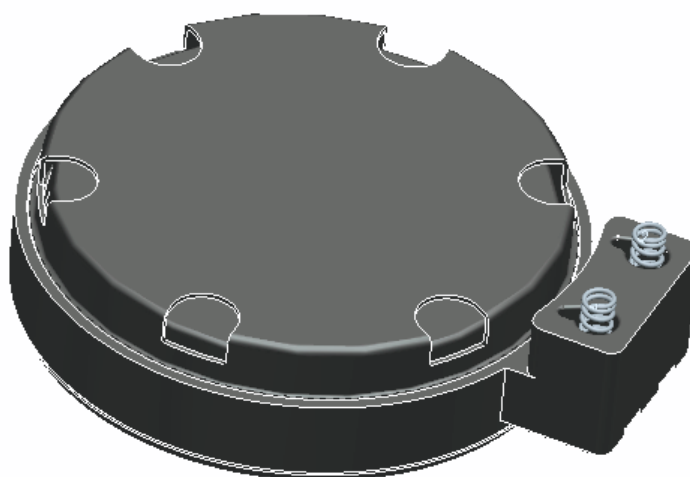
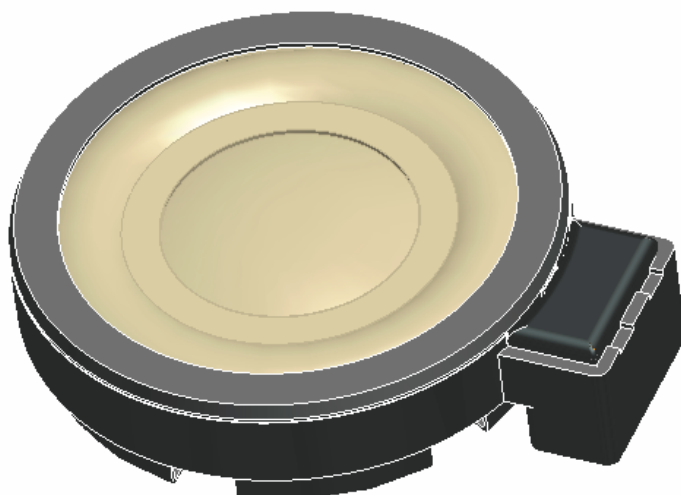




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SPEAKER-16-4.7-MFD

Change History

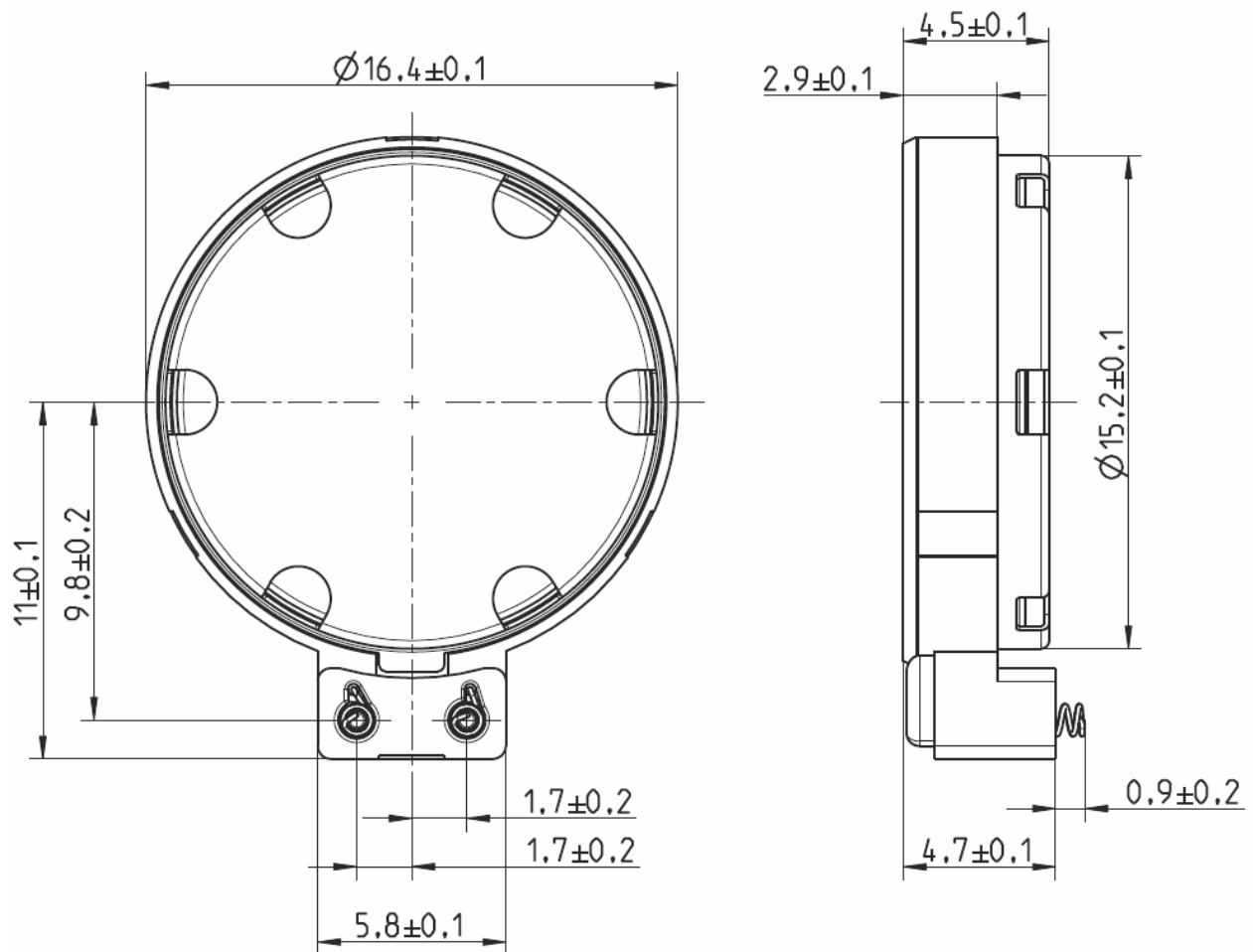
Status	Version	Date	ECR	Comment / Changes	Initials of owner
Draft	A1	18.02.08		Draft specification for first samples	MW
Draft	A2	02.03.09		Draft specification for first samples	HW
Draft	A3	15.05.09		Draft specification for samples	HW
Release	A	15.10.09		First released Version	HW/AH
Release	B	07.12.09		Dimension update	HW/AH
Release	C	27.01.10		Spring Force added	HW
Release	D	15.02.10	2818	Main tolerance and Handling Force update	HW

