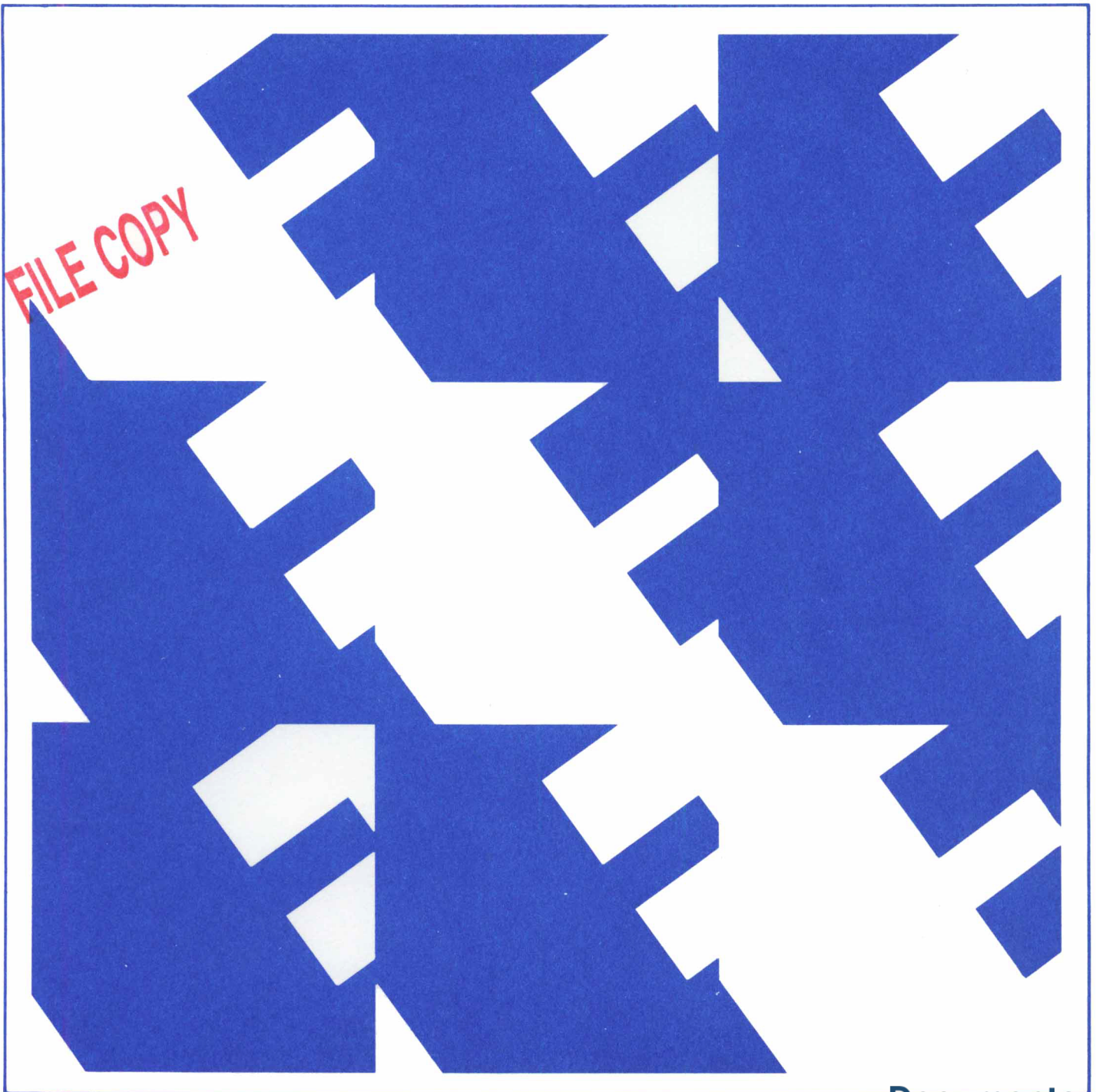


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IEEE Standard Specification Format Guide and Test Procedure for Single-Axis Laser Gyros



IEEE Std 647-1981



IEEE
Std 647-1981

IEEE Standard Specification Format Guide and Test Procedure for Single-Axis Laser Gyros

Sponsor

**Gyro and Accelerometer Panel of the
IEEE Aerospace Electronics System Society**

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Foreword

(This Foreword is not a part of IEEE Std 647-1981, IEEE Standard Specification Format Guide and Test Procedure for Single-Axis Laser Gyros.)

