

Airborne Sound Insulation

with XL2-TA Sound Level Meter



This application note describes the verification of the airborne sound insulation in buildings with the XL2-TA Sound Level Meter. All measurements are in accordance with the standard ISO16283-1, which replaces the corresponding parts of the older ISO140-4.

The airborne sound insulation describes sound insulation between rooms. The sound insulation is calculated by combining multiple sound pressure level and reverb time measurements. The investigated frequency range is typically from 50 Hz to 5 kHz. The test results can be used to quantify, assess and compare the airborne sound insulation in unfurnished or furnished rooms. The measured airborne sound insulation is frequency-dependent and can be converted into a single number sound reduction index to characterize the acoustic performance.

This application note applies for rooms with a volume larger or equal than 25 m³. Special methods apply for smaller rooms as specified in ISO 16283-1.

Related standards:

ISO 16283-1	Describes the procedures for field measurements of sound insulation in buildings. (replaces the corresponding parts of ISO140-4)
ISO 717	Describes the rating of sound insulation in buildings
IEC 61672-1	Specifies the requirements for a class 1 sound level meter
IEC 61260	Specifies the requirements for octave-band and third-octave band filters
ISO 3382-2	Specifies the measurement of the RT60 reverberation time

Instrument Configuration

The sound level meter shall meet the requirements of a class 1 instrument in accordance with the standard IEC 61672-1. The recommended configuration consists of

- XL2-TA Sound Level Meter
(XL2 Sound Level Meter with Type Approval Option installed)
- Optional Extended Acoustic Pack installed
(required for the RT60 measurement in 1/3 octave resolution)
- Sound Insulation Option or an
enabled Sound Insulation Reporter 365 annual subscription
- M2230 Measurement Microphone
- ASD Cable
- NTi Audio Precision Calibrator
- Microphone Tripod
- DS3 Dodecahedron Speaker
- PA3 Power Amplifier
- Computer/Tablet with Sound Insulation Reporter Software



The sound pressure level measuring system shall be calibrated at intervals not exceeding two years.

Required measurements

- Noise level in source room
- Noise level in receiving room
- Background noise level in receiving room
- Reverberation time RT60 in receiving room

At the beginning and at the end of each measurement day, the entire sound pressure level measuring system shall be checked with the precision calibrator. This shall meet the class 1 requirements in accordance with IEC 60942.

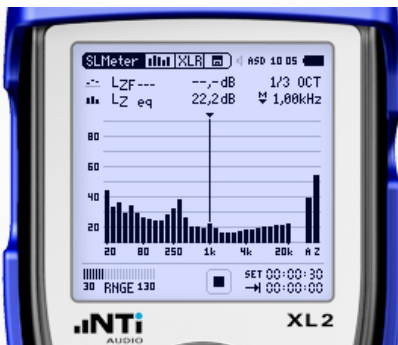


Wear hearing protection for all measurements!

1. Room Selection

The airborne sound insulation is measured between two rooms. One room is chosen as the source room and the other one is chosen as the receiving room. In case the volumes of the two rooms differ, then the smaller room shall be used as receiving room.

2. Measure Background Noise Level L_b in Receiving Room



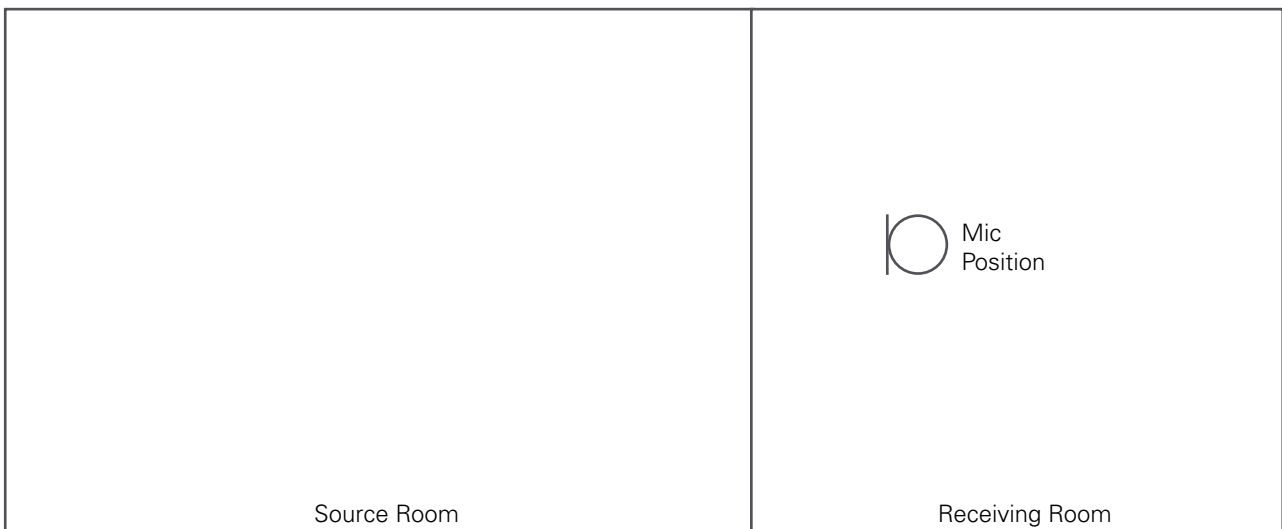
Background Noise Spectrum in Receiving Room

