



Test Report



ELECTROMAGNETIC COMPATIBILITY TEST REPORT

Tests performed at:

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Radio Test Site
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On

Sepura Limited

TETRA Antenna Patterns for SC2024 Radio

Document History

Version	Date	Affected page(s)	Description of modifications	Revised by	Approved by
00	03/07/23		Initial release		

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Test Report

Product: TETRA Antenna Patterns for SC2024 Radio

Company: Sepura Limited

Representative: John Thacker

Address: 9000 Cambridge Research Park
Beach Drive
Waterbeach
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CB25 9TL

Start Date: 27th June 2023

End Date: 29th June 2023

Report Written By: Stephen Browning

Report Authorised By: Dave Smith

Date: 3rd July 2023

Signature:

Position: Senior Engineer

This section intentionally left blank, by dB Technology, for additional signatories (if required - e.g. 'responsible party')

Additional signatory:

dB Technology can only report on the specific unit(s) tested at its site. The responsibility for extrapolating this data to a product line lies solely with the manufacturer. Statements of compliance (below) rely on the correct information/instructions having been provided by the manufacturer with regard to operating modes and functionality. This information can only be derived from the manufacturer's detailed knowledge of the unit/system being tested.

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1 Introduction

This document describes testing performed by dB Technology (Cambridge) Ltd.

Sections 2 and 3 of this document contain information that has been supplied by /agreed with the customer commissioning this set of work (typically the representative named at the start of this report). Any inaccuracies are the responsibility of the customer and may have a bearing on the validity of this report.

2 General Information

2.1 Product Name and Contact Details

<i>Product:</i>	TETRA Antenna Patterns for SC2024 Radio
<i>Company:</i>	Sepura Limited
<i>Representative:</i>	John Thacker
<i>Address:</i>	9000 Cambridge Research Park Beach Drive Waterbeach Cambridgeshire CB25 9TL

2.2 Product Description

This report covers measurements on five different antennas used with Sepura SC2024 Tetra radios.

2.3 Details of EUT

EUT Item	Manufacturer	Model	Description	Serial No.
1	Sepura Limited	300-00366	TETRA Antenna	-
2	Sepura Limited	300-00499	TETRA Antenna	-
3	Sepura Limited	300-00662	TETRA Antenna	-
4	Sepura Limited	300-01031	TETRA Antenna	-
5	Sepura Limited	300-01032	TETRA Antenna	-

2.4 List of Peripherals

Item	Manufacturer	Model	Description	Serial No.
6	Sepura Limited	SC2024	Portable TETRA Radio	-

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3 Test Results

The following pages give details and results of each individual test.

3.1 Antenna Pattern

3.1.1 Method

The radiation pattern was established as follows. The UUT was placed on a table at the centre of the turntable of a CISPR16 open area test site and faced a receiving antenna at a 10m distance. The receiving antenna was connected to an RF receiver. The receiver was tuned to the appropriate frequency. The receiver mode was set to peak detection with a 120kHz bandwidth.

The turntable was set to 0° position. The height of the receiving antenna was adjusted to produce a maximum level on the RF receiver. This level was recorded. The UUT was then rotated clockwise by 10° (i.e. angle of 10°). The receiver reading was recorded (without adjusting the height of the receiving antenna). This process was repeated at 10° steps until the UUT returned to the starting position (facing the receive antenna). Receiver readings were converted to equivalent antenna gain measurements. The resulting polar plots are shown in the results sections

3.1.2 Converting raw receiver readings to equivalent antenna gain

Measurements were made with the same set up as described above but with the EUT replaced by a calibrated reference antenna (mini-bicon) connected to a signal generator. The reference antenna was positioned at the centre of the turntable at the same height as the antenna on the EUT.

The level of the signal generator (*Sig_Gen_1*) at the reference input was measured using a power meter. The gain of the reference Antenna (*Antenna_Gain_1*) was taken from a calibration report.

The height of the receiving antenna was adjusted over the range 1m to 4m until a maximum reading was recorded on the RF receiver (*Receiver_Level_1*).

3.1.3 Derivation of Correction Factors

Measurement of reference antenna:

$$Receiver_Level_1 + CFa = Sig_Gen_1 + Antenna_Gain_1$$

Measurement of EUT:

$$Receiver_Level_EUT + CFa = Output_Level_EUT + Antenna_Gain_EUT$$

Correction CFa is common to both equations (related to site, receiver, receiver cable, distance etc) so:

$$Antenna_Gain_EUT = Receiver_Level_EUT + CFb$$

$$where CFb = Sig_Gen_1 + - Output_Level_EUT + Antenna_Gain_1 - Receiver_Level_1$$

The value of the output level of the EUT was provided by the manufacturer.

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3.1.4 Results of establishing correction factor (1)

For polar plots taken on 27/06/2023

Radiated Emissions Results (Substitution Method) #Ref00										
Date: 27/06/2023 Test Engineer: Stephen Browning										
Notes	Freq. MHz	Fact Set	Sub'n Ant Gain dBi	Dist- ance (m)	Ant. Pol.	Output Level of EUT dBm	Sig Gen Level Sub'n Ant dBm	Rec'vr Level Sub'n Ant dBuV		Gain CF dB
	406.1	1	-0.4	10	V	15.3	-5.7	60.8		-82.3
	410	1	-0.4	10	v	15.3	-5.7	60.4		-81.8
	418	1	-0.3	10	v	15.2	-5.7	60.5		-81.6
	420	1	-0.3	10	v	15.1	-5.7	60.3		-81.5
	430	1	-0.1	10	v	15.0	-5.7	60.7		-81.6
	450	1	-0.2	10	v	15.0	-5.7	61.3		-82.1
	460	1	-0.2	10	v	14.9	-5.8	61.0		-82.0
	470	1	-0.2	10	v	14.9	-5.8	60.6		-81.5
Notes:										
	120kHz peak detector used for all measurements.									
	Gain Correction factors. Based on EIRP substitution measurement - transmit power figures provided by Sepura Limited.									

For polar plots taken on 29/06/2023

Radiated Emissions Results (Substitution Method) - Correction Factors #Ref00										
Date: 29/06/2023 Test Engineer: Stephen Browning										
Notes	Freq. MHz	Fact Set	Sub'n Ant Gain dBi	Dist- ance (m)	Ant. Pol.	Output Level of EUT dBm	Sig Gen Level Sub'n Ant dBm	Rec'vr Level Sub'n Ant dBuV		Gain CF dB
	410	1	-0.4	10	v	15.3	-0.5	65.1		-81.2
	420	1	-0.3	10	v	15.1	-0.5	65.1		-81.0
	430	1	-0.1	10	v	15.0	-0.5	65.6		-81.3
Notes:										
	120kHz peak detector used for all measurements.									
	Gain Correction factors. Based on EIRP substitution measurement - transmit power figures provided by Sepura Limited.									

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3.1.5 Test Equipment

Test Equipment				
Ref:	Description:	S/N:	Cal. Date	Cal Interval (Months)
R20	R&S ESR3 EMI Test Receiver	102463	12/09/2022	12
CBL134	RG214 - 25m N-N	CBL134	09/05/2023	12
A39	Schwarzbeck VULP 9118A Log Periodic	581	23/07/2021	36
OATS6	OATS - 10m NSA compliant_ANSI C63.4:2014 / EN55016-1-4:2019	006	16/07/2021	36
A30	Schwarzbeck MiniBicon (30MHz to 1GHz)	9115-180	22/07/2021	36
SG19	SRS SG386 DC to 6GHz Signal Generator	002670	01/12/2022	12
PM6	Marconi 6960B RF Power Meter	236923/003	26/10/2022	12
PS10	Marconi 6910 RF Power Sensor (-30dBm / +20dBm) 10MHz to 20GHz	5009	26/10/2022	12
SW001	dBEmissionsV3_190808		Not Req.	—
Correction Factors				
CF1:A30_dBi_21A.txt				

