AUT Studio - Introduction

- Antenna Under Test Studio -

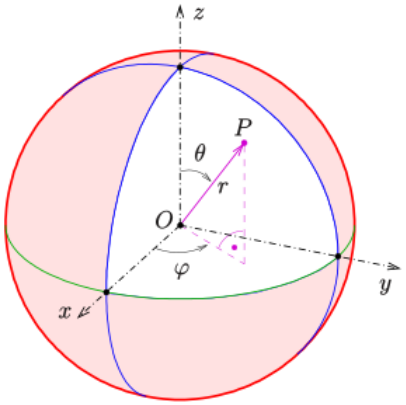
Software to analyze spherical antenna measurement and simulation data of different sources, enabling optimized antenna development process within the automotive industries and all involved companies.

Table of Contents

Application Environment

AUT Studio

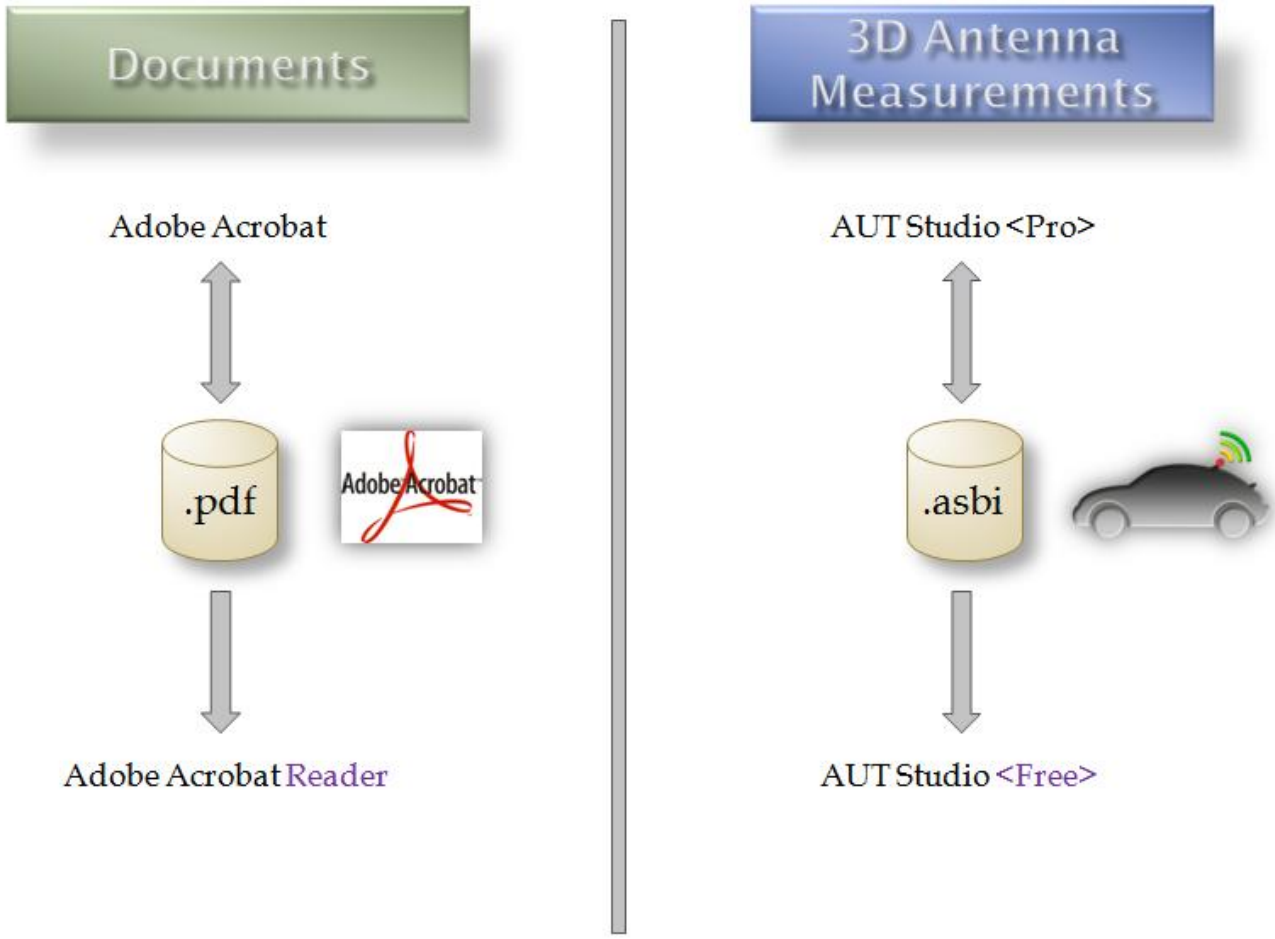
comes with a deep integration of Microsoft Word and Microsoft Excel, which provides the export of data to Excel and the creation of reports with Word.



To meet the requirements of different automotive OEMs, the output coordinate system is customizable.

Data Exchange

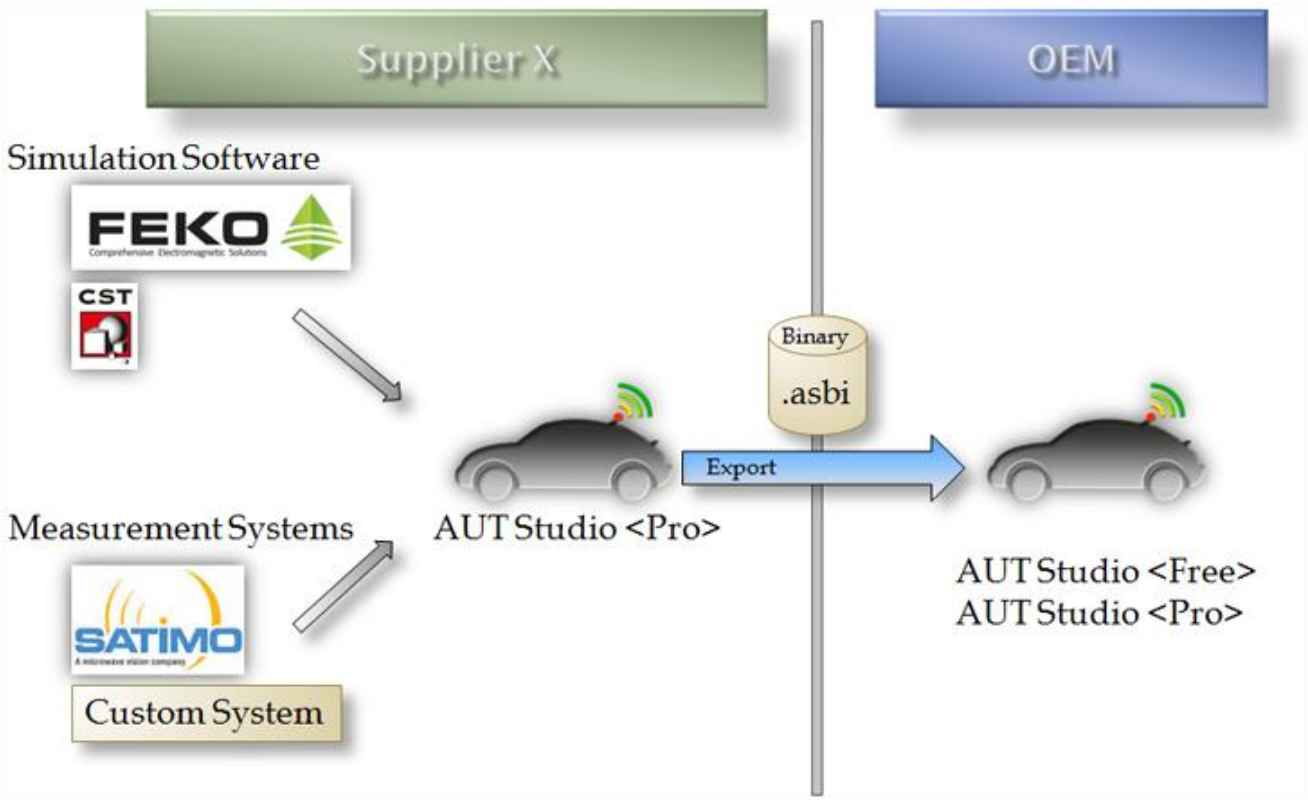
To enable the cooperation of all involved parties of the development process, the data can be exchanged like the Adobe Acrobat principle of the Portable Document Format. **AUT Studio** comes with a free of charge version, which acts as a viewer.



Data Exchange: Example

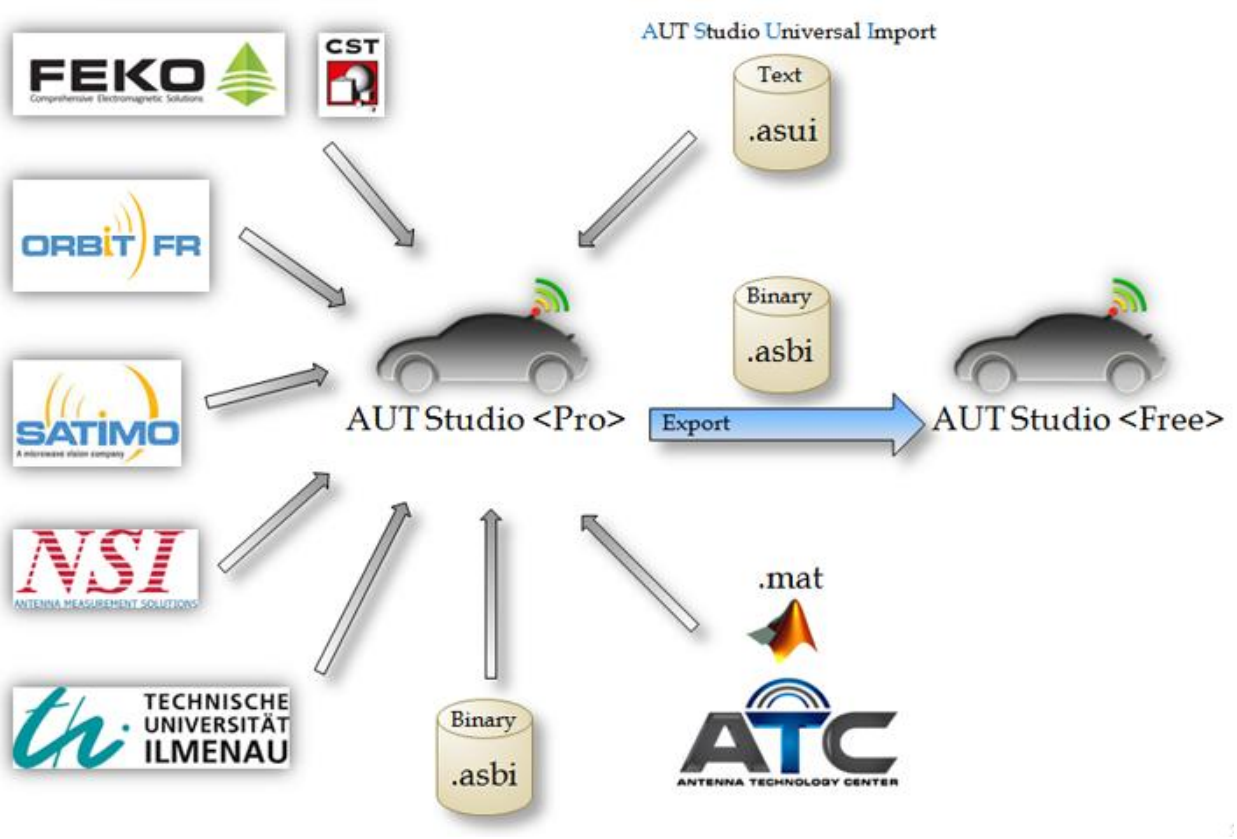
The antenna supplier imports the measurement and/or simulation data to **AUT Studio** with the knowledge of the specific setups of simulation tools, proprietary measurement systems, used car front position etc.

The automotive OEM get the (*.asbi) file from the supplier and can presume that all specifics are considered by the supplier.

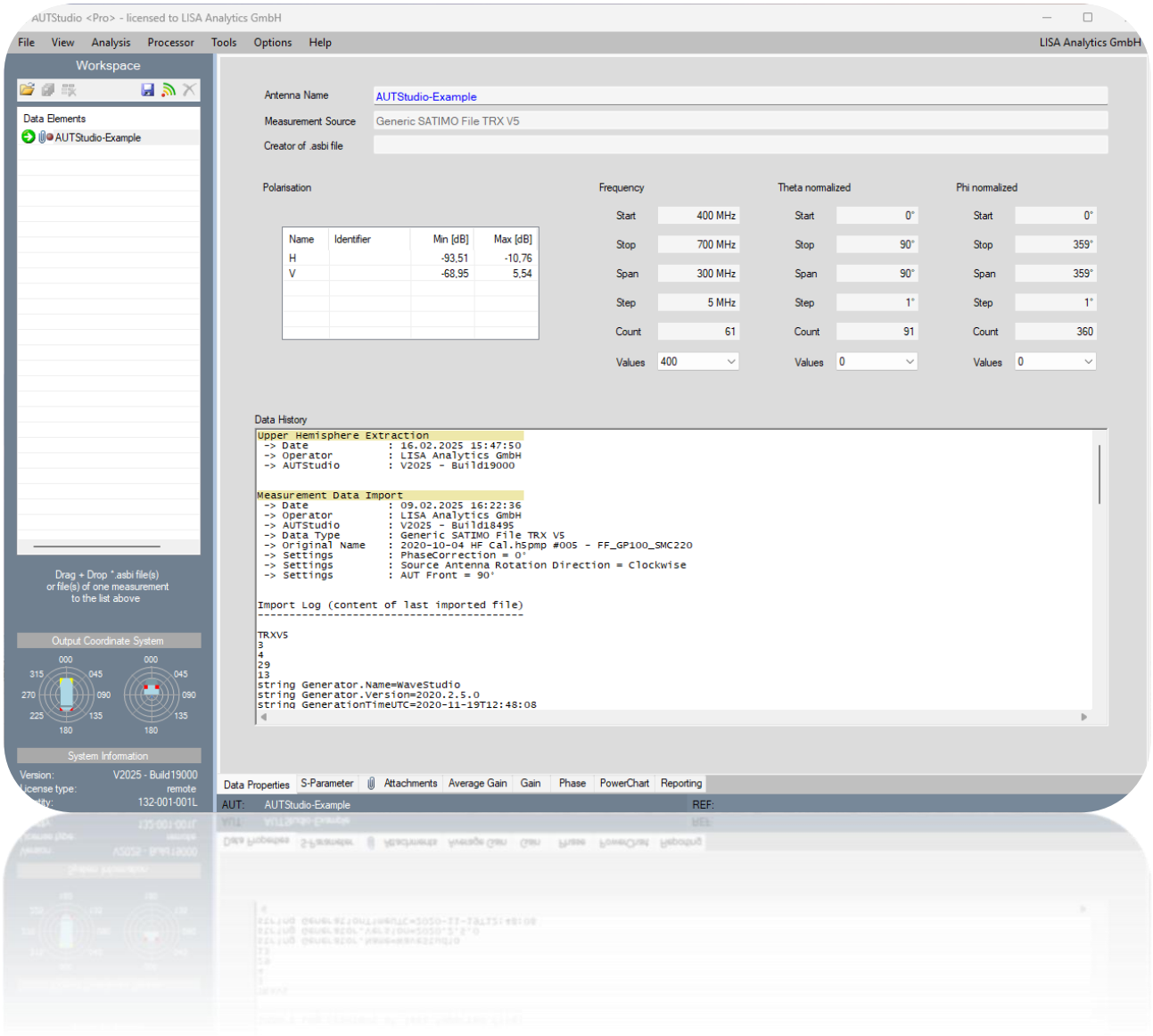


Interfaces

AUT Studio has interfaces to all most used simulation tools and measurement systems. Other systems can be easily integrated in the development process by using the AUT Studio Universal Import (*.asui) text format.

