

Wielokanałowy dźwięk przestrzenny

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Politechnika Gdańska

Od dźwięku mono do stereo

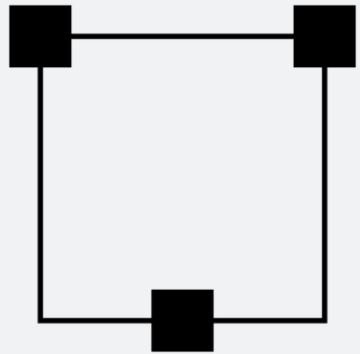
- 1877 – fonograf (T. Edison)
- 1930s – pierwsze techniki zapisu i reprodukcji dźwięku stereo (A. Blumlein)
- 1950s – wciąż większość domowych urządzeń audio jest 1-kanałowych (mono)
- 1970s – stereo staje się standardem w nagraniach oraz w systemach odtwarzania



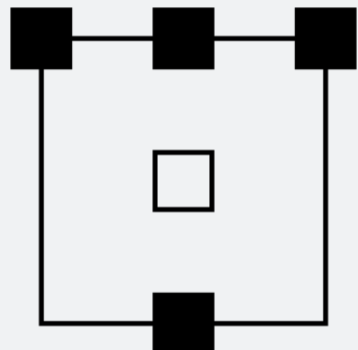
Dźwięk wielokanałowy *surround*

- 1940s – *Fantasia* (Walt Disney) – technika 3.0/5.0 (“*Fantasound*”)
- 1950s – pierwsze produkcje filmowe 4.0
- 1970s – *Dolby Stereo* (technika 4.0) – a także pierwszy film *Star Wars*
 - 1970s – kwadrofonia
 - 1970s – Początki techniki dźwięku 360 – **ambisonia**
- 1990s – *Dolby Digital Surround* (5.1)
- 1999 – Super Audio CD (SACD)
- 2012 – Dolby Atmos (dźwięk 3D, dźwięk immersyjny, dźwięk przestrzenny)

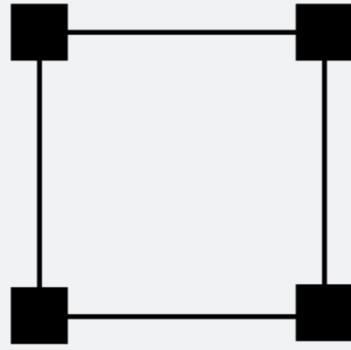
Dźwięk wielokanałowy *surround*



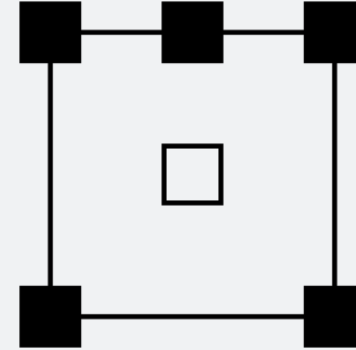
3.0



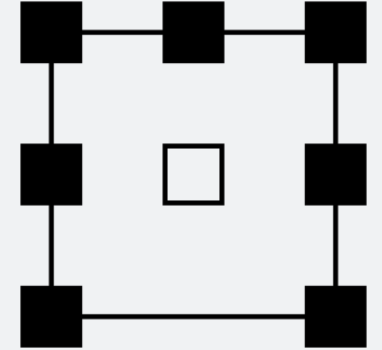
4.1



4.0 "kwadrofonia"
























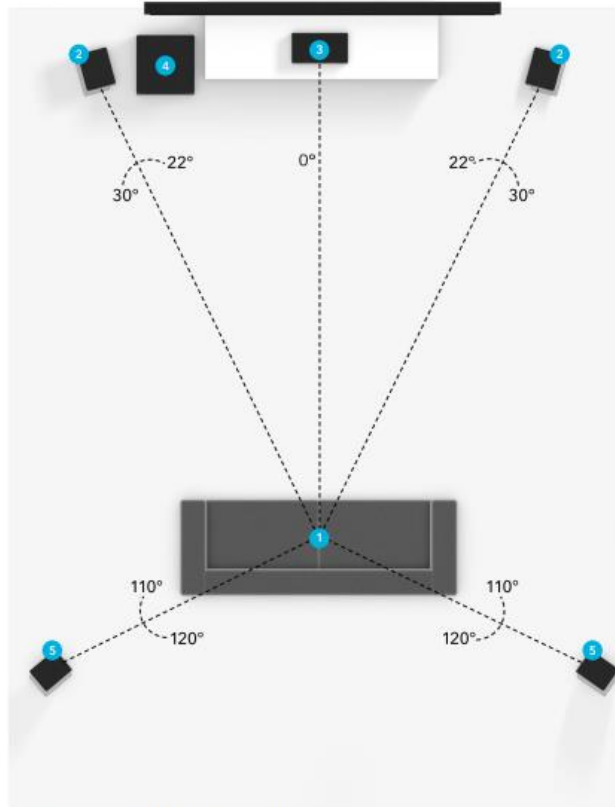
5.1



7.1

Standard speaker channel layouts

Icon	System	Channels	LFE	Front				Sides	Back		
				FL+FR	FC	FLC+FRC	TFL+TFR	SL+SR	BL+BR	BC	TBL+TBR
	Mono ^[Note 1]	1.0	No	No	Yes	No	No	No	No	No	No
	Stereo ^[Note 2]	2.0	2.1	Yes	No	No	No	No	No	No	No
	Stereo	3.0	3.1	Yes	Yes	No	No	No	No	No	No
	Surround	3.0	No	Yes	No	No	No	No	No	Yes	No
	Quad	4.0	No	Yes	No	No	No	No	Yes	No	No
	Side Quad	4.0	No	Yes	No	No	No	Yes	No	No	No
	Surround	4.0	4.1	Yes	Yes	No	No	No	No	Yes	No
	(Front)	5.0	5.1	Yes	Yes	No	No	No	Yes	No	No
	Side ^[40]	5.0	5.1	Yes	Yes	No	No	Yes	No	No	No
	Atmos ^[41]	5.1.4	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes
	Hexagonal (Back)	6.0	6.1	Yes	Yes	No	No	No	Yes	Yes	No
	Front	6.0	6.1	Yes	Yes	Yes	No	No	No	Yes	No
	(Side)	6.0	6.1	Yes	Yes	No	No	Yes	No	Yes	No
	Wide	7.1	Yes	Yes	Yes	Yes	No	No	Yes	No	No
	Side ^[40]	7.0	7.1	Yes	Yes	Yes	No	Yes	No	No	No
	Surround ^[42]	7.0	7.1	Yes	Yes	No	No	Yes	Yes	No	No
	Atmos ^[41]	7.1.4	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes
	Octagonal	8.0	No	Yes	Yes	No	No	Yes	Yes	Yes	No
	Surround	9.0	9.1	Yes	Yes	No	Yes	Yes	Yes	No	No
	Surround	11.0	11.1	Yes	Yes	Yes	Yes	Yes	Yes	No	No
	Atmos ^[41]	11.1.4	Yes	Yes	Yes	Yes	No	Two per side	Two per side	Yes	Yes



SPEAKER PLACEMENT FOR 5.1 SETUP

5.1 Virtual Speakers

1. Seating position
2. Left & right speakers
3. Center speaker
4. Subwoofer
5. Left & right surround speakers

Dolby Atmos speaker setups: What do these numbers mean?

