iDB® and iVIBE® Performance Tests – Sound

Identical circuits are used in both instruments and in what follows we refer to them collectively as iVIBE.

The iVIBE sound processing circuits are designed to meet the Class 1 requirements of BS EN 61672-1:2013. The ultimate performance of the instrument will depend on whether a Class 1 or Class 2 microphone is used. The following tables and charts give details of the typical performance of the iDB and iVIBE instruments when an electrical stimulus is applied instead of the microphone.

For the purpose of these tests, the instrument was calibrated to give a reading of 94.0 dB when a 50.0 mV RMS 1.0 kHz sine wave stimulus is applied to the microphone input. The ACO 7146 Class 1 microphone (with integral preamplifier) normally supplied with the iVIBE has a typical sensitivity of 42.2 mV/Pa at 1.0 kHz (i.e. about -1.4dB less). A typical performance chart for this microphone is given in the Appendix

The iVIBE records inputs between +30 dB and +125 dB on a single range with a linearity of better the ±0.5 dB for inputs greater than 40 dB.

The iVIBE noise floor, as measured with the microphone input shorted, is typically 25 dB or less for both the A and C weightings with 50mV/Pa sensitivity.

iVIBE is able to measure and record A and C frequency weightings simultaneously together with L_{Cpeak} and overload time as a percentage of measuring time. Both instruments also contain an accurate atmospheric pressure sensor.

For the purposes of these tests, the stimulus signals were generated by a TTi 50 MHz Function Generator (Model TG5011) and the RMS stimulus voltages measured by a Keysight 6.5 digit DVM (Model 34461A). A -50.00 dB precision attenuator was also used.

The test results confirm that the performance of the iDB and iVIBE sound processing circuits exceed the Class 1 requirements of BS EN61672-1:2013.

Frequency Weightings - BS EN 61672-1 Section 5.5

500.0 mV RMS sine wave applied giving a reading of 114.0 dB at 1.0 kHz

Frequency Hz	BS 61672 dB		iVIBE dB		Deviation dB		Class 1 tolerance dB
	A	C	A	C	A	C	
10.0	-70.4	-14.3	-73.6	-17.2	-3.2	-2.9	+3.0, - infinity
12.5	-63.4	-11.2	-66.1	-12.9	-2.7	-1.7	+2.5, - infinity
16.0	-56.7	-8.5	-57.9	-9.4	-1.2	-0.9	+2.0, -4.0
20.0	-50.5	-6.2	-51.7	-7.3	-1.2	-1.1	+2.0, -2.0
25.0	-44.7	-4.4	-45.6	-5.1	-0.9	-0.7	+2.0, -1.5
31.5	-39.4	-3.0	-39.9	-3.4	-0.5	-0.4	+1.5, -1.5
40.0	-34.6	-2.0	-35.1	-2.2	-0.5	-0.2	+1.0, -1.0
50.0	-30.2	-1.3	-30.5	-1.4	-0.3	-0.1	+1.0, -1.0
63.0	-26.2	-0.8	-26.4	-0.9	-0.2	-0.1	+1.0, -1.0
80.0	-22,5	-0.5	-23.0	-0.6	-0.5	-0.1	+1.0, -1.0
100	-19.1	-0.3	-19.7	-0.3	-0.6	0.0	+1.0, -1.0
125	-16.1	-0.2	-16.3	-0.2	-0.2	0.0	+1.0, -1.0
160	-13.4	-0.1	-13.1	-0.1	0.3	0.0	+1.0, -1.0
200	-10.9	0.0	-10.9	0.0	0.0	0.0	+1.0, -1.0
250	-8.6	0.0	-8.9	0.0	-0.3	0.0	+1.0, -1.0
315	-6.6	0.0	-6.9	0.0	-0.3	0.0	+1.0, -1.0
400	-4.8	0.0	-5.0	0.0	-0.2	0.0	+1.0, -1.0
500	-3.2	0.0	-3.3	0.0	-0.1	0.0	+1.0, -1.0
630	-1.9	0.0	-1.9	0.0	0.0	0.0	+1.0, -1.0
800	-0.8	0.0	-0.8	0.0	0.1	0.0	+1.0, -1.0
1000	0.0	0.00	0.0	0.0	0.0	0.0	+0.7, -0.7
1250	+0.6	0.0	0.6	-0.1	0.0	-0.1	+1.0, -1.0
1600	+1.0	-0.1	0.9	-0.1	-0.1	0.0	+1.0, -1.0
2000	+1.2	-0.2	1.1	-0.2	-0.1	0.0	+1.0, -1.0
2500	+1.3	-0.3	1.2	-0.3	-0.1	0.0	+1.0, -1.0
3150	+1.2	-0.5	1.1	-0.6	-0.1	-0.1	+1.0, -1.0
4000	+1.0	-0.8	0.9	-0.9	-0.1	-0.1	+1.0, -1.0
5000	+0.5	-1.3	0.6	-1.4	0.1	-0.1	+1.5, -1.5
6300	-0.1	-2.0	-0.1	-2.1	0.0	-0.1	+1.5, -2.0
8000	-1.1	-3.0	-1.1	-3.2	0.0	-0.3	+1.5, -2.5
10,000	-2.5	-4.4	-2.6	-4.7	-0.1	-0.4	+2.0, -3.0
12,500	-4.3	-6.2	-4.6	-6.7	-0.3	-0.5	+2.0, -5.0
16,000	-6.6	-8.5	-7.4	-9.3	-0.8	-0.8	+2.5. -16.0
20,000	-9.3	-11.2	-10.3	-11.8	-1.0	-0.6	+3.0, - infinity

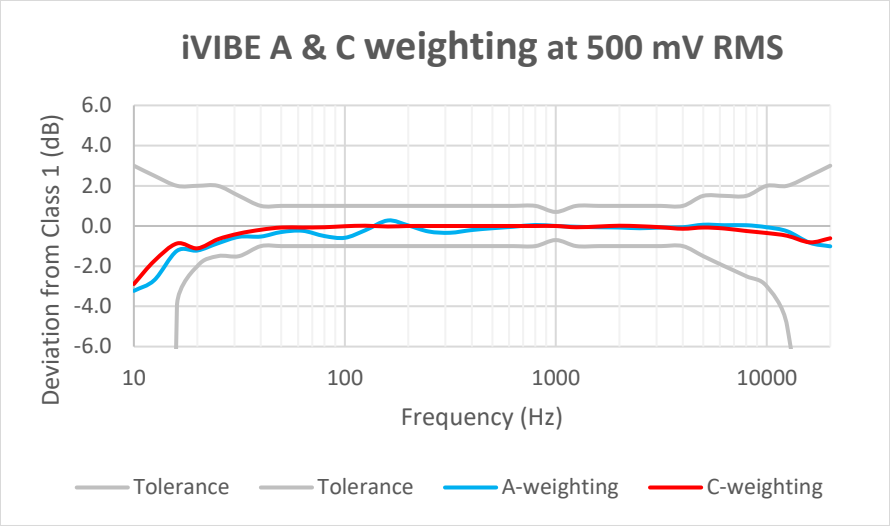
50.0 mV RMS sine wave applied giving a reading of 94.0 dB at 1.0 kHz

