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## 11x15x3.5 MM SPEAKER

The 11 x 15 x 3.5 mm rectangular speaker is a high end miniature speaker specifically designed for portable devices, music phones and smartphones where high quality sound is required.

It delivers pure , uncolored sound reproduction in applications with small space.

Suitable for mono and stereo applications.



### Features:

- Flat, wide frequency response
- Low resonance frequency (800Hz) in 1cm<sup>3</sup> closed back cavity
- Compound membrane with additional stiffening plate for inner damping and low THD
- Extremely robust spring connector
- 100% in-line measurement of all specified acoustical and electrical parameters

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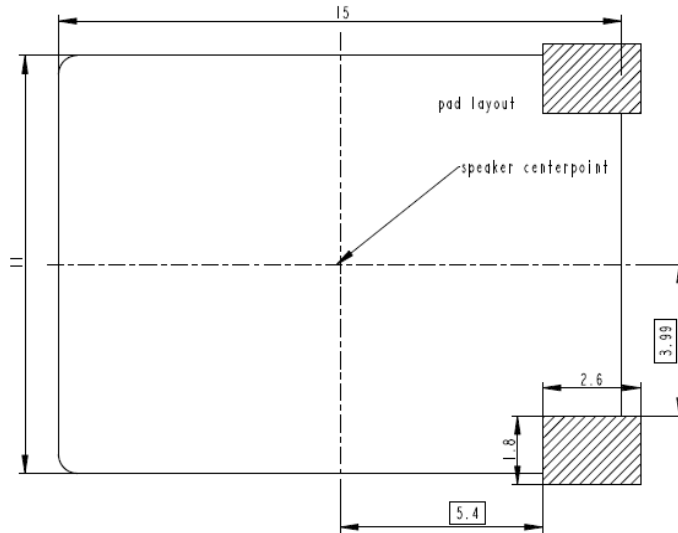
## 1. Theory of operation

The 11x15x3.5 rectangular speaker is an electro dynamic transducer, designed to translate electrical analog signals into sound. The input signal is fed into a coil in a magnetic field, which is attached to a membrane. Through the principle of the electromagnetic force, the membrane is moved according to the contents of the input signal.