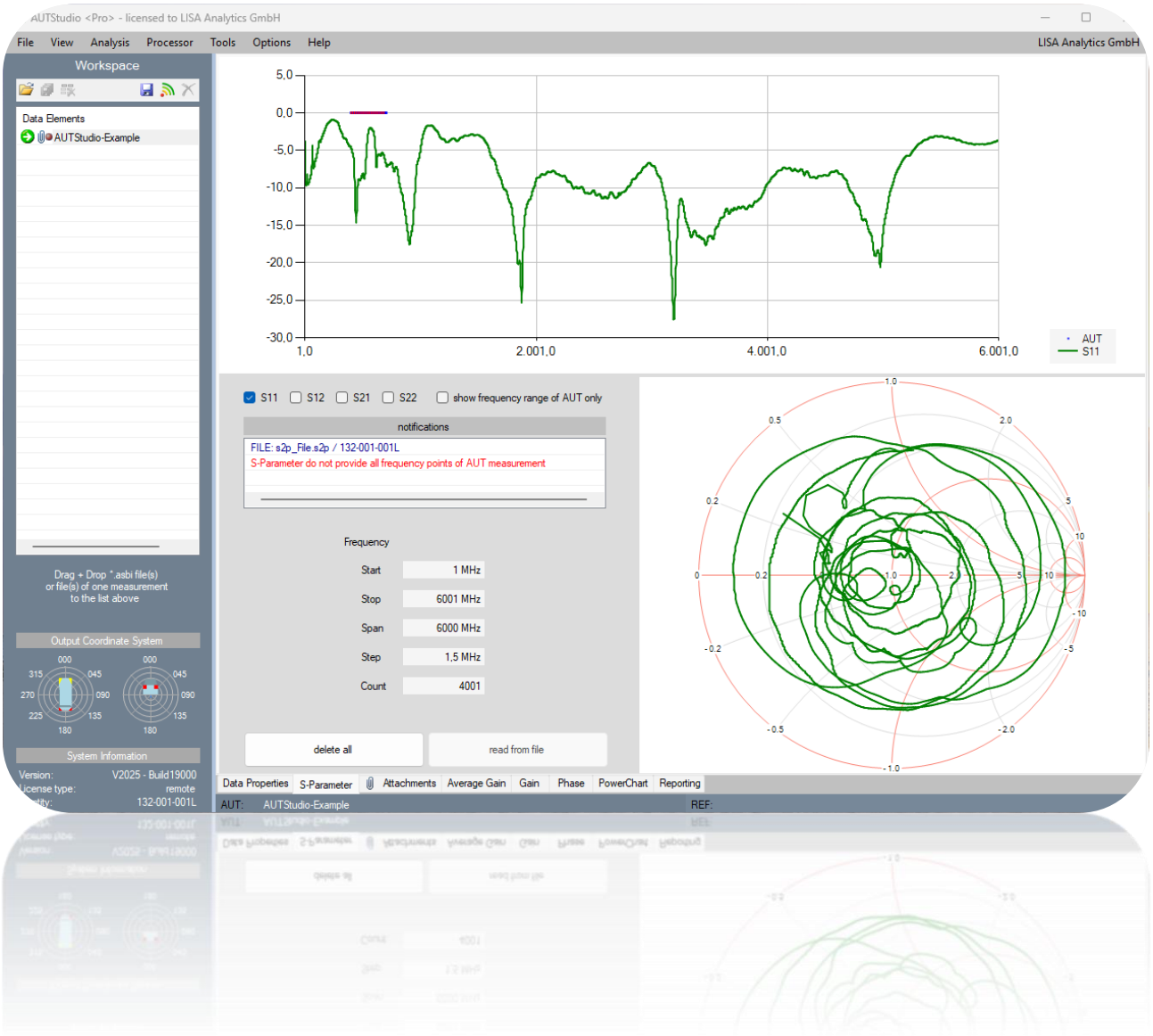


Data Properties



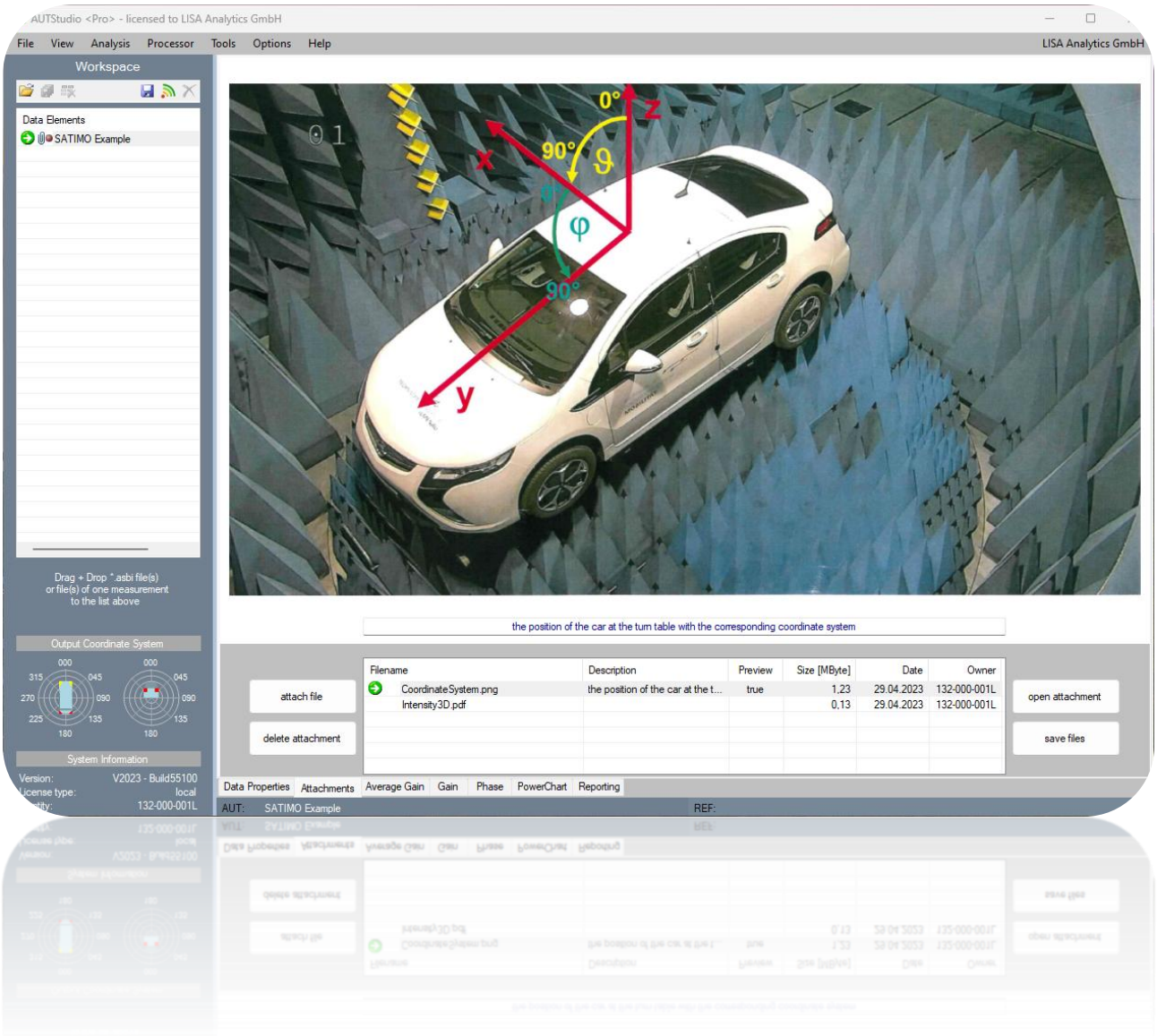
Usually a dataset of a measurement does not contain information about the source. **AUT Studio** documents the import procedure and all data manipulations done by the providing company.

S-Parameter



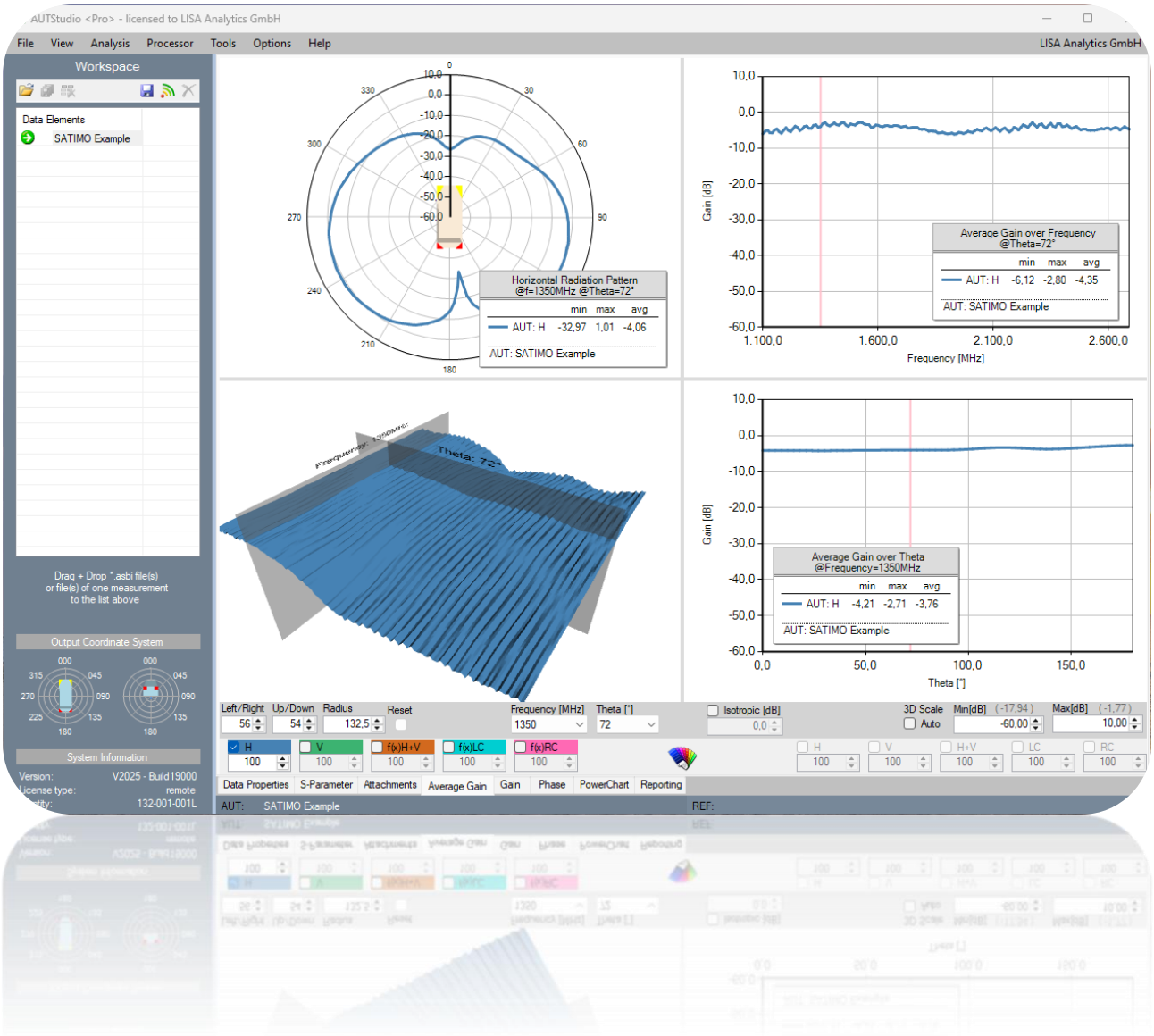
Usually a dataset of a measurement does not contain information about the reflection coefficients or a characteristic amplifier curve. **AUT Studio** allows the storage of such a S-Parameter file.

Attachments



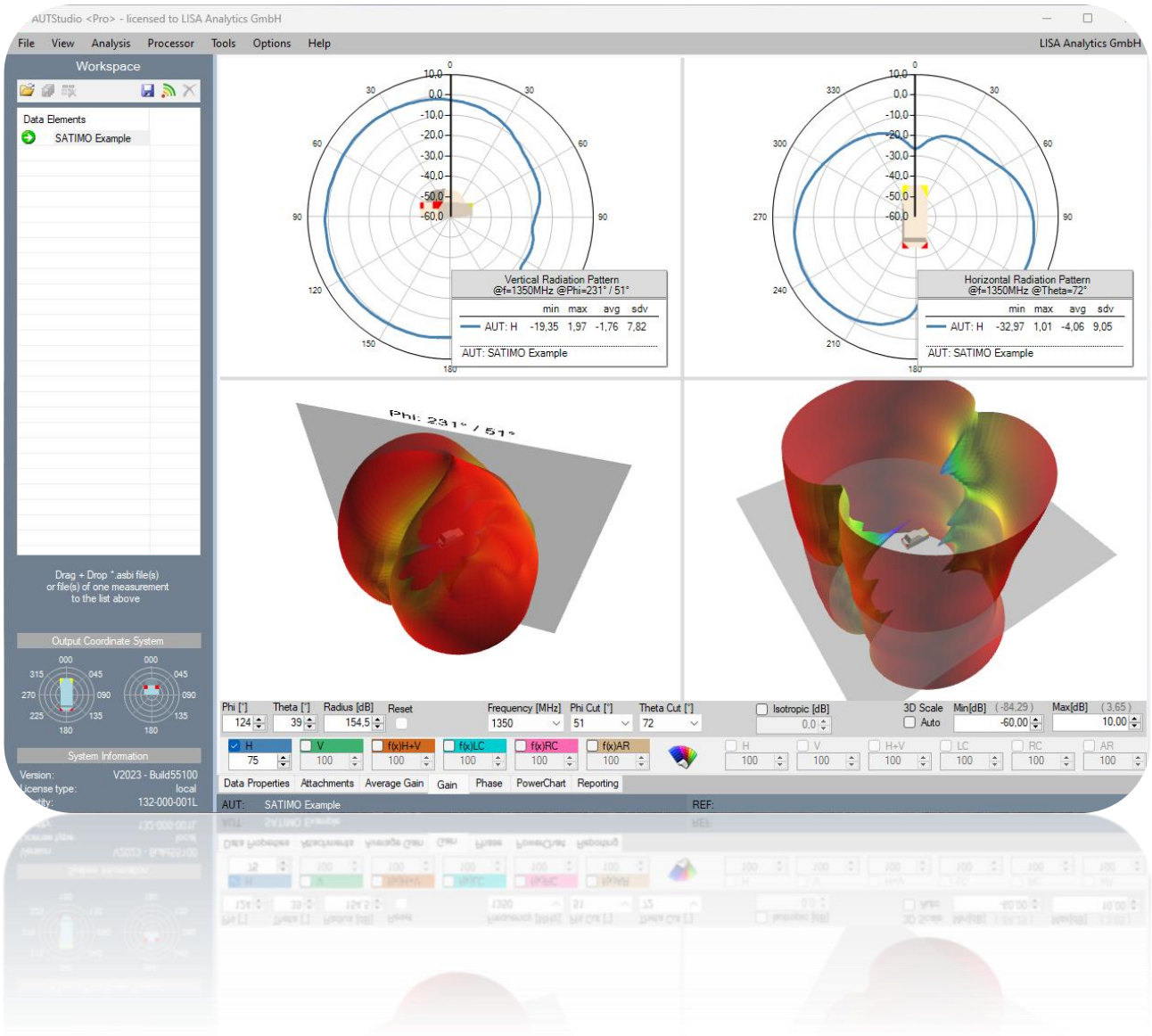
Usually a dataset of a measurement system contains only the measured data of the network analyzer. **AUT Studio** allows attachments for each dataset and provides a quick preview of pictures in place.

Average Gain



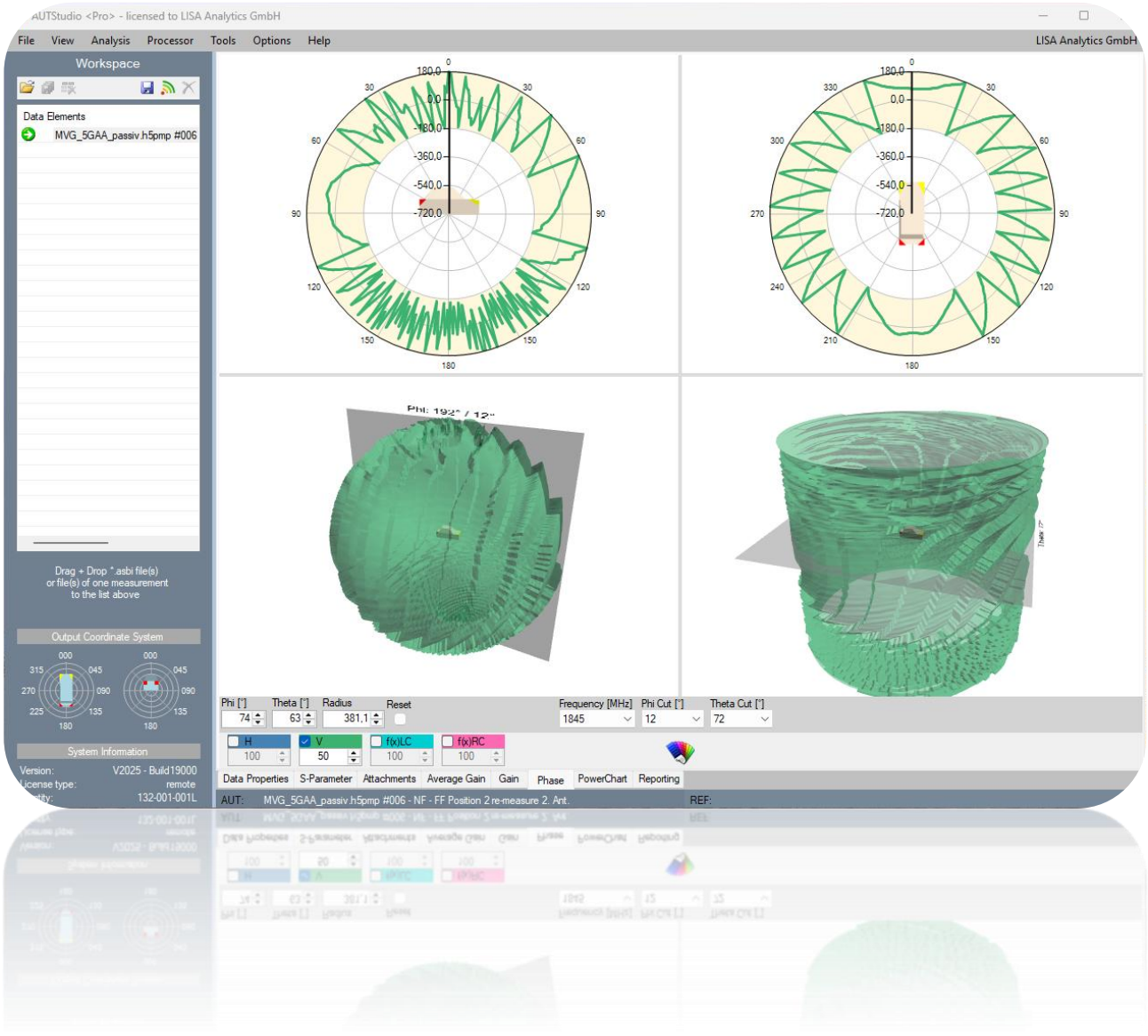
AUT Studio calculates a matrix of average values which allows a review of the measurement at a glance.
With an easy to use interactive charting it is a good starting point for comprehensive comparisons…