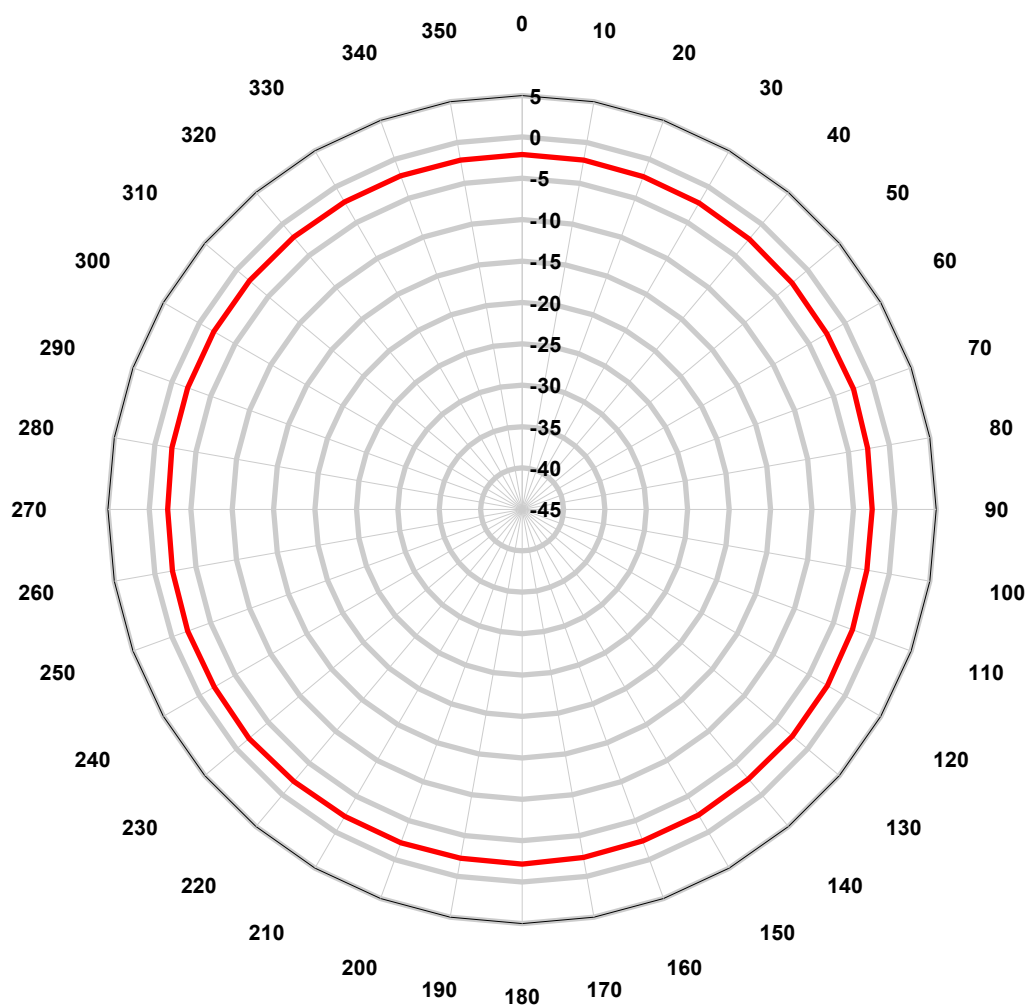
3.2 Antenna Pattern Results

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300-00499, Free Space, 406 MHz

— Antenna Gain (dBi)



	MAX	MIN	AVG
Antenna Gain (dBi)	-1.95	-2.74	-2.26

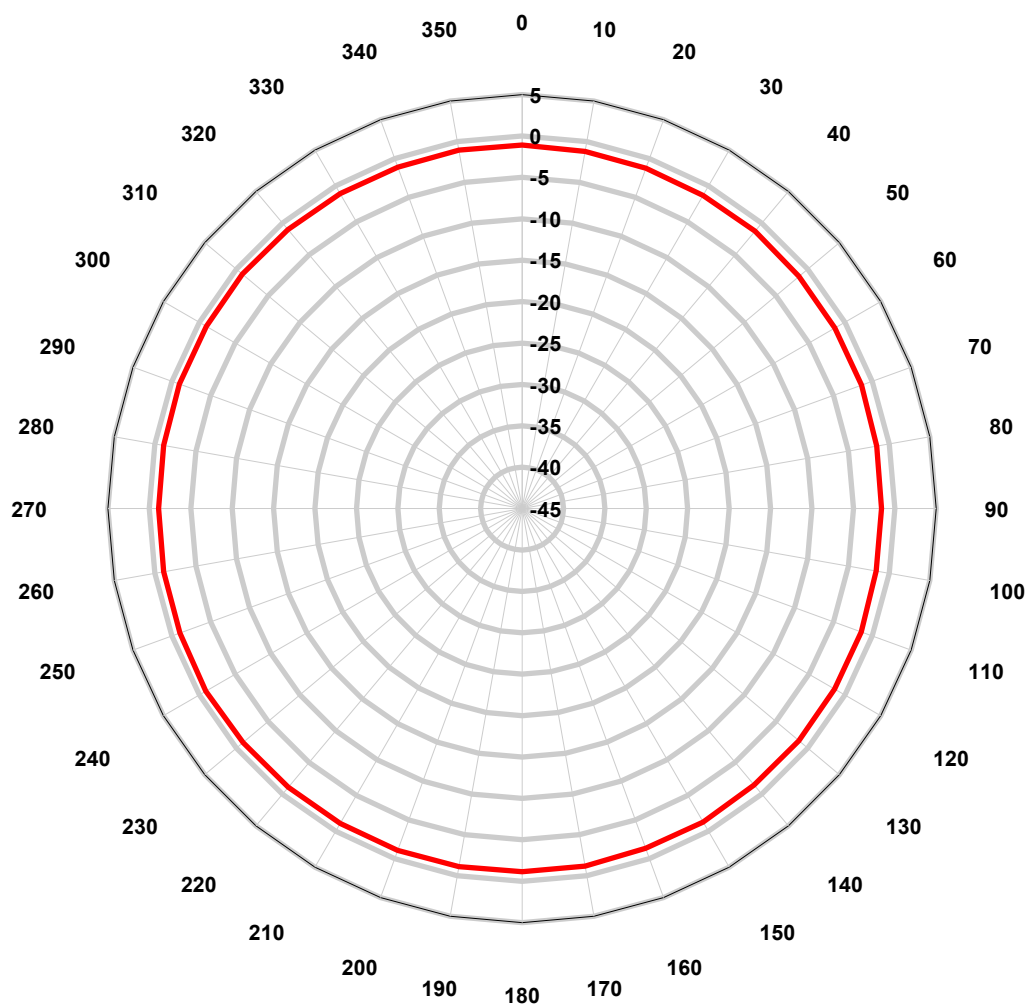
3.2.1 Polar plot : 300-00499, Free Space, 406 MHz

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300-00499, Free Space, 410MHz

— Antenna Gain (dBi)



	MAX	MIN	AVG
Antenna Gain (dBi)	-0.91	-1.62	-1.20

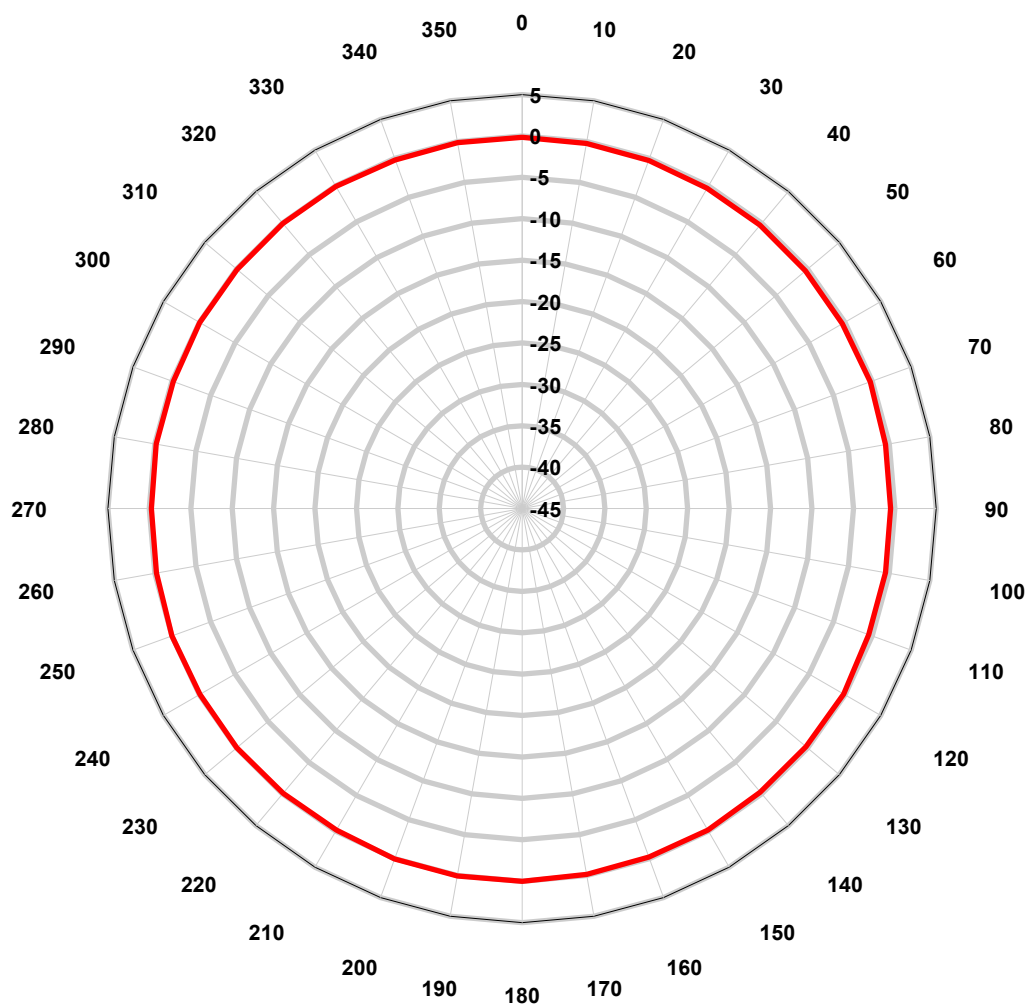
3.2.2 Polar plot : 300-00499, Free Space, 410 MHz

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300-00499, Free Space, 418 MHz

— Antenna Gain (dBi)