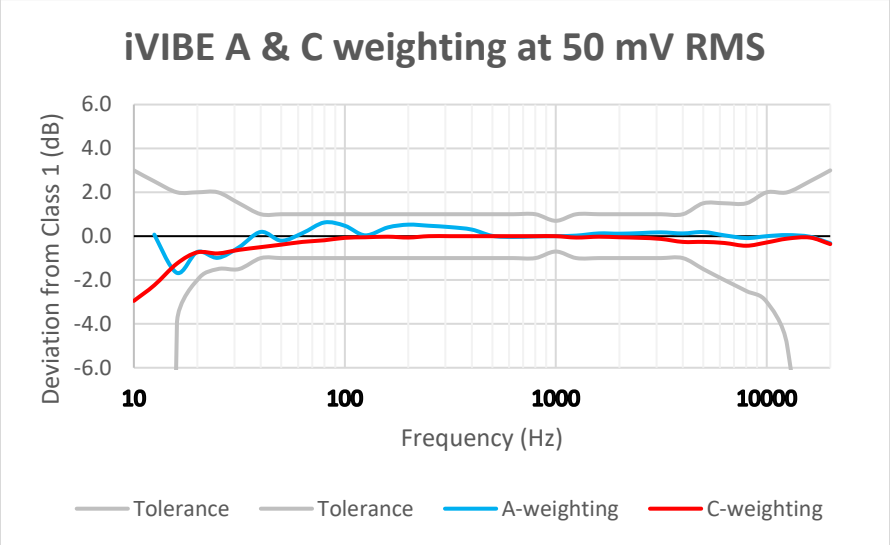
Frequency Hz	BS 61672 dB		iVIBE dB		Deviation dB		Class 1 tolerance dB
	A	C	A	C	A	C	
10.0	-70.4	-14.3	-65.2	-17.3	<35dB	-3.0	+3.0, - infinity
12.5	-63.4	-11.2	-63.3	-13.4	0.1	-2.2	+2.5, - infinity
16.0	-56.7	-8.5	-58.4	-9.8	-1.7	-1.3	+2.0, -4.0
20.0	-50.5	-6.2	-51.2	-6.9	-0.7	-0.7	+2.0, -2.0
25.0	-44.7	-4.4	-45.7	-5.2	-1.0	-0.8	+2.0, -1.5
31.5	-39.4	-3.0	-39.9	-3.6	-0.5	-0.6	+1.5, -1.5
40.0	-34.6	-2.0	-34.4	-2.5	0.2	-0.5	+1.0, -1.0
50.0	-30.2	-1.3	-30.4	-1.7	-0.2	-0.4	+1.0, -1.0
63.0	-26.2	-0.8	-26.1	-1.1	0.1	-0.3	+1.0, -1.0
80.0	-22,5	-0.5	-21.9	-0.7	0.6	-0.2	+1.0, -1.0
100	-19.1	-0.3	-18.6	-0.4	0.5	-0.1	+1.0, -1.0
125	-16.1	-0.2	-16.1	-0.3	0.0	-0.1	+1.0, -1.0
160	-13.4	-0.1	-13.0	-0.1	0.4	0.0	+1.0, -1.0
200	-10.9	0.0	-10.4	-0.1	0.5	-0.1	+1.0, -1.0
250	-8.6	0.0	-8.1	0.0	0.5	0.0	+1.0, -1.0
315	-6.6	0.0	-6.2	0.0	0.4	0.0	+1.0, -1.0
400	-4.8	0.0	-4.5	0.0	0.3	0.0	+1.0, -1.0
500	-3.2	0.0	-3.2	0.0	0.0	0.0	+1.0, -1.0
630	-1.9	0.0	-1.9	0.0	0.0	0.0	+1.0, -1.0
800	-0.8	0.0	-0.8	0.0	0.0	0.0	+1.0, -1.0
1000	0	0	0.0	0.0	0.0	0.0	+0.7, -0.7
1250	+0.6	0.0	0.6	-0.1	0.0	-0.1	+1.0, -1.0
1600	+1.0	-0.1	1.1	-0.1	0.1	0.0	+1.0, -1.0
2000	+1.2	-0.2	1.3	-0.3	0.1	-0.1	+1.0, -1.0
2500	+1.3	-0.3	1.4	-0.4	0.1	-0.1	+1.0, -1.0
3150	+1.2	-0.5	1.4	-0.6	0.2	-0.1	+1.0, -1.0
4000	+1.0	-0.8	1.1	-1.1	0.1	-0.3	+1.0, -1.0
5000	+0.5	-1.3	0.7	-1.6	0.2	-0.3	+1.5, -1.5
6300	-0.1	-2.0	-0.1	-2.3	0.0	-0.3	+1.5, -2.0
8000	-1.1	-3.0	-1.2	-3.4	-0.1	-0.4	+1.5, -2.5
10,000	-2.5	-4.4	-2.5	-4.7	0.0	-0.3	+2.0, -3.0
12,500	-4.3	-6.2	-4.3	-6.3	0.0	-0.1	+2.0, -5.0
16,000	-6.6	-8.5	-6.6	-8.6	0.0	-0.1	+2.5. -16.0
20,000	-9.3	-11.2	-9.6	-11.6	-0.3	-0.4	+3.0, - infinity

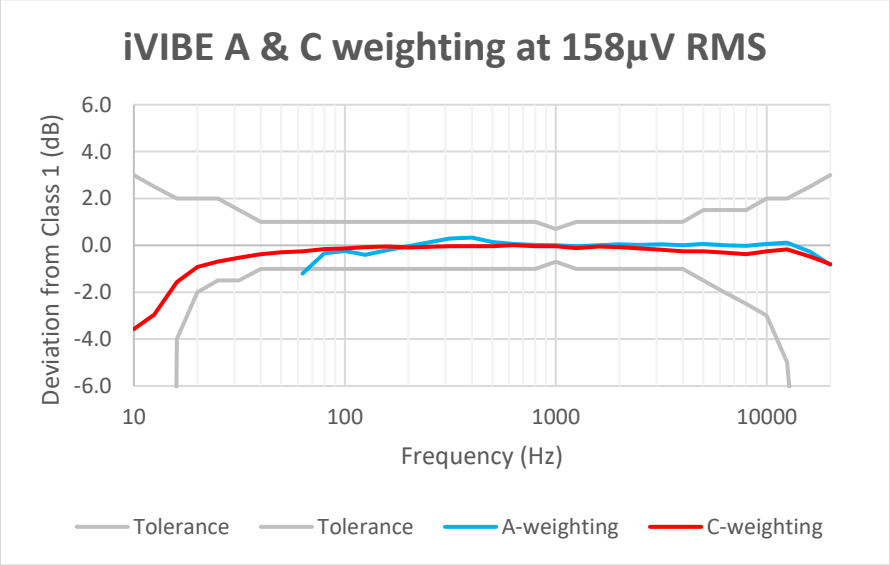
158.1 µV RMS sine wave applied giving a reading of 64.0 dB at 1.0 kHz