Gain



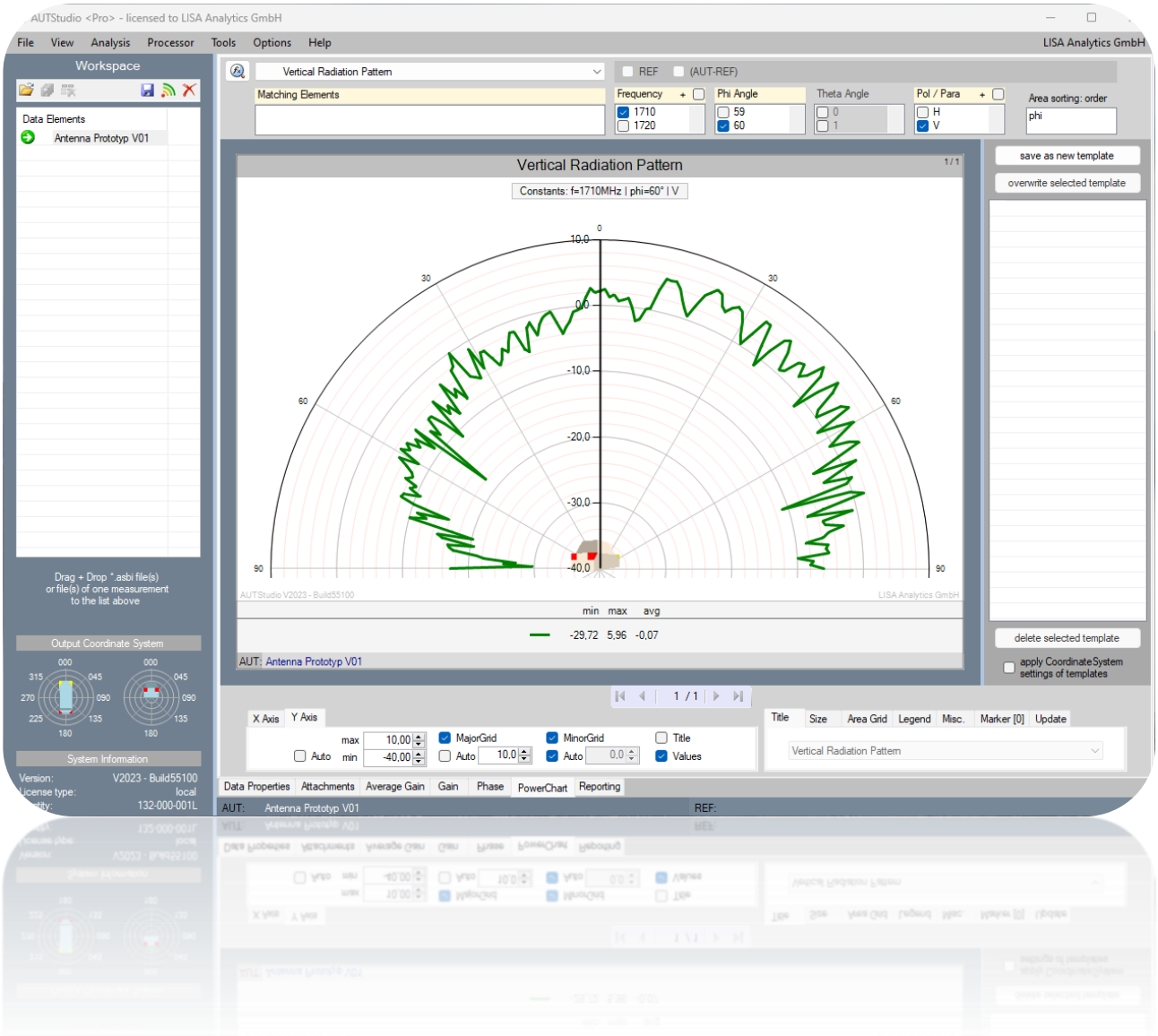
An <u>interactive “on the fly” 3D view</u> algorithm brings the visualization part of a measurement system or simulation tool to the engineer’s desktop.

Phase



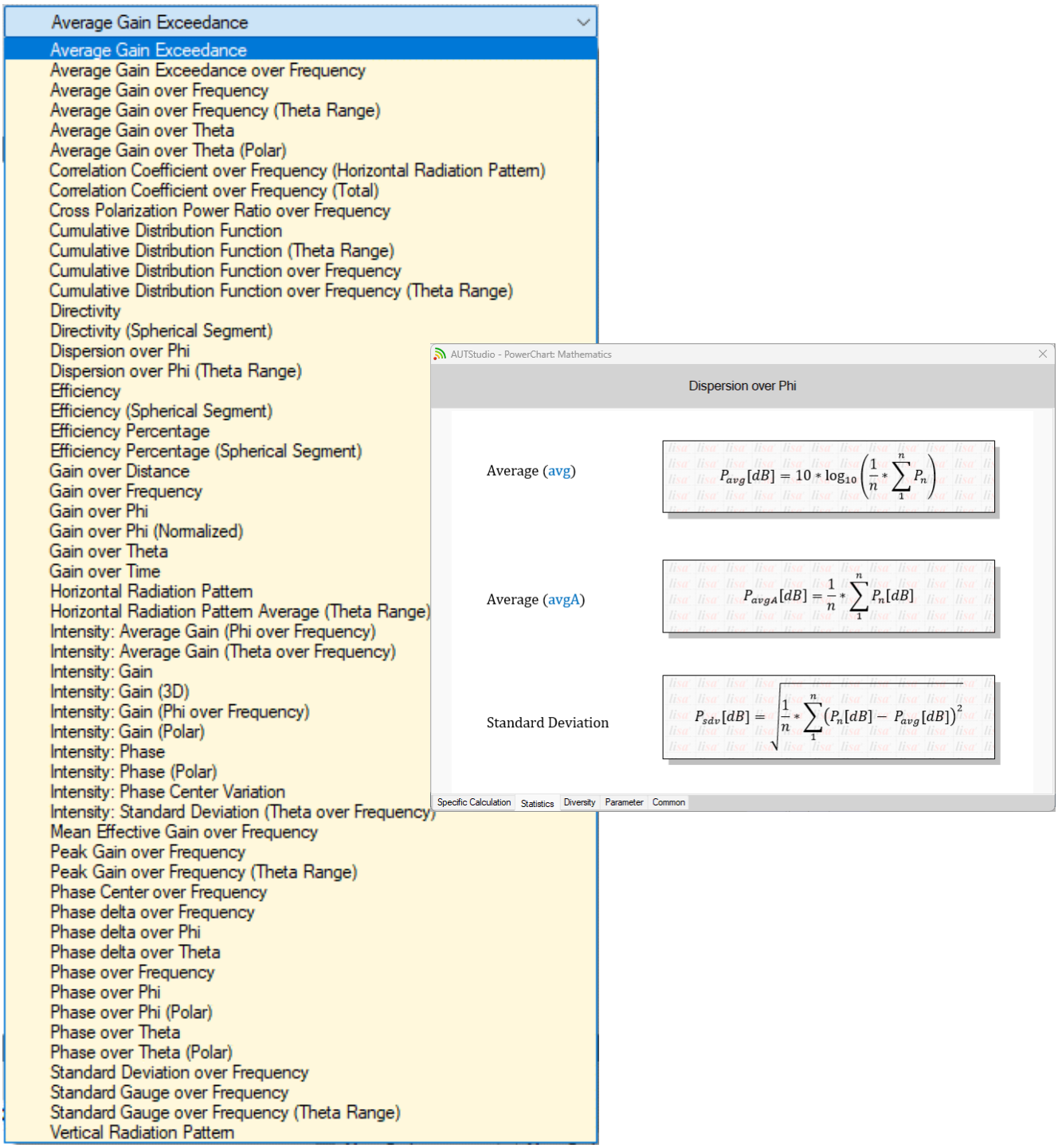
An <u>interactive “on the fly” 3D view</u> algorithm brings the visualization part of a measurement system or simulation tool to the engineer’s desktop.

PowerChart



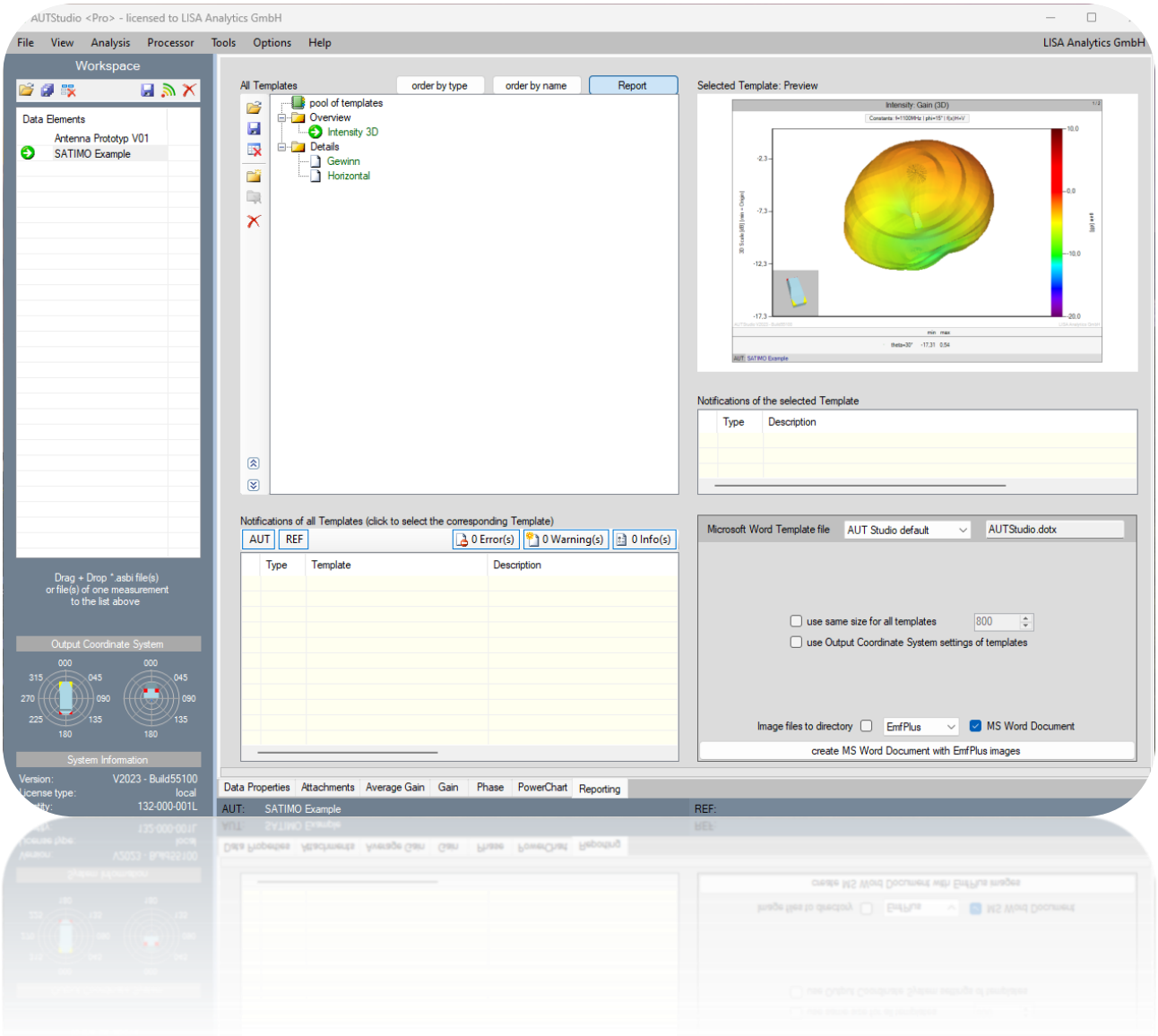
PowerChart contains a pool of requested analyzing methods of the automotive industry, gathered during 10 years. It contains Time Domain, Correlation, Diversity und Intensity charts. Configurations (limits of axis, grids, etc.) can be saved as Templates, used for reporting.

PowerChart: All available Types



To allow a correct interpretation of the shown results, **PowerChart** has open mathematics for each type of chart.

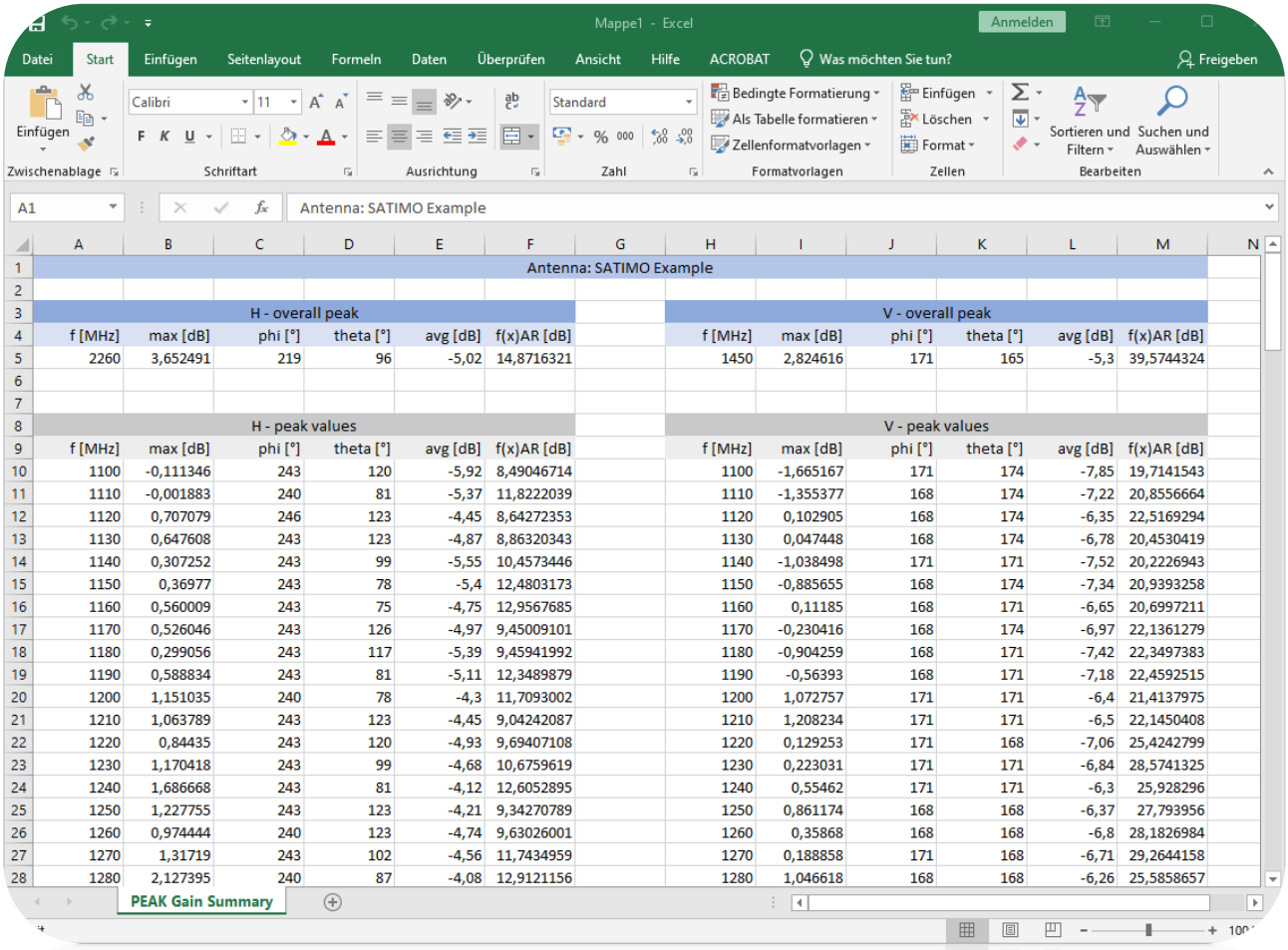
Reporting



Reporting is a very powerful and time saving function based on Templates, defined with **PowerChart**. It creates a self-defined report with MS Word or a directory structure with graphic files within seconds. To create the same report for another measurement it needs only a few clicks.

Data Summaries

Detailed data summaries are available and the calculated data is provided as a MS Excel Sheet.



