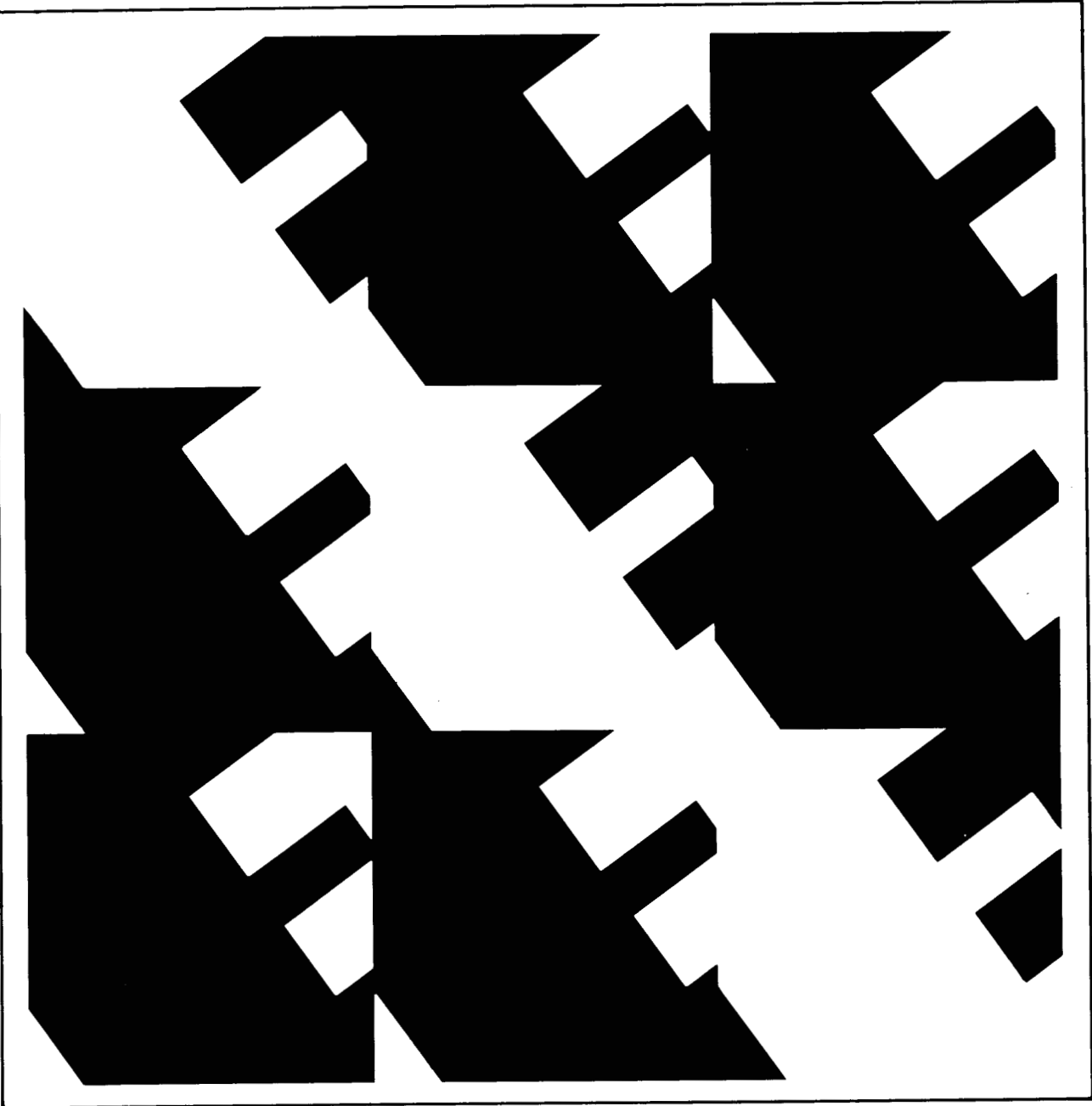


IEEE Standard Pulse Terms and Definitions

IEEE Std 194-1977



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

July 26, 1977

SH11940

IEEE Standard Pulse Terms and Definitions

Sponsor
**High-Frequency Instruments and
Measurements Committee of the
IEEE Instrumentation and Measurements Group**

© Copyright 1977 by

The Institute of Electrical and Electronics Engineers, Inc.