Frequency Hz	BS 61672 dB		iVIBE dB		Deviation dB		Class 1 tolerance dB
	A	C	A	C	A	C	
10.0	-70.4	-14.3	-40.6	-17.9	<35dB	-3.6	+3.0, - infinity
12.5	-63.4	-11.2	-40.6	-14.2	<35dB	-3.0	+2.5, - infinity
16.0	-56.7	-8.5	-40.6	-10.1	<35dB	-1.6	+2.0, -4.0
20.0	-50.5	-6.2	-40.5	-7.1	<35dB	-0.9	+2.0, -2.0
25.0	-44.7	-4.4	-40.2	-5.1	<35dB	-0.7	+2.0, -1.5
31.5	-39.4	-3.0	-39.3	-3.5	<35dB	-0.5	+1.5, -1.5
40.0	-34.6	-2.0	-36.9	-2.4	<35dB	-0.4	+1.0, -1.0
50.0	-30.2	-1.3	-32.5	-1.6	<35dB	-0.3	+1.0, -1.0
63.0	-26.2	-0.8	-27.4	-1.1	-1.2	-0.3	+1.0, -1.0
80.0	-22,5	-0.5	-22.8	-0.7	-0.3	-0.2	+1.0, -1.0
100	-19.1	-0.3	-19.3	-0.4	-0.2	-0.1	+1.0, -1.0
125	-16.1	-0.2	-16.5	-0.3	-0.4	-0.1	+1.0, -1.0
160	-13.4	-0.1	-13.6	-0.2	-0.2	-0.1	+1.0, -1.0
200	-10.9	0.0	-10.9	-0.1	0.0	-0.1	+1.0, -1.0
250	-8.6	0.0	-8.5	-0.1	0.1	-0.1	+1.0, -1.0
315	-6.6	0.0	-6.3	0.0	0.3	0.0	+1.0, -1.0
400	-4.8	0.0	-4.5	0.0	0.3	0.0	+1.0, -1.0
500	-3.2	0.0	-3.1	0.0	0.1	0.0	+1.0, -1.0
630	-1.9	0.0	-1.8	0.0	0.1	0.0	+1.0, -1.0
800	-0.8	0.0	-0.8	0.0	0.0	0.0	+1.0, -1.0
1000	0	0	0	0.0	0.0	0.0	+0.7, -0.7
1250	+0.6	0.0	0.6	-0.1	0.0	-0.1	+1.0, -1.0
1600	+1.0	-0.1	1.0	-0.2	0.0	-0.1	+1.0, -1.0
2000	+1.2	-0.2	1.3	-0.3	0.1	-0.1	+1.0, -1.0
2500	+1.3	-0.3	1.3	-0.4	0.0	-0.1	+1.0, -1.0
3150	+1.2	-0.5	1.3	-0.7	0.1	-0.2	+1.0, -1.0
4000	+1.0	-0.8	1.0	-1.1	0.0	-0.3	+1.0, -1.0
5000	+0.5	-1.3	0.6	-1.6	0.1	-0.3	+1.5, -1.5
6300	-0.1	-2.0	-0.1	-2.3	0.0	-0.3	+1.5, -2.0
8000	-1.1	-3.0	-1.1	-3.4	0.0	-0.4	+1.5, -2.5
10,000	-2.5	-4.4	-2.4	-4.7	0.1	-0.3	+2.0, -3.0
12,500	-4.3	-6.2	-4.2	-6.4	0.1	-0.2	+2.0, -5.0
16,000	-6.6	-8.5	-6.9	-9.0	-0.3	-0.5	+2.5. -16.0
20,000	-9.3	-11.2	-10.1	-12.0	-0.8	-0.8	+3.0, - infinity

Note: 158.1 µV signal generated using a -50.00 dB attenuator


iVIBE A & C weighting at 500 mV RMS
Deviation from Class 1 (dB)
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
10
100
1000
10000
Frequency (Hz)
Tolerance
Tolerance
A-weighting
C-weighting


iVIBE A & C weighting at 50 mV RMS
Deviation from Class 1 (dB)
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
10
100
1000
10000
Frequency (Hz)
Tolerance
Tolerance
A-weighting
C-weighting


iVIBE A & C weighting at 158µV RMS
Deviation from Class 1 (dB)
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
10
100
1000
10000
Frequency (Hz)
Tolerance
Tolerance
A-weighting
C-weighting

Level Linearity - BS EN 61672-1 Section 5.5

iVIBE has a single measurement range spanning 95 dB for sound pressure levels between 30 dB and 125 dB for both A and C frequency weightings. Performance tests were carried out at frequencies of 4.0 kHz, 1.0 kHz and 40 Hz. Stimuli below 10 mV RMS were generated with the aid of a -50.00 dB precision attenuator.

For BS 61672 Class 1, the linearity deviations (Dev.) shall not exceed ±0.8 dB over the linear measurement range of the instrument and shall not exceed ±0.3 dB within any 10 dB portion thereof.

iVIBE Level Linearity at 4.0 kHz

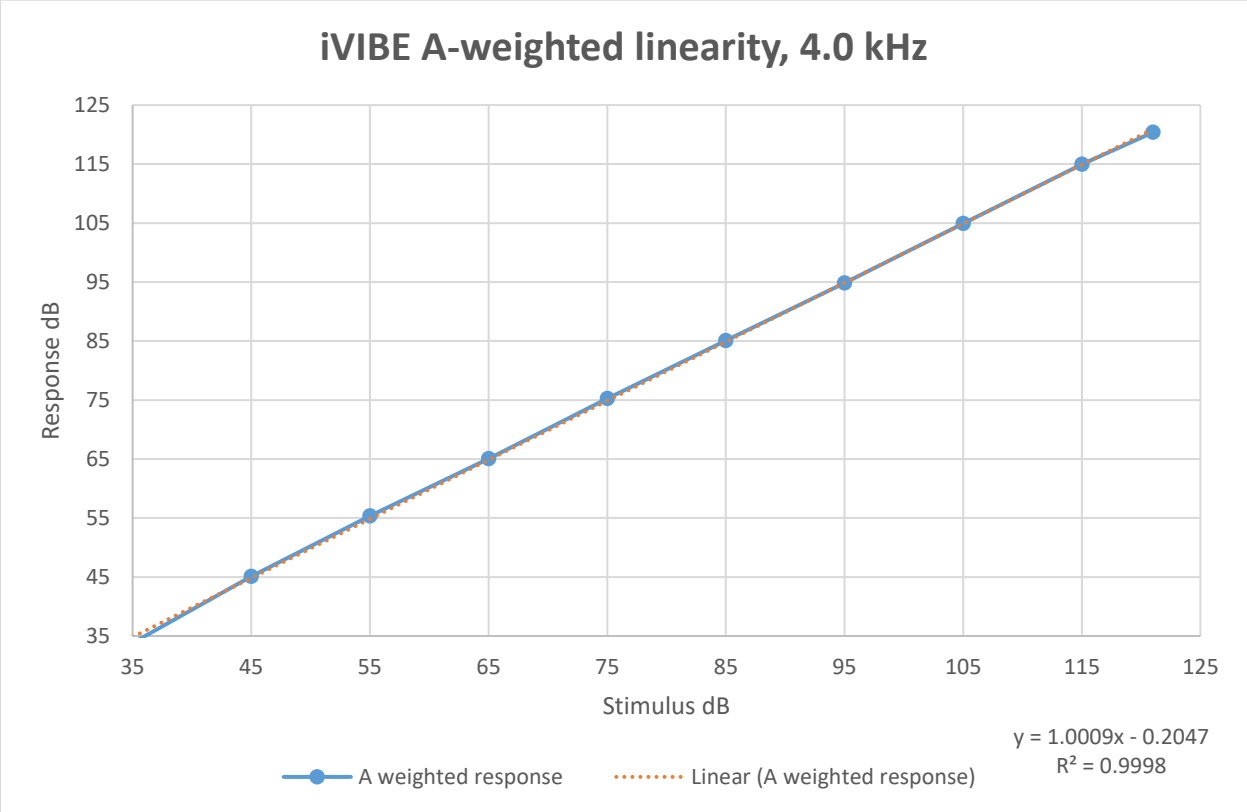
Stimulus mV RMS	True A dB	iVIBE A dB	Dev. A dB	True C dB	iVIBE C dB	Dev. C dB
1000.0	121.0	120.4	-0.6	119.2	118.4	-0.8
500.0	115.0	114.9	-0.1	113.2	113.1	-0.1
158.1	105.0	104.9	-0.1	103.2	103.1	-0.0
50.00	95.0	94.8	-0.2	93.2	92.9	-0.3
15.81	85.0	85.1	0.1	83.2	83.4	0.2
5.00	75.0	75.2	0.3	73.2	73.4	0.2
1.581	65.0	65.1	0.1	63.2	63.0	-0.2
0.500	55.0	55.3	0.3	53.2	53.1	0.0
0.158	45.0	45.1	0.1	43.2	43.1	-0.1
0.050	35.0	33.8	-1.2	33.3	31.6	-1.7