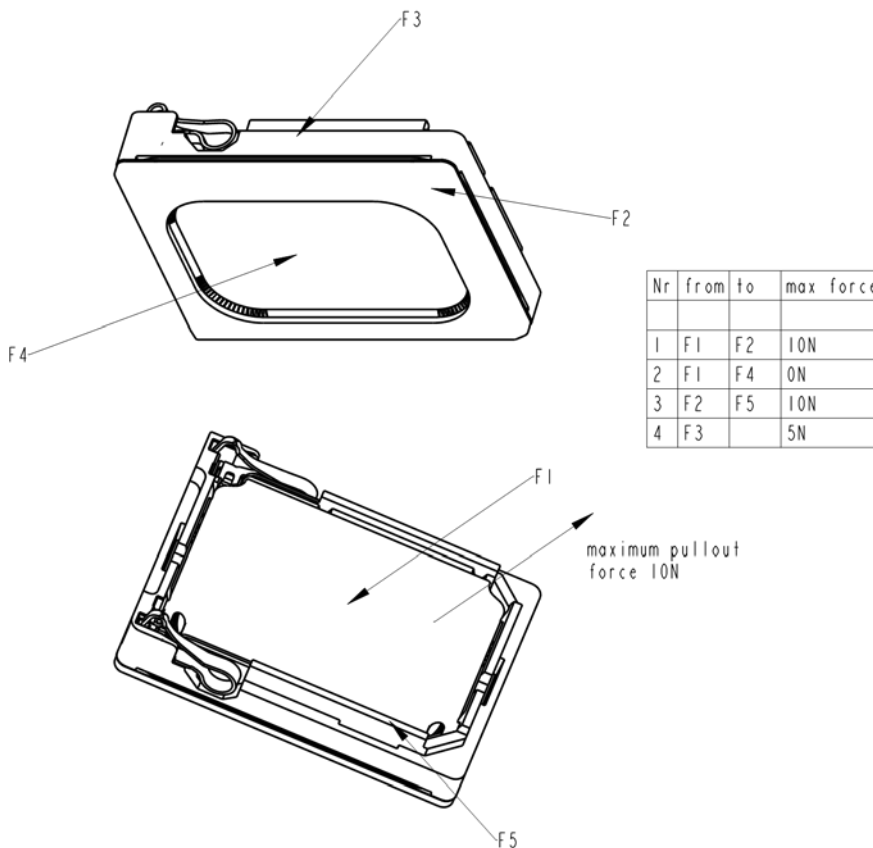


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## 2.3. Pad layout



## 2.4. Force layout

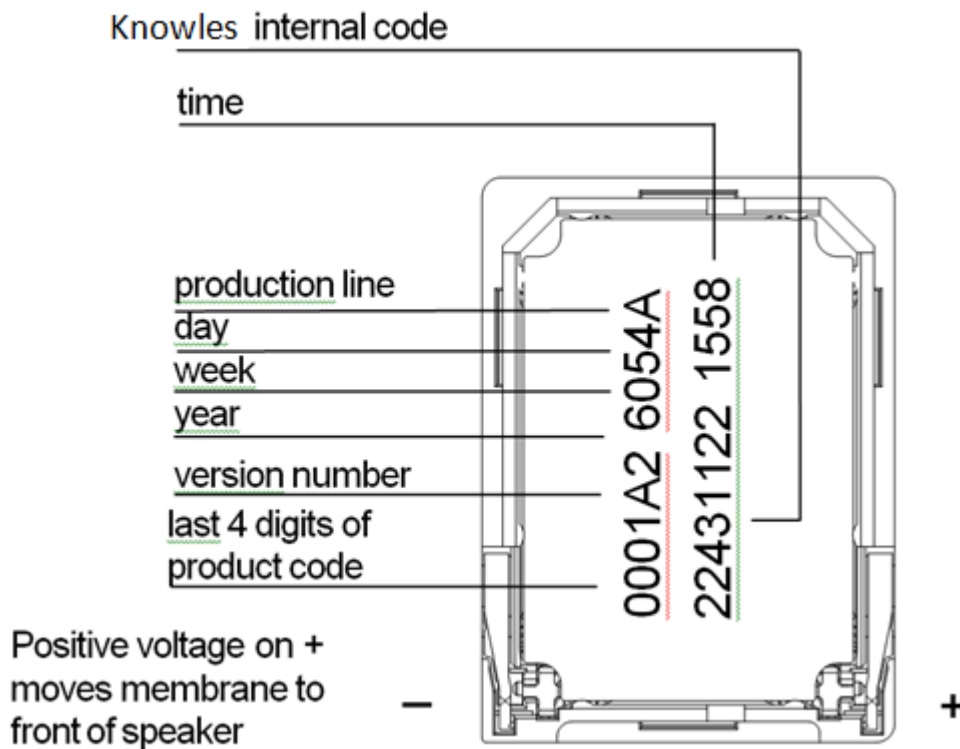


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## 2.5. Material list

1. MATERIAL of BASKET: Polycarbonate
2. MATERIAL of MEMBRANE: Polyarylate-Compound
3. MATERIAL of POT: soft magnetic Iron
4. MATERIAL of MAGNET: Nd Fe B /N42
5. MATERIAL of CONTACT CrNi-Steel, gold plated
6. MATERIAL of COVER: Polycarbonate
7. DIMENSION: 15x11x3.5mm
8. MASS: 1.6g