Antenna: SATIMO Example

H - overall peak					
f [MHz]	max [dB]	phi [°]	theta [°]	avg [dB]	f(x)AR [dB]
2260	3,652491	219	96	-5,02	14,8716321

V - overall peak					
f [MHz]	max [dB]	phi [°]	theta [°]	avg [dB]	f(x)AR [dB]
1450	2,824616	171	165	-5,3	39,5744324

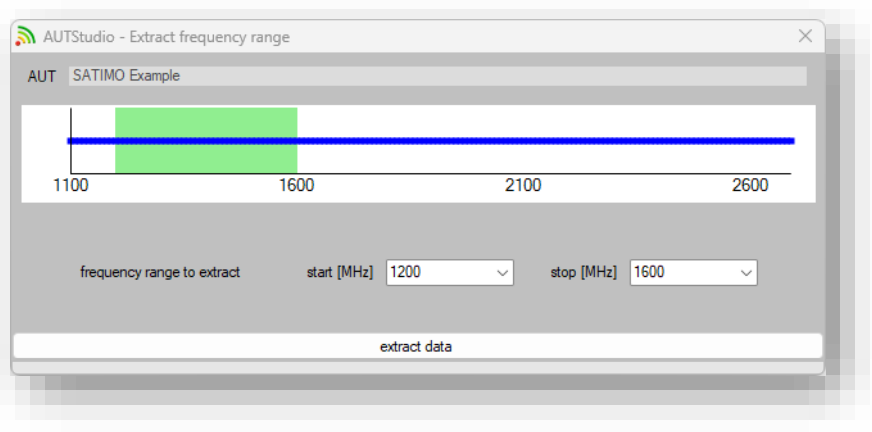
H - peak values					
f [MHz]	max [dB]	phi [°]	theta [°]	avg [dB]	f(x)AR [dB]
1100	-0,111346	243	120	-5,92	8,49046714
1110	-0,001883	240	81	-5,37	11,8222039
1120	0,707079	246	123	-4,45	8,64272353
1130	0,647608	243	123	-4,87	8,86320343
1140	0,307252	243	99	-5,55	10,4573446
1150	0,36977	243	78	-5,4	12,4803173
1160	0,560009	243	75	-4,75	12,9567685
1170	0,526046	243	126	-4,97	9,45009101
1180	0,299056	243	117	-5,39	9,45941992
1190	0,588834	243	81	-5,11	12,3489879
1200	1,151035	240	78	-4,3	11,7093002
1210	1,063789	243	123	-4,45	9,04242087
1220	0,84435	243	120	-4,93	9,69407108
1230	1,170418	243	99	-4,68	10,6759619
1240	1,686668	243	81	-4,12	12,6052895
1250	1,227755	243	123	-4,21	9,34270789
1260	0,974444	240	123	-4,74	9,63026001
1270	1,31719	243	102	-4,56	11,7434959
1280	2,127395	240	87	-4,08	12,9121156

V - peak values					
f [MHz]	max [dB]	phi [°]	theta [°]	avg [dB]	f(x)AR [dB]
1100	-1,665167	171	174	-7,85	19,7141543
1110	-1,355377	168	174	-7,22	20,8556664
1120	0,102905	168	174	-6,35	22,5169294
1130	0,047448	168	174	-6,78	20,4530419
1140	-1,038498	171	171	-7,52	20,2226943
1150	-0,885655	168	174	-7,34	20,9393258
1160	0,11185	168	171	-6,65	20,6997211
1170	-0,230416	168	174	-6,97	22,1361279
1180	-0,904259	168	171	-7,42	22,3497383
1190	-0,56393	168	171	-7,18	22,4592515
1200	1,072757	171	171	-6,4	21,4137975
1210	1,208234	171	171	-6,5	22,1450408
1220	0,129253	171	168	-7,06	25,4242799
1230	0,223031	171	171	-6,84	28,5741325
1240	0,55462	171	171	-6,3	25,928296
1250	0,861174	168	168	-6,37	27,793956
1260	0,35868	168	168	-6,8	28,1826984
1270	0,188858	171	168	-6,71	29,2644158
1280	1,046618	168	168	-6,26	25,5858657

Data Manipulation

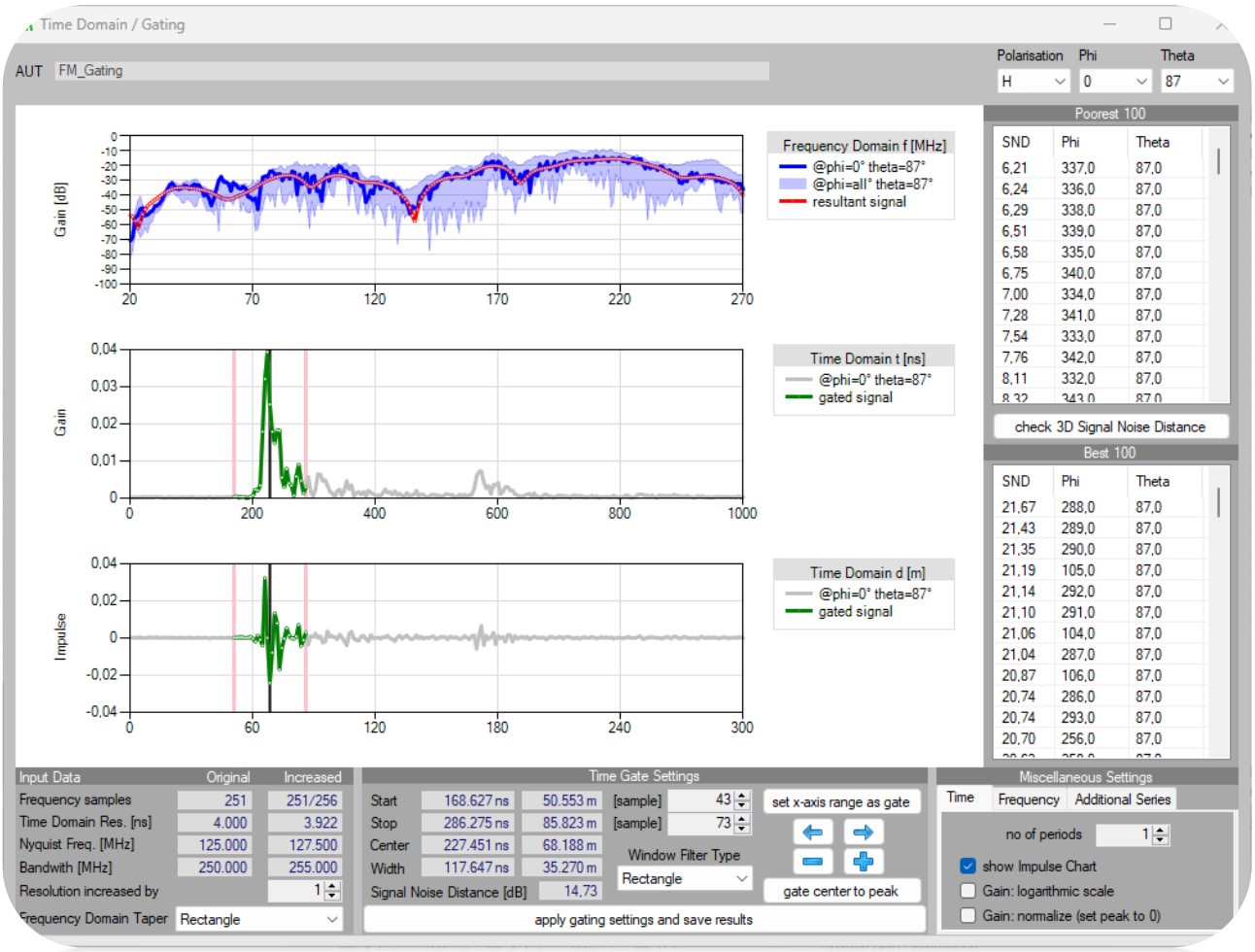
Sometimes it is necessary to have only some frequency points, only a specific theta range or only the upper hemisphere of a measurement/simulation dataset.

AUT Studio provides some functions to do that and creates the result as a new dataset, without changing the original dataset.



The new dataset contains a manipulation history, which is shown on the page Data Properties / Data History

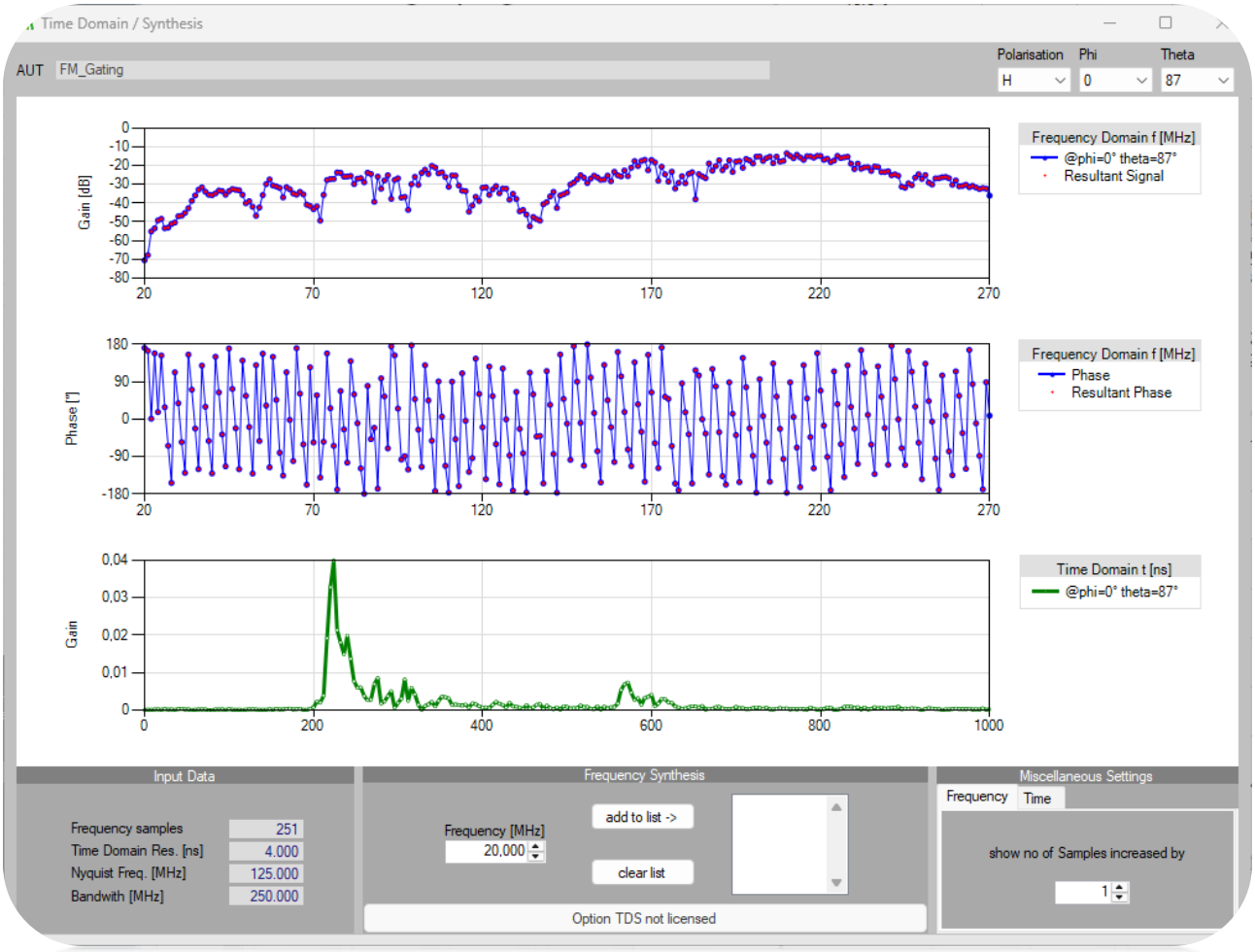
Time Domain Gating



With a very comprehensive and easy to use time domain gating function you can take a look behind the scenes and reduce the noise, the signal eventually contains.

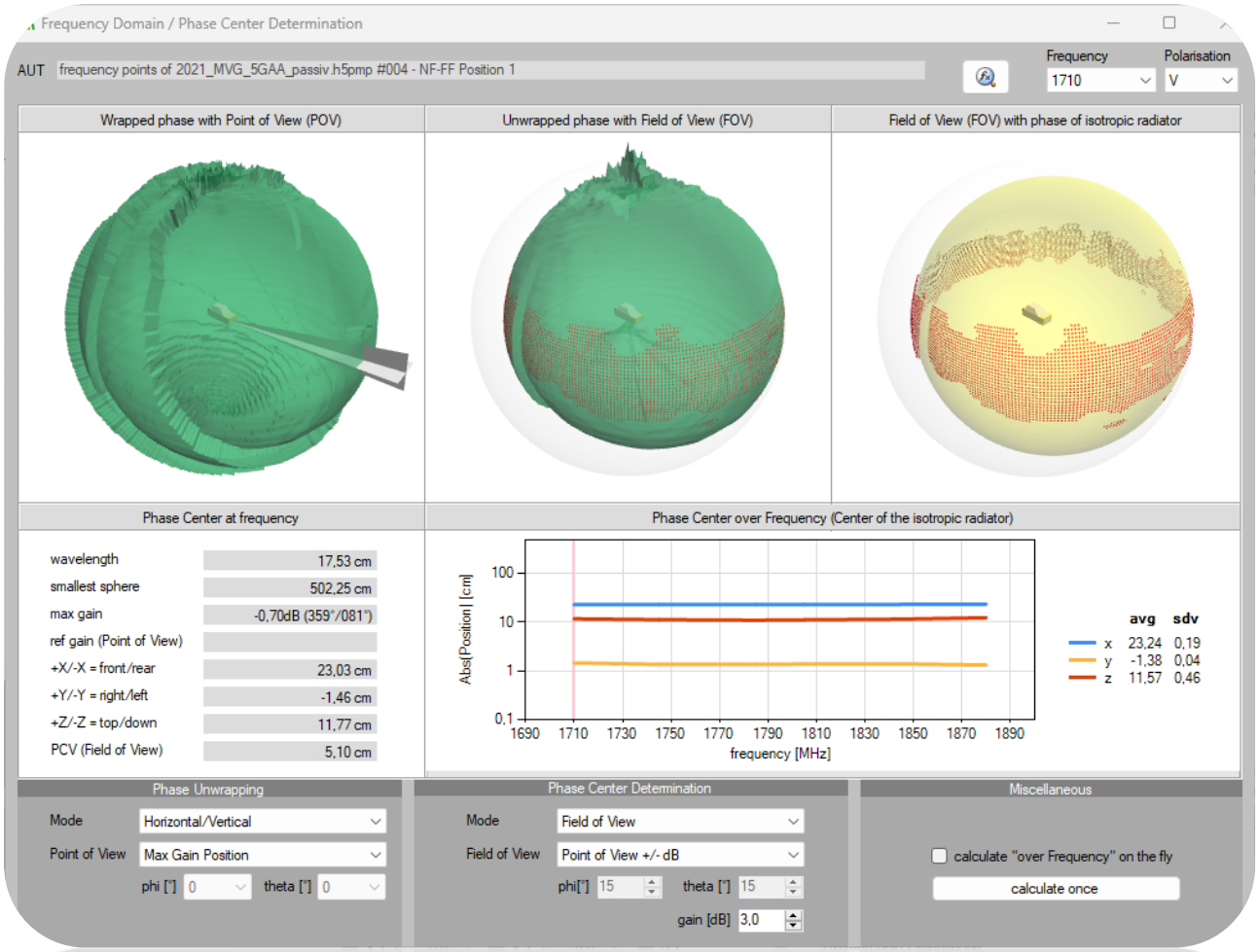
This function creates a new dataset and documents itself by adding an attachment and maintaining the data history.

Time Domain Synthesis



The time domain function can synthesize frequency points which was not measured. That makes it possible to create dedicated frequency points or to create a frequency sweep with a smaller step size in retrospect.

Phase Center Determination



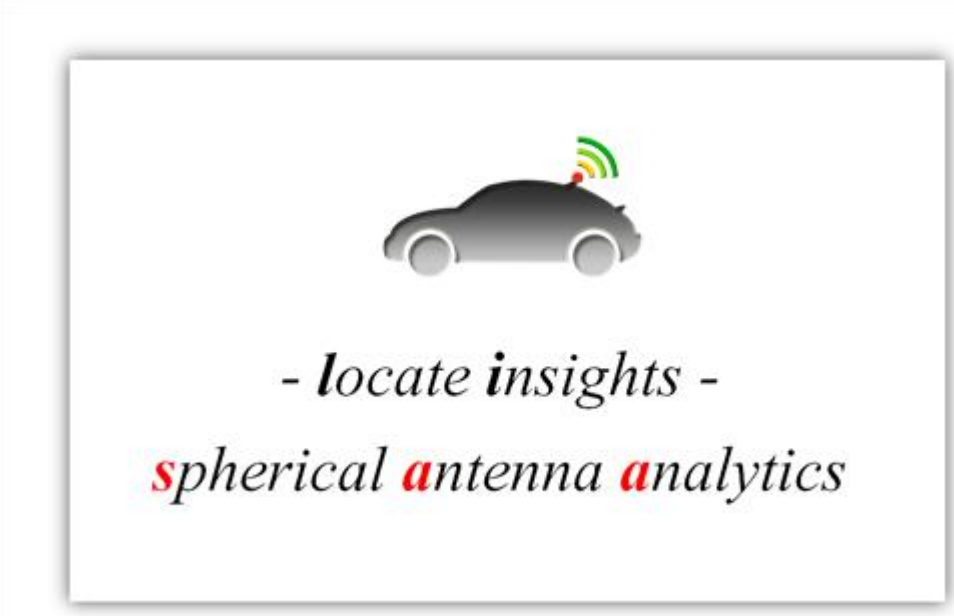
To determine the phase center, it is necessary to unwrap the phase, define the Point of View and the Field of View. **AUT Studio** visualizes all three steps and the resulting isotropic radiator, which makes the verification of the chosen settings possible.