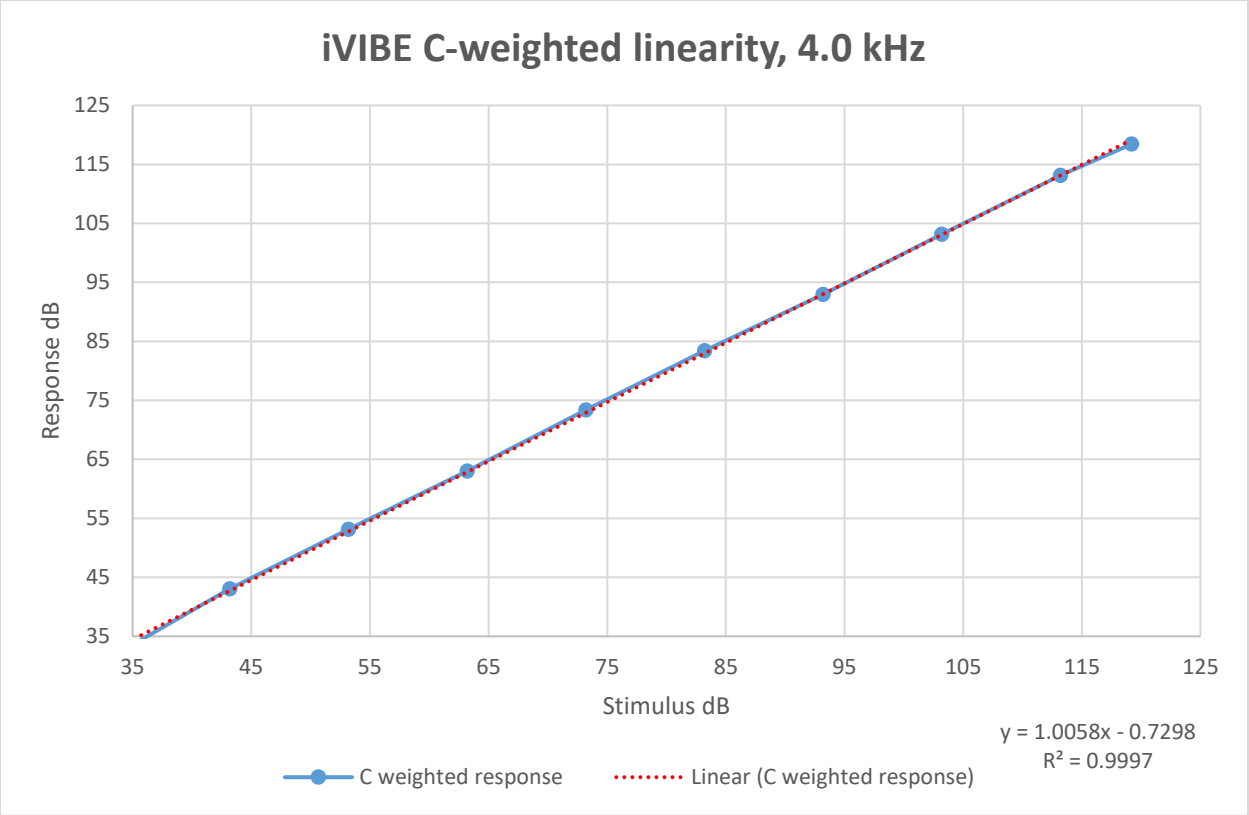
iVIBE Level Linearity at 1.0 kHz

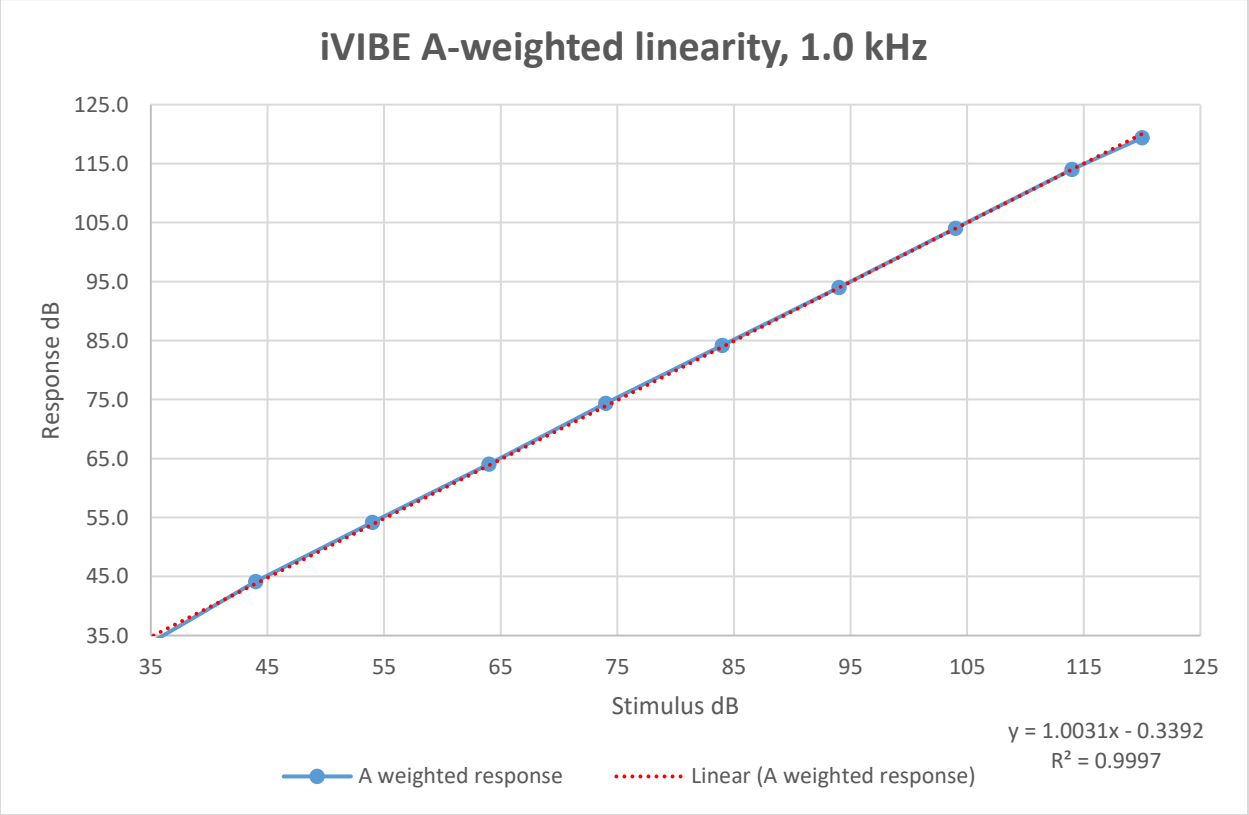
Stimulus mV RMS	True A dB	iVIBE A dB	Dev. A dB	True C dB	iVIBE C dB	Dev. C dB
1000.0	120.0	119.4	-0.6	120.0	119.4	-0.6
500.0	114.0	114.0	0.0	114.0	114.0	0.0
158.1	104.0	104.1	0.1	104.0	104.1	0.1
50.00	94.0	94.0	0.0	94.0	94.0	0.0
15.81	84.0	84.2	0.2	84.0	84.2	0.2
5.00	74.0	74.4	0.4	74.0	74.3	0.3
1.581	64.0	64.1	0.1	64.0	64.0	0.0
0.500	54.0	54.2	0.2	54.0	54.2	0.2
0.158	44.0	44.2	0.2	44.0	44.1	0.1
0.050	34.0	32.6	-1.4	34.0	32.8	-1.2

