

4. Data Variant B

2xLTE, 1xGNSS, BT, SDARS

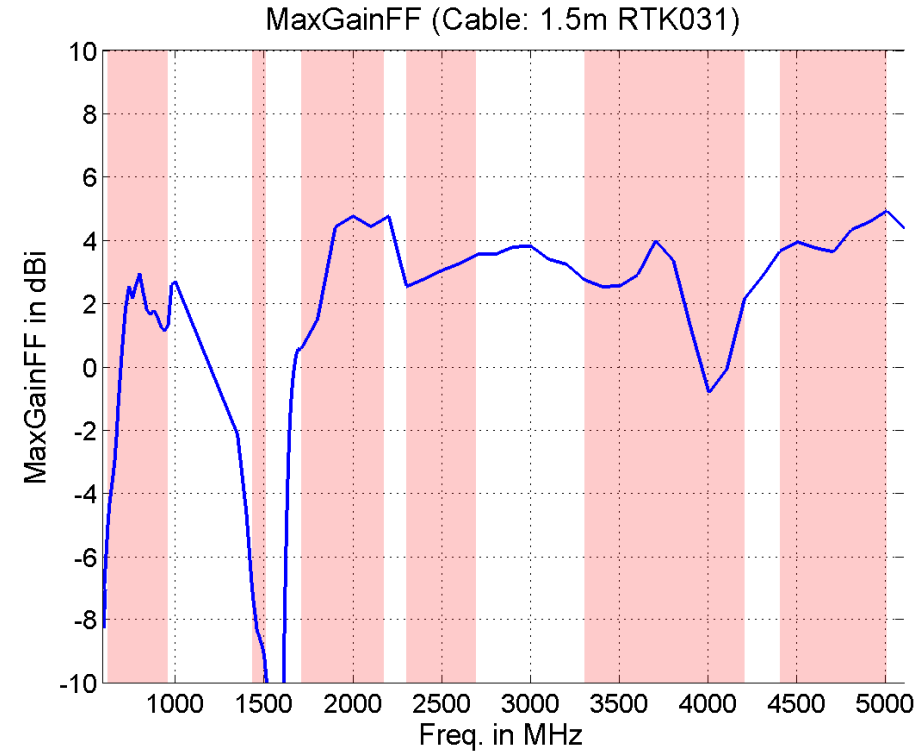
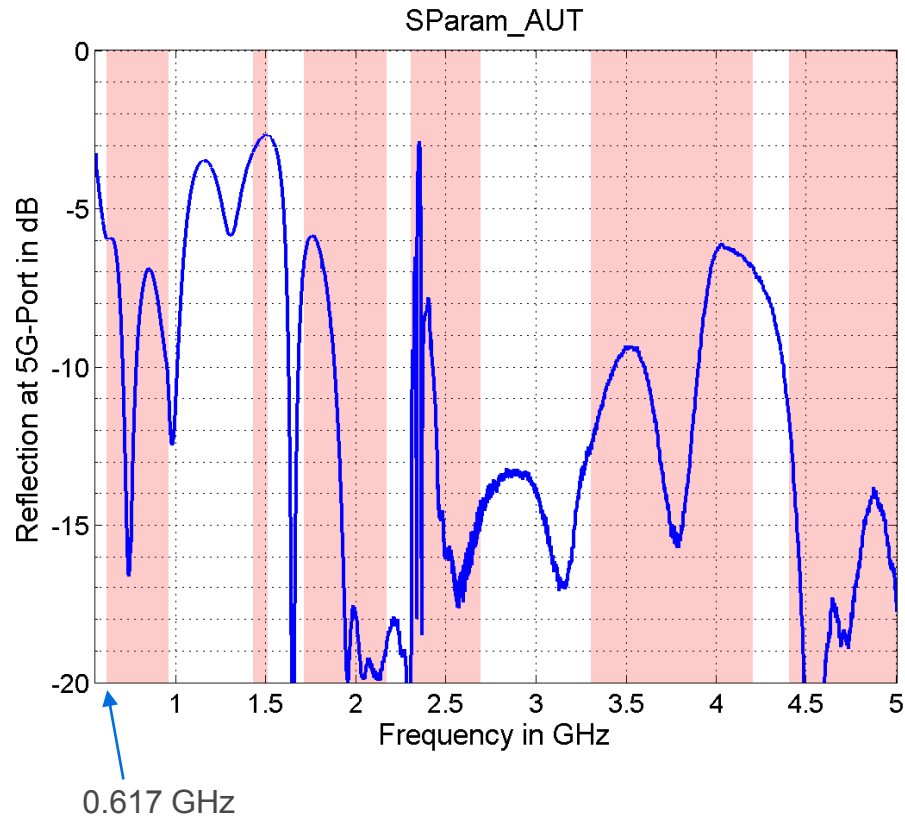


4.1 LTE Front



4.1 Variant B: LTE Antenna Performance Matching (LTE front)

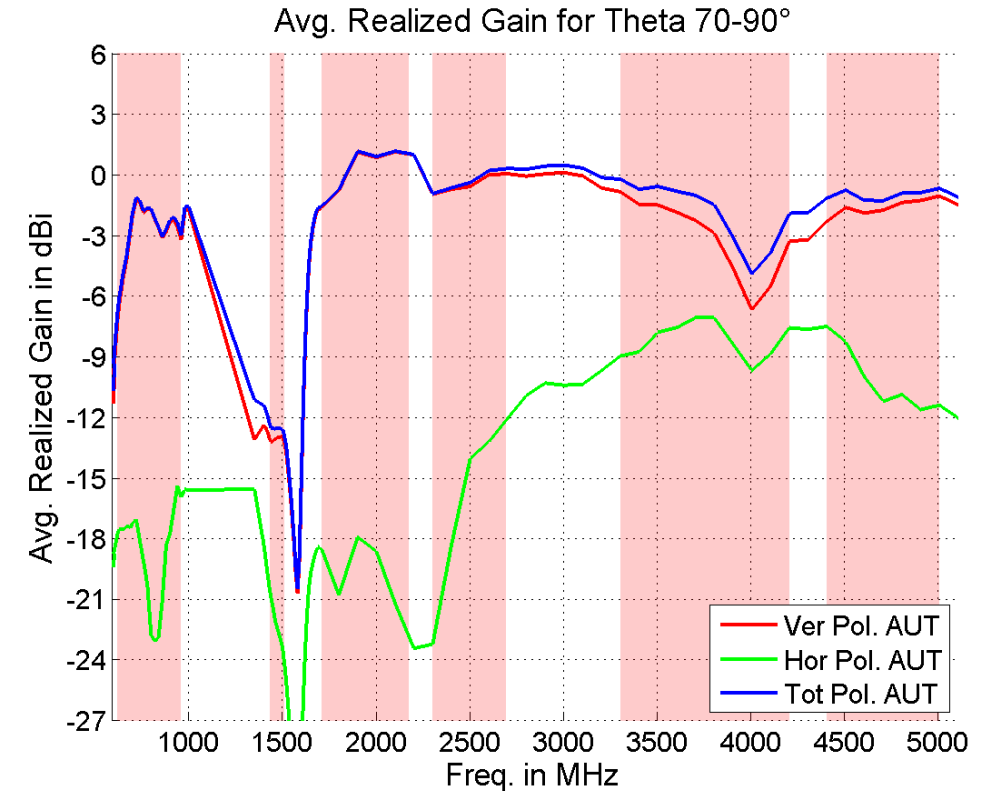
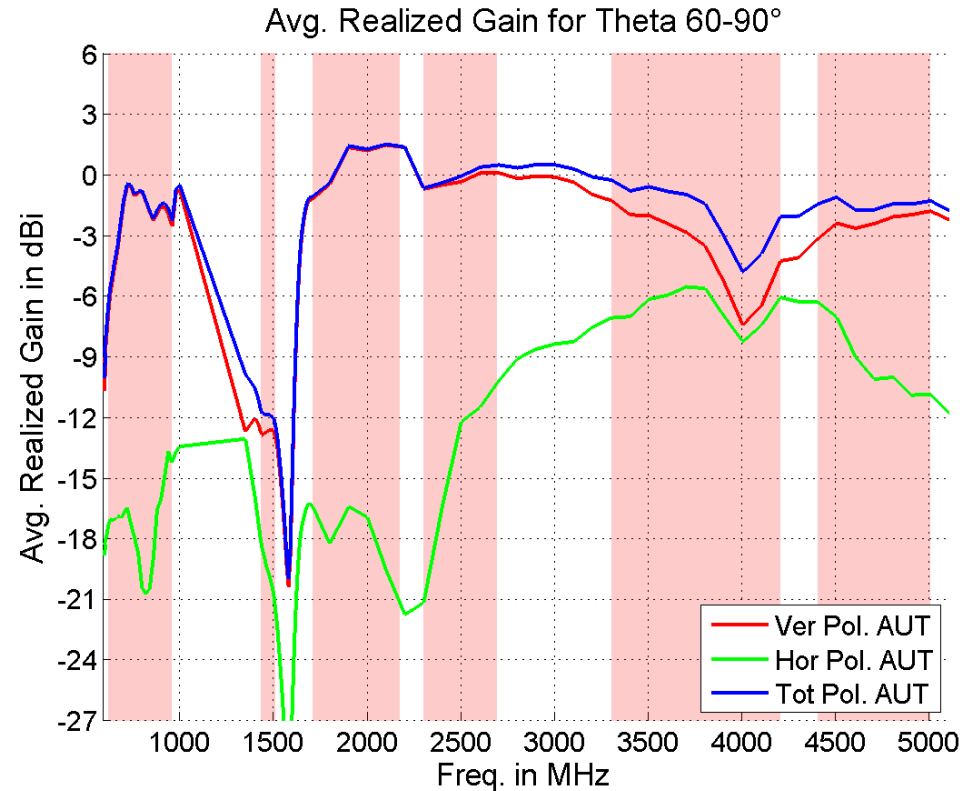
Chamber



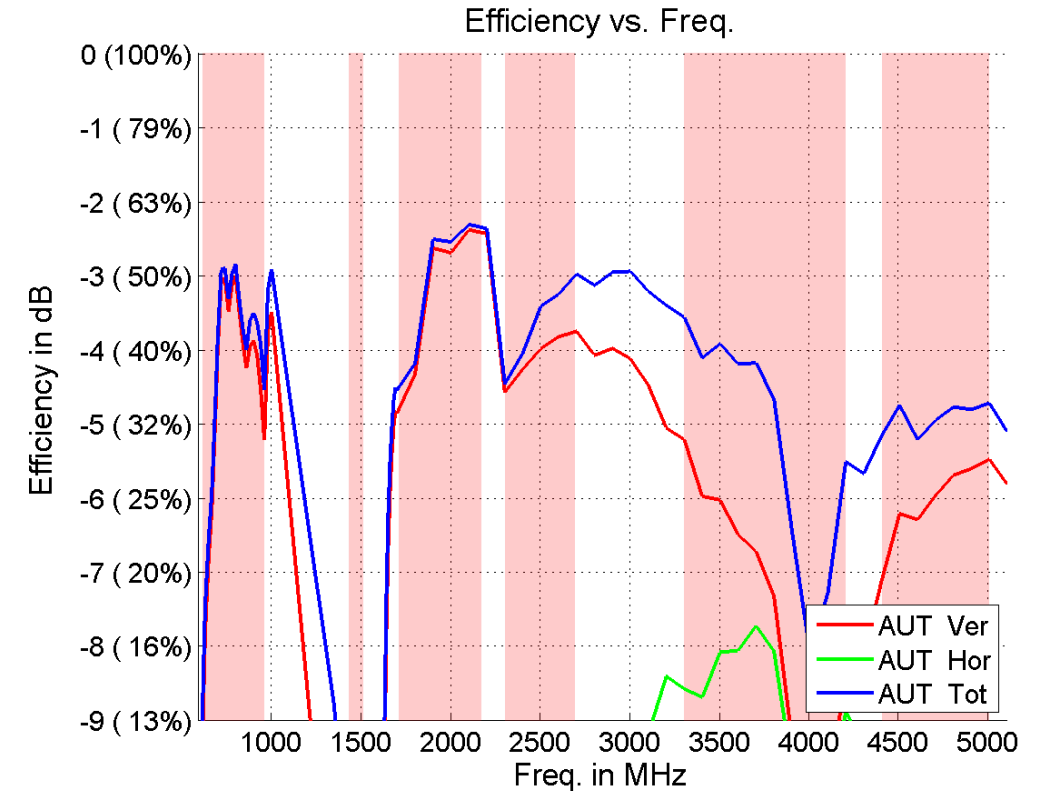
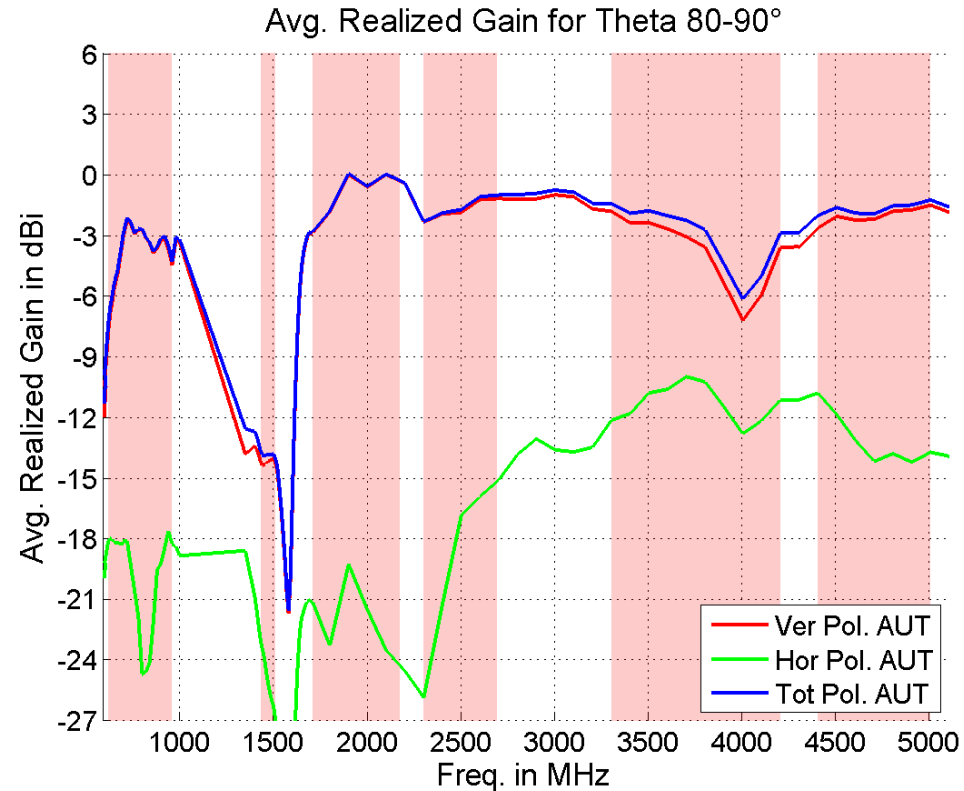
- The MaxGainFF-values are determined with 1.5m RTK031 cable (attenuation added to the measurement results).
- See attached file “Audi_CS_S10_VariantB_LTEf_gain_maxFF.csv” for the equivalent raw MaxGainFF-data.



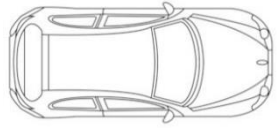
4.1 Variant B: LTE Antenna Performance Gain and Efficiency (LTE front)



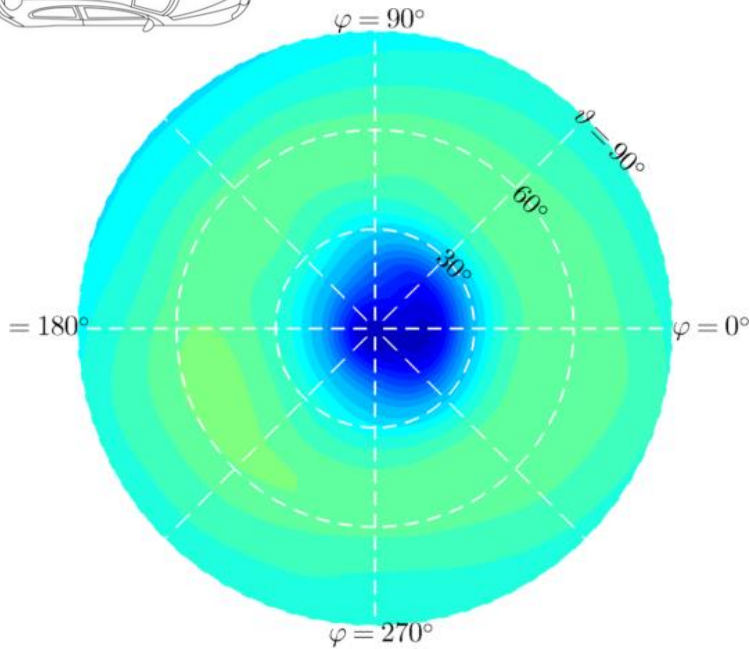
4.1 Variant B: LTE Antenna Performance Gain and Efficiency (LTE front)



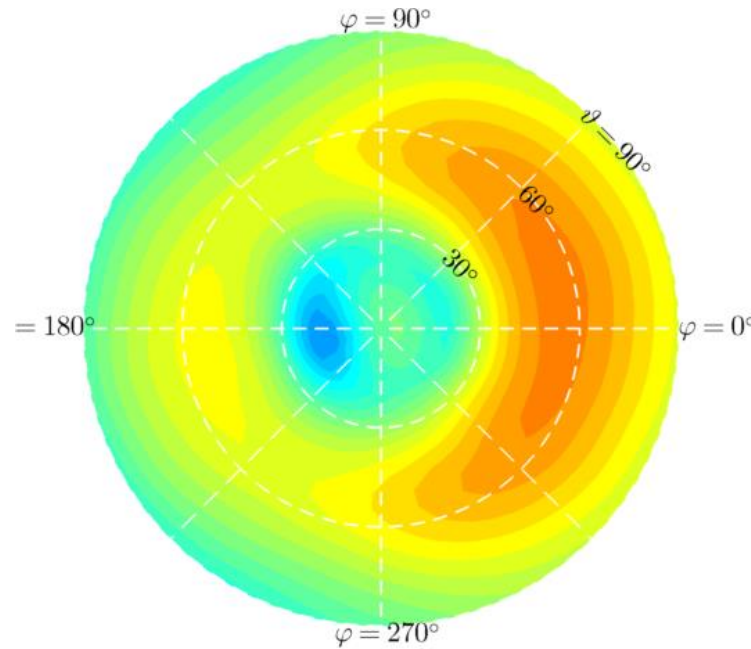
4.1 Variant B: LTE Antenna Performance 3D-Chart (LTE front)



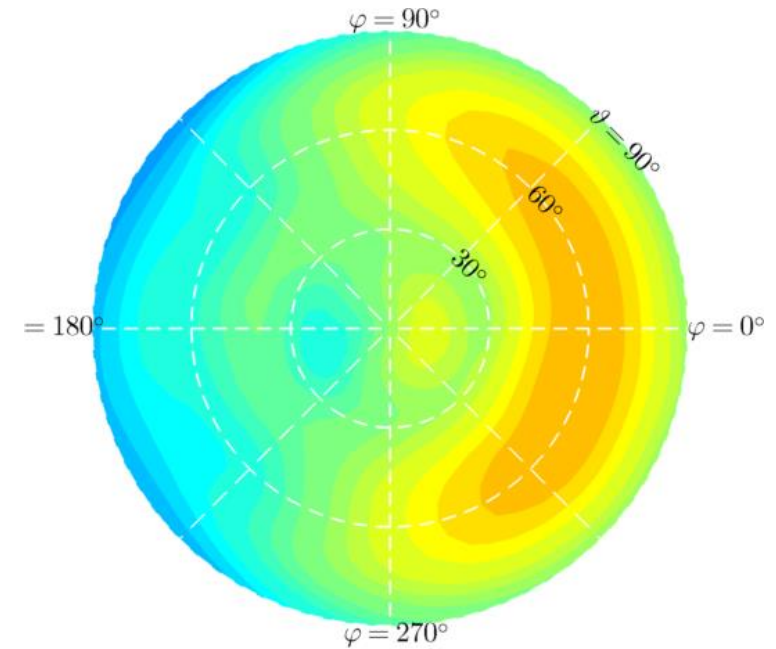
Driving Direction



-20 -15 -10 -5 0 5 10
AUT total gain at 620MHz / dBi



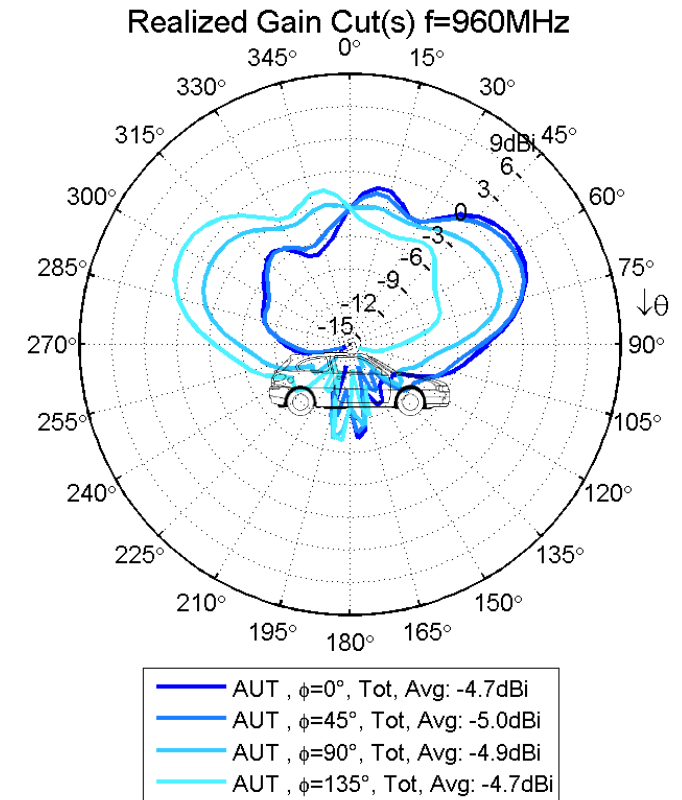
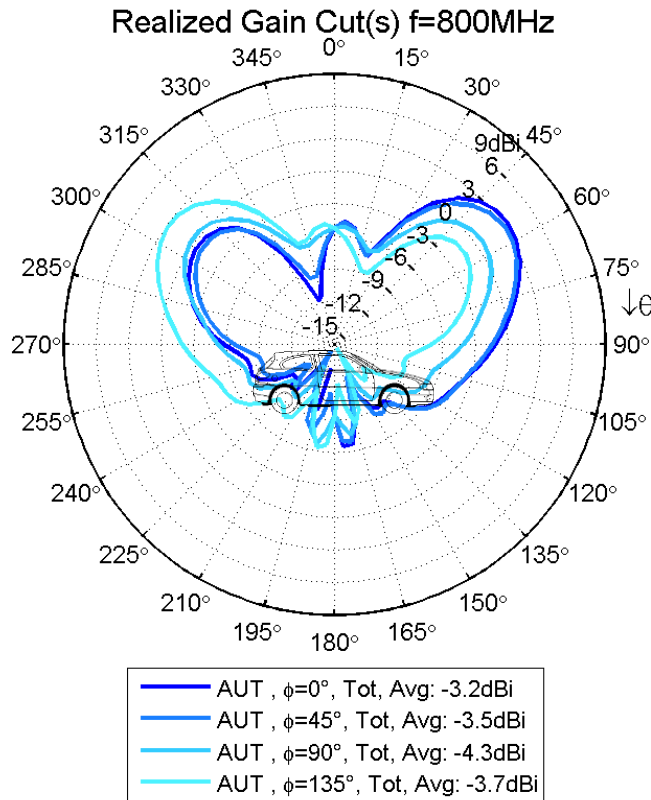
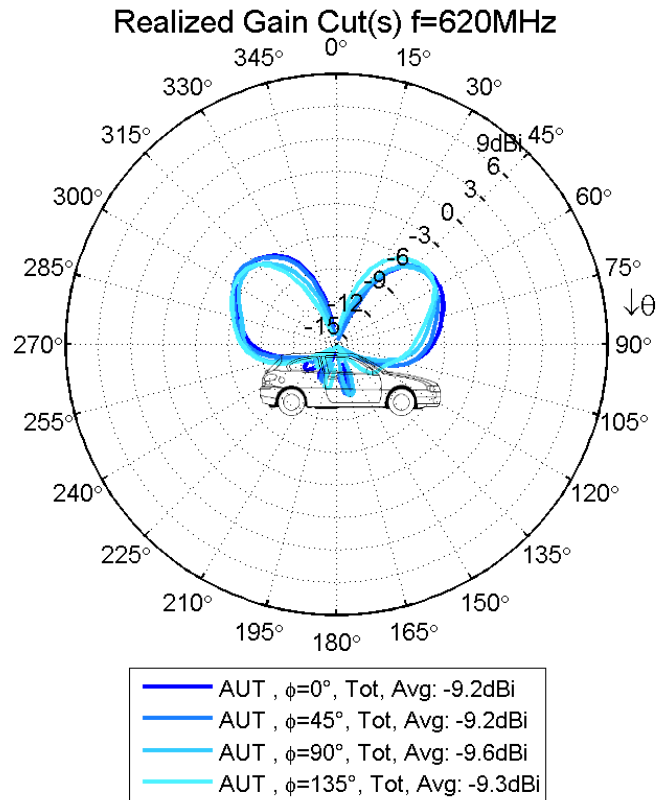
-20 -15 -10 -5 0 5 10
AUT total gain at 800MHz / dBi



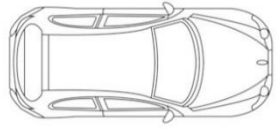
-20 -15 -10 -5 0 5 10
AUT total gain at 960MHz / dBi



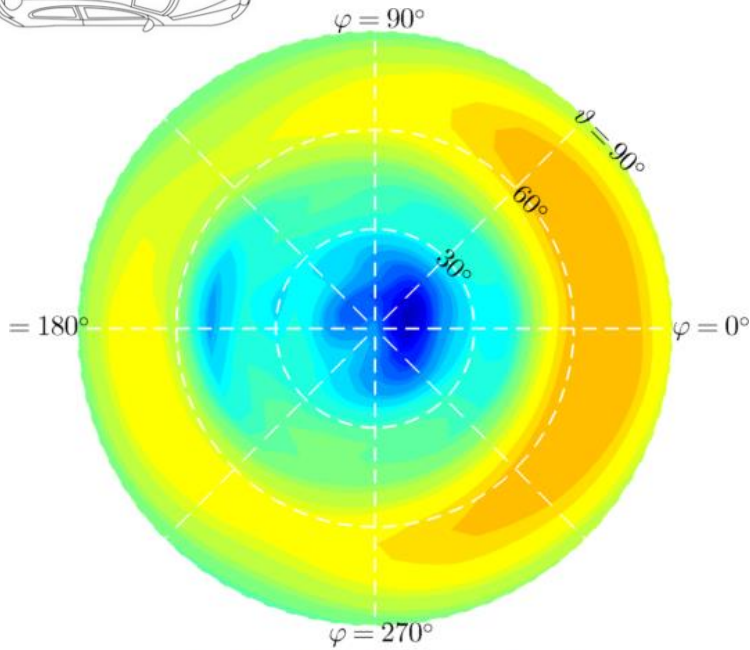
4.1 Variant B: LTE Antenna Performance Gain-Cuts (LTE front)



