The IEEE Technical Committee 10—The Waveform Generation, Measurement, and Analysis Committee: Update 2021

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The IEEE Technical Committee 10 (TC-10), the Waveform Generation, Measurement, and Analysis Committee of the IEEE Instrumentation and Measurement Society (IMS), supports the advancement of industries and other entities that research, develop, manufacture, and use technologies and instruments that generate or acquire signals. These signals are ubiquitous and used in many technologies, such as, but not limited to, communication, computing, transportation, medicine, entertainment, manufacturing, and agriculture. The TC-10 work, therefore, impacts everyone. Because the TC-10 is a developer of documentary standards, the TC-10's goal is achieved by fulfilling, as best as possible, the global need for standardized terms, test methods, and computational methods that are used to describe and measure the parameters that describe the performance of signal generators and waveform recorders and analyzers. The TC-10 has developed and maintains the following documentary standards: IEEE Std 181-2011, Standard on Transitions, Pulses, and Related Waveforms [1]; IEEE Std 1057-2017, Standard for Digitizing Waveform Recorders [2]; IEEE Std 1241-2010, Standard for Terminology and Test Methods for Analog-to-Digital Converters [3]; IEEE Std 1658-2011, Standard for Terminology and Test Methods for Digital-to-Analog Converters [4]; IEEE Std 1696-2013, Standard for Terminology and Test Methods for Circuit Probes [5]; and IEEE Std. 2414-2020, Standard for Jitter and Phase Noise [6]. Additional information on these standards and the TC-10 can be found in [7], [8].

The TC-10 comprises over 50 members from around the globe, with the majority in Western Europe and the United States. The members are an international group of electronics engineers, mathematicians, professors and physicists with representatives from national metrology laboratories, national science laboratories, component manufacturers, the test instrumentation industry, academia, and end users. Developing standards in the fields of the TC-10 means being at the forefront of the transfer of knowledge from research to manufacturing and vice versa.

There currently are three active projects within the TC-10. One focuses on the revision of the IEEE Std 1241, another on the revision of the IEEE Std 1658, and the third on the revision of the IEEE Std 1696. The activities and status of these three projects are described here.

Per the Project Authorization Request (PAR), the official IEEE-Standards Association (SA) document authorizing the revision of the analog-to-digital converter (ADC) standard, IEEE Std 1241-2010, the PAR approval date was 30 June 2016, which is the official start date of the revision. However, the active and earnest revision of the IEEE Std 1241 did not start until the "restart" meeting of 29 June 2021. A kick-off meeting had occurred previously to the restart meeting but changes in the 1241Working Group (1241WG) leadership precluded any actual start of a revision. Prior to the restart meeting, potential participants were identified and contacted, and a call for participation was announced by the IEEE-SA. These responses established the 1241WG membership, which comprises about 20 people from around the world.

Since the restart meeting, significant progress has been made in the revision of the Std 1241. The Std 1241 is a long document, about 130 pages comprising 14 technical clauses, three informative annexes, and one normative annex. The 1241WG decided to collectively address the revision by sequential review of the clauses and annexes. This review-and-revision process was achieved by members of the 1241WG providing comments and suggesting changes to the document on a regular, nominally monthly, interval. These comments were the basis for discussions during the 1241WG meetings, which have occurred almost monthly since the restart meeting. All meetings, thus far, have been web-based. By the end of 2021, the 1241WG had reviewed, revised, and corrected most of the Std 1241-2010 up to Clause 14. The text of several clauses was revised, updated and/or corrected, algorithms were corrected, and figures were updated. For the Std 1241, being largely a test method standard, significant changes were not deemed or determined necessary at this time. However, there was a significant number of minor revisions, changes, and corrections to the Std 1241-2021 but no single significant modification. The Std 1241 PAR expiration date is 31 December 2022. Depending on the progress in finalizing the draft of the Std 1241 for

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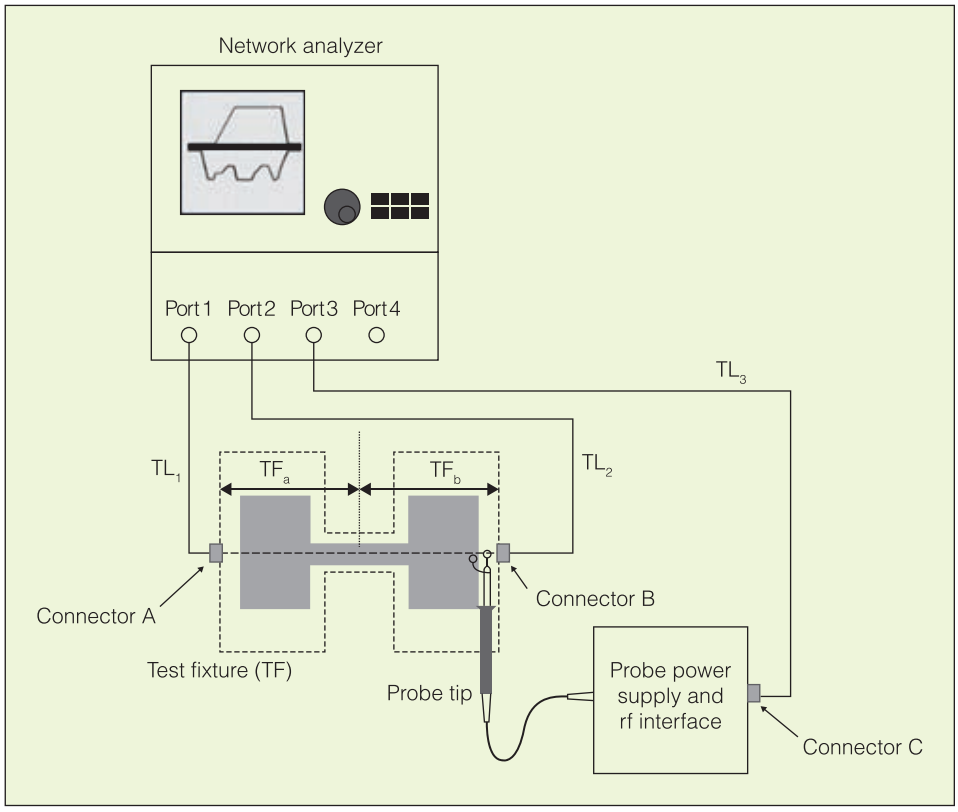