	MAX	MIN	AVG
Antenna Gain (dBi)	0.06	-0.51	-0.19

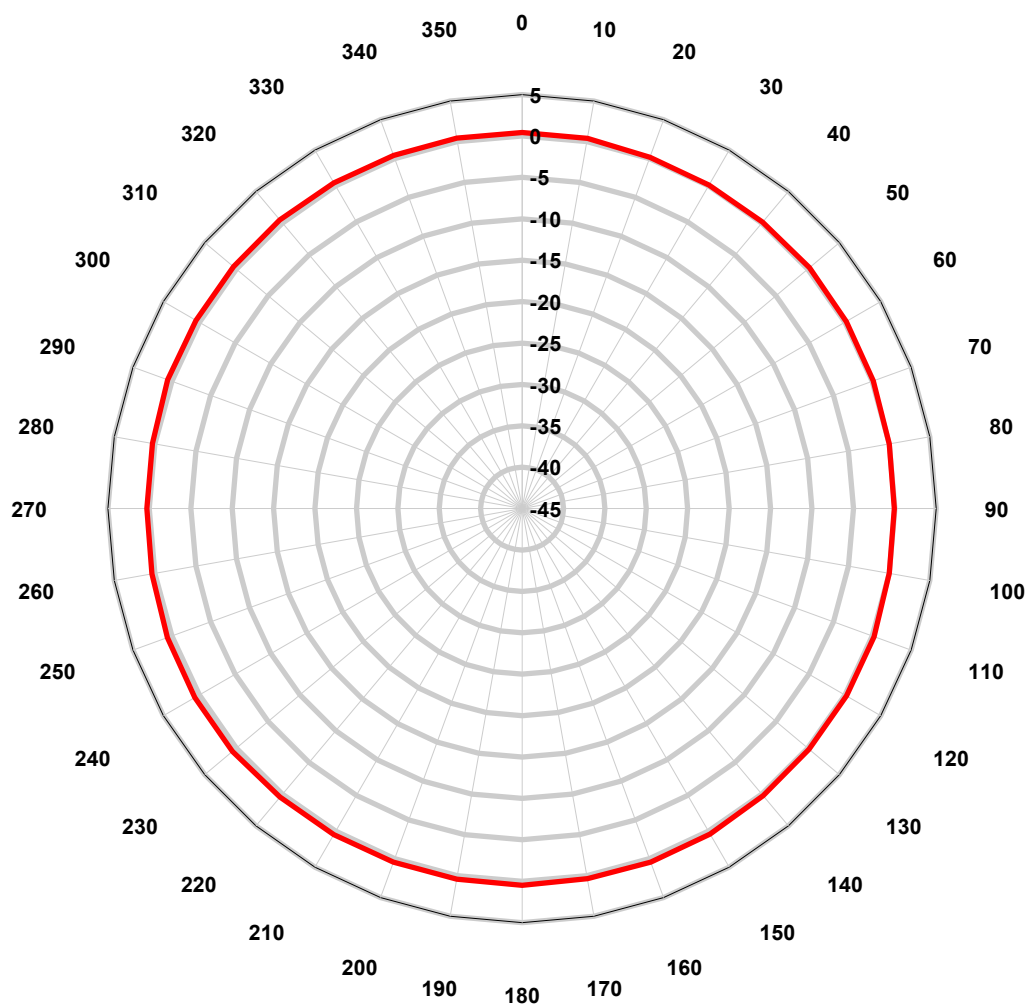
3.2.3 Polar plot : 300-00499, Free Space, 418 MHz

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300-00499 Free Space 430 MHz

— Antenna Gain (dBi)



	MAX	MIN	AVG
Antenna Gain (dBi)	0.63	-0.05	0.35

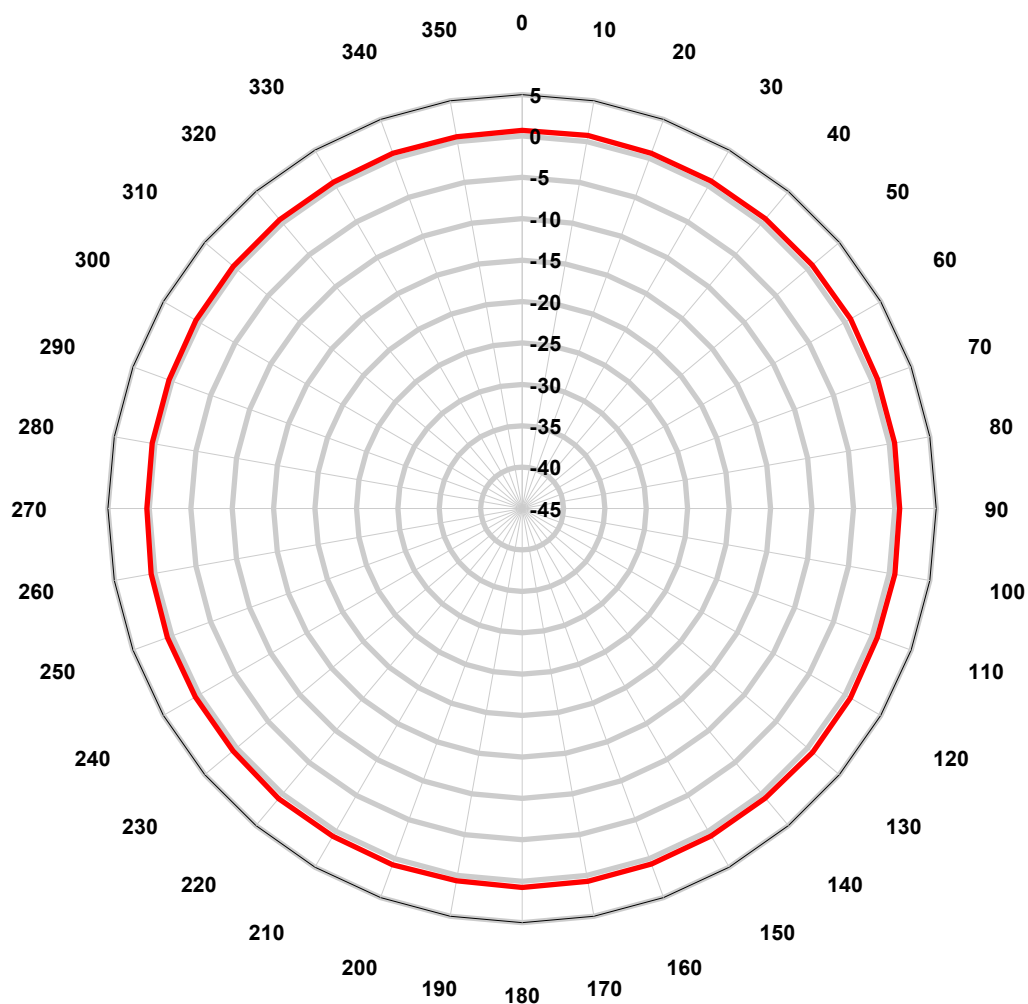
3.2.4 Polar plot : 300-00499, Free Space, 430 MHz

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300-00499 Free Space 450 MHz

— Antenna Gain (dBi)



	MAX	MIN	AVG
Antenna Gain (dBi)	0.80	0.31	0.63

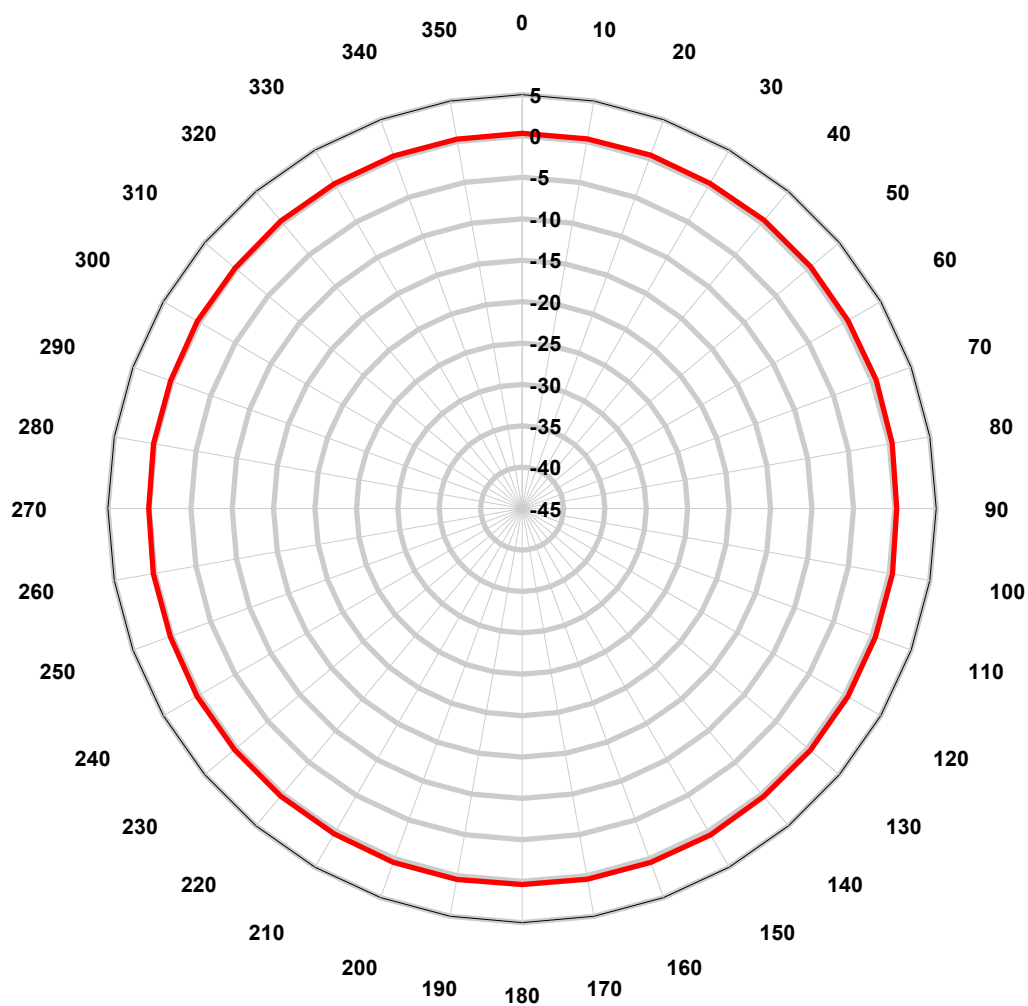
3.2.5 Polar plot : 300-00499, Free Space, 450 MHz

