International Standard

ISO 11554

Optics and photonics — Lasers and laser-related equipment — Test methods for laser beam radiant power, radiant energy and temporal characteristics

Optique et photonique — Lasers et équipements associés aux lasers — Méthodes d'essai de la puissance rayonnante, de l'énergie rayonnante et des caractéristiques temporelles des faisceaux lasers

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Contents

Page

Foreword ... **iv**
Introduction ... **vi**
1 Scope ... **1**
2 Normative references ... **1**
3 Terms and definitions ... **1**
4 Symbols and units of measurement ... **2**
5 Measurement principles ... **3**
6 Measurement configuration, test equipment and auxiliary devices ... **3**
6.1 Preparation ... 3
6.1.1 Sources with small divergence angles ... 3
6.1.2 Sources with large divergence angles ... 3
6.1.3 RIN measurement ... 4
6.1.4 Measurement of small signal cut off frequency ... 5
6.2 Control of environmental impacts ... 6
6.3 Detectors ... 6
6.4 Beam-forming optics ... 7
6.5 Optical attenuators ... 7
7 Measurements ... **7**
7.1 General ... 7
7.2 Radiant power of cw lasers ... 7
7.3 Radiant power stability of cw lasers ... 8
7.4 Radiant pulse energy of pulsed lasers ... 8
7.5 Radiant energy stability of pulsed lasers ... 8
7.6 Temporal radiant pulse shape, radiant pulse duration, rise time, fall time and peak radiant power ... 8
7.7 Radiant pulse duration stability ... 8
7.8 Radiant pulse repetition rate ... 8
7.9 Relative intensity noise, RIN ... 9
7.10 Small signal cut-off frequency ... 9
8 Evaluation ... **9**
8.1 General ... 9
8.2 Radiant power of cw lasers ... 10
8.3 Radiant power stability of cw lasers ... 10
8.4 Radiant pulse energy of pulsed lasers ... 10
8.5 Radiant energy stability of pulsed lasers ... 11
8.6 Temporal radiant pulse shape, radiant pulse duration, rise time, fall time and peak radiant power ... 11
8.7 Radiant pulse duration stability ... 13
8.8 Radiant pulse repetition rate ... 13
8.9 Relative intensity noise, RIN ... 13
8.10 Small signal cut-off frequency ... 13
9 Test report ... **13**
Annex A (informative) **Relative intensity noise (RIN)** ... **17**
Bibliography ... **19**

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 172, *Optics and photonics*, Subcommittee SC 9, *Laser and electro-optical systems,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 123, *Lasers and photonics,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This fifth edition cancels and replaces the fourth edition (ISO 11554:2017) which has been technically revised.

The main changes are as follows:

a) Whole document: The term “power" and “energy” that mean optical power and optical energy have been replaced by “radiant power” and “radiant energy”, respectively, and the word “spectral density” has been replaced by “spectral” in order to align with ISO 80000-7:2019 and the International Electrotechnical Vocabulary.

b) Normative references: IEC 61040:1990 has been removed because it was withdrawn in August 2011.

c) In 3.1, the definition of RIN has been corrected. The word “relative intensity noise spectral density” has been replaced by “spectral relative intensity noise”.

d) In Figure 2, keys 4, 5 and 6 have been amended.

e) In 6.3, the explanatory text has been added instead of referencing IEC 61040:1990.

f) In 6.5,The term “laser power density” has been replaced by “irradiance” in order to align with ISO 80000-7: 2019.

g) In 7.9, measurement procedure has been modified to clarify the method for removing thermal and shot noise terms as well as pre-amplifier noise from the measured noise power.

h) In Clause 9 c) 5), the terms “current or energy input”, “pulse energy”, “pulse duration” and “pulse repetition rate” have been modified in order to clarify their characteristics.

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i) In Annex A, the word “spectral density of the power fluctuations” and “spectral density function $S_{\Delta P}(f)$” have been replaced by “spectral irradiation fluctuations” and “power spectrum $S_{\Delta P}(f)$”, respectively.

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Introduction

The measurement of laser radiant power (radiant energy for pulsed lasers) is a common type of measurement performed by laser manufacturers and users. Radiant power (radiant energy) measurements are needed for laser safety classification, stability specifications, maximum laser output specifications, damage avoidance, specific application requirements, etc. This document provides guidance on performing laser radiant power (radiant energy) measurements as applied to stability characterization. The stability criteria are described for various temporal regions (e.g. short-term, medium term and long term) and provide methods to quantify these specifications. This document also covers pulse measurements where detector response speed can be critically important when analysing pulse shape or peak radiant power of short pulses. To standardize reporting of radiant power (radiant energy) measurement results, a report template is also included.

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Optics and photonics — Lasers and laser-related equipment — Test methods for laser beam radiant power, radiant energy and temporal characteristics

1 Scope

This document specifies test methods for determining the radiant power and radiant energy of continuous wave and pulsed laser beams, as well as their temporal characteristics of pulse shape, pulse duration and pulse repetition rate. Test and evaluation methods are also given for the radiant power stability of cw-lasers, radiant energy stability of pulsed lasers and pulse duration stability.

The test methods given in this document are used for the testing and characterization of lasers.

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.

ISO 11145, *Optics and photonics — Lasers and laser-related equipment — Vocabulary and symbols*

ISO/IEC Guide 99, *International vocabulary of metrology — Basic and general concepts and associated terms (VIM)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 11145, ISO/IEC Guide 99 and the following apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
relative intensity noise
RIN
$R(f)$
quotient of the radiant power mean square fluctuations to the square of the mean radiant power, normalized to a frequency band of unit width

$$R(f) = \frac{\left\langle \Delta P(f)^2 \right\rangle}{\langle P \rangle^2} \cdot \frac{1}{\Delta f}$$

where Δf is the equivalent noise bandwidth.

Note 1 to entry: The relative intensity noise $R(f)$ or RIN [see Formula] is explicitly spoken of as the “spectral relative intensity noise”, but usually simply referred to as RIN.

Note 2 to entry: For further details, see Annex A.

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