sound reinforcement & microphones

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SOUND REINFORCEMENT
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statement

most SR-systems work perfectly

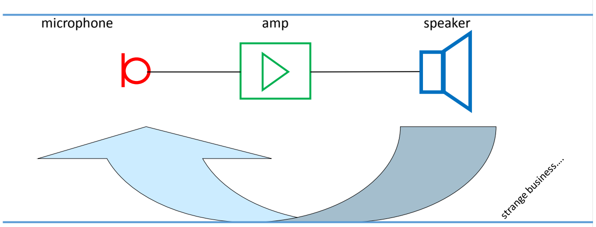
- until a microphone is connected….

content

- SR and microphones – what are the challenges
- microphones – what's that?
- specs – known and less known
- microphones and soundfield
- measurement methods

the challenge

challenge: no positive feed back



challenge: sufficient amplification

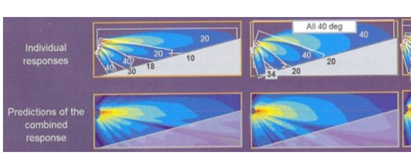
challenge: make the artist shine

challenge: stage monitoring

challenge: source separation

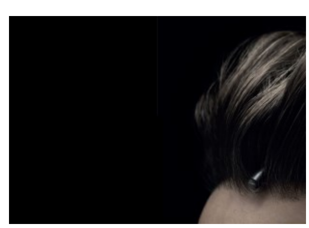
challenge: SR + recording / broadcast

challenge: arrays and off axis response



the stage is an important listening area!

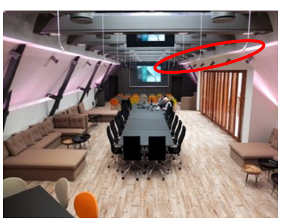
challenge: sometime invisible mics



challenge: “Interesting” venues

challenge: “Interesting” venues

challenge: uniformity of units



challenge: the weather…

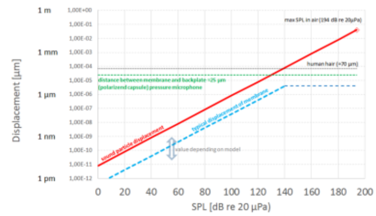
challenge: rugged gear needed

challenge: no handling noise…..

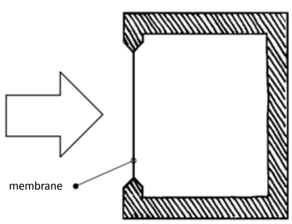
…..getting the
right
gear

microphone design

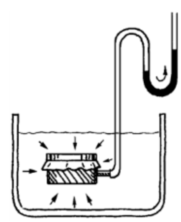
sound particle displacement vs membrane displacement (@1kHz)



pressure microphone



membrane manometer

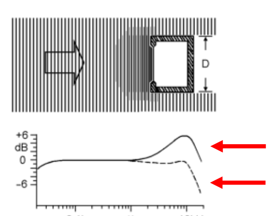


the pressure is measured
no matter the direction
of the membrane

getting the polar plots

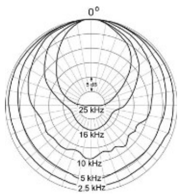
set up for the
measurement
of polar plot

high frequency lift + directivity

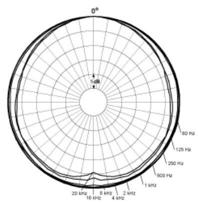


pressure
microphone

directional characteristic, omni

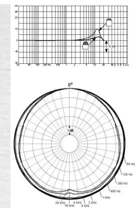


24 mm



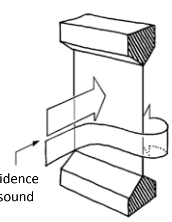
~ 5.4 mm

DPA d:screet 4060 / 4061



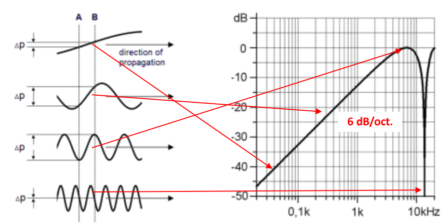
pressure gradient microphone

pressure gradient ≈
pressure difference
between the two sides
of the membrane



incidence
of sound

pressure difference between to points

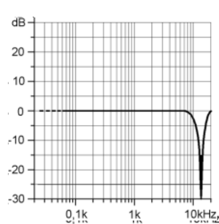


pressure difference between to points

correction:

