IEC

IEC 61196-1-123

Edition 1.0 2023-03

INTERNATIONAL STANDARD

Coaxial communication cables –
Part 1-123: Electrical test methods – Test for attenuation constant of radiating cable

IEC 61196-1-123:2023-03(en)

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 33.120.10

ISBN 978-2-8322-6463-8

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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COAXIAL COMMUNICATION CABLES –

**Part 1-123: Electrical test methods –
Test for attenuation constant of radiating cable**

FOREWORD

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IEC 61196-1-123 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.

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

Draft	Report on voting
46A/1613/FDIS	46A/1625/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.

A list of all the 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- withdrawn,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.

COAXIAL COMMUNICATION CABLES –

Part 1-123: Electrical test methods – Test for attenuation constant of radiating cable

1 Scope

This part of IEC 61196 defines the test method to determine the attenuation constant of radiating coaxial communication cables that are intended for use in wireless communication systems such as tunnels, railways, highways, subways, elevators and other confined areas in which conventional antenna transmission is not satisfactory or even impossible.

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

IEC 61196-4, *Coaxial communication cables − Part 4: Sectional specification for radiating cables*

3 Terms and definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61196-1 and IEC 61196-4 apply.

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

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

3.2 Abbreviated terms

CUT Cable under test

VNA Vector network analyser

4 Methodology

4.1 General

The measurements of attenuation for radiating cables can be carried out by one of the two following methods, where the free-space method shall be the arbitration method if there is an argument:

– free-space method;

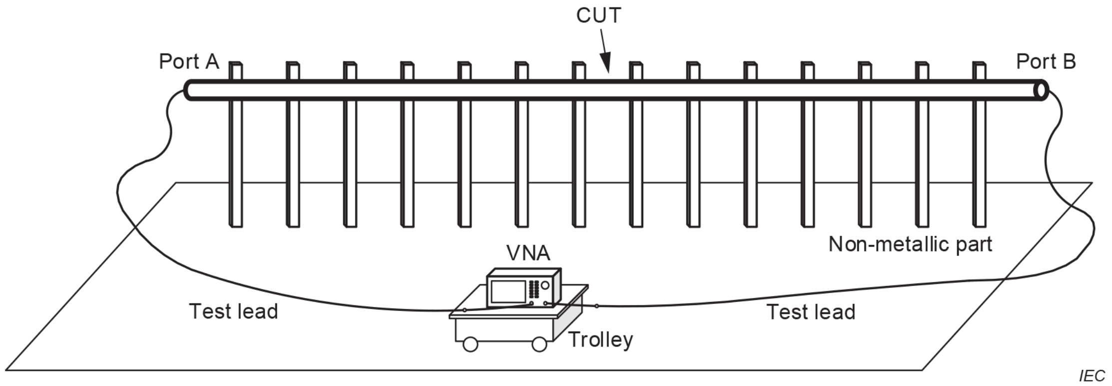
– ground-level method.

4.2 Free-space method

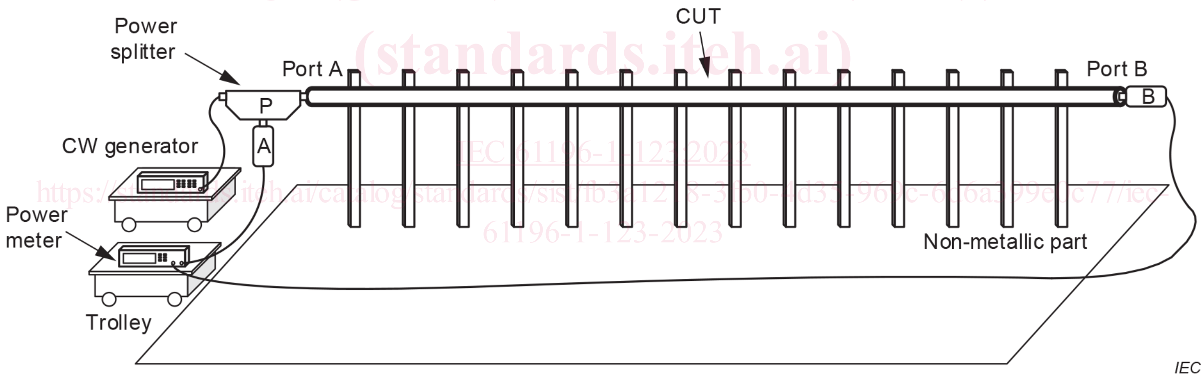
The arrangement of the cable is given in Figure 1a) and Figure 1b), respectively. The cable is laid on non-metallic posts at a height of 1,5 m to 2 m.

NOTE Figure 1a) addresses a VNA test arrangement while Figure 1b) provides a power meter test arrangement. The end user can choose the method to be used.