Contact Information

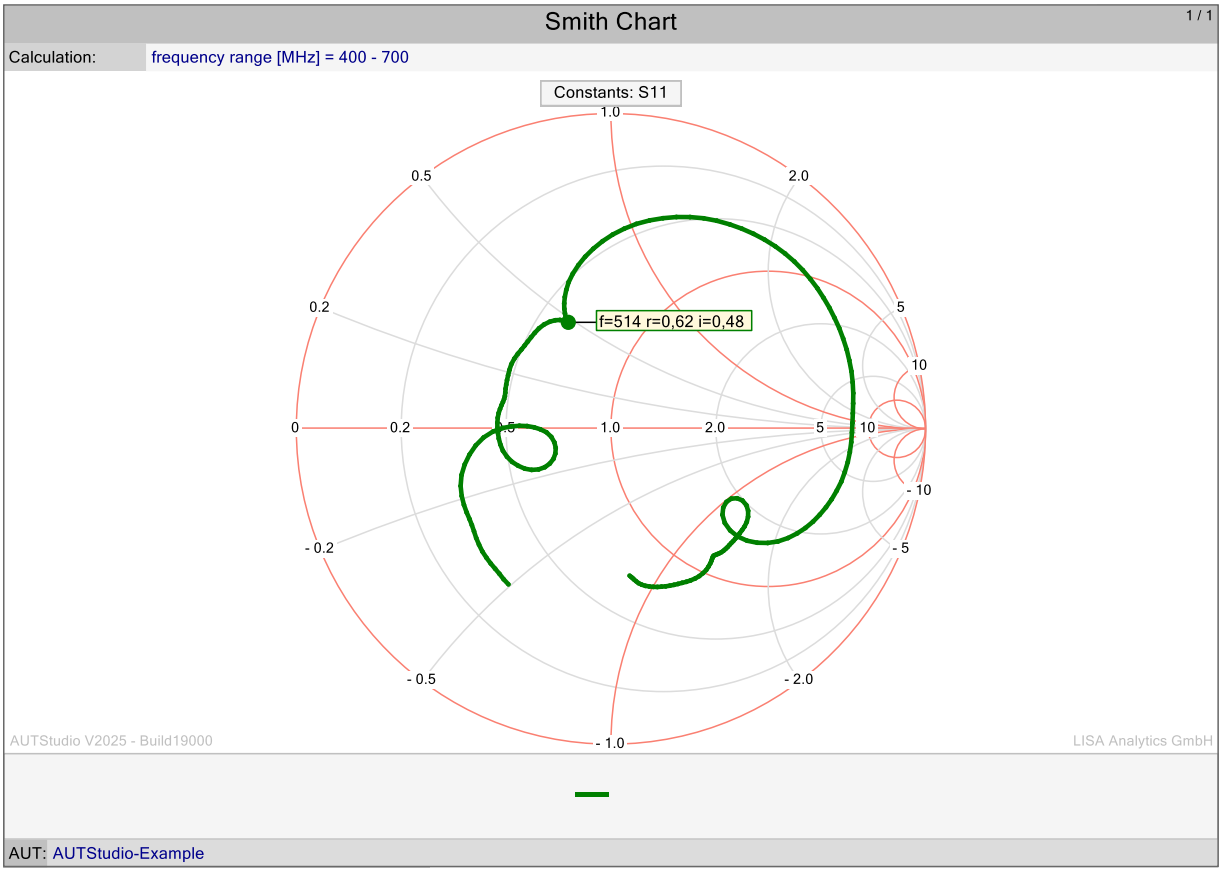
LISA Analytics GmbH
www.lisa-analytics.de