## 2.6. Part marking

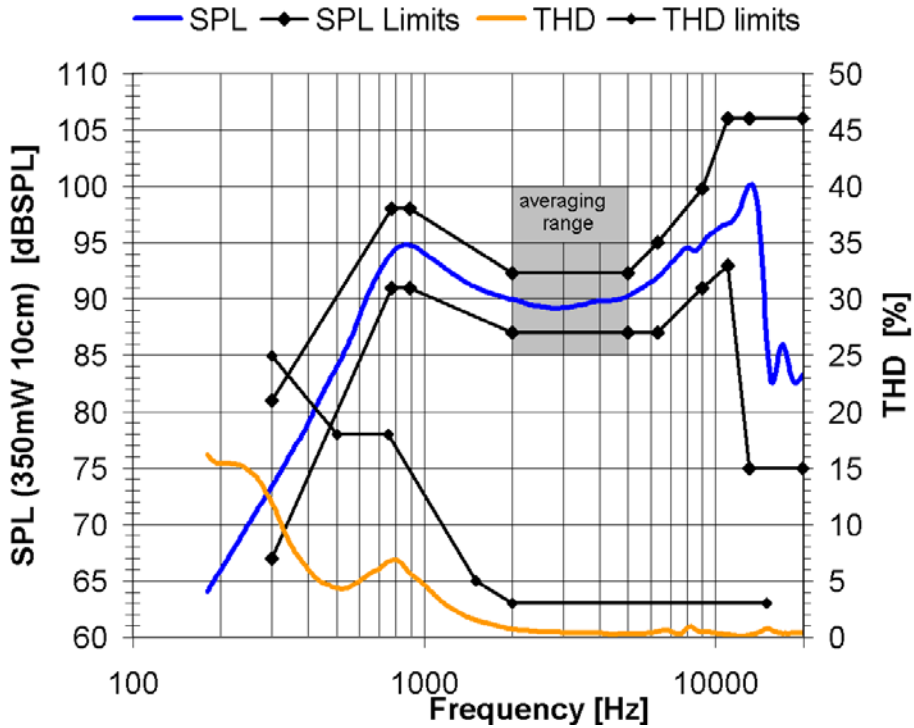


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## 3. Electrical and Acoustical Specifications

### 3.1. Frequency response

TYPICAL FREQUENCY RESPONSE measured in Baffle according to 3.4  
(distance  $d = 10\text{cm}$ , with back cavity  $1\text{cm}^3$  at  $350\text{mW}$ )

