

**Minutes of TC-10 Waveform Recorder Subcommittee Meeting of
April 27, 2006 in Sorrento, Italy**

Attendance:

Tom Linnenbrink	Hittite Microwave
Jerry Blair	Bechtel Nevada
Eualia Balestrieri	University of Sannio
Sol Max	LTX Corporation
Francisco Alegria	Tech. Univ. of Lisbon
Paolo Carbone	University of Perugia
Antonio Cruz Serra	Tech. Univ. of Lisbon
Dario Petri	University of Trento
Linus Michaeli	Tech. Univ. of Kosice

1. Agenda

Bill Boyer distributed an agenda by email prior to the meeting. It is attached to the minutes.

2. Review of Assignments from previous meeting.

The names in parentheses after each item are the responsible persons.

Annex H. This is now Annex G. The new material supplied by sol Max was not included. I will regenerate the figures with Kaleidagraph starting with the data files. (Sol Max, Jerry Blair, Bill Boyer)

Annex A. Sol Max has reviewed the Annex. Two references still need to be included. all present agreed to eliminate the non-matrix algorithms. (Jerry Blair, Bill Boyer)

Annex B. (Phase Noise) I proposed deleting this, but most thought it should remain. The Mathematica programs need to be included, and the figures need to be improved. (Jerry Blair)

Clause 7.4. Figures need an x-axis label. (sol Max, Jerry Blair)

General. For consistency of appearance Jerry Blair will redo all plots using Kaleidagraph and Francisco Alegria will do diagrams in Visio. (Jerry Blair, Francisco Alegria)

Clause 7.7 Total Harmonic Distortion.

- The equations were all retyped, so they should be checked. (All)

- THE – When introduced it should be mentioned that it is only a temporary variable and not of importance. It should be removed from the definitions. (Jerry Blair, Bill Boyer)
- The mod notation is inconsistent. The uncapitalized form should be used throughout and the notation should be explained. Try to find references for the mathematics. (Jerry Blair)

Clause 8. Changes need to be reviewed. (Jerry Blair)

Clause 8.4. Change name to "signal-to-noise over a specified bandwidth."
Get copy of VIMS (international vocabulary for measurement Systems) and check terminology against it. (Bill Boyer, Jerry Blair)

Clause 8.5.1.1. This was put in the draft as 8.5.2. It was reviewed at the meeting. It needs pictures and more explanation. (Jerry Blair)

Clause 16.1. Needs change to say that no general test method is recommended. (Bill Boyer)

Clause 4.4. Point out the differences between DFT and spectrum analyzer. (Sol Max)

TOC. The table of contents needs to be updated to reflect the changes in the document. (Bill Boyer)

Clause 5.2. Replace "precision terminating resistor" with "precision RF terminator" or "standard terminator" to make clear that it is not just the DC resistance that needs to be precise. (Bill Boyer)

Clause 5.1. Replace "appropriate output level" with an explanation of what is appropriate. Add "use precision impedance, low loss cable" (Bill Boyer, Fang Xu to review all of Clause 5.)

Review of entire draft. The draft was divided into 4 approximately equal parts for review. Everyone should review as much of the draft as possible doing the assigned section first. Mark up the draft in "track changes" mode.

- Beginning through Clause 4.4, Fang Xu.
- Clauses 4.5 through 7.6, Francisco Alegria.
- Clauses 7.7 through 10, Sol Max.
- Clause 11 to end, Jerry Blair.

Standard 181. I have a Word copy and will help extract parts. (Jerry Blair, Bill Boyer)

Clause 4.6.10. Explain "synchronous with sampling clock." (Sol Max)

SFDR – The current general agreement is to include harmonics in SFDR. IEC standard includes harmonics.

8.8 and 8.9 New sections on Spurious components and SFDR. Change notation to $X[n]$ from $X[f]$. (Bill Boyer)

Grounding. Find a reference on grounding to place at the proper place in the standard (Tom Linnenbrink). Ask Steve Tilden if he will write something on grounding for this standard. Put a grounding section under test setup. (Bill Boyer)

