IEC 61196-1-119

Edition 3.0 2023-07

INTERNATIONAL STANDARD

colour inside

Coaxial communication cables – Part 1-119: Electrical test methods – RF power for coaxial cables and cable assemblies

IEC 61196-1-119:2023-07(en)

IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, …). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch
Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org
The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC 61196-1-119

Edition 3.0 2023-07

INTERNATIONAL STANDARD

colour inside

Coaxial communication cables – Part 1-119: Electrical test methods – RF power for coaxial cables and cable assemblies

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ICS 33.120.10

ISBN 978-2-8322-7184-1

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

COAXIAL COMMUNICATION CABLES –

Part 1-119: Electrical test methods – RF power for coaxial cables and cable assemblies

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.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at https://patents.iec.ch. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 61196-1-119 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 third edition cancels and replaces the second edition published in 2020. This edition constitutes a technical revision.

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

a) complete technical revision;
b) extension to measure also cable assemblies.

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

Draft	Report on voting
46A/1622/CDV	46A/1629/RVC

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 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.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

COAXIAL COMMUNICATION CABLES –

Part 1-119: Electrical test methods – RF power for coaxial cables and cable assemblies

1 Scope

This part of IEC 61196 provides test methods for RF power rating and power withstanding of RF coaxial cables and cable assemblies at specified frequency, temperature and altitude.

This document is applicable to RF coaxial cables and cable assemblies.

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 61196-1-113, *Coaxial communication cables – Part 1-113: Electrical test methods – Test for attenuation constant*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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

3.1
power rating
input power at a specified frequency and normalized environmental conditions, which can be handled continuously without either the maximum permissible operating voltage, or maximum inner conductor temperature being exceeded, when the cable assembly is terminated by a load corresponding to the characteristic impedance

3.2
power withstanding
ability of RF coaxial cable and cable assembly to handle power specified in the relevant specification at the temperature, altitude and frequency as specified

3.3
average power
energy transfer rate of an RF coaxial cable and cable assembly averaged over many periods of the RF waveform at the specified frequency, temperature and altitude

3.4
peak power
maximum RF power P_{max} injected in a RF coaxial cable and cable assembly with a pulse duration τ over period T with the duty factor R at the specified temperature and altitude

Note 1 to entry: The relationship of duty factor, pulse duration and period is as shown in Figure 1 and expressed as Formula (1).

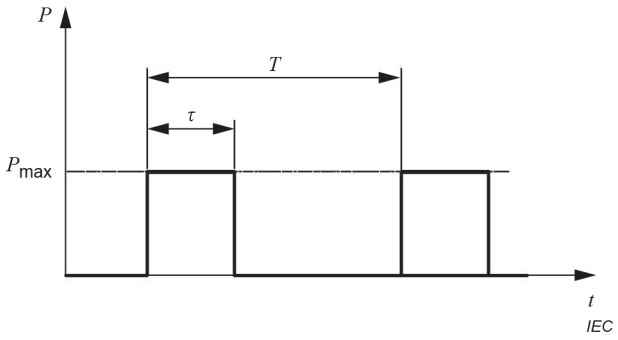

Figure 1 – Illustration of peak power

$$R = \frac{\tau}{T} \times 100\ (\%) \tag{1}$$

where:

R is the duty factor, in %;

τ is the pulse duration, in s;

T is a period of pulse, in s.

3.5
continuous wave power
when duty factor R = 1 in Formula (1), the power curve in Figure 1 approximates a straight line

4 Preparation of test sample (TS)

4.1 Coaxial cable

Both ends of the coaxial cable should be terminated with suitable high-power RF coaxial connectors to make an RF cable assembly as a test sample (TS). The length of the cable should be long enough so that the heat dissipation caused by the connectors at both ends can be negligible. The selected connectors shall be suitable to connect to the test equipment directly. Their RF power rating shall be higher than the RF power of the coaxial cable to be tested.

For a test of average power and continuous wave power rating the temperature of the inner conductor of the TS shall be monitored.

a) Drill a small hole at the centre of the cable length and at least 0,5 m away from both sides of the TS so that a temperature sensor can be inserted to measure the temperature of the inner conductor.

b) Insert a temperature sensor (such as fibre optic temperature sensor) into the hole to measure the temperature T_i of the inner conductor.

If specified in the relevant specification the temperature of the inner conductor of the TS shall also be monitored as well for a power withstanding test. If the temperature rating of the dielectric and inner conductor is not a concern, the test can be conducted without monitoring the temperature of the inner conductor.

4.2 Cable assembly

Each cable assembly to be tested shall be a test sample (TS).

For a test of average power and continuous wave power rating the temperature of the inner conductor of the TS shall be monitored.

The TS shall be prepared as follows:

a) Drill a small hole at the centre of the cable length, and at both ends of connectors and also at both connections between the connector and the cable respectively so that a thermosensor can be inserted to measure the temperature of the inner conductor. If the least cross section of the connector is neither positioned at the end of the connector nor on the connection between connector and cable, drill also a hole on the position with the least cross section.
b) Insert a thermocouple (such as fibre optic temperature sensor) into each hole to measure the temperature T_{ix} of the inner conductor.

If specified in the relevant specification, the temperature of inner conductor of the TS shall also be monitored for a power withstanding test. If the temperature rating of the dielectric and inner conductor is not a concern, the test can be conducted without monitoring the temperature of the inner conductor.

5 Test conditions

The test shall be performed at stable conditions of temperature and atmospheric pressure.

a) Temperature stability:

   When the temperature variation of the test sample is not more than ±2 °C within 5 min, the temperature shall be considered stable.