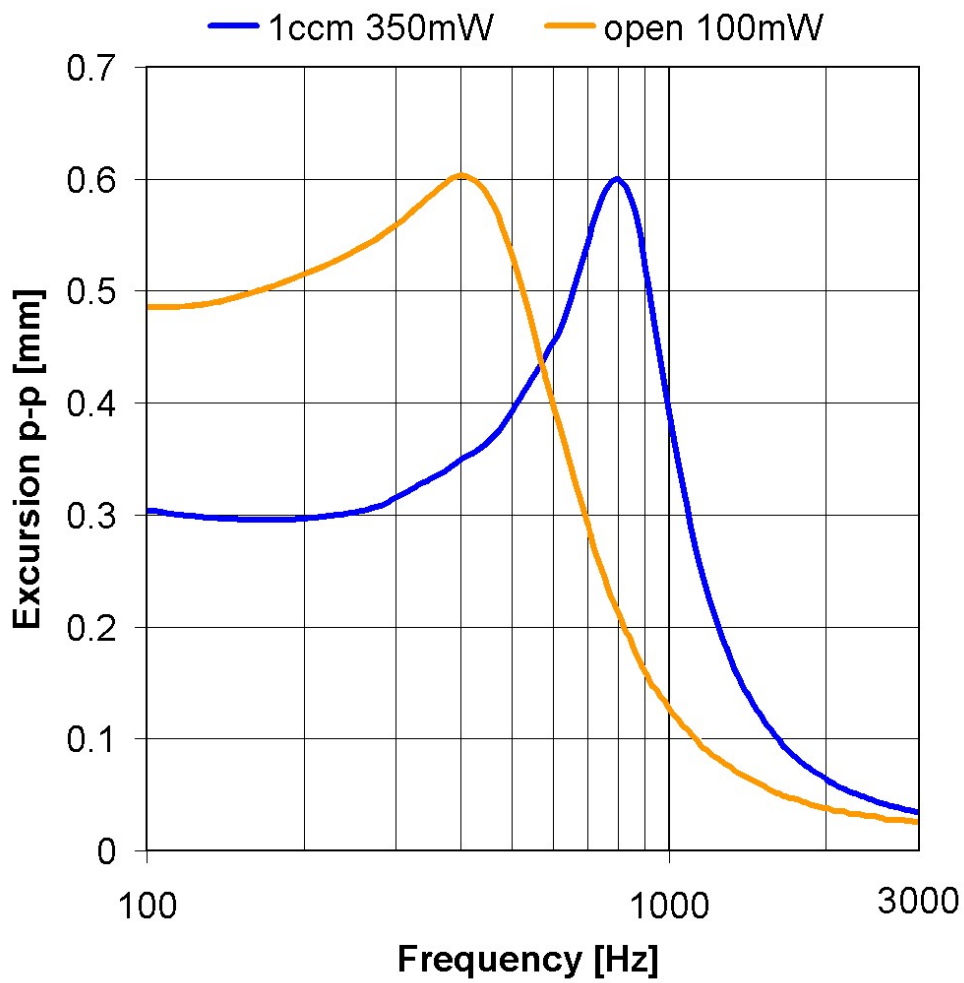


| Tolerance window |                            |                            |        |                    |
|------------------|----------------------------|----------------------------|--------|--------------------|
| f [Hz]           | lower limit [SPL floating] | upper limit [SPL floating] | f [Hz] | upper limit [%THD] |
| 300              | 67                         | 81                         | 300    | 25                 |
| 770              | 91                         | 98                         | 500    | 18                 |
| 890              | 91                         | 98                         | 750    | 18                 |
| 2000             | 87                         | 92,5                       | 1500   | 5                  |
| 5000             | 87                         | 92,5                       | 2000   | 3                  |
| 6300             | 87                         | 95                         | 15000  | 3                  |
| 9000             | 91                         | 100                        |        |                    |
| 11000            | 93                         | 106                        |        |                    |
| 13000            | 75                         | 106                        |        |                    |
| 20000            | 75                         | 106                        |        |                    |



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## 3.2. Excursion



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### 3.3. Electro-acoustic characteristics acc. IEC 268-5

#### 3.3.1. LOUDSPEAKER IN 1cm<sup>3</sup> MEASUREMENT ADAPTER ACC. TO 3.4

|   |                    |                            |
|---|--------------------|----------------------------|
| 1. RATED IMPEDANCE  | Z:                 | 8Ω                         |
| 2. VOICE COIL RESISTANCE  | R:                 | 7.4Ω ± 10%                 |
| 3. RESONANCE FREQUENCY  | f <sub>0</sub> :   | 800Hz ± 7.5%               |
| 4. MAXIMUM LINEAR EXCURSION                                     | X <sub>max</sub> : | +/- 0.30mm                 |
| 5. CHARACT. SENSITIVITY (1W in 1m)<br>average from 2kHz to 5kHz |                    | 73 ± 2dB                   |
| 6. THD  |                    | according to Sheet 190 - 3 |
| 7. RUB & BUZZ<br>at 350mW                                       |                    | no audible rub & buzz      |

#### 3.3.2. LOUDSPEAKER IN BAFFLE WITHOUT BACK CAVITY

|                                |                  |       |
|--------------------------------|------------------|-------|
| 1. TYPICAL RESONANCE FREQUENCY | f <sub>0</sub> : | 450Hz |
|--------------------------------|------------------|-------|

