

Title:	Noise Emission From ION-M 17P/19P	Doc-No.:	
File:	Noise Emission ION-M_RevA.doc	Rev.:	A
Distribution:	NextG	Security:	confidential
Author:	Arndt Pischke	Date:	2010-03-22
Responsible:		Department:	AMBG – R&D

# Noise Emission From ION-M 17P/19P

## 1 General

This report summarizes results from noise measurements of ION-M 17P/19P remote units. The units were also placed in a shroud. The report compares the noise emission of a single remote unit with the emission of 2 remote units.

## 2 Test Setup

Measurements were done first outside of the Andrew building and later indoor. The outdoor noise floor was too high for measuring distances larger than 5m. Indoor measurements confirmed the noise levels in a small range 1-5 m. Larger distances could not be measured because of the size of the room.

For larger distances the measured values were extrapolated according to standard acoustic calculations. The **sound pressure level (SPL)** decreases with doubling of distance by (-)6 dB. The sound pressure decreases with the ratio  $1/r$  to the distance.

Measurement device: CHAUVIN ARNOUX Sonometre CDA 830 No. \*8662\*

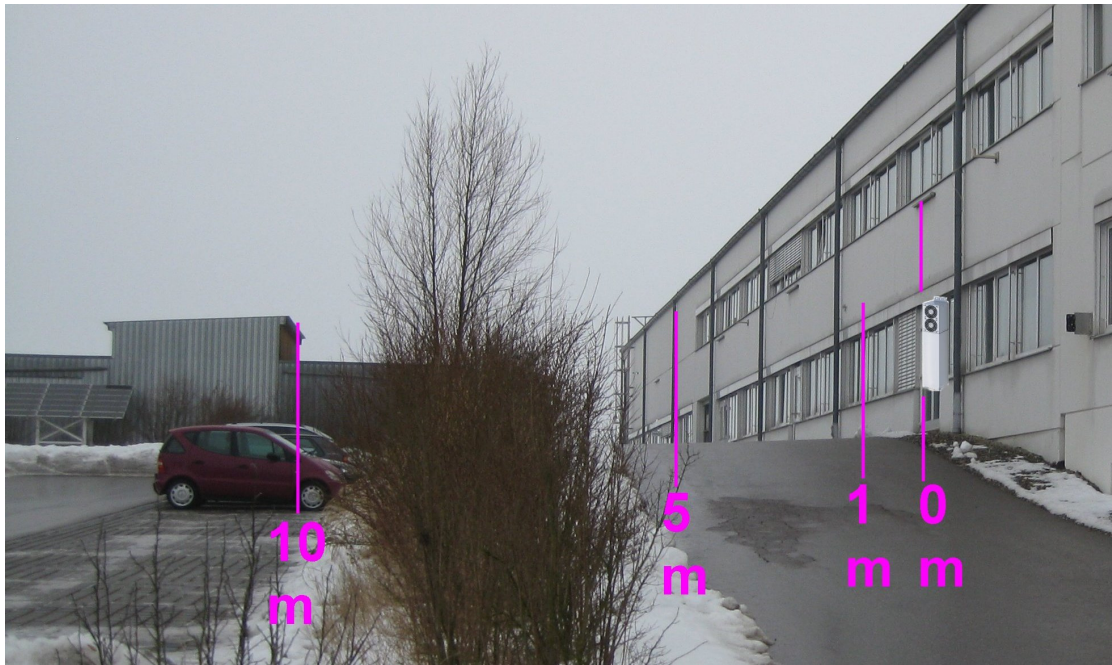
Settings: Lo = 35 - 100dB, Response: Fast, Funct: A

Measurement tolerance  $\pm 2$  dB.



Indoor measurement setup.

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Outdoor measurement setup.

### 3 Measurement Results

The differences between measurements with a shroud and without is +0.8 / -0.3 dBA and are in the same region as the measurement uncertainty of the noise measurement device. Therefore data from measurements without shroud are good approximations for measurements with shroud and vice versa.

The following graph shows the sound pressure level versus distance from the ION-M 17P/19P remote unit for different parameter variations. In the tests at 35°C ambient temperature and 43dBm output power (upper curve) the fans were running on 100%, i.e. that curve is the upper limit of noise emission from one ION remote unit.

