Recognized as an
American National Standard (ANSI)

IEEE Std 301™-1988(R2006)
(Revision of IEEE Std 301-1976)

IEEE Standard Test Procedures for Amplifers and Preamplifers used with Detectors of Ionizing Radiation

Sponsor

Nuclear Instruments and Detectors Committee
of the
IEEE Nuclear and Plasma Sciences Society

Reaffirmed March 30, 2006
Approved October 20, 1988
IEEE Standards Board

Approved June 21, 1989
American National Standards Institute

© Copyright 1989 by

The Institute of Electrical and Electronics Engineers, Inc
345 East 47th Street, New York, NY 10017, USA

No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher

IEEE Standards documents are developed within the Technical Committees of the IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Board. Members of the committees serve voluntarily and without compensation. They are not necessarily members of the Institute. The standards developed within IEEE represent a consensus of the broad expertise on the subject within the Institute as well as those activities outside of IEEE which have expressed an interest in participating in the development of the standard.

Use of an IEEE Standard is wholly voluntary. The existence of an IEEE Standard does not imply that there are no other ways to produce, test, measure, purchase, market, or provide other goods and services related to the scope of the IEEE Standard. Furthermore, the viewpoint expressed at the time a standard is approved and issued is subject to change brought about through developments in the state of the art and comments received from users of the standard. Every IEEE Standard is subjected to review at least every five years for revision or reaffirmation. When a document is more than five years old, and has not been reaffirmed, it is reasonable to conclude that its contents, although still of some value, do not wholly reflect the present state of the art. Users are cautioned to check to determine that they have the latest edition of any IEEE Standard.

Comments for revision of IEEE Standards are welcome from any interested party, regardless of membership affiliation with IEEE. Suggestions for changes in documents should be in the form of a proposed change of text, together with appropriate supporting comments.

Interpretations: Occasionally questions may arise regarding the meaning of portions of standards as they relate to specific applications. When the need for interpretations is brought to the attention of IEEE, the Institute will initiate action to prepare appropriate responses. Since IEEE Standards represent a consensus of all concerned interests, it is important to ensure that any interpretation has also received the concurrence of a balance of interests. For this reason IEEE and the members of its technical committees are not able to provide an instant response to interpretation requests except in those cases where the matter has previously received formal consideration.

Comments on standards and requests for interpretations should be addressed to:

Secretary, IEEE Standards Board
345 East 47th Street
New York, NY 10017
USA

IEEE Standards documents are adopted by the Institute of Electrical and Electronics Engineers without regard to whether their adoption may involve patents on articles, materials, or processes. Such adoption does not assume any liability to any patent owner, nor does it assume any obligation whatever to parties adopting the standards documents.

Foreword

(This Foreword is not a part of IEEE Std 301-1988, IEEE Standard Test Procedures for Amplifiers and Preamplifiers used with Detectors of Ionizing Radiation.)

This standard describes test procedures for amplifiers and preamplifiers that are used with semiconductor, scintillation, and proportional detectors in the spectrometry of ionizing radiation. It supersedes ANSI/IEEE Std 301-1976, IEEE Standard Test Procedures for Amplifiers and Preamplifiers for Semiconductor Radiation Detectors for Ionizing Radiation. The title was changed because the same amplifiers used for semiconductor detectors are applicable to other types.

Amplifier technology has progressed to the point where the spectrometer performance may be limited as much by the multichannel analyzer (MCA) as by the amplifier. Because of this and because of the impracticality of standardizing on one MCA with so many on the market, MCAs, with minor exceptions, are not a part of the measurement procedure in this publication.

In this standard, measuring procedures are given in greater detail than in the earlier publication because with modern amplifiers, perceived performance often depends on the details of measurement. Thus, many of the details of the procedures must be standardized as well as the amplifier specifications.

Tests that are specific to amplifiers with time-variant pulse-shaping filters are not included in this standard, nor are tests for pile-up rejectors. Time-variant filters allow shorter pulse-shaping times than linear filters for the same signal-to-noise ratio (snr), and pile-up rejectors, as the name implies, block pulses that overlap earlier ones, allowing higher count rates for a given spectral-line resolution. Both techniques have the greatest application at the energy extremes: at very low energies because wide pulses must be used to optimize the snr, and at high energies where detector artifacts cause low-side tailing of spectrum lines. The tailing obscures low-intensity lines falling just below higher energy lines, and pile-up causes phantom peaks to appear at energy multiples of the spectrum lines.

In this standard, $t_{0.5}$ or $t_{1/2}$ (the pulse width at 50% of peak amplitude) is the main-amplifier indicator of shaping time because this parameter best enables a performance comparison among different amplifiers. Also, compared with other parameters, this one is the easiest to measure accurately with an oscilloscope and pulse generator.

Companions to this document are ANSI/IEEE Std 300-1988 [1],[1] ANSI/IEEE Std 325-1986 [2], and IEEE Std 194-1977 [3].

At the time it approved this standard, the Nuclear Instruments and Detectors Committee of the IEEE Nuclear and Plasma Sciences Society had the following membership:

Sanford Wagner, *Chair*
Louis Costrell, *Secretary*

Muzaffer Atac	Edward Fairstein*	D. E. Persyk
J. G. Bellian	F. S. Goulding	P. L. Phelps
J. A. Coleman	R. M. Keyser	D. E. Stilwell
D. C. Cook	F. A. Kirsten	K. L. Swinth
J. F. Detko	H. W. Kraner	F. J. Walter
	G. L. Miller	

*Served as project leader for the development of this standard.

[1]The numbers in brackets correspond to those of the references listed in 1.5.