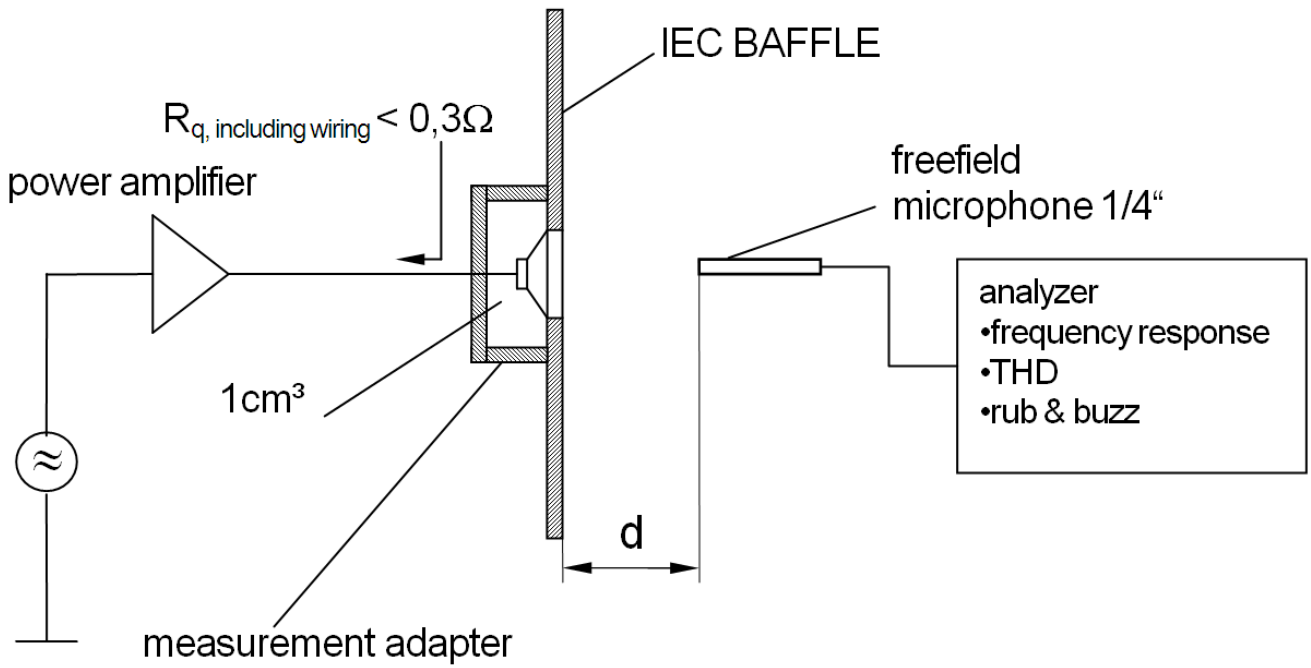
#### 3.3.3. Loudspeaker mounted in Lifetime test device (closed Box 2ccm, open front)

Signal IEC268-1 with high-pass 12dB/Oct. at 800Hz, crest factor 2, used for all operating lifetime tests

|                          |                               |        |
|--------------------------|-------------------------------|--------|
| 1. MAX.SHORT TERM POWER  | 1sec ON, 1min. OFF, 60 cycles | 1000mW |
| Ambient temperature 70°C |                               |        |
| 2. MAX LONG TERM POWER   | 1min ON, 2min. OFF, 10 cycles | 600mW  |
| Ambient temperature 70°C |                               |        |
| 3. MAX. NOISE POWER      | (PHC continuous) 500h         | 500mW  |
| Ambient temperature 70°C |                               |        |