*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.*

Approved February 17, 1975

IEEE Standards Board

Joseph L. Koepfinger, *Chairman*

Warren H. Cook, *Vice Chairman*

Sava I. Sherr, *Secretary*

Jean Jacques Archambault
Robert D. Briskman
Dale R. Cochran
Louis Costrell
Frank Davidoff
Jay Forster
Irvin N. Howell, Jr

Stuart P. Jackson
Irving Kolodny
William R. Kruesi
Benjamin J. Leon
Anthony C. Lordi
Donald T. Michael
Voss A. Moore
William S. Morgan

William J. Neiswender
Gustave Shapiro
Ralph M. Showers
Robert A. Soderman
Leonard Thomas
Charles L. Wagner
William T. Wintringham†

†Deceased

Foreword

(This foreword is not a part of IEEE Std 194-1977, IEEE Standard Pulse Terms and Definitions.)

This standard supersedes IEEE Std 194-1951, Standards on Pulses: Definition of Terms - Part I, 1951. It should be used in conjunction with IEEE Std 181-1977, IEEE Standard on Pulse Measurement and Analysis by Objective Techniques.

The previous editions of the IEEE standards on pulses were published in 1951-1955, a period when pulse measuring instruments (principally, the cathode ray oscilloscope) were completing their evolution from qualitative indicators to quantitative instruments. These previous standards reflected this evolutionary stage in nomenclature, definitions, and methods of measurement which relied heavily on visual observation and subjective evaluation. No review of the growth of pulse technology in the intervening years is needed here; by 1966, when the IEEE Subcommittee on Pulse Techniques was formed, the previous edition of this standard was obsolete.

The greatest challenge the subcommittee faced was the development of a standard which would satisfy the needs of a wide range of users, users whose measurement practices ranged from the casual and inexact to the most careful and exact. Since a standard which covers exact work can, by degradation or omission, also cover inexact work, the subcommittee developed a standard which satisfies the needs of the user and manufacturer of sophisticated pulse apparatus. Nonetheless, study of Fig 2 will show that, barring changes in nomenclature, nothing has changed and the previous practices of the casual user are preserved.

The subcommittee also made the following decisions relative to the content of this standard:

- (1) No frequency domain terms (for example, bandwidth) would be used or defined.
- (2) No terms which link the time and frequency domains (for example, pulse bandwidth) would be used or defined.
- (3) No acronyms or coined words would be used or defined.
- (4) No synonyms would be used or defined. (For example, pulse is defined and impulse is neither used nor defined.)
- (5) The introduction of new concepts would be minimized. The only new concepts that are introduced are found in the definitions of epochs (2.3.2 and 5.3.2.8), feature (2.3.3), and quadrant (3.4.2).

The presentation of definitions in this standard, and within its sections, starts with the most general terms and proceeds to the definition of terms which are more specific *in terms of terms that have been defined previously*. This arrangement, while sacrificing alphabetical listing, yields a logical presentation of significant tutorial value. Terms that are adjectives are defined separately (in sections 2.4 and 2.5) from terms that are nouns (all sections except 2.4 and 2.5) with the expectation that, as the need arises, adjective and noun terms will be combined to provide the required term.

Since its formation in 1966, the IEEE Subcommittee on Pulse Techniques has been broadly based. Collectively, its members represented or provided liaison with seven IEEE societies or groups (Circuits and Systems, Computer, Electron Devices, Engineering in Medicine and Biology, Instrumentation and Measurement, Magnetics, and Nuclear and Plasma Sciences), six technical associations (American Society for Testing and Materials, Electronic Industries Association, Instrument Society of America, National Conference of Standards Laboratories, Precision Measurement Association, and Scientific Apparatus Makers Association), and three technical committees of the International Electrotechnical Commission (Electron Tubes and Valves, Electronic Measuring Equipment, and Magnetic Materials and Components). Nine members of the subcommittee were from six countries other than the U.S. (France, Germany, Hungary, Japan, the Netherlands, and the United Kingdom). Subcommittee members who represented users of pulse apparatus outnumbered members who represented manufacturers.

Beginning in 1970 the liaison between the subcommittee and Technical Committee 66, Electronic Measuring Equipment, of the International Electrotechnical Commission (IEC) became progressively closer and culminated in an informal mutual understanding that both groups would attempt to provide their parent organizations with pulse standards which were the same. This

goal was achieved; IEC Publication 469-1, 1974, Pulse Techniques and Apparatus, Part 1: Pulse Terms and Definitions, is technically (and, otherwise, substantially) identical to this standard.