Preparation

- Select the RTA page of SLMeter function on XL2-TA Sound Level Meter.
- Select third-octave resolution measurement.
- It's recommended to leave the room for this measurement thus any noise generated by the operator will not affect the measurement.

Measurement

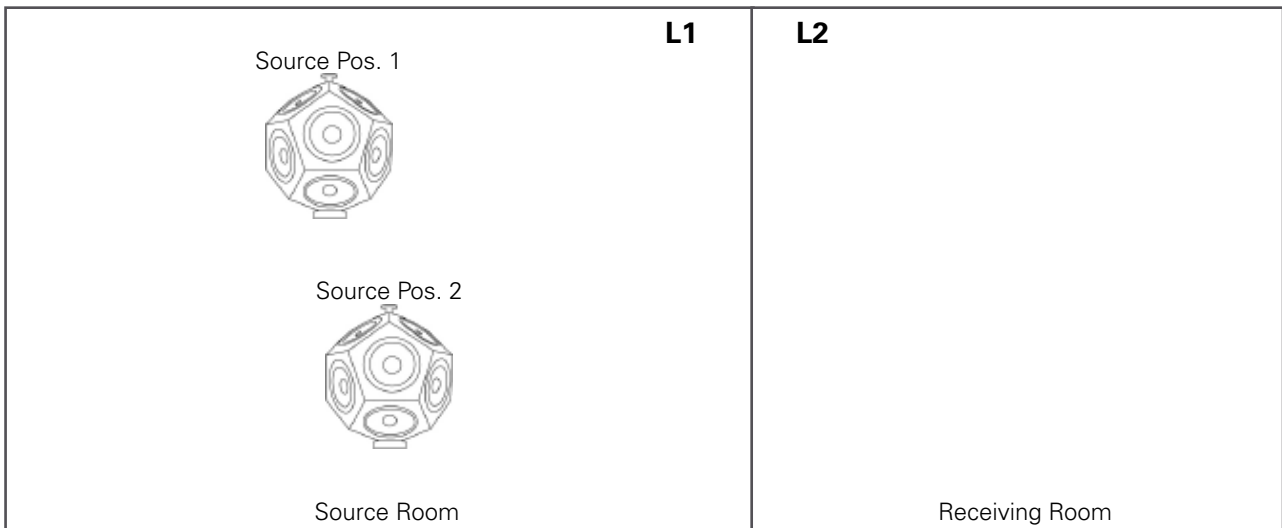
- Measure the background noise LZeq in the receiving room for 30 seconds.
- Store the reading in the XL2. This is required for post calculation of the sound insulation.
- Capture the reading as a reference for the next step. This is required to adjust the speaker output level accordingly.



