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Validation of a sound level meter

Identification

Measurement system consisting of software RT-Capture, version 1.44 and sound card M-Audio PN: AU02-073B0, ser.no. 396Z073007F6E (channel 1 only).

The measurements have been carried out during the period Sept 21-26, 2007

Measurement method

The measurement system has been evaluated according to applicable parts of IEC 61672-2. This standard describes a procedure for type testing of sound level meters specified according to IEC 61672-1. As the tested measurement system does not include any microphone, all tests with acoustical signals have been excluded. Also, all environmental tests have been excluded. The manual has not been checked.

Environmental conditions

Room temperature	23 ± 2°C
Humidity	40 ± 15 % RH

The measurement system had the following settings during the measurements.

Microphones: Class - Unknown; Sens 20 mV/Pa; Gain 0,0 dB;
Soundcard: Record - Fast Track Pro In 1/2; Playback - Fast Track Pro Out 1/2; Quality - 48000 Hz, 24 bits, Stereo; Buffer size - Large; WDM Mode
Level Meter & Log: Log interval - 10 s; Report interval - Same as "Log interval"; Lmax reading time - 1 s; LEQ warning level - 100 dB; Max warning level - 115 dB; LEQ corr. - 0 dB; L/Lmax corr. - 0 dB; Measurement uncertainty corr. - 2 dB
Bandwidth limit on SPL/LEQ: Unchecked

The measurement results are only valid for the tested object and the settings above.

Result

Summary

The measurement system complies with IEC 61672-1 at tested parameters besides for an asymmetry of the overload detector at 31,5 Hz. This asymmetry is probably related to the characteristics of the sound card. The system does not have any under-range indicator which is required by IEC 61672-1.

The measured characteristics are given below with references to their respective clause in IEC 61672-2.

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9.5.4 Frequency weighting

The frequency weightings A, C and Z fulfils the requirements of IEC 61672-1.

Frequency (Hz)	Deviation from expected frequency response (dB)		
	A-weighting	C- weighting	Z- weighting
10	-0,6	-0,4	-0,3
12,5	-0,5	-0,3	-0,2
16	-0,3	-0,2	-0,1
20	-0,2	-0,2	-0,1
25	-0,2	-0,1	-0,1
31,5	-0,2	0,0	-0,1
40	-0,1	0,0	-0,1
50	-0,1	0,0	-0,1
63	-0,1	0,0	-0,1
80	0,0	0,0	-0,1
100	0,0	0,0	-0,1
125	0,0	0,0	-0,1
160	0,1	0,0	-0,1
200	0,0	0,0	-0,1
250	0,0	0,0	-0,1
315	0,0	0,1	-0,1
400	0,0	0,1	-0,1
500	0,0	0,1	-0,1
630	0,0	0,0	-0,1
800	0,0	0,1	0,0
1k	0,0	0,0	0,0
1,25k	0,0	0,0	-0,1
1,6k	0,0	0,1	-0,1
2k	0,0	0,1	-0,1
2,5k	0,0	0,0	-0,1
3,15k	0,0	0,0	-0,1
4k	0,0	0,0	-0,1
5k	0,1	0,0	-0,1
6,3k	0,0	0,0	-0,1
8k	0,0	0,0	0,0
10k	0,1	0,0	-0,1
12,5k	0,0	0,0	-0,1
16k	0,0	0,0	-0,1
20k	0,0	0,0	-0,1

Table 1. Measured deviation from expected frequency response re. 1 kHz.

9.8.1 Level linearity at room temperature

The level linearity for an A-weighted measurement with time weighting F, L_{AF} , and with time averaging, L_{Aeq} , fulfils the requirements of IEC 61672-1 within the following ranges.

Frequency	L_{AF}	L_{Aeq}
31,5 Hz	41-90 dB	41-90 dB
1 kHz	39-130 dB	39-130 dB
12,5 kHz	40-126 dB	40-126 dB

Table 2. Dynamic range where the level linearity requirements are fulfilled.