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300-00499 Free Space 460 MHz

— Antenna Gain (dBi)



	MAX	MIN	AVG
Antenna Gain (dBi)	0.50	0.07	0.35

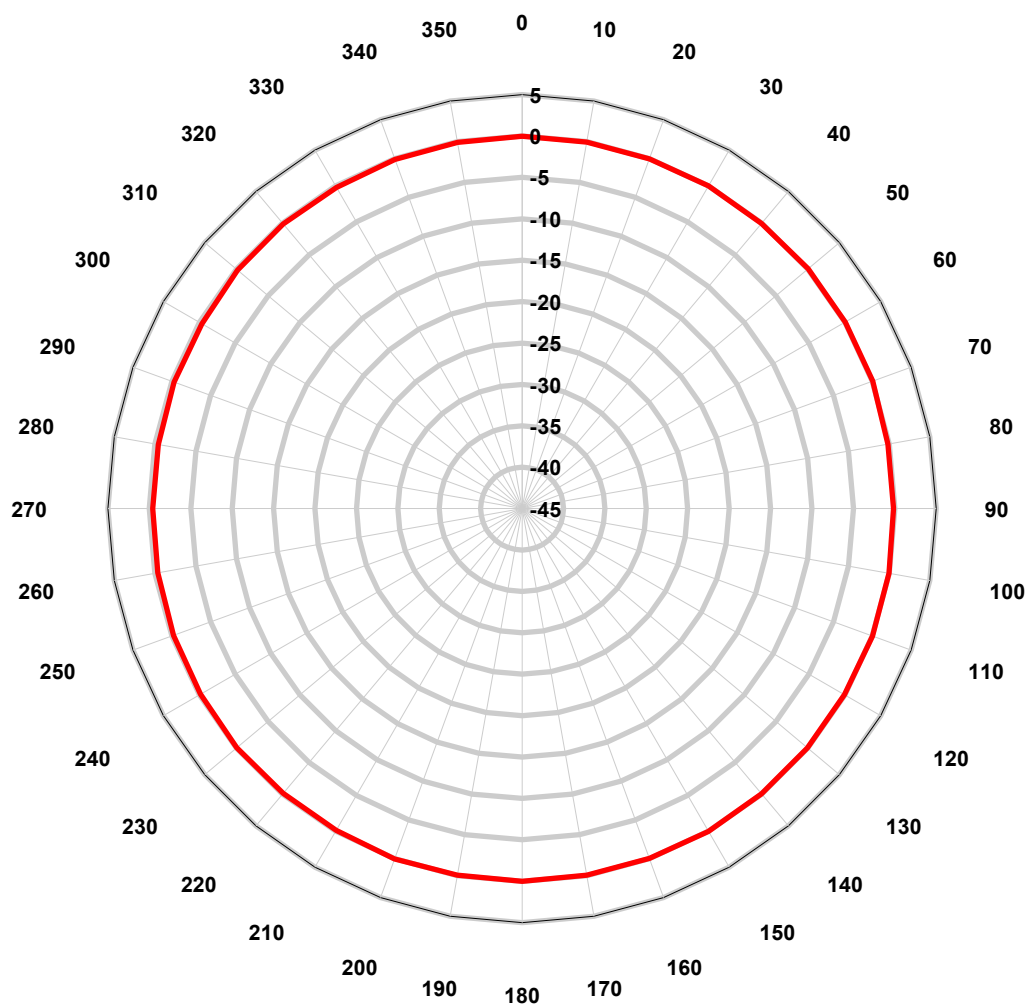
3.2.6 Polar plot : 300-00499, Free Space, 460 MHz

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300-00499 Free Space 470 MHz

— Antenna Gain (dBi)



	MAX	MIN	AVG
Antenna Gain (dBi)	0.07	-0.40	-0.10

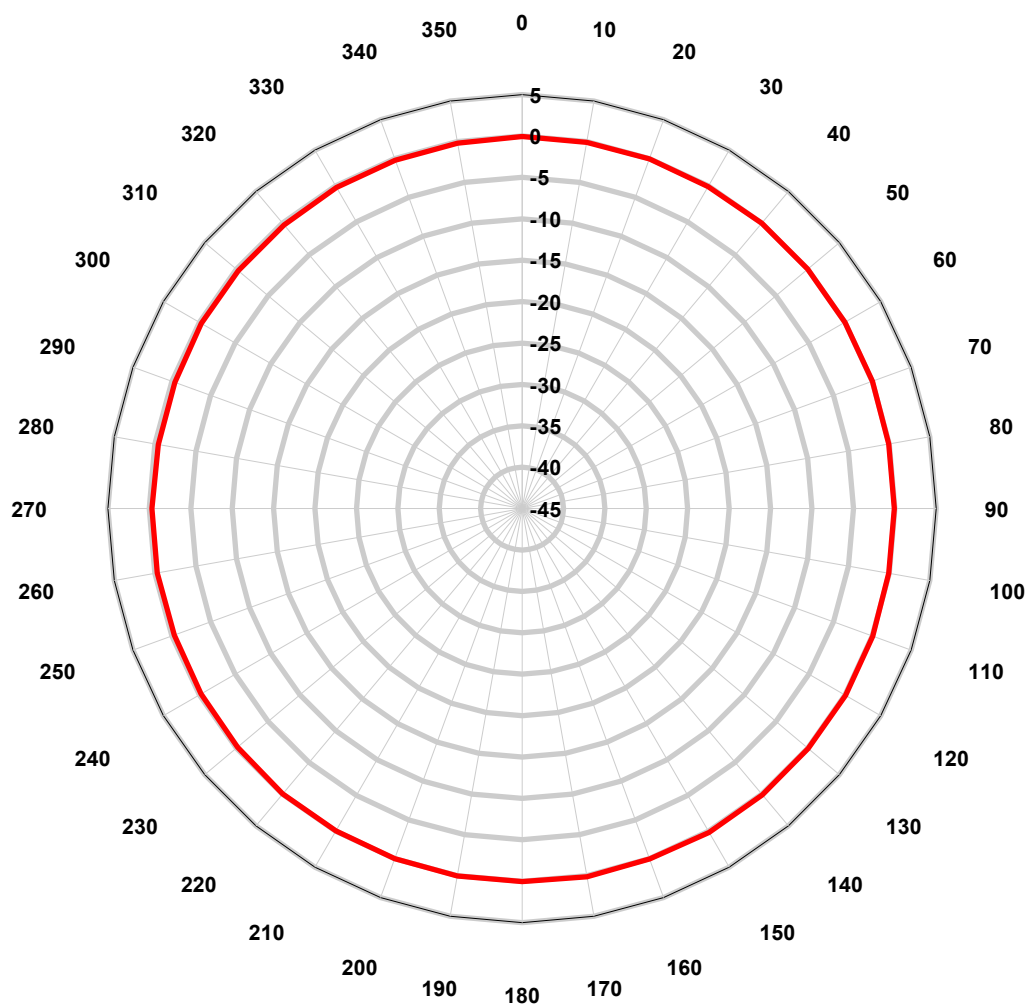
3.2.7 Polar plot : 300-00499, Free Space, 470 MHz

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300-00663 Free Space 450 MHz

— Antenna Gain (dBi)