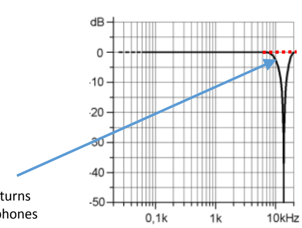
Mechanical:
a more sloppy
membrane

Electrical:
lowpass,
6 dB / octave



pressure difference between to points

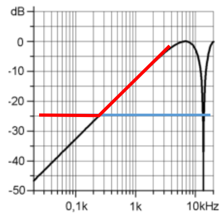
at this frequency the
microphone normally turns
into a pressure microphones



influence of distance relative to source

the back of the membrane is further away compared to the front.

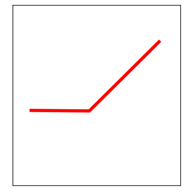
hence we can have an additional difference - or gradient



pressure gradient due to distance

this is the raw frequency response before correction

(near sound source)



pressure gradient due to distance

frequency response after correction

(near sound source)

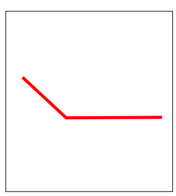
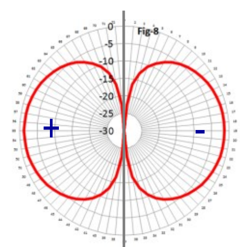
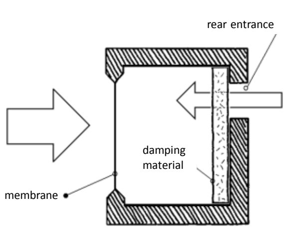
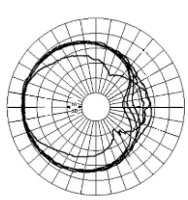


figure 8 (rotated)

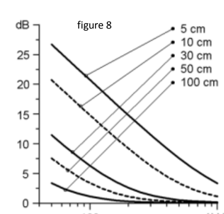


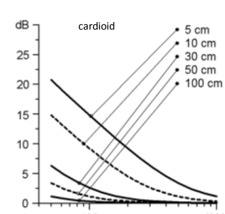
pressure gradient microphone





proximity – how much?



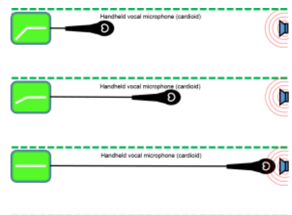


proximity (pressure gradient microphone)

microphone
(cardioid)

flat response
for distant
sound sources
(>1 meter)

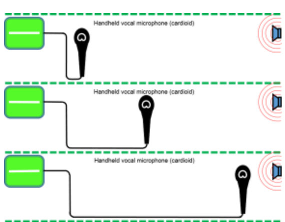
proximity



handheld vocal
microphone
(cardioid)

flat response
close to the
source
(<0.1 meter)

proximity



handheld vocal
microphone
(cardioid)

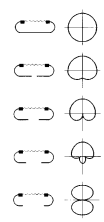
no proximity
effect when
angle of
incidence is
approximately
90 degrees

acoustical principles

by the acoustical coupling between front and back of membrane various characteristics are acheived

closed space behind membrane: pressure microphone
directional characteristic: **omni**

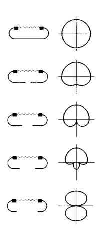
open space behind membrane:
pressure gradient microphone
directionality: **figure 8 → cardioid**



acoustical principles

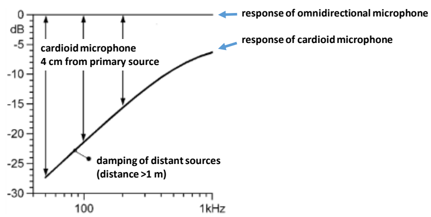
?

we'll come
back to that



an example

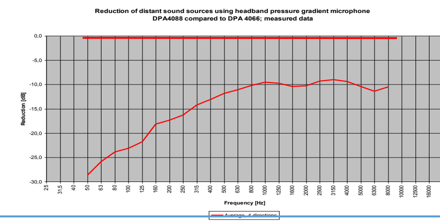
reduction of distant sound sources



cardioid
vs.
omni

in theory

reduction of distant sound sources



DPA 4066
(omni) vs.
DPA 4088
(cardioid)

measurement
Sound ex:
d:fine omni vs.
cardioid

microphone specs

introduction - what to specify?