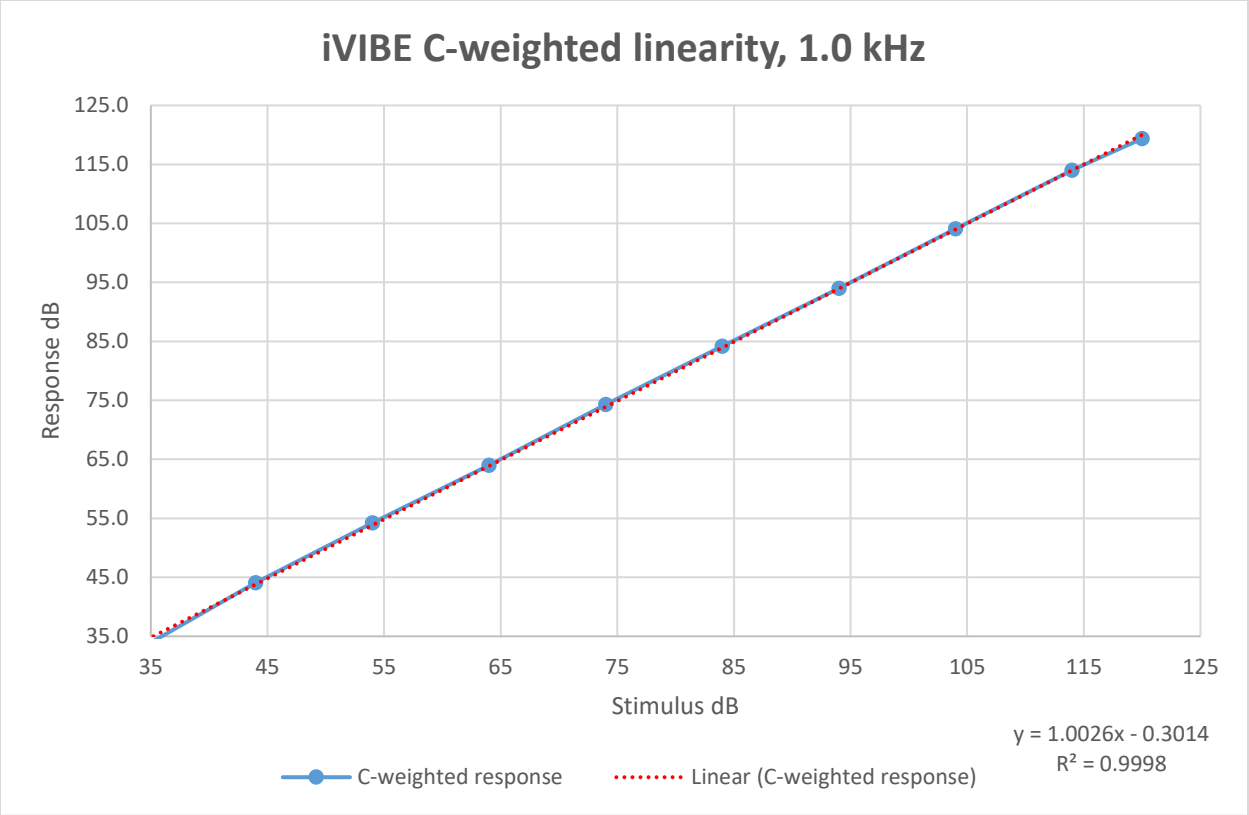
iVIBE Level Linearity at 40 Hz

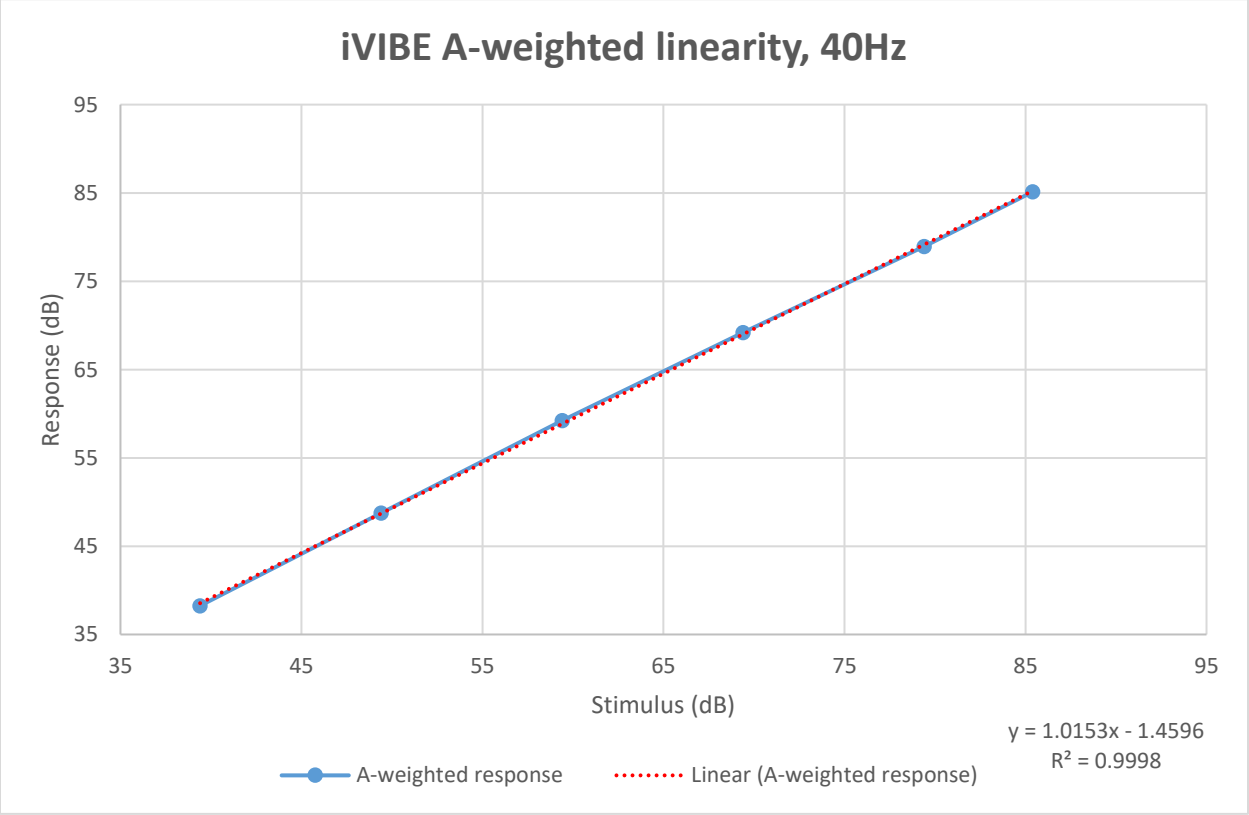
Stimulus mV RMS	True A dB	iVIBE A dB	Dev. A dB	True C dB	iVIBE C dB	Dev. C dB
1000.0	85.4	85.1	-0.3	118.0	117.1	-0.9
500.0	79.4	78.9	-0.5	112.0	111.8	-0.2
158.1	69.4	69.2	-0.2	102.0	101.9	-0.1
50.00	59.4	59.2	-0.2	92.0	91.8	-0.2
15.81	49.4	48.8	-0.6	82.0	82.0	0.0
5.00	39.4	38.2	-1.2	72.0	72.1	0.1
1.581	29.4	<35dB		62.0	61.8	-0.2
0.500	19.4	<35dB		52.0	51,6	-0.4
0.158	9.4	<35dB		42.0	41.7	-0.3
0.050	-0.6	<35dB		32.0	29.8	-2.1