When shopping for Dolby Atmos home theater components, you'll see a new way of describing speaker configurations.

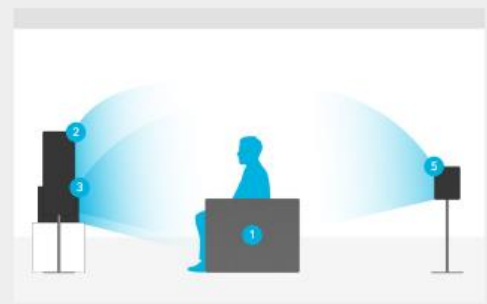
5.1

This refers to the number of traditional surround speakers (front, center, surround, etc.)

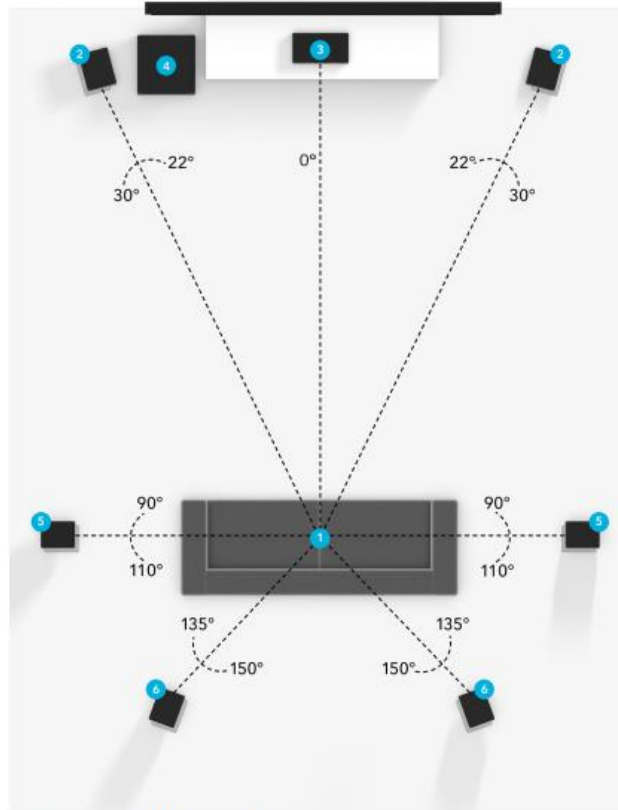
This number refers to how many powered subwoofers you can connect to your receiver.



PERSPECTIVE DETAIL FOR 5.1 SETUP



VIRTUAL SPEAKER PLACEMENT DETAIL FOR 5.1 SETUP



SPEAKER PLACEMENT FOR 7.1 SETUP

7.1 Virtual Speakers

1. Seating position
2. Left & right speakers
3. Center speaker
4. Subwoofer
5. Left & right surround speakers
6. Left & right rear surround speakers

Dolby Atmos speaker setups: What do these numbers mean?

When shopping for Dolby Atmos home theater components, you'll see a new way of describing speaker configurations.

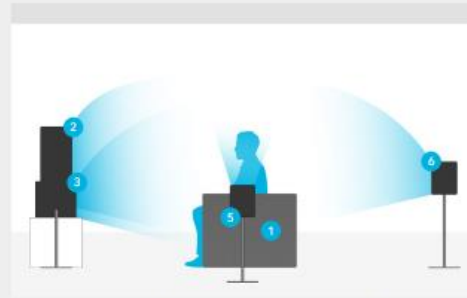
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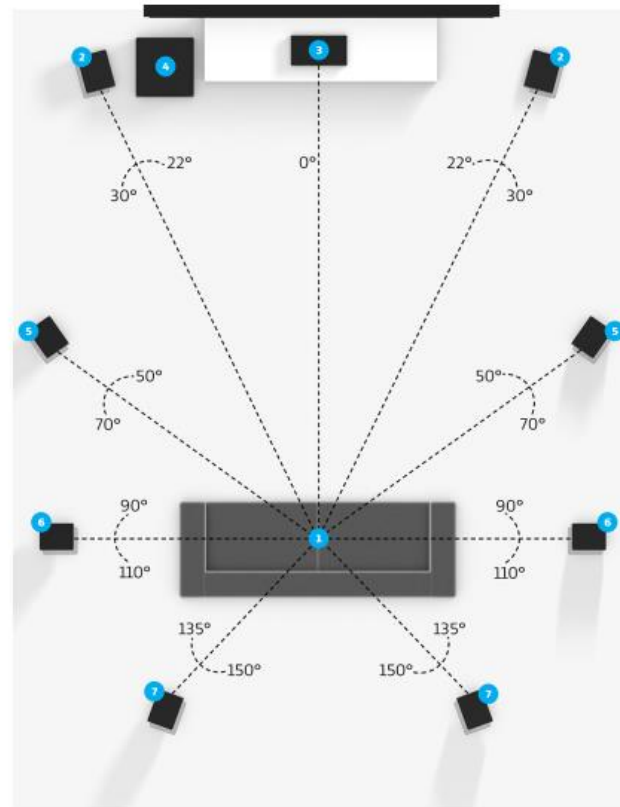
PERSPECTIVE DETAIL FOR 7.1 SETUP



VIRTUAL SPEAKER PLACEMENT DETAIL FOR 7.1 SETUP

9.1 Virtual Speakers

1. Seating position
2. Left and right speakers
3. Center speaker
4. Subwoofer
5. Left and right wide speakers
6. Left and right surround speakers
7. Left and right rear surround speakers



Speaker placement for 9.1 setup

Dolby Atmos speaker setups: What do these numbers mean?

When shopping for Dolby Atmos home theater components, you'll see a new way of describing speaker configurations.