The cable shall be at least 10 λ, where λ is the cable wavelength of the measuring frequency, but not shorter than 50 m or 10 λ, the larger value being applicable.



a) VNA test arrangement



b) Power meter test arrangement

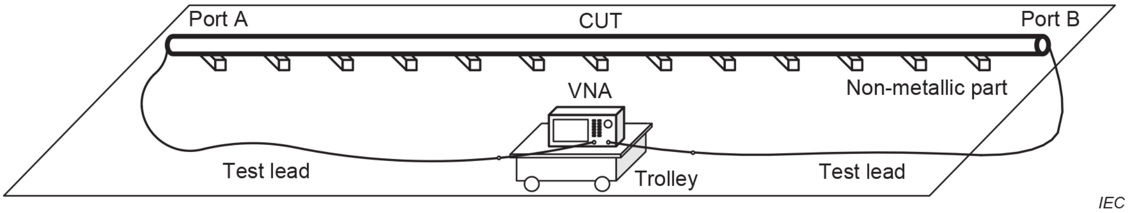
Figure 1 – Attenuation constant with free-space method

4.3 Ground-level method

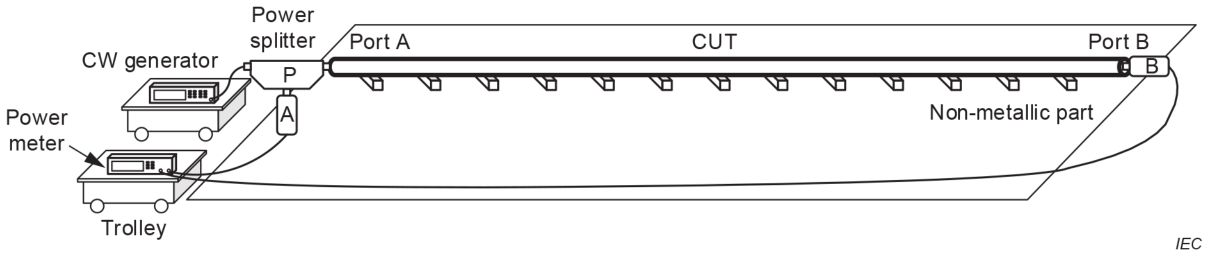
The arrangement of the cable is given in Figure 2a) and Figure 2b), respectively. The cable is laid on non-metallic spacers, which gives the cable a distance from the concrete floor of 10 cm to 12 cm.

NOTE Figure 2a) addresses a VNA test arrangement while Figure 2b) provides a power meter test arrangement. The end user can choose the method to be used.

The cable shall be at least 10 λ, where λ is the cable wavelength of the measuring frequency, but not shorter than 50 m or 10 λ, the larger value being applicable.



a) VNA test arrangement



b) Power meter test arrangement

Figure 2 – Attenuation constant with ground-level method

5 Test procedures

5.1 General

For the VNA test arrangement, the attenuation constant is defined by:

$$\alpha = 10 \cdot \log\left(\frac{P_1}{P_2}\right) \cdot \frac{100}{l} \qquad (1)$$

where

α is the attenuation constant, expressed in dB/100 m (frequency dependent);

P_1 is the input power of a receiver where the load impedance and the receiver impedance are equal and of the same value as the nominal value of the specimen, expressed in dBm;

P_2 is the output power of a source where the load impedance and the source impedance are equal and of the same value as the nominal value of the specimen, expressed in dBm;

l is the physical length of the specimen, expressed in m.

When calibration of the vector network analyzer (VNA) with S-parameter is performed, the attenuation constant can also be expressed as:

$$\alpha = -20 \times \log\left|S_{21}\right| \cdot \frac{100}{l} \qquad (2)$$

For the field test arrangement, the attenuation constant is calculated as follows:

$$\alpha = (P_{CUT} - P_{cal}) \cdot \frac{100}{l} \quad (3)$$

where

P_{cal} is the power obtained at calibration, expressed in dB;

P_{CUT} is the power obtained at CUT, expressed in dB;

l is the physical length of the specimen, expressed in m.

5.2 Equipment

– A vector network analyzer (VNA) capable of performing S_{21} measurements and a THRU calibration kit shall be used.

– Two power meters, a power splitter and a RF CW generator shall be used.

5.3 Calibration

The attenuation of the test setup shall be measured over the whole specified frequency range according to the following test arrangements, respectively.

– For the VNA test arrangement, two test leads shall be used with a nominal impedance of the test system. A full two port calibration shall be performed according to instructions of the VNA via using either an OSL or E-cal kit. Temperature of the coaxial test leads shall be kept constant after calibration and during the CUT measurement to avoid uncertainty of the test result caused by instable attenuation of the test leads.

– For the power meter test arrangement, the power meter B is attached to the power splitter's port. For each frequency, the calibration power level is recorded: $P_{cal}(f) = P_A(f) - P_B(f)$.

5.4 Measurement

For the VNA test arrangement, the CUT should be connected to the calibrated test setup. The attenuation should be measured over the whole specified frequency range and at the same frequency points as for the calibration procedure within the specified frequency range.

For the power meter test arrangement, the CUT is connected between the port of the power splitter and power meter B.

For each frequency, the power level is recorded: $P_{CUT}(f) = P'_A(f) - P'_B(f)$.

The attenuation constant is calculated at each frequency: $\alpha(f) = P_{CUT}(f) - P_{cal}(f)$.

The CUT should be allowed to stabilize to the ambient temperature for a minimum period of 2 h.

The test data and ambient temperature should be recorded.