	MAX	MIN	AVG
Antenna Gain (dBi)	0.15	-0.42	-0.09

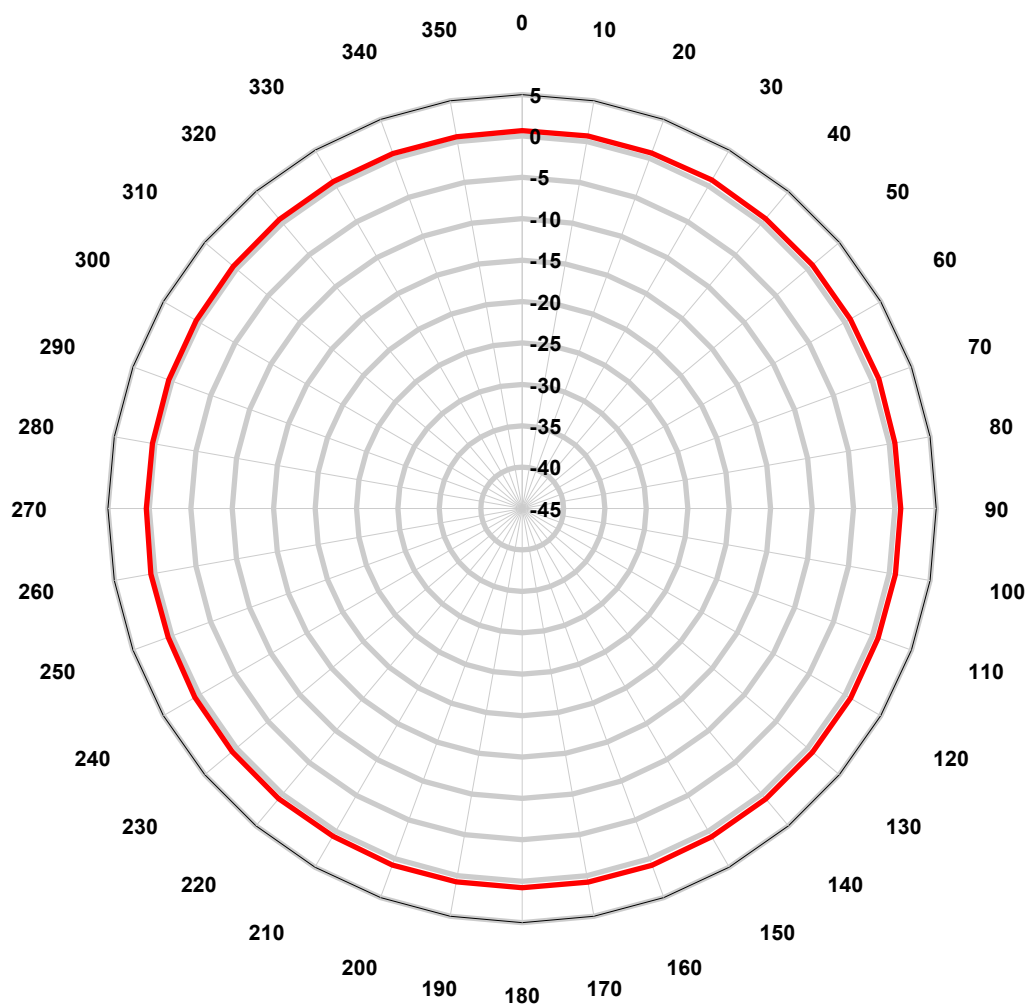
3.2.8 Polar plot : 300-00663, Free Space, 450 MHz

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300-00663 Free Space 460 MHz

— Antenna Gain (dBi)



	MAX	MIN	AVG
Antenna Gain (dBi)	0.84	0.33	0.67

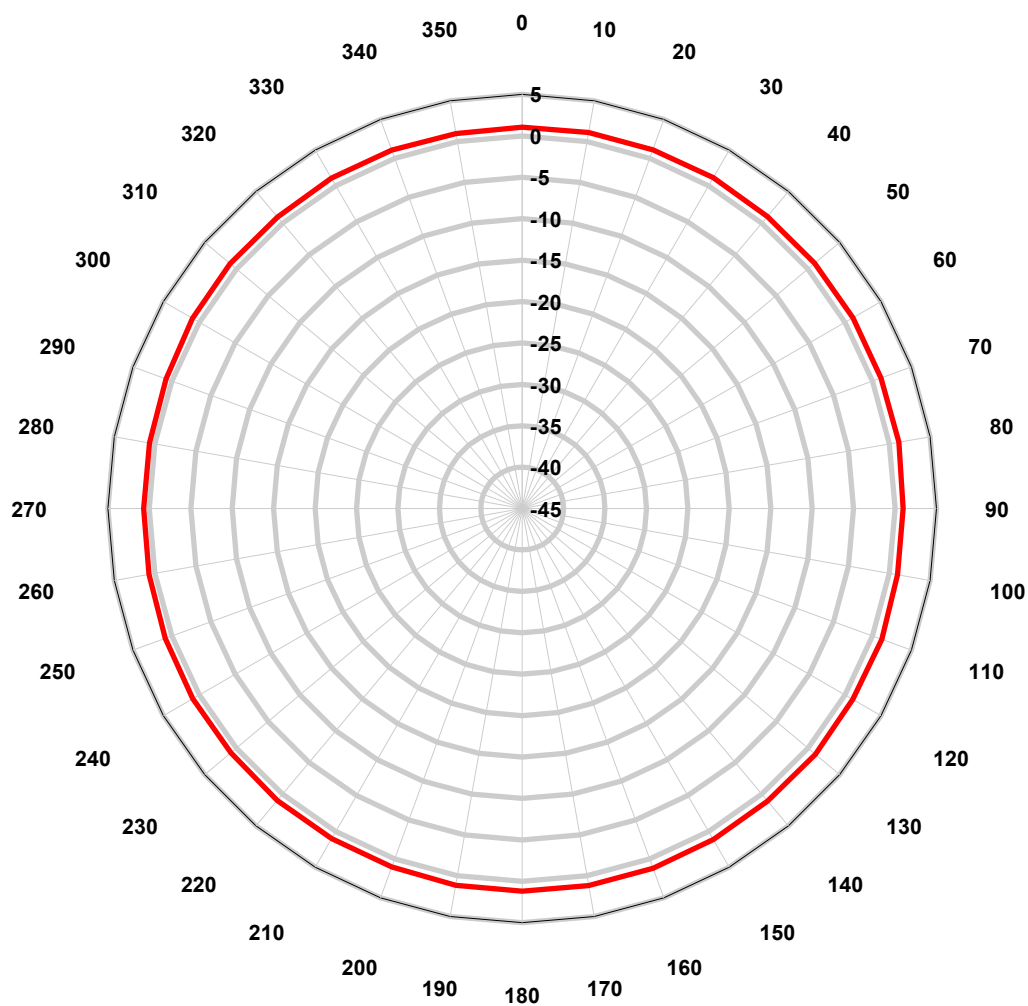
3.2.9 Polar plot : 300-00663, Free Space, 460 MHz

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300-00663 Free Space 470 MHz

— Antenna Gain (dBi)



	MAX	MIN	AVG
Antenna Gain (dBi)	1.22	0.66	1.03

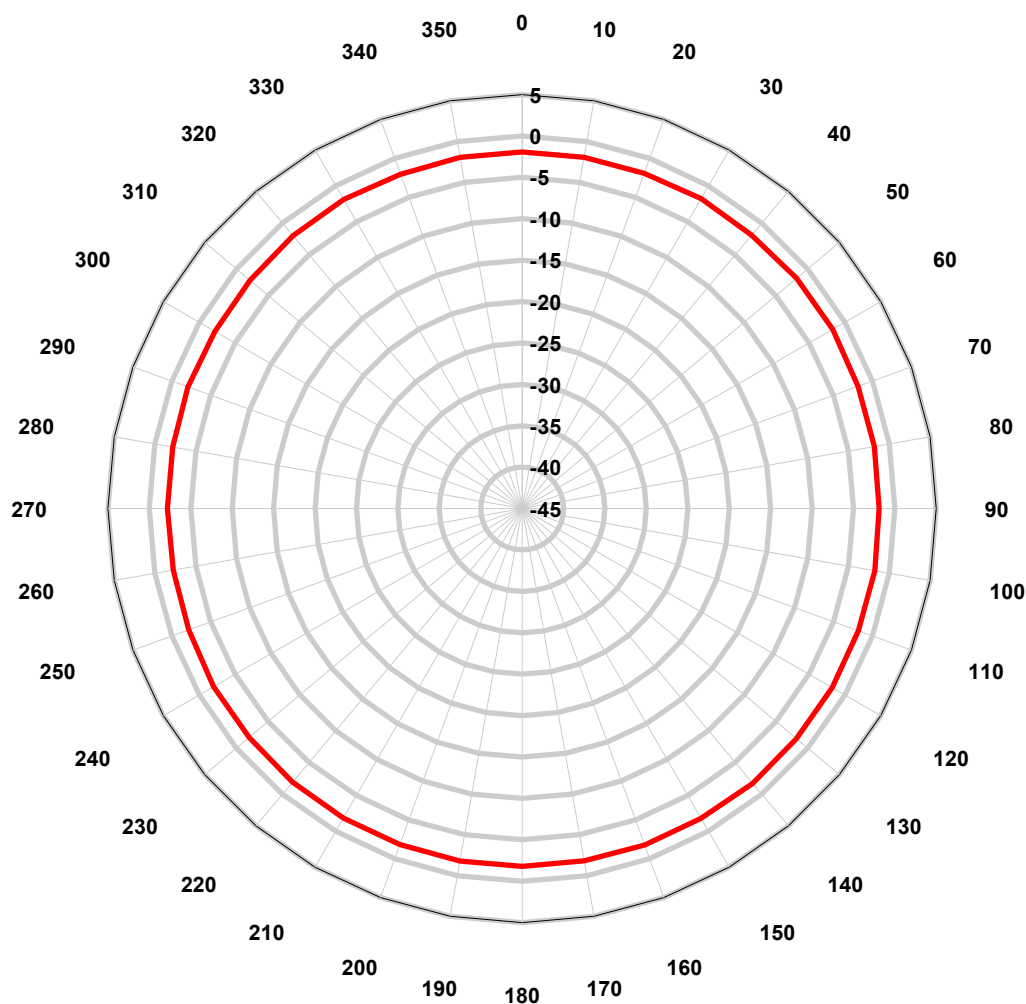
3.2.10 Polar plot : 300-00663, Free Space, 470 MHz

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300-01032 Free Space 450 MHz

— Antenna Gain (dBi)