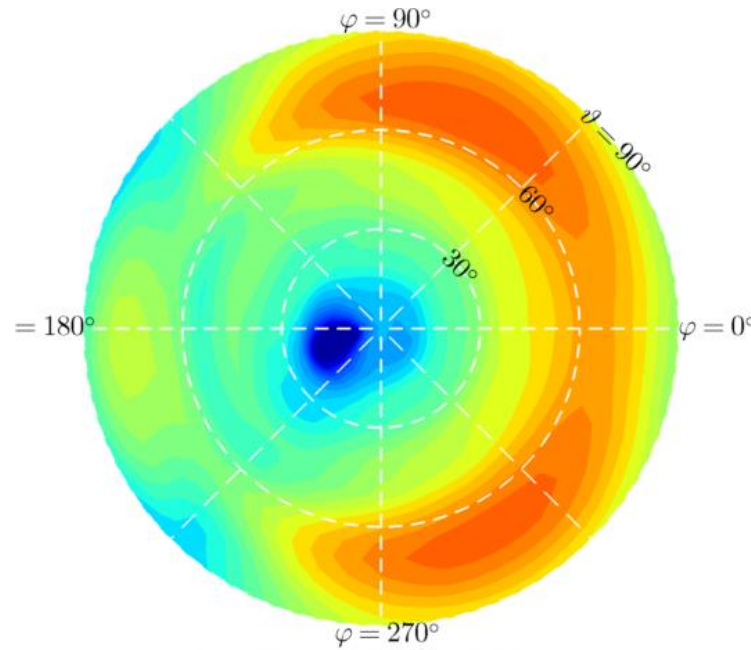
4.1 Variant B: LTE Antenna Performance 3D-Chart (LTE front)



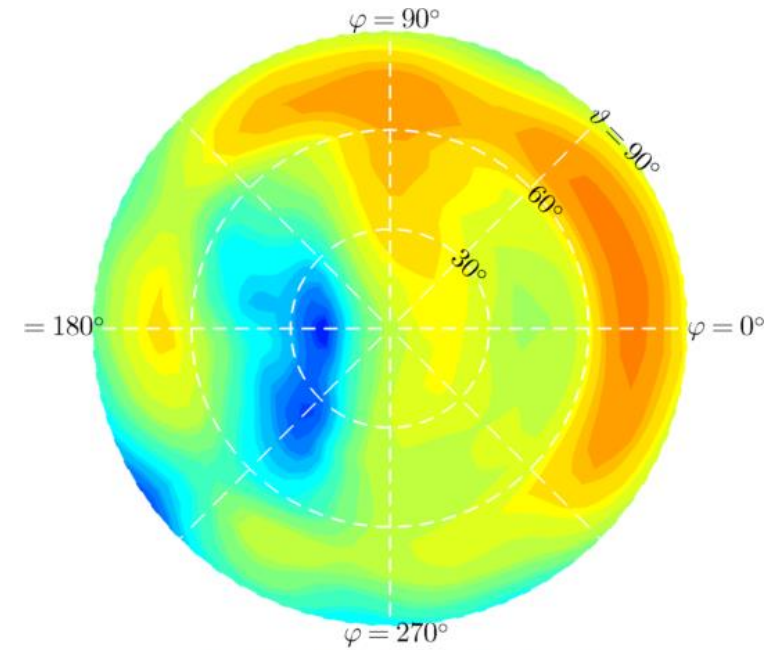
Driving Direction



-20 -15 -10 -5 0 5 10
AUT total gain at 1800MHz / dBi



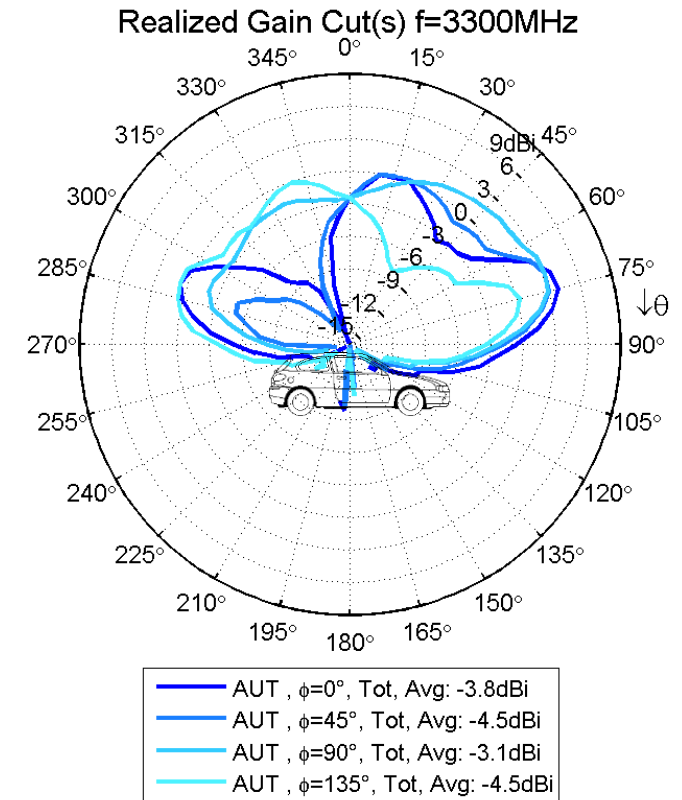
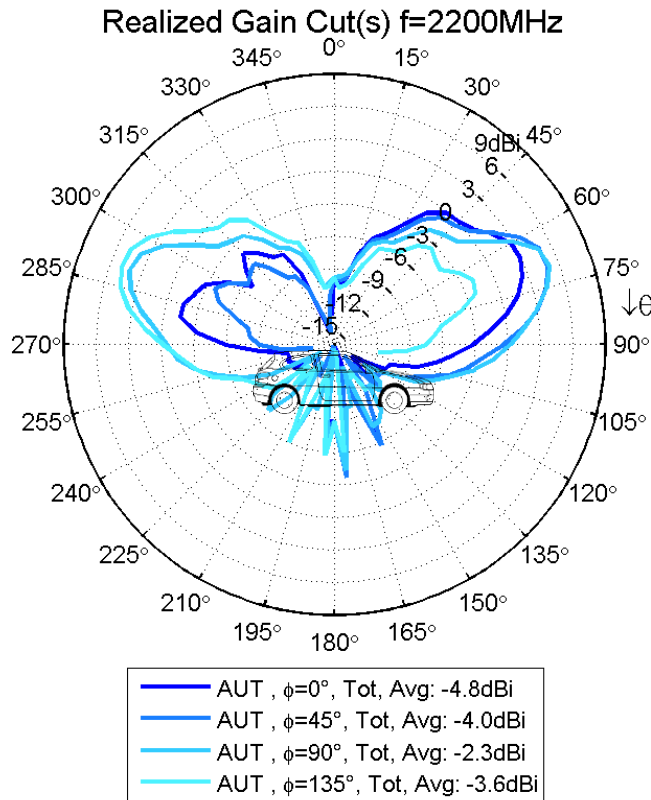
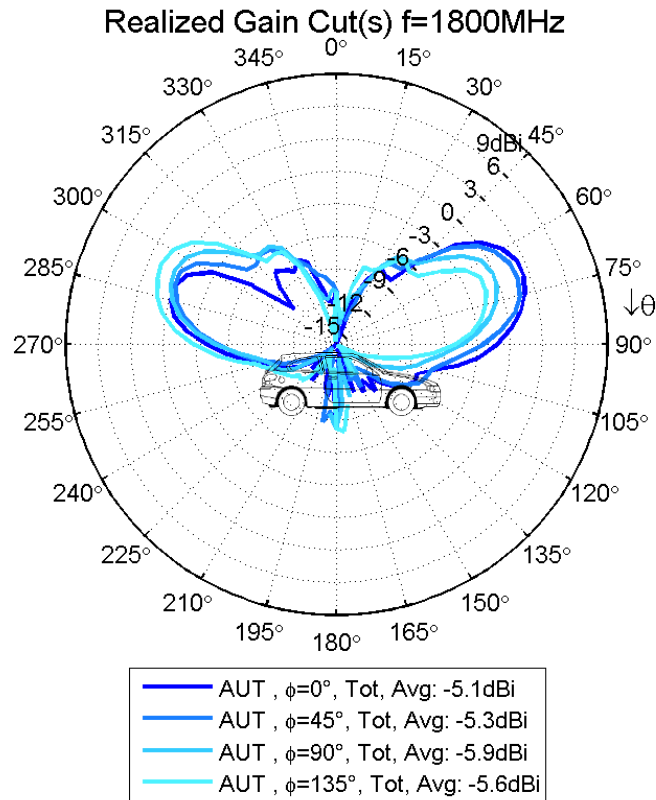
-20 -15 -10 -5 0 5 10
AUT total gain at 2200MHz / dBi



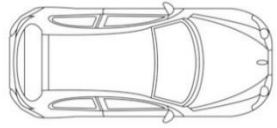
-20 -15 -10 -5 0 5 10
AUT total gain at 3300MHz / dBi



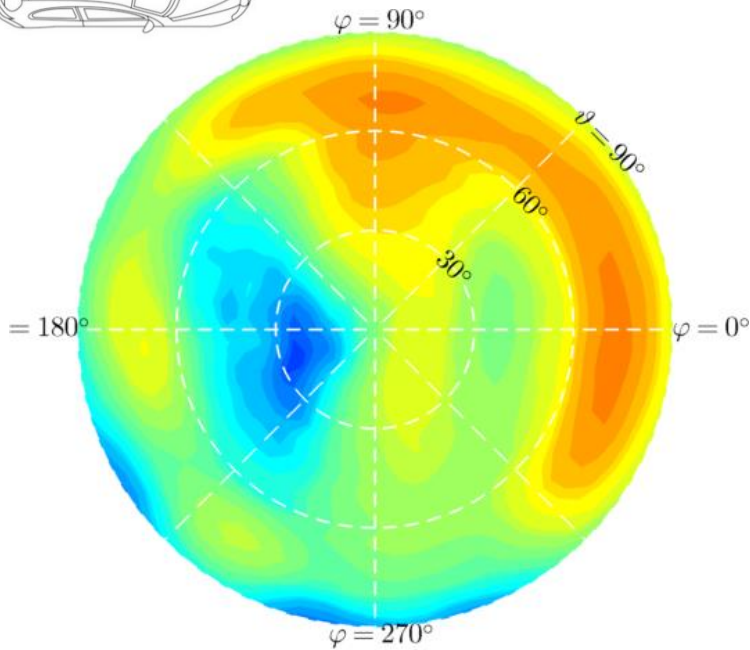
4.1 Variant B: LTE Antenna Performance Gain-Cuts (LTE front)



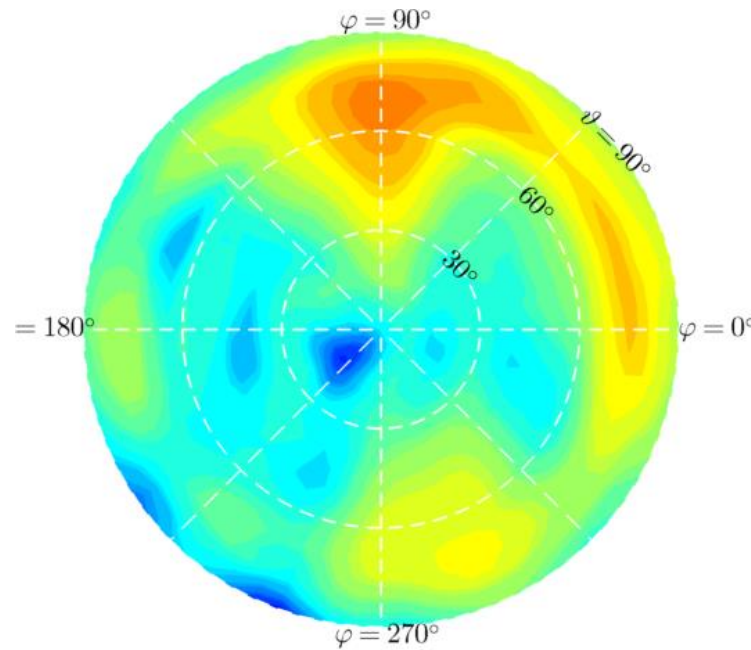
4.1 Variant B: LTE Antenna Performance 3D-Chart (LTE front)



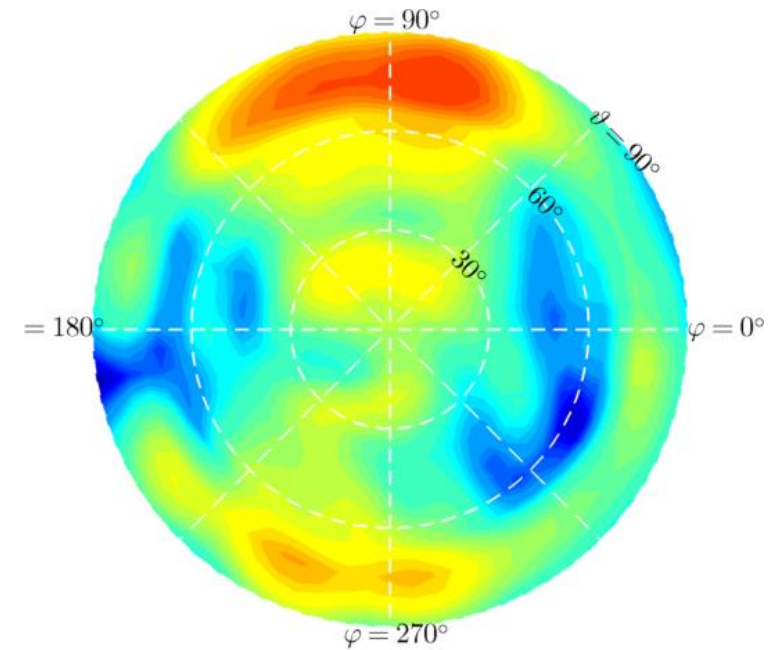
Driving Direction



-20 -15 -10 -5 0 5 10
AUT total gain at 3500MHz / dBi



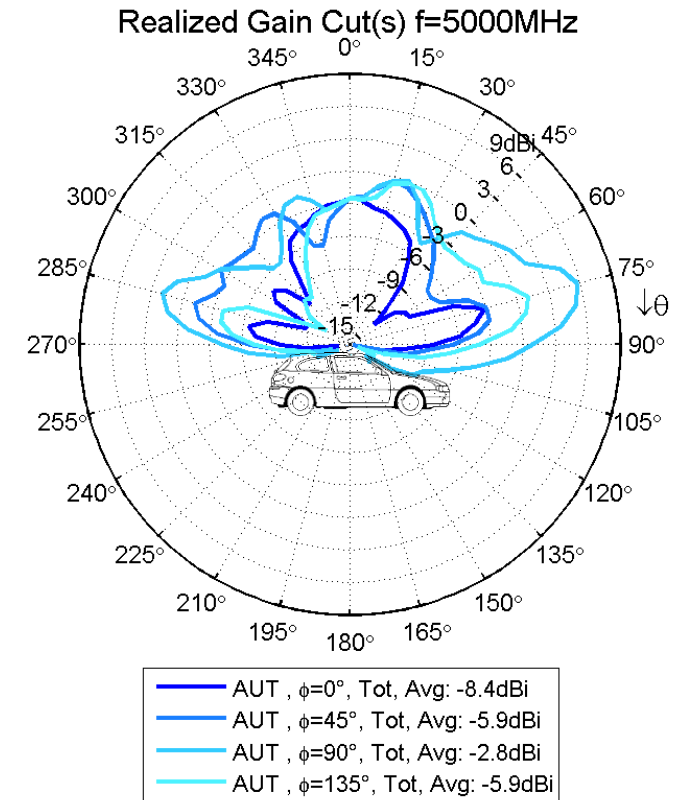
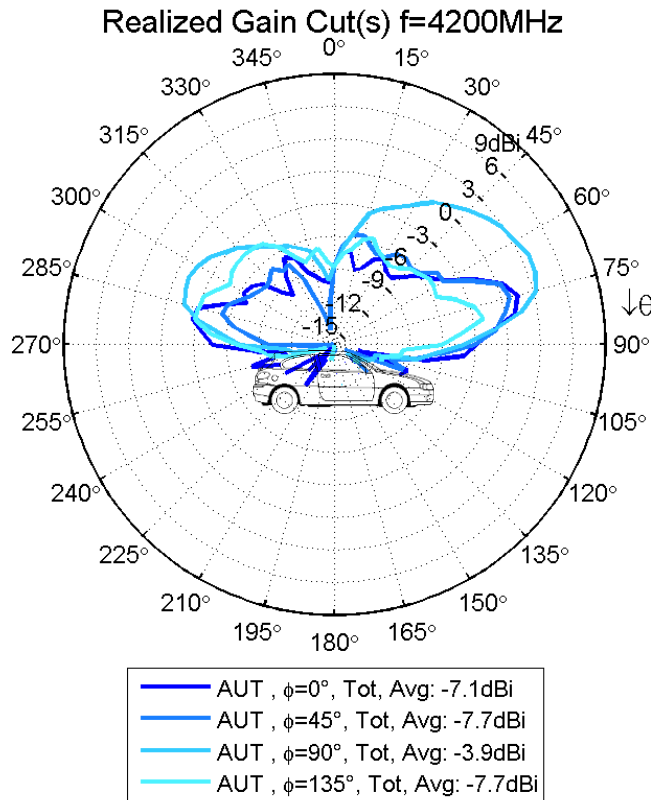
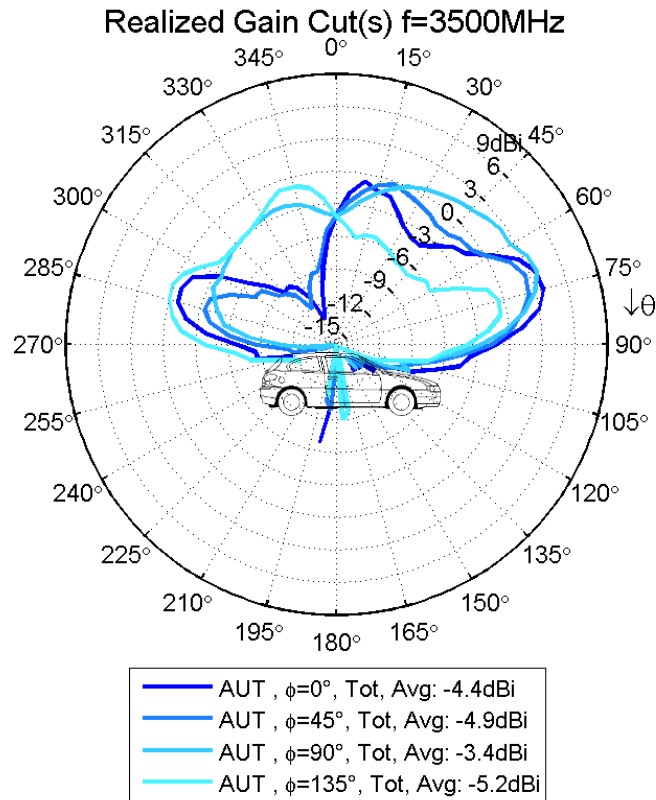
-20 -15 -10 -5 0 5 10
AUT total gain at 4200MHz / dBi



-20 -15 -10 -5 0 5 10
AUT total gain at 5000MHz / dBi



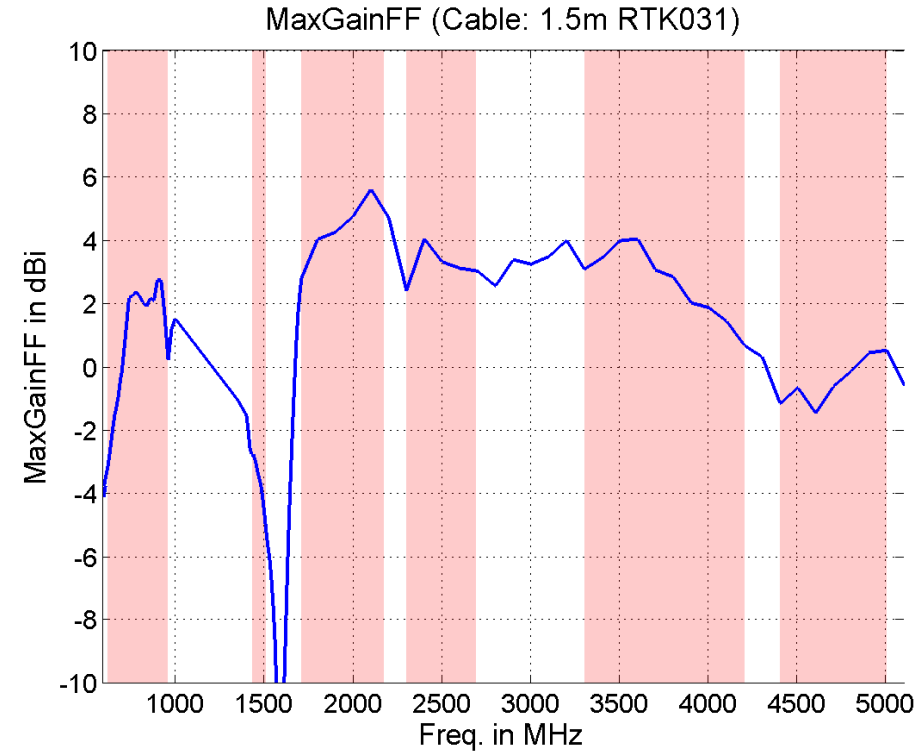
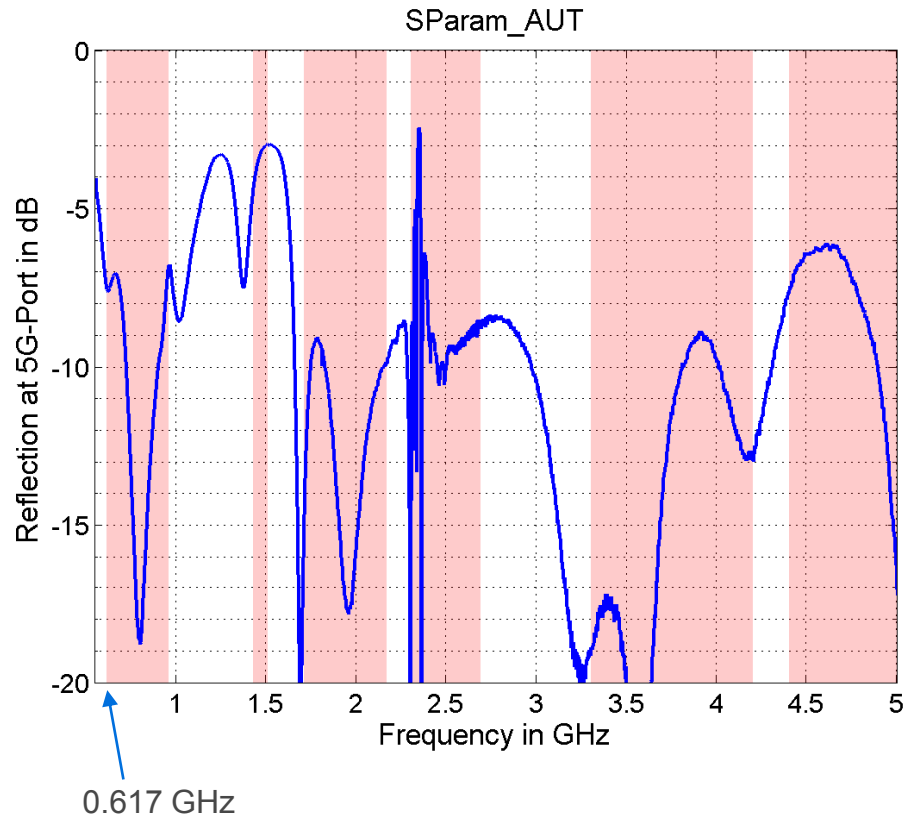
4.1 Variant B: LTE Antenna Performance Gain-Cuts (LTE front)



4.2 LTE Back



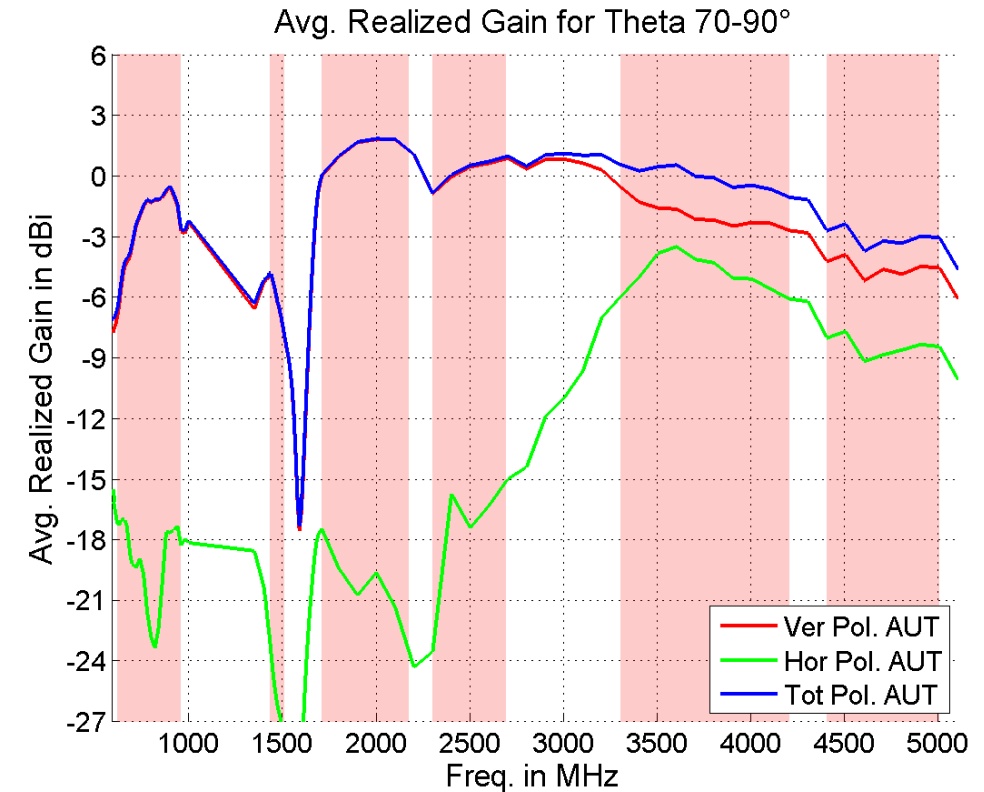
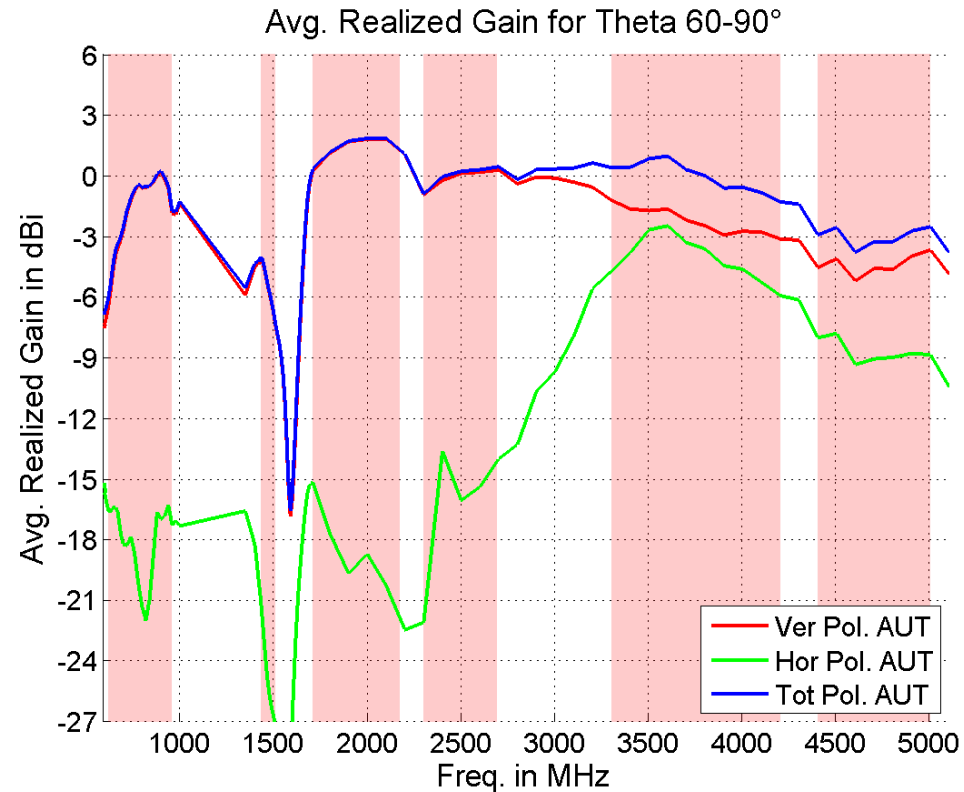
4.2 Variant B: LTE Antenna Performance Matching (LTE back)