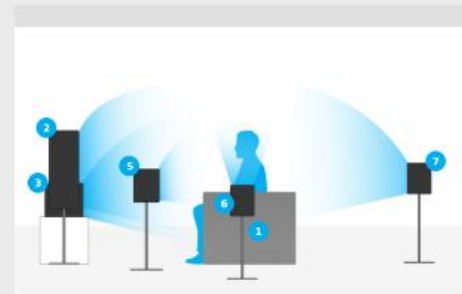
9.1

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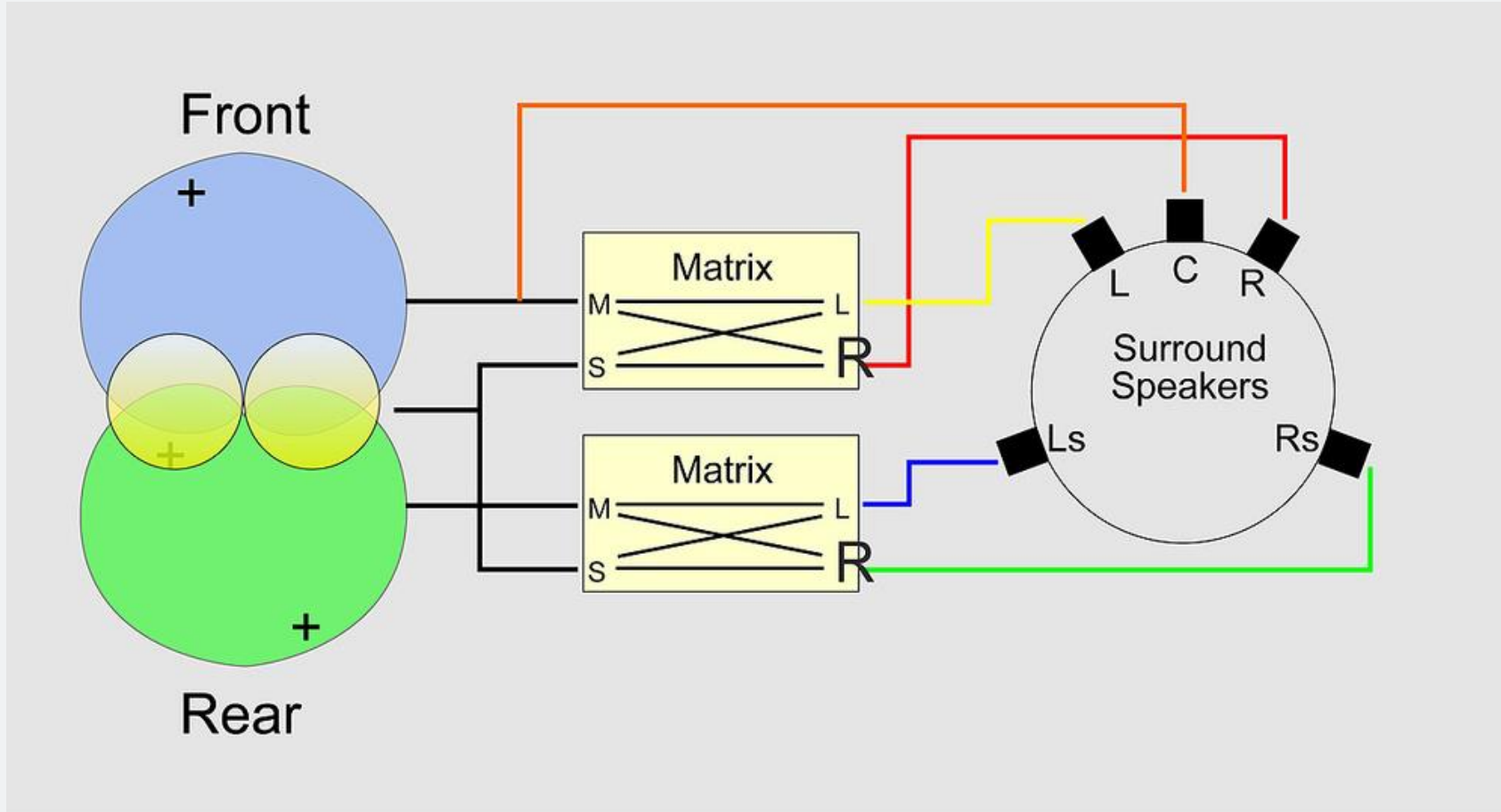