Measure background noise level L_b

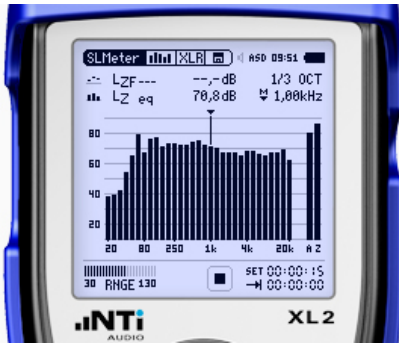
3. Test Signal for Sound Level Measurement

- Position the speaker in the source room.
- The measurements have to be carried out at least at two different speaker positions thus define the both positions.
- Choose position 1 at least 0.5 m from any room boundary and at least 1.0 m from the separating partition. Position 2 shall be in a different plane relative to the room boundaries with a minimum 1.4 m distance to position 1. The distances are measured from the center of the Dodecahedron Speaker DS3. In case the separation partition is a floor and the speaker is in the upper room, then the Dodecahedron Speaker DS3 has to be at least 1 m above the floor.
- Start the pink noise test signal at a low level.
- Increase the level until it is minimum 10 dB higher in each frequency band from 50 Hz to 5000 Hz in the receiving room than the background noise measured in step 2. In case this is not possible, then the MS Excel calculation form will automatically apply corrections in accordance with ISO 16283-1.

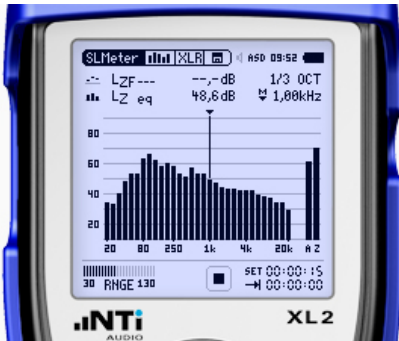


Position the test signal for the sound level measurements

4. Measure Sound Levels L1 and L2 at speaker position 1



Noise Spectrum in Source Room



Noise Spectrum in Receiving Room

Preparation

- Define five microphone positions in the source- and receiving room distributed within the maximum permitted space throughout the room. The positions shall be in a different plane relative to the room boundaries and shall not form a regular grid. For example mark the positions on the floor with a tape. The following minimum distances apply:

- 0.7 m between microphone positions
- 0.5 m between any microphone position and any room boundary
- 1.0 m between any microphone position and the speaker

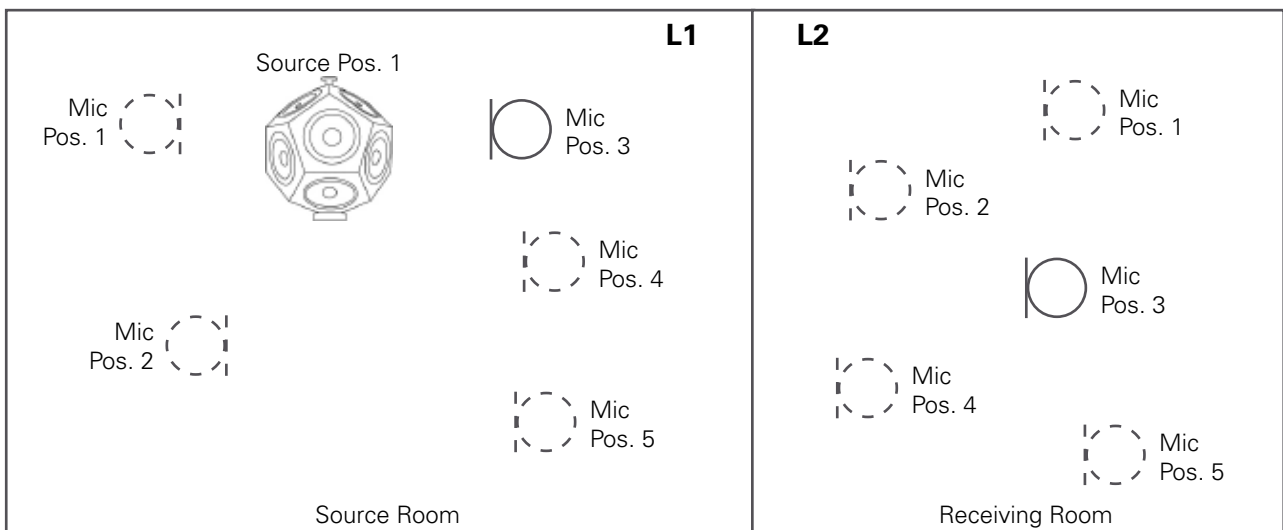
- It's recommended to leave the room for the level measurement as the operator introduces additional absorption.

Measurements in Source Room

- Measure the sound level spectrum LZeq in the source room at each position for a measurement period of 15 seconds.
- Store the individual readings in the XL2 for post calculation of the sound insulation.