   When using a test chamber, the temperature shall be considered stable when the temperature variation of the chamber and the test sample is no more than ±2 °C within 5 min.

b) Altitude stability:

   When the power rating is specified for a specific altitude, the altitude is considered stable when the pressure variation inside the low-pressure test chamber is within the range of ±5 % of the specified value within 10 min.

6 Test principle

A combination of power source, directional coupler, fixed attenuator (when required), power meter and load are used for the test, as shown in Figure 2. At the directional coupler, the incident power P_i is split between the coupled port P_f and the transmitted port that is connected to the TS. The reference power P_0 is measured by a power meter. If necessary, a fixed attenuator can be inserted between the directional coupler and power meter to adjust the power level to the test range of the power meter. A feed line may also be used. If a feed line is used, the input power of the test sample will be attenuated by the feed line. The TS is terminated with a load.

Since the coupling factor C (calculated from Formula (2)) of the coupler, attenuation value D (calculated from Formula (3)) of the fixed attenuator and the attenuation A of the feed line (if used) are fixed, the actual input power of the sample can be obtained from Formula (4).

$$C = 10\lg\frac{P_i}{P_f} \tag{2}$$

$$D = 10\lg\frac{P_f}{P_g} \tag{3}$$

$$P = P_o + D + C - A \tag{4}$$

where:

C coupling factor of the coupler, in dB;

P_i incident power to the coupler, in dB;

P_f power value at the coupled port, in dB;

D attenuation of the fixed attenuator, in dB;

P_g power value attenuated by the fixed attenuator, in dB;

P incident power value at the TS, in dB;

P_o reference power, in dB;

A attenuation of the feed line, in dB.

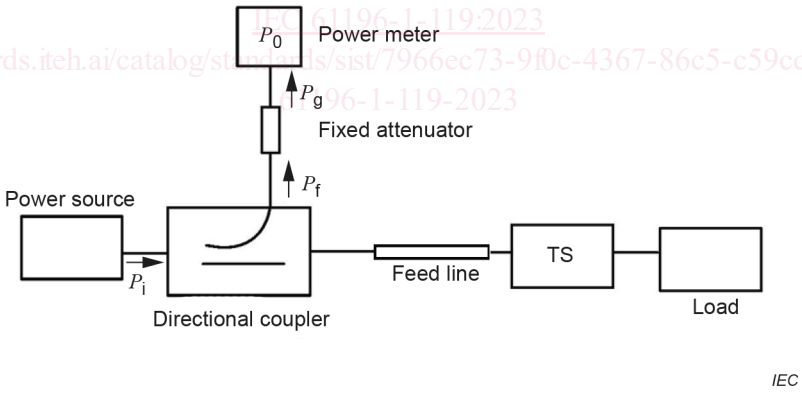

Figure 2 – Test principle

7 Test equipment

Test equipment is as follows:

a) Power source, directional coupler, fixed attenuator, power meter, high-power load or absorber. The rated power of the selected devices shall be more than 2 to 2,5 times of the maximum power measured, so as to prevent the devices from burning out due to overheating in case of non-steady power.

b) Temperature sensors to measure inner and outer conductor temperatures with sufficient sensitivity and an accuracy of ±1 °C.

c) Temperature–altitude test chamber (if applicable) meeting the test requirements as stated in the relevant specifications.

d) Test room to prevent air circulation, such as fans of the climatic cabinet. If necessary, the test room should fit into the climatic cabinet and be large enough so that the test items can be 20 cm (8 in) away from the walls of the test room.

e) Load with a voltage standing wave ratio (VSWR) of less than 1,2.

NOTE The VSWR of the load is an important factor as regards RF test results and the capability in the application, see Annex B for details.

8 Test procedure

8.1 Power withstanding

8.1.1 Average power/continuous wave power withstanding

8.1.1.1 Test procedure

The test procedure is as follows:

a) Connect the TS into the power test system as shown in Figure 2.

b) If specified in the relevant specification, for coaxial cables, use the temperature sensor to monitor inner conductor temperatures t_i in middle of the TS and record the temperature values t_i. For cable assemblies, use the temperature sensor to monitor inner conductor temperatures t_{ix} in the middle of the TS and at both ends of connectors and also at both connections between the connector and the cable respectively. Record the temperature values t_{ix}.

c) The TS shall be stored and stabilized at room temperature unless otherwise specified in the relevant specification. If the ambient temperature and/or altitude for the test are specified in the relevant specification, the TS shall be placed in a temperature and/or altitude test chamber for testing. The temperature and/or air pressure in the test chamber shall conform to the relevant specification and shall be monitored throughout the test.

d) Set test parameters of frequency and average power and continuous wave power. Start the test.

e) Keep the input power steady at that frequency for a duration as specified in the relevant specification. The temperature of the surface of the TS shall be monitored and recorded by a temperature sensor when required in the relevant specification.

f) If a frequency range is specified in the relevant specification, the maximum power shall be applied at the maximum frequency for 60 min after the temperature is stabilized.

g) If the above e) test conditions are not available, the test shall be carried out at high-frequency, middle-frequency and low-frequency points, respectively. Unless otherwise specified in the relevant specification, the high-frequency point selected in the test shall be within 10 % of the upper limit frequency of the sample, and the test duration shall not be less than 60 min. The middle-frequency point should be the approximate intermediate frequency in the frequency range, and the test duration should not be less than 20 min. The low-frequency point should be within 0,10 GHz at the lower end of the frequency range, and the test duration should not be less than 20 min.

h) The TS should be carefully observed during the test for evidence of breakdown and burning.

i) The TS shall be stored and stabilized at room temperature after the test. If specified, verify compliance to electrical specifications according to relevant standards.

8.1.1.2 Requirements

During the test, there shall be no breakdown and burning on the TS and, when specified, temperature rises of the TS and the test chamber shall comply with the relevant specifications.