Contents

1. Mechanical Characteristics	4
1.1. Main Dimensions	4
1.2. Contact Layout	5
1.3. Contact Force	5
1.4. Print Code.....	6
1.5. Forces on Component	7
1.6. Material List	8
2. Electro-Acoustic Characteristics	9
2.1. Frequency response	9
2.2. Electro-Acoustic Parameters	10
2.3. Power Handling	10
2.4. Measurement Setup (acoustics).....	11
2.5. Measured Parameters	11
2.6. Vibra Parameters.....	12
2.7. Measurement setup (Vibra Function)	13
2.8. Measured Parameters (Vibra Function).....	13
2.9. Measurement adapter.....	14
3. Environmental Conditions	15
3.1. Storage	15
3.2. Transportation	15
3.3. Functionality	15
4. Environmental Tests	16
Qualification Tests	16
Requalification Tests	16
Sample Size, Sequence	16
Period of Shelf-Life	16
Testing Procedures	16
5. Related Documents	20

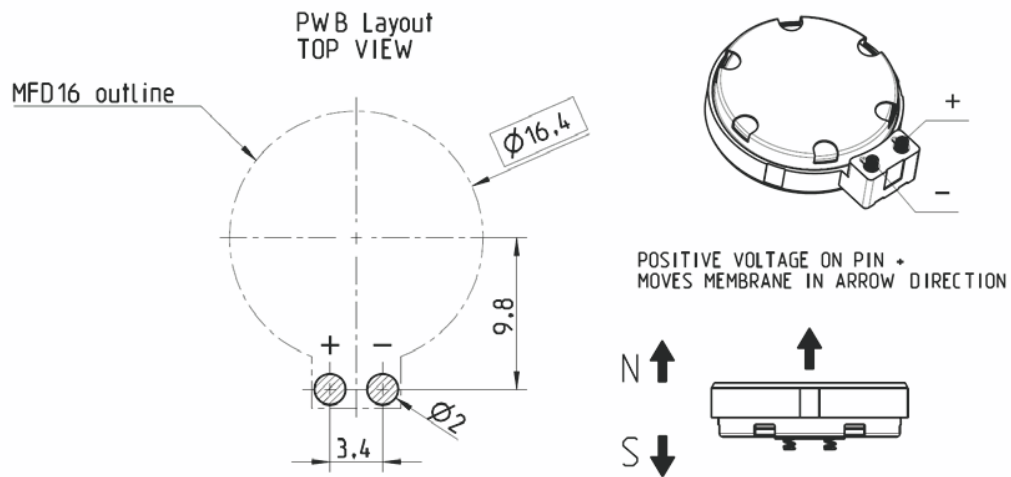
1. Mechanical Characteristics

1.1. Main Dimensions

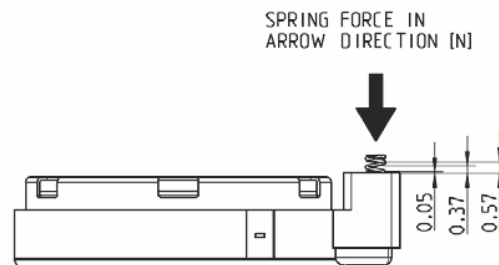


This product is non-automotive qualified

1.2. Contact Layout



1.3. Contact Force

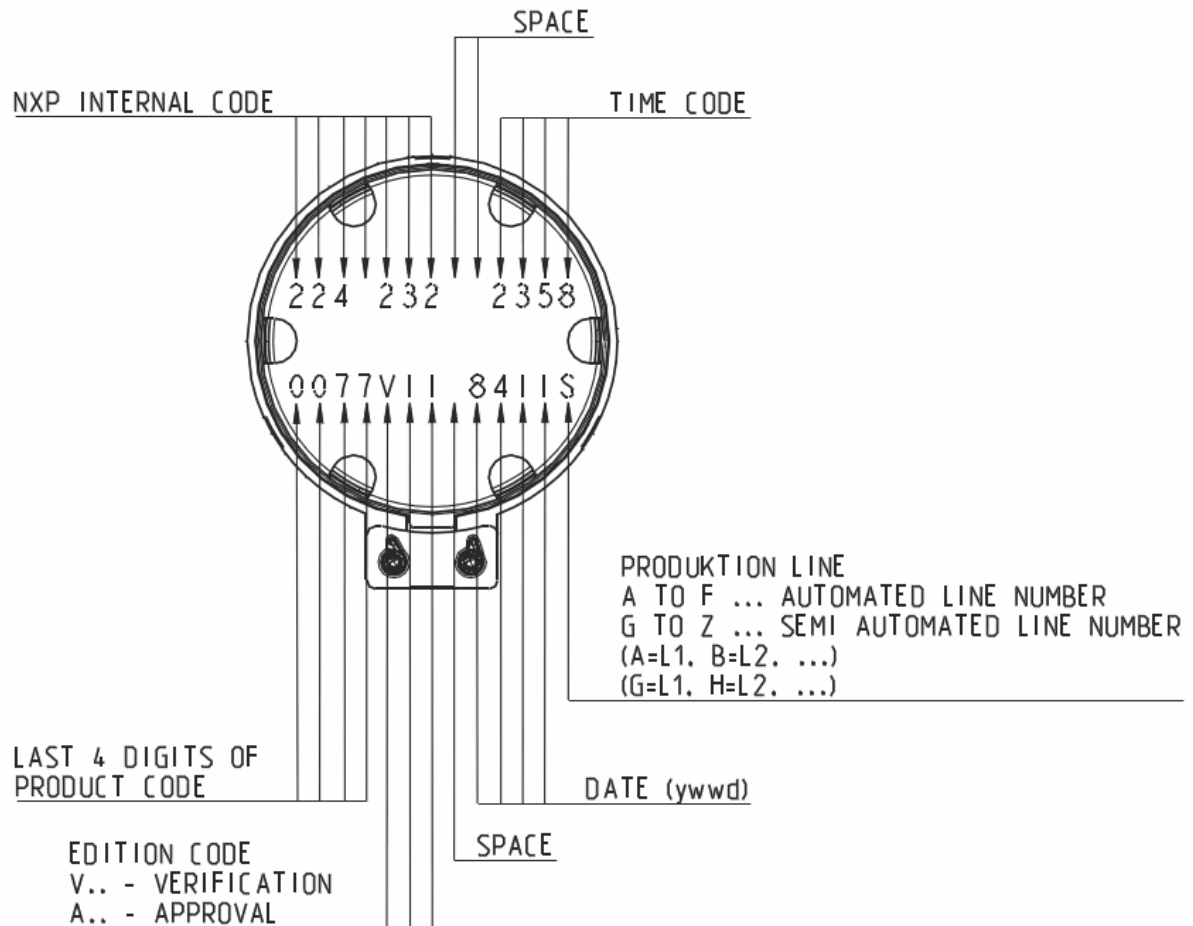


SPRING FORCE TABLE	
	FORCE [N]
SPRING FORCE AT 0.57	0.3 \pm 0.1
SPRING FORCE AT 0.37	MIN 0.35
SPRING FORCE AT 0.05	MAX 1.8

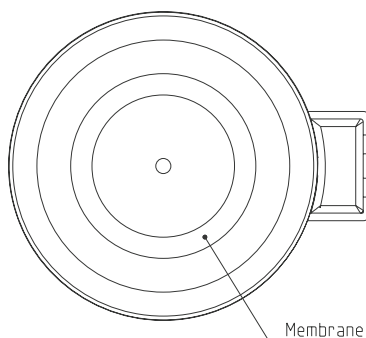
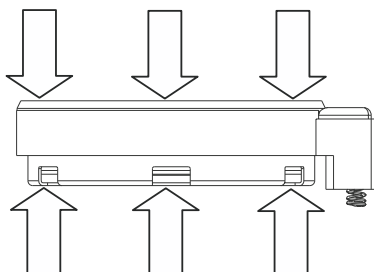
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1.4. Print Code