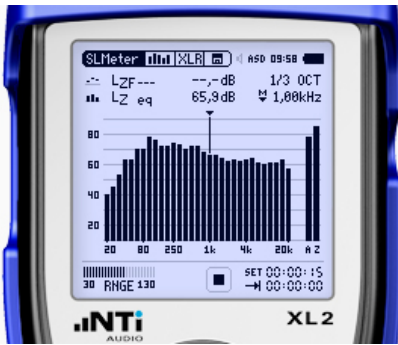
Measurements in Receiving Room

- Measure the sound level spectrum LZeq in the source room at each position for a measurement period of 15 seconds.
- Store the individual readings in the XL2 for post calculation of the sound insulation.



Measure the sound levels in source and receiving room at speaker position 1

5. Measure Sound Levels L1 and L2 at Speaker Position 2

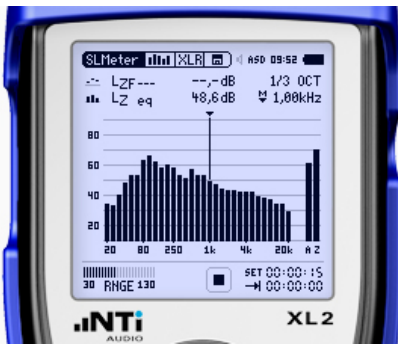


Noise Spectrum in Source Room

- Move the Dodecahedron Speaker DS3 to position 2 in the source room.

Measurements in Source Room

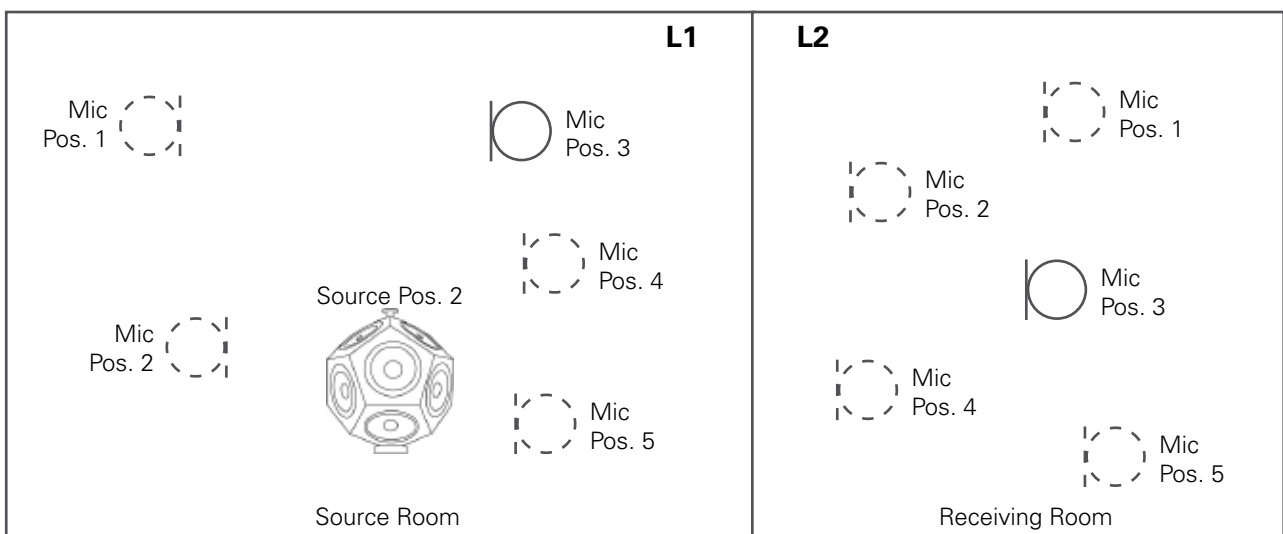
- Measure the sound level spectrum LZeq in the source room at each position for a measurement period of 15 seconds.
- Store the individual readings in the XL2 for post calculation of the sound insulation.



Noise Spectrum in Receiving Room

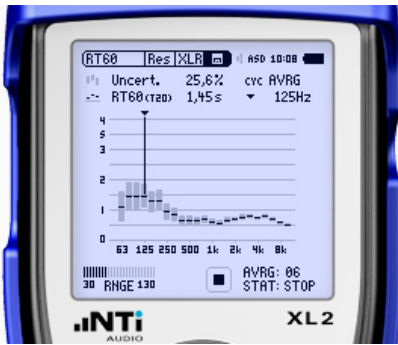
Measurements in Receiving Room

- Measure the sound level spectrum LZeq in the source room at each position for a measurement period of 15 seconds.
- Store the individual readings in the XL2 for post calculation of the sound insulation.