Perspective detail for 9.1 setup

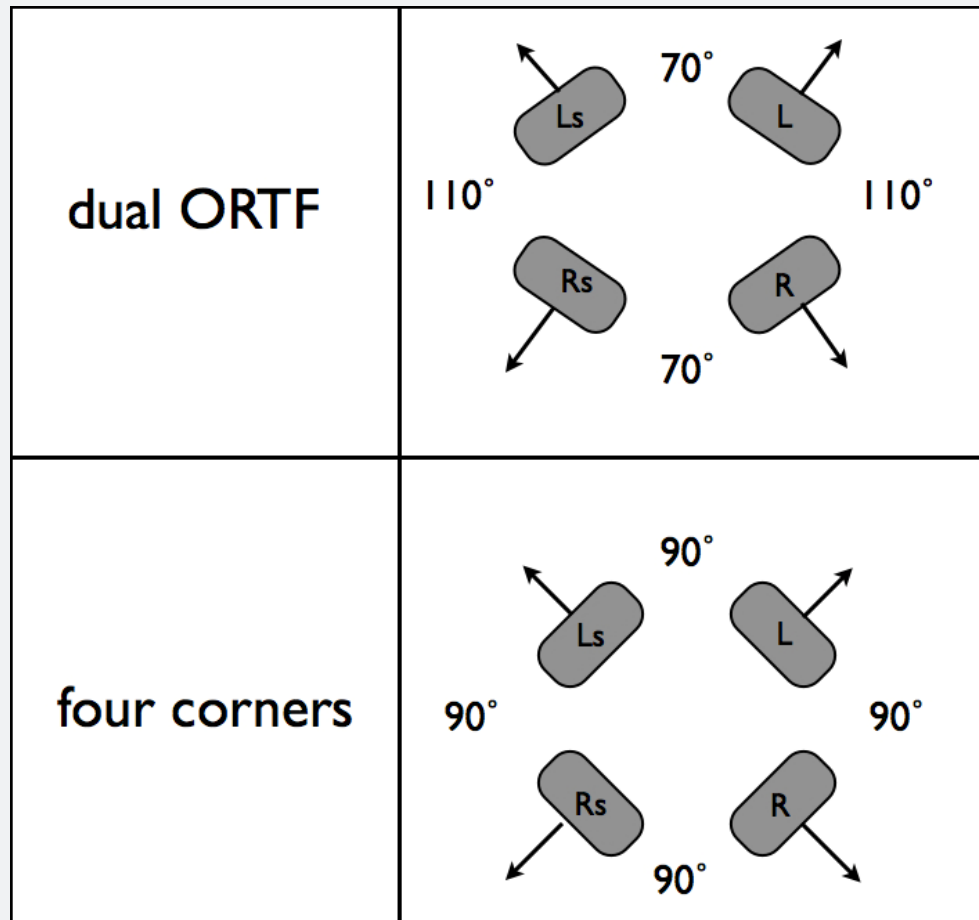


Virtual speaker placement detail for 9.1 setup

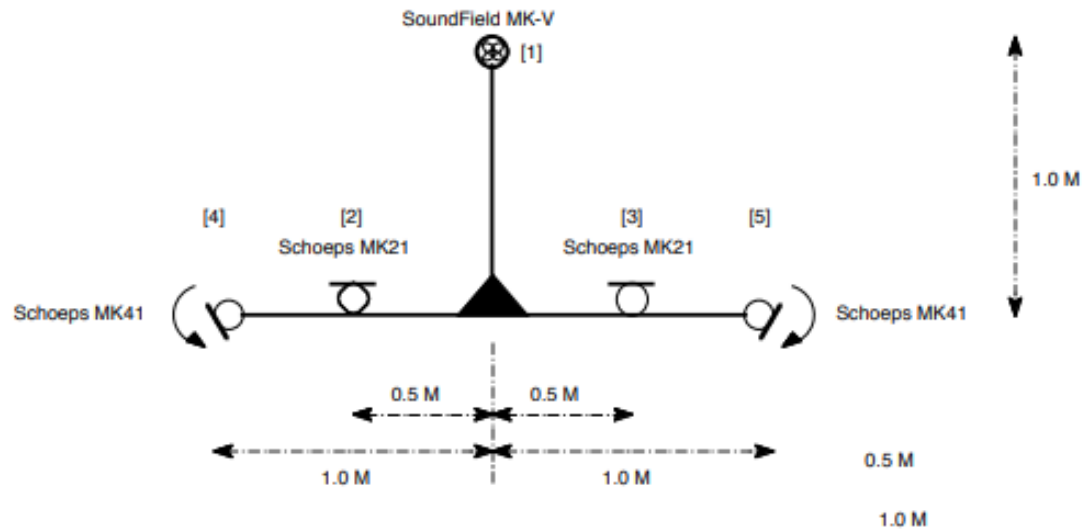
Double-MS



Double-ORTF



Surround-sound Decca tree



STEREO CONFIGURATIONS DERIVED FROM
SURROUND-SOUND DECCA TREE

- 1: SoundField MK-V Microphone (various XY options)
- 2: Near-coincident frontal stereo pair: Mics 2&3
- 3: Near-coincident surround stereo pair: Mics 4&5
- 4: Traditional Decca Tree: Mics 1,2,&3
- 5: "Ambient" Decca Tree: Mics 1,4,&5