**Agenda for Waveform Recorder Subcommittee Meeting
April, 2006**

1. Introductions
2. Review of status of the draft – a new draft was created dated April 6, 2006. This draft includes assignments from Sol Max, Jerry Blair and Bill Boyer plus whatever other editing changes I felt were beneficial.
3. Review of status of assignments per minutes of Nov 2005:
 - **Annex H, Presentation of Sinewave data** Fix figures (Jerry Blair, done by B. Boyer?)
 - **Annex A, Sinewave Fitting** review new material (Sol Max, Blair)
 - **Clause 7.4 INL. Modify new example figures** (Sol Max) **partially done**
 - **Clause 7.6 Hysteresis. Modify new figure.** (Sol Max) **done**
 - **Clause 7.7 Total Harmonic Distortion. Various corrections to submitted material** (Jerry Blair, Sol Max)
 - **Clause 8 Noise Fix typos, change A_{vm} to Avg** (Boyer) done
 - **Clause 8.1 to 8.3 Various changes** (Alegria, Blair review)
 - **Clause 8.5, 8.6, 8.7.1, 8.7.2 Note ideal quantization is rms. Fix typos. Use FSR/2 in ENOB equation. Redfine sigma squared. Minor rewording** (Boyer) - **done**
 - **Clause 8.5.1.1 ENOB test method** – add material (Blair)
 - **Clause 16.1 Test method for cycle time. Eliminate** (Boyer) **done**
 - **Clause .4 DFT** - Fix DFT and add IDFT definition (Boyer) done
 - Eliminate differential impedance to ground (Boyer) done
 - Substitute BW for B for bandwidth everywhere (Boyer) done hopefully
 - Substitute $2\pi f$ for omega everywhere (Boyer) done hopefully
 - Include algorithms from 181 instead of referencing them (Boyer) (I did this for one instance where it was easy, but left the reference only for precursor and overshoot since it would have involved several pages from 181. Noted we have always referred to 181 in both 1057 and 1241 for making this measurement.)
 - Parseval theorem. Get from Wikipedia (Boyer) done
 - **Clause .4.6.8 Sinewave Histogram** - Fix reference and equation numbers (Blair)
 - **Clause .4.6.10 Triangle Wave Tests-** Fix text relating to synchronous clock (Sol Max) done?
 - **Introduction** – add names of more people (Boyer) started
 - **References:** lots of them need to be verified and identified (everyone)
 - **Spurious components:** write section for this and SFDR (Boyer) done
 - **Annex E** – remove and renumber Annexes behind it (Boyer) done
 - **Annex G** – review formulas (Alegria)
 - **Look over all material in draft in red and propose what should be done** (All)
 - **Look other issues identified in attachment** (All)

4. Other business

5. Review action items

Some issues with April 06 1057 draft:

New proposed first cut definitions:

quantization noise: Equivalent noise produced during the quantization of a continuous range variable. A quantization process of step size Q produces an rms quantization noise of $Q/12$ when the continuous variable range is much larger than Q .

Bill Boyer 3/18/06 9:24 AM
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Text issues

Fix notation in Fig 7 in 4.6.2

Need [Dynad] reference in 4.6.8.2

In 4.6.10.1.1 May need a reference for equation 31.

In 4.6.10.2 uncertain about section is referenced in step 4 of algorithm.

And need to fix notation in Fig. 11, 12. (Also do we really need Figure 12?
This about the only place where we diagram an algorithm.)

In 4.6.10.3 has ADC specific language i.e. sampling clock

4.6.10.4 unknown reference for uncertainties in values of the code transition levels

In 7.7 THD, is A_{rms} really an rms quantity. The equation doesn't look like it.

In 7.9.1 on NPR, need a figure more appropriate for waveform recorders. This one shows a clock generator.

7.9.2 Are B10 and B15 appropriate references.

In 8.0 we say noise does not include sample rate errors but does include fixed error in sample time. Is this consistent?

8.4 Normalized SNR measures was rewritten and needs to be reviewed.
SSBWSNR was deleted.

Section 8.8 on spurious components and 8.9 on SFDR are new and need to be reviewed by the whole committee.

9.2.1 Test method for transition duration. Propose putting algorithm in our text instead of simply referencing 181.

9.4.1 Test method for overshoot. Last time I proposed putting algorithm in our text instead of simply referencing 181. Having actually looked at how much of 181 would be required, I think we should continue to just reference it as we have in the past.

Annex A –

Can we eliminate the non-matrix algorithms? Noticed they are not in 1241.

A revised version of A-3 was submitted and should be reviewed by the whole committee. In A.3 need new references [\[B31 Schoukens et. al. 1992\]](#) and [\[B32 Kollar et. al. 2004\]](#)

Bill Boyer 3/30/06 1:08 PM
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Annex B Phase Noise: [\(ended here Apr 2\)](#)

Need Mathematica program for computing integral (4 places)

Undefined variable “p” in Eq B-4. (Maybe a typo. Was also in UG)

Annex E Software considerations:

Propose eliminating old “toolkit” text.

Annex F Triangle Wave considerations:

Rand M ??

What is correct equation reference in item (3).

Annex G Presentation of sinewave data:

Need cleaner plots.

Is reference [B15] correct