PRINT CODE FOR SEMI/AUTOMATED LINE



1.5. Forces on Component



STATE	MAX PERMANENT FORCE [N]	MAX HANDLING FORCE [N]
FROM FRONT TO BACK	10	20
MEMBRANE	0	0

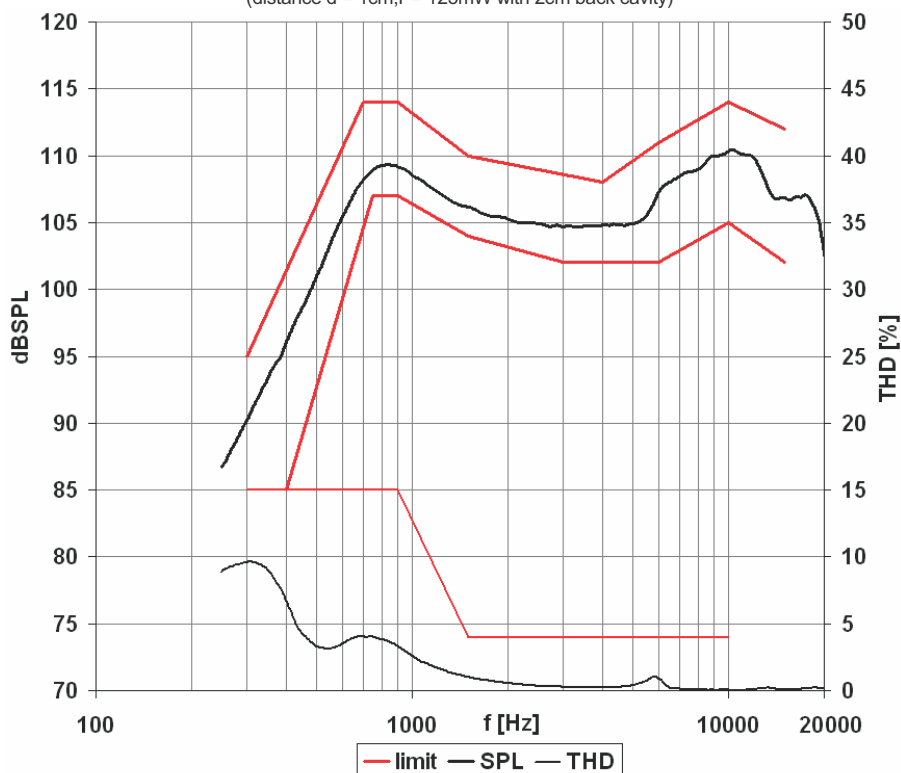
1.6. Material List

- | | |
|------------------------------|--------------------|
| 1. Material of housing: | PC |
| 2. Material of membrane: | Plastic Foil |
| 3. Material of pot: | Soft Magnetic Iron |
| 4. Material of topplate | Soft Magnetic Iron |
| 5. Material of magnet: | Nd Fe B |
| 6. Material of contact | Stainless Steel |
| 7. Material of cover: | PC |
| 8. Material of bottom: | Stainless Steel |
| 9. Material of vibra spring: | CrNi-Steel |
| 10. Dimensions [mm]: | ø16.4 x 4.7 |
| 11. Mass: | 3.0 g |

2. Electro-Acoustic Characteristics

2.1. Frequency response

Typical frequency response measured on baffle according to 2.4.
in measurement adapter according to 2.9
(distance $d = 1\text{cm}$, $P = 125\text{mW}$ with 2cm back cavity)



Tolerance window				
f [Hz]	lower limit [dB SPL]	upper limit [dB SPL]	f [Hz]	upper limit [%THD]
300		95	300	15
400	85		900	15
700		114	1500	4
750	107		10000	4
900	107	114		
1500	104	110		
3000	102			
4000		108		
6000	103	111		
10000	105	114		
15000	102	112		

2.2. Electro-Acoustic Parameters

Loudspeaker mounted in adapter acc. to 2.9 measured on baffle according to 2.4.

1. Rated impedance	Z:	8Ω
2. Voice coil resistance	R:	7.2Ω±10%
3. Resonance frequency in 2ccm (measured @15mW) f_0 :		740Hz±10%
3.1. Resonance frequency with open back	f_0 :	540Hz typical
4. Maximum usable excursion	$x_{\max \text{ p-p}}$:	0.6mm p-p
5. Nominal characteristic sensitivity (calculated for 1W in 1m) average from 2kHz to 5kHz		74±2dB
5.1. Measured characteristic sensitivity (at 125mW in 1cm) average from 2kHz to 5kHz		105±2dB
6. THD		according chapter 2.1.
7. Rub & buzz		< 80dBSPL (300Hz -1500Hz) in 1cm at 500mW (2V _{eff})

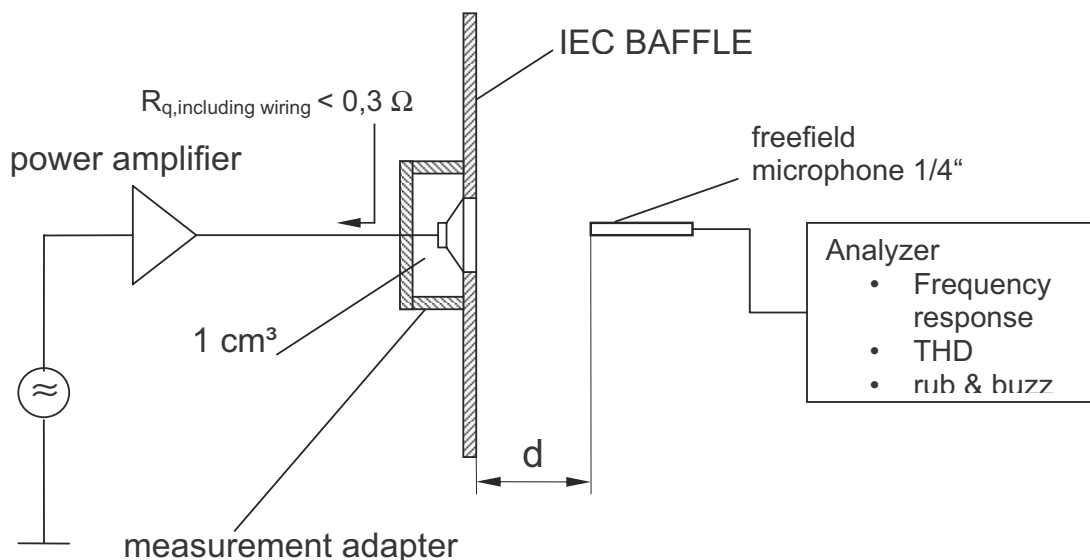
All acoustic measurements at 23±2°C

2.3. Power Handling

Loudspeaker mounted in lifetime test device (1ccm back cavity, open front)