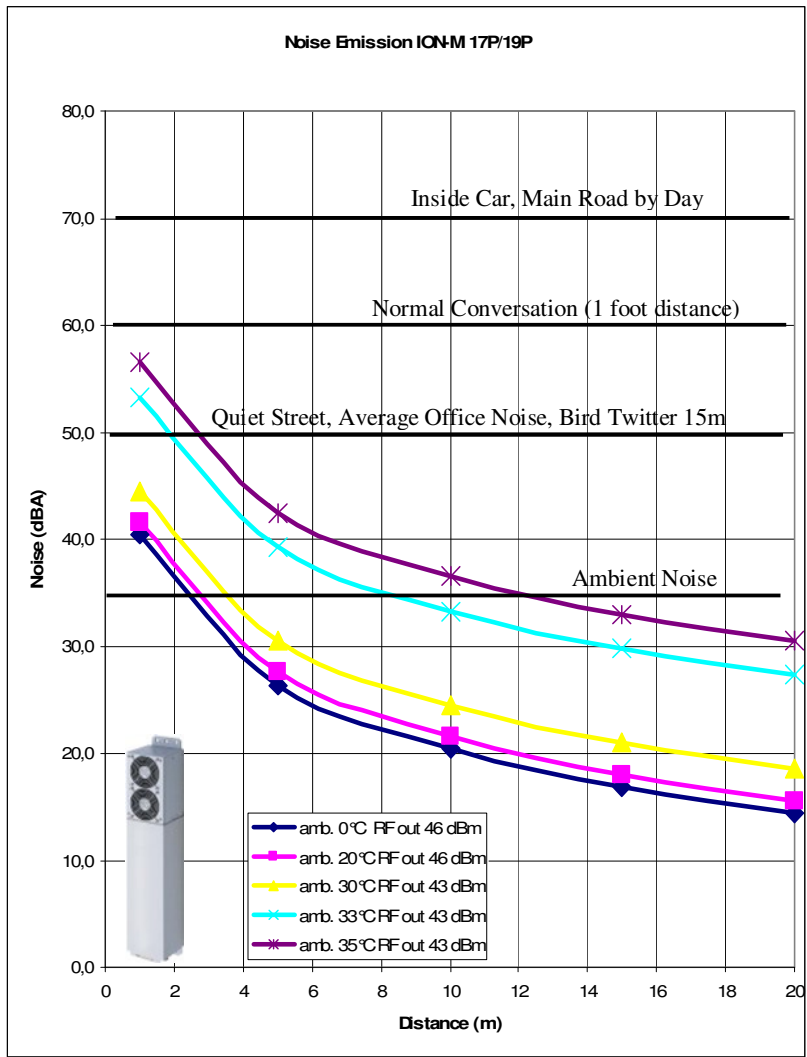
The lower curve (0°C and 46dBm output power) represents the noise emission for the lowest fan speed, i.e. it represents the lowest possible noise from the remote unit.

The ambient noise floor is at around 35 dBA. Measurements were possible only to this limit. Values below the ambient noise were calculated according to standard acoustic calculations (<http://www.sengpielaudio.com/calculator-distance.htm>). 35dBA corresponds to a “very quiet room fan at low speed at 1 m distance.

From the graph it can be seen that the crossing of the upper curve (fan runs on 100% speed) with the ambient noise floor is at 12m distance. At that point the noise of an ION remote unit should not be detectable for a person. That should be the same for a remote unit in a shroud.