- it's FAT
- (there is no such thing as a low-fat microphone……… ;o)
- it sounds COOL
- it's PINK
- it's OLD!!! (wauw)
- all the others are using it
- it's CHEAP
- or
- it's EXPENSIVE

or: IEC 60268-4

is a measurement standard, not a performance standard

no manufacturer uses all of it

the microphone

membrane	transducer	input
coupling to the soundfield	"power plant"	preamp
pressure	**dynamic** (coil, ribbon)	analogue
pressure gradient	**condenser** LF HF, electret	**digital**
other	**other**	**other**

basic electrical specifications

- sensitivity – determines preamp requirements
- frequency response – is it wide or narrow enough?
- directivity pattern – sound pickup from where?
- THD/clip – can the microphone handle the SPL?
- noise level – quieter than recording ambient level?
- power requirements – can the preamp supply?
- impedance – does the cable and preamp affect signal?
- pop noise / wind noise? Other specs?

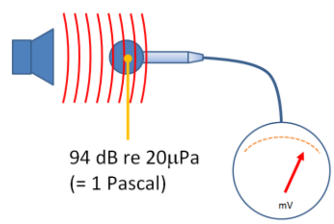
how to read mic specs?

Specifications for 4041-SP Large Diaphragm Microphone, P48

[illegible]	[illegible]
Principle of operation:	Pressure
Cartridge type:	24 mm (1 in) condenser with stainless steel diaphragm
Frequency range, ± 2 dB:	20Hz - 20kHz with 4 - 6 dB soft boost at 8 kHz
Sensitivity, nominal, ± 2 dB:	70 mV/Pa; -26dB re. 1 V/Pa
Equivalent noise level, A-weighted:	Max. 8 dB(A) re. 20 µPa
Equivalent noise level, ITU-R BS.468-4:	Max. 20 dB
S/N ratio, re. 1 kHz at 1 Pa (94 dB SPL):	86 dB(A)
Total harmonic distortion (THD):	<0.5% THD up to 120 dB SPL peak, <1% THD up to 126 dB SPL peak
Dynamic range:	Typ. 118 dB
Max. SPL, peak before clipping:	134 dB
Output impedance:	<200 Ohm
Cable drive capability:	Up to 100 m (328 ft)
Current consumption:	2.20 mA
Connector:	3-pin XLR-M (Standard P48)
Weight:	190 g (6.7 oz)
Capsule diameter:	24 mm (1 in)
Length:	170 mm (6.69 in)

microphone sensitivity

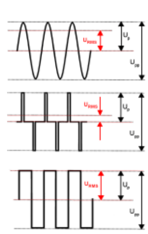
sensitivity



RMS vs peak

the figure shows three signals with identical peak-to-peak values

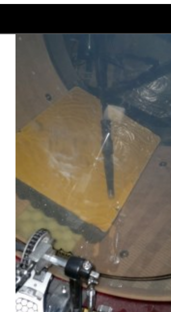
- but different RMS-values.



check SPL

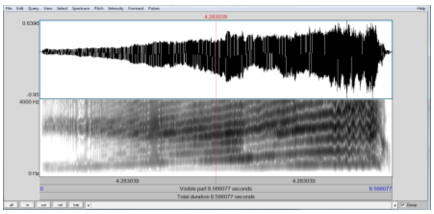
Peak level

155 dB



take care of unexpected sound

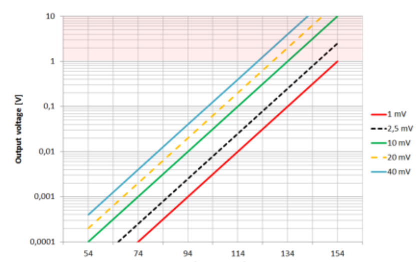
a voice -



voice level

152.4 dB re 20 uPa, peak!!!!!!