	MAX	MIN	AVG
Antenna Gain (dBi)	-1.69	-2.23	-1.91

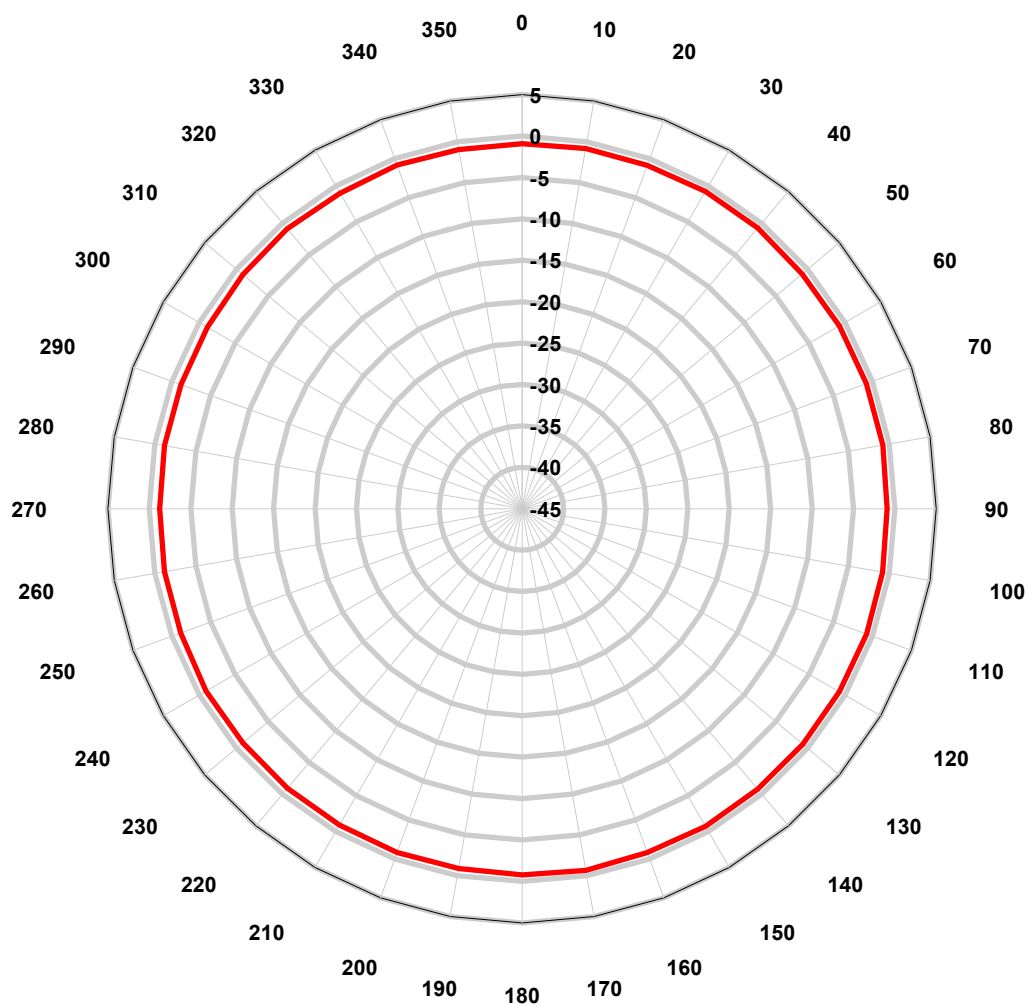
3.2.11 Polar plot : 300-01032, Free Space, 450 MHz

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300-01032 Free Space 460 MHz

— Antenna Gain (dBi)



	MAX	MIN	AVG
Antenna Gain (dBi)	-0.66	-1.25	-0.89

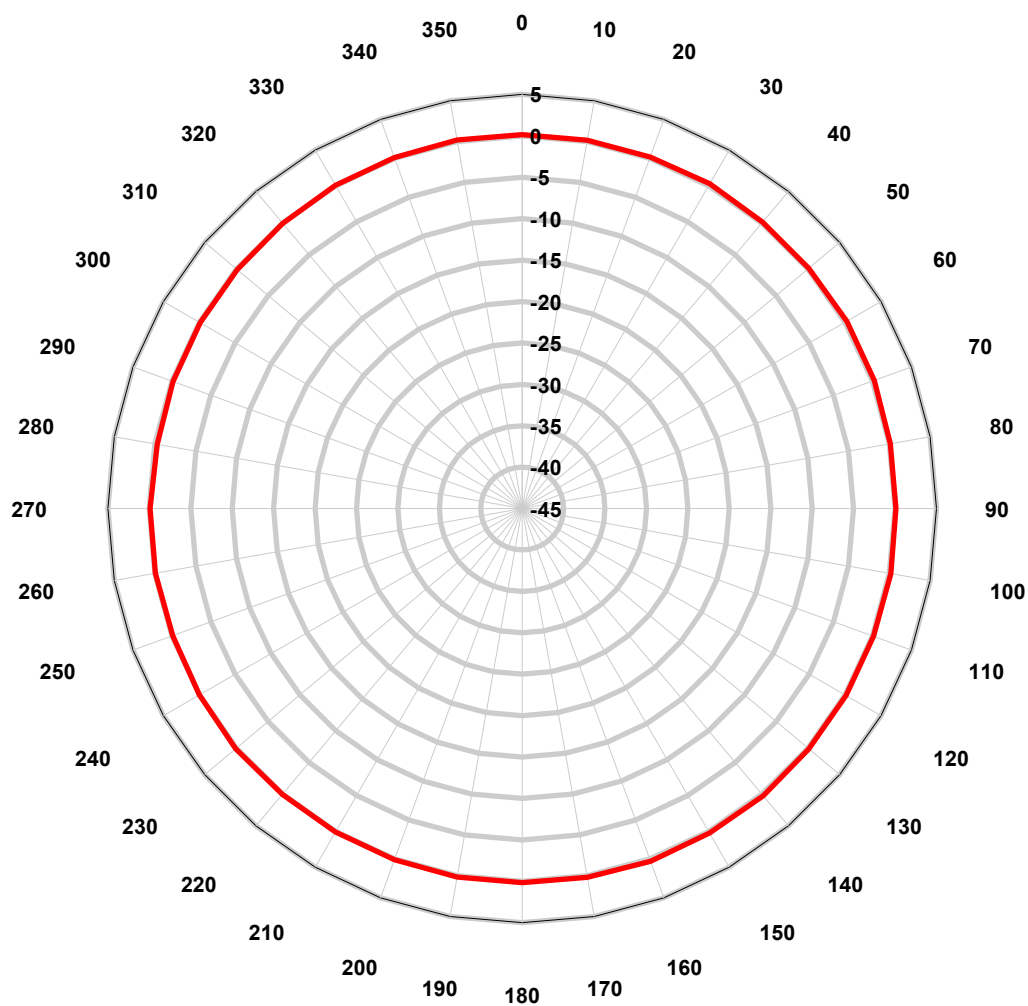
3.2.12 Polar plot : 300-01032, Free Space, 460 MHz

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300-01032 Free Space 470 MHz

— Antenna Gain (dBi)



	MAX	MIN	AVG
Antenna Gain (dBi)	0.32	-0.26	0.10

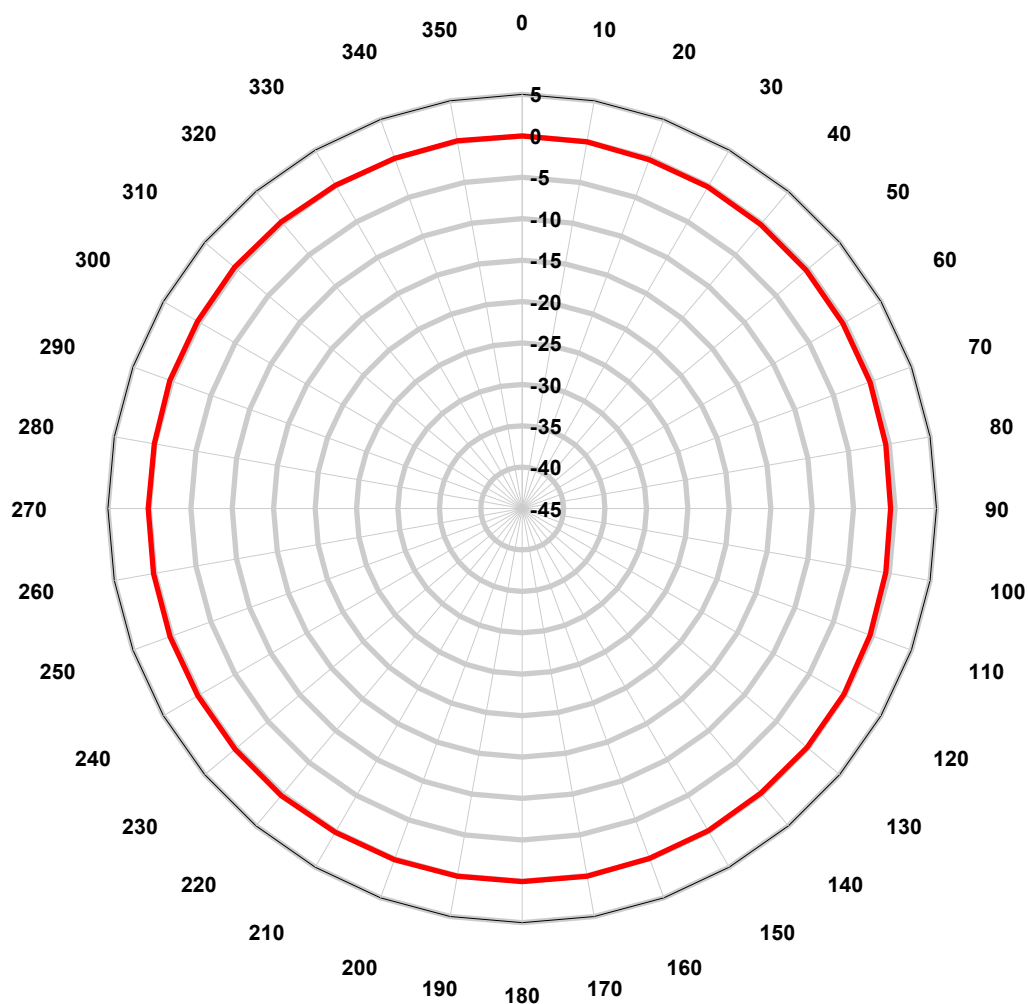
3.2.13 Polar plot : 300-01032, Free Space, 470 MHz