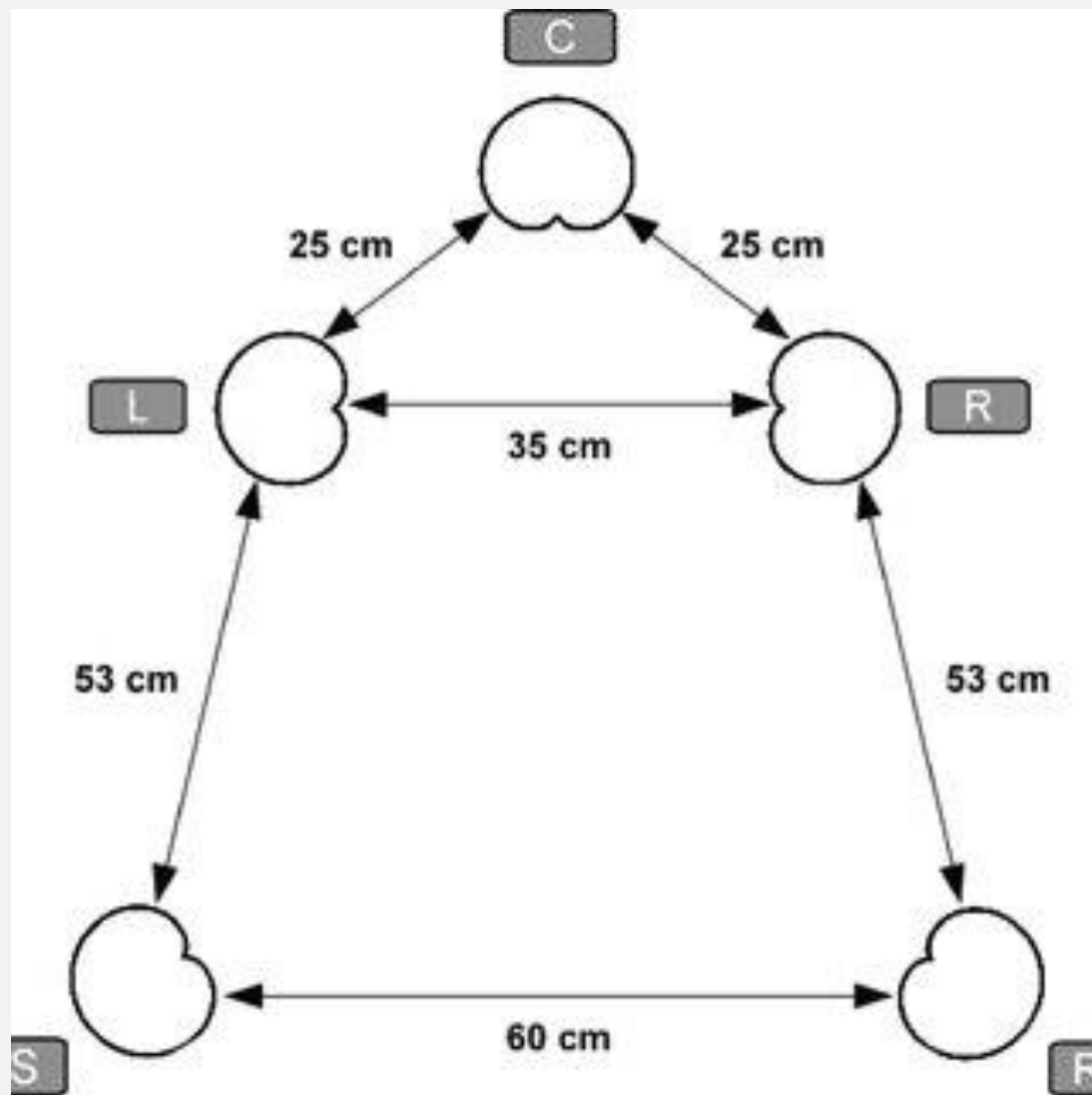
FIGURE-7



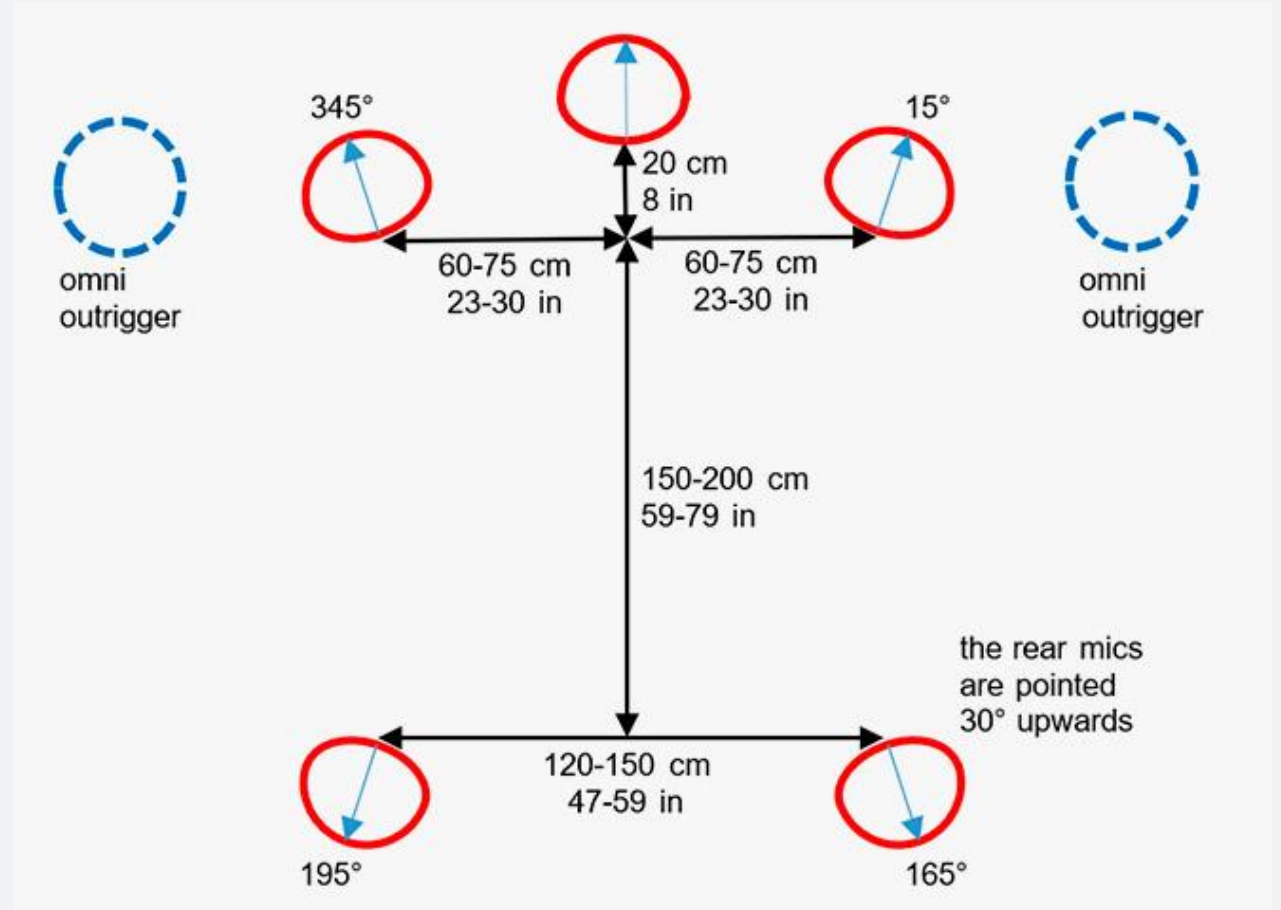
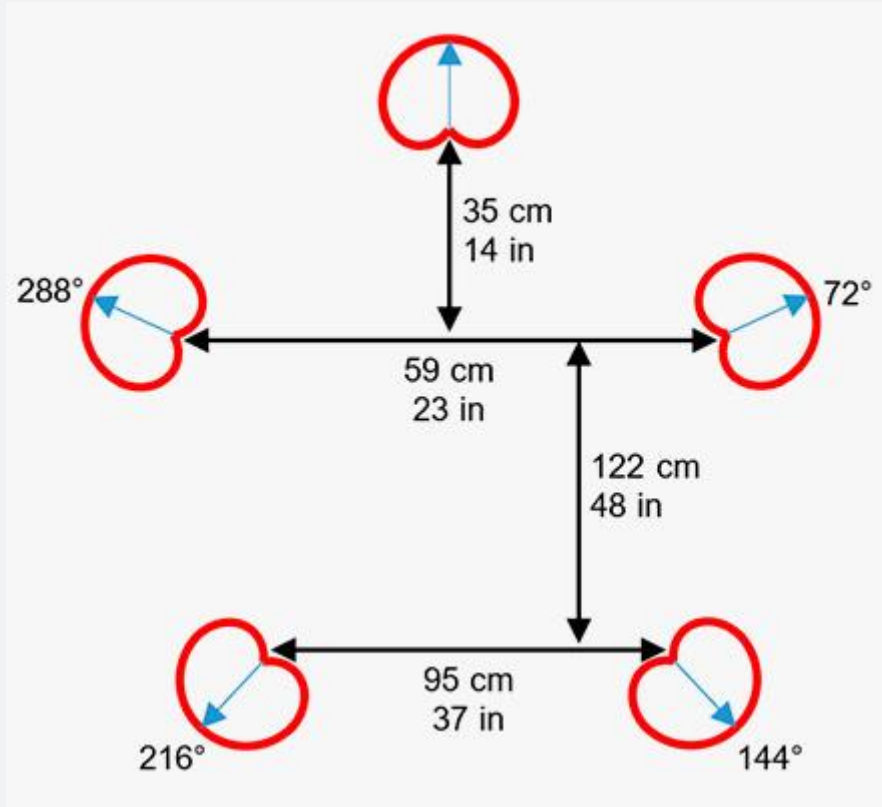
RON STREICHER's
SURROUND-SOUND DECCA TREE