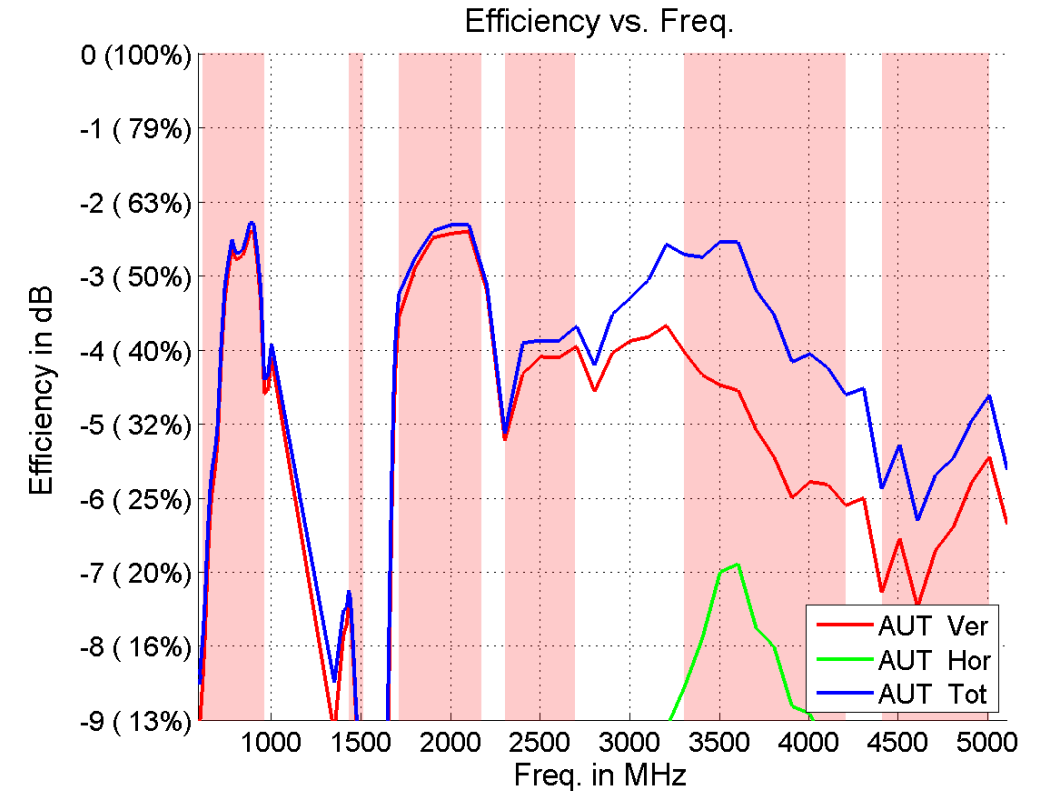
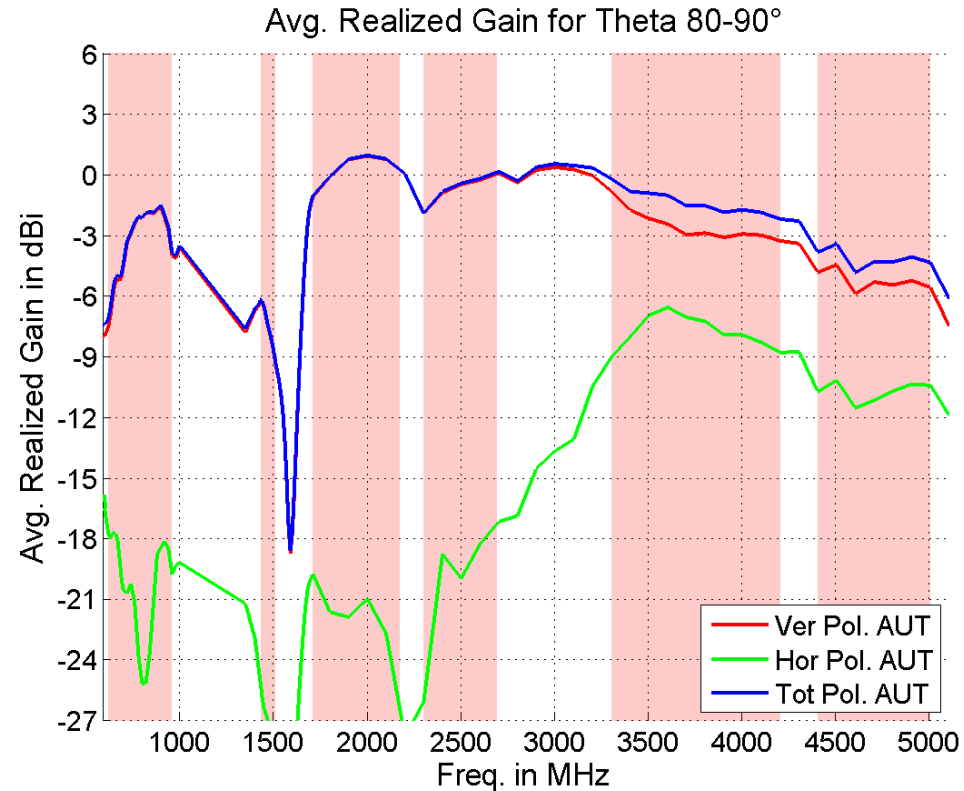
- The MaxGainFF-values are determined with 1.5m RTK031 cable (attenuation added to the measurement results).
- See attached file “Audi_CS_S10_VariantB_LTEb_gain_maxFF.csv” for the equivalent raw MaxGainFF-data.



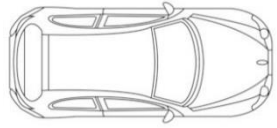
4.2 Variant B: LTE Antenna Performance Gain and Efficiency (LTE back)



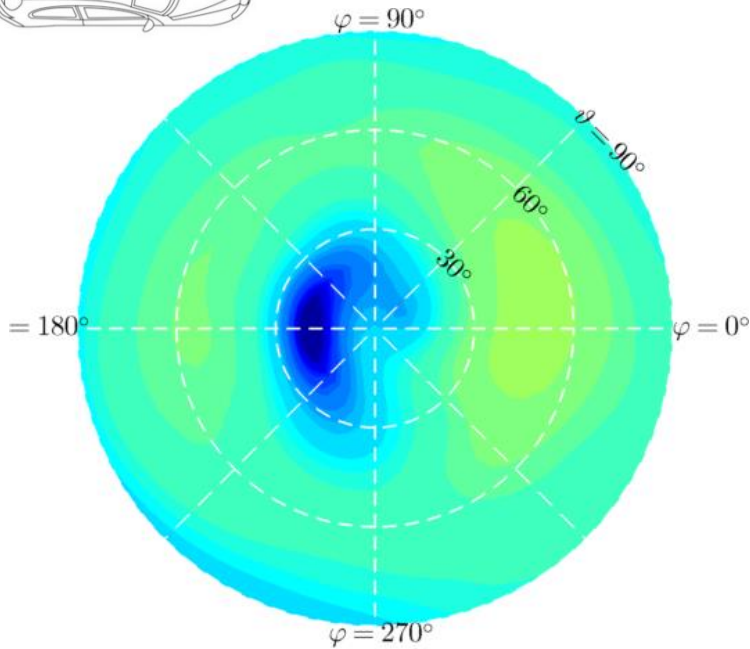
4.2 Variant B: LTE Antenna Performance Gain and Efficiency (LTE back)



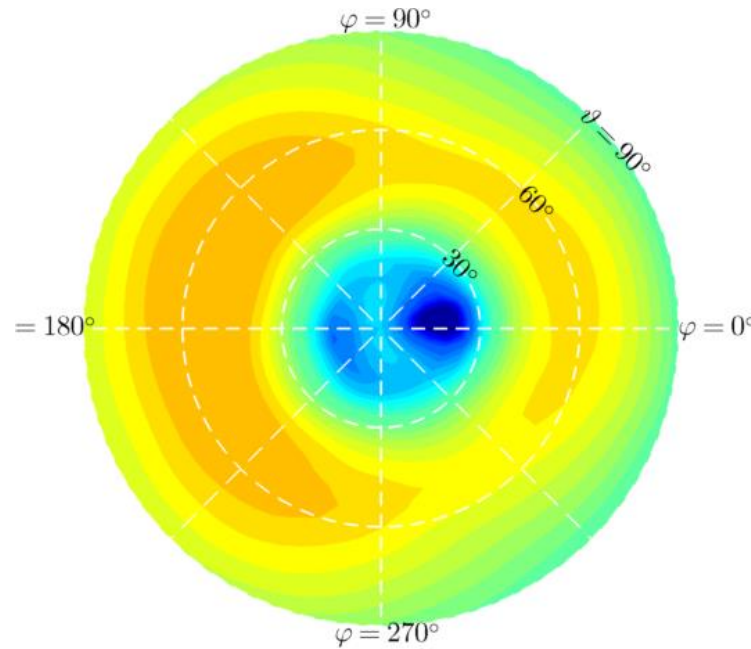
4.2 Variant B: LTE Antenna Performance 3D-Chart (LTE back)



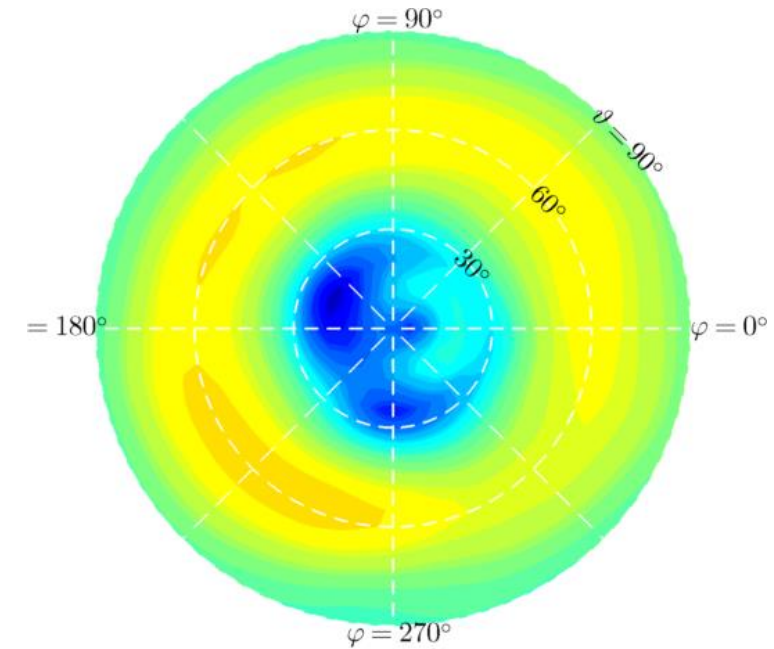
Driving Direction



-20 -15 -10 -5 0 5 10
AUT total gain at 620MHz / dBi



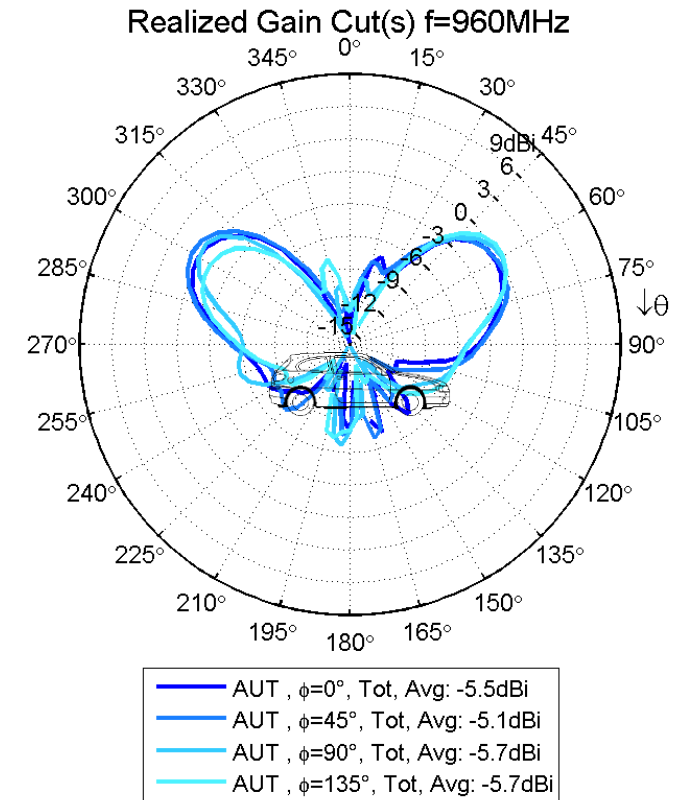
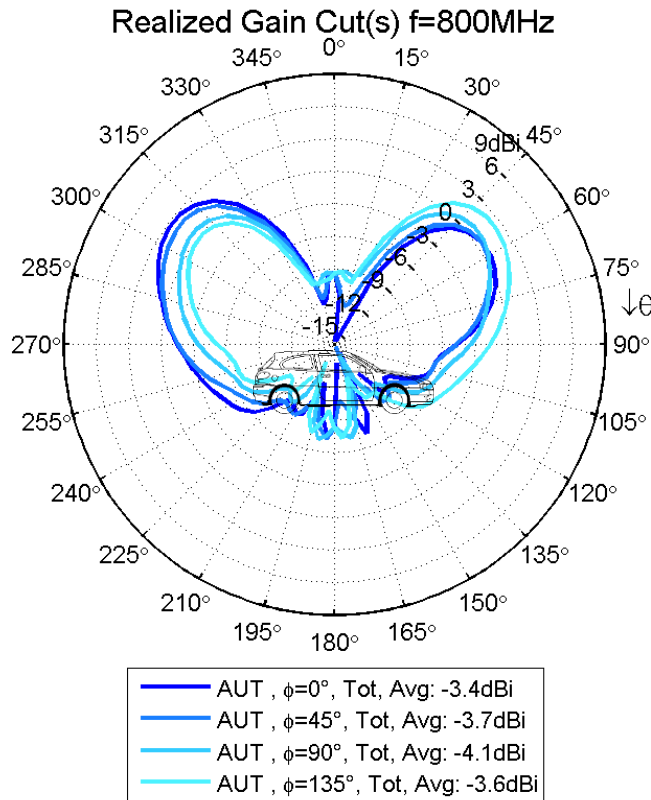
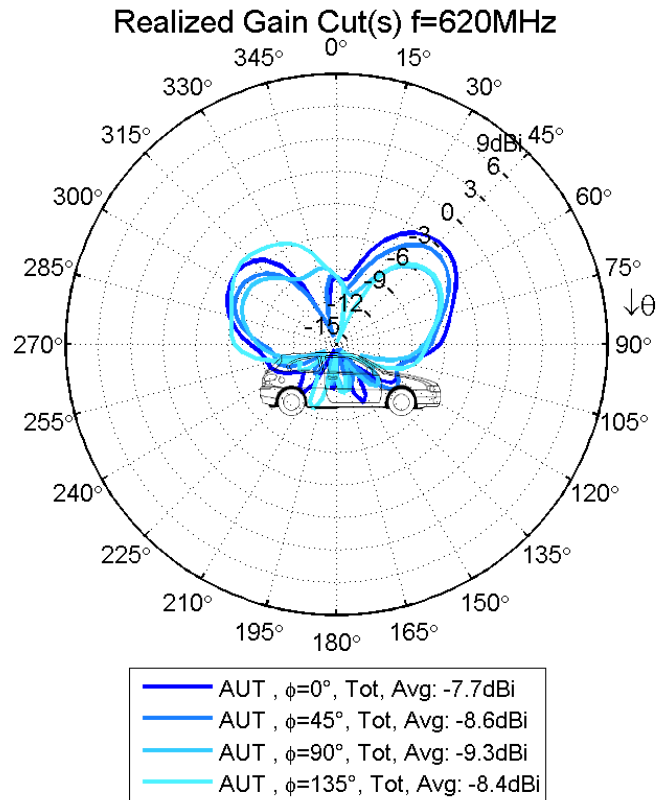
-20 -15 -10 -5 0 5 10
AUT total gain at 800MHz / dBi



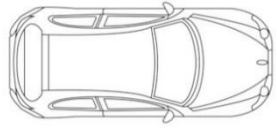
-20 -15 -10 -5 0 5 10
AUT total gain at 960MHz / dBi



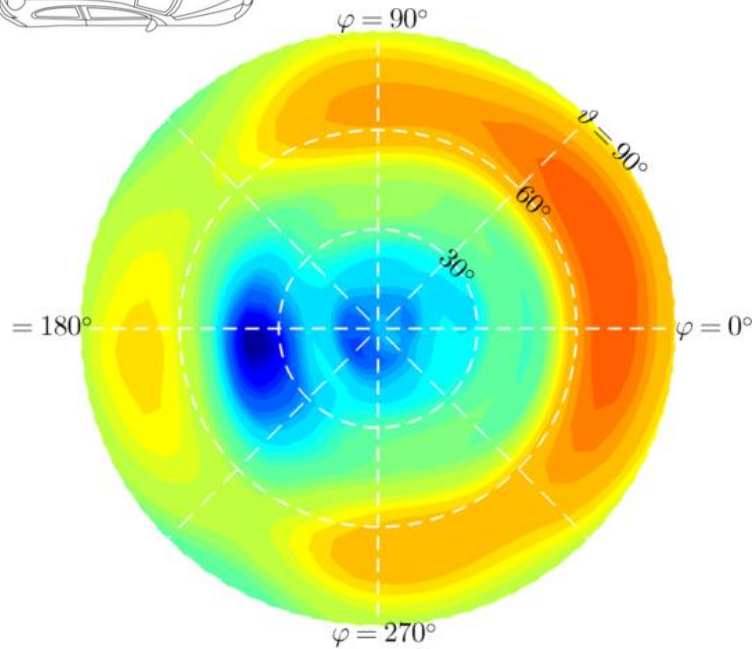
4.2 Variant B: LTE Antenna Performance Gain-Cuts (LTE back)



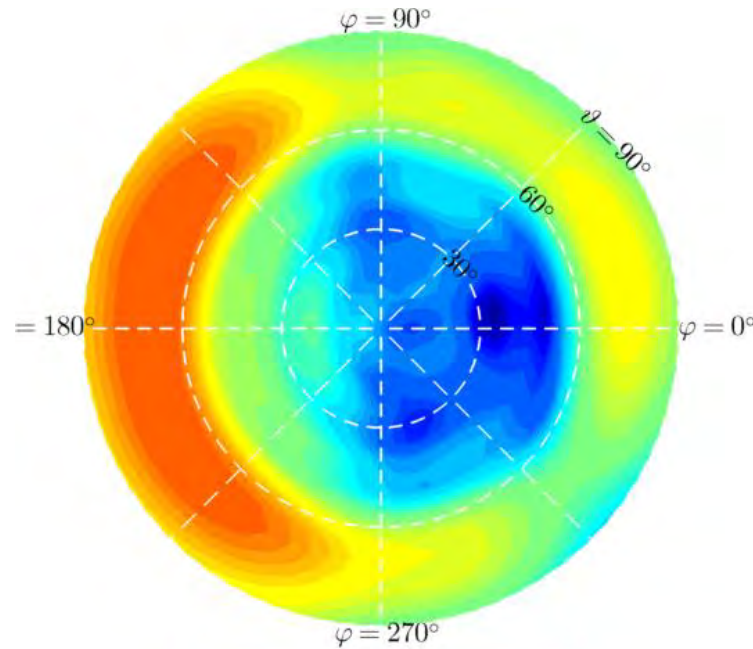
4.2 Variant B: LTE Antenna Performance 3D-Chart (LTE back)



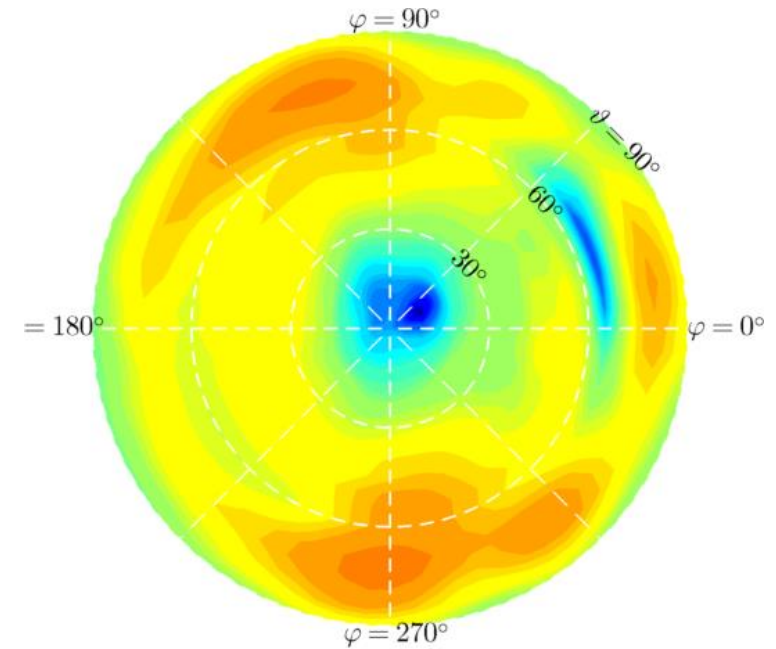
Driving Direction



-20 -15 -10 -5 0 5 10
AUT total gain at 1800MHz / dBi



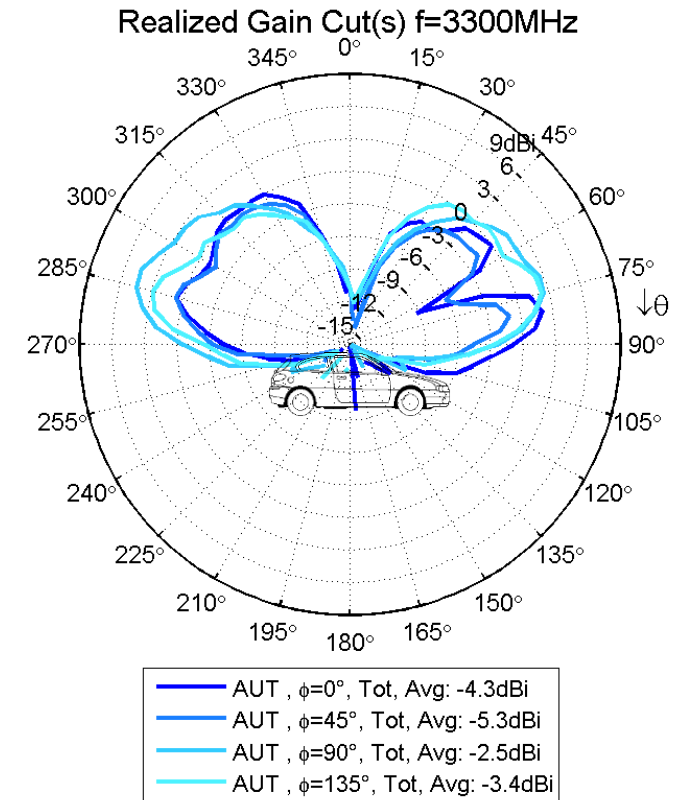
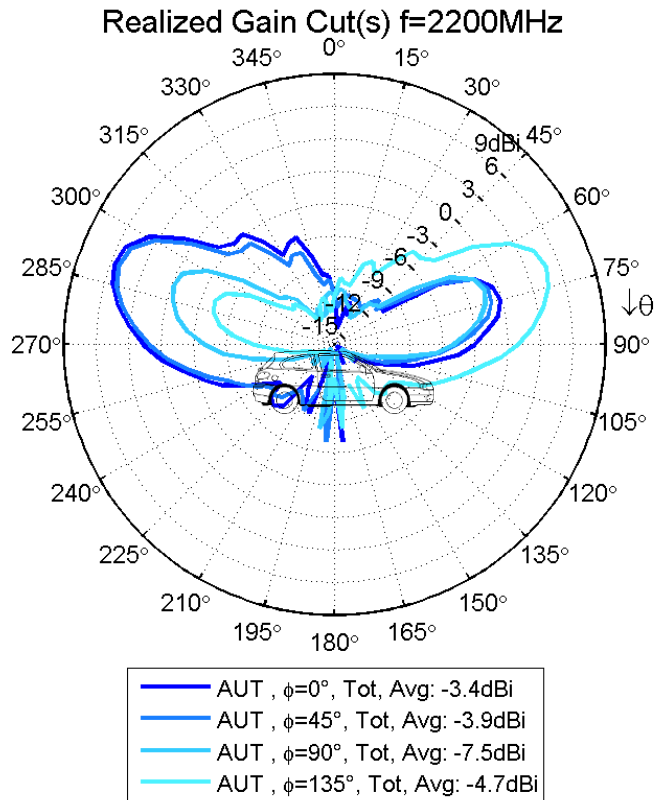
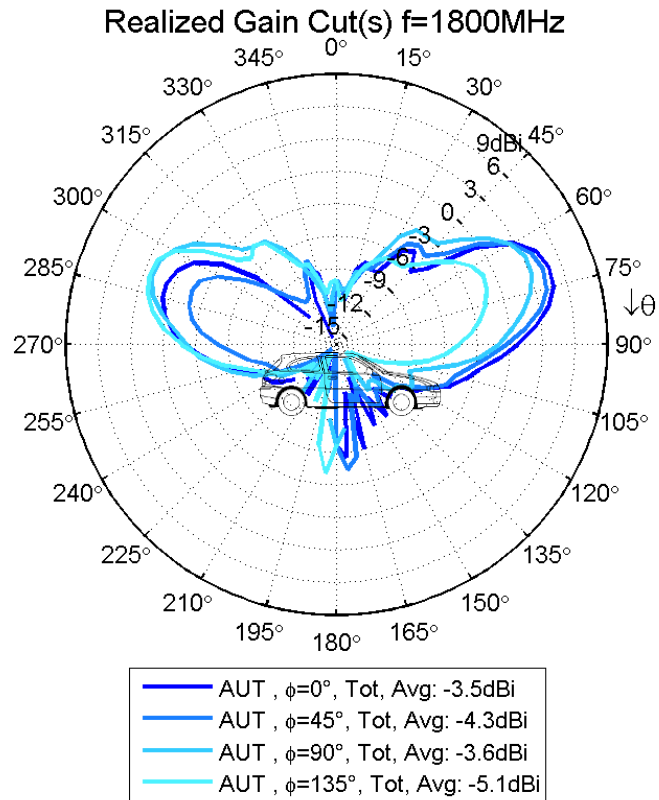
-20 -15 -10 -5 0 5 10
AUT total gain at 2200MHz / dBi