1. MAX.SHORT TERM POWER (1sec. ON / 60sec. OFF) 1000mW (RMS)
(pink noise, 2nd order high pass filtered, -3dB at 800Hz, crest factor 2)
2. MAX. CONTINUOUS POWER (500h) 500mW (RMS)
(pink noise, 2nd order high pass filtered, -3dB at 700Hz, crest factor 2)

2.4. Measurement Setup (acoustics)



2.5. Measured Parameters

2.5.1. Sensitivity

SPL is expressed in dB rel 20μPa, computed according to IEC 268-5

Measurement set up according chapter 2.4 and 2.9.

This test is performed for 100% of products in the production line

2.5.2. Frequency response

Frequency response is measured according test set up in chapter 2.4 and 2.9 data sheet and checked against the tolerance window defined in chapter 2.1. This Test is performed for 100% of products in the production line.

2.5.3. Total harmonic distortion (THD)

Is measured according IEC 268-5 (2nd to 5th harmonics) and test set up in chapter 2.4 and 2.9 and checked against the tolerance window defined in chapter 2.1. This test is performed for 100% of products in the production line.

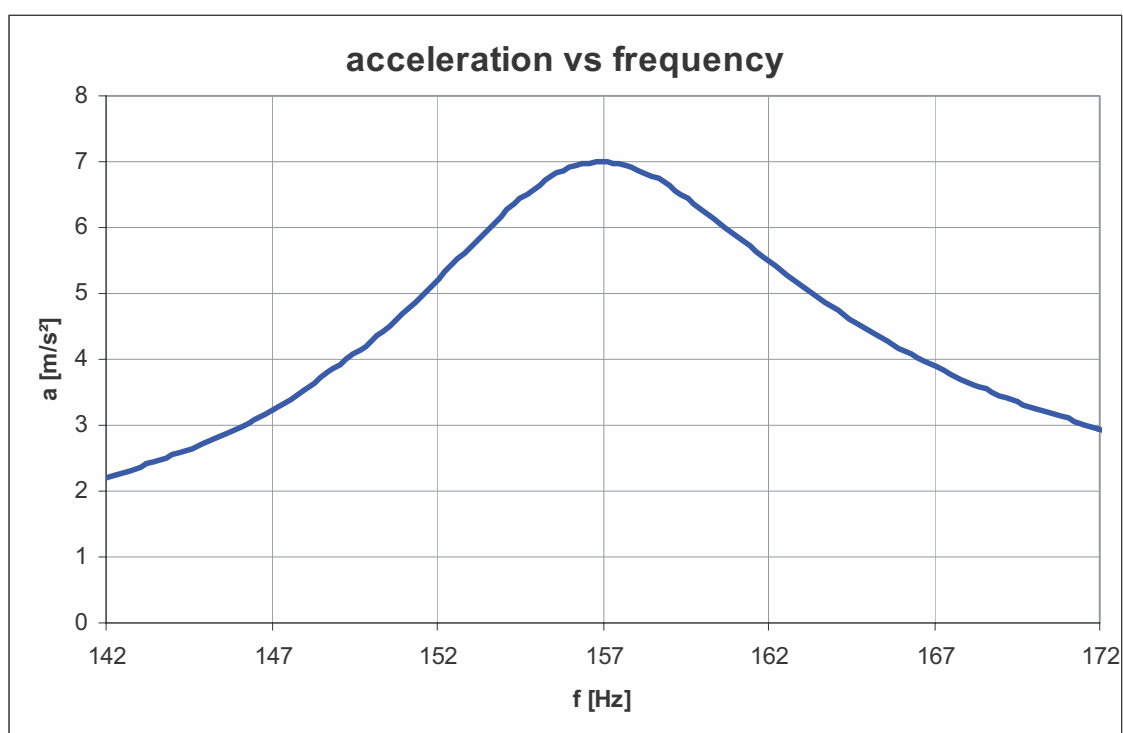
2.5.4. Rub& Buzz

Rub & Buzz will be measured in the Inline-measuring device with a sinusoidal sweep. Rub & Buzz is defined as the maximum level of no harmonic energy, expressed as signal to non-harmonic content ratio, in a certain frequency-range. Signal and evaluation criteria are according to chapter 2.2. This test is performed for 100% of products in the production line.