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300-00662 Free Space 410 MHz

— Antenna Gain (dBi)



	MAX	MIN	AVG
Antenna Gain (dBi)	0.33	-0.53	-0.02

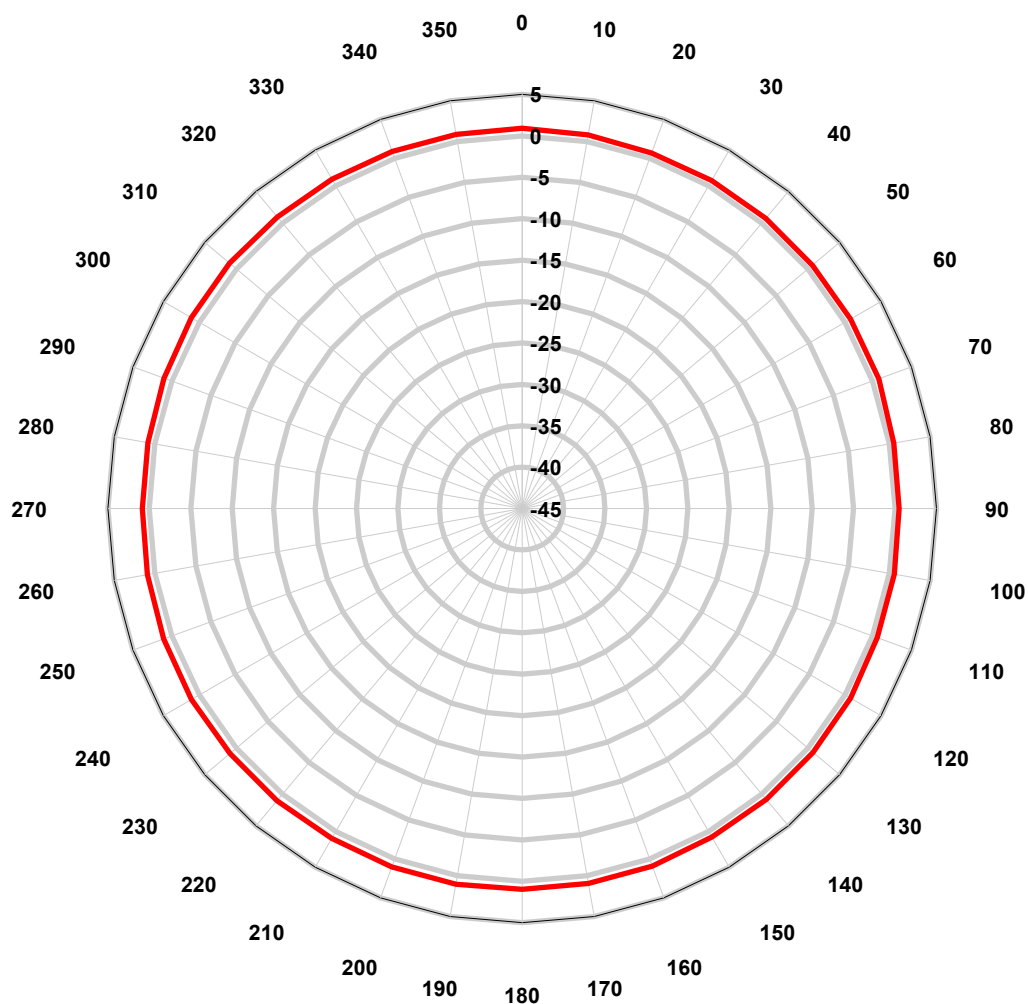
3.2.14 Polar plot : 300-00662, Free Space, 410 MHz

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300-00662 Free Space 420 MHz

— Antenna Gain (dBi)



	MAX	MIN	AVG
Antenna Gain (dBi)	1.12	0.49	0.87

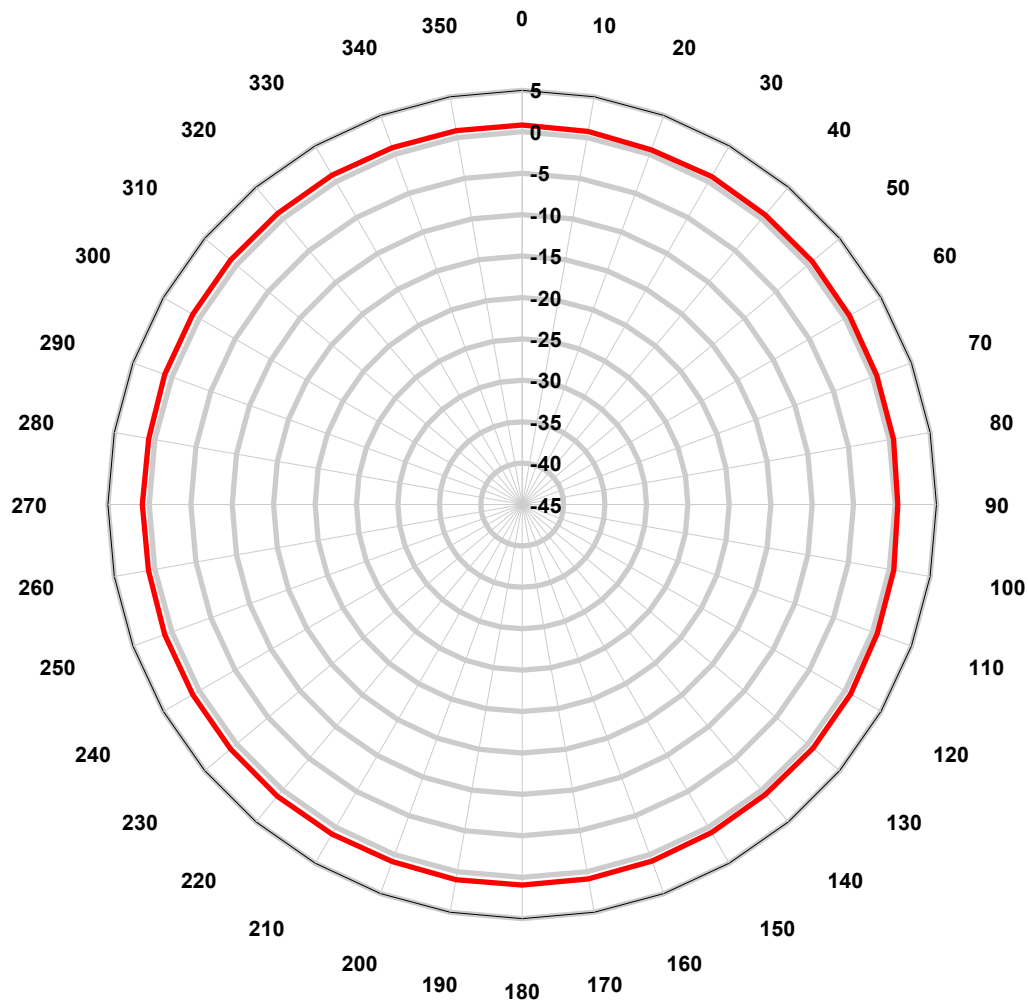
3.2.15 Polar plot : 300-00662, Free Space, 420 MHz

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300-00662 Free Space 430 MHz

— Antenna Gain (dBi)



