

IEEE TC-10: What's It All About?

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I. INTRODUCTION

There is a need throughout the world for uniform test methods for devices used to generate, measure, and analyze waveforms; uniformly-defined terms that describe these devices, and their operation and performance characteristics; and uniform methods of computing the values of the parameters describing these performance characteristics. Users need to be able to unambiguously specify the device performance required for particular applications. Manufacturers need to be able to unambiguously state the performance of their devices (e.g., instruments, components, etc.). Metrology facilities need to perform calibrations with well-defined methods to produce reliable, unambiguous data expressed in clear terms. Measurement instruments need to acquire data with well-defined methods and present it clearly. Technical Committee 10 (TC-10), the Waveform Generation, Measurement, and Analysis Committee of the Instrumentation and Measurement (I&M) Society, is tasked to develop standards to address these needs. TC-10 comprises an international group of electronics engineers, mathematicians, and physicists with representatives from national metrology laboratories, national science laboratories, ADC manufacturers, the test instrumentation industry, academia, and users.

The initial project for TC-10 was to develop the IEEE Standard for Digitizing Waveform Recorders, IEEE Std 1057-1994 [1]. Work on this standard unofficially began with the "Seminar on Waveform Recorder Measurement Needs and Techniques for Evaluation/Calibration," hosted by

the National Institute of Standards and Technology (NIST) in 1981. Dissatisfied with the state of measurement standards and test techniques for waveform recorders, a group of concerned users, manufacturers, and researchers who attended the seminar formed a committee to crystallize waveform recorder specifications and achieve consensus on them. This effort gathered additional members and became affiliated with the IEEE Instrumentation and Measurement Society in 1983. The initial work was completed in 1988, and a Trial-Use Standard [2] was issued in July of 1989. Since that time, the standard has been substantially revised, resulting in the current standard, which now has full-use status.

During the course of developing IEEE Std 1057, TC-10 noted that much of the standard applied to analog-to-digital converters (ADCs). However, it was aware that there are additional terms and test methods that are unique to ADC characterization. Consequently, when IEEE Std 1057 was completed, TC-10 focused its attention on a standard specifically for ADCs. The Subcommittee on ADCs was formed to develop the IEEE Standard for Terminology and Test Methods for Analog-to-Digital Converters. This standard was completed and released in December 2000 as IEEE Std 1241-2000 [3].

Several standards have previously been written that address the testing of analog-to-digital converters either directly or indirectly. These include:

- IEEE Std 1057-1994, which describes the testing of waveform recorders. This standard has been used as a guide for many of the techniques described in this standard.
- IEEE Std 746-1984 [4], which addresses the testing of analog-to-digital and digital-to-analog

converters used for PCM television video signal processing.

- JESD99-1 [5], which deals with the terms and definitions used to describe analog-to-digital and digital-to-analog converters. This standard does not include test methods.
- IEC 60748-4, Interface Integrated Circuits, Semiconductor Devices- Integrated Circuits, which provides [6] criteria for Analogue-Digital Converters (ADC).

IEEE Std 1241-2000 for analog-to-digital converters is intended to focus specifically on terms and definitions as well as test methods for ADCs for a wide range of applications.

The Subcommittee on Pulse Techniques (SCOPT) was formed to revise and combine two out-of-date IEEE standards dealing with pulses. Since 1996, the SCOPT has been writing a revision to the now-withdrawn standards, IEEE Std 181-1977, Standard on Pulse Measurement and Analysis by Objective Techniques [7] and IEEE Std 194-1977, Standard Pulse Terms and Definitions [8]. These standards dealt with terms and definitions for describing and computing waveform parameters and for describing the waveform measurement process. The revised standard combines information from both of these withdrawn IEEE standards and supersedes both of them.

Development of a set of agreed-upon terms and definitions presented the greatest difficulty because of the pervasive misuse, misrepresentation, and misunderstanding of terms. Legacy issues for instrumentation manufacturers and terms of common use also had to be addressed. In the end, however, the importance of unambiguously and accurately defined terms prevailed. Consequently, many terms were deleted and many others added. Most definitions were modified. This work finally ended in September 2002 with an IEEE Std 181 (Draft) [9] agreed upon by the SCOPT.

The IEEE Std 181-1977 superseded the IEEE Std-181-1955 [10], Methods of Measurement of Pulse Quantities. The IEEE Std 194-1977 superseded IEEE Std 194-1951, Standards on Pulses: Definition of Terms - Part 1, 1951 [11]. Close collaboration with the International Electrotechnical Commission (IEC) resulted in IEC Publication 469-1, 1974, Pulse Techniques and Apparatus, Part 1: Pulse Terms and Definitions [12], which is substantially the same as IEEE Std 194-1977. Further collaboration with the IEC resulted in IEC Publication 469-2, 1974, Pulse Techniques and Apparatus, Part 2: Pulse Measurement and Analysis, General Considerations [13], which is substantially the same as IEEE 181-1977.