9.9 Under-range indicator

No under-range indicator is implemented in the system.

9.10 Self-generated noise

The self-generated noise with the microphone input terminated by a short circuit is given in table 3 below.

Frequency weighting	Self-generated noise
A	33,6 dB
C	32,4 dB
Z	40,2 dB

Table 3. Self-generated electrical noise.

9.11 Decay time constant for time weightings F and S

Fulfils the requirements for a class 1 sound level meter according to IEC 61672-1.

When a signal with frequency 4 kHz is suddenly shut off, the displayed sound pressure level of the measurement system is decaying with a rate of 26 dB/s with time weighting F and with 4,0 dB/s with time weighting S. The requirements according to IEC 61672-1 are ≥25 dB/s and 3,4-5,3 dB/s, respectively.

For a stationary 1 kHz signal, the difference between the displayed sound pressure level of time weighting F and S is 0,0 dB.

9.12/13 Toneburst response, single burst

Fulfils the requirements for a class 1 sound level meter according to IEC 61672-1.

The deviation from expected response of a single 4 kHz toneburst is given in table 4-6. The tests have been made with different levels and lengths of the toneburst.

Burst length	Deviation at different toneburst levels (dB)			
	127 dB	107 dB	87 dB	67 dB
1000 ms	-0,1	0,0	0,0	0,0
500 ms	0,0	0,0	0,0	0,0
200 ms	0,0	0,0	0,0	0,0
100 ms	-0,1	0,0	0,0	0,0
50 ms	-0,1	-0,1	-0,1	-0,1
20 ms	-0,1	0,0	0,0	0,0
10 ms	-0,1	-0,1	-0,1	-0,1
5 ms	0,0	0,0	0,0	0,0
2 ms	-0,1	-0,1	-0,1	-
1 ms	-0,1	-0,1	-0,1	-
0,5 ms	-0,2	-0,1	-0,1	-
0,25 ms	-0,2	-0,1	-0,1	-

Table 4. Deviation from expected response of a single toneburst, time weighting F.

Burst length	Deviation at different toneburst levels (dB)			
	127 dB	107 dB	87 dB	67 dB
1000 ms	0,0	0,0	0,0	0,0
500 ms	0,0	0,0	0,0	0,0
200 ms	-0,1	-0,1	-0,1	0,0
100 ms	-0,1	-0,1	-0,1	0,0
50 ms	-0,1	-0,1	-0,1	0,0
20 ms	-0,1	-0,1	-0,1	0,0
10 ms	-0,1	-0,1	-0,1	-
5 ms	-0,1	-0,1	-0,1	-
2 ms	-0,1	-0,1	0,0	-

Table 5. Deviation from expected response of a single toneburst, time weighting S.

Burst length	Deviation at different toneburst levels (dB))			
	127 dB	107 dB	87 dB	67 dB
1000 ms	-0,1	0,0	0,0	0,0
500 ms	-0,1	0,0	0,0	0,0
200 ms	-0,1	0,0	0,0	0,1
100 ms	-0,1	0,0	0,0	0,2
50 ms	-0,1	0,0	0,0	-
20 ms	-0,1	0,0	0,0	-
10 ms	-0,1	0,0	0,0	-
5 ms	-0,1	-0,1	0,0	-
2 ms	-0,1	-0,1	0,0	-
1 ms	-0,1	-0,1	-	-
0,5 ms	-0,2	-0,1	-	-
0,25 ms	-0,2	-0,2	-	-

Table 6. Deviation from expected response of a single toneburst, time averaging 10 s.

When the signal level was gradually increased until overload was indicated, the deviation from expected reading was 0,0 dB at time weighting F, S and L_{eq} at input signals with burst lengths 0,25 ms, 2 ms and 0,25 ms, respectively.