FIGURE-14

INA-5



Fukada tree



Super Audio CD

- Nośnik hybrydowy: warstwa CD stereo oraz 5.1 SACD



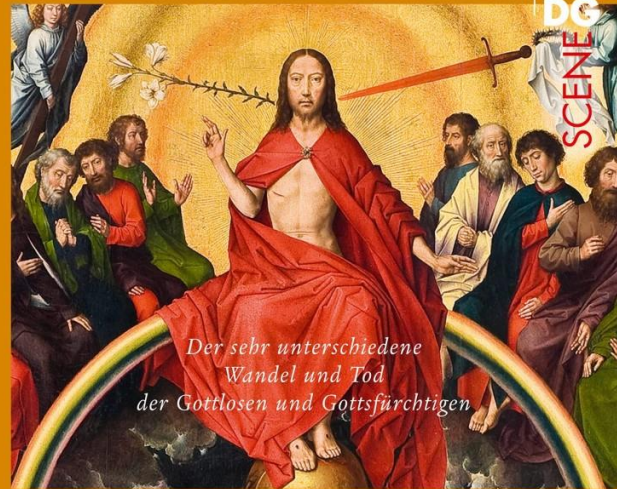
Characteristic	CD layer (optional)	SACD layer
Disc capacity	700 MB ^[12]	4.7 GB ^[13]
Audio encoding	16-bit pulse-code modulation	1-bit Direct Stream Digital
Sampling frequency	44.1 kHz	2,822.4 kHz (2.8224 MHz)
Audio channels	2 (stereo)	Up to 6 (discrete surround)
Playback time if stereo	80 minutes ^[14]	110 minutes without DST compression ^[13]

Wydane płyty SACD w Polsce

- Polskie Radio – *Tryptyk sakralny (Credo Pendereckiego, III Symfonia Góreckiego, Missa pro pace Kilara)* (DVD, SACD) (2006)
- Ars Sonora – Jan Bokszczanin – *Recital Organowy w Kościele Franciszkanów w Zamościu* (SACD) (2022)
- BeArTon – utwory Chopina, Lutosławskiego, Bacewicz, Pendereckiego, Góreckiego, Kilara, Karłowicza, Szymanowskiego (SACD) (2002-2012) (17 płyt)

MUSICA BALTICA 9

JOHANN DANIEL PUCKLITZ
ORATORIO SECONDO



GOLDBERG BAROQUE ENSEMBLE | ANDRZEJ SZADAJKO conductor

English text enclosed • Texte en français inclus • Mit deutschem Text

MDG 902 2241-6

Musica Baltica 9

Johann Daniel Pucklitz: Oratorio Secondo

MUSIKPRODUKTION
DABRINGHAUS UND GRIMM

Der sehr unterschiedene Wandel und Tod der Gottlosen und Gottsfürchtigen (1747)

The very different Conduct and Death of the Godless and God-fearing (1747)

La conduite et la mort très différentes des impies et des craignant Dieu (1747)

Ina Siedlaczek, soprano
David Erler, alto
Georg Poplutz, tenor
Thilo Dahmann, bass

Goldberg Baroque Ensemble
Goldberg Vocal Ensemble
Andrzej Szadajko, conductor

1 - 19	CD 1 – First part	
	Total Time	54'15
1 - 20	CD 2 – Second part	
	Total Time	63'33
CD 1 + CD 2		
	Total Time:	1'58'23



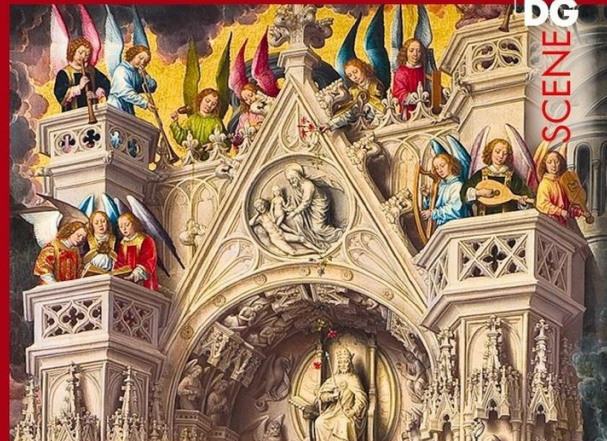
no picture / only music kein Bild / nur Musik	Playable	Stereo	5.1	24/2	222 RECORDING
© + © 2021	CD + DVD-Video + DVD-Audio/Video-Player	+	-	-	
© 2021	SACD - Player	+	+	+	
Made in Germany	Multiplayer (all formats)	+	+	+	

Musikproduktion Dabringhaus und Grimm, Bachstr. 35, D-32756 Detmold, Tel. +49-(0)5231-93890, Fax. +49-(0)5231-26186



MUSICA BALTICA 10

FRIEDRICH CHRISTIAN SAMUEL MOHRHEIM
CANTATAS & ARIAS



SIRI KAROLINE THORNHIL soprano FRANZISKA GOTTWALD alto
VIRGIL HARTINGER tenor STEPHAN MACLEOD bass
GOLDBERG BAROQUE ENSEMBLE / ANDRZEJ SZADAJKO conductor

English text enclosed • Texte en français inclus • Mit deutschem Text

MDG 902 2254-6

Musica Baltica 10

Friedrich Samuel Mohrheim (1719–1780) DABRINGHAUS UND GRIMM

MUSIKPRODUKTION
DABRINGHAUS UND GRIMM

Cantatas & Arias

1 - 6	Der Herr ist mit mir. <i>Festo Annunciationis Mariae (1765)</i> PL-GD Ms Joh. 63	14'24
7 - 12	Uns ist ein Kind geboren. <i>Feria 1. Nativit: Christi</i> PL-GD Ms. Joh. 61	14'48
13 - 16	Ehre sey Gott in der Höhe. <i>Cantata Feria prima Nativitatis Christi. (1778)</i> PL-GD Ms. Joh. 65	11'54
17	Tochter des Himmels. <i>Aria Communio.</i> PL-GD Ms. Joh. 66	6'33
18 - 19	Auserwählte Schar. <i>Festo Michaelis.</i> PL-GD Ms. Joh. 173b	5'27
20 - 28	Der Herr ist Gott, der uns erleuchtet. <i>Feria 2. Pentecost.</i> PL-GD Ms. Joh. 173a	20'39
Total Time		73'47

Siri Karoline Thornhill, soprano
Franziska Gottwald, alto
Virgil Hartinger, tenor
Stephan MacLeod, bass