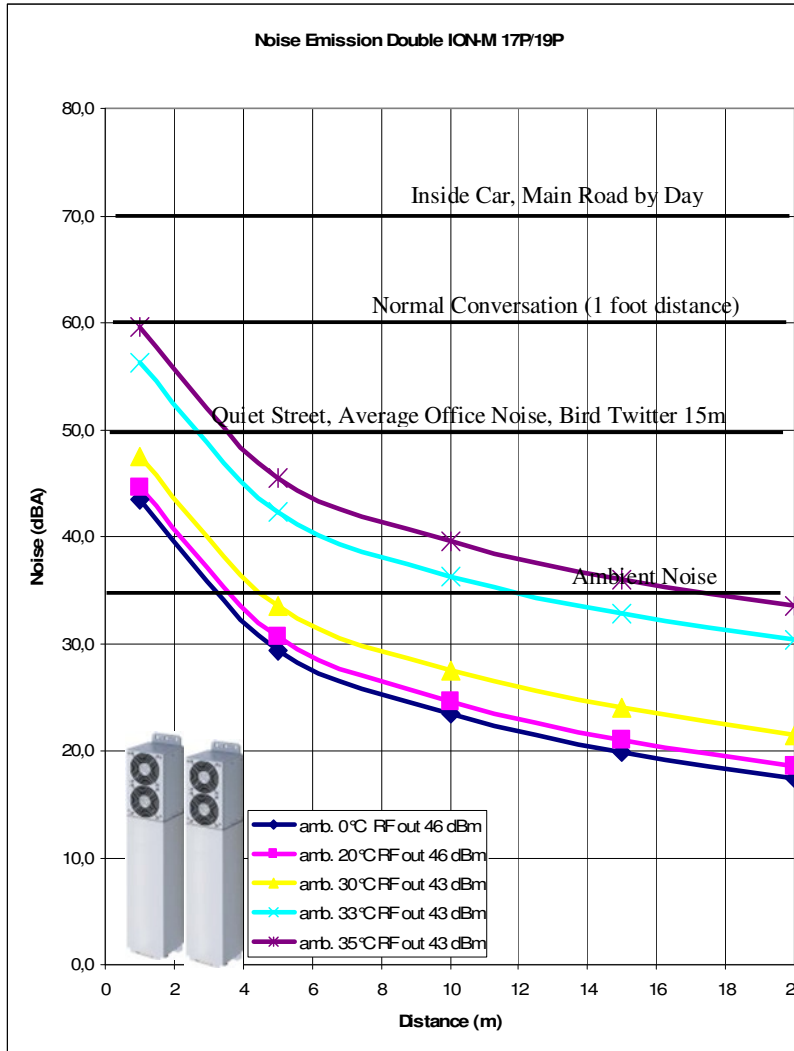
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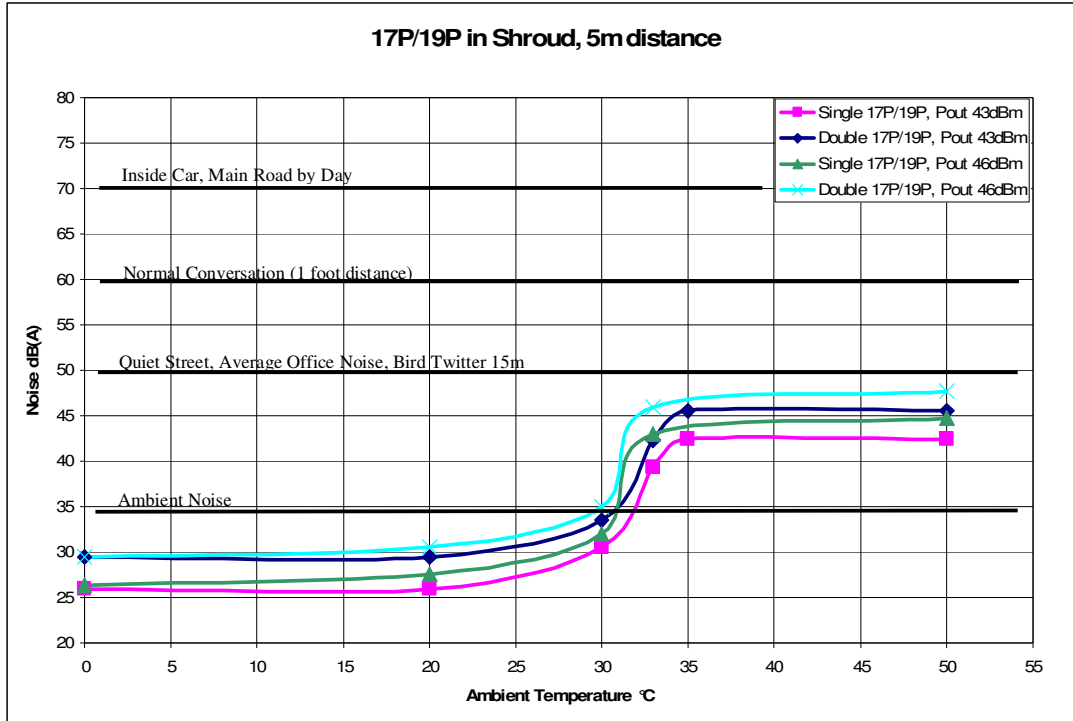
The following graph shows the sound pressure level of *two* ION-M 17P/19P remote units. Also here the difference between measurement with and without shroud are neglectable.  
 The crossing of the worst case noise from the 2 ION remotes with the noise floor is at 17 meters. At that distance the ION noise is not longer hearable by a person.  
 The lowest curve represents the noise emission at the slowest fan speed. I.e. at a distance of 3 meters the 2 ION remote units are not hearable.