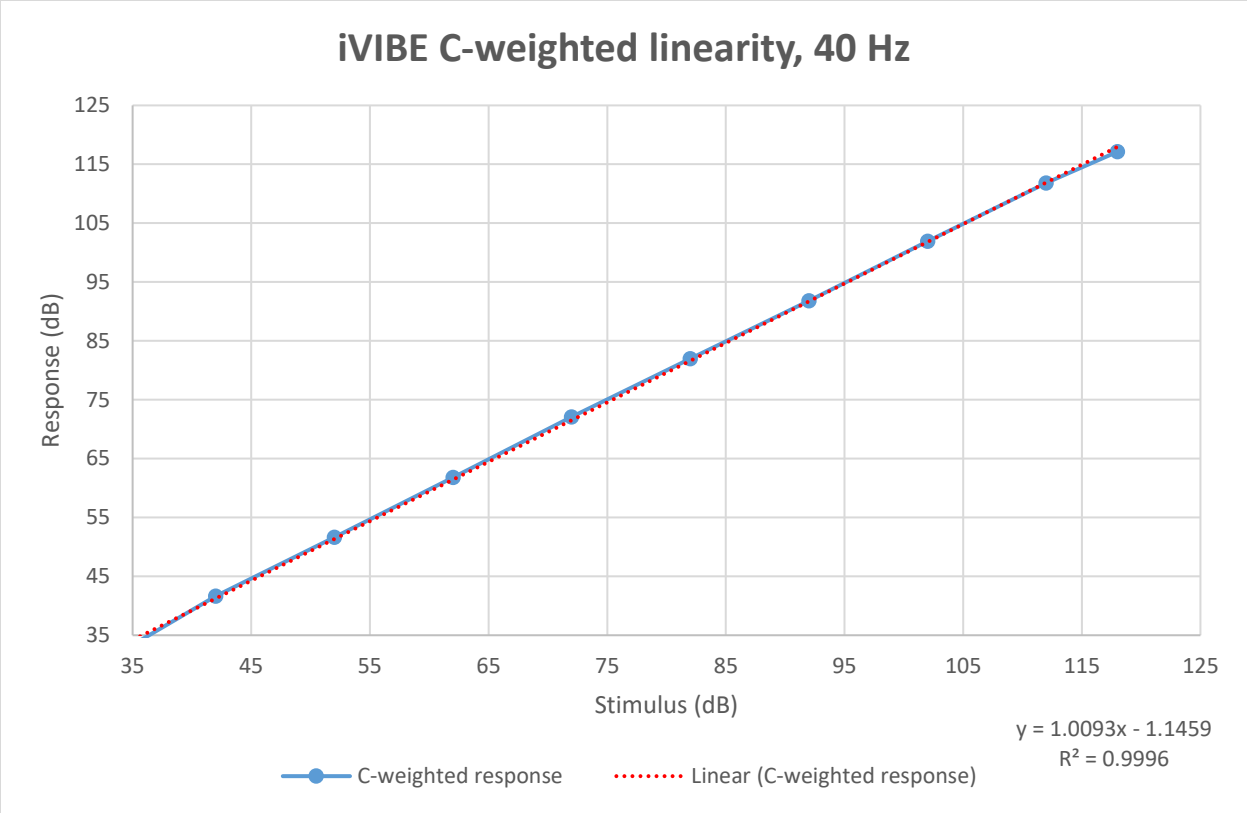



iVIBE C-weighted linearity, 4.0 kHz
Response dB
125
115
105
95
85
75
65
55
45
35
35
45
55
65
75
85
95
105
115
125
Stimulus dB
y = 1.0058x - 0.7298
R² = 0.9997
C weighted response
Linear (C weighted response)


iVIBE A-weighted linearity, 1.0 kHz
Response dB
125.0
115.0
105.0
95.0
85.0
75.0
65.0
55.0
45.0
35.0
35
45
55
65
75
85
95
105
115
125
Stimulus dB
y = 1.0031x - 0.3392
R² = 0.9997
A weighted response
Linear (A weighted response)


iVIBE C-weighted linearity, 1.0 kHz
125.0
115.0
105.0
95.0
85.0
75.0
65.0
55.0
45.0
35.0
Response dB
35
45
55
65
75
85
95
105
115
125
Stimulus dB
y = 1.0026x - 0.3014
R² = 0.9998
C-weighted response
Linear (C-weighted response)


iVIBE A-weighted linearity, 40Hz
95
85
75
65
55
45
35
Response (dB)
35
45
55
65
75
85
95
Stimulus (dB)
y = 1.0153x - 1.4596
R² = 0.9998
A-weighted response
Linear (A-weighted response)



Noise Floor - BS EN 61672-1 Section 5.7

iVIBE	A -weighting	C-weighting
Maximum noise floor at 50mV/Pa	25 dB	25 dB
Level at which noise floor causes a non-linearity of < 0.4dB	42 dB	42 dB
Level at which noise floor causes a non-linearity of < 1.0 dB	37 dB	37 dB

Time-weightings F and S – BS EN 61672-1 Section 5.8

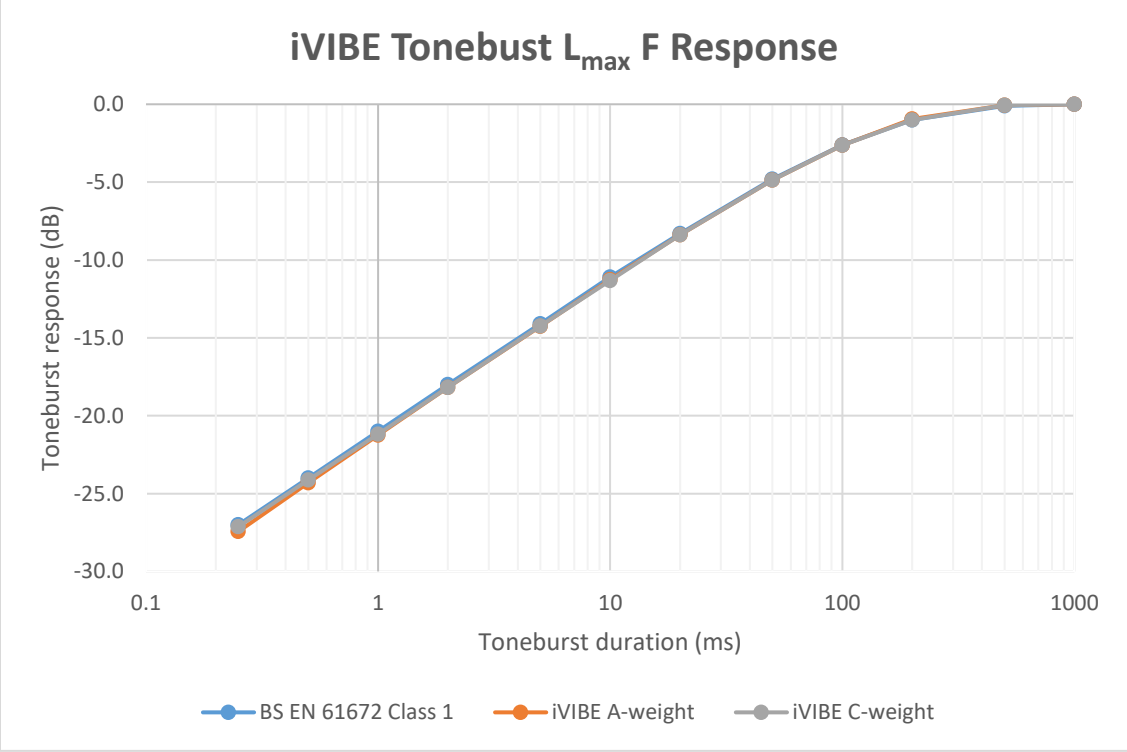
iVIBE uses digital filters to meet the design goal time constants of 0.125 sec for the F time weight filter and 1.0 sec for the S time weight filter. Their accuracy is confirmed by the accuracy of the following toneburst measurements.