Fig. 1. Test setup for measuring the input impedance of single-ended stand-alone probe, as described in IEEE Std 1696-2013, [7] ©2020 IEEE.

balloting and on the balloting process, it may be necessary to request an extension to the PAR. Future revisions to the IEEE Std 1241 may include quantum-based ADC metrology.

The PAR approval date for the digital-to-analog converter (DAC) standard, IEEE Std 1658-2011, was 14 June 2018. The 1658WG kick-off meeting was held 20 July 2021. Prior to the kick-off meeting, potential participants were identified and contacted and a call for participation was announced by the IEEE-SA. These responses established the 1658WG membership which comprises about 20 people from around the world.

Eight meetings have been held since the kickoff meeting, where the draft standard was revised. Meetings have been held initially monthly. Since February 2022, they have been moved to twice per month, to speed up the revision process. The 1658WG decided to revise the draft essentially during the meetings with some assignments to volunteers on specific aspects where some of the 1658WG members were more expert. All meetings, thus far, have been web-based.

Main revisions were made with the aim of generalizing the DAC architecture terminology and to improve the compliance of the Std 1658 with the other TC-10 standards. In particular, a significant revision was made to Clause 1.6 that provides the DAC background. The major changes to this clause included: a) improving the general DAC model by including several DAC architectures; and b) improving the explanation of the behavior of the DAC, which is supported by new figures. A new subclause, 4.3.1, was added that provides considerations about static testing for high-resolution DACs.

The Std 1658 PAR expiration date is 31 December 2022. Depending on the progress in finalizing the draft of the Std 1658 for balloting and on the balloting process, it may be necessary to request an extension to the PAR.

The revision process for the circuit probe standard, IEEE Std 1696-2013, has not yet started as a kick-off meeting has not yet been scheduled. The chair for the 1696 Working Group is working with IEEE-SA to announce a call for participation. The PAR for the Std 1696 was approved on 10 February 2021 and has an expiration date of 31 December 2025. An example of one of the test set ups described in IEEE Std 1696 is shown in Fig. 1.

The TC-10 is currently engaged in the revision of the Std 1241, Std 1658 and Std 1696. The TC-10 invites you to participate in these revisions. These standards are essential for accurate, reproducible, reliable, and communicable characterization of the performance of these devices, which supports technology and product advancement, product comparison and performance tracking, and device calibration and traceability. The TC-10 continually updates and improves its existing standards and develops new ones as needed by its stakeholders. The TC-10 encourages fresh ideas and new perspectives.

If you are interested in the TC-10's work and would like to join one or more of its subcommittees, please visit the TC-10 home page at http://tc10.ieee-ims.org/tc10-home or its IEEE-SA home page at https://sagroups.ieee.org/im-wma-tc10/. Contact information for the subcommittee chairs can be found on these web sites.

References

[1] *IEEE Standard for Transitions, Pulses, and Related Waveforms*, IEEE Std. 181-2011, Institute of Electrical and Electronics Engineers, 2011.

[2] *IEEE Standard for Digitizing Waveform Recorders*, IEEE Std. 1057-2017, Institute of Electrical and Electronics Engineers, 2017.

[3] *IEEE Standard for Terminology and Test Methods for Analog-to-Digital Converters*, IEEE Std. 1241-2010, Institute of Electrical and Electronics Engineers, 2010.

[4] *IEEE Standard for Terminology and Test Methods of Digital-to-Analog Converter Devices*, IEEE Std. 1658-2011, Institute of Electrical and Electronics Engineers, 2011.

[5] *IEEE Standard for Terminology and Test Methods for Circuit Probes*, IEEE Std. 1696-2013, Institute of Electrical and Electronics Engineers, 2017.
[6] *IEEE Standard for Jitter and Phase Noise*, IEEE Std. 2414-2020, Institute of Electrical and Electronic Engineers, 2017.
[7] S. Rapuano, J. Jendzurski, L. De Vito, S. J. Tilden, W. B. Boyer and N. G. Paulter, "The documentary standards of the IEEE technical committee 10," *IEEE Instrum. Meas. Mag*., vol. 23, no. 8, pp. 8–13, Nov. 2020.
[8] L. De Vito, J. Jendzurski, S. Rapuano, W. B. Boyer, J. Blair and N. G. Paulter, "The IEEE technical committee 10: the waveform generation, measurement, and analysis committee," *IEEE Instrum. Meas. Mag.*, vol. 24, no. 8, pp. 7–10, Nov. 2021.

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William Boyer is retired from Sandia National Laboratories in Albuquerque, New Mexico, USA. For most of his career at Sandia, he was responsible for the development of large high speed data acquisition systems. He is currently the Chair of the TC-10 Subcommittee responsible for the IEEE 1057 Waveform Recorder Standard.

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