Application note

for Directional MIC

Revision

Date	Version	Status	Changes	Approver
2016/07/26	V0.1		First release	LC

This document introduces the matters that customer must pay attention to during their product design or manufacturing process, when directional microphone is adopted. With help of this application note customer could avoid the potential failures of microphone.

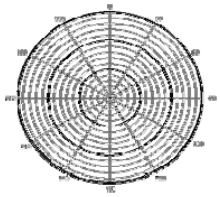
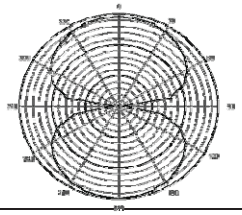
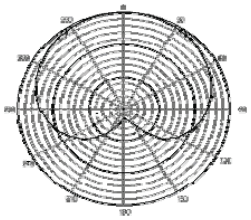
1. Brief introduction of MIC

1.1 Definition of directivity

Directivity is an index to present the sound pickup ability to the sound from different angle for a certain frequency.

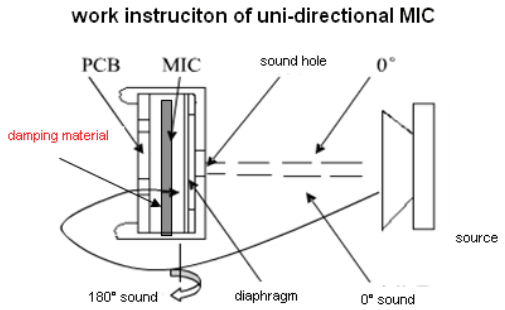
1.2 MIC Types and character

There are there types of MIC: omni-directional, bi-directional and unidirectional.

Directivity	Character	Polar pattern	Application Note
Omni-directional	1 ） Sensitivity is irrelevant to the direction of sound; 2 ） Sound enters into MIC from the sound hole at the bottom of the ferrule.		The sound hole should not be covered.
Bi-directional	1) It has“8”form directivity. Sensitivity is relevant to the direction of sound. 2) Sound enters into MIC from the holes on PCB and the sound hole at the bottom of the ferrule.		Both sound hole and holes on PCB should not be covered.
Uni-directional	1）Sensitivity is relevant to the direction of sound. 2）Sound enters into MIC from the holes on PCB and the sound hole at the bottom of the ferrule, but there is damping material in MIC.		

2. Working principle of uni-directional MIC

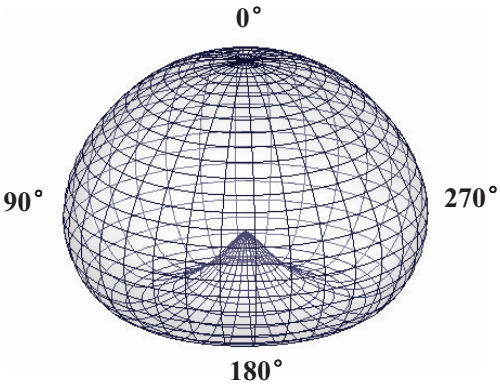
1) There are sound holes at the bottom of the ferrule (0°direction) and sound holes on PCB(180°direction) . The damping material is installed in the back cavity of MIC (between diaphragm and PCB).



2) Besides the sound entered into MIC from the sound hole at the bottom of ferrule, sound could also enters into MIC from the holes on PCB and reach the diaphragm. Because of the damping material the sound from the holes on PCB is damped and delayed. Therefore, the MIC sensitivity is determined by the difference of the two sound pressure.

3) Because the two sounds on the diaphragm are from the same source, and the sound path is different, there is a phase difference between the two sounds. With the variation of angle, the phase difference changed, the pressure on the diaphragm changed too, which produce the directivity. Generally it is present with a polar pattern.

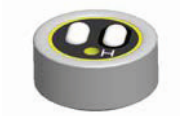
4) Polar pattern:



The sensitivity of 0°is the highest; the sensitivity of 90°and 270° is 6dB lower than that of 0°. The sound from 180°is shielded greatly.

3. Note for structure design

3.1Typical uni-directional product

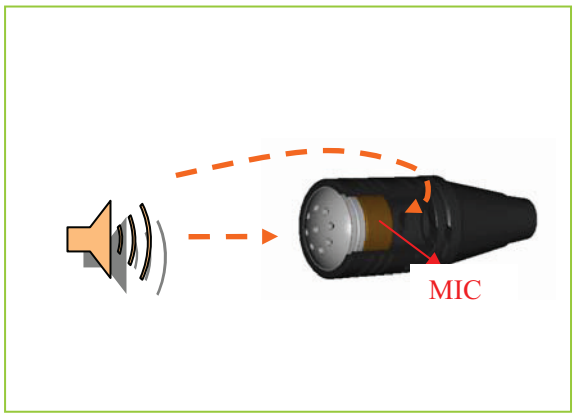
Typical MIC	Dimension (outer diameter*height) mm	Picture Appli	cation
4022	4.0*2.2		Head phone, Bluetooth headset
6027	6.0*2.7		Head phone, Camera
9745	9.0*4.5		TV/PC computer, conference telephone

