Test Report

ELECTROMAGNETIC COMPATIBILITY TEST REPORT

Tests performed at:

dB Technology (Cambridge) Ltd
Radio Test Site
Twentypence Road,
Cottenham,
Cambridge
U.K.
CB24 8PS
Tel: 01954 251974
Web: www.dbtechnology.co.uk

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		

Test Report

Product:	TETRA Antenna Patterns for SC2024 Radio
Company:	Sepura Limited
Representative:	John Thacker
Address:	9000 Cambridge Research Park Beach Drive Waterbeach Cambridgeshire 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:	Dave Smith Digitally signed by Dave Smith DN: C=UK, O=dB Technology, CN=Dave Smith, E=mail@dbtechnology.co.uk Reason: I am approving this document Location: Cottenham Date: 2023-07-03 10:52:53 Foxit Reader Version: 9.2.0
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.

Test Report

Table of Contents

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

Product:	TETRA Antenna Patterns for SC2024 Radio
Company:	Sepura Limited
Representative:	John Thacker
Address:	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	-

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.

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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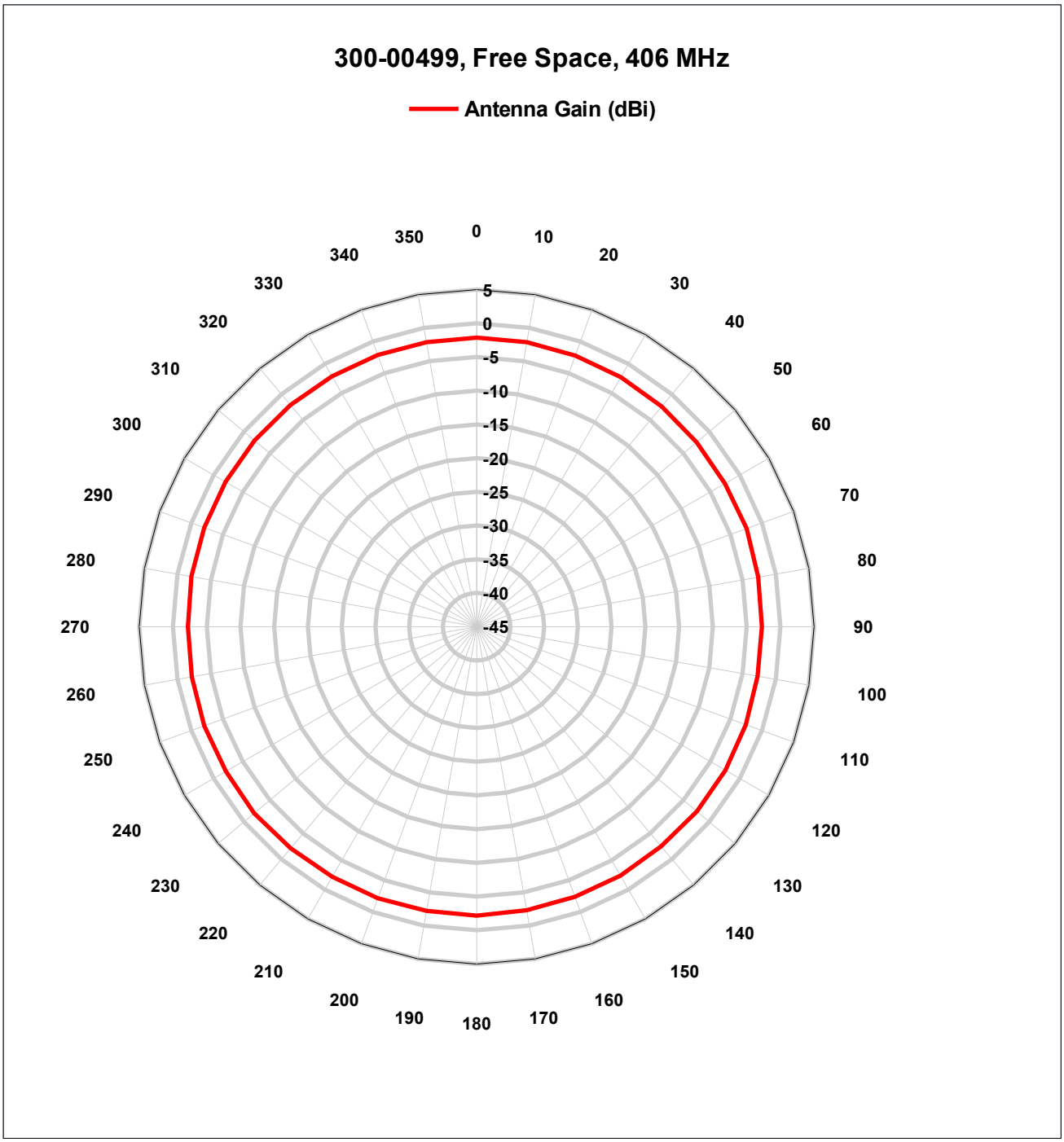
3.1.5 Test Equipment