Measure the sound levels in source and receiving room at speaker position 2

6. Measure Reverberation Time T2 in Receiving Room



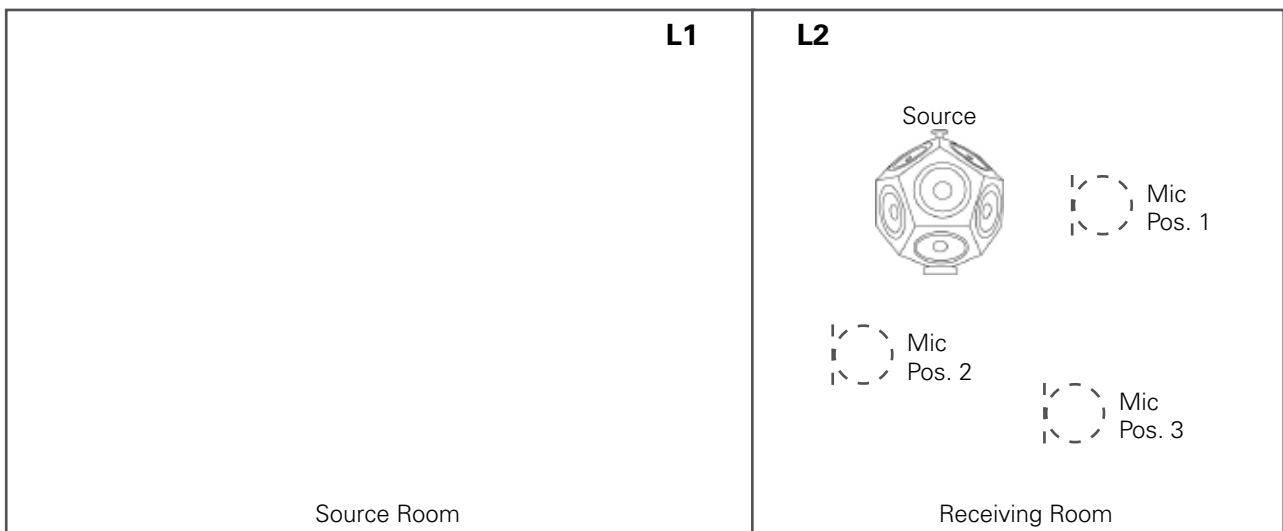
RT60 Reverb Time T
in Receiving Room

Preparation

- Move the Dodecahedron Speaker DS3 to the receiving room.
- Select three microphone positions in the receiving room.
- Select the RT60 measurement function on XL2 Sound Level Meter.
- Select the 1/3 octave resolution on the XL2.

Measure the Reverberation Time T2 in the Receiving Room

- Start the measurement on the XL2.
- Start / stop the test signal.
- Measure at least two decays.
- Stop the measurement on the XL2.
- Repeat the same at least at two other microphone positions.
- Store the individual readings on the XL2 for post calculation of the sound insulation.



Measure the reverberation time T in receiving room

7. Sound Insulation Reporter

Verify and document all readings by using the Sound Insulation Reporter software. This is a PC-Software dedicated for building acoustics professionals.

You may load all measurement records into the software and generate the Airborne Sound Insulation report. The form calculates the level difference $D_{w'}$, the standardized level difference $D_{nT,w'}$, the normalized level difference $D_{n,w}$ and the apparent sound reduction index $R'_{w'}$ based on the reference curve shifting method in accordance with the standard ISO 717-1.

The following calculations are used:

- $D = L1 - L2$
- $D_{nT} = D + 10 \lg (T/0.5)$
- $R' = D + 10 \lg (S/A)$
- $A = 0.16 * V / T$

with

A	Equivalent absorption area of the receiving room in m ²
D	Level difference between source and receiving room
D_{nT}	Standardized level difference (the level difference D is standardized to the 0.5 seconds reference value of the reverberation time in the receiving room)
$D_{nT,w}$	Weighted standardized level difference (is the value of the reference curve at 500 Hz after shifting the reference curve)
L1	Sound pressure level in the source room in dB
L2	Sound pressure level in the receiving room in dB
R'	Apparent sound reduction index of field measurement
$R'_{w'}$	Weighted apparent sound reduction index (is the value of the reference curve at 500 Hz after shifting the reference curve)
S	Partition area in m ² of the wall between source and receiving room
T	Reverberation time RT60 in receiving room
V	Volume of receiving room in m ³

The following page shows a sample report.