Peak (unweighted)	dB	RMS (A-weighted)
	160	
Extreme(!) singer @ lips Inside kickdrum	150	
Snare drum, rim shot Extreme crowd noise	140	Extreme trumpet @ center of bell piece Extreme crowd (boxing match)
Alto/soprano sax @ center of bell piece Exposed positions in symphony orchestra	130	Extreme trumpet @ 0.5 meter
Bass drum @ front skin Symbal	120	Typical rehearsal room (rock) Pain in the ear
Violin @ ear	110	Highly exposed positions in symphony orch. a loud discotheques Cheering crowd, large football stadium
Single string picking of Spanish guitar, @ 10 cm	100	Outdoor rock concert (recomm. max level) Grand piano @ 3 meter (lid open)
	90	Acoustic guitar @ 3 meter Oboe @ 3 meter



output
vs
SPL

microphone directivity

getting the polar plots

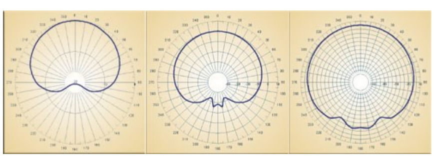
set up for the
measurement
of polar plots

tracking the cardioid….

polar plot

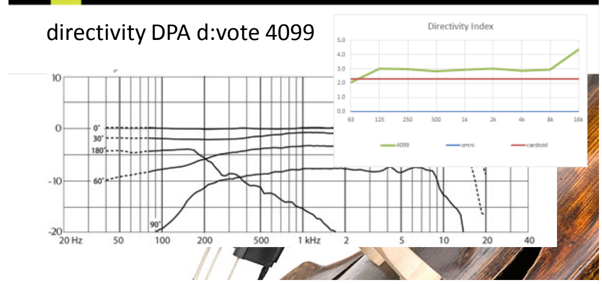
a polar plot/diagram is used to show how certain frequencies are reproduced when they enter the microphone from various angles

polar plots

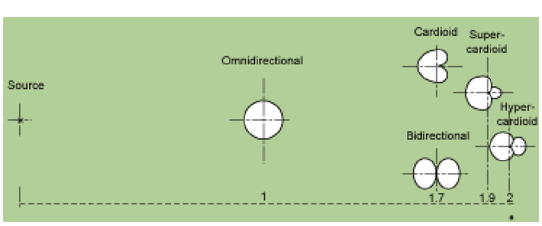


the same microphone – but different scalings

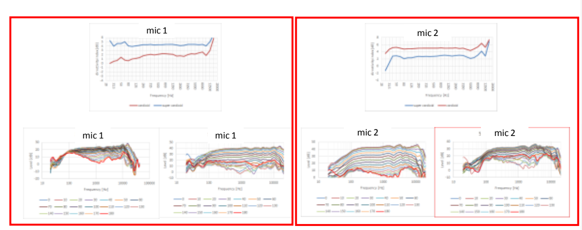
directivity DPA d:vote 4099



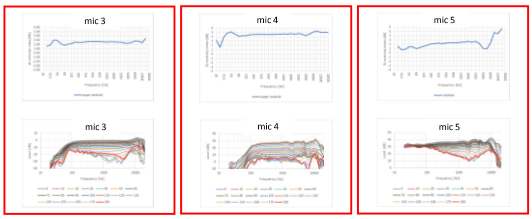
directionality



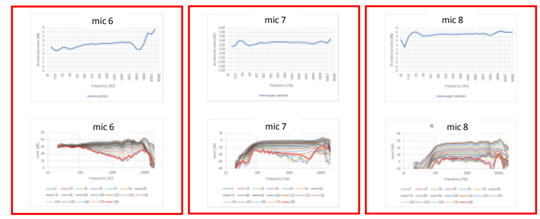
directivity index (DI) (= 10 * log directivity factor)



directivity index (DI)

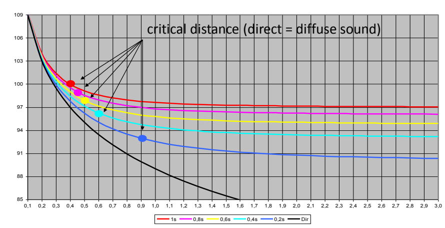


directivity index (DI)