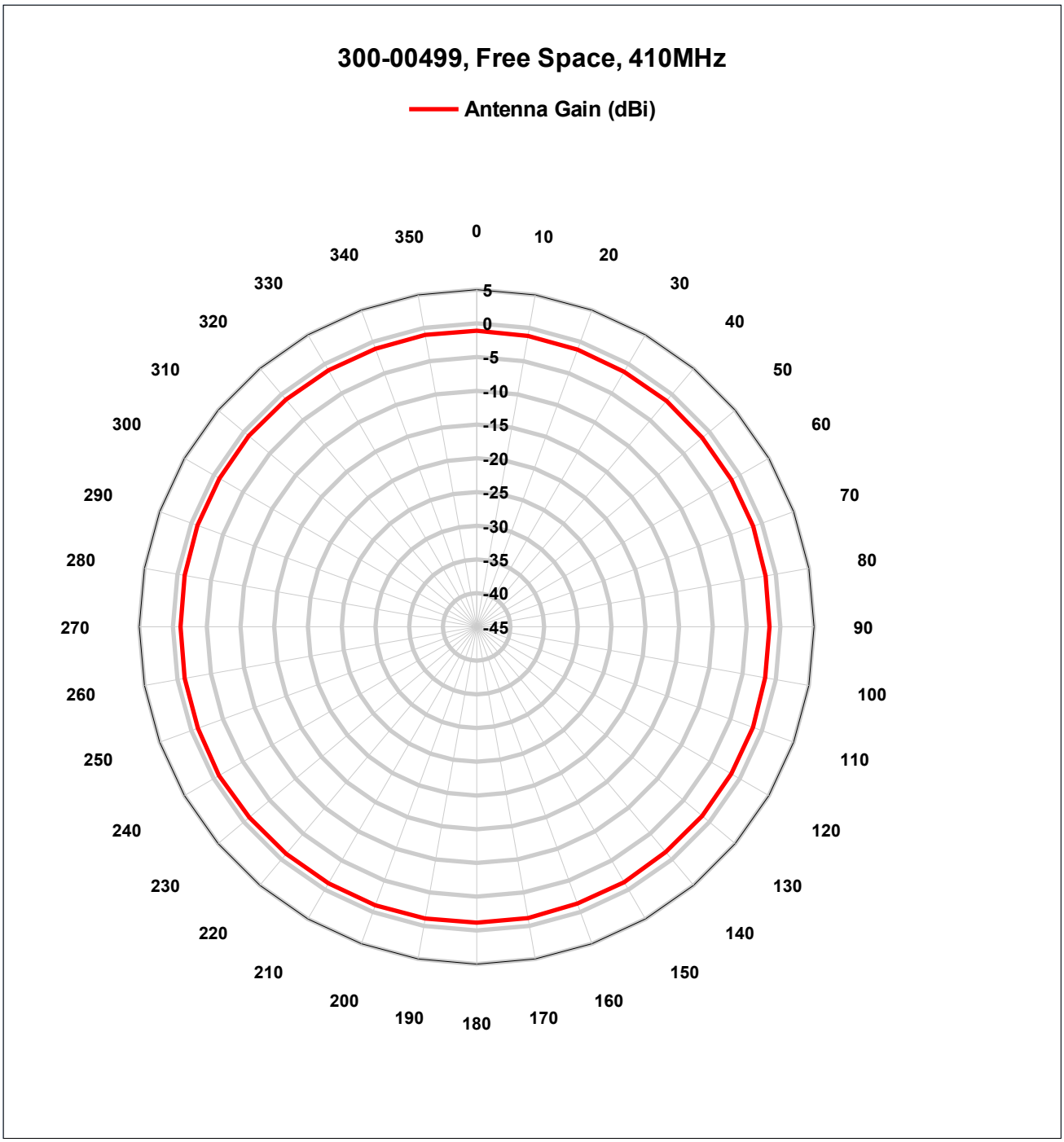
Test Equipment				
Ref:	**Description:**	**S/N:**	**Cal. Date**	**Cal Interval (Months)**
R20	R&S ESR3 EMI Test Receiver	102463	12/09/2022	12
CBL134	RG214 - 25m N-N	CBL134	09/05/2023	12
A39	Schwarzbeck VULP 9118A Log Periodic	581	23/07/2021	36
OATS6	OATS - 10m NSA compliant_ANSI C63.4:2014 / EN55016-1-4:2019	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