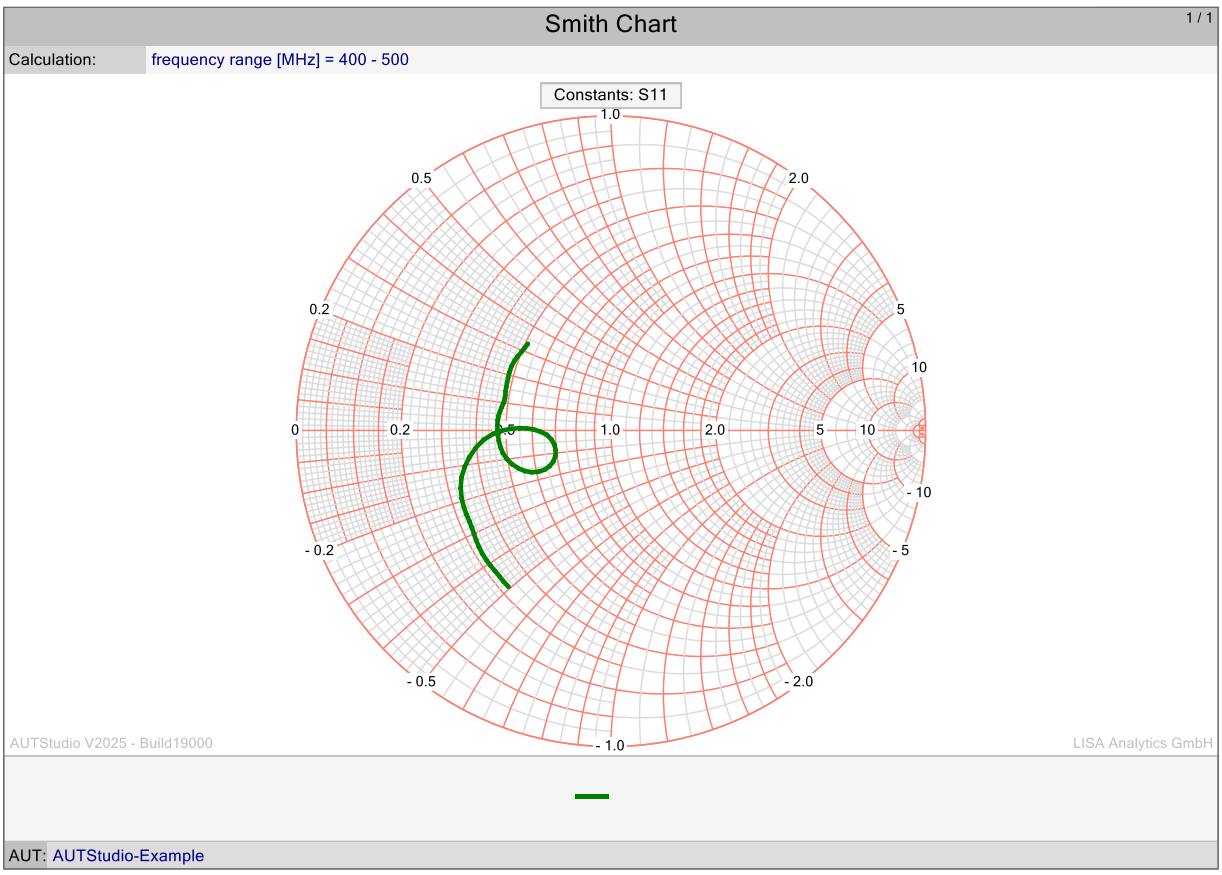
Holger Försterling
Managing Director

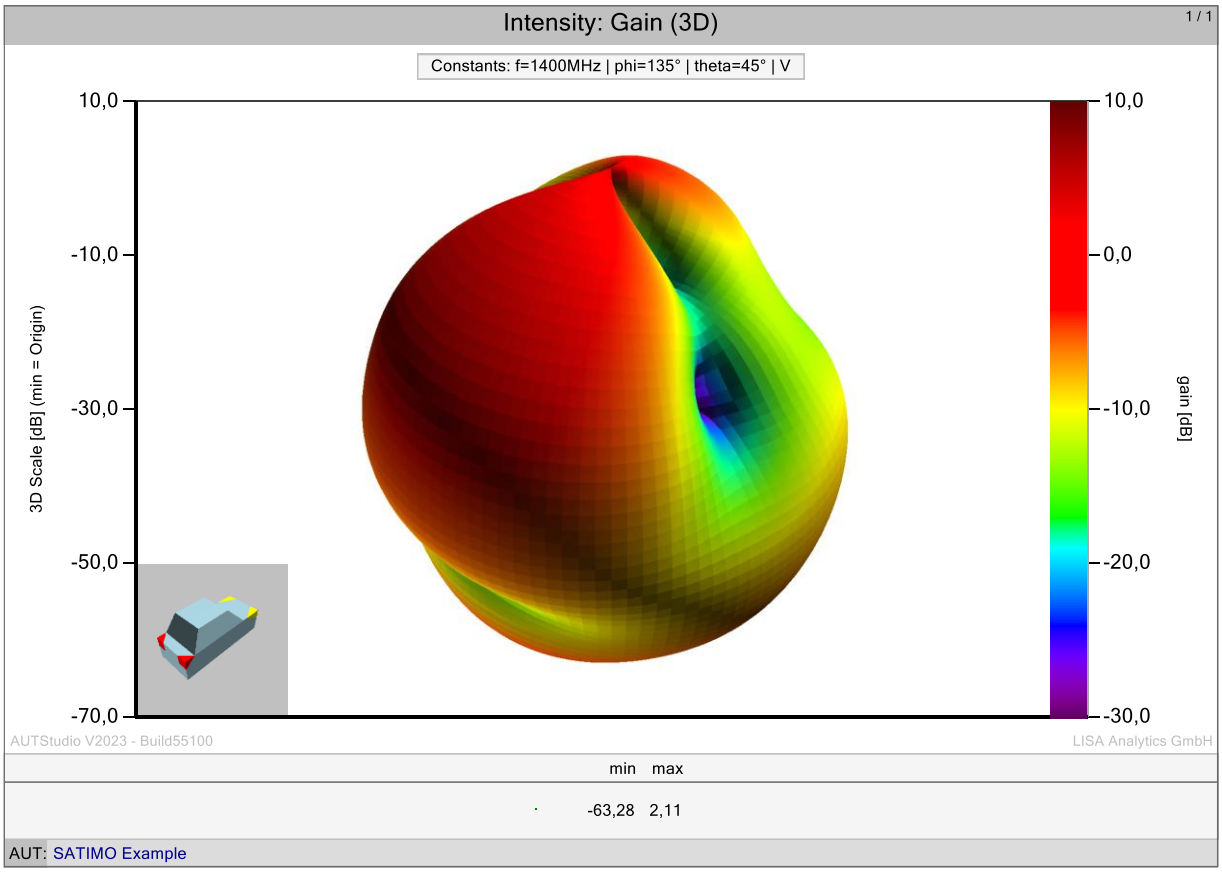
holger.foersterling@lisa-analytics.de

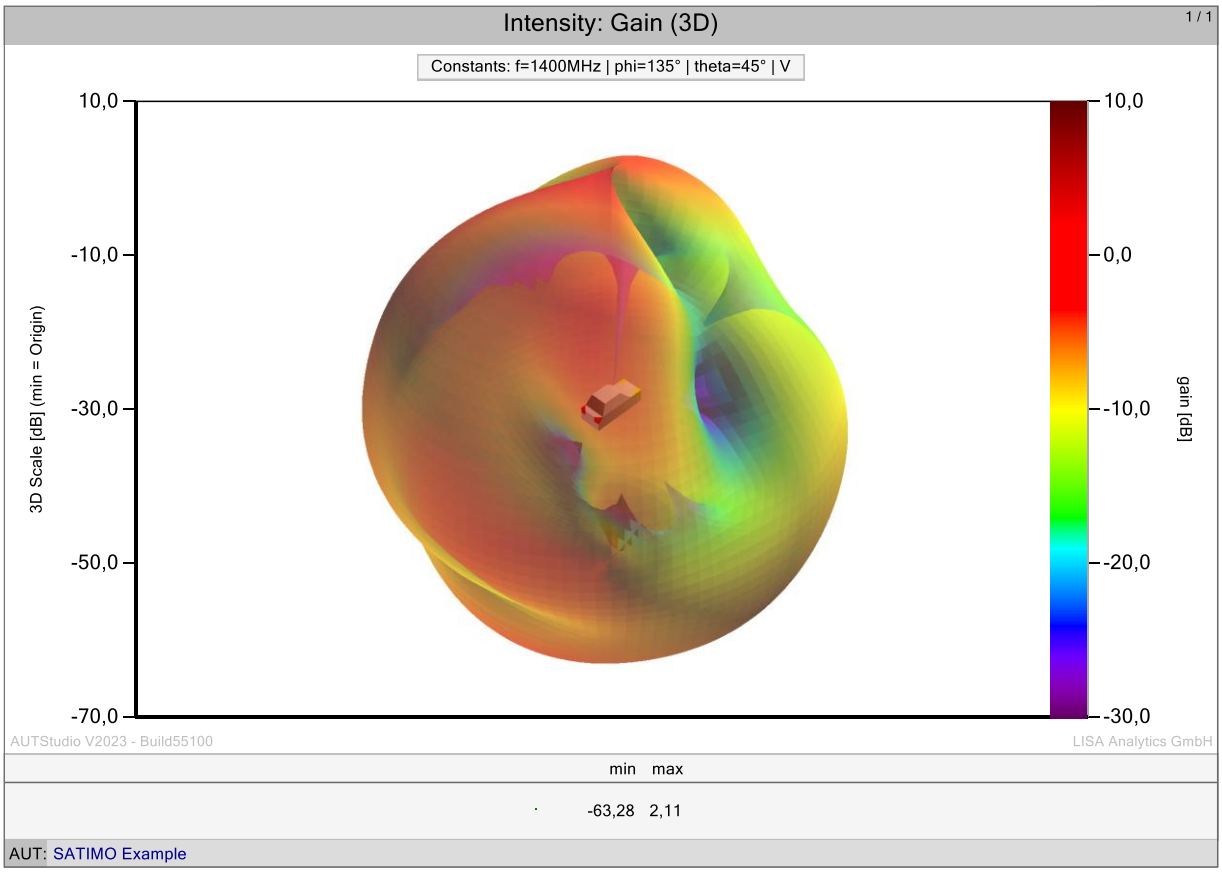


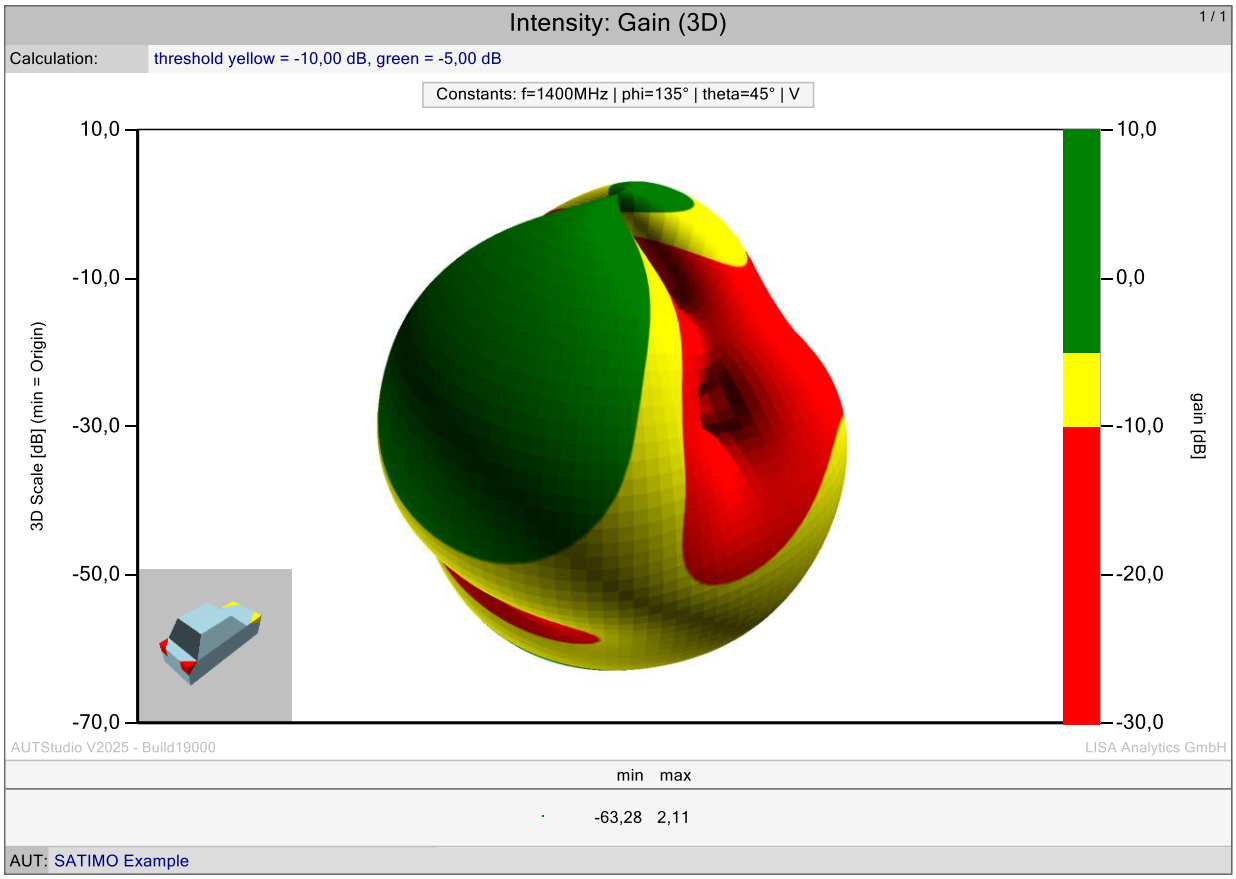
Appendix: Chart Examples

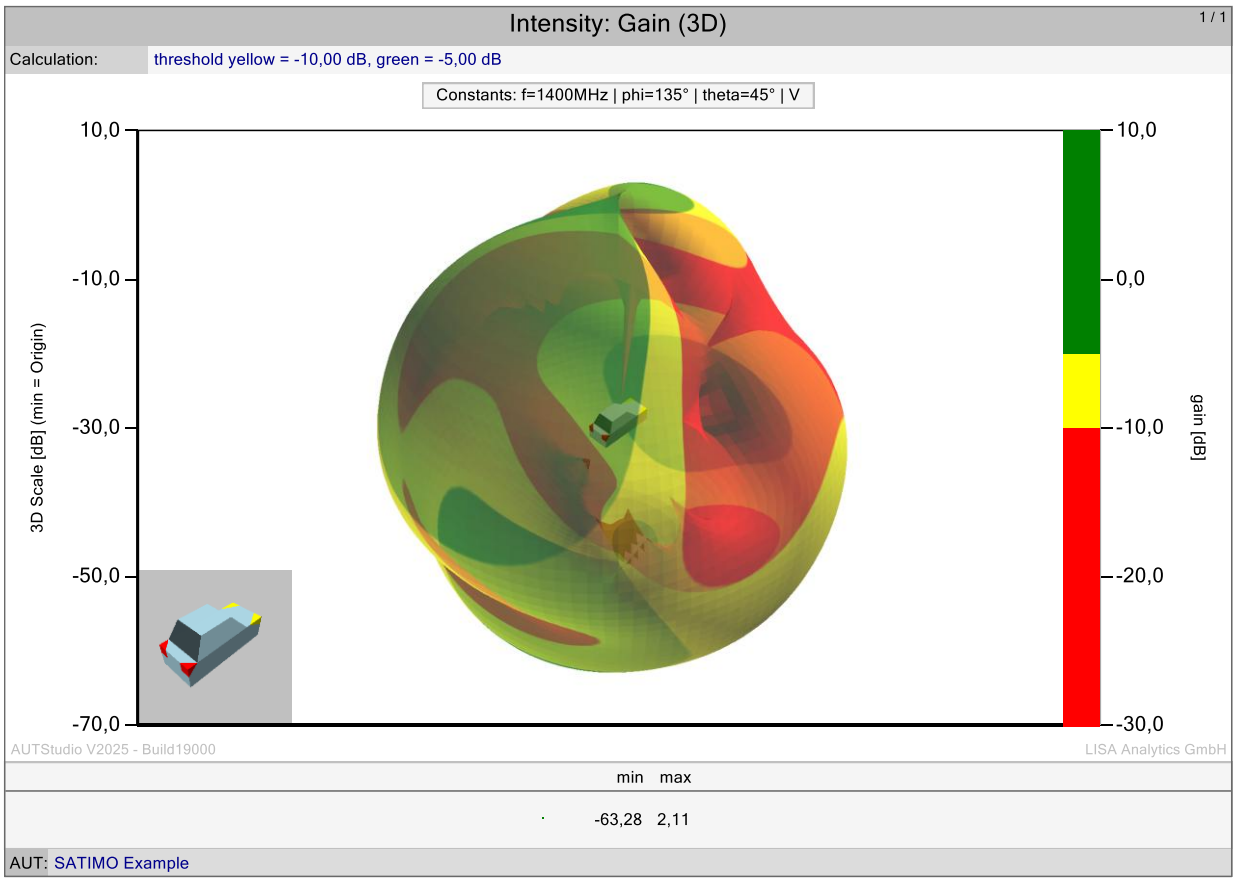


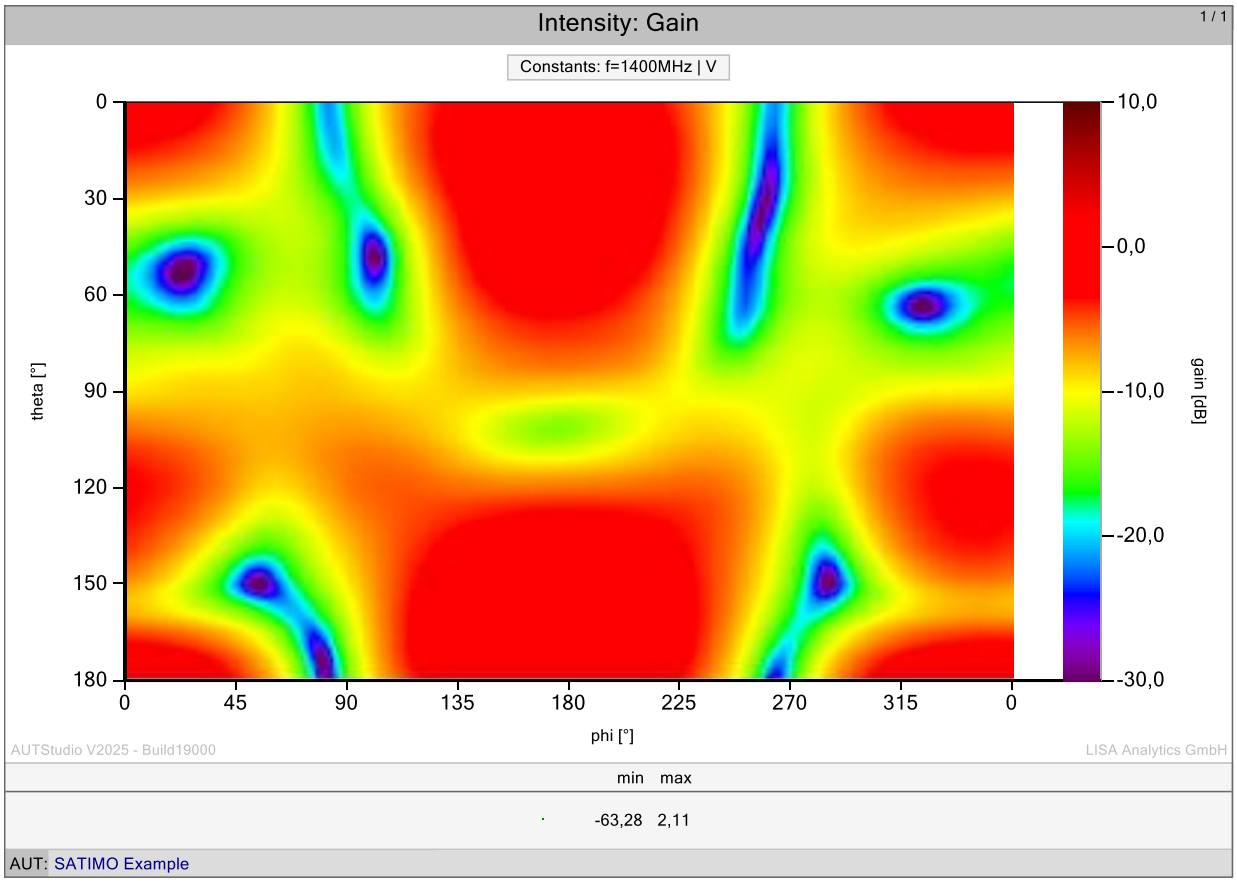


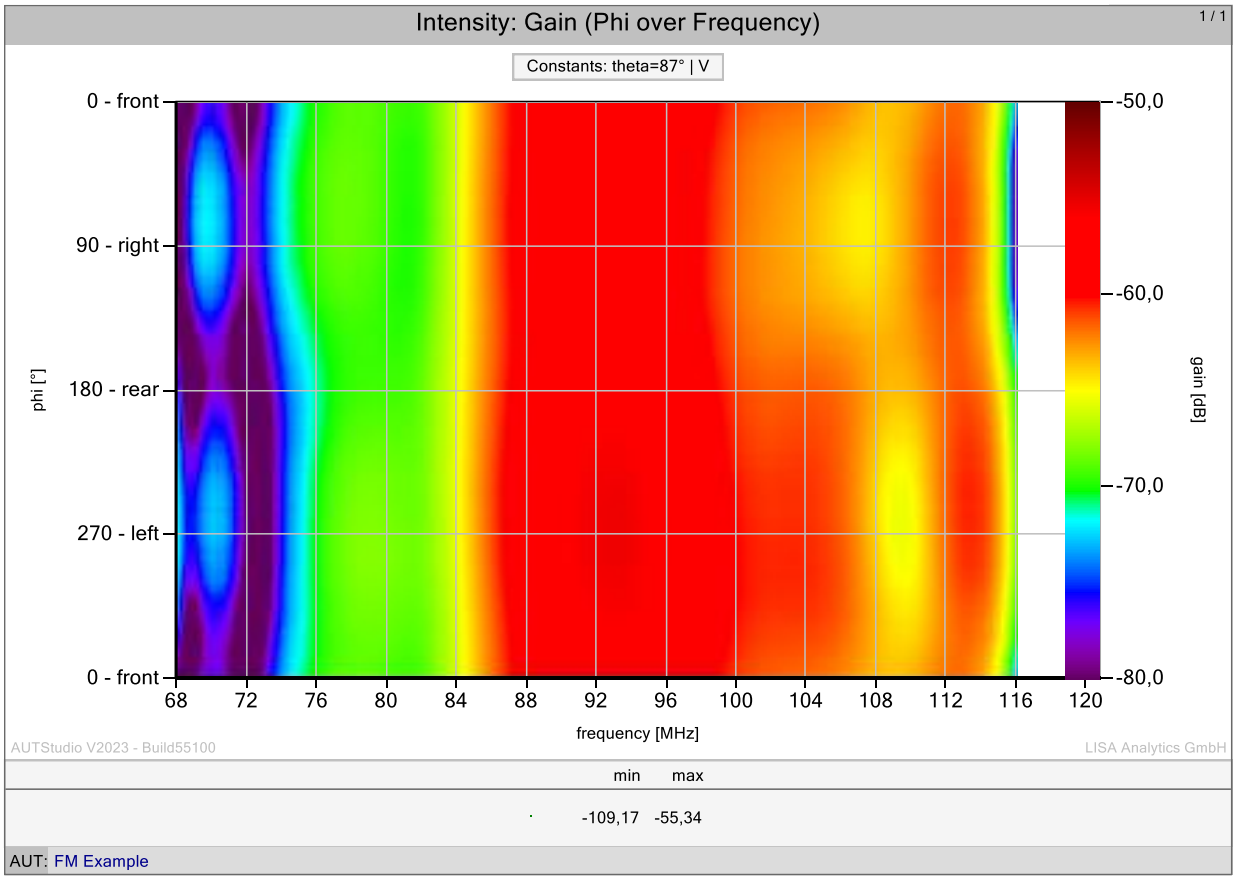

Intensity: Gain (3D)
1 / 1
Constants: f=1400MHz | phi=135° | theta=45° | V
10,0
-10,0
-30,0
-50,0
-70,0
3D Scale [dB] (min = Origin)
10,0
0,0
-10,0
-20,0
-30,0
gain [dB]
AUTStudio V2023 - Build55100
LISA Analytics GmbH
min max
-63,28 2,11
AUT: SATIMO Example


Intensity: Gain (3D)
1 / 1
Constants: f=1400MHz | phi=135° | theta=45° | V
10,0
-10,0
-30,0
-50,0
-70,0
3D Scale [dB] (min = Origin)
10,0
0,0
-10,0
-20,0
-30,0
gain [dB]
AUTStudio V2023 - Build55100
LISA Analytics GmbH
min max
-63,28 2,11
AUT: SATIMO Example


Intensity: Gain (3D)
1 / 1
Calculation:
threshold yellow = -10,00 dB, green = -5,00 dB
Constants: f=1400MHz | phi=135° | theta=45° | V
10,0
-10,0
-30,0
-50,0
-70,0
3D Scale [dB] (min = Origin)
10,0
0,0
-10,0
-20,0
-30,0
gain [dB]
AUTStudio V2025 - Build19000
LISA Analytics GmbH
min max
-63,28 2,11
AUT: SATIMO Example


Intensity: Gain (3D)
1 / 1
Calculation:
threshold yellow = -10,00 dB, green = -5,00 dB
Constants: f=1400MHz | phi=135° | theta=45° | V
10,0
-10,0
-30,0
-50,0
-70,0
3D Scale [dB] (min = Origin)
10,0
0,0
-10,0
-20,0
-30,0
gain [dB]
AUTStudio V2025 - Build19000
LISA Analytics GmbH
min max
-63,28 2,11
AUT: SATIMO Example


Intensity: Gain
1 / 1
Constants: f=1400MHz | V
0
30
60
90
120
150
180
theta [°]
0
45
90
135
180
225
270
315
0
phi [°]
10,0
0,0
-10,0
-20,0
-30,0
gain [dB]
AUTStudio V2025 - Build19000
LISA Analytics GmbH
min max
-63,28 2,11
AUT: SATIMO Example


