IEC-60286-16 revision 5 test signal description

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IEC-60286-16 revision 5 requires manufacturers to verify STIPA implementations according to Annex C. Although not fully completed yet, several test signals have been generated and are ready for download. Additionally, also test signals have been made according to other Annexes. Accompanying with each set of test signals, Matlab source code is provided.

The main goal of the test signal test bench is to verify that the STI algorithms have been properly implemented. For example, a common mistake is that MTF's are derived without squaring the filterbank output resulting in subtle but slightly higher m-values and thus overestimating the STI. To test the MTF extraction algorithm, test signals have been generated based on sine-wave carriers (instead of noise carriers) with an intensity modulation depth from 0,0 to 1,0 in 0,1 steps. Sine wave carriers have been used to reduce the uncertainty. Since the STI has a nonlinear relationship with m-values, the STI will not be in 0.1 steps as shown in the table below. In this list both fixed m-values and fixed TI values are given as input (bold) to derive the other values. STI and TI values supposed to be similar if all bands yield the same TI-value and level dependent features have been disabled.

m	SNR	(S)TI
0.00	-15	0.00
0.03	-15	**0.00**
0.06	-12	**0.10**
0.10	-9.5	0.18
0.11	-9	**0.20**
0.20	-6	**0.30**
0.30	-3.7	0.38
0.33	-3	**0.40**
0.40	-1.8	0.44
0.50	0	**0.50**
0.60	1.8	0.56
0.67	3	**0.60**
0.70	3.7	0.62
0.80	6	**0.70**
0.89	9	**0.80**
0.90	9.5	0.82
0.94	12	**0.90**
0.97	15	**1.00**
1.00	15	1.00

Table with related m, SNR and STI (or TI) values. Bold values are used as input to derive the other values.

Annex C.3.2 - STIPA direct method modulation depth testing

The MTF dynamic range can be tested using 11 test signals (based on sine wave carriers) with different modulation depths from 0,0 to 1,0 in 0,1 steps. Before performing the tests, be assured that level dependent features have been disabled. Also, be aware that electrically injected signal should not lead to distortion.

Annex C.3.2 - indirect method modulation depth testing

The indirect method uses impulse responses as an input to determine the MTF. For that purpose exponentially decayed sine wave carriers have been generated based on a range of reverberation times [0,125 0,250 0,5 1 2 4 8] sec. The derived modulation depths are modulation frequency dependent as given by the formula below.

$$m\left(f_m RT_{60}\right) = \frac{1}{\sqrt{1+\left[\frac{2\pi f_m RT_{60}}{log\left(10^6\right)}\right]^2}}$$

Annex C.4.2 - STIPA direct method filter bank slope test

The analysis octave filter bank should in essence comply with class 1 characteristics. In general base 2 band filters are used. Though, class 1 filters are not steep enough to accommodate the level dependent masking features. LDM require that filter slopes should be at least 41 dB/octave (at least 41 dB down at the adjacent octave band). If this requirement can't be met, the STI will remain underestimated for low sound pressure levels due to overlap between octave filter bands. For this purpose several test signals have been generated using a modulated carrier in the observed band (125 up to 8000 Hz) while in the neighbouring band (upper and lower) a continuous (non-modulated) tone is produced at 41 dB higher overall level. The test results should yield an m-value of at least 0,5 or higher in the observed band.

Annex A.2.2. STIPA weight factor test

Additionally to Annex C and although being informative Annex A also contains some statements that could be supported by test signals. For testing if the appropriate weight and redundancy factors have been used, modulated sine wave carrier have been generated in octave band pairs (125/250 250/500 500/1000 1000/2000 2000/4000 4000/8000). When level dependent features are disabled, the six pair will result in the following STI-values:

pair	STI
125/250	0,13
250/500	0,28
500/1000	0,40
1000/2000	0,53
2000/4000	0,49
4000/8000	0,30

Annex A.3.1.2 STIPA filter bank phase distortion test

Steep filter banks may cause leading and lagging for certain frequencies which could yield to intrinsic lower m-values. A.3.1.2 states that the filter bank should not yield a STI bias of 0,01 or higher for the STI (or TI) range between 0,1 and 0,9. For that purpose test signals have been generated based on two sine carrier per octave band located at the edge of the central 1/2 octave (fc/2^(1/4) and fc*2^(1/4)). These locations are the extremes for the STI test signal, which is always half an octave wide.