Standardized level difference in accordance with ISO 16283-1
Field measurements of airborne sound insulation between rooms



Client: Demo

Date of test: 15/11/2017

Location: Partition from Sample Room 1 to Sample Room 2

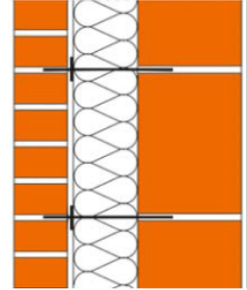
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XL2 Sound Level Meter: A2A-05850-E0 (M4260: 3285), A2A-05850-E0 (M2210: 1465)

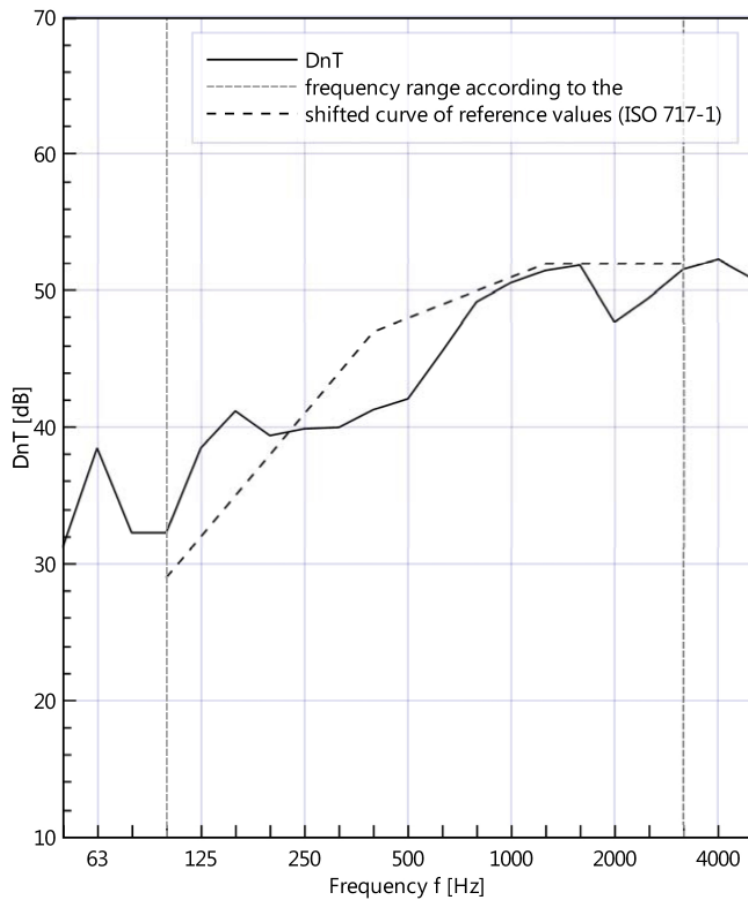
Area of common partition: 15 m²

Source room volume: 50 m³

Receiving room volume: 50 m³



Frequency f Hz	DnT 1/3 octave dB
50	31.2
63	38.5
80	32.3
100	32.3
125	38.5
160	41.2
200	39.4
250	39.9
315	40.0
400	41.3
500	42.1
630	45.6
800	49.2
1000	50.6
1250	51.5
1600	51.9
2000	47.7
2500	49.5
3150	51.6
4000	52.3 *
5000	50.9 *



* 1.3 dB correction applied,
value at the limit of measurement

Rating in accordance with ISO 717-1:

DnT,w(C;Ctr) = 48 (-1; -3) dB

C₅₀₋₃₁₅₀ = -1 dB;

C₅₀₋₅₀₀₀ = -1 dB;

C₁₀₀₋₅₀₀₀ = -1 dB

Evaluation based on field measurement using
results obtained by an engineering method.

C_{tr,50-3150} = -4 dB;

C_{tr,50-5000} = -4 dB;

C_{tr,100-5000} = -3 dB

No. of test report: 1234

Name of test institute:

Building Acoustic Inc.

Date: 20/11/2017

Signature:



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