial communication cables – Part 1-302: Mechanical test methods – Test for eccentricity*

IEC 61196-1-313, *Coaxial communication cables – Part 1-313: Mechanical test methods – Adhesion of dielectric and sheath*

IEC 61196-1-314:2015, *Coaxial communication cables – Part 1-314: Mechanical test methods – Test for bending*

IEC 61196-1-316, *Coaxial communication cables – Part 1-316: Mechanical test methods – Test of maximum pulling force of cable*

IEC 61196-1-317, *Coaxial communication cables – Part 1-317: Mechanical test methods – Test for crush resistance of cable*

IEC TR 62222, *Fire performance of communication cables installed in buildings*

IEC 62230, *Electric cables – Spark-test method*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61196-1:2005 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
radiating cable
coaxial communication cable with outer conductor that is intentionally not completely closed, so that part of the electromagnetic wave energy transmitted or received through the cable is coupled by a bidirectional transmission system formed by the outer conductor of the cable and the external environment

Note 1 to entry: The coupling intensity between the cable and mobile equipment depends on:

– the construction of the cable;

– the characteristics of the antenna (such as the type, the orientation, gain, etc.);

– the distance and orientation of the mobile antenna from the cable;

– the nature of ambient atmosphere;

– the operating frequency range;

– the manner of installation of the cable;

– the shape, material and size of surrounding buildings.

3.2
uniformly radiating type cable
radiating cable with its outer conductor intentionally slotted in different slots along the cable, so that electromagnetic energy radiating along the cable is uniform in a specific frequency range

Note 1 to entry: According to the design, the end of the input signal is the transceiver end, and the other is the load end.

3.3
stop frequency band
frequency band at which the peak of attenuation or standing wave appears due the cable construction, such as the slot pitch

Note 1 to entry: Stop frequency band cannot be used to transmit signals.

3.4
coupling loss
L_c
ratio of the power P_t transmitted into the radiating cable at one point to the power P_r received by a half-wavelength dipole antenna located at a distance from the radiating cable at the same point (see formula (1))

$$L_c = 10\log_{10}\frac{P_t}{P_r} \quad (1)$$

where

L_c is coupling loss, in dB;

P_t is the transmission power in the radiating cable at one point, in W;

P_r is the receiving power of the half-wavelength dipole antenna at a distance from the radiating cable at the same point, in W.

Note 1 to entry: Coupling loss is an important parameter of radiating coaxial cables to distinguish them from general coaxial communications cables.

3.5
link loss
ratio of the input power P_{in} transmitted into the transceiver end of the radiating cable from the signal source to the power P_r received by a half-wavelength dipole antenna located at a distance from the radiating cable, expressed by formula (2):

$$L_L = 10\log_{10}\frac{P_{in}}{P_r} \quad (2)$$

where

L_L is the link loss, in dB;

P_{in} is the input power transmitted into the transceiver end of the radiating cable from the signal source, in W;

P_r is the receiving power of the half-wavelength dipole antenna at a distance from the radiating cable, in W.

4 Materials and construction

4.1 General

The cable is composed of the inner conductor, dielectric, outer conductor and sheath; its construction shall be in accordance with 4.2 to 4.5 of this document and the requirements stated in the detail specification.

4.2 Inner conductor

IEC 61196-1:2005, 4.4.1 to 4.4.3 apply.

The conductor material shall be copper-clad aluminium copper tube or as stated in the detail specification.

The conductor shall consist of a solid wire, corrugated or smooth tube, or as stated in the detail specification.

In addition, IEC 61196-1:2005, 4.4.4 applies.

The inner conductor diameter (and thickness for smooth tube inner conductor) shall be stated in the detail specification.

For the corrugated inner conductor, the peak diameter and root diameter and pitch shall be specified in the detail specification.

The tolerance on the inner conductor shall be specified in the detail specification.

4.3 Dielectric

The dielectric material shall be as stated in the detail specification.

The construction of the dielectric shall be one of the following:

– solid dielectric;
– air spaced dielectric;
– semi air spaced dielectric (e.g. cellular polymer dielectric).

The diameter and tolerance shall be stated in the detail specification.

The recommended outer diameter ratings of the dielectric (the rounded value of the approximate outer diameter of the dielectric) should be as follows:

9 mm (3/8"), 12 mm (1/2"), 22 mm (7/8"), 32 mm (1 1/4"), 42 mm (1 5/8") or as stated in the detail specification.