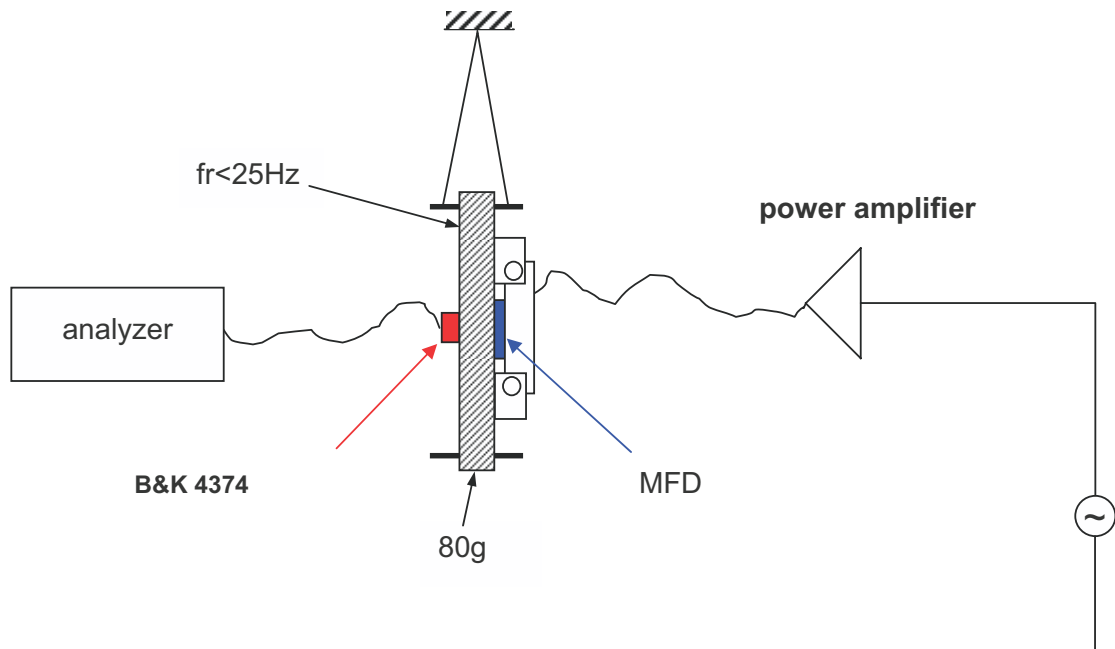
2.6. Vibra Parameters

Loudspeaker mounted in adapter acc. to 2.7

- | | | |
|---|-------------|----------------------|
| 1. Resonance frequency (measured @0.35V/15mW) | f_0 : | 157Hz±7Hz |
| 2. Max. Acceleration (measured @0.35V/15mW between 152-162Hz) | a_{max} : | >6,5m/s ² |