II. RESULTS

The efforts of TC-10 have resulted in three IEEE standards.

A. IEEE Std 1057-1994, "Standard for Digitizing Waveform Recorders"

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B. IEEE Std 1241-2000, "Standard for Terminology and Test Methods for Analog-to-Digital Converters"

This standard identifies analog-to-digital converter (ADC) error sources and provides test methods with which to perform the required error measurements. The information in this standard is useful both to manufacturers and to users of ADCs in that it provides a basis for evaluating and comparing existing devices, as well as providing a template for writing specifications for the procurement of new ones. In some applications, the information provided by the tests described in this standard can be used to correct ADC errors, such as, gain and offset errors. This standard also presents terminology and definitions to aid the user in defining and testing ADCs.

C. IEEE Std 181 (Draft), "Standard on Transitions, Pulses, and Related Waveforms"

The purpose of the standard is to facilitate accurate and precise communication concerning parameters of transition, pulse, and related waveforms and the techniques and procedures for measuring them. Because of the broad applicability of electrical pulse technology in the electronics industries (such as computer, telecommunication, and test instrumentation industries), the development of unambiguous definitions for pulse terms and the presentation of methods and/or algorithms for their calculation is important for communication between manufacturers and consumers within the electronics industry. The availability of standard terms, definitions, and methods for their computation helps improve the quality of products and helps the consumer better compare the performance of different products. Improvements to digital waveform recorders have facilitated the capture, sharing, and processing of waveforms. Frequently these waveform recorders have the ability to process the waveform internally and provide pulse parameters. This standard is needed to ensure that the definitions and methods of computation for pulse parameters are consistent.

III. CONTINUING ACTIVITY

TC-10 is promoting awareness of its activities and soliciting involvement from interested people. To that end, papers have been presented at IMTC and IMEKO conferences over the past several years. It also has a general interest in incorporating IEEE standard terms, definition, and test methods into IEC standards. Specific activities of the three TC-10 subcommittees follow.

A. Subcommittee on Digital Waveform Recorders (1057)

IEEE Std. 1057-1994 has been re-instated and is in revision at this time. To the extent applicable, portions of IEEE Std. 1241-2000 are incorporated. In common areas between the standards, terms and methods originally published in 1057 were refined and enhanced in 1241. 1057 is leveraging these advances. In a similar manner, pulse terms, definitions, and test methods developed in IEEE Std 181 will be incorporated. Pulse techniques are especially important since many digital oscilloscopes directly report pulse parameters. Finally, the subcommittee is working to improve definitions and test methods for critical metrics, such as, Effective Number of Bits (ENOB).

B. Subcommittee on ADC (1241)

The subcommittee is promoting awareness of IEEE Std 1241-2000 through papers at conferences as well as in trade journals. It is seeking to promote usage with a logo that manufacturers can use if they follow IEEE Std. 1241-2000, analogous to the "Intel Inside" logo. While the subcommittee collects responses to IEEE Std. 1241-2000, it supports the development of terms and techniques currently being pursued for 1057. This subcommittee is also participating on the IEC SC47A/WG4 committee developing standard IEC 60748-4-3 on Dynamic criteria for Analogue-Digital Converters (ADC).

C. Subcommittee on Pulse Techniques (SCOPT) (181)

SCOPT has completed the revision of the proposed IEEE standard, P181. Balloting has also been completed on the P181 and all participating members of the balloting committee accepted the proposed standard without change. The IEEE Standards Board Review Committee meets in March 2003 to decide on whether or not to accept the P181 as an IEEE standard, and if accepted it will be published as the IEEE Std 181-2003. We hope that this new standard will be published early in 2003, before IMTC 2003. After publication, the subcommittee plans to approach the IEC to update its standards [11,12] with IEEE Std 181 terms and test methods. SCOPT has presented a paper at IMTC 2002 and will present one at IMTC 2003 on the IEEE Std 181. SCOPT is currently addressing how to promote awareness of IEEE Std 181. It welcomes your suggestions and participation.

IEEE standards are living documents. They must be revised and/or renewed every five years. TC-10 is dedicated to nurturing its three current standards and promoting their acceptance. Further, it is considering developing a new standard for digital-to-analog converters (DACs). Your comments and participation are welcomed.

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