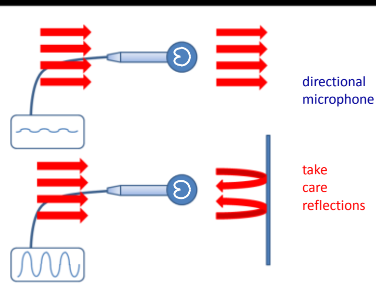


microphone & soundfield

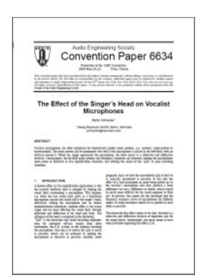
point source, in reverberant field



soundfield

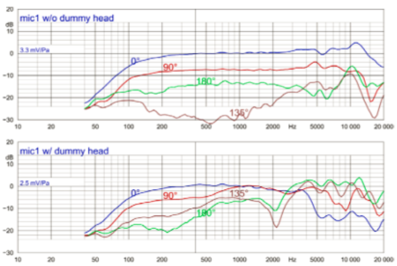


directivity in practice

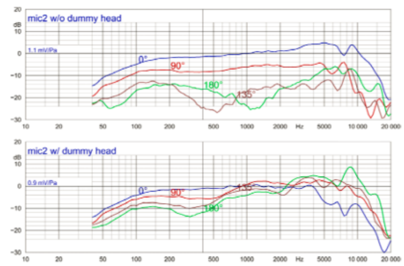

Audio Engineering Society

Convention Paper 6634

The Effect of the Singer's Head on Vocalist Microphones

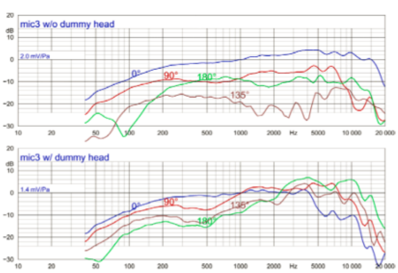


reference:
Martin Schneider



it turns more or less to an omni

reference:
Martin Schneider



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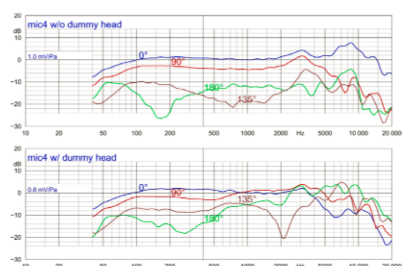
Martin Schneider



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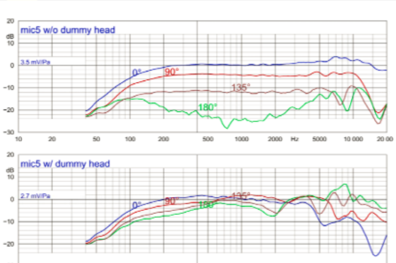
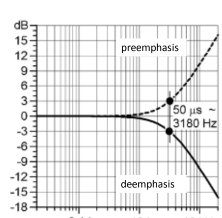
Martin Schneider



it turns more or less to an omni

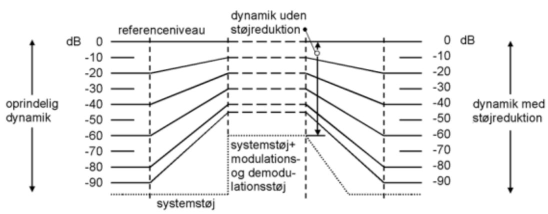
reference:
Martin Schneider

wireless transmission, analog, emphasis



some analog systems apply a short time constant which in practis is no emphasis

wireless transmission, analog, compander



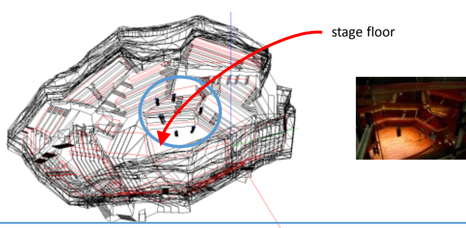
providing power for all microphones

what have we? 3 volt+ 5 volt?

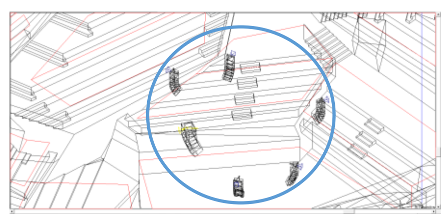
48 volt? – few systems

(it's a work of art to make condeser microphone heads for handheld wireless transmitters work as well as when connectet to a genuine 48 v phantom supply.)