	MAX	MIN	AVG
Antenna Gain (dBi)	0.99	0.35	0.78

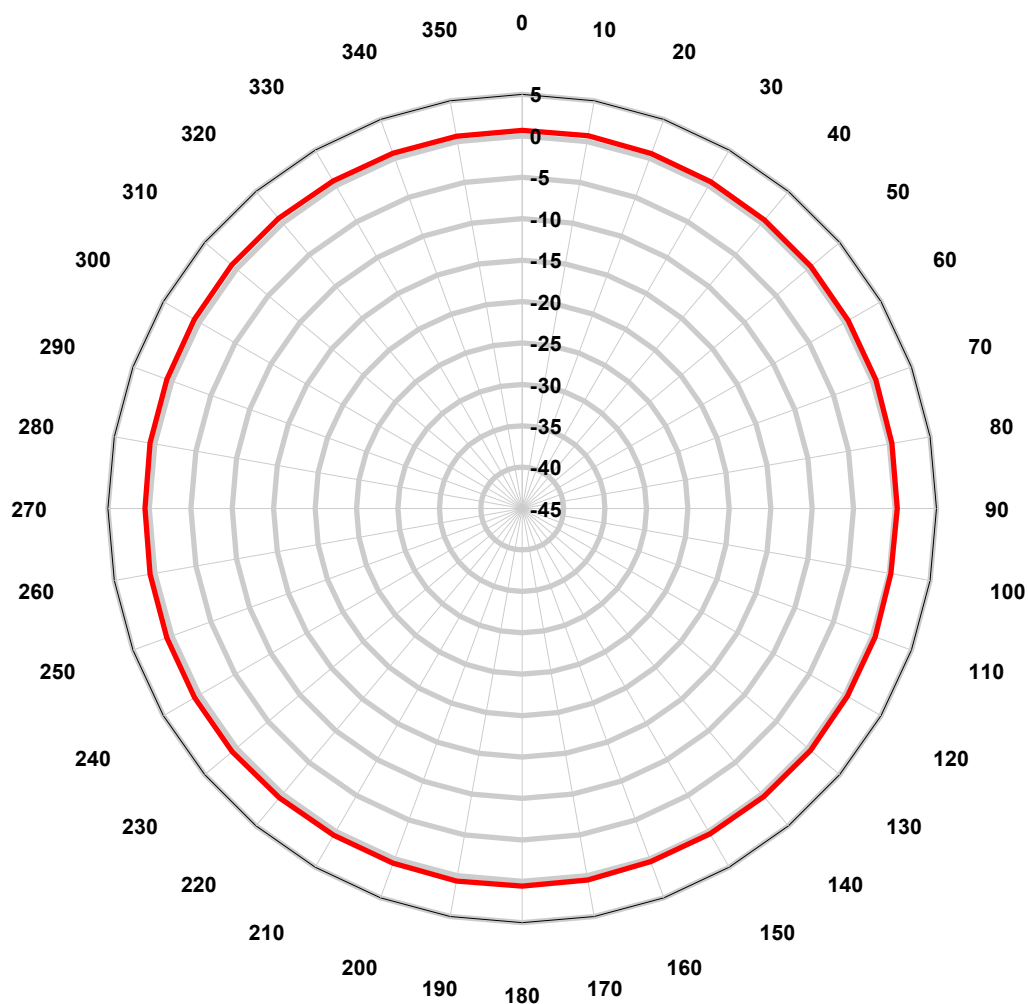
3.2.16 Polar plot : 300-00662, Free Space, 430 MHz

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300-01031 Free Space 410 MHz

— Antenna Gain (dBi)



	MAX	MIN	AVG
Antenna Gain (dBi)	0.76	0.18	0.54

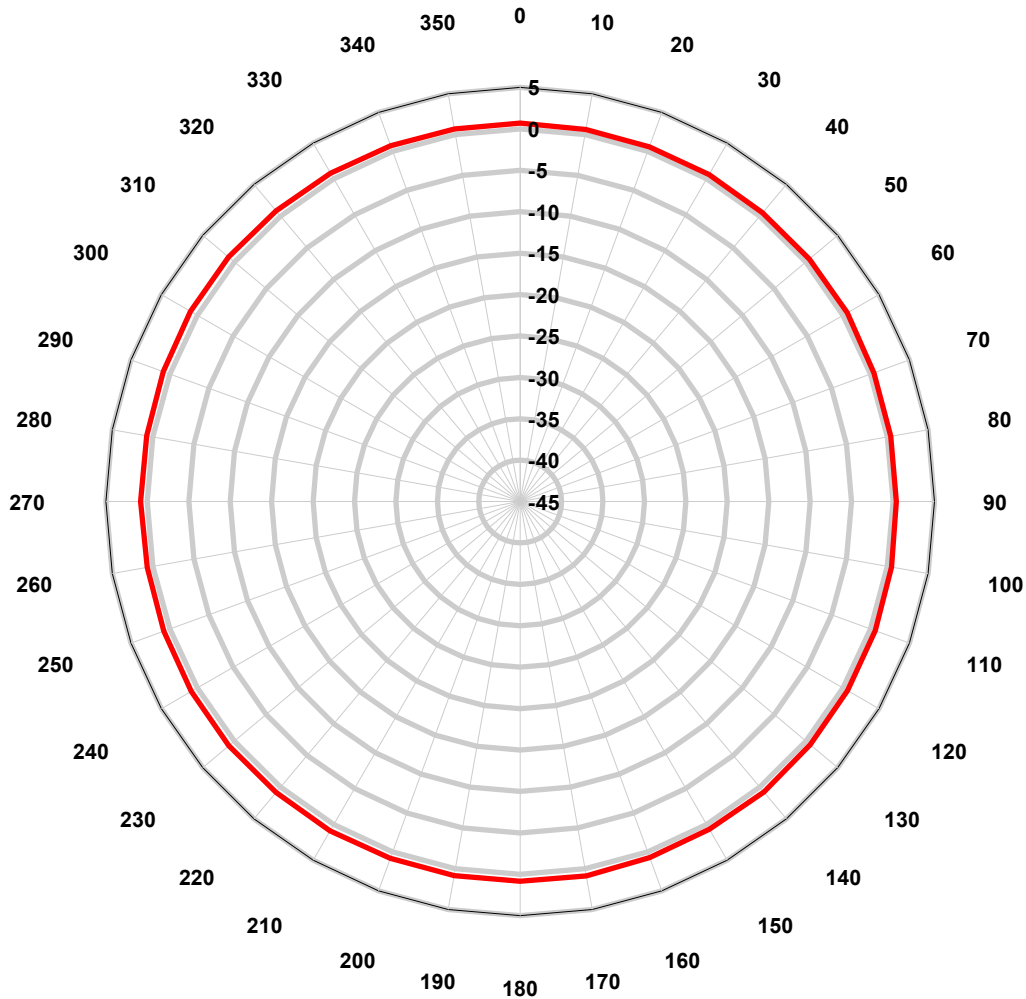
3.2.17 Polar plot : 300-01031, Free Space, 410 MHz

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300-01031 Free Space 420 MHz

— Antenna Gain (dBi)



	MAX	MIN	AVG
Antenna Gain (dBi)	0.95	0.38	0.71

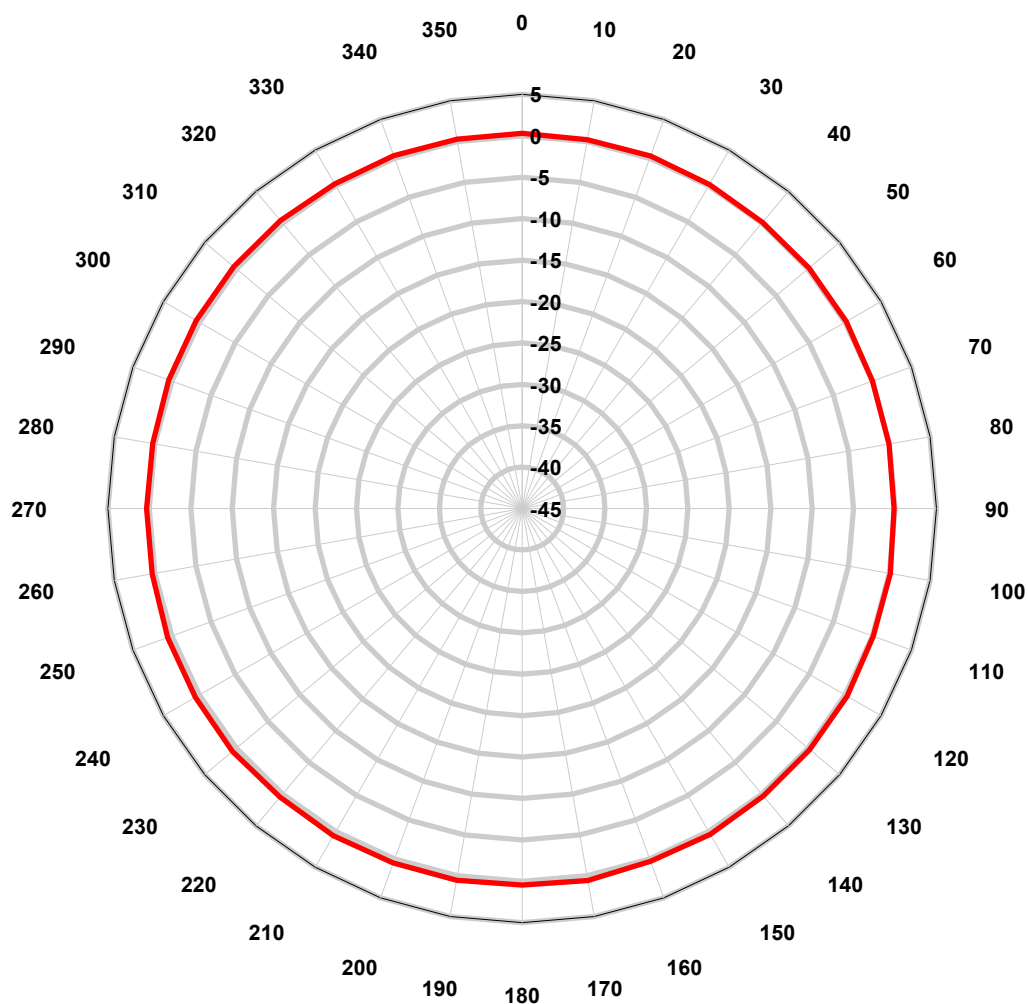
3.2.18 Polar plot : 300-01031, Free Space, 420 MHz

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300-01031 Free Space 430 MHz

— Antenna Gain (dBi)



	MAX	MIN	AVG
Antenna Gain (dBi)	0.64	-0.13	0.33

3.2.19 Polar plot : 300-01031, Free Space, 430 MHz

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Photos

The following pages show various photographs taken during the testing.

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Photo 1: Radiated Emissions : Polar plot measurement setup



Photo 2: Radiated Emissions : Helical Antenna

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Photo 3: Radiated Emissions : Quarter Wave Antenna