Toneburst Response - BS EN 61672-1 Section 5.9

4.0 kHz toneburst, L_{max} response, F time weighting

iVIBE: L_A= 114.8 dB, iVIBE: Lc =113.0dB

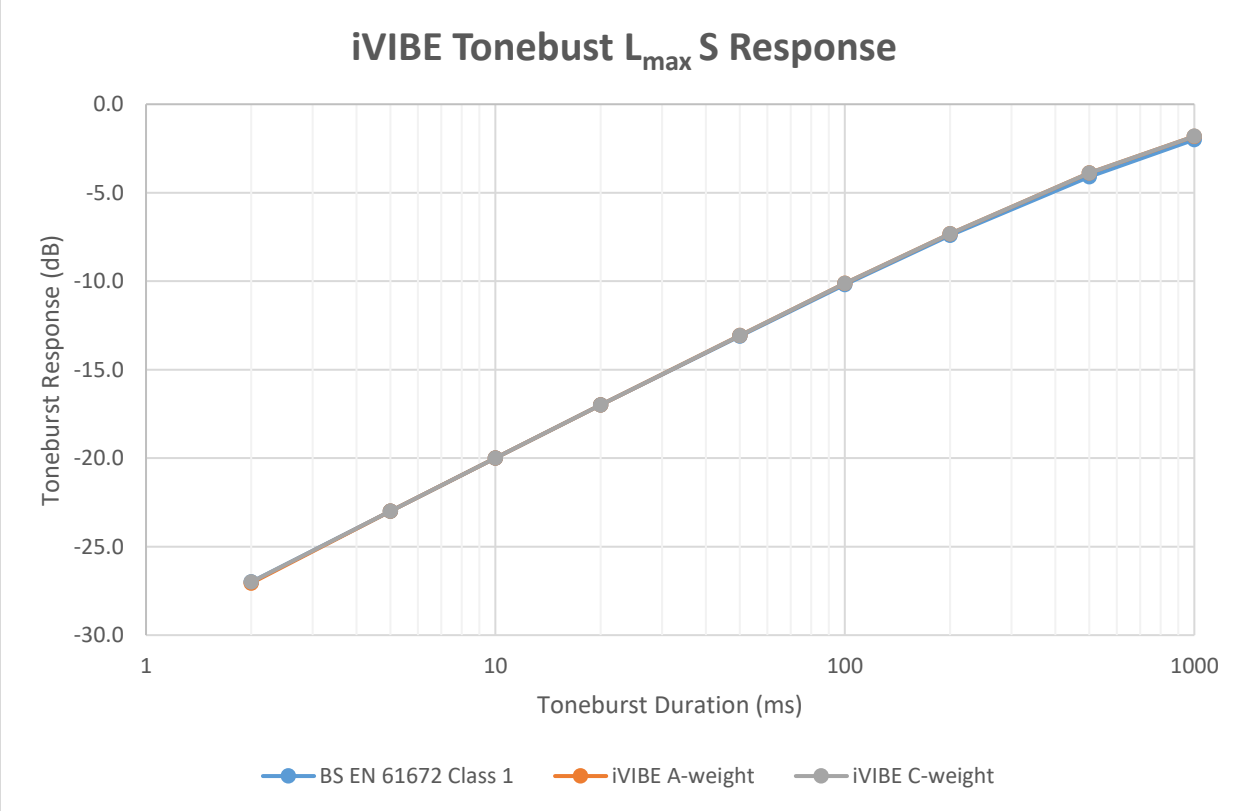
Toneburst Duration ms	BS 61672 L_{AFmax} - L_A L_{CFmax} – L_C dB	iVIBE L_{AFmax} - L_A dB	iVIBE L_{CFmax} – L_C dB	iVIBE L_{AFmax} dB	iVIBE L_{CFmax} dB	Class 1 Tol. + dB	Class 1 Tol. – dB
1000	0.0	0	0	114.8	113.0	0.5	-0.5
500	-0.1	-0.1	-0.1	114.7	112.9	0.5	-0.5
200	-1.0	-0.9	-1.0	113.9	112.0	0.5	-0.5
100	-2.6	-2.6	-2.6	112.2	110.4	1.0	-1.0
50	-4.8	-4.9	-4.9	109.9	108.1	1.0	-1.0
20	-8.3	-8.4	-8.4	106.4	104.6	1.0	-1.0
10	-11.1	-11.3	-11.3	103.6	101.7	1.0	-1.0
5	-14.1	-14.3	-14.3	100.6	98.7	1.0	-1.0
2	-18.0	-18.1	-18.2	96.6	94.8	1.0	-1.5
1	-21.0	-21.3	-21.2	93.6	91.8	1.0	-2.0
0.5	-24.0	-24.3	-24.1	90.5	88.9	1.0	-2.5
0.25	-27.0	-27.4	-27.1	87.4	85.9	1.0	-3.0