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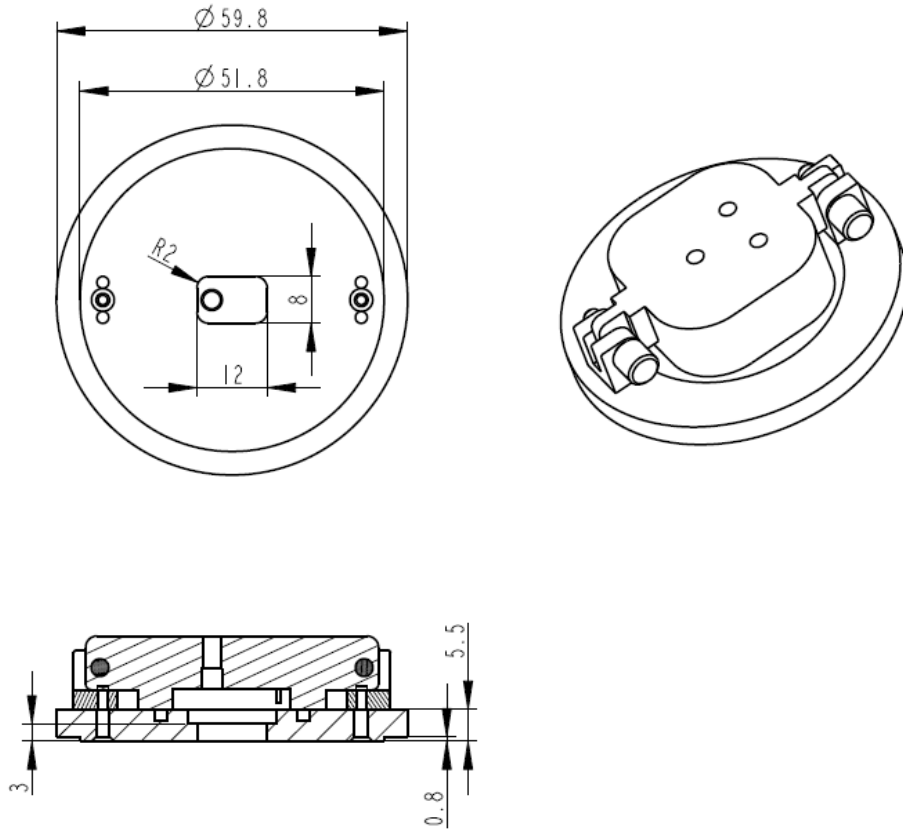
### 3.4. Measurement setup



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## 3.5. Measurement adapter 1 cm<sup>3</sup>



### 3.6. Measured Parameters

#### 3.6.1. Sensitivity

SPL is expressed in dB rel 20 $\mu$ Pa, computed according to IEC 268-5. Measurement set up and parameters according chapter 3.4. This test is performed for 100% of products in the production line.

#### 3.6.2. Frequency response

Frequency response is measured according test set up in chapter 3.4 data sheet and checked against the tolerance window defined in chapter 3.1. This Test is performed for 100% of products in the production line.

#### 3.6.3. Total harmonic distortion (THD)

Is measured according IEC 268-5 (2nd to 5th harmonics) and test set up in chapter 3.4. This test is performed for 100% of products in the production line.

#### 3.6.4. 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 3.3. This test is performed for 100% of products in the production line.

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## 4. Environmental Conditions

### 4.1. Storage

The transducer fulfills 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.

### 4.2. Transportation

The transducer fulfills 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

### 4.3. Functionality

The transducer fulfills 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.

## 5. Environmental tests

### 5.1. Qualification tests

According to our milestone plan (Product Creation Process), a complete qualification test will be done at design validation of products manufactured under serial conditions.

1x per year and product family a requalification takes place. The qualification process covers all tests described under 5.5 and a complete inspection.

### 5.2. Reliability tests

1x per month and product family samples are taken and submitted to tests described under 5.5.2

### 5.3. 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 5.1 and 5.2.

### 5.4. Period of Shelf-Life

The period of shelf-life is 2 years.