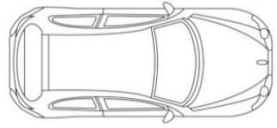
-20 -15 -10 -5 0 5 10
AUT total gain at 3300MHz / dBi



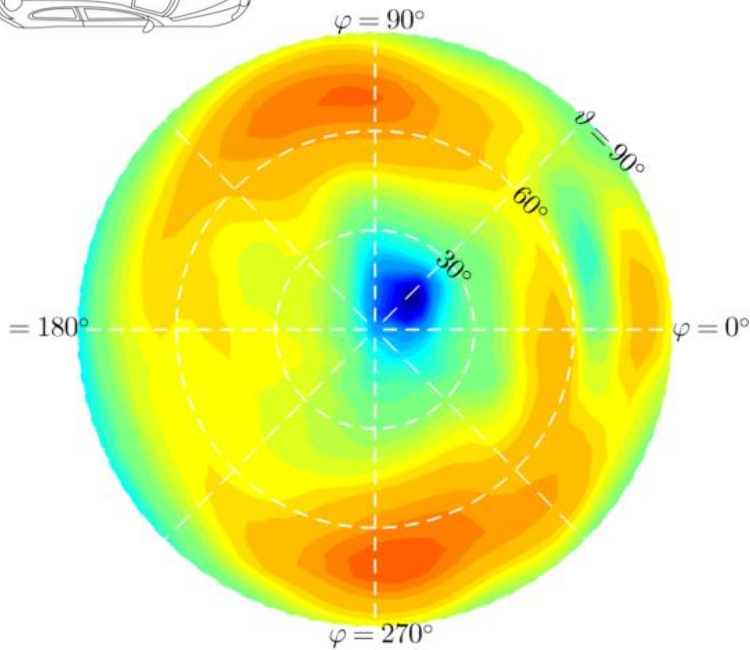
4.2 Variant B: LTE Antenna Performance Gain-Cuts (LTE back)



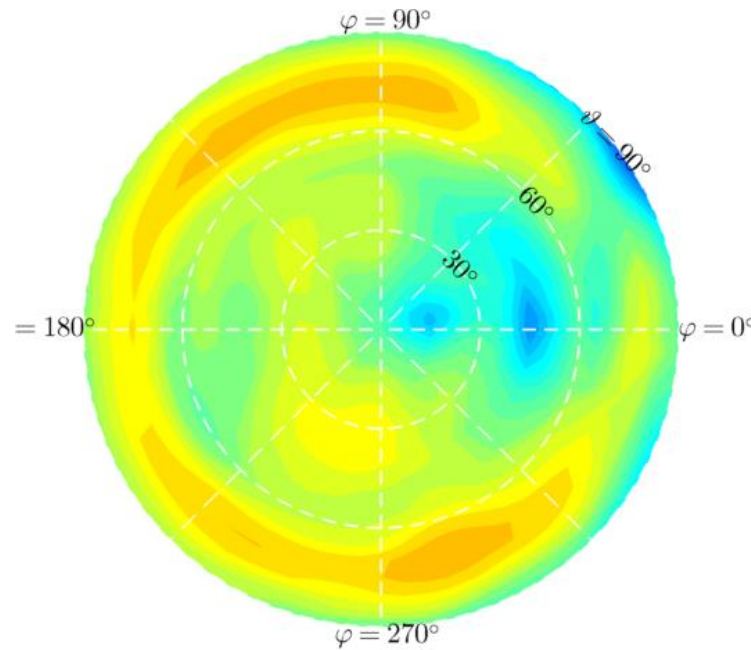
4.2 Variant B: LTE Antenna Performance 3D-Chart (LTE back)



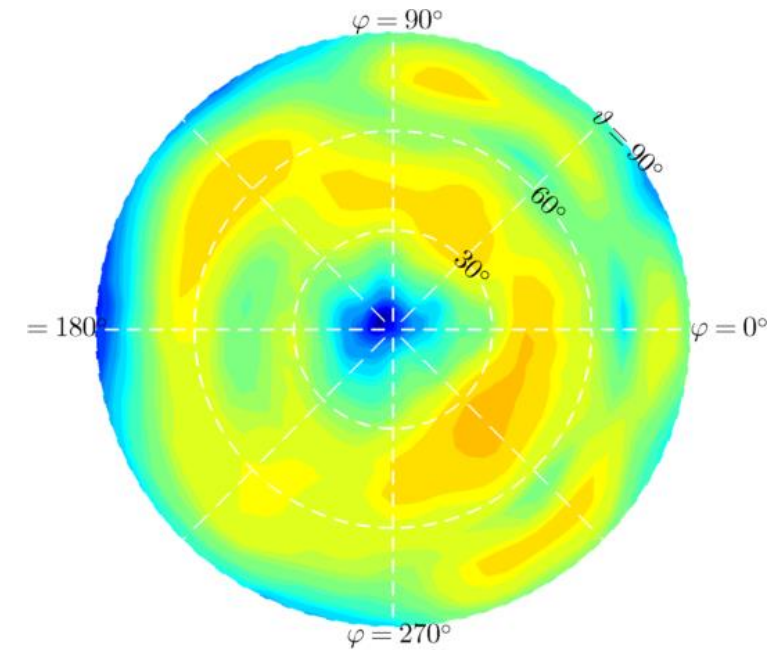
Driving Direction



-20 -15 -10 -5 0 5 10
AUT total gain at 3500MHz / dBi



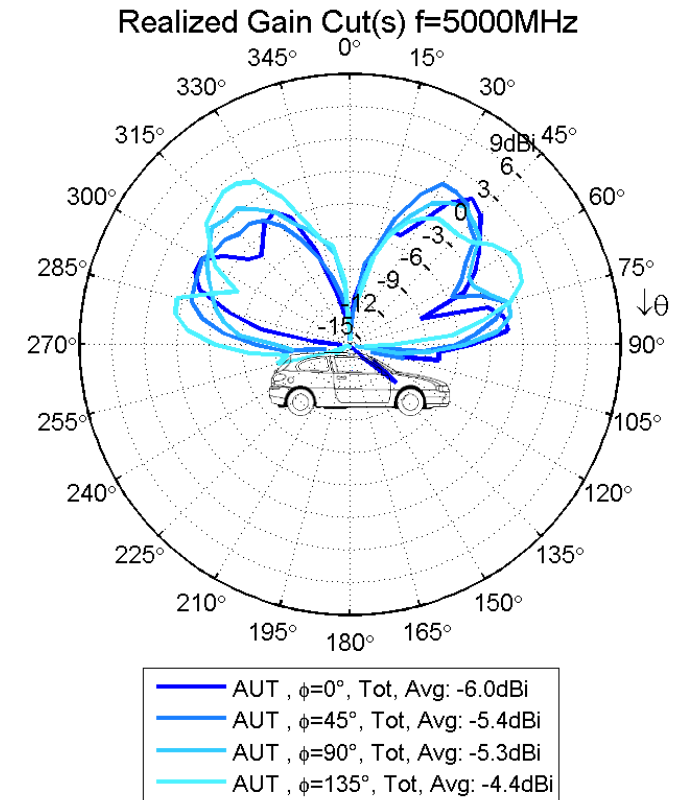
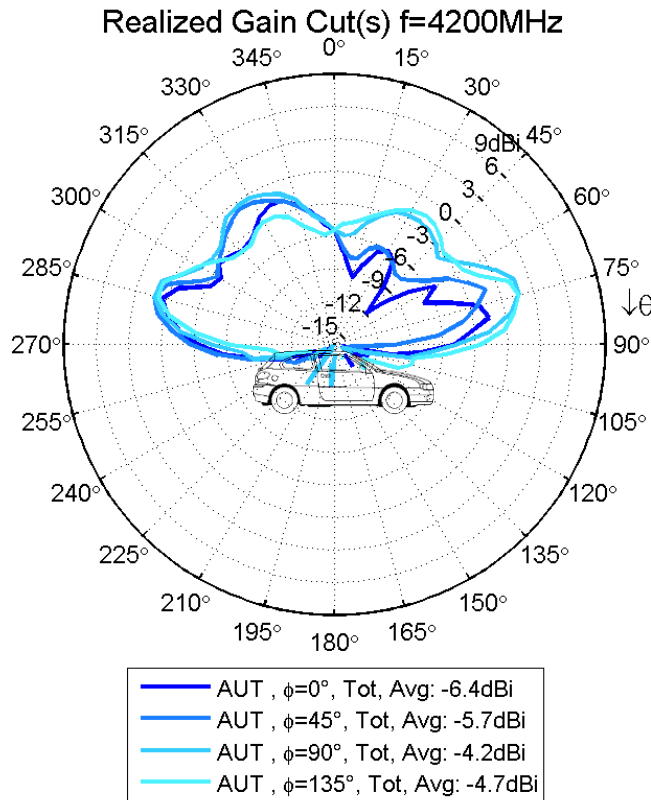
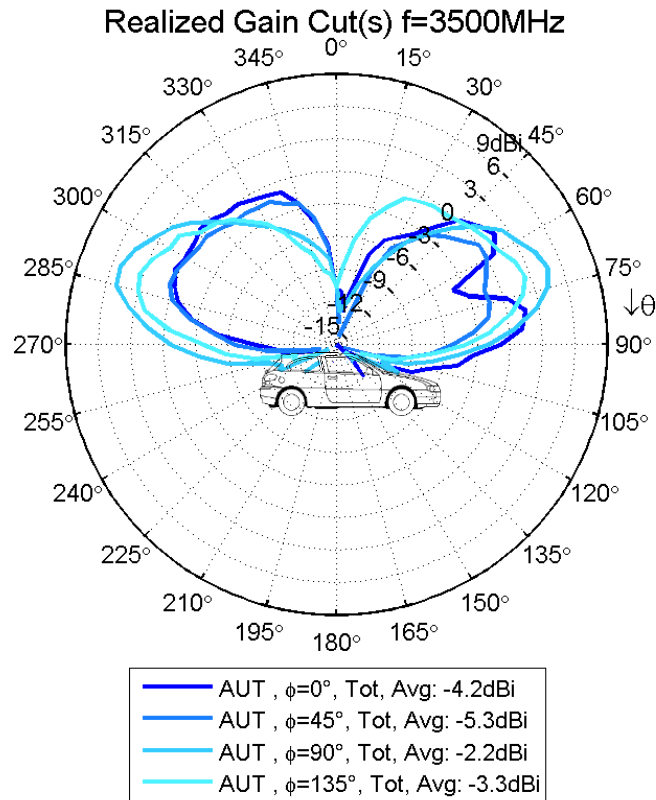
-20 -15 -10 -5 0 5 10
AUT total gain at 4200MHz / dBi



-20 -15 -10 -5 0 5 10
AUT total gain at 5000MHz / dBi



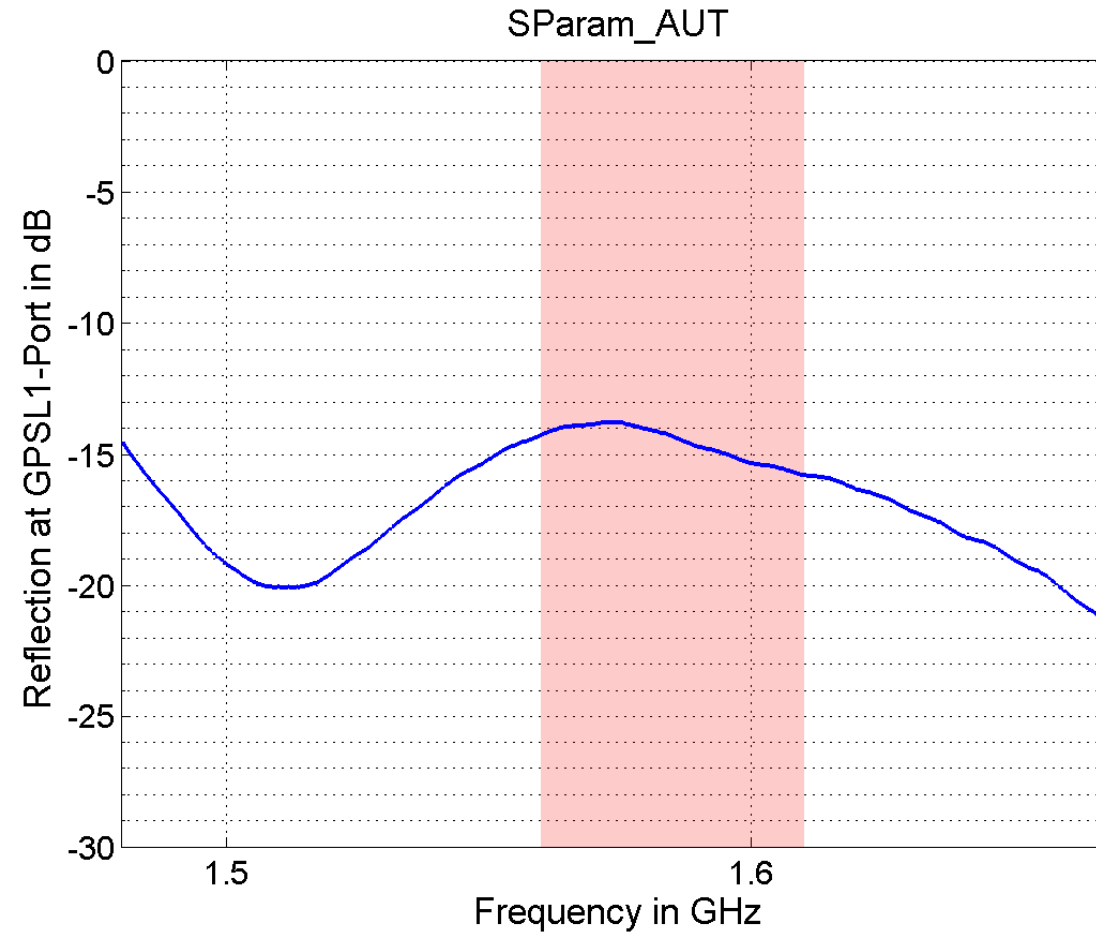
4.2 Variant B: LTE Antenna Performance Gain-Cuts (LTE back)



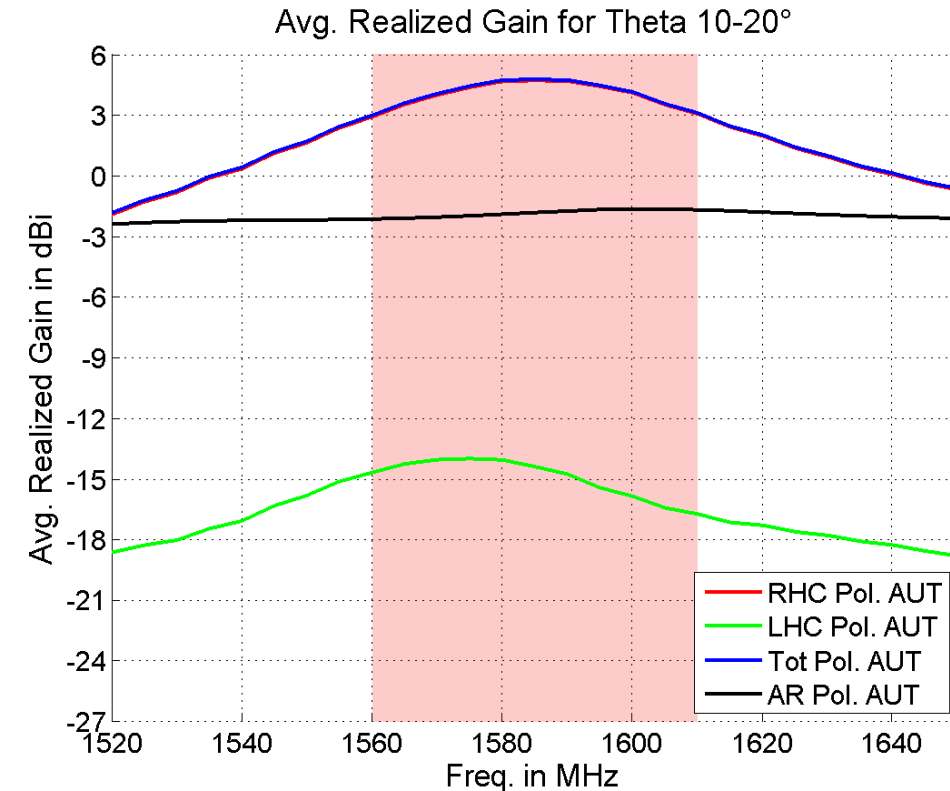
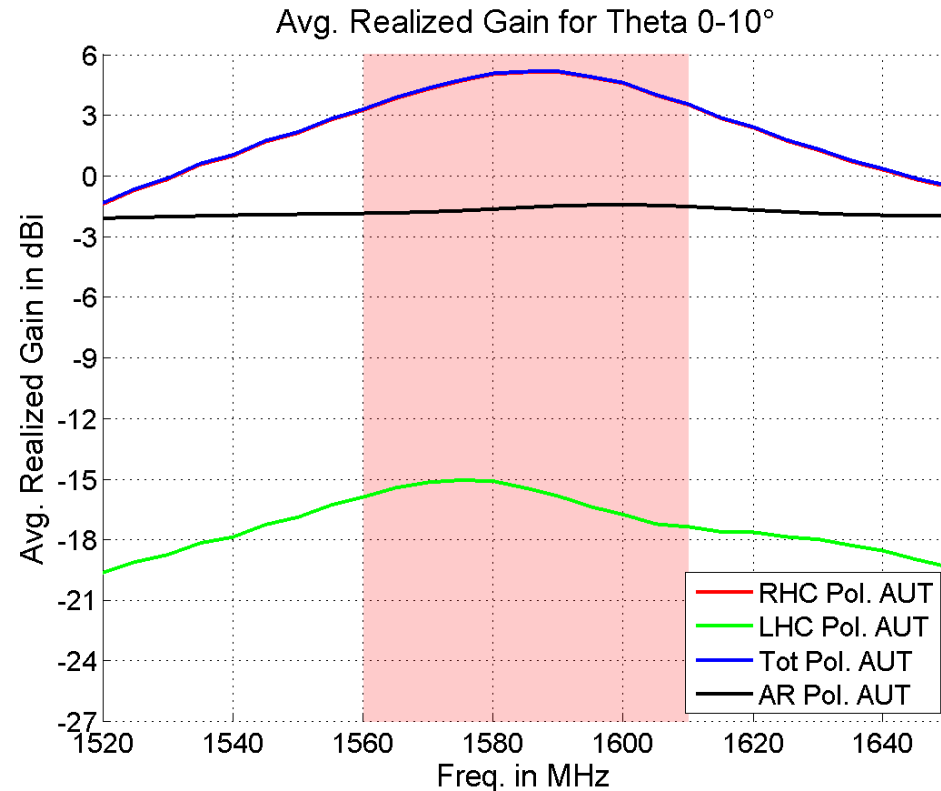
4.3 GNSS L1



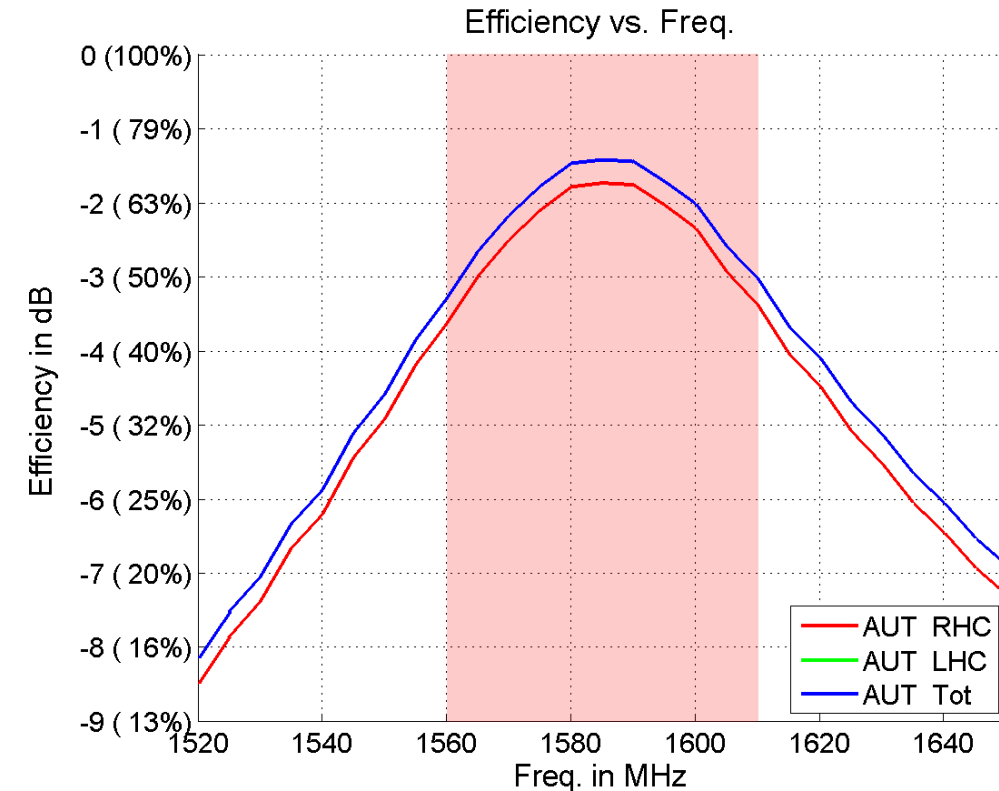
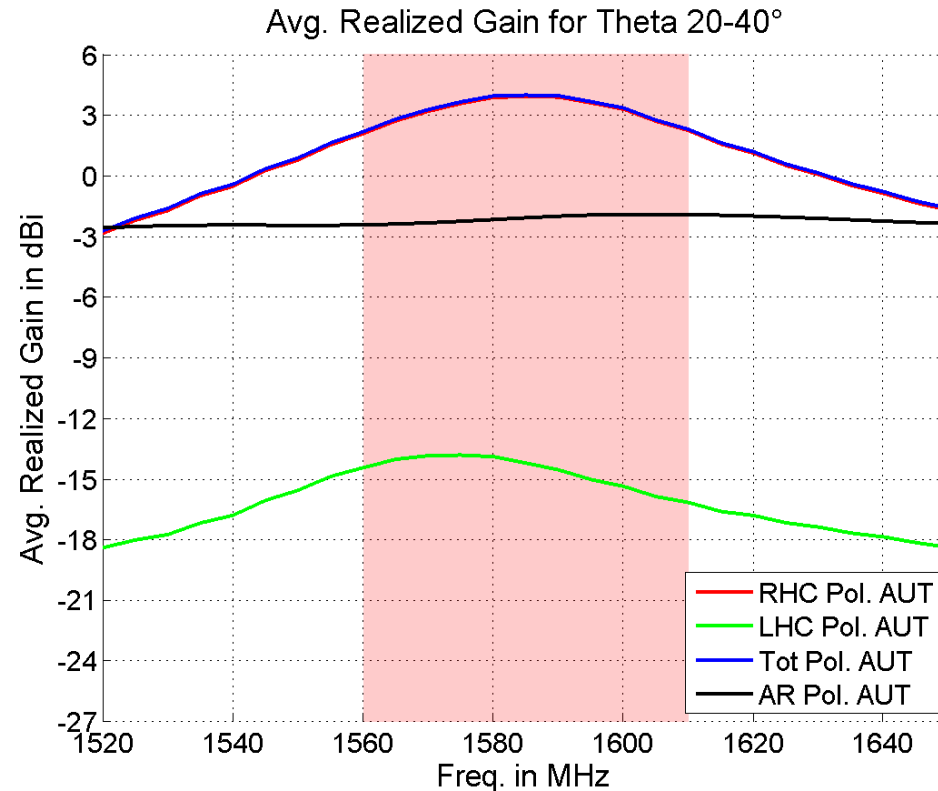
4.3 Variant B: Satellite Antenna Performance Matching (GNSS L1)



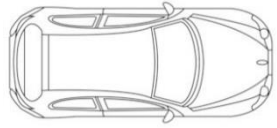
4.3 Variant B: Satellite Antenna Performance Gain and Efficiency (GNSS L1)



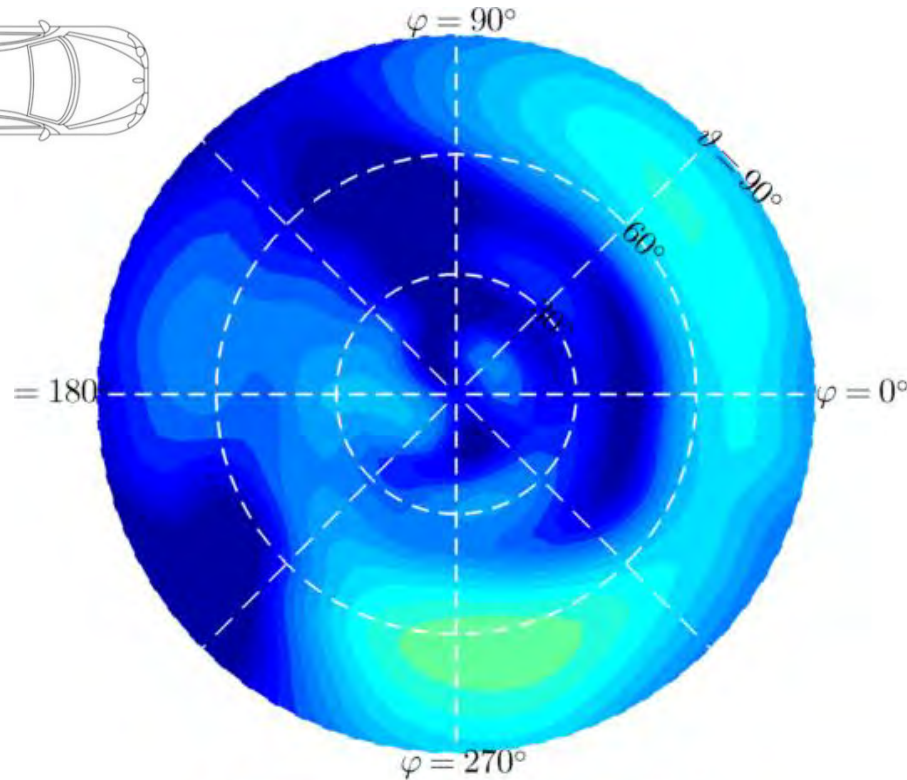
4.3 Variant B: Satellite Antenna Performance Gain and Efficiency (GNSS L1)



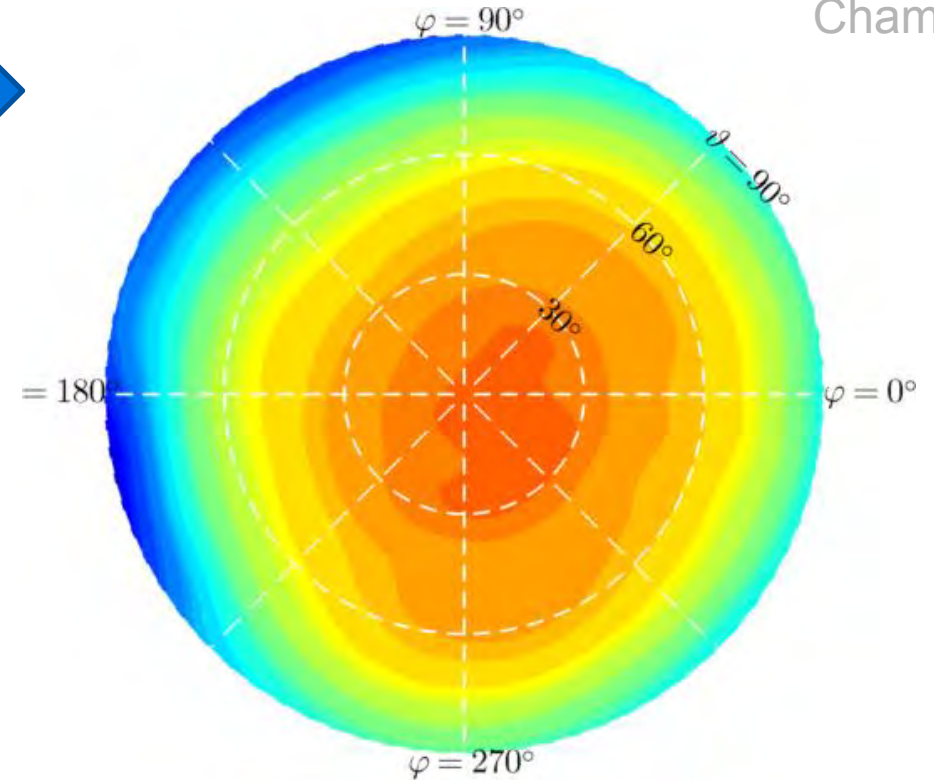
4.3 Variant B: Satellite Antenna Performance 3D-Chart (GNSS L1)