4.0 kHz toneburst, L_{max} response, S time weighting

iVIBE: L_A= 114.8 dB, iVIBE: Lc =113.0dB

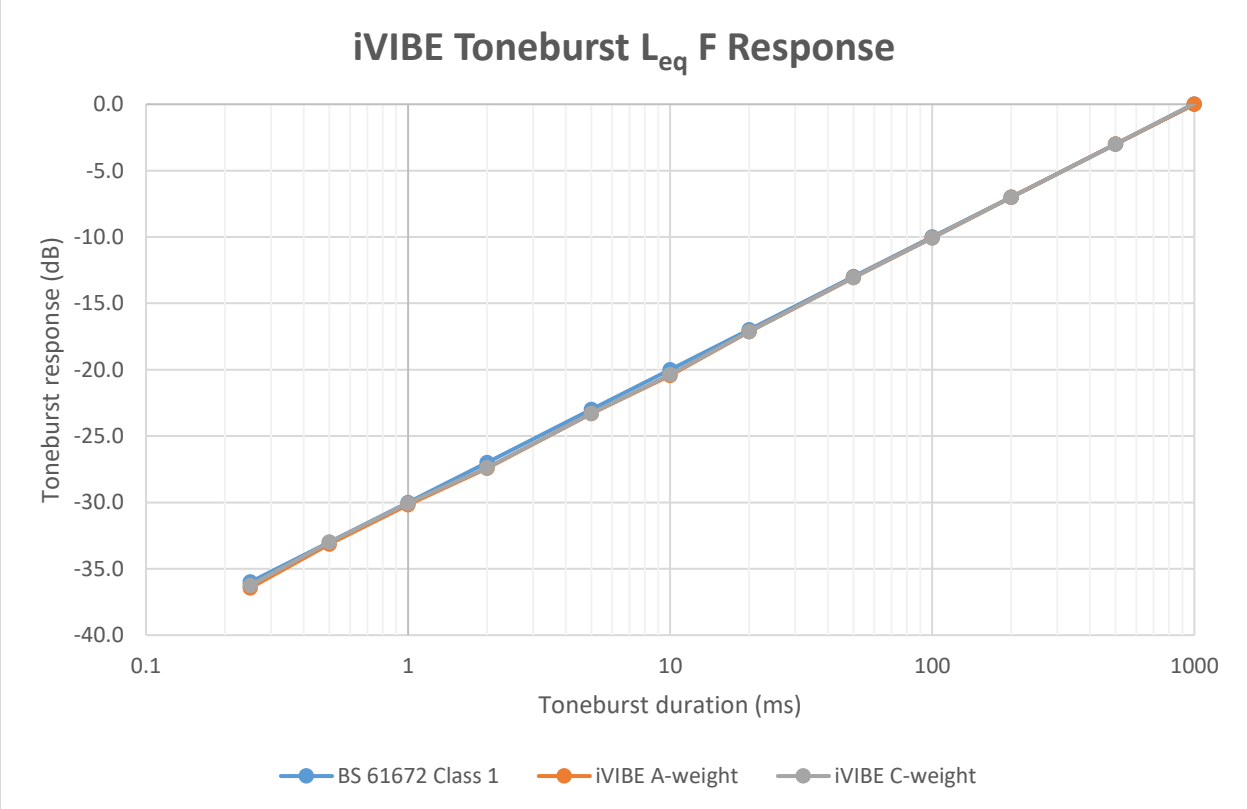
Toneburst Duration ms	BS 61672 L_{ASmax} - L_A L_{CSmax} – L_C dB	iVIBE L_{ASmax} - L_A dB	iVIBE L_{CSmax} – L_C dB	iVIBE L_{ASmax} dB	iVIBE L_{CSmax} dB	Class 1 Tol. + dB	Class 1 Tol. – dB
1000	-2.0	-1.8	-1.8	113.0	111.2	0.5	-0.5
500	-4.1	-3.9	-3.9	110.9	109.1	0.5	-0.5
200	-7.4	-7.3	-7.3	107.5	105.7	0.5	-0.5
100	-10.2	-10.1	-10.1	104.7	102.9	1.0	-1.0
50	-13.1	-13.1	-13.1	101.8	99.9	1.0	-1.0
20	-17.0	-17.0	-17.0	97.8	96.0	1.0	-1.5
10	-20.0	-20.0	-20.0	94.8	93.0	1.0	-2.0
5	-23.0	-23.0	-23.0	91.8	90.0	1.0	-2.5
2	-27.0	-27.0	-27.0	87.8	86.0	1.0	-3.0



4.0 kHz toneburst, L_{eq} response, F time weighting

iVIBE: L_A= 114.8 dB, iVIBE: Lc =113.0dB

Toneburst Duration ms	BS 61672 L_{AE} - L_A L_{CE} – L_C dB	iVIBE L_{AE} - L_A dB	iVIBE L_{CE} – L_C dB	iVIBE L_{AE} dB	iVIBE L_{CE} dB	Class 1 Tol. + dB	Class 1 Tol. – dB
1000	0.0	0.0	00.0	114.8	113.0	0.5	-0.5
500	-3.0	-3.0	-7.0	111.8	110.0	0.5	-0.5
200	-7.0	-7.0	-7.0	107.8	106.0	0.5	-0.5
100	-10.0	-10.1	-10.1	104.7	102.9	1.0	-1.0
50	-13.0	-13.1	-13.1	101.7	99.9	1.0	-1.0
20	-17.0	-17.1	-17.1	97.7	95.9	1.0	-1.0
10	-20.0	-20.4	-20.4	94.4	92.6	1.0	-1.0
5	-23.0	-23.3	-23.3	91.5	89.7	1.0	-1.0
2	-27.0	-27.4	-27.4	87.4	84.6	1.0	-1.5
1	-30.0	-30.2	-30.1	84.6	82.9	1.0	-2.0
0.5	-33.0	-33.1	-33.0	81.7	80.0	1.0	-2.5
0.25	-36.0	-36.4	-36.2	78.4	76.8	1.0	-3.0



C-weighted peak sound level - BS EN 61672 Section 5.13

		BS 61672	iVIBE	iVIBE	iVIBE	Tol.
Cycles	**Frequency Hz**	**L_{Cpeak}-L_C dB**	**L_{Cpeak}-L_C dB**	**L_{Cpeak} dB**	**L_C dB**	**Class 1 dB**
one	31.5	2.5	3.2	113.8	110.6	+2, -2
one	500	3.5	3.4	117.4	114.0	+1, -1
one	8000	3.4	3.6	114.3	110.7	+2, -2
+half cycle	500	2.4	2.3	116.3	114.0	+1, -1
-half cycle	500	2.4	2.4	116.4	114.0	+1, -1

NOTES

Revision history:

- Issue 1, 18 October 2016, original

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APPENDIX – CLASS 1 MICROPHONE PERFORMANCE

Calibration Chart

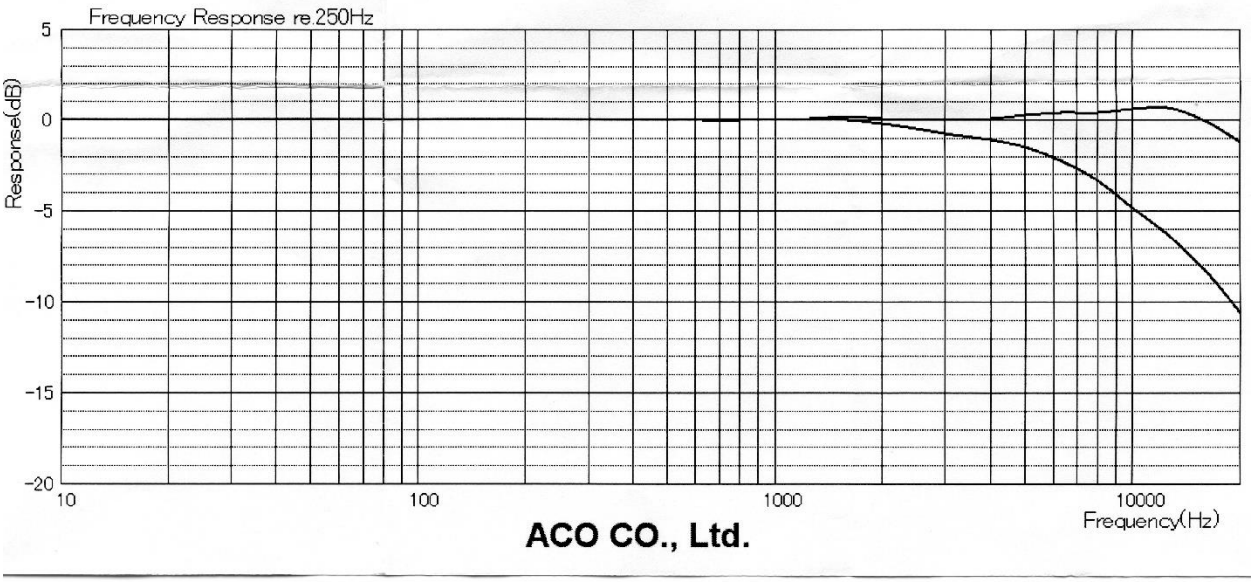
1/2" Prepolarized Microphone

Cartridge TYPE	:	7146
Serial No	:	64634/9873
Sensitivity (at 250Hz)	:	48.4 mV/Pa
		−26.3 dB re 1V/Pa
Cartridge Capacitance	:	17.4 pF
Polarization Voltage	:	0 V

Pressure Sensitivity(Included preamplifier) : 42.2 mV/Pa

Envitonmental Calibration Conditions

Temperature	:	24 ℃
Humidity	:	62 %
Barometric pressure	:	994 hpa
Date	:	2016/5/13
Operator	:	A. I



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