This standard was prepared by the Gyro and Accelerometer Panel of the Aerospace Electronics Systems Society of the Institute of Electrical and Electronics Engineers. It consists of two parts:

Part I is a specification format guide for the preparation of a laser gyro specification. It provides a common meeting ground of terminology and practice for manufacturers and users. The user is cautioned not to overspecify; only those parameters that are required to guarantee proper instrument performance in the specific application should be controlled. In general, the specification should contain only those requirements that can be verified by test or inspection. Parameters in addition to those given in this standard are not precluded.

Part II is a compilation of recommended procedures for testing a laser gyro. These procedures, including test conditions to be considered, are derived from those currently in use. For a specific application, the test procedure should reflect the requirements of the specifications; therefore, not all tests outlined in this standard need be included, nor are additional tests precluded. In some cases, alternative methods for measuring performance characteristics have been included or indicated.

The intent is for the specification writer to extract the applicable test conditions and equipment requirements from Section 9 for inclusion in the appropriate sections listed under 4.5 of this standard. Similarly, it is intended that the writer extract the applicable test procedures from Section 10 for inclusion in the appropriate sections listed under 4.6. Part II can also be used as a guide in the preparation of a separate laser gyro test specification with appropriate section numbering.

Blank spaces in the text of this document permit the insertion of specific parameter values and their tolerances. Brackets are used to enclose alternative choices of dimensional units, signs, axes, etc. Boxed statements are included for information only and are not part of the specification or test procedures. The terminology used conforms to ANSI/IEEE Std 100-1977, IEEE Standard Dictionary of Electrical and Electronics Terms. The units used conform to IEEE Std 268-1979, IEEE Standard Metric Practice. The abbreviation of units conform to ANSI/IEEE Std 260-1978, Standard Letter Symbols for Units of Measurement. The graphic symbols used conform to ANSI/IEEE Std 315-1975 Graphic Symbols for Electrical and Electronics Diagrams.

This standard defines the requirements and test procedures for a single axis laser gyro in terms unique to the laser gyro. The requirements contained herein cover applications where the laser gyro is used as an angular motion sensor in navigation and control systems.

The term *laser gyro* is accepted to include the electronics necessary to operate the gyro and to condition the output signal. The laser gyro provides an output frequency proportional to inertial angular rate about the input axis which is perpendicular to the plane of the area enclosed by the laser path.

Appendix A lists various laser gyro design features for which this format is applicable. The table is not intended to make any suggestion regarding the selection of particular design features that might restrict the free choice of manufacturers.

The IEEE will maintain this standard current with the state of the technology. Comments are invited on this standard as are suggestions for additional material. These should be addressed to:

Secretary
IEEE Standards Board
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This publication represents a group effort on a large scale. A total of 107 individuals attended 26 meetings of the Gyro and Accelerometer Panel while this standard was in preparation. The major contributors to this standard were the following:

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IEEE Standard Specification Format Guide and Test Procedure for Single-Axis Laser Gyros

Part I — Specification Format

1. Scope

This standard defines the requirements for a single-axis laser gyro to be used as a sensor in [an attitude control system, an angular displacement measuring system, an angular rate measuring system, _____]. This includes the electronics necessary to operate the gyro and to condition the output signal.

2. Applicable Documents

The following documents form a part of the specification to the extent specified herein. In the event of any conflict between the requirements of this standard and the listed documents, the requirements of this standard shall govern.

Give identification number, title, date of issue, and revision letter of each listed document.