### 5.5. Testing Procedures

#### 5.5.1. Storage Tests

##### 5.5.1.1. Cold Storage Test

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

##### 5.5.1.2. Heat Storage Test

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

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### 5.5.1.3. Temperature Cycle Test

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

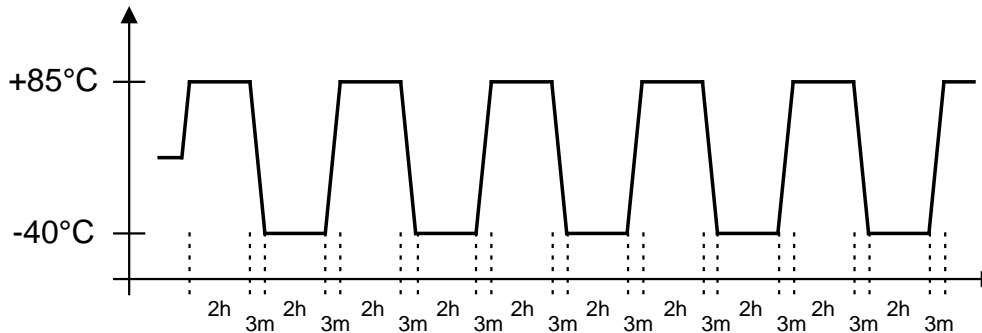


Figure 5-1: Temperature Cycle Test

### 5.5.1.4. Temperature / Humidity Cycle Test

| Parameter                                  | Test Method and Conditions  | Duration  | Evaluation Standard  |
|--|---|---|--|
| Damp heat, cyclic<br>(Ref. IEC 60068-2-30) | +25°C/+55°C<br>90% to 95% RH.<br>Temp. change time <3h<br>See Figure 5-2 below<br><u>Caution:</u> no condensed water on products! | 6 cycles / 144h<br>12h at each temperature<br>(inclusive temp ramp up/down) | Measurements after 2 hours recovery time.<br>All samples fully operable.<br>All acoustical parameters according specification with tolerances increased by 50 %. |

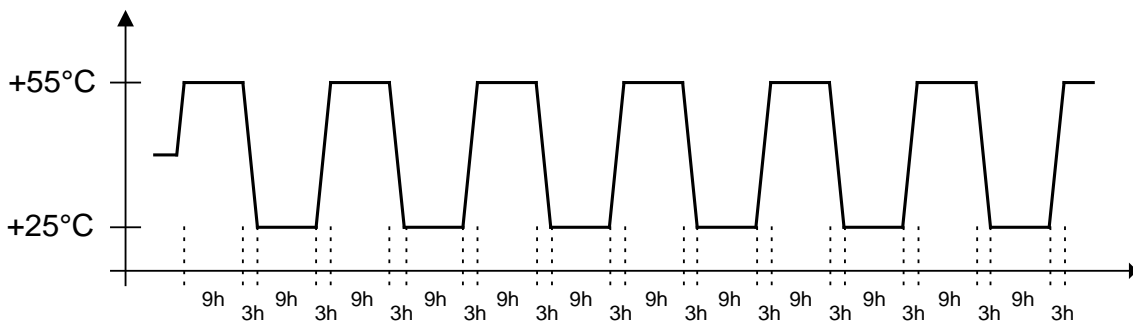


Figure 5-2: Temperature / Relative Humidity Cycle Test



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## 5.5.2. Operating Tests

### 5.5.2.1. Cold Operation Test

| Parameter                                  | Test Method and Conditions  | Duration | Evaluation Standard   |
|--|---|----------|---|
| Cold Operation Test<br>(Ref. EN 60068-2-1) | -20°C<br>rel. humidity not controlled<br>signal acc. Chapter 3.3.3. | 72h      | Measurements after 2 hours recovery time.<br>All samples fully operable.<br>THD may be increased after test. All other acoustical parameters according specification with tolerances increased by 50 %. |

