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

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



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 documents 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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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 172, *Optics and photonics*, Subcommittee SC 9, *Electro-optical systems*.

This fourth edition cancels and replaces the third edition (ISO 11554:2006) which has been technically revised. The following changes were made:

- a) [Subclause 3.1](#): definition of RIN was changed in order to harmonize with ISO 11145:2016.
- b) [Clause 4](#), note 3: Expression for dB calculation was corrected.
- c) [Figure 3](#): Explanation of M was modified.
- d) [Subclause 7.9](#): Measurement of RIN was added, and former content of [7.9](#) was moved to [7.10](#).
- e) [Subclause 7.10](#): Explanation for the measurement of small signal cut-off frequency was modified.
- f) [Subclause 8.9](#): Explanation for RIN was added and former content of [8.9](#) was moved to [8.10](#).
- g) [Clause 9](#), item 8): Parameters for RIN were added, and former content of item 8) was moved to item 9).
- h) Equation numbers were renumbered.

Introduction

The measurement of laser power (energy for pulsed lasers) is a common type of measurement performed by laser manufacturers and users. Power (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 power (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 power of short pulses. To standardize reporting of power (energy) measurement results, a report template is also included.

This document is a Type B standard as stated in ISO 12100.

The provisions of this document may be supplemented or modified by a Type C standard.

Note that for machines which are covered by the scope of a Type C standard and which have been designed and built according to the provisions of that standard, the provisions of that Type C standard take precedence over the provisions of this Type B standard.

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

1 Scope

This document specifies test methods for determining the power and 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 power stability of cw-lasers, 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)*

IEC 61040:1990, *Power and energy measuring detectors, instruments and equipment for laser radiation*

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 <http://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

relative intensity noise

RIN

$R(f)$

quotient of the radiant power mean square fluctuations to the mean square radiant power, normalized to a frequency band of unit width

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

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

Note 2 to entry: For further details, see [Annex A](#).