2.1 Specifications

- 2.1.1 Government
- 2.1.2 Industry/Technical
- 2.1.3 Company

2.2 Standards

- 2.2.1 Government

2.2.2 Industry/Technical

(1) IEEE Std 100-1977, Standard Dictionary of Electrical and Electronics Terms.

2.2.3 Company

2.3 Drawings

- 2.3.1 Government
- 2.3.2 Industry/Technical
- 2.3.3 Company

2.4 Bulletins

- 2.4.1 Government
- 2.4.2 Industry/Technical
- 2.4.3 Company

2.5 Other Publications

Other applicable documents should be listed under the appropriate paragraph.

3. Requirements

3.1 Description. The major components of the laser gyro herein specified are: a _____ gain medium, a closed path optical resonator utilizing _____, and a combining optics readout device (including pulse forming electronics) consisting of _____.

The particular laser gyro specified may have

additional major components as follows: a _____ anti-lock device, a _____ path length control, temperature or temperature compensation, power supplies for _____, and an excitation control.

To fill in the blanks, refer to Appendix A for examples.

3.2 General Requirements

3.2.1 Precedence. In the event of conflict among the purchase agreement, this specification, and other documents referred to herein, the order of precedence shall be as follows:

- (1) purchase agreement
- (2) this specification and its applicable drawings (see 3.4.2 and 3.5.1)
- (3) other applicable documents (see Section 2)

3.2.2 Definitions. The following standard and the model equation of 6.3 define terminology used in this specification:

ANSI/IEEE Std 100-1977, IEEE Standard Dictionary of Electrical and Electronics Terms.

3.3 Performance. Performance characteristics shall be as specified hereinafter.

The tolerances include a summation of manufacturing and test errors, and environmental effects. Any exception due to environmental effects will be listed in 3.6.3.1.

When required by the application, the sensitivity of a gyro characteristic to variations in voltage, frequency, temperature, or other variables shall be included in the paragraph specifying that characteristic.

3.3.1 Input Rates

3.3.1.1 Input Rate Limits. The input rate limits about the gyro input axis shall be $\pm$ _____ [rad/s, °/s, °/h].

The clockwise and counter clockwise input rate limits need not be equal. Multiple rate limits may be specified.

3.3.1.2 Minimum Input Rate. The minimum rate of rotation about the input axis for which the performance is of the specified quality shall be $\pm$ _____ [rad/s, °/s, °/h].

This characteristic is important for laser gyros which do not provide a mechanism to avoid lock-in. At some rate below the minimum input rate the specified scale factor nonlinearity may be exceeded. Lock-in rate may be of interest as a performance characteristic when the specified operating rate is expected to approach lock-in.

3.3.2 Gyro Scale Factor. _____ "/p $\pm$ _____ %.

The scale factor is the angular input in arc seconds (") equivalent to a digital pulse (p) output. The scale factor is directly proportional to the enclosed ring area, and inversely proportional to the total path length and operating wavelength.

3.3.2.1 Gyro Scale Factor Errors

(1) *Asymmetry.* The difference between the scale factor measured with a positive input rate and a negative input rate shall not exceed _____ [ppm, %].

The specific input rotational rate(s) at which the scale factor asymmetry is to be determined may be specified. The asymmetry is the ratio of the difference in magnitudes of scale factor measured for CW and CCW inputs to one-half the sum of the same magnitudes.

(2) *Nonlinearity.* _____ [ppm, %, _____], [maximum, 1σ , _____].

The nonlinearity is determined at specified constant rates of rotation covering the input range. This nonlinearity characterizes the change of scale factor from a defined calibration reference (such as the mean of all samples of a test set, or a value established at a pre-selected rate) measured over the input range.

(3) *Repeatability.* [ppm, %], [maximum spread, 1σ , _____].

Repeatability involves changes in scale factor that occur between periods of operation. Thermal cycles and other environmental exposures, shutdowns, time between runs, remounting, and additional factors pertinent to the particular application should be specified.