3.2 Housing design

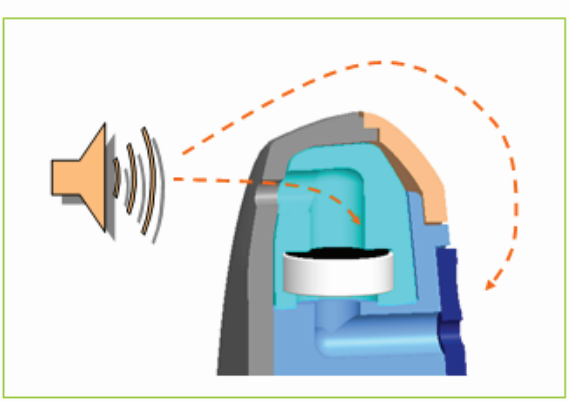
There are two housing design type for uni-directional MIC: double sound entries and single sound entry

3.2.1 Double sound entries

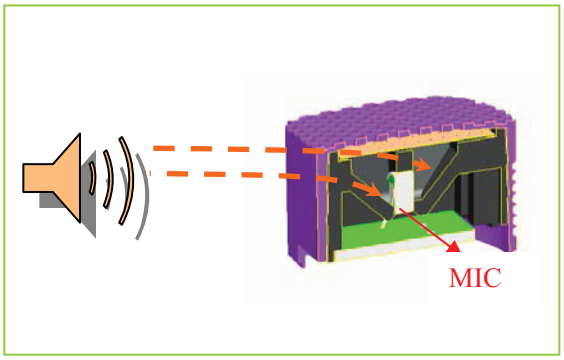
Free field design



Near field design



3.2.2 Single sound entry



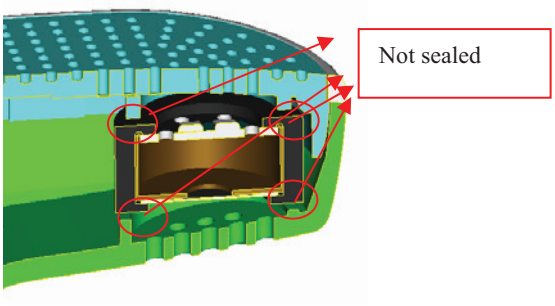
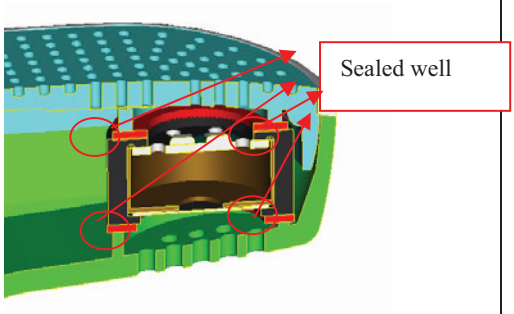
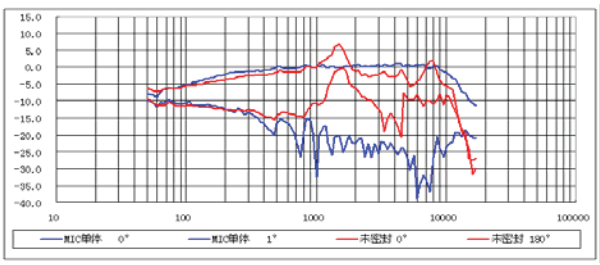
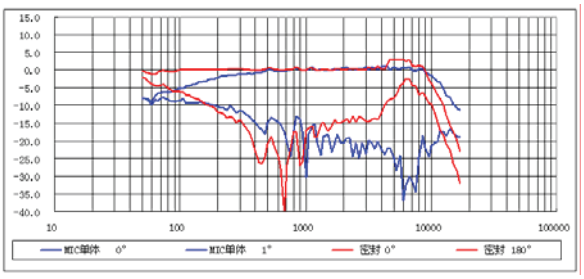
3.3 Note for design

1）Sound holes in the ferrule and PCB should not be covered. Sound source should be at the 0°direction, and the distance between two sound entries should be as far as possible.

2） The amount, form and size of sound holes in housing is depended on the space and cosmetic design. As for MIC performance, the more the hole amount is, the large the hole is, the better.

3）To get better performance, the cavity for MIC placement should be isolated with other cavities of housing.