Driving
Direction



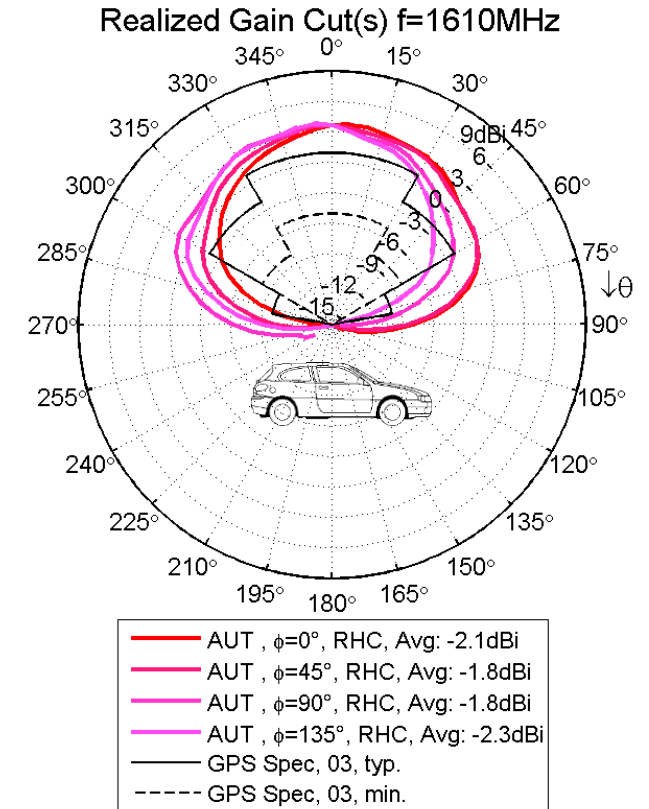
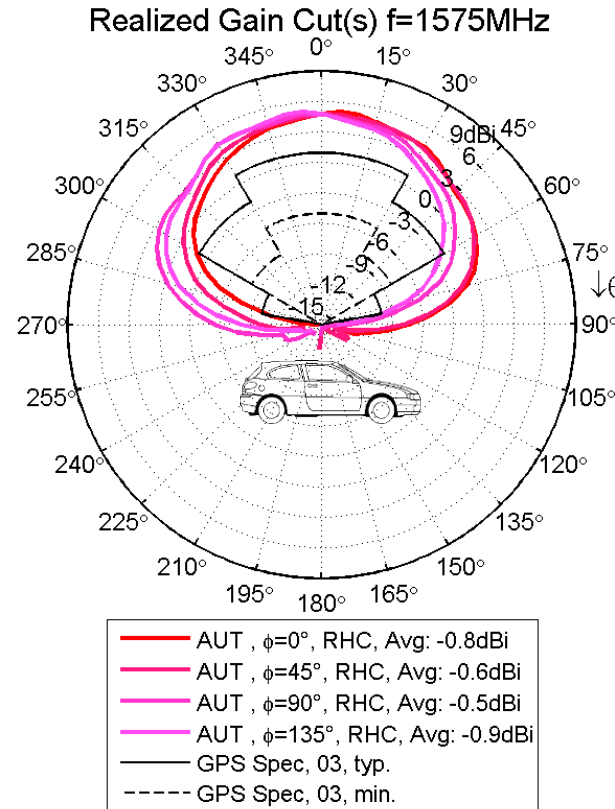
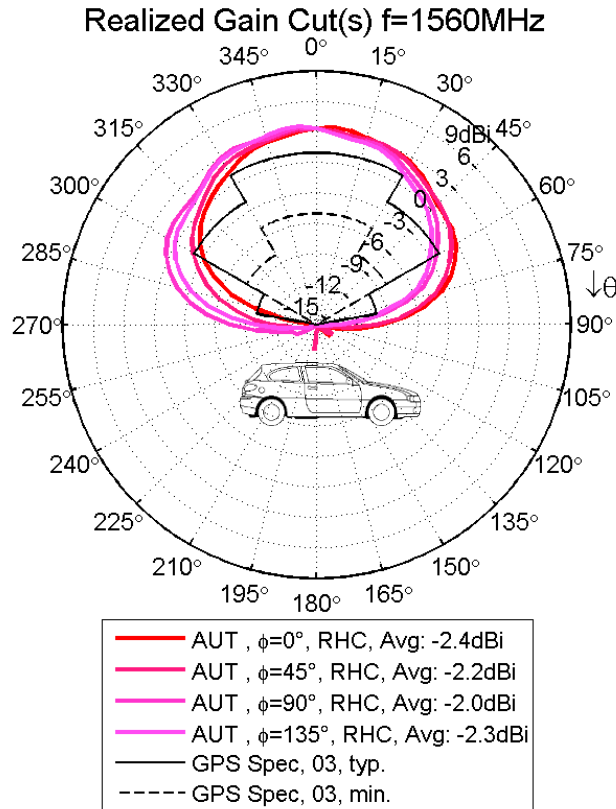
-20 -15 -10 -5 0 5 10
AUT LHCP gain at 1575MHz / dBi



-20 -15 -10 -5 0 5 10
AUT RHCP gain at 1575MHz / dBi



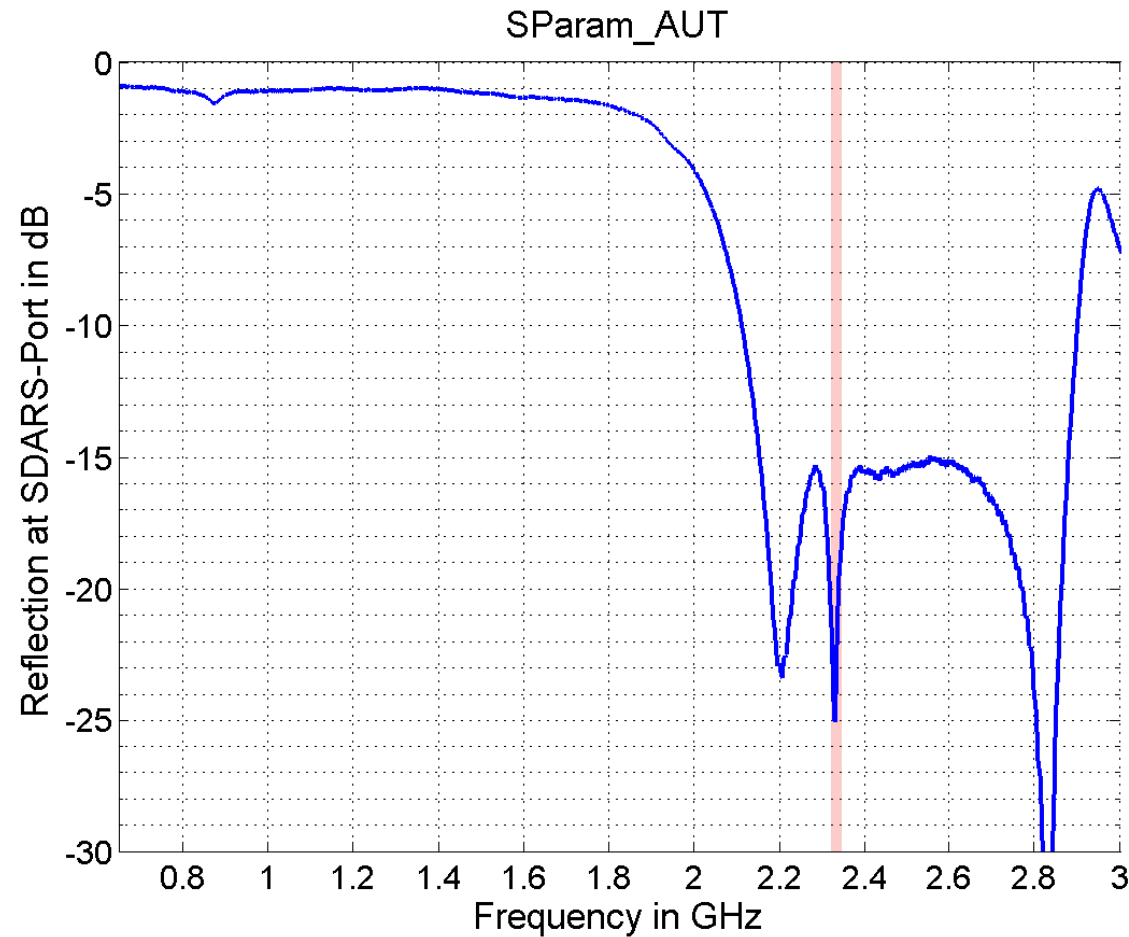
4.3 Variant B: Satellite Antenna Performance Gain-Cuts (GNSS L1)



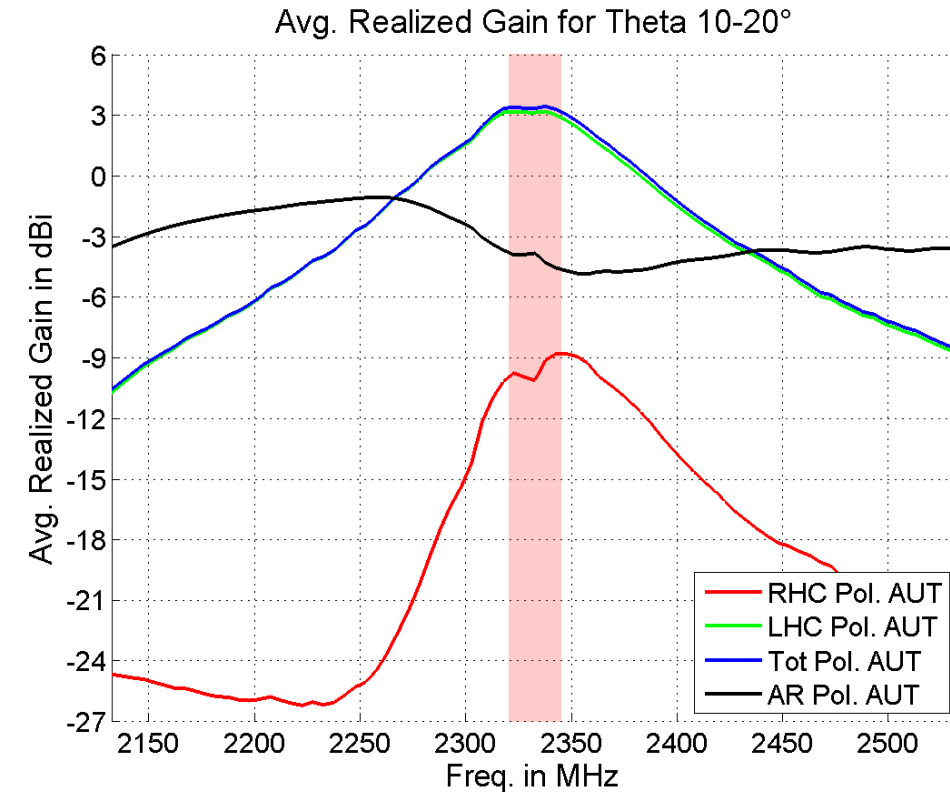
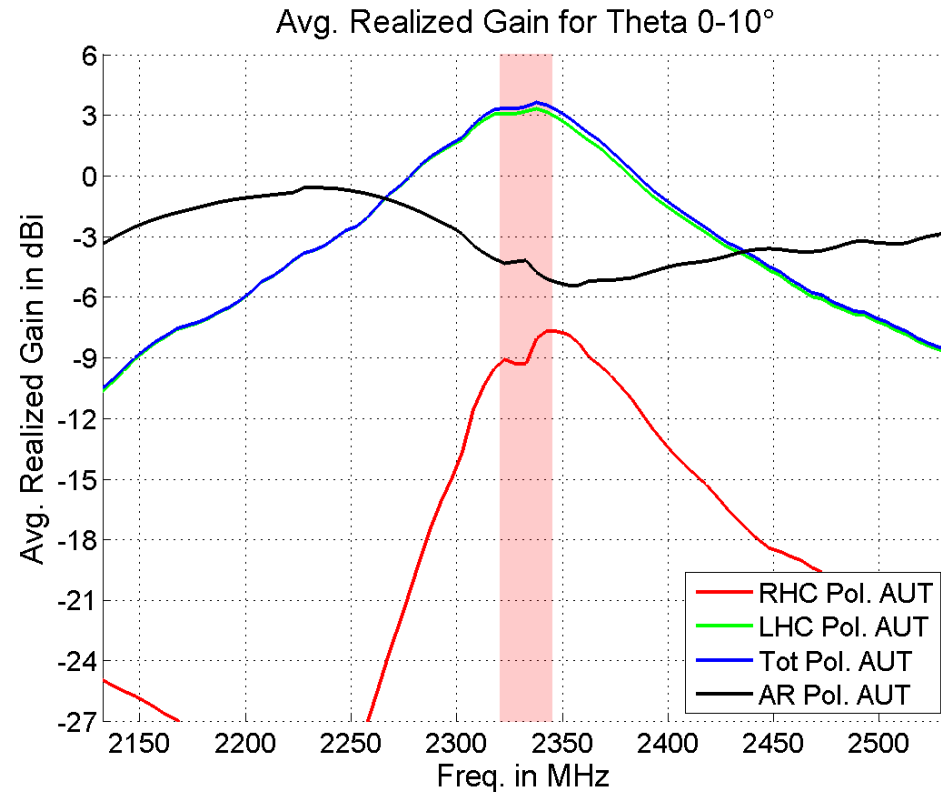
4.4 SDARS



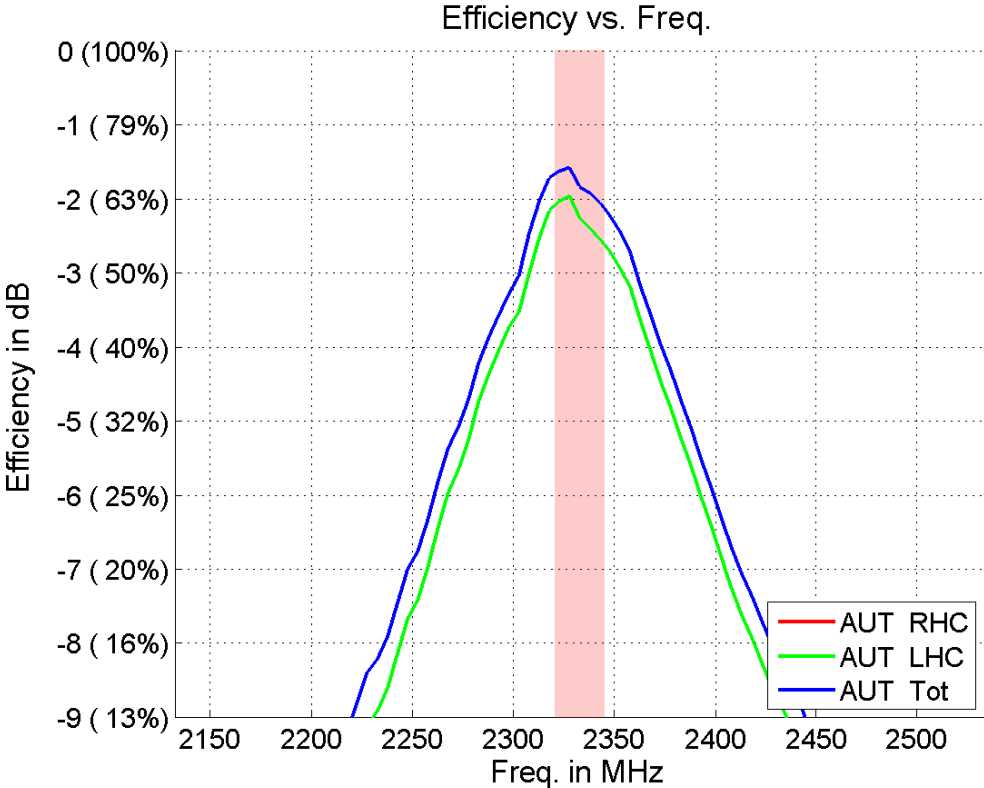
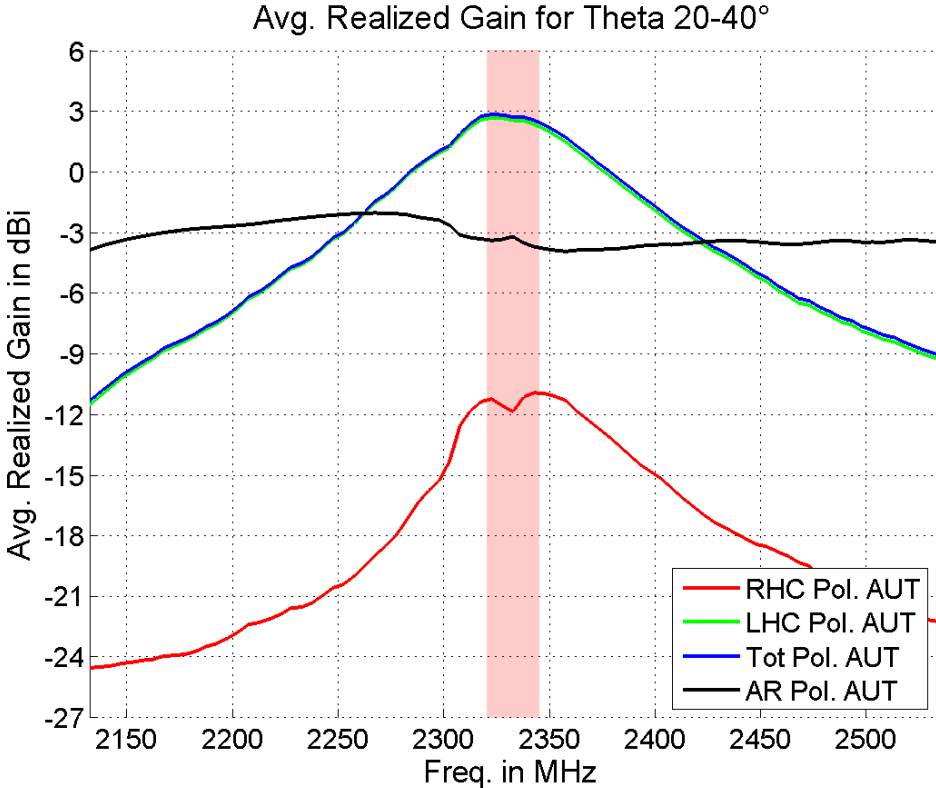
4.4 Variant B: Satellite Antenna Performance Matching (SDARS)



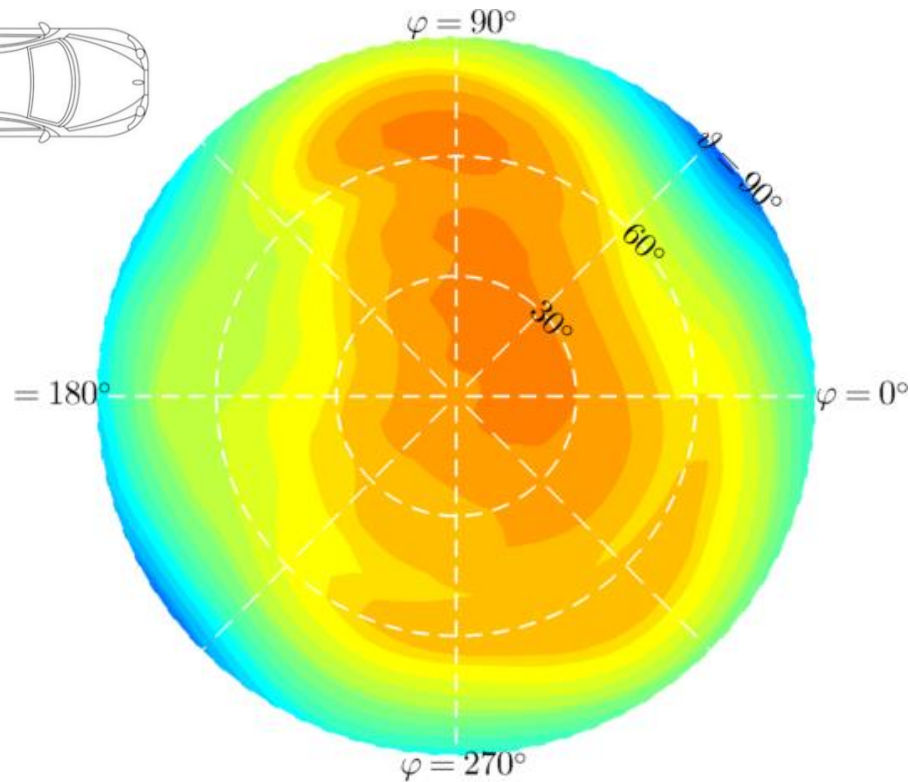
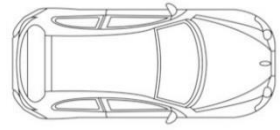
4.4 Variant B: Satellite Antenna Performance Gain and Efficiency (SDARS)



4.4 Variant B: Satellite Antenna Performance Gain and Efficiency (SDARS)

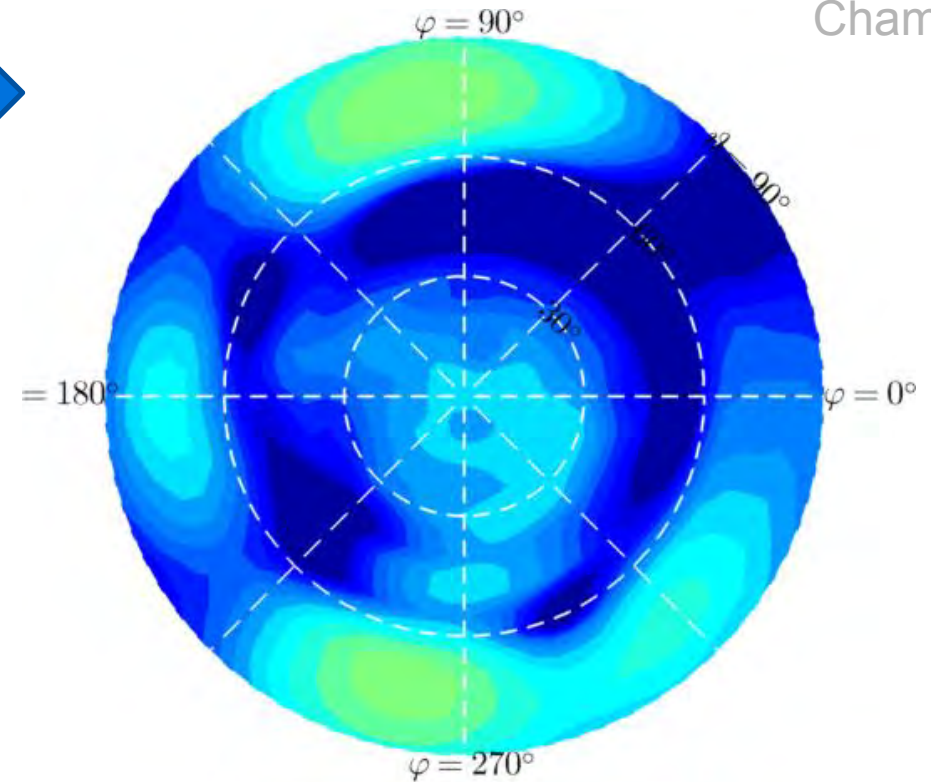


4.4 Variant B: Satellite Antenna Performance 3D-Chart (SDARS)



-20 -15 -10 -5 0 5 10
AUT LHCP gain at 2332.5MHz / dBi

Driving
Direction

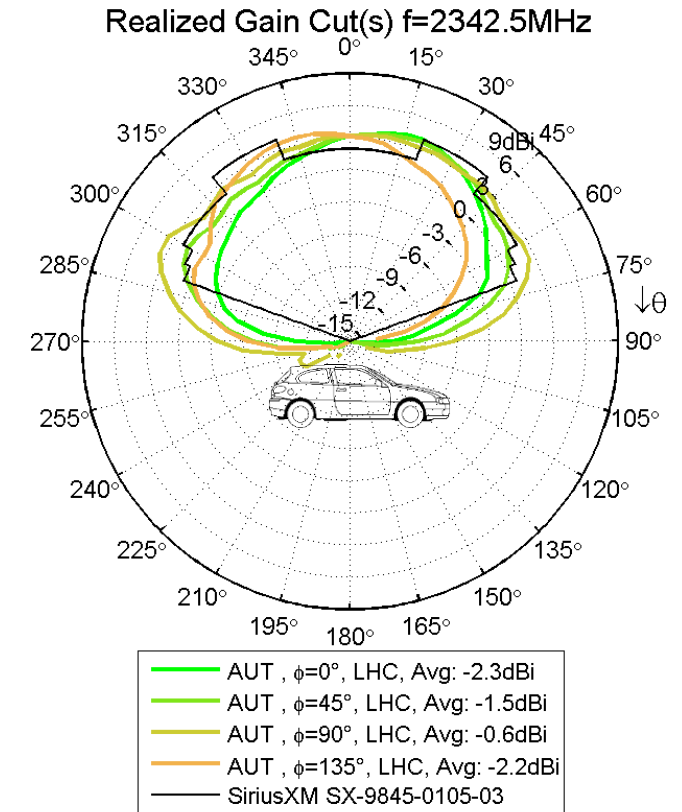
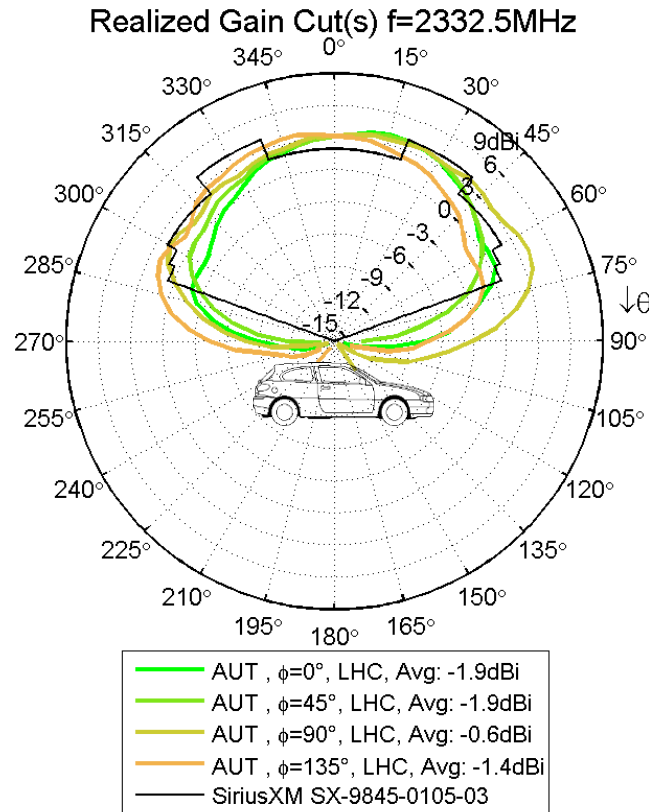
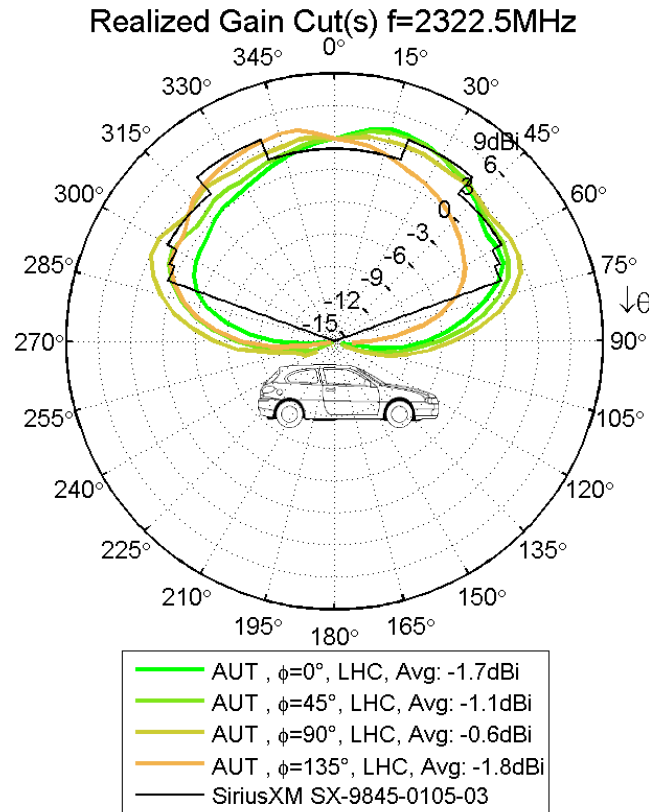


