

**Minutes of TC-10 Waveform Recorder Subcommittee Meeting of  
November 2-3, 2005 in Las Vegas Nevada**

**Attendance:**

Tom Linnenbrink	Q-Dot
Bill Boyer	Sandia National Laboratories
Jerry Blair	Bechtel Nevada
Eualia Balestrieri	University of Sannio
Sol Max	LTX Corporation
Francisco Alegria	Tech. Univ. of Lisbon
Fang Xu	Teradyne
Steve Tilden	Texas Instruments
Bob Graham	Sandia National Laboratories

**1. Agenda**

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

**2. Draft Status**

A new version of the draft was put on the website prior to the meeting. That version was used during the meeting

**3. Review of Assignments from previous meeting.**

The name in parentheses after each item is the responsible person. If my meeting notes did not say who was responsible, I selected a name. Please let me know if you were incorrectly selected. Items that are marked “done” on the agenda were not discussed.

**Annex I.** Annex I, presentation of sinewave data, was written and reviewed. It will be moved to make the bibliography the last section. A number of typos need to be fixed. Where it talks about decomposing NAD into noise and distortion, put a reference to the clause (8.2 equation (64)) that tells how to do it. Check all units for correct use and capitalization. Sol Max will produce a figure for the last section, the alternate presentation. (Jerry Blair, Sol Max)

**Annex A.** The four-parameter sine fit was rewritten to fix a problem that was discovered by Istvan Kollar and to add comments about calculating an initial frequency estimate and stopping conditions. This did not get reviewed. (Jerry Blair)

**Clause 7.4.** Better figures are needed (Sol Max)

**Clause 7.6, Hysteresis.** Need figure. Need “alternation” in places. Need to change definition to “max value for the codes” (Sol Max)

### Clause 7.7 Total Harmonic Distortion

- Describe range for  $h$  equation 47. Change equations for harmonic energy to sum from 2 rather than 1.
- First sentence: it is unclear what normalized means. Changed to “scaled”. The scale factor is the rms value of the output at the frequency corresponding that of the input signal.
- Remove %THD and THDdb; define as a ratio and say it can be expressed as % or db.
- In 7.7 use less equations and use words instead.
- Make consistency of  $f_h$  vs. just  $h$ .
- In (49) put “where clause to define  $f_i$  and  $f_s$ ”
- Blair to make changes and Alegria will review.

**ASIDE** Section 4.4 should show a spectrum with positive and negative frequencies also show one with negative frequencies at the high end. Show two harmonics – one aliased and one not. Steve and Francisco will review.

**Clause 8.** Need to change things like rms\_NAD to use of subscripts. Also need a symbol for noise – whole word in italics. Francisco Alegria will be the symbol policeman.

**Clause 16.** We will leave this out.

**Clause 14.3** Convert the red material into text. (Jerry Blair)

### 4. Review of Standard

- **Scope:** put mention of std 1241.
- **Introduction:** Add names of a lot more people: other contributors, officers.
- **Guidance to user:** update talk about Annex F
- **Annex F:** make reference to Hungarian site
- **Definitions and symbols:** suggestions being made and changes made on the fly.

- **PDF:** define distribution function and probability density as its derivative.
- **3.1.59** Separate definitions of quantization error and quantization noise. (Fang Xu).
- Make changes to agree with 181.
- Italicize all defined terms in draft. (Bob Graham)
- **4.2.2** Shorten last paragraph to apply to WF recorders rather than ADCs. (Jerry Blair)
- **4.4.2** explain what is meant by bin number (integer and non-integer). Define frequency bins in clause 3. (Jerry Blair)
- **Clause 4.6.10** Check on the statement about having sufficient overdrive with only one hit in the first and last bins. (Jerry Blair)
- **Input impedance.** Change dc resistance to low frequency impedance.

**Agenda for Waveform Recorder Subcommittee Meeting  
November 2,3 2005**

1. Introductions
2. Review of status of the draft
3. Review of status of assignments per minutes of May 2005:
  - **Annex I, Section 4.5.6 Presentation of Sinewave data** (Jerry Blair)
  - **Clause 4.1 Change effective bits to effective number of bits** (Boyer) - done
  - **Clause 7.3 Change .9 to 0.9** (Boyer) - done
  - **Clause 7.4 INL. Provide better example figures** (Sol Max)
  - **Clause 7.4 INL examples. Fix incorrect references to figures** (Boyer) done
  - **Clause 7.6 Hysteresis. Need figure. Need “alternation” in places. Need to change definition to “max value for the codes”** (Sol Max)
  - **Clause 7.7 Total Harmonic Distortion. Various corrections to submitted material** (Jerry Blair, Sol Max)
  - **Clause 8 Noise Fix equation and section numbers** (Boyer) - done
  - **Clause 8 Noise. Add definition of rms noise** (Blair)
  - **Clause 8.1.1.1 Fix equations** (Boyer) - done
  - **Clause 8.4.1 Test method for random noise. Add text about rationale for low noise method** (Boyer) - done
  - **Clause 8.4.2 Low noise test method for random noise. Various editing changes.** (Boyer) - done
  - **Clause 10.3.3 Inserted new section from David Bergman** (Boyer) - done
  - **Clause 16.1 Test method for cycle time. Discuss problems** (Blair)
  - **Clause 17 Trigger parameters. Add minimum to trigger delay def.** (Boyer) - done
  - **Clause 3 Definitions. Fix trigger jitter clause number. Add definition of DB Full Scale** (Boyer) - done
  - **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 Nov 2005 1057 draft:

Clause 4.5.5 Equation 17 needs a definition of rho and reference for Tables available

Still a lot of cryptic text between 4.5 and 4.6 on the effects of aberrations in sine wave sources on all of the tests for which sine waves are used. Propose to drop

Clause 4.6.2 "The recorder input level is calculated from the known transfer function of the DAC ( $G_{DAC}$ ,  $OFF_{DAC}$  do we need an  $N_{DAC}$  like in the figure?),"

Clause 4.6.4.3 need better explanation of rationale for this test

Clause 4.6.4.3.1  $G_{[xx]}$ ?? Is the figure in this reference.

Clause 4.7.4. Step response parameter measurement errors. Unwritten text. Propose to drop

Clause 7.7. What is "emplitude". Is this a word.

Clause 7.9.1. Need figure for Noise Power Ratio testing

Clause 10.3.1. "(what if bandwidth is  $>$  Nyquist)"

Clause 10.3.5. where reference to new reference be made

Clause 14.3. Comments on test equipment and making measurements – unwritten section

Annex B. Missing Mathematica equation/figure. What is equation 13?

Annex E. Is this already covered in Clauses 9 and 10?

Annex F. What is the software tool kit? Is it still available?

Annex G Bibliography. Make this one last. Currently would be H. Needs lots of work. Hopefully can recover from old 1057 and 1241 references.

. Minutes said 7.1.2 was also missing, but I cannot find a 7.1.2.

Section 8.1.3.1 refers to an apparently old version of THD testing using Coherent sampling. Needs to be fixed.

we still use THA in Clause 8.2.3.

Need reference  $G_{xx}$  for low noise calculation of ENOB.

Issue need to see if the two explanations for the need for a low noise test method are equivalent. (In doing this I corrupted the entire clause numbering system. .

Issue: consider combining two clauses on test equipment performance.

**Jerry proposed new definition:**

Decibels full scale (dB FS). The rms amplitude of any signal in decibels relative to a sinewave that spans the entire input range of the recorder.

Note issue in 10.2 about reference frequency from 10.1.1

Need correct committee name, update members but need more.