Goldberg Baroque Ensemble
Goldberg Vocal Ensemble
Andrzej Szadajko, conductor



no picture / only music kein Bild / nur Musik	Playable	Stereo	5.1	24/2	222 RECORDING
© + © 2022	CD + DVD-Video + DVD-Audio/Video-Player	+	-	-	
© 2022	SACD - Player	+	+	+	
Made in Germany	Multiplayer (all formats)	+	+	+	

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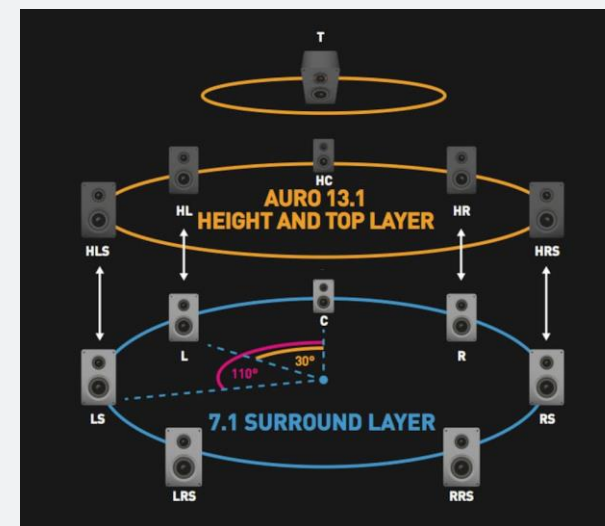


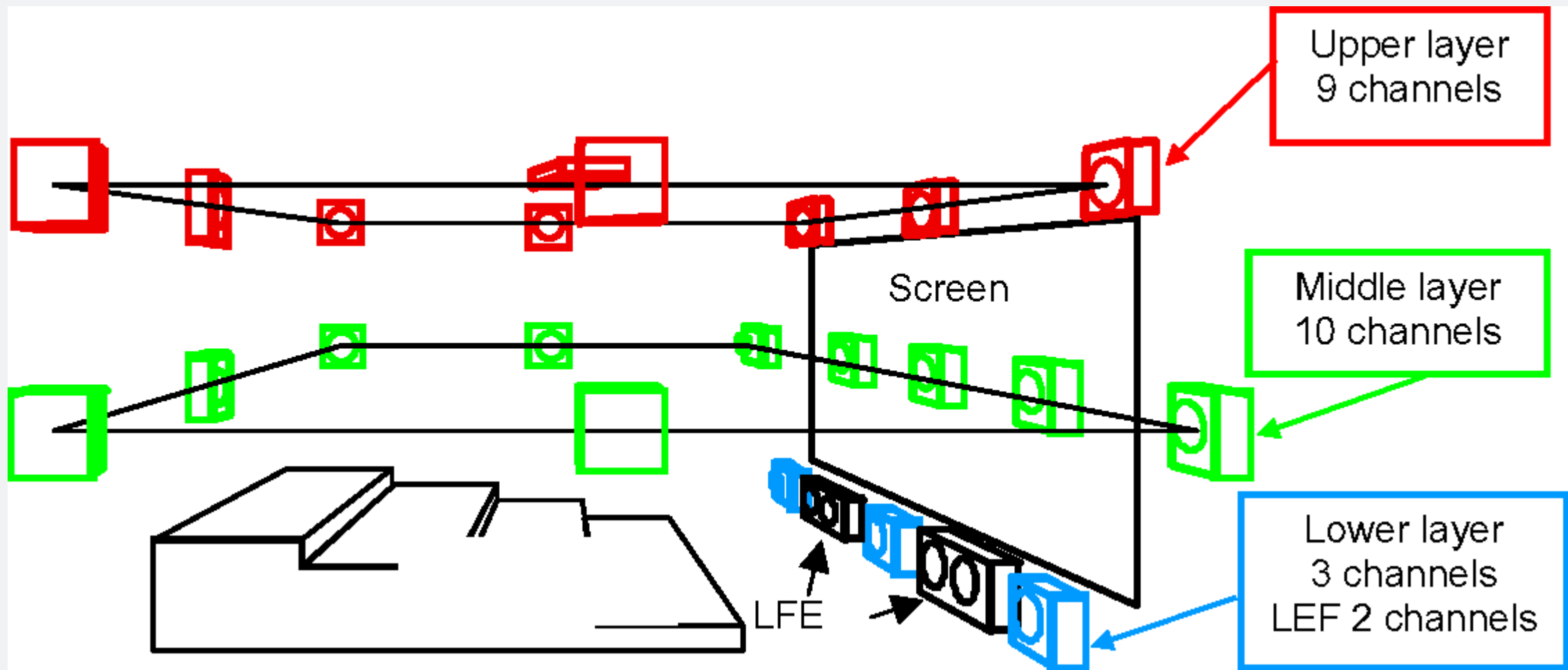
“Dźwięk 3D” (*spatial audio, immersive audio*)