-20 -15 -10 -5 0 5 10
AUT RHCP gain at 2332.5MHz / dBi



4.4 Variant B: Satellite Antenna Performance Gain-Cuts (SDARS)

Chamber

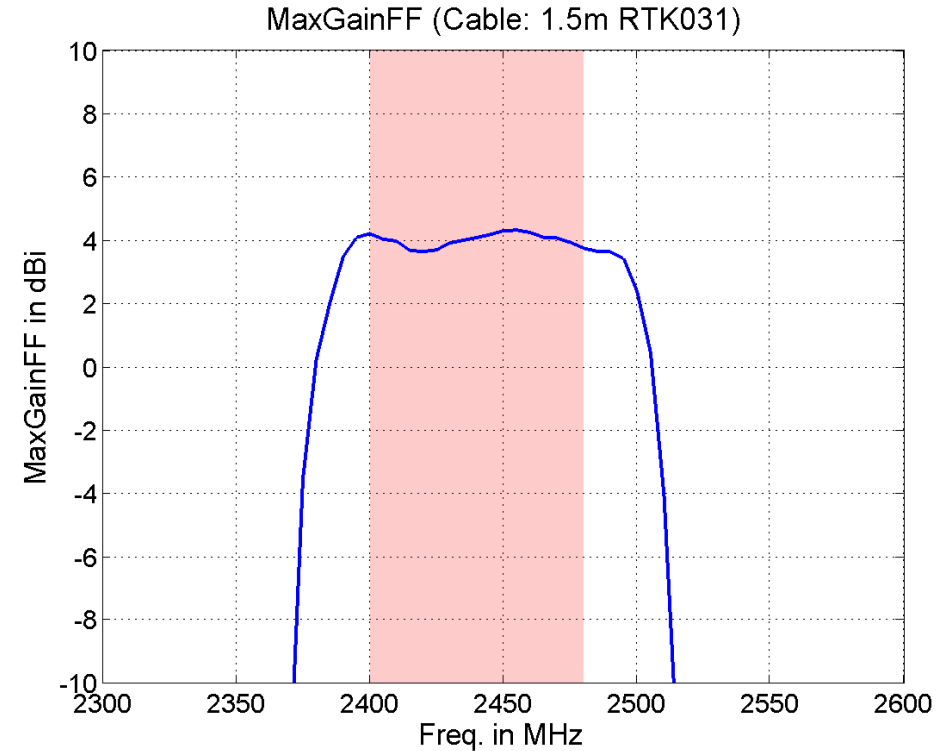
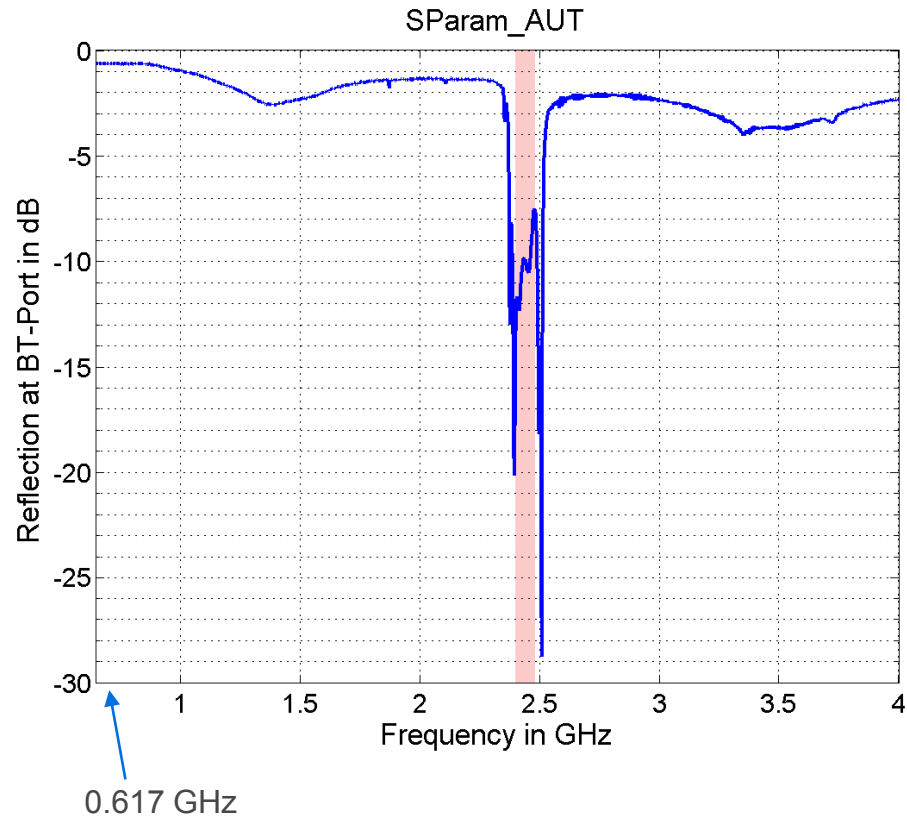


4.5 Bluetooth



4.5 Variant B: Bluetooth Antenna Performance Matching (BT)

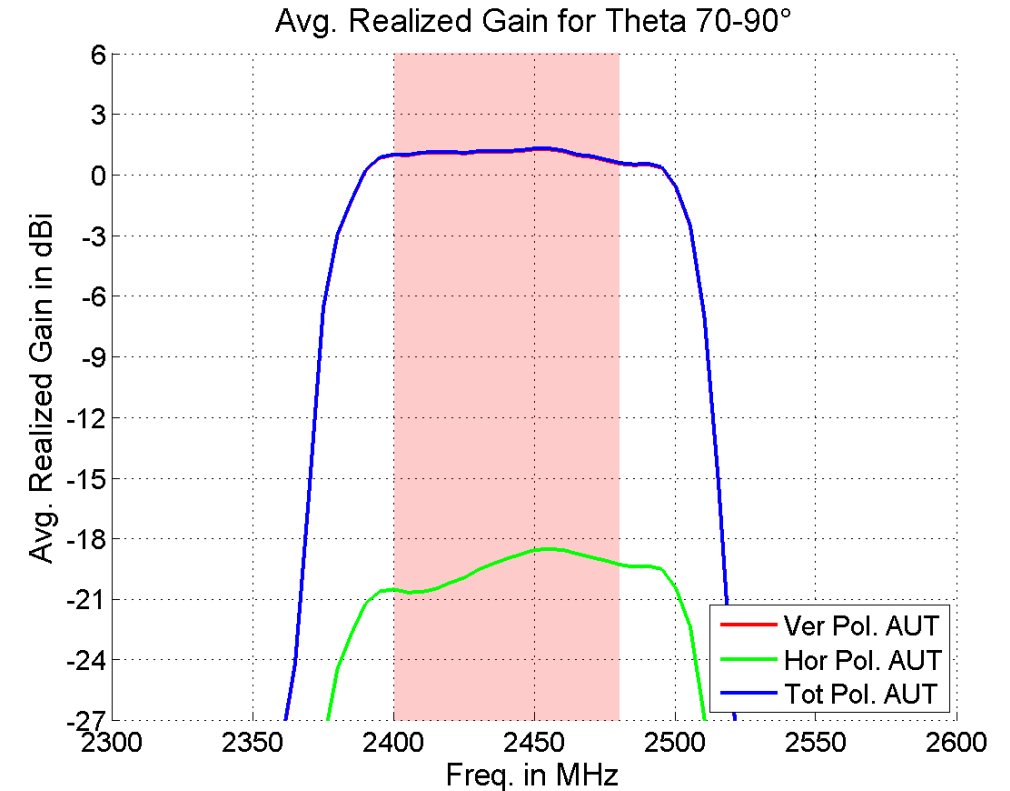
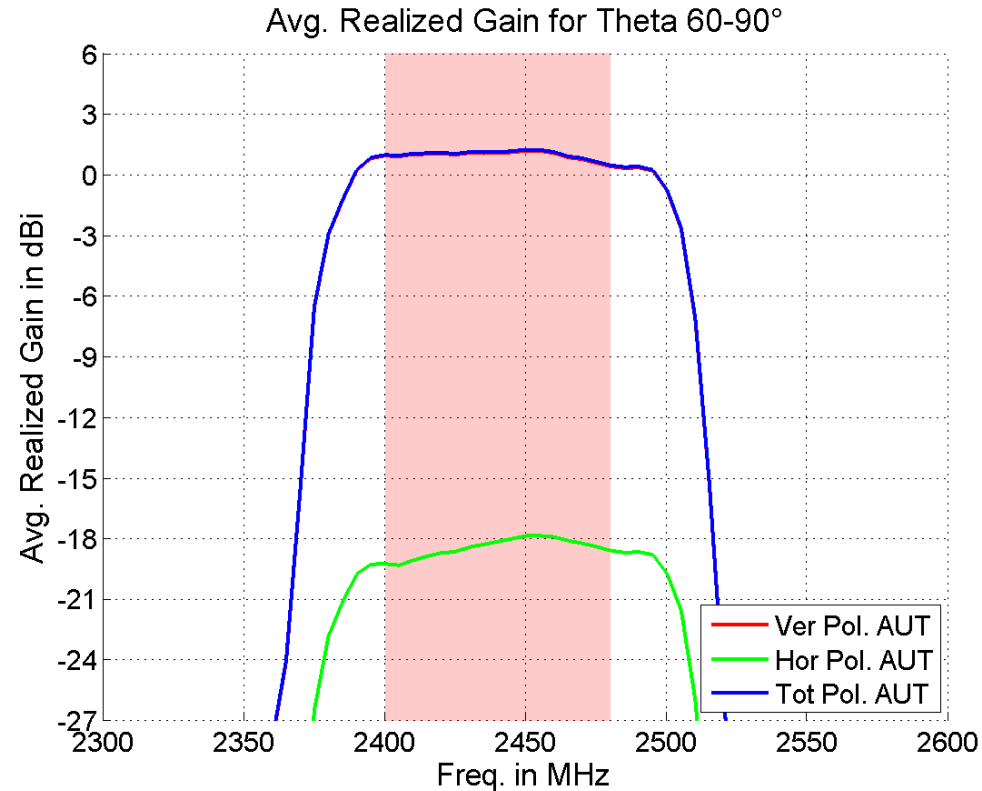
Chamber



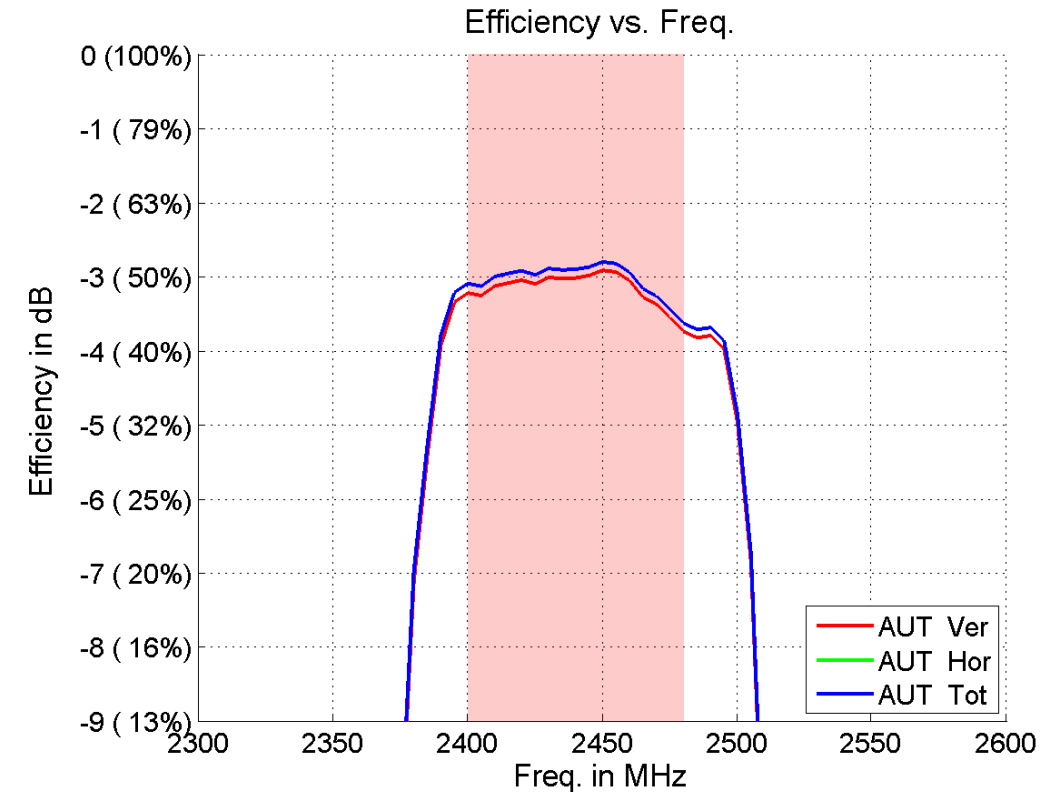
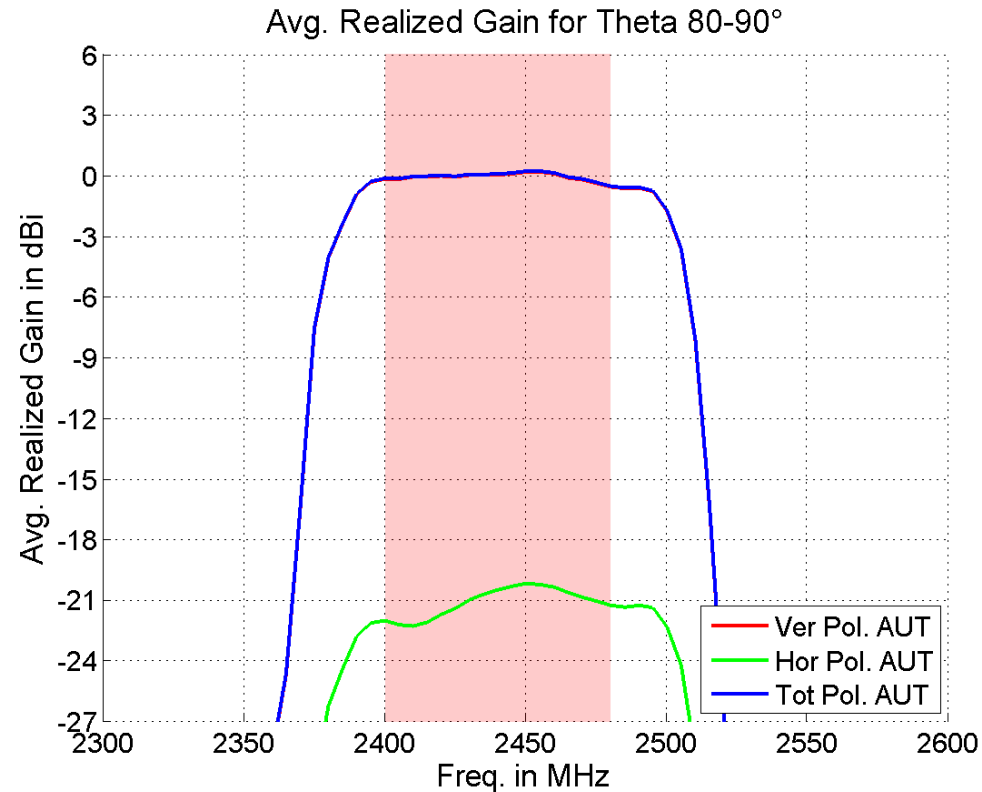
- The MaxGainFF-values are determined with 1.5m RTK031 cable (attenuation added to the measurement results).
- See attached file “Audi_CS_S10_VariantB_BT_gain_maxFF.csv” for the equivalent raw MaxGainFF-data.



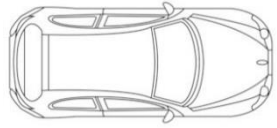
4.5 Variant B: Bluetooth Antenna Performance Gain and Efficiency (BT)



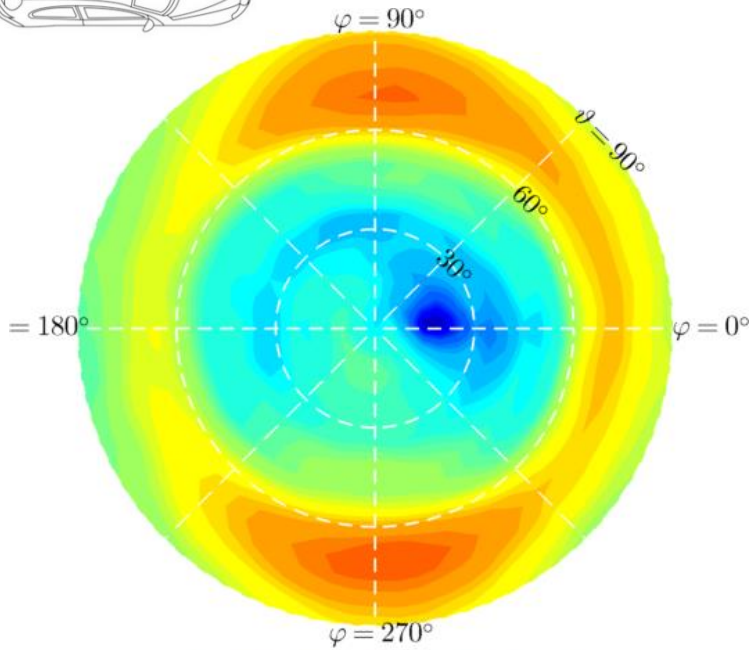
4.5 Variant B: Bluetooth Antenna Performance Gain and Efficiency (BT)



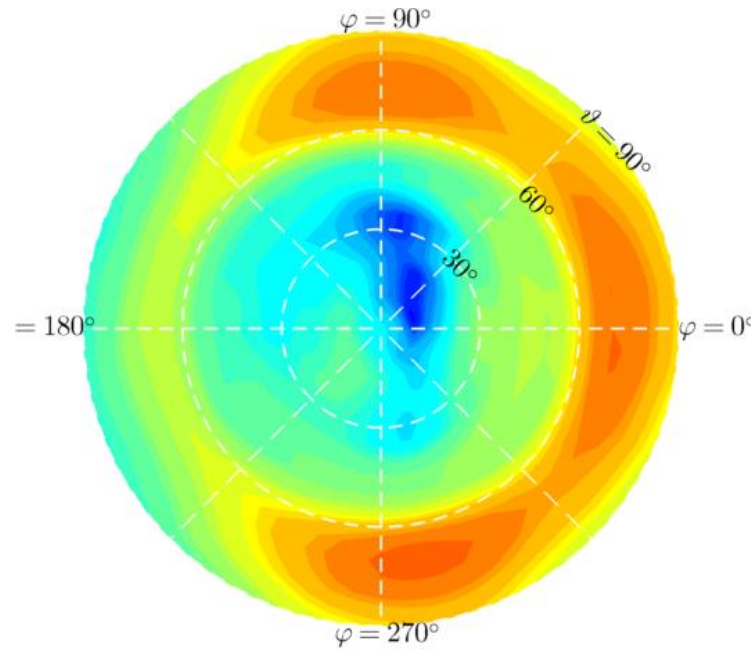
4.5 Variant B: Bluetooth Antenna Performance 3D-Chart (BT)



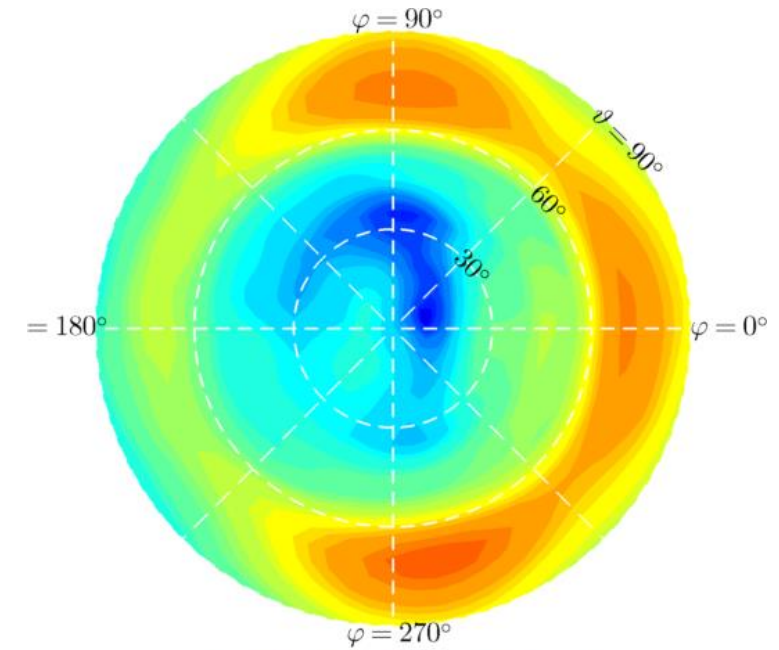
Driving Direction



-20 -15 -10 -5 0 5 10
AUT total gain at 2400MHz / dBi



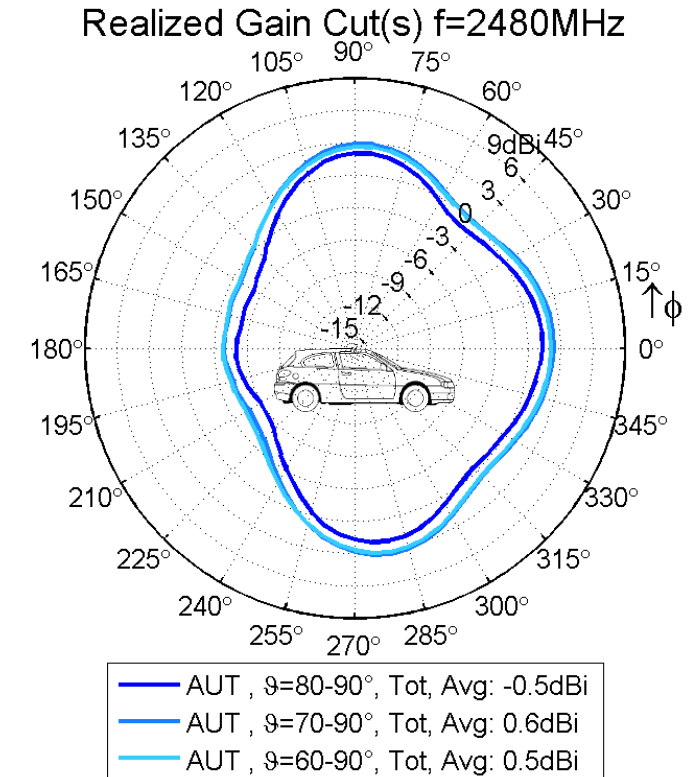
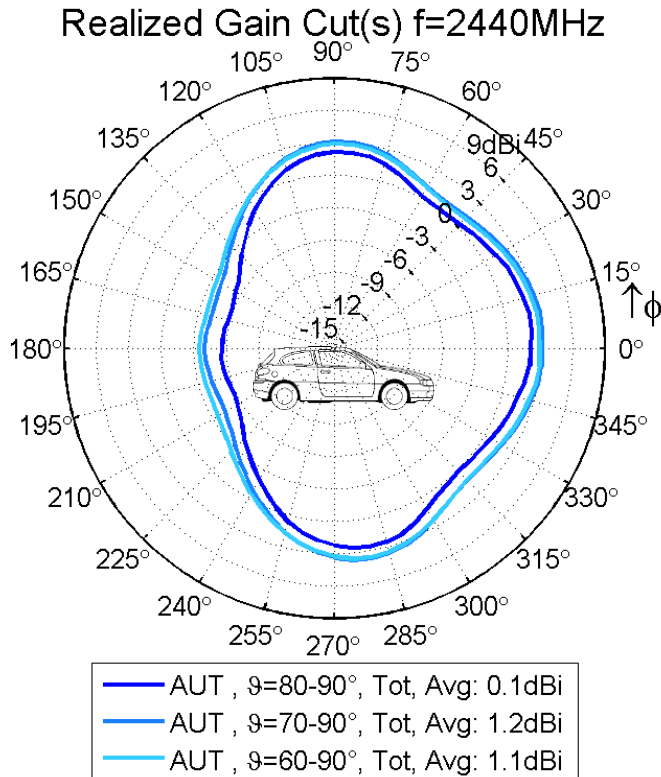
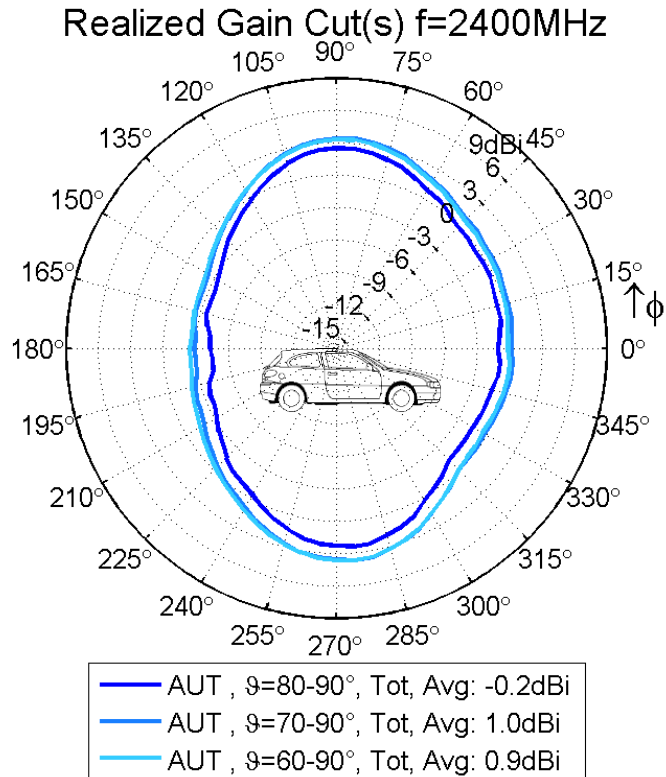
-20 -15 -10 -5 0 5 10
AUT total gain at 2440MHz / dBi