### 5.5.2.2. Dry Heat Operation Test

| Parameter                                 | Test Method and Conditions  | Duration | Evaluation Standard  |
|---|---|----------|--|
| Dry Heat Operation<br>(Ref. EN 60068-2-2) | +70°C<br>rel. humidity not controlled<br>signal acc. Chapter 3.3.3. | 500h     | Measurements after 2 hours recovery time.<br>All samples fully operable.<br>The allowable change in sensitivity shall not be greater than 3 dB. All other acoustical parameters according specification with tolerances increased by 50 %. |

### 5.5.3. Salt Mist Test

| Parameter   | Test Method and Conditions   | Duration | Evaluation Standard   |
|---|--|----------|---|
| Salt Mist<br>(Ref. IEC60068-2-52,<br>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.<br>Component may have reduced performance, but must still function properly. The allowable sensitivity difference shall not be greater than ±3dB from initial sensitivity. |

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## 5.5.4. Guided Free Fall Test - protected product

| Parameter  | Test Method and Conditions  | Conditions / Sample size  | Evaluation Standard   |
|--|---|---|---|
| Mechanical shock<br>(Ref. IEC60068-2-32 Ed), Procedure 1 | Speaker in drop test box or representative mechanics from a height of 1.5m onto concrete floor. | 30 units<br>Two drops on each side (2x6)<br>One drop on each edge (1x12)<br>Two drops on each corner (2x8)<br>(40 drops in total) | Component may have reduced performance, but must still function properly. The allowable sensitivity difference shall not be greater than $\pm 3$ dB from initial sensitivity. |

## 5.5.5. Random Free Fall Test (Tumble Test) – protected product

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

## 5.5.6. Resistance to Electrostatic Discharge

| Parameter  | Test Method and Conditions  | Conditions / Sample size                                 | Evaluation Standard  |
|--|---|--|--|
| Resistance to ESD<br>IEC61000-4-2 Level 4<br>(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.<br>Level 4: contact +/- 8kV, air +/- 15kV | 10 exposures on each polarity / 5 units<br>DUT Power off | All samples fully operable.<br>All acoustical parameters according specification with tolerances increased by 50%. |

## 6. Related Documents

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

## 7. Change History

| Status   | Version | Date     | ECR  | Comment / Changes                                      | Initials of owner |
|----------|---------|----------|------|--|-------------------|
| Obsolete | A       | 22.05.05 |      | First release  |                   |
| Obsolete | B       | 17.05.05 | 898  | Second revision  |                   |
| Obsolete | C       | 16.06.05 | 1011 | Third revision   |                   |
| Obsolete | D       | 11.07.05 | 1089 | Change cover outer shape                               | MS                |
| Obsolete | E       | 06.12.05 | 1453 | Stamp print/resonance frequency diagram                | AH                |
| Obsolete | F       | 21.03.06 | 1612 | Stamp/floating tolerance/test signal                   | AH                |
| Obsolete | G       | 08.11.06 | 1738 | Rebranding Philips to NXP                              | CP                |
| Obsolete | H       | 01.02.10 | 2705 | Dimensioning contact position/spring force curve       | FL                |
| Obsolete | I       | 29.03.10 | 2802 | Update legal disclaimer/update logo and template       | CP                |
| Obsolete | J       | 08.06.10 | 2865 | Update material list                                   | CP                |
| Obsolete | K       | 23.03.11 | 3062 | Contact height tolerance/Migration to Knowles template | SA/CP             |
| Obsolete | L       | 12.09.11 | 3298 | Rephrase theory of operation/remove word "RA"          | HB/CP             |
| Release  | M       | 09.07.12 | 3767 | Publish document to newest template version            | CP/RB/HB          |

## 8. Disclaimer

Stresses above the Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only. The device may not function when operated at these or any other conditions beyond those indicated under "Electrical and Acoustical Specifications". Exposure beyond those indicated under "Electrical and Acoustical Specifications" for extended periods may affect device reliability.

This product is not qualified for use in automotive applications

Frequency range for Telekom use

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