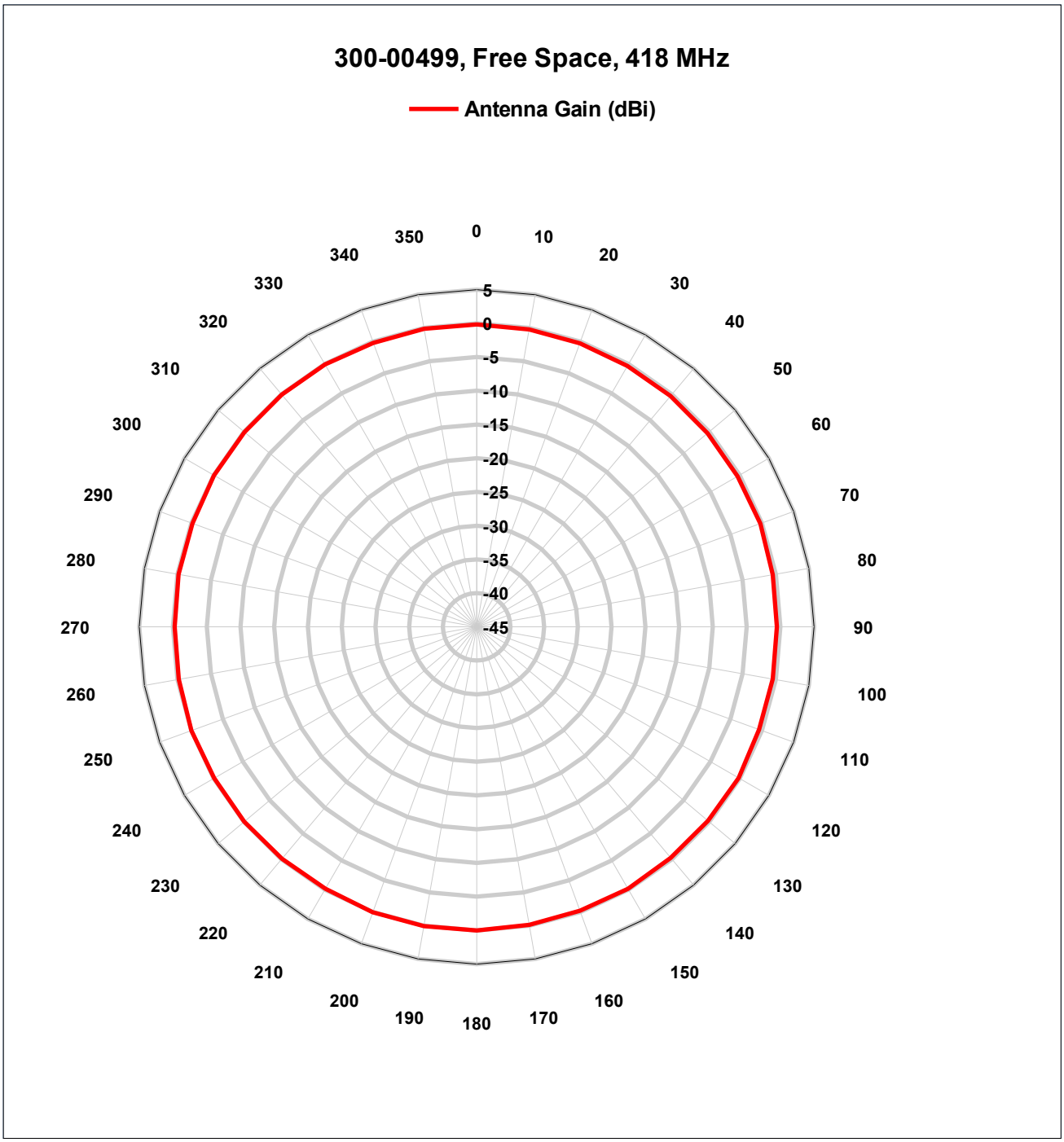
	MAX	MIN	AVG
Antenna Gain (dBi)	-1.95	-2.74	-2.26

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