The IEEE Subcommittee on Pulse Techniques, which prepared this standard, had the following members:

P. E. Stuckert*, *Chairman* (1971-1977)

J. C. Hubbs, *Chairman* (1966-1971)

D. Antonucci
J. F. Bogan
J. R. Brown, Jr
R. C. Cady
P. W. Crapuchettes
J. F. Delany
E. Fairstein
R. W. Frank
C. Franklin
R. J. Frick
I. Frigyes*
H. N. Frihart
C. Gabbitas
A. D. Garofalo

B. Gogos
B. Harrison
J. L. Hayes
C. J. Hirsch
Y. Hoshiko*
B. Kaufman
M. Kawashima
F. R. Kotter
L. S. Kreyer
J. McHattie*
L. H. Montgomery
C. H. Moulton
T. Muto
N. S. Nahman

J. E. Niebuhr
R. N. Noyce
R. Olivier*
E. Olsen
P. A. Painchaud*
L. Rohde
G. F. Ross
S. S. Shamis
D. B. Sharp*
F. A. Thomas
A. A. Toppeto
C. E. White
J. Worcester
H. A. Zimmerman

* Members of International Electrotechnical Commission Technical Committee 66: Electronic Measuring Equipment, Subcommittee 66A: Generators, Working Group I: Pulse Techniques and Apparatus.

This standard was approved by the IEEE G-IM Technical Committee on High Frequency Instrumentation and Measurement, which had the following members:

G. U. Sorger, *Chairman*

B. O. Weinschel, *Vice Chairman*

S. F. Adams
G. L. Allerton
T. N. Anderson
R. W. Beatty
W. Collier

S. Evendorff
R. G. Fellers
E. A. Fitzgerald
E. W. Houghton
R. A. Lebowitz
J. McKiernan

J. R. Reeder
U. L. Rohde
R. M. Showers
R. A. Soderman
P. E. Stuckert

Contents

SECTION	PAGE
1. General.....	7
1.1 Scope.....	7
1.2 Object.....	7
2. General Terms.....	7
2.1 Coordinate System.....	7
2.2 Wave, Pulse, and Transition.....	7
2.3 Waveform, Epoch, and Feature.....	7
2.4 Qualitative Adjectives.....	7
2.5 Quantitative Adjectives.....	8
2.6 Time-Related Definitions.....	9
2.7 Reference Lines and Points.....	9
2.8 Miscellaneous.....	10
3. The Single Pulse.....	10
3.1 Major Pulse Waveform Features.....	10
3.2 Magnitude Parameters and References.....	10
3.3 Time Parameters and References.....	11
3.4 Other Pulse Waveform Features.....	12
4. The Single Transition.....	12
4.1 Step.....	12
4.2 Ramp.....	12
5. Complex Waveforms.....	12
5.1 Combinations of Pulses and Transitions.....	12
5.2 Waveforms Produced by Magnitude Superposition.....	12
5.3 Waveforms Produced by Continuous Time Superposition of Simpler Waveforms.....	13
5.4 Waveforms Produced by Noncontinuous Time Superposition of Simpler Waveforms.....	13
5.5 Waveforms Produced by Operations on Waveforms.....	14
6. Time Relationships Between Different Waveforms.....	15
6.1 Pulse Advance (Delay).....	15
6.2 Pulse Advance (Delay) Interval.....	15
6.3 Pulse Coincidence (Noncoincidence).....	15
6.4 Pulse Coincidence (Noncoincidence) Duration.....	15
7. Distortion, Jitter, and Fluctuation.....	15
7.1 Distortion.....	15
7.2 Qualitative Distortion Terms.....	16
7.3 Jitter and Fluctuation.....	16
8. Miscellaneous Pulse Terms.....	16
8.1 Operations on a Pulse.....	16
8.2 Operations by a Pulse.....	17
8.3 Operations Involving the Interaction of Pulses.....	17
8.4 Logical Operations with Pulses.....	17

FIGURES

Fig 1 Single Pulse	11
Fig 2 Composite Waveform	13
Fig 3 Pulse Burst Envelopes	14
Fig 4 Pulse Waveform Distortion and Pulse Waveform Feature Distortion	15