-20 -15 -10 -5 0 5 10
AUT total gain at 2480MHz / dBi



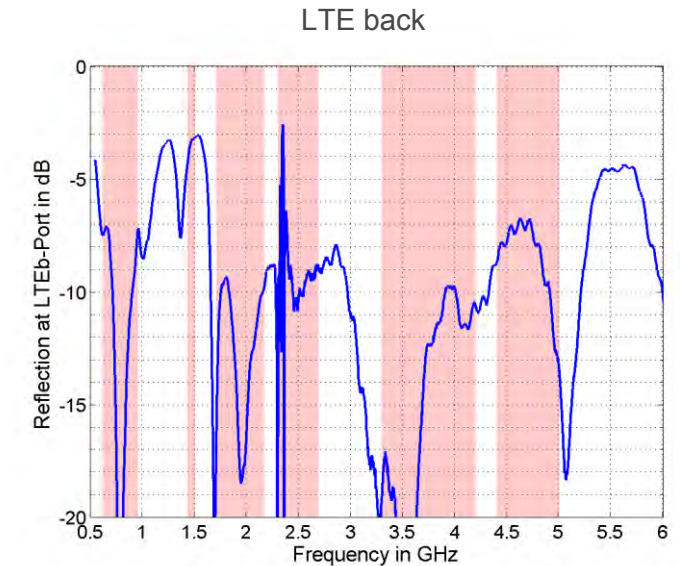
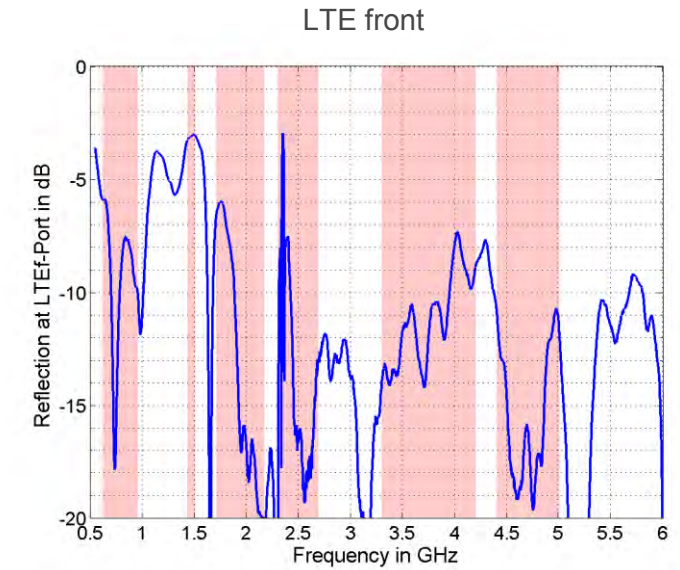
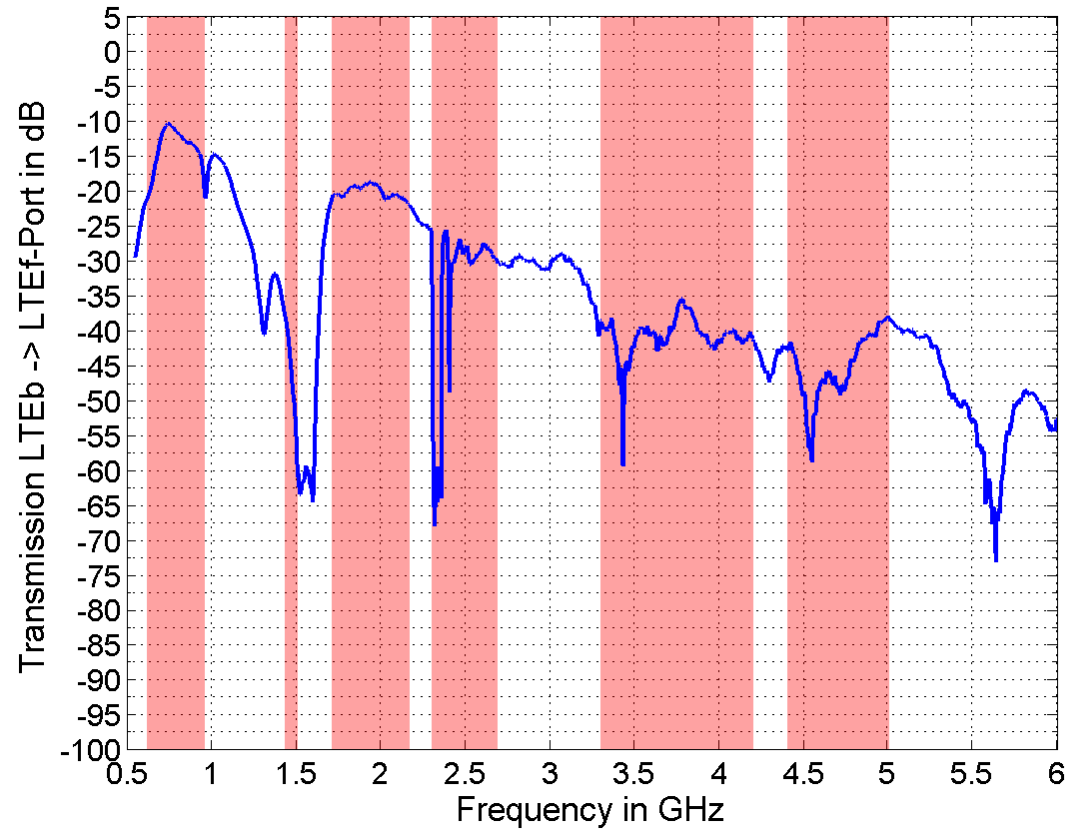
4.5 Variant B: Bluetooth Antenna Performance Gain-Cuts (BT)



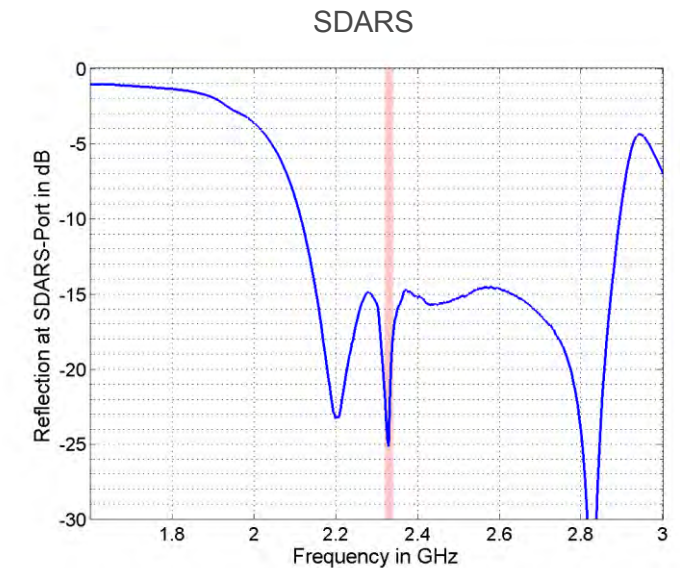
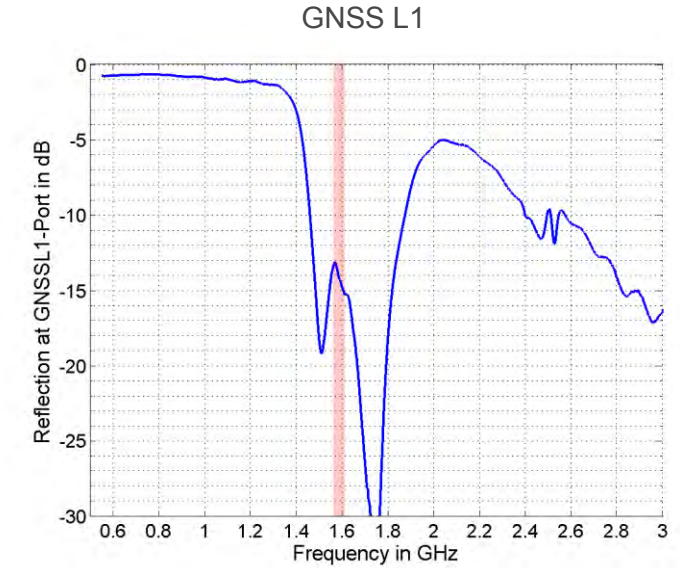
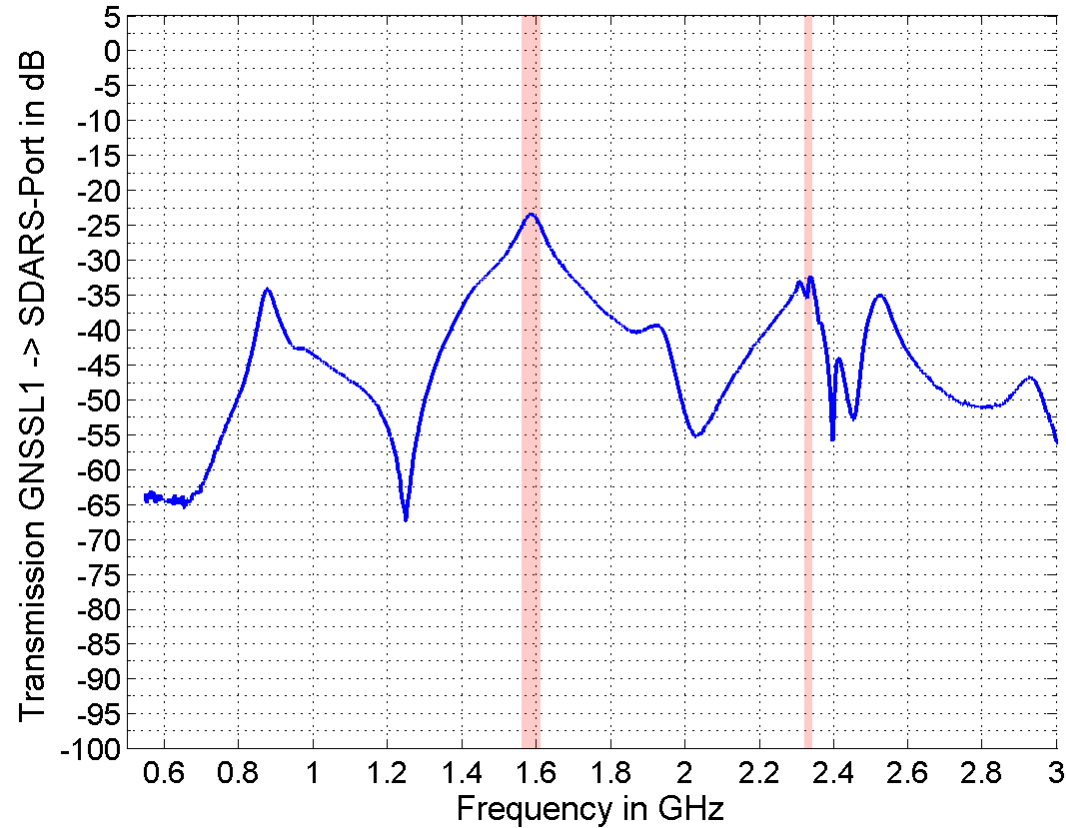
4.6 Decoupling



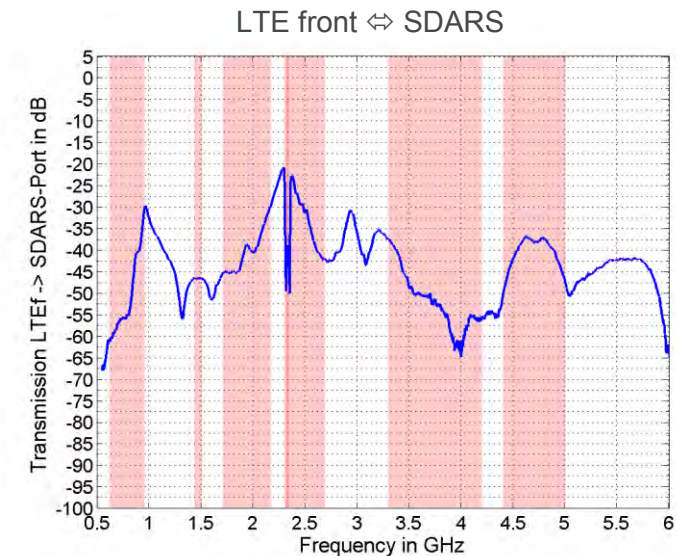
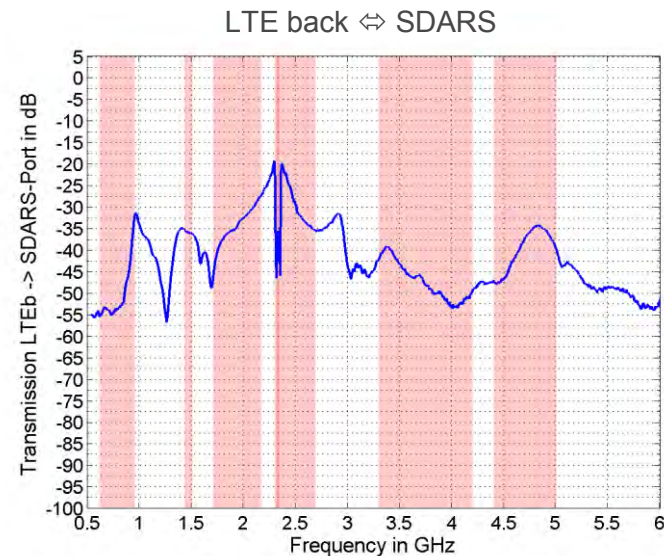
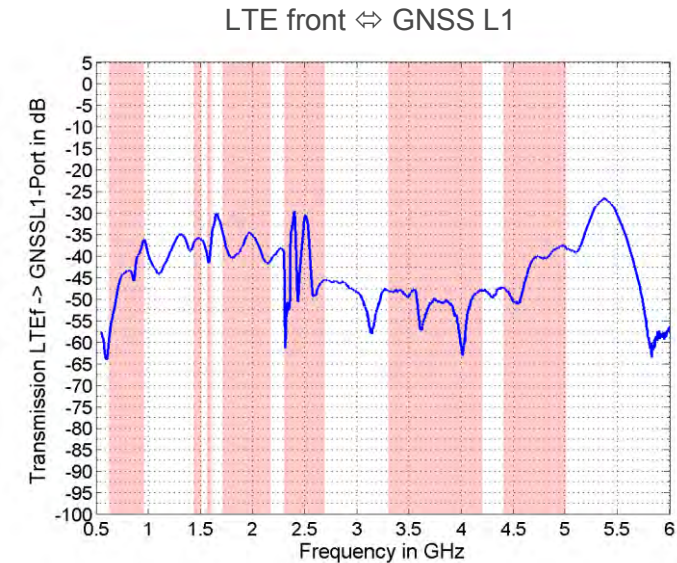
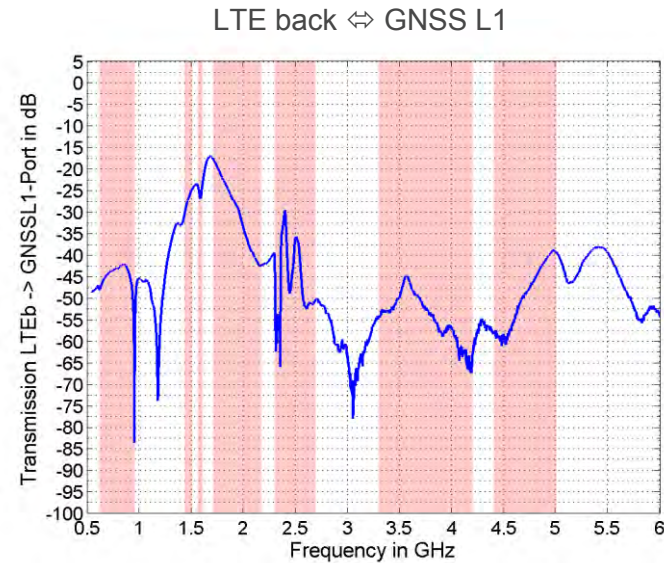
4.6 Variant B: Decoupling LTE front $\Leftrightarrow$ LTE back



4.6 Variant B: Decoupling GNSS L1 $\Leftrightarrow$ SDARS

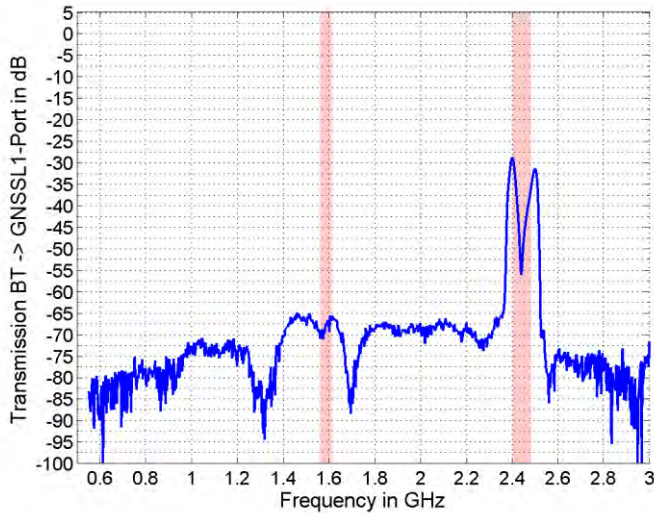


4.6 Variant B: Decoupling LTEs <=> SATs

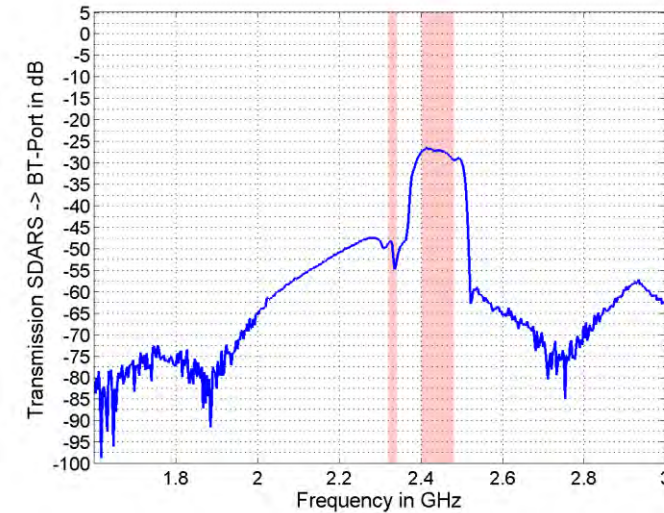


4.6 Variant B: Decoupling SAT/ LTE <=> BT

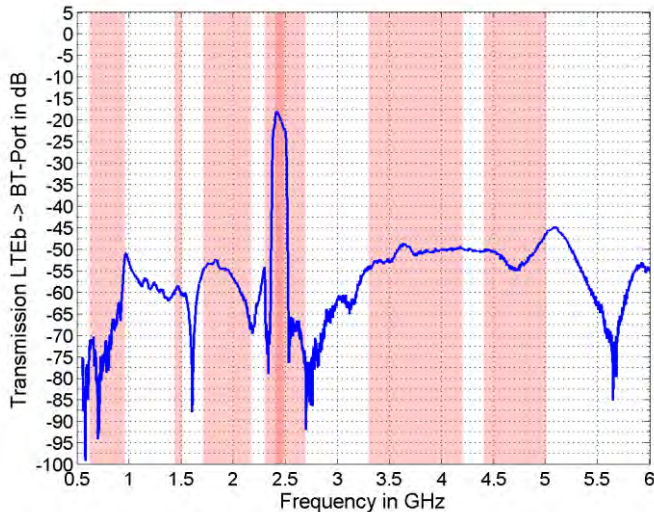
GNSS L1 ↔ BT



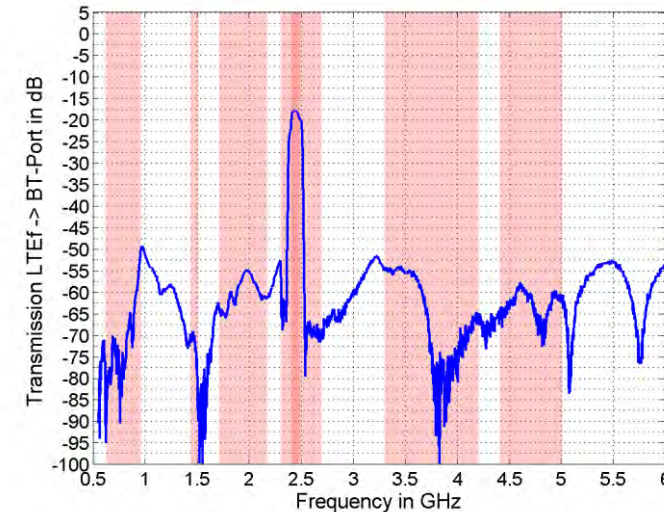
SDARS ↔ BT



LTE back ↔ BT



LTE front ↔ BT







Mobilfunkstoßfängerantenne *Cellular Bumper Antenna*

TE Wireless: 920-654-001

VW/Audi: 4M0.035.507.A

5G weltweit
5G worldwide

- Montage auf elektrischem Gegengewicht
- metal mount

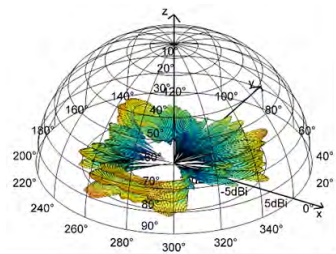


Änderungen vorbehalten / *Subject to alterations*

Technische Daten / *Technical Data*

Impedanz / <i>Impedance</i>	50 Ohm
Anschluss / <i>Connector</i>	FAKRA Kodierung A / <i>code A</i>
Abmessungen / <i>Dimensions</i>	62x46x85 mm ³
Abmessungen ohne Gehäuse (nur Leiterplatte) / <i>Dimensions without casing (only PCB)</i>	1,6x29,1x79,9 mm ³
Hersteller / <i>Manufacturer</i>	Hirschmann Car Communication GmbH Stuttgarter Strasse 45 - 51 D - 72654 Neckartenzlingen
Frequenzbänder / <i>Frequency Bands</i>	617 MHz – 698 MHz 698 MHz – 960 MHz 1427,9 MHz – 1510,9 MHz 1710 MHz – 1990 MHz 1990 MHz – 2170 MHz 2300 MHz – 2690 MHz 3300 MHz – 4200 MHz 4400 MHz – 5000 MHz

Berechnungsvorschrift integraler Antennengewinn / Calculation formula of partial antenna gain



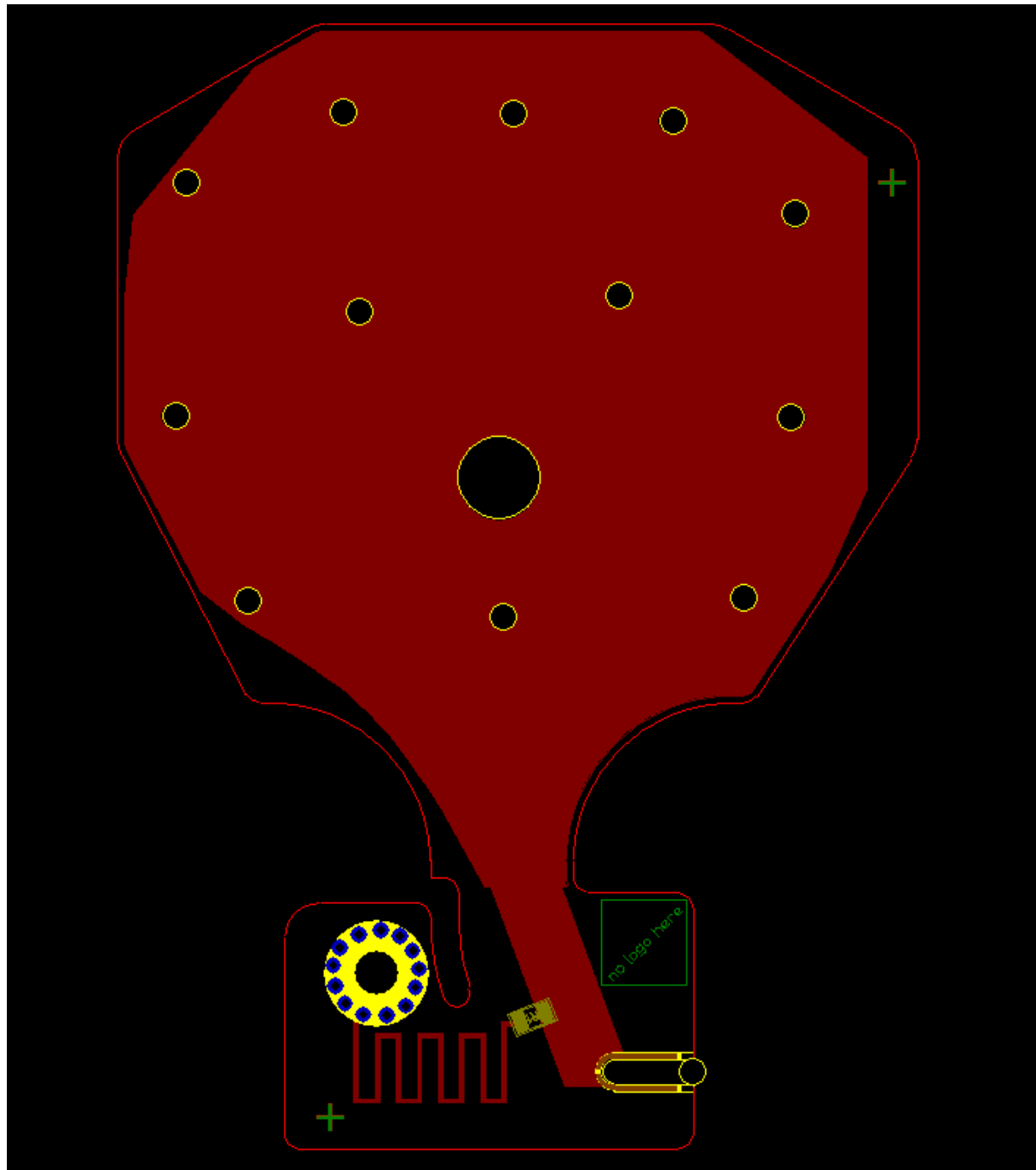
$$\Rightarrow \text{p. ave. gain} = 10 \log \left(\frac{\sum_{iPhi=0^\circ}^{360^\circ} \sum_{iTheta=70^\circ}^{90^\circ} G(iTheta, iPhi) \sin(iTheta)}{nPhi \sum_{iTheta=70^\circ}^{90^\circ} \sin(iTheta)} \right) = x \text{ dBi}$$