2.7. Measurement setup (Vibra Function)



2.8. Measured Parameters (Vibra Function)

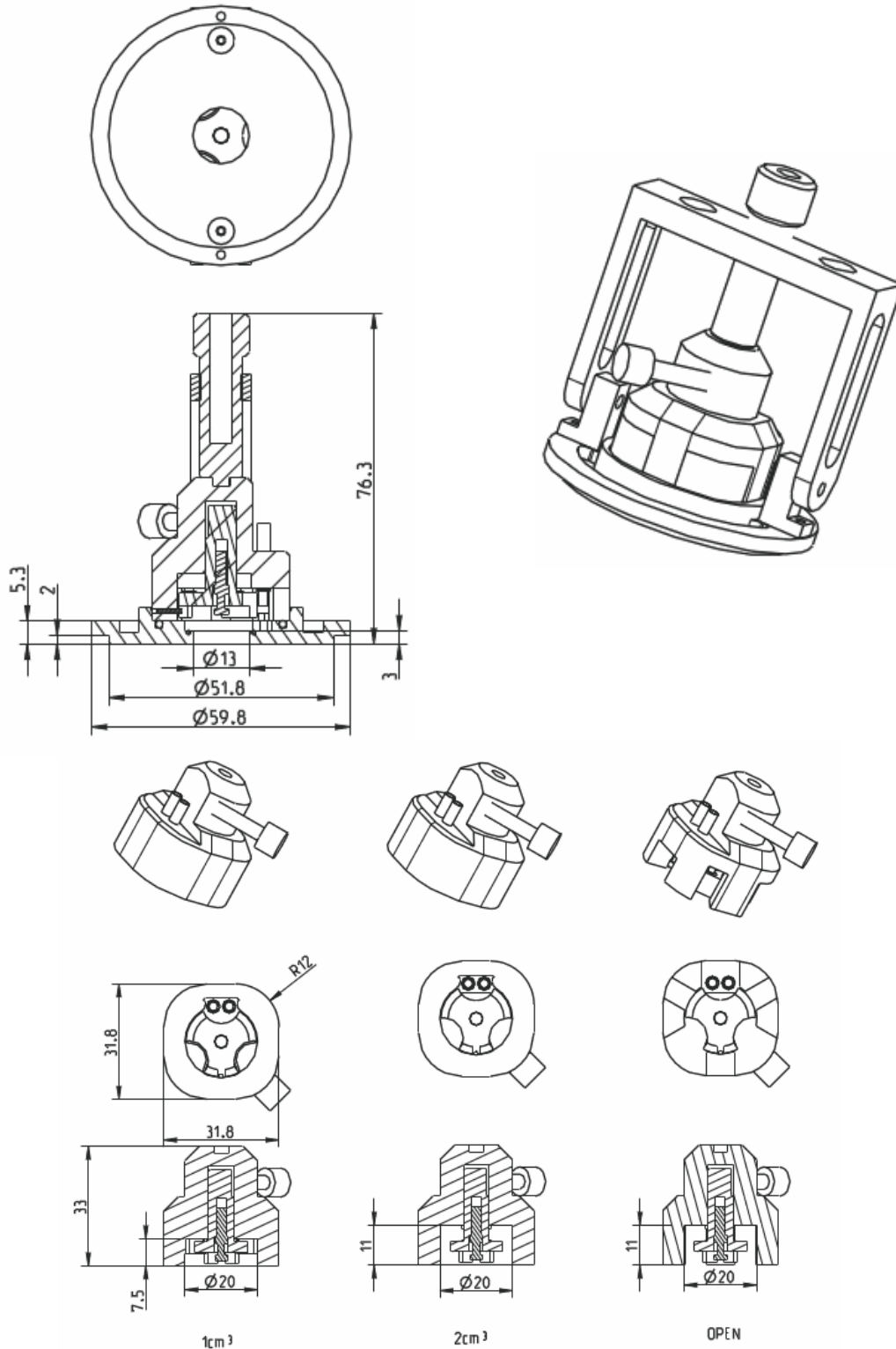
2.8.1. acceleration

Device is measured mounted on a mass of 100g in the center of gravity. This mass is mounted on a suspension with a resulting resonance frequency of less than 25Hz. An acceleration sensor (B&K 4374) is mounted in the center of gravity for measuring the acceleration. The maximum acceleration in the defined frequency range is detected by sweeping the input voltage from the minimum to the maximum frequency.

2.8.2. Vibra Resonance Frequency

The electrical impedance of the device is measured. The first maximum of the impedance (in the range of 150-162Hz) corresponds with the vibra resonance frequency.

2.9. Measurement adapter



3. Environmental Conditions

3.1. Storage

The transducer fulfils the specified data after treatment according to the conditions of

ETS 300 019-2-1

Specification of environmental test: Storage

Test spec. T 1.2: Weather protected, not temperature controlled storage locations.

3.2. Transportation

The transducer fulfils the specified data after treatment according to the conditions of

ETS 300 019-2-2

Specification of environmental test: Transportation

Test Spec. T 2.3: Public Transportation

3.3. Functionality

The transducer fulfils the specified data after treatment according to the conditions of

ETS 300 019-2-5

Specification of environmental test: Ground vehicle installations

Test spec. T 5.1: Protected installation

ETS 300 019-2-7

Specification of environmental test: Portable and non-stationary use

Test spec. T 7.3E: Partly weather protected and non-weather protected locations.

4. Environmental Tests

Qualification Tests

According to our milestone plan (Product Creation Process), a complete qualification test will be done at design validation on products, manufactured under serial conditions and 1x per year and product family. The qualification process covers all tests described under 4.5 and a complete inspection takes place.