9.14 Response to repeated tonebursts

Fulfils the requirements for a class 1 sound level meter according to IEC 61672-1.

The deviation from expected response of repeated 4 kHz tonebursts is given in table 7. The tests have been made with different levels and lengths of the tonebursts.

Burst lengt	Burst level 127 dB		Burst level 49 dB	
	Burst period	Deviation	Burst period	Deviation
1000 ms	3000 ms	0,0 dB	3000 ms	0,2 dB
500 ms	3000 ms	0,1 dB	3000 ms	0,6 dB
200 ms	1000 ms	0,0 dB	1000 ms	0,4 dB
100 ms	1000 ms	0,0 dB	1000 ms	0,2 dB
50 ms	200 ms	-0,1 dB	200 ms	0,3 dB
20 ms	200 ms	0,0 dB	100 ms	0,4 dB
10 ms	200 ms	0,0 dB	50 ms	0,4 dB
5 ms	200 ms	-0,1 dB	20 ms	0,3 dB
2 ms	200 ms	-0,1 dB	10 ms	0,4 dB
1 ms	200 ms	-0,1 dB	5 ms	0,4 dB
0,5 ms	200 ms	-0,1 dB	2 ms	0,2 dB
0,25 ms	200 ms	-0,2 dB	1 ms	0,2 dB

Table 7. Deviation from expected response of a repeated tonebursts, time-average sound pressure level.

9.15 Overload indication

Fulfils partly the requirements for a class 1 sound level meter according to IEC 61672-1.

Tested by gradually increasing the amplitude of positive and negative one-half-cycle sine signals. The first overload shall be indicated at the same level within 1,8 dB for the positive and negative one-half-cycles. That is not the case for 31,5 Hz test signals, see table 8.

Measurement parameter	31,5 Hz		1 kHz		4 kHz	
	Pos	Neg	Pos	Neg	Pos	Neg
L_{AF}	132,0 dB	136,8 dB	130,6 dB	130,6 dB	130,6 dB	130,6 dB
L_{Cpeak}	132,0 dB	137,0 dB	130,6 dB	130,6 dB	130,8 dB	130,8 dB

Table 8. Un-weighted level at first overload indication for positive and negative one-half-cycle sine signals.

9.16 Peak C sound level

Fulfils the requirements for a class 1 sound level meter according to IEC 61672-1.

Tested by comparing the response of a one-cycle or a one-half-cycle sine signal with the response of the same signal continuously.

Signal	Level 125 dB			Level 39 dB		
	31,5 Hz	500 Hz	8 kHz	31,5 Hz	500 Hz	8 kHz
1 cycle	0,5 dB	0,1 dB	-0,3 dB	0,5 dB	0,1 dB	-0,3 dB
Pos ½-cycle	-	-0,2 dB	-	-	-0,2 dB	-
Neg ½-cycle	-	-0,2 dB	-	-	-0,2 dB	-

Table 9. Deviation from expected reading

9.20 Crosstalk

Fulfils the requirements for a class 1 sound level meter according to IEC 61672-1.

The microphone input channel 1 was short-circuited and a sine signal with level 1 dB below overload was connected to channel 2.

Signal frequency channel 2	Reading channel 1
31,5 Hz	34 dB
1 kHz	34 dB
8 kHz	38 dB

Table 10. A-weighted reading on channel 1 when signal applied to channel 2.

The expanded measurement uncertainty is equal or less than the maximum expanded uncertainties given in IEC 61672-1 Annex A.

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2$, which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with EA Publication EA-4/02 (formerly EAL-R2). The long term stability of the calibrated object is not included in the reported expanded uncertainty of measurement.

Traceability

The measurement results are by regular calibrations of the laboratory's standards traceable to the Swedish National Standards for electrical quantities and time and frequency.

Instruments used

Signal generator Stanford Research Systems DS360, ser.no. 61240
Digital voltmeter Agilent 34401, ser.no. US36053916

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