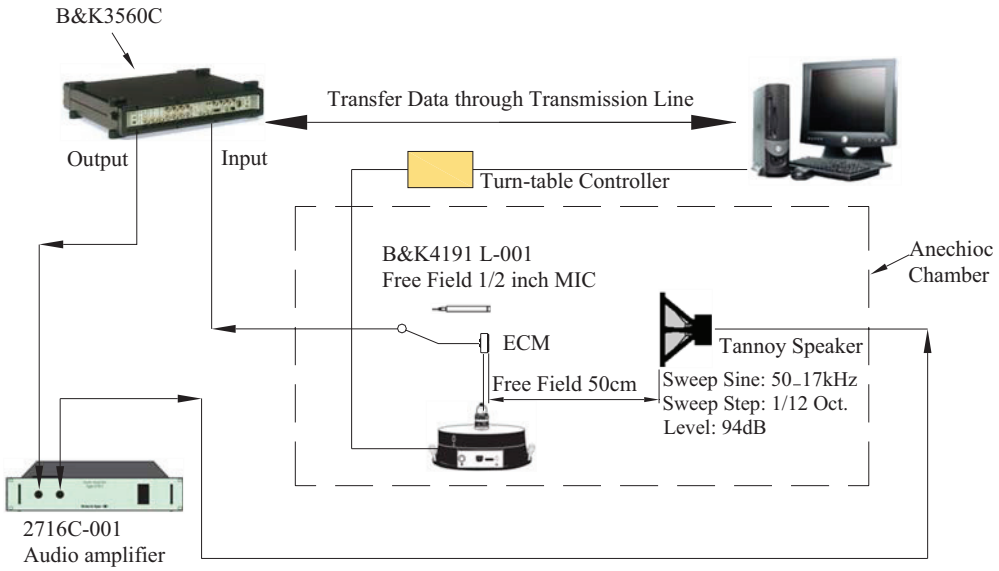
Example：

NG		OK
Design		
FR		

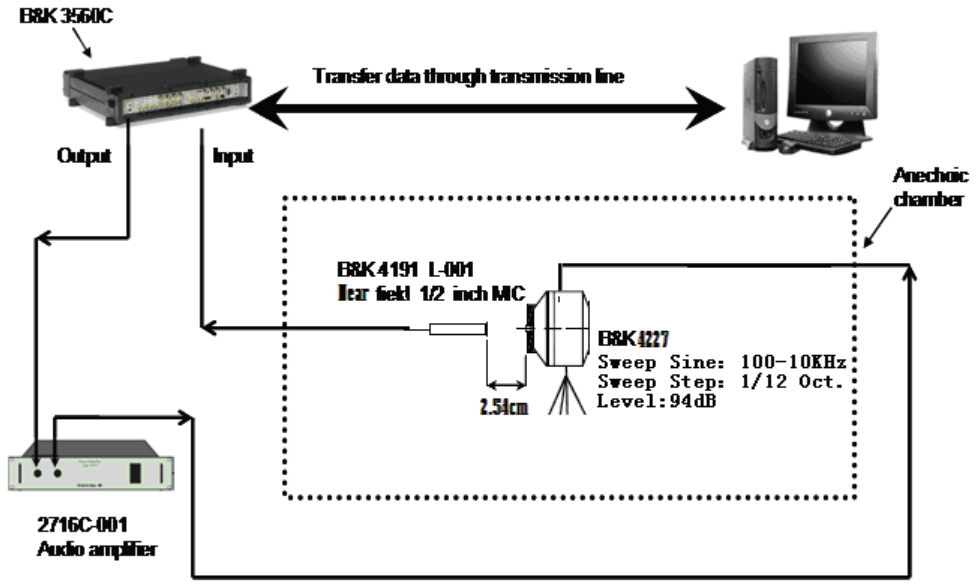
4. Performance

4.1 Test difference between near field and free field：

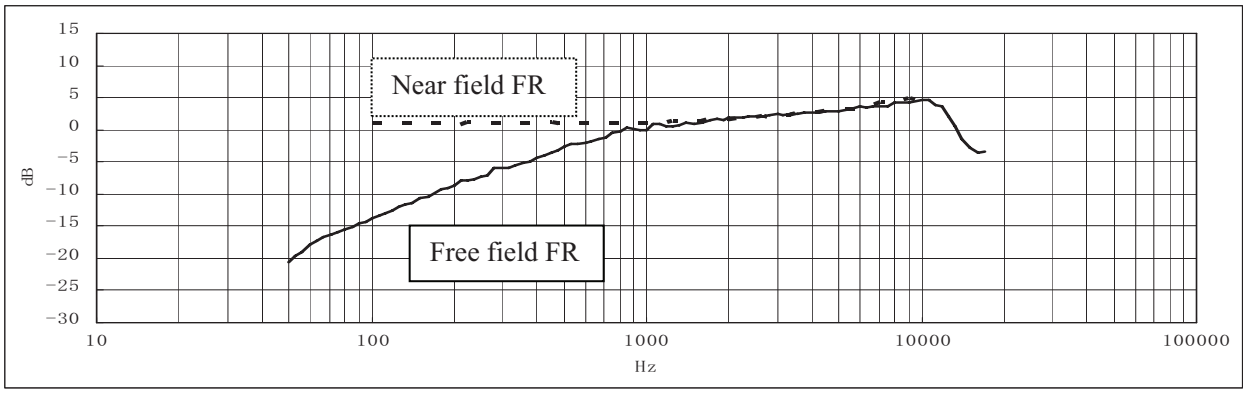
Free field test:（50cm）



Near field test:（2.54cm）



4.2 FR difference between near field and free field



Note: 1. Uni-directional MIC has obvious close-talking effect;

2. For near field, the RF is flat, which will be benefit for sound pickup. As for the free field the FR at lower frequencies is low, which could cancel the noise at lower frequencies.