Intensity: Gain (Phi over Frequency)
1 / 1
Constants: theta=87° | V
0 - front
90 - right
180 - rear
270 - left
0 - front
phi [°]
68
72
76
80
84
88
92
96
100
104
108
112
116
120
frequency [MHz]
-50,0
-60,0
-70,0
-80,0
gain [dB]
AUTStudio V2023 - Build55100
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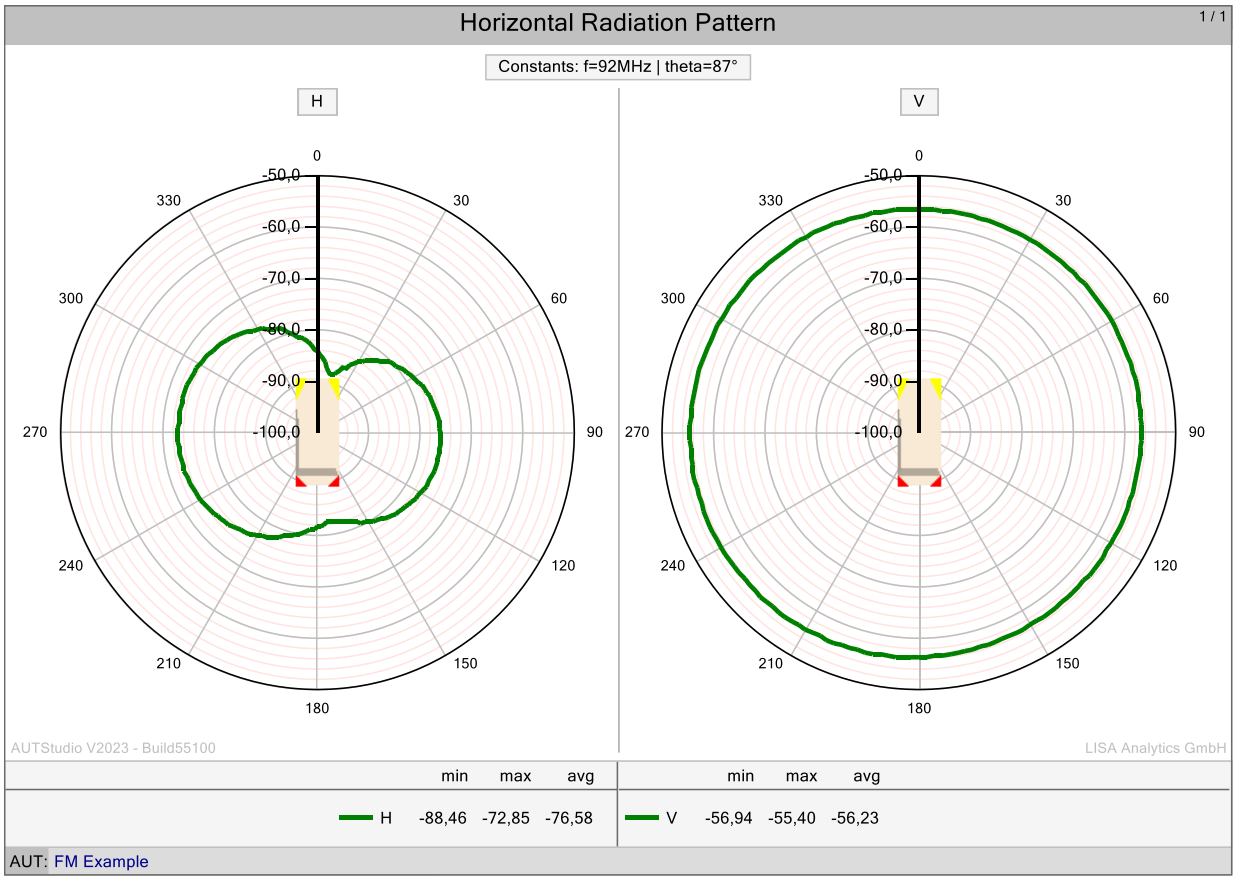
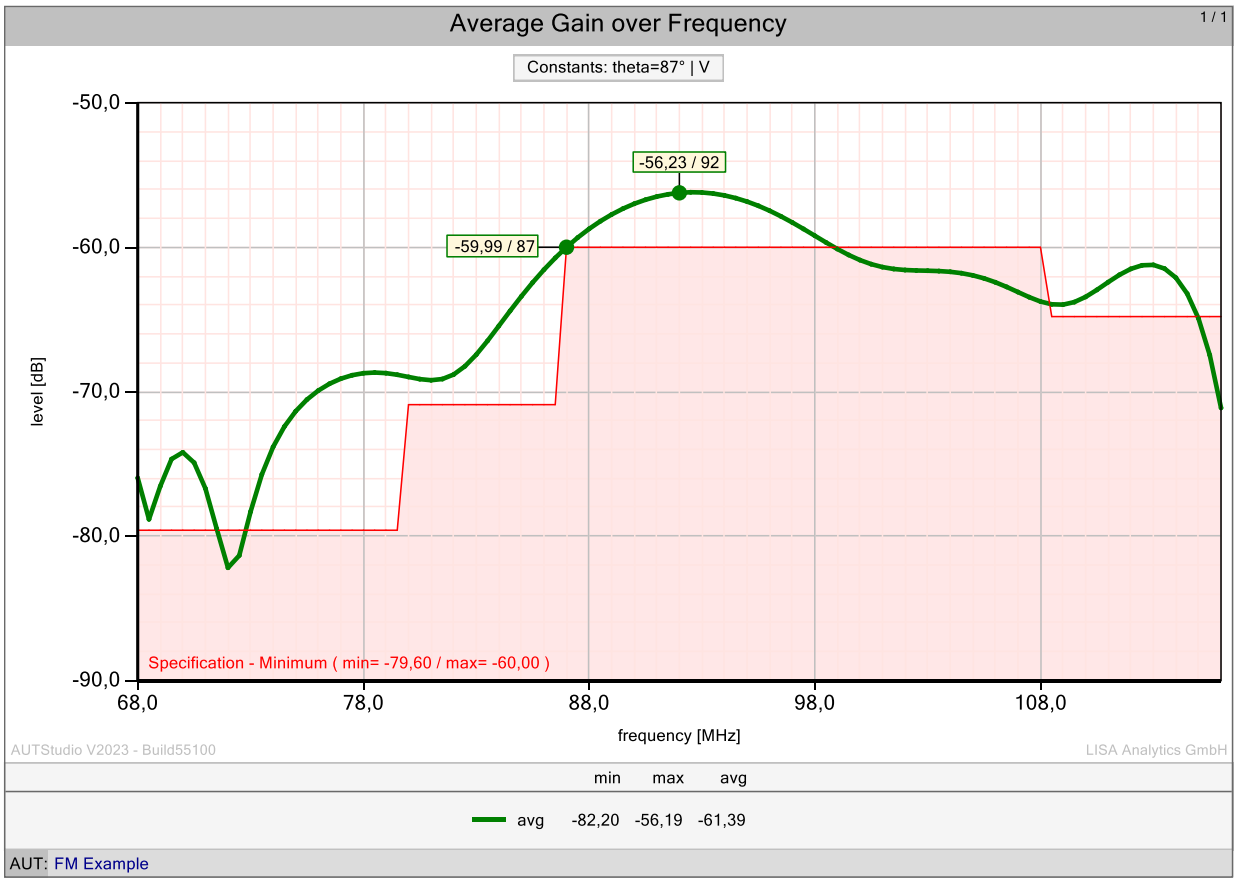
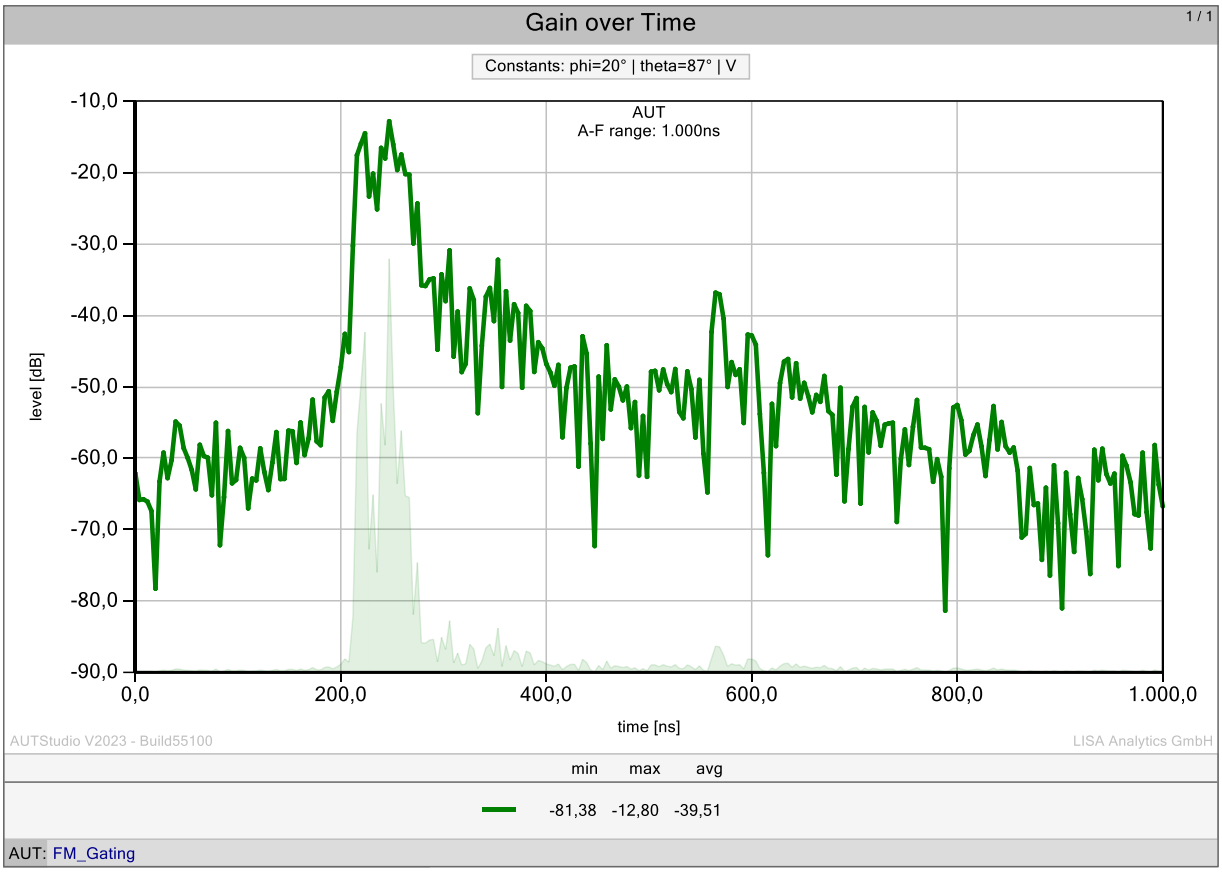
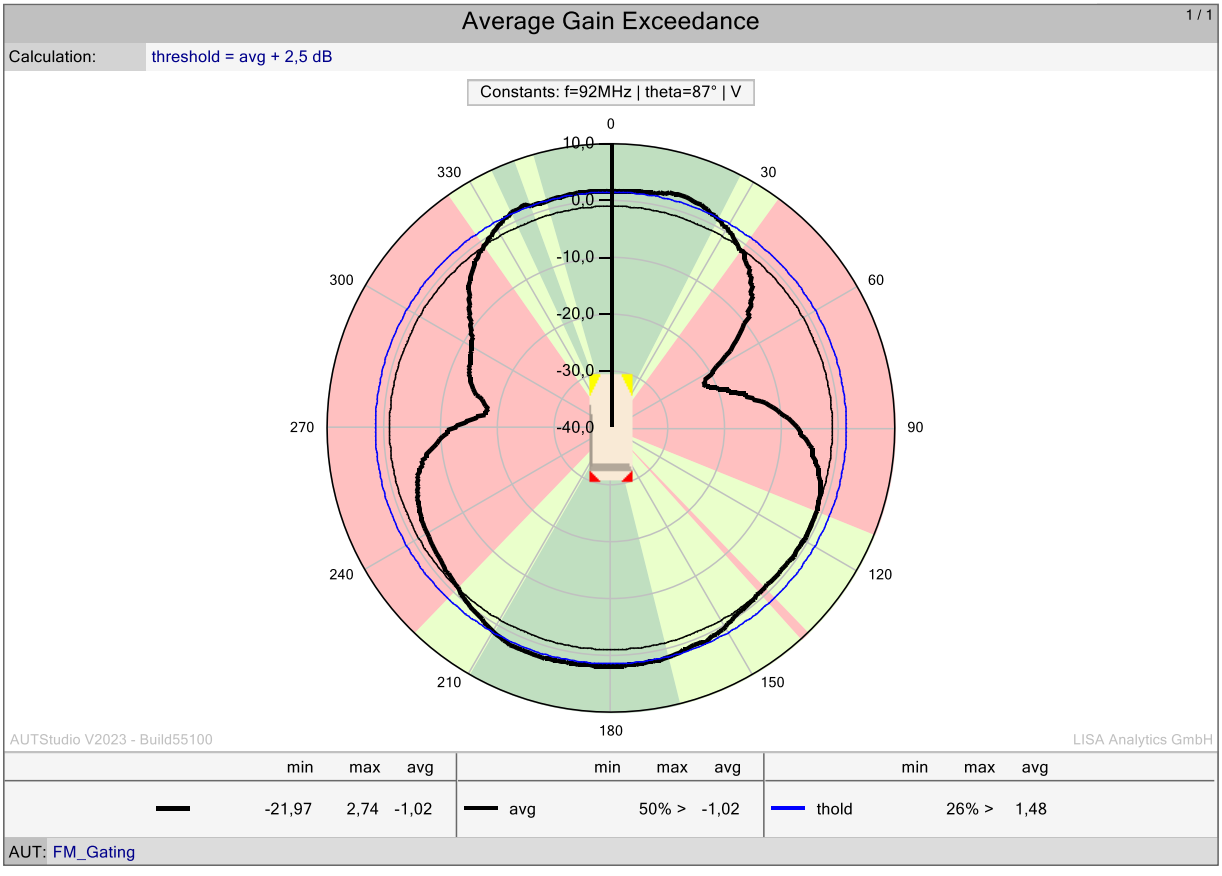
min max
-109,17 -55,34
AUT: FM Example


Horizontal Radiation Pattern
1 / 1
Constants: f=92MHz | theta=87°
H
V
0
30
60
90
120
150
180
210
240
270
300
330
-50,0
-60,0
-70,0
-80,0
-90,0
-100,0
AUTStudio V2023 - Build55100
LISA Analytics GmbH
min max avg
H -88,46 -72,85 -76,58
V -56,94 -55,40 -56,23
AUT: FM Example


Average Gain over Frequency
1 / 1
Constants: theta=87° | V
-50,0
-60,0
-70,0
-80,0
-90,0
level [dB]
-56,23 / 92
-59,99 / 87
Specification - Minimum (min= -79,60 / max= -60,00)
68,0
78,0
88,0
98,0
108,0
frequency [MHz]
AUTStudio V2023 - Build55100
LISA Analytics GmbH
min max avg
avg -82,20 -56,19 -61,39
AUT: FM Example

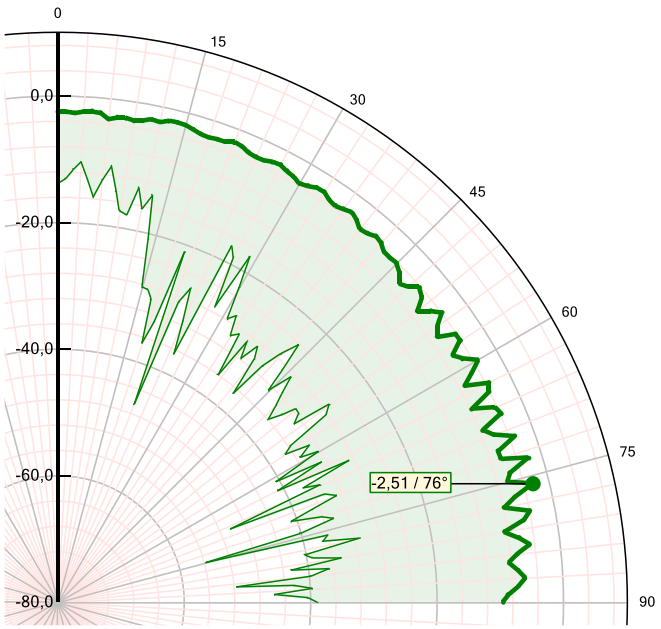

Gain over Time
1 / 1
Constants: phi=20° | theta=87° | V
AUT
A-F range: 1.000ns
-10,0
-20,0
-30,0
-40,0
-50,0
-60,0
-70,0
-80,0
-90,0
level [dB]
0,0
200,0
400,0
600,0
800,0
1.000,0
time [ns]
AUTStudio V2023 - Build55100
LISA Analytics GmbH
min max avg
-81,38 -12,80 -39,51
AUT: FM_Gating


Average Gain Exceedance
1 / 1
Calculation: threshold = avg + 2,5 dB
Constants: f=92MHz | theta=87° | V
0
30
60
90
120
150
180
210
240
270
300
330
10,0
0,0
-10,0
-20,0
-30,0
-40,0
AUTStudio V2023 - Build55100
LISA Analytics GmbH
min max avg
-21,97 2,74 -1,02
avg 50% > -1,02
thold 26% > 1,48
AUT: FM_Gating

Average Gain over Theta (Polar)

1 / 2

Constants: f=1800MHz



AUTStudio V2023 - Build55100 LISA Analytics GmbH

	min	max	avg		min	max	avg
H avg	-9,52	-1,82	-3,86	H min	-55,75	-10,30	-20,75

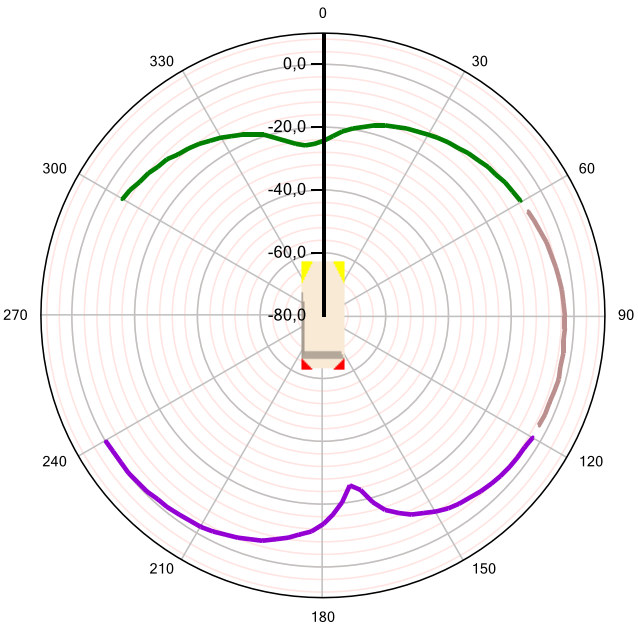
AUT: Antenna Prototyp V01

Horizontal Radiation Pattern Average (Theta Range) - Diversity

1 / 1

Calculation: Diversity: Selection Combining | theta=(0° - 90°)

Constants: f=1200MHz | H



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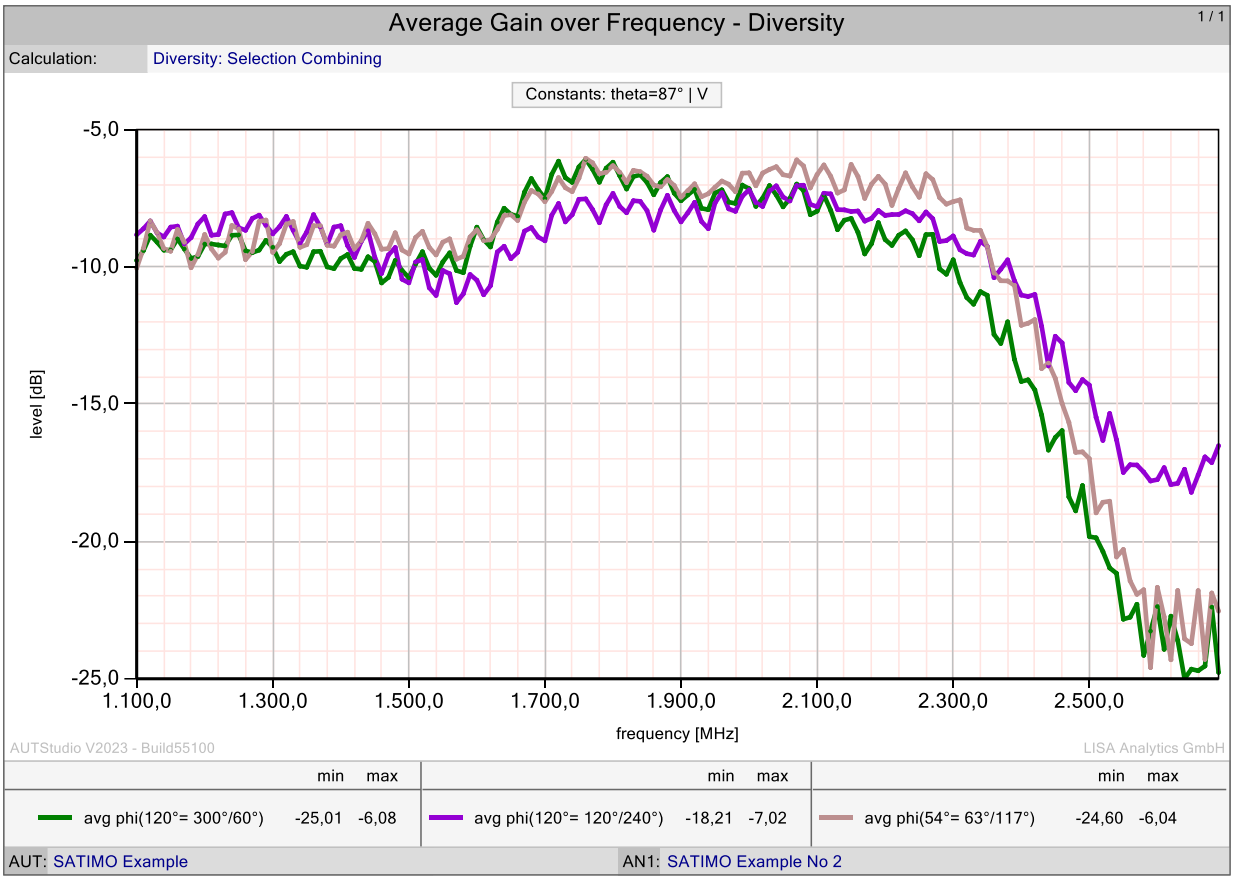
	avg		avg		avg
avg phi(120°= 300°/60°)	-11,97	avg phi(120°= 120°/240°)	-4,34	avg phi(54°= 63°/117°)	-3,44