Requalification Tests

1x per month and product family samples are taken and submitted to tests described under 0

Sample Size, Sequence

Unless otherwise stated 20 arbitrary new samples will be used to perform each test for both, qualification and requalification test as described under 0 and 0.

Period of Shelf-Life

The period of shelf-life is 12 months.

Testing Procedures

Storage Tests

Low Temperature Storage Test

Parameter	Test Method and Conditions	Duration	Evaluation Standard
Low Temperature Storage (Ref. EN 60068-2-1)	-40°C rel. humidity not controlled	168h	Measurements after 2 hours recovery time. All samples fully operable. All acoustical parameters according specification with tolerances increased by 50 %.

High Temperature Storage Test

Parameter	Test Method and Conditions	Duration	Evaluation Standard
Dry Heat Storage (Ref. EN 60068-2-2)	+85°C rel. humidity not controlled	168h	Measurements after 2 hours recovery time. All samples fully operable. All acoustical parameters according specification with tolerances increased by 50 %.

Temperature Cycle Test

Parameter	Test Method and Conditions	Duration	Evaluation Standard
Change of Temperature (Ref. EN 60068-2-14)	-40°C/+85°C Transition time <3 min. See Figure 4-1 below	5 cycles >2h for each temperature	Measurements after 2 hours recovery time. All samples fully operable. All acoustical parameters according specification with tolerances increased by 50 %.

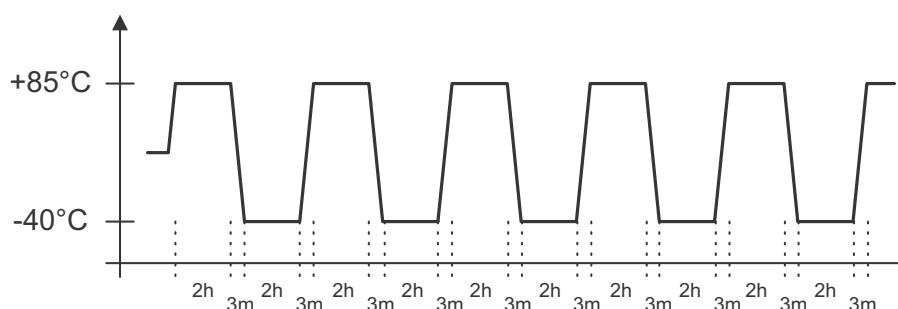


Figure 4-1: Temperature Cycle Test

Temperature / Humidity Cycle Test

Parameter	Test Method and Conditions	Duration	Evaluation Standard
Damp heat, cyclic (Ref. IEC 60068-2-30)	+25°C/+55°C 90% to 95% RH. Temp. change time <3h See Figure 4-2 below <u>Caution:</u> no condensed water on products!	6 cycles. 24h at each temperature	Measurements after 2 hours recovery time. All samples fully operable. All acoustical parameters according specification with tolerances increased by 50 %.