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The following graph displays the noise measurements of one or two remote units in a shroud at a distance of 5 meters.  
 At that distance the IONs become hearable by a person at around 30°C (hot summer day).



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## 4 References

### How loud is dangerous? Typical dbA levels

190 dBA	Heavy weapons, 10 m behind the weapon (maximum level)
180 dBA	Toy pistol fired close to ear (maximum level)
170 dBA	Slap on the ear, fire cracker explodes on shoulder, small arms at a distance of 50 cm (maximum level)
160 dBA	Hammer stroke on brass tubing or steel plate at 1 m distance, airbag deployment very close at a distance of 30 cm (maximum level)
150 dBA	Hammer stroke in a smithy at 5 m distance (maximum level)
130 dBA	Loud hand clapping at 1 m distance (maximum level)
120 dBA	Whistle at 1 m distance, test run of a jet at 15 m distance
	<b>Threshold of pain, above this fast-acting hearing damage in short action is possible</b>
115 dBA	Take-off sound of planes at 10 m distance
110 dBA	Siren at 10 m distance, frequent sound level in discotheques and close to loudspeakers at rock concerts, violin close to the ear of an orchestra musicians (maximum level)
105 dBA	Chain saw at 1 m distance, banging car door at 1 m distance (maximum level), racing car at 40 m distance, possible level with music head phones
100 dBA	Frequent level with music via head phones, jack hammer at 10 m distance
95 dBA	Loud crying, hand circular saw at 1 m distance
90 dBA	Angle grinder outside at 1 m distance
	<b>Over a duration of 40 hours a week hearing damage is possible</b>
85 dBA	2-stroke chain-saw at 10 m distance, loud WC flush at 1 m distance
80 dBA	Very loud traffic noise of passing lorries at 7.5 m distance, high traffic on an expressway at 25 m distance
75 dBA	Passing car at 7.5 m distance, un-silenced wood shredder at 10 m distance
70 dBA	Level close to a main road by day, quiet hair dryer at 1 m distance to ear
65 dBA	<b>Bad risk of heart circulation disease at constant impact is possible</b>
60 dBA	Noisy lawn mower at 10 m distance
55 dBA	Low volume of radio or TV at 1 m distance, noisy vacuum cleaner at 10 m distance
50 dBA	Refrigerator at 1 m distance, bird twitter outside at 15 m distance
45 dBA	Noise of normal living; talking, or radio in the background
40 dBA	<b>Distraction when learning or concentration is possible</b>
35 dBA	Very quiet room fan at low speed at 1 m distance
25 dBA	Sound of breathing at 1 m distance
0 dBA	Auditory threshold

<http://www.sengpielaudio.com/TableOfSoundPressureLevels.htm>

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Important thresholds on the decibel scale:

0 dBA

Threshold of hearing

20 dBA

Rustling leaves, quiet living room

30 dBA

Quiet office

40 dBA

Quiet conversation

45 dBA

Threshold of distraction, according to EPA

50 dBA

Quiet street, average office noise

60 dBA

Normal conversation (1 foot distance)

70 dBA

Inside car

75 dBA

Loud singing (3 feet)

80 dBA

Typical home-stereo listening level

— <http://tldp.org/HOWTO/Unix-Hardware-Buyer-HOWTO/index.html>





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In [http://www.engineeringtoolbox.com/decibel-dba-levels-d\\_728.html](http://www.engineeringtoolbox.com/decibel-dba-levels-d_728.html) is also a list of “Acceptable Noise – dBA Levels.

Location	Effects	$L_{eq}$ (dBA)	Time (hours)	Time of day
Bedroom	sleep disturbance, annoyance	> 30	8	night
Living area	annoyance, speech interference	> 50	16	day
Outdoor living area	moderate annoyance	> 50	16	day
Outdoor living area	serious annoyance	> 55	16	day
Outdoor living area	sleep disturbance, with open windows	> 45	8	night
School classroom	speech interference, communication disturbance	> 35	8	day
Hospitals patient rooms	sleep disturbance, communication interference	> 30-35	8	day and night