AUT: SATIMO Example AN1: SATIMO Example No 2


Average Gain over Frequency - Diversity
1 / 1
Calculation: Diversity: Selection Combining
Constants: theta=87° | V
-5,0
-10,0
-15,0
-20,0
-25,0
level [dB]
1.100,0
1.300,0
1.500,0
1.700,0
1.900,0
2.100,0
2.300,0
2.500,0
frequency [MHz]
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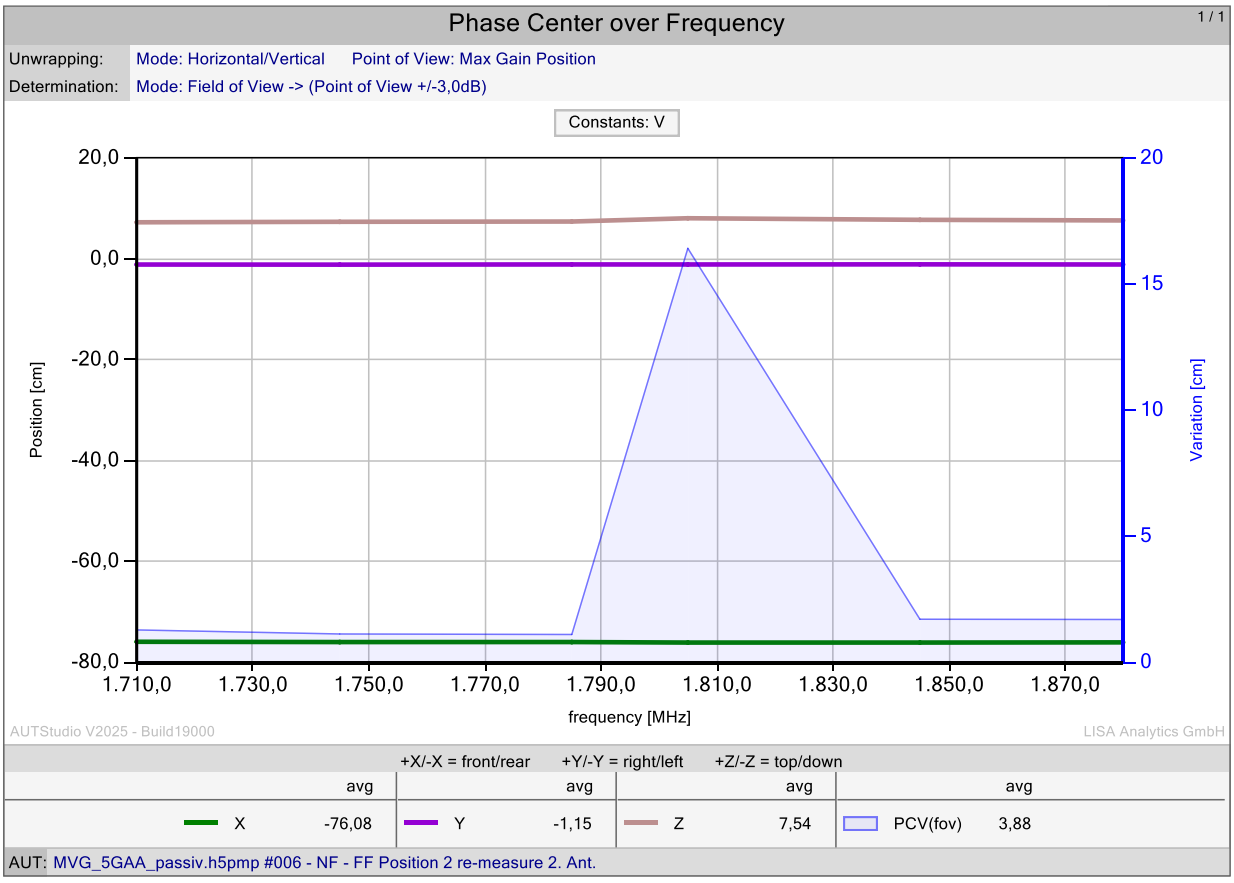
min max
avg phi(120°= 300°/60°) -25,01 -6,08
min max
avg phi(120°= 120°/240°) -18,21 -7,02
min max
avg phi(54°= 63°/117°) -24,60 -6,04
AUT: SATIMO Example
AN1: SATIMO Example No 2


Phase Center over Frequency
1 / 1
Unwrapping: Mode: Horizontal/Vertical Point of View: Max Gain Position
Determination: Mode: Field of View -> (Point of View +/-3,0dB)
Constants: V
20,0
0,0
-20,0
-40,0
-60,0
-80,0
Position [cm]
20
15
10
5
0
Variation [cm]
1.710,0
1.730,0
1.750,0
1.770,0
1.790,0
1.810,0
1.830,0
1.850,0
1.870,0
frequency [MHz]
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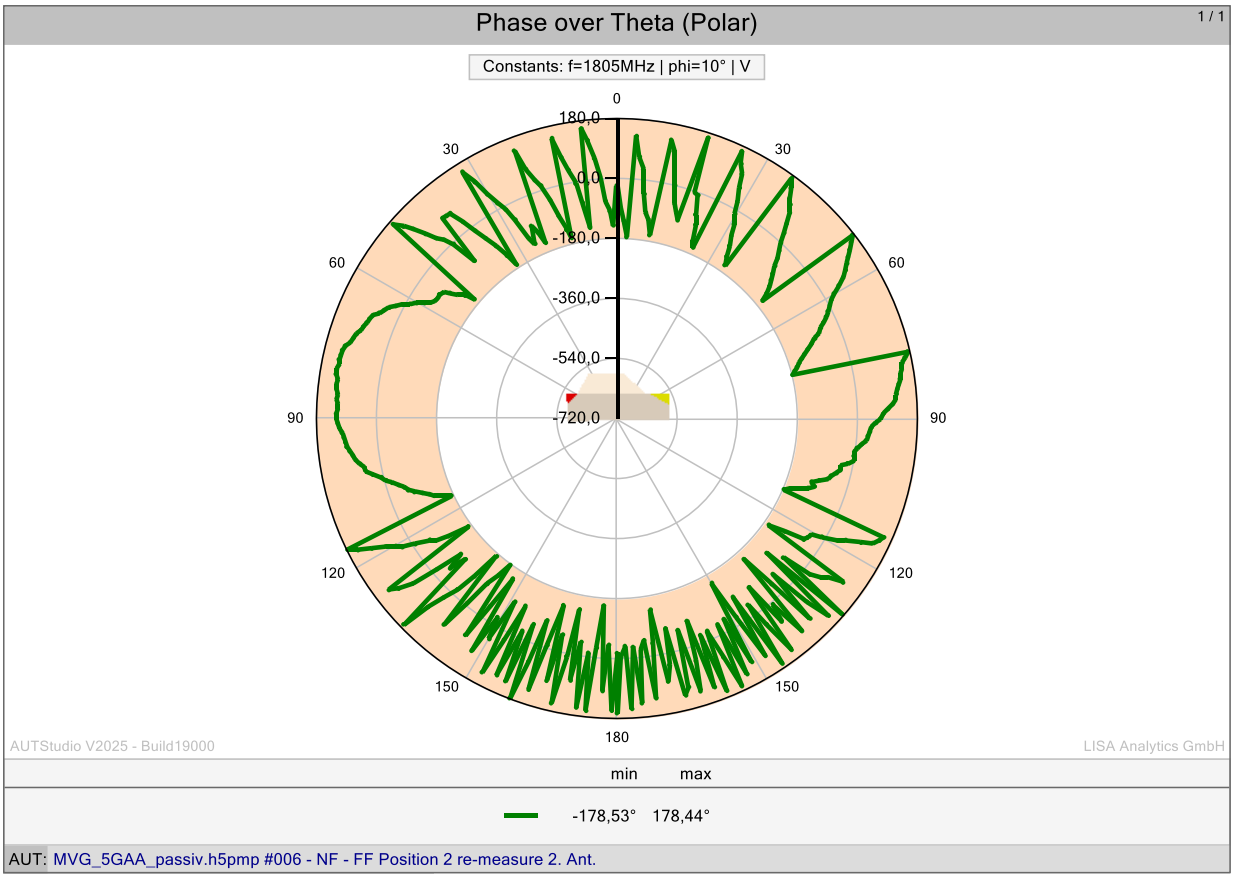
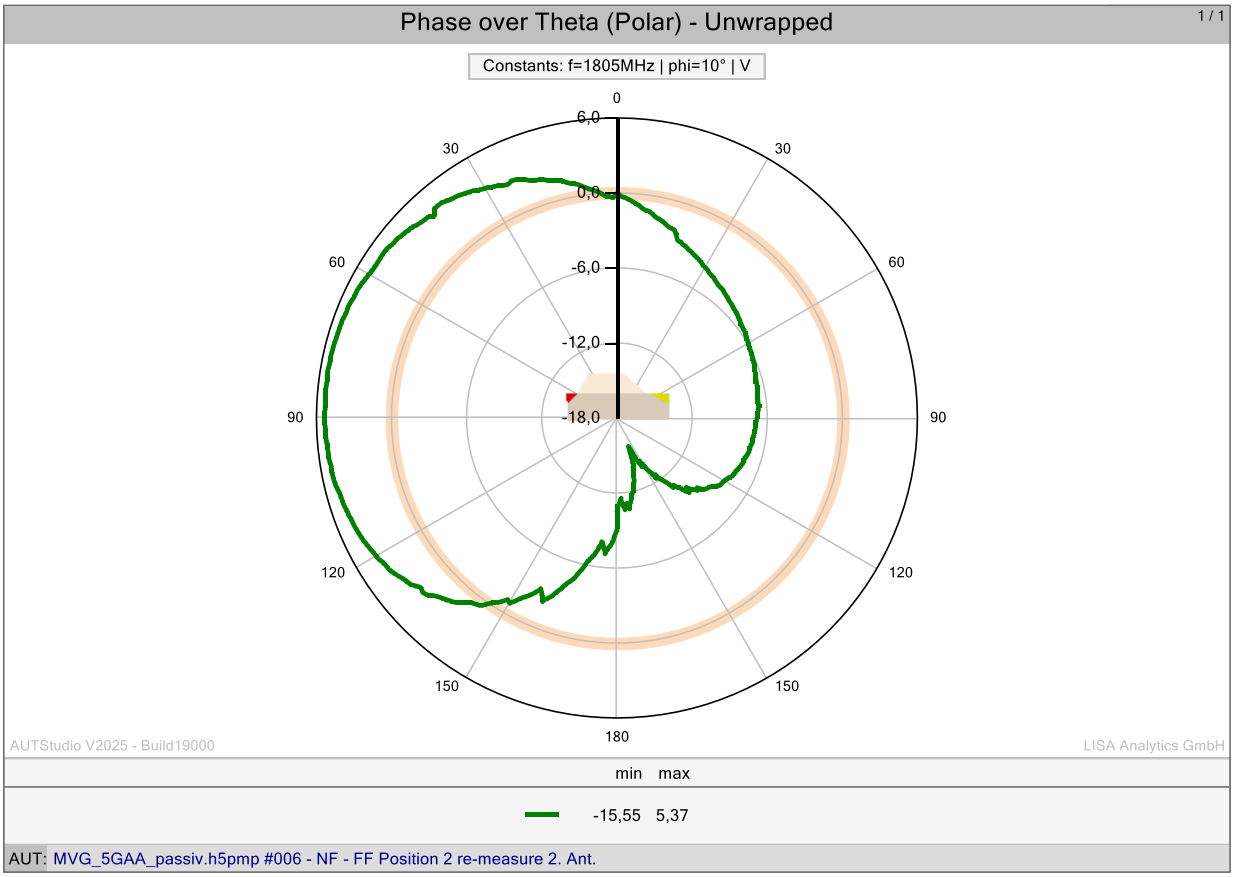
LISA Analytics GmbH
+X/-X = front/rear +Y/-Y = right/left +Z/-Z = top/down
avg
X -76,08
avg
Y -1,15
avg
Z 7,54
avg
PCV(fov) 3,88
AUT: MVG_5GAA_passiv.h5pmp #006 - NF - FF Position 2 re-measure 2. Ant.

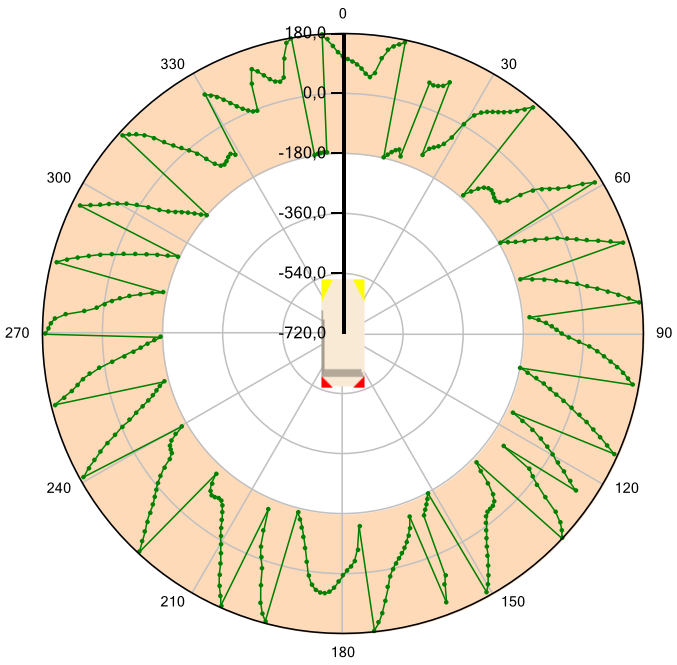

Phase over Theta (Polar)
1 / 1
Constants: f=1805MHz | phi=10° | V
0
30
60
90
120
150
180
180,0
0,0
-180,0
-360,0
-540,0
-720,0
AUTStudio V2025 - Build19000
LISA Analytics GmbH
min
max
-178,53°
178,44°
AUT: MVG_5GAA_passiv.h5pmp #006 - NF - FF Position 2 re-measure 2. Ant.


Phase over Theta (Polar) - Unwrapped
1 / 1
Constants: f=1805MHz | phi=10° | V
0
30
60
90
120
150
180
6,0
0,0
-6,0
-12,0
-18,0
AUTStudio V2025 - Build19000
LISA Analytics GmbH
min
max
-15,55
5,37
AUT: MVG_5GAA_passiv.h5pmp #006 - NF - FF Position 2 re-measure 2. Ant.

Phase over Phi (Polar)

1 / 1

Constants: f=1805MHz | theta=80° | H



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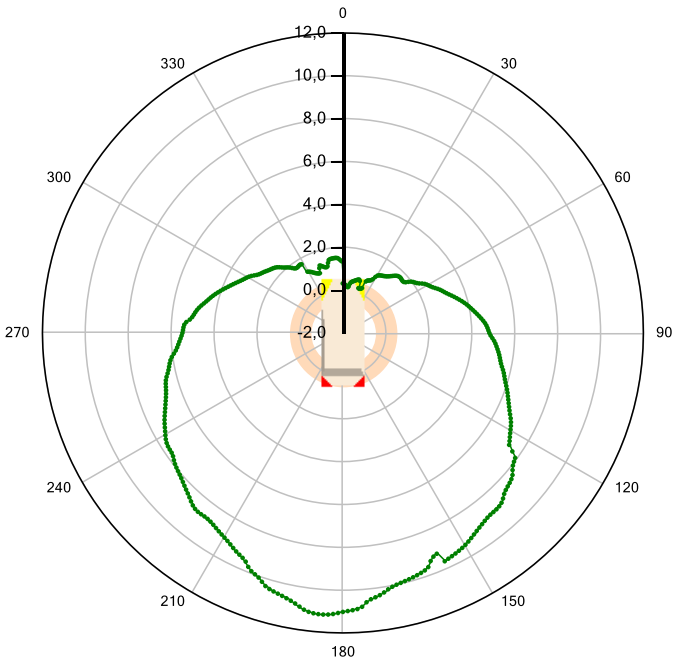
	min	max
—	-179,61°	179,15°

AUT: MVG_5GAA_passiv.h5pmp #006 - NF - FF Position 2 re-measure 2. Ant.

Phase over Phi (Polar) - Unwrapped

1 / 1

Constants: f=1805MHz | theta=80° | H



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	min	max
—	0,15	11,17

AUT: MVG_5GAA_passiv.h5pmp #006 - NF - FF Position 2 re-measure 2. Ant.