4.4 Outer conductor

The outer conductor material shall be plain or coated copper wire, metallic tape with or without slots as stated in the detail specification.

The typical construction of the outer conductor shall be braid with low coverage, or slotted tape(s) rounding, or slotted corrugated tube, or slotted smooth tube, or as stated in the detail specification.

For the corrugated outer conductor, the peak diameter and root diameter and pitch shall be as specified in the detail specification.

The diameter and thickness of the outer conductor shall be specified in the detail specification.

The tolerance on the outer conductor shall be specified in the detail specification.

4.5 Sheath

The sheath of a cable shall be in accordance with IEC 61196-1:2005, 4.7 with the following amendments and additions:

a) The outer sheath of the cable shall be as specified in the detail specification.

b) The typical material of sheath shall be PE, LSZH, PVC, etc.

c) The diameter and thickness and tolerance of sheath shall be as stated in the detail specification.

d) For self-supporting cables, the cable design will be an 8-figure design including a messenger wire. The messenger wire position versus the coupling holes will be such that it favours the foreseen radiating pattern.

e) For cables intended for outdoor use or exposed to sunlight, the cable shall pass the UV stability test according to IEC specification.

f) Under the sheath, strips that meet product performance requirements can be permitted, such as non-conductive strips, flame-retardant strips, etc.

5 IEC type designation

5.1 Type name

The type name of the cable includes the nominal characteristic impedance and the dielectric outer diameter rating, expressed as follows:

a) the nominal characteristic impedance, in ohms, such as "50";

b) the outer diameter ratings of the dielectric, in millimetres (inch). See Subclause 4.3.

Example: 50-22 (7/8") is a cable, its nominal characteristic impedance is 50 Ω, and its outer diameter rating of dielectric is 22 mm (7/8").

5.2 Variant

The variant of the cable includes type, sheath material, outer conductor material and its construction, expressed as follows:

a) Type

U – uniformly radiating type cable

The type of non-uniformly radiating type cable is omitted.

b) a dash symbol

c) Sheath material

PE – polyethylene

LSZH – low smoke zero halogen polyolefin

PVC – polyvinyl chloride

d) a dash symbol

e) Outer conductor material and construction

C – copper tape wrapped longitudinally with slots or wrapped helically with gaps

AL – aluminium tape wrapped longitudinally with slots or wrapped helically with gaps

CT – copper corrugated tube with slots

ALT – aluminium corrugated tube with slots

W – copper wires wrapped helically with gaps or braided with low coverage factor

Example: 50-42 (1 5/8") U—LSZH-C is one variant of type 50-42 (1 5/8") radiating cable. It is a uniformly radiating type cable, its sheath material is low smoke zero halogen polyolefin, and its outer conductor is copper tape wrapped longitudinally with slots.

6 Standard rating and characteristics

6.1 Nominal characteristic impendence

The nominal characteristic impedance shall be specified in the detail specification. Typical impedance should be 50 Ω and 75 Ω.

6.2 Rated temperature range

The rating temperature range shall be specified in Table 1 or in the detail specification.

Table 1 – Rated temperature

Parameter	LSZH sheath °C	PE sheath °C	PVC sheath °C
Operational temperature range	−25 to 70	−40 to 70	−15 to 70
Storage temperature range	−25 to 70	−40 to 70	−15 to 70
Installation temperature range	−15 to 60	−30 to 60	0 to 60

6.3 Operating frequency

The maximum operating frequency range is specified in Table 2 or in the detailed specification.

Table 2 – Operating frequency

Type	Maximum recommended frequency GHz	Cut-off frequency GHz
50-9	6,00	12,79
50-12	6,00	9,14
50-22	4,80	5,18
50-32	3,60	3,71
50-42	2,70	2,78
NOTE The cut-off frequency is calculated under the condition that the effective dielectric constant of the dielectric is 1,25. The change of the product structure dimension in the manufacturing process will also affect the change of the cut-off frequency.		

6.4 Stop frequency band

The stop frequency band shall be specified in the detail specification and shall not be used.

6.5 Radiating characteristics

Except for uniformly radiating type cables, the radiating characteristics of cables are evaluated by the coupling loss; when required, radiating characteristics can also be evaluated by the coupling loss or radiation intensity around circumferential orientation of radiating cables, see Annex A and Annex B.