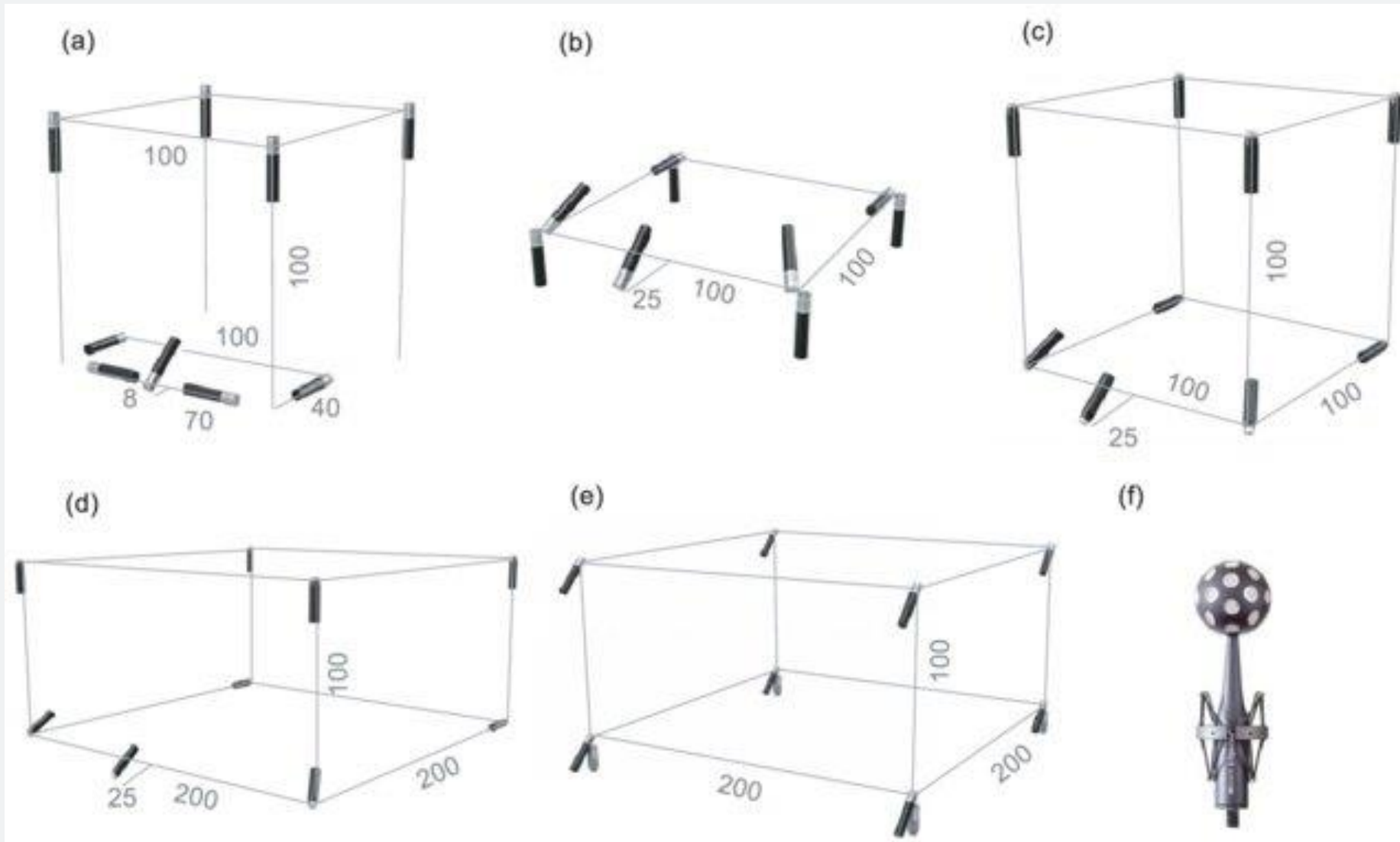
Techniki / technologie dźwięku przestrzennego

- Dolby Atmos
- Auro-3D
- Sony 360 Reality Audio
- MPEG-H 3D Audio
- Hamasaki 22.2
- ambisonia (technika 360, “kompatybilna” z powyższymi, najczęściej spotykana w VR)

➔ 5.1.2, 5.1.4, 7.1.2, 7.1.4, itp. itd. (kanały wysokości to najczęściej ostatnia cyfra)







- (a) OCT-3D, (b) PCMA-3D, (c) 2L-Cube, (d) Decca Cuboid, (e) Hamasaki Cube, (f) Eigenmike EM32.

ORTF-3D



3D-MARCo



Pure Audio Blu-ray (BD)



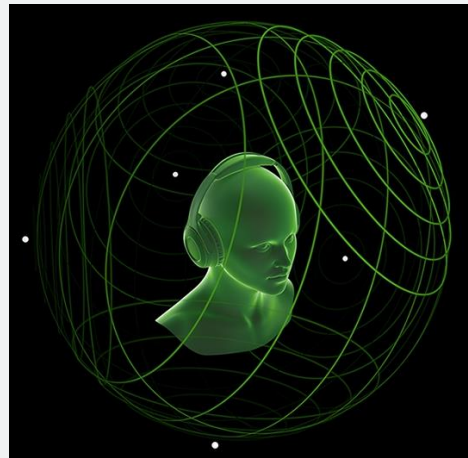
Pure Audio Blu-ray (BD)

Główne wytwórnie płytowe wydające płyty BD:

- Berliner Philharmoniker Recordings (DE)
- Deutsche Grammophon (DE)
- FARAO Classics (DE)
- IAN productions (DE)
- LSO Live (GB)
- 2L (NOR)
- Sono Luminus (US)
- Universal Music (US)

Dźwięk 3D na słuchawkach (*binaural*)

- Apple – AirPods Pro (gen.1, gen.2), AirPods Max, AirPods (gen.3), Beats Fit Pro
- Sony – dużo modeli
- Audio-Technica, Sennheiser, Bose



Platformy streamingowe

 TIDAL

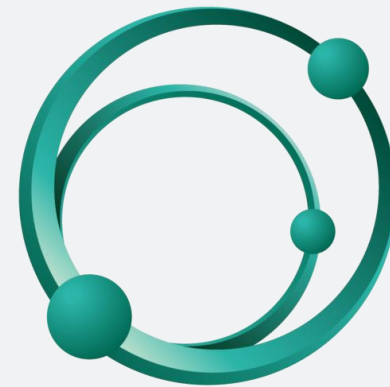
 deezer

 Apple Music

 qobuz

 amazon music

 DOLBY[®]
ATMOS[™]



360
REALITY
AUDIO

Źródła, linki

- <https://theconversation.com/how-stereo-was-first-sold-to-a-skeptical-public-103668>
- https://en.wikipedia.org/wiki/Stereo_%22360_Sound%22#Other_mentions_of_%22_Stereo_360_Sound%22
- <http://www.widescreenmuseum.com/sound/fantasound1.htm>
- <https://variety.com/2020/artisans/awards/george-lucas-dolby-sound-star-wars-1203487459/>
- https://en.wikipedia.org/wiki/Super_Audio_CD
- <https://www.sa-cd.net/showthread/60627/60628>
- <https://www.prsa.pl/print.aspx?id=192269>
- https://dobreplyty.pl/produkt/jan-bokszczanin-recital-organowy-w-kosciele-franciszkanow-w-zamosciu_arso-cd-211-sacd/
- <https://www.bearton.pl/pl/category/sacd/>
- https://www.bearton.pl/pl/kategoria-produktu/super-audio/?product_view=list
- <https://kultura.trojmiasto.pl/Andrzej-Szadejko-wycofuje-swoje-plyty-z-Fryderykow-n175970.html>
- <https://www.pureaudio-bluray.com/>
- <https://pureaudiorecordings.com/en/>
- <https://www.2l.no/pages/album/150.html>
- <https://orcd.co/nidaros-lux>
- <https://www.discogs.com/release/5588236-Queen-A-Night-At-The-Opera>
- <https://www.pinkfloyd.com/tdsotm50/>
- <https://support.apple.com/en-us/HT211775>
- <https://www.sony.com.au/electronics/360-reality-audio#sonyproducts>
- https://przemekdanowski.com/?page_id=36
- <https://www.youtube.com/playlist?list=PLKXwvyq1q-egPCCwiF6ajb49Cadur6uZA>
- <https://hoast.iem.at/channel/cxzT43bTN8EJldgw>