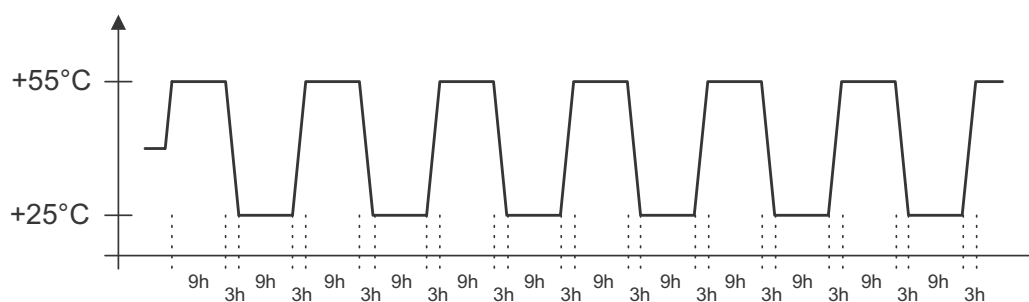


Figure 4-2: Temperature / Relative Humidity Cycle Test

Operating Tests

Cold Operation Test

Parameter	Test Method and Conditions	Duration	Evaluation Standard
Cold Operation Test (Ref. EN 60068-2-1)	-20°C rel. humidity not controlled signal acc. Chapter 2.3	72h	Measurements after 2 hours recovery time. All samples fully operable. THD may be increased after test. All other acoustical parameters according specification with tolerances increased by 50 %.

Dry Heat Operation Test

Parameter	Test Method and Conditions	Duration	Evaluation Standard
Dry Heat Operation (Ref. EN 60068-2-2)	+70°C rel. humidity not controlled signal acc. Chapter 2.3	500h	Measurements after 2 hours recovery time. All samples fully operable. The allowable change in sensitivity shall not be greater than 3 dB. All other acoustical parameters according specification with tolerances increased by 50 %.

Salt Mist Test

Parameter	Test Method and Conditions	Duration	Evaluation Standard
Salt Mist (Ref. IEC60068-2-52, Kb / Severity 2)	The part must be subjected to 2 hours spray of 5% NaCl salt mist, at 35°C then be left at 40°C and 95% RH for 22h.	3 cycles	The samples shall be washed after the test with distilled water and dried at T< 50°C. Component may have reduced performance, but must still function properly. The allowable sensitivity difference shall not be greater than ±3dB from initial sensitivity.

Shock Resistance Test (Free Fall Test) - unprotected product

Parameter	Test Method and Conditions	Conditions / Sample size	Evaluation Standard
Mechanical shock (Ref. IEC60068-2-32 Ed), Procedure 1	Drop of sample without fixation of release plane from a height of 1.5m onto concrete floor.	Each 3 shocks in both directions of the 3 axes. (18 drops in total)	Component may have reduced performance, but must still function properly. The allowable sensitivity difference shall not be greater than ± 3 dB from initial sensitivity.

Impact Durability Test (Tumble Test) – protected product

Parameter	Test Method and Conditions	Conditions / Sample size	Evaluation Standard
Impact durability (in a Tumble Tester) (Ref. IEC60068-2-32 Ed) (SPR a7.1.1)	Speaker <i>in drop test box</i> or representative mechanics. Random drops on steel base.	30 units 180 drops, 1m DUT power off	Component may have reduced performance, but must still function properly. The allowable sensitivity difference shall not be greater than ± 3 dB from initial sensitivity.

Resistance to Electrostatic Discharge

Parameter	Test Method and Conditions	Conditions / Sample size	Evaluation Standard
Resistance to ESD IEC61000-4-2 Level 4 (SPR c 2.5.1)	One pole is grounded and the ESD pulse is applied to the other pole. The speaker must be stressed first with one polarisation and then with the other polarisation. DUT must be discharged between each ESD exposure. Level 4: contact +/- 8kV, air +/- 15kV	10 exposures on each polarity / 5 units DUT Power off	All samples fully operable. All acoustical parameters according specification with tolerances increased by 50%.

5. Related Documents

IEC 268-5	Sound System equipment Part 5: Loudspeaker
IEC 68-2	Environmental testing
EN 60068-2	Environmental testing
ISO 2859 - 1	Sampling procedures for inspection by attributes Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection
ISO 3951	Sampling procedures and charts for inspection by variables for percent defectives.
ETS 300 019-2-1	Specification of environmental test: Storage Test spec. T 1.2: Weather protected, not temperature controlled storage locations
ETS 300 019-2-2	Specification of environmental test: Transportation Test spec. T 2.3: Public Transportation
ETS 300 019-2-5	Specification of environmental test: Ground vehicle installations Test spec. T 5.1: Protected installation
ETS 300 019-2-7	Specification of environmental test: Portable and non-stationary use Test spec. T 7.3E: Partly weather protected and non-weather protected locations