acoustical modelling

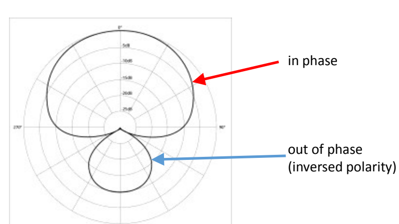


acoustical modelling

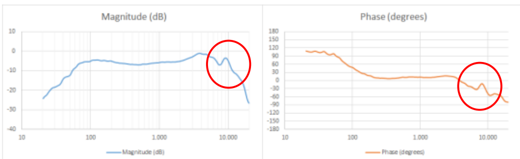


microphone, phase & polarity

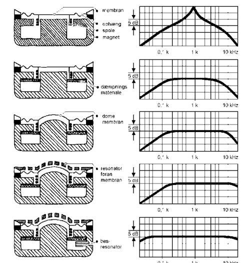
polarity (pin 2 is positive when the pressure is positive)



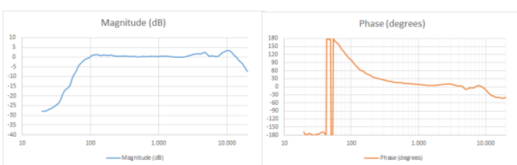
magnitude and phase (handheld vocal, dynamic)



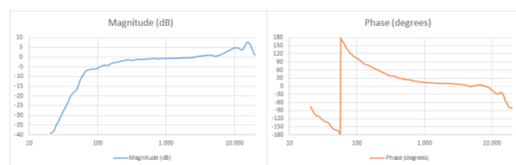
dynamic mic.



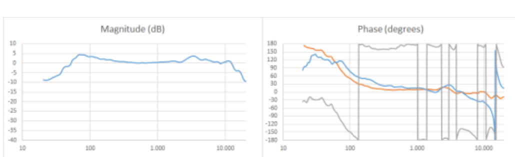
magnitude and phase (handheld vocal condenser)



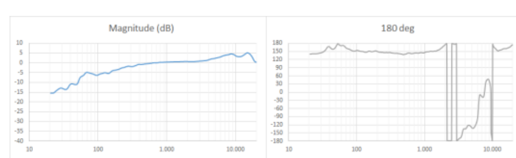
magnitude and phase (handheld vocal condenser)



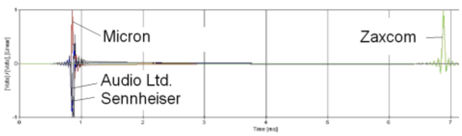
magnitude and phase (handheld vocal condenser)



magnitude and phase (instrument condenser)



polarity & latency

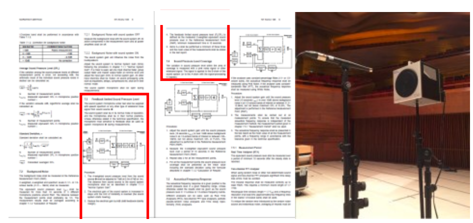


WinMLS measurement

Brand	Transmitter	Band	bit/kHz	Encr.	Polarity	latency
AKG	DMS800	UHF	24/48	612 bit	N	4.0 ms
Audio-Technica	System 10 pro	2.4 GHz	24/48	---	P	3.8 ms
Beyerdynamic	TG1000	UHF	16 bit	x	P	3.0 ms
Lectrosonics	UM400		24/48		P	2.5 ms
Line 6	TB2, XD-V70L, XD-75V	2.4 GHz		256 bit	P	?
Mipro	ACT-8Ta, ACT-80T	UHF/2.4 GHz			?	?
Sabine / Sacom	DS8000			256 bit	?	3
Sennheiser	EW D1	2.4 GHz		256 bit	N	3.9
Sennheiser	System 9000	UHF LR/HD		256 bit	N	3.0
Shure	PGX1/ULX-D1		24/48	256 bit	P	2.9 ms
Sony	DWT-801	SD / HD	24t/48	128 bit	P	3.6/4.0
Sony	ZTX-B02RC	2.4 GHz		128 bit	N	7.0
Trantec	SD7000				P	?
(Wisycom)	MTP30		(Dig.H.)	-	switch	4.0 ms
X2 Digital Wireless	XDR 95			-	N	?
Zaxcom	TRX 900, TRX 900 LTS			256 bit	P	7.7

feed back measurement

measurement: NT ACOU 108



summing up

- many parameters have an influence on the performance
- one over-all goal is smoothness
- the microphone is difficult to evaluate from the spec sheet
- however, sensitivity, and frequency can always be checked
- check for structure borne sound
- wireless systems and condensers; make sure the the performance is optimum

thank you!

check this out:

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