$nPhi \Rightarrow$ number of elevation cuts

$G \Rightarrow$ total gain ($G_{Theta} + G_{Phi}$)

p. ave. gain $\Rightarrow$ partial average gain

Antennenlayout / Antenna Layout

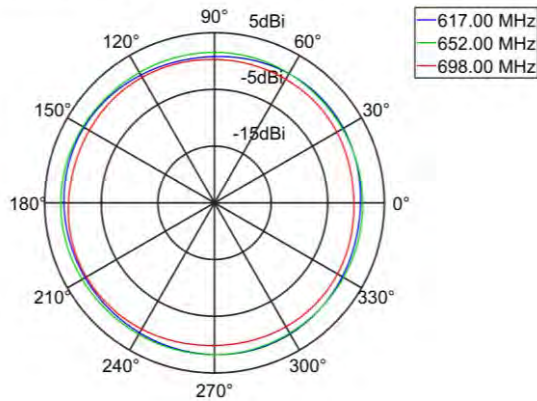


Antennengewinn / Antenna Gain
Mounted on sirius ground plane

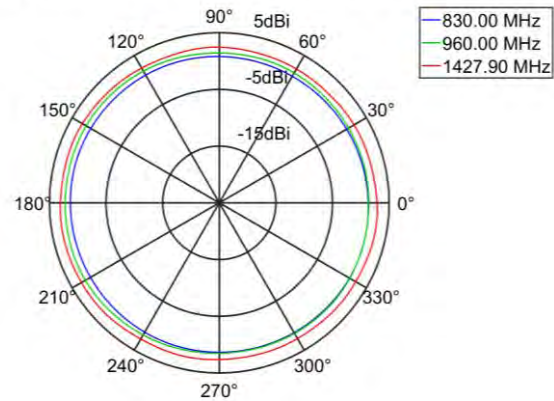
frequency band in MHz			partial average gain of freq. band in dBi (Theta=[60-90]°)		max. gain in partial area (Theta=[60-90]°)	absolut maximum gain (Theta=[0-180]°)
begin		end	average	maximum	in freq. band in dBi	in freq. band in dBi
617	-	698	1,2	1,7	4,2	4,3
698	-	960	1,3	1,9	4,0	4,5
1427,9	-	1510,9	2,9	3,2	5,1	5,1
1710	-	1990	3,6	3,9	6,5	6,5
1990	-	2170	3,6	4,0	6,9	6,9
2300	-	2690	2,9	3,4	8,6	8,6
3300	-	4200	2,2	2,7	7,3	7,3
4400	-	4990	0,8	1,6	6,7	7,0

Horizontale Antennendiagramme / Horizontal Radiation Patterns Mounted on sirius ground plane

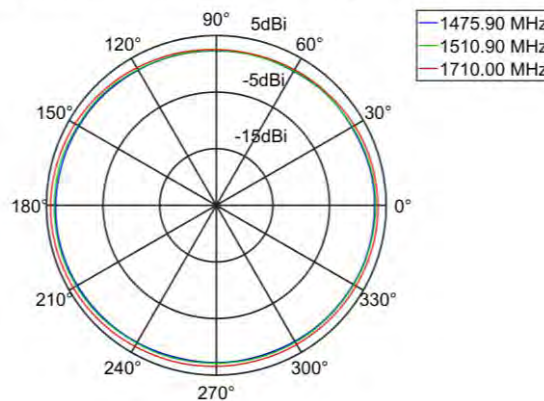
radiation pattern of the antenna
realized partial average gain (E_Total, Theta = [60.00 - 90.00]°)



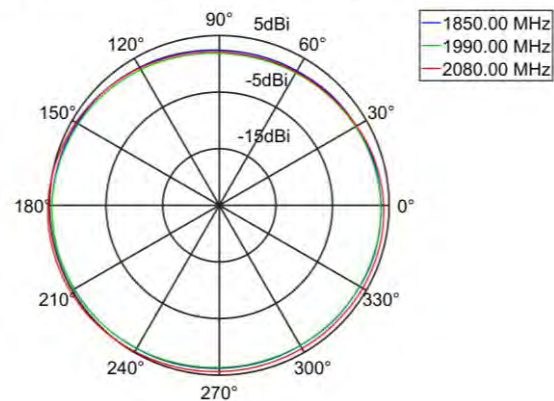
radiation pattern of the antenna
realized partial average gain (E_Total, Theta = [60.00 - 90.00]°)



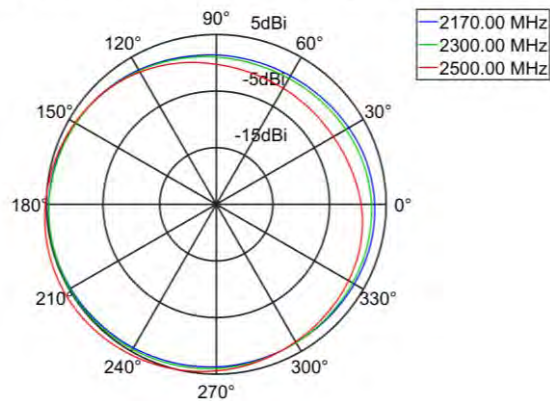
radiation pattern of the antenna
realized partial average gain (E_Total, Theta = [60.00 - 90.00]°)



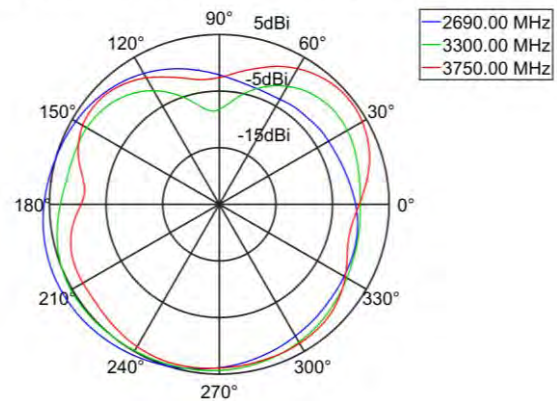
radiation pattern of the antenna
realized partial average gain (E_Total, Theta = [60.00 - 90.00]°)



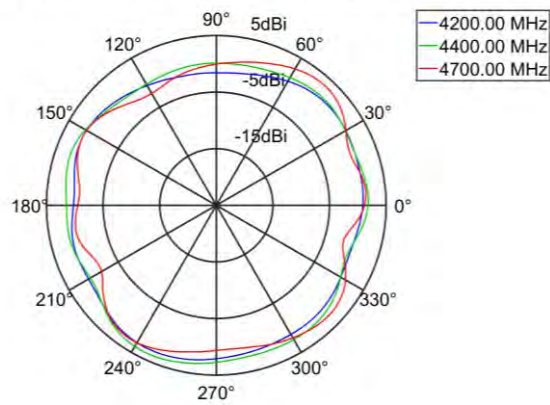
radiation pattern of the antenna
realized partial average gain (E_Total, Theta = [60.00 - 90.00]°)



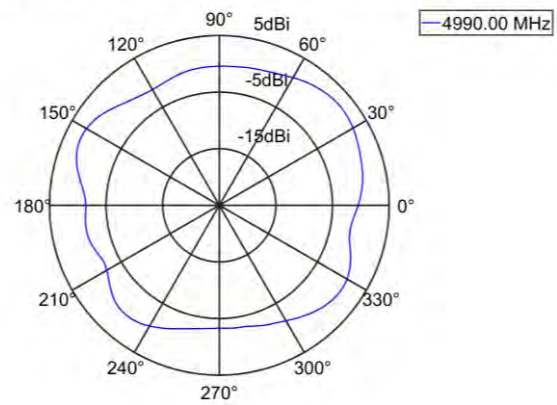
radiation pattern of the antenna
realized partial average gain (E_Total, Theta = [60.00 - 90.00]°)



radiation pattern of the antenna
realized partial average gain (E_Total, Theta = [60.00 - 90.00]°)

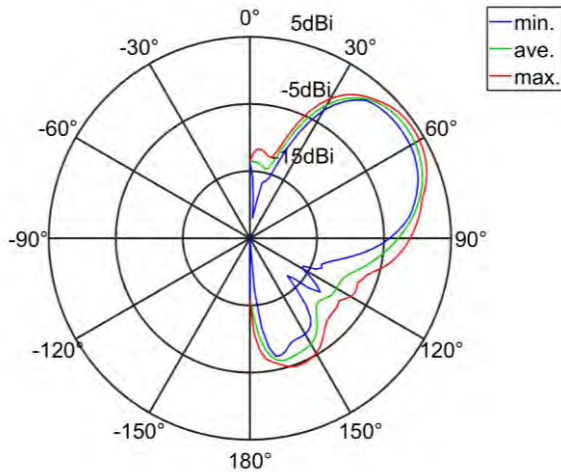


radiation pattern of the antenna
realized partial average gain (E_Total, Theta = [60.00 - 90.00]°)

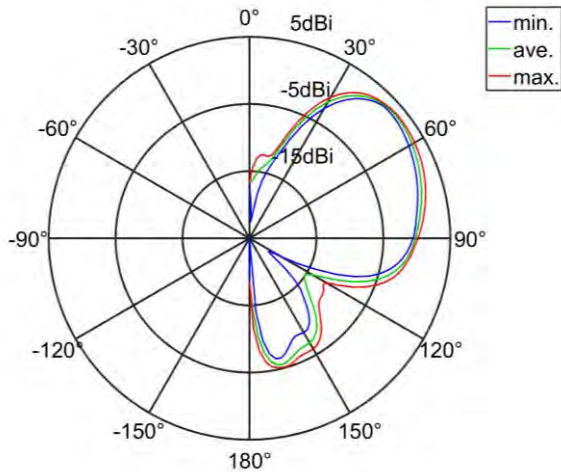


Vertikale Antennendiagramme / Vertical Radiation Patterns Mounted on sirius ground plane

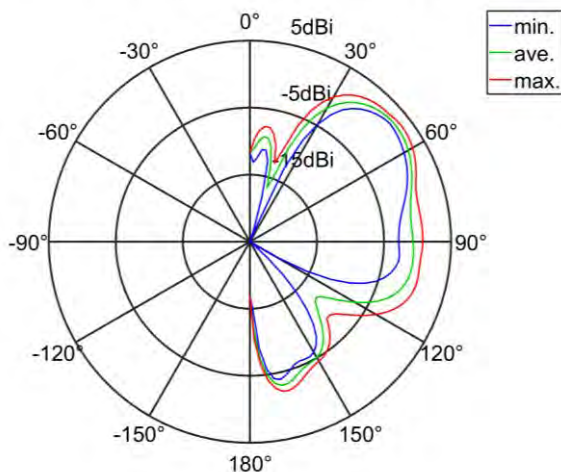
radiation pattern of the antenna (elevation cut)
realized gain (E_Total, Freq = 617.00 MHz)



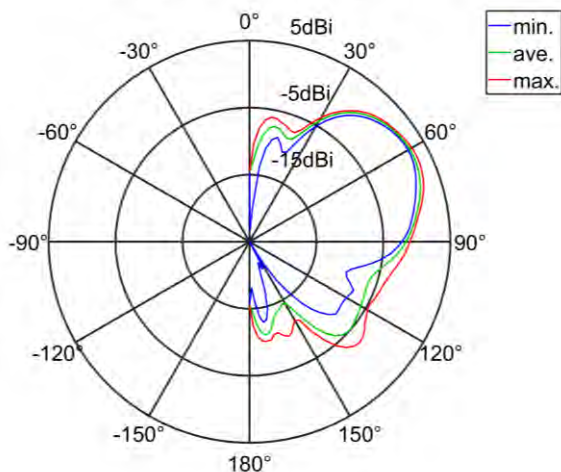
radiation pattern of the antenna (elevation cut)
realized gain (E_Total, Freq = 652.00 MHz)



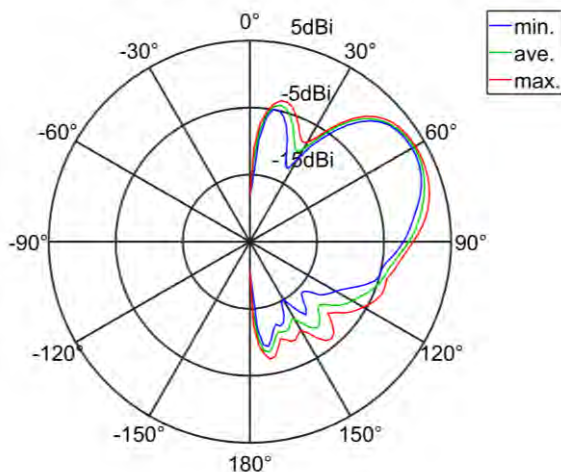
radiation pattern of the antenna (elevation cut)
realized gain (E_Total, Freq = 698.00 MHz)



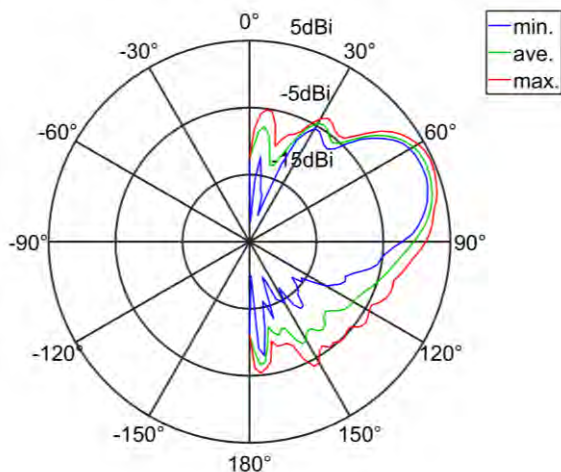
radiation pattern of the antenna (elevation cut)
realized gain (E_Total, Freq = 830.00 MHz)



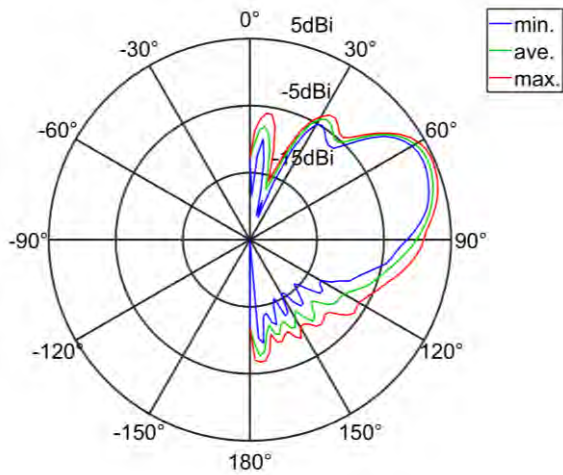
radiation pattern of the antenna (elevation cut)
realized gain (E_Total, Freq = 960.00 MHz)



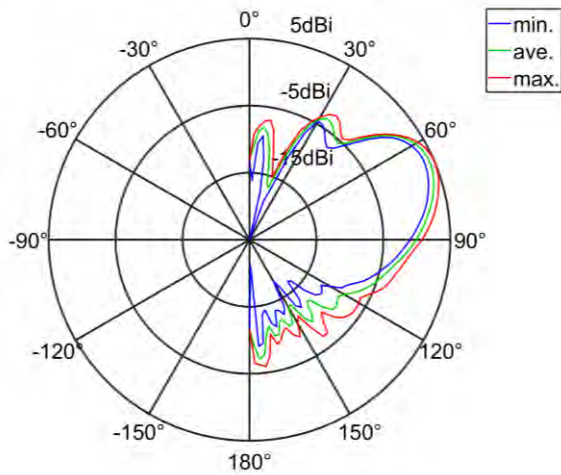
radiation pattern of the antenna (elevation cut)
realized gain (E_Total, Freq = 1427.90 MHz)



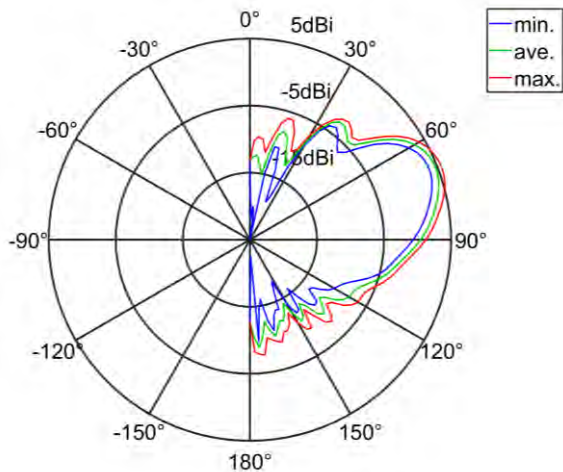
radiation pattern of the antenna (elevation cut)
realized gain (E_Total, Freq = 1475.90 MHz)



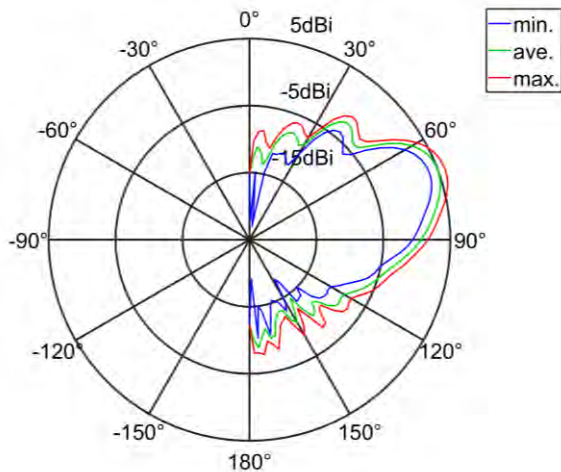
radiation pattern of the antenna (elevation cut)
realized gain (E_Total, Freq = 1510.90 MHz)



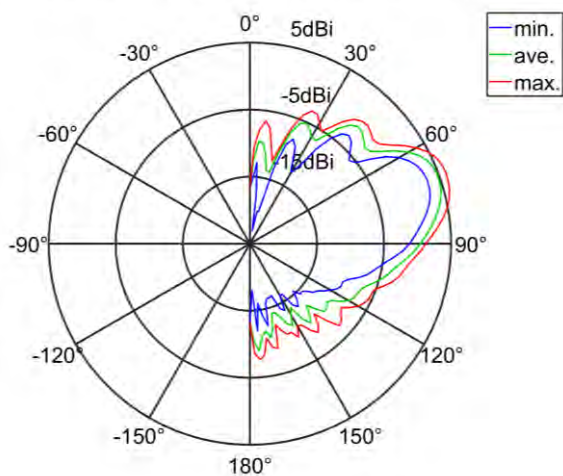
radiation pattern of the antenna (elevation cut)
realized gain (E_Total, Freq = 1710.00 MHz)



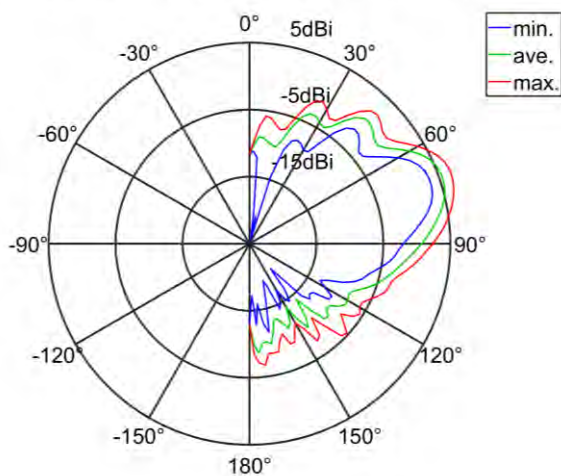
radiation pattern of the antenna (elevation cut)
realized gain (E_Total, Freq = 1850.00 MHz)



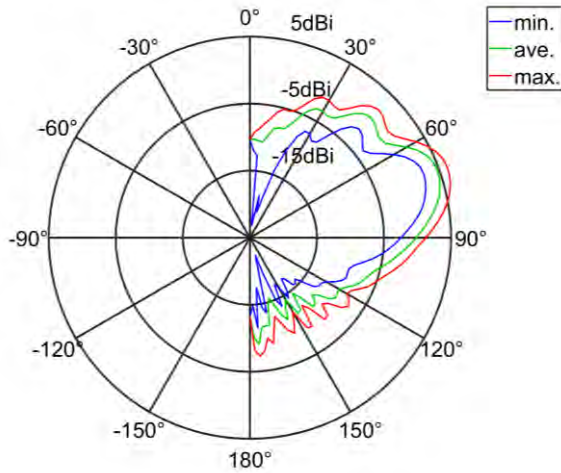
radiation pattern of the antenna (elevation cut)
realized gain (E_Total, Freq = 1990.00 MHz)



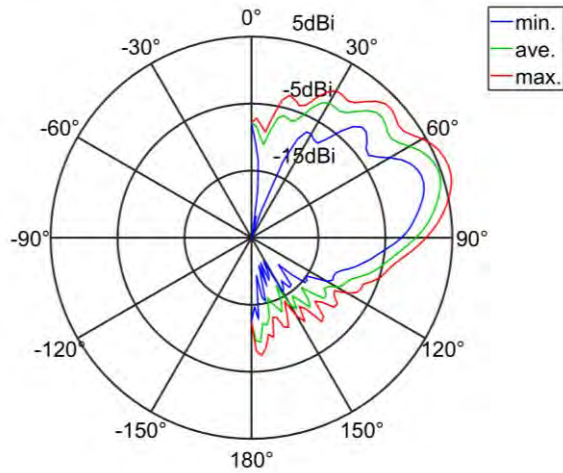
radiation pattern of the antenna (elevation cut)
realized gain (E_Total, Freq = 2080.00 MHz)



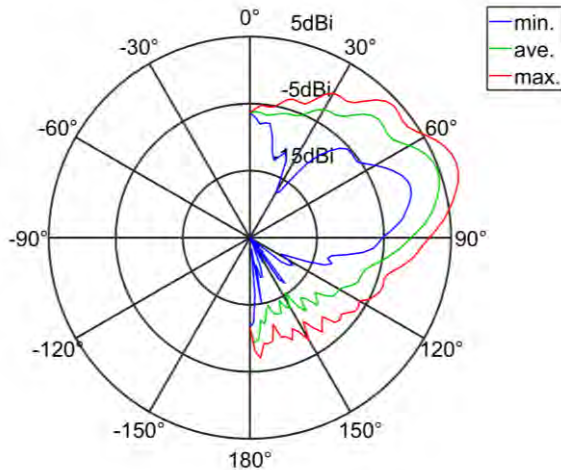
radiation pattern of the antenna (elevation cut)
realized gain (E_Total, Freq = 2170.00 MHz)



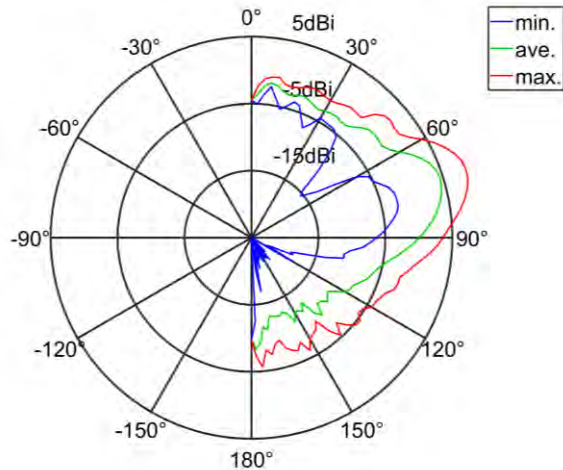
radiation pattern of the antenna (elevation cut)
realized gain (E_Total, Freq = 2300.00 MHz)



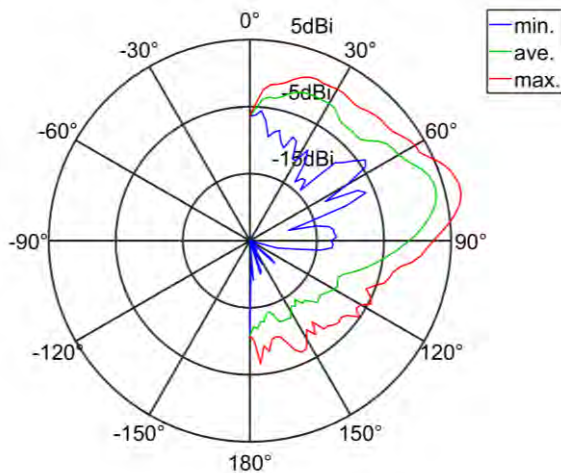
radiation pattern of the antenna (elevation cut)
realized gain (E_Total, Freq = 2500.00 MHz)



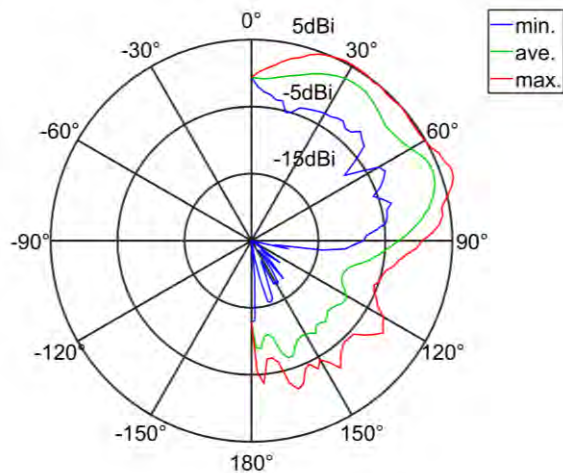
radiation pattern of the antenna (elevation cut)
realized gain (E_Total, Freq = 2690.00 MHz)



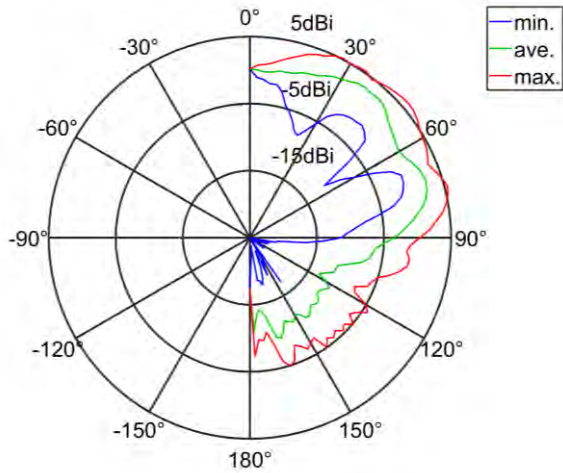
radiation pattern of the antenna (elevation cut)
realized gain (E_Total, Freq = 3300.00 MHz)



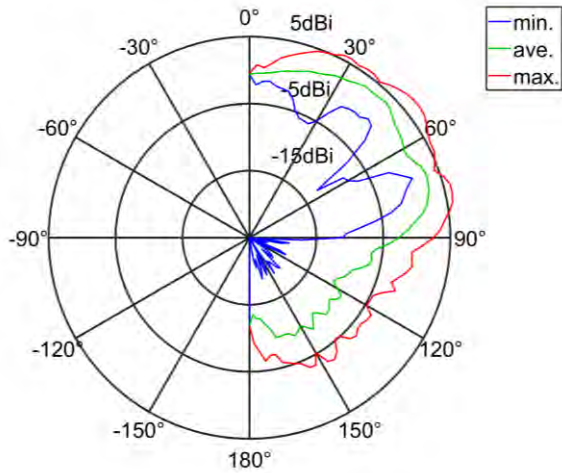
radiation pattern of the antenna (elevation cut)
realized gain (E_Total, Freq = 3750.00 MHz)



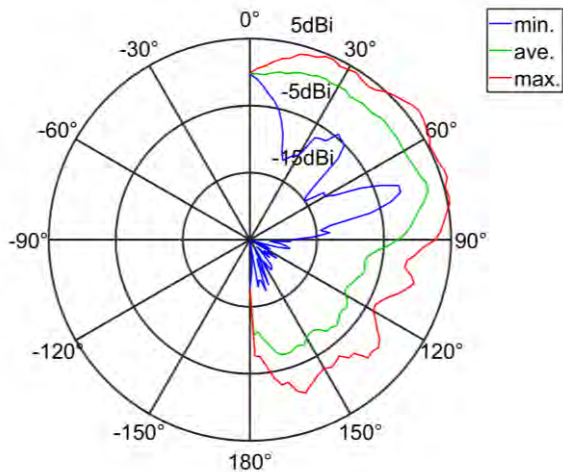
radiation pattern of the antenna (elevation cut)
realized gain (E_Total, Freq = 4200.00 MHz)



radiation pattern of the antenna (elevation cut)
realized gain (E_Total, Freq = 4400.00 MHz)



radiation pattern of the antenna (elevation cut)
realized gain (E_Total, Freq = 4700.00 MHz)



radiation pattern of the antenna (elevation cut)
realized gain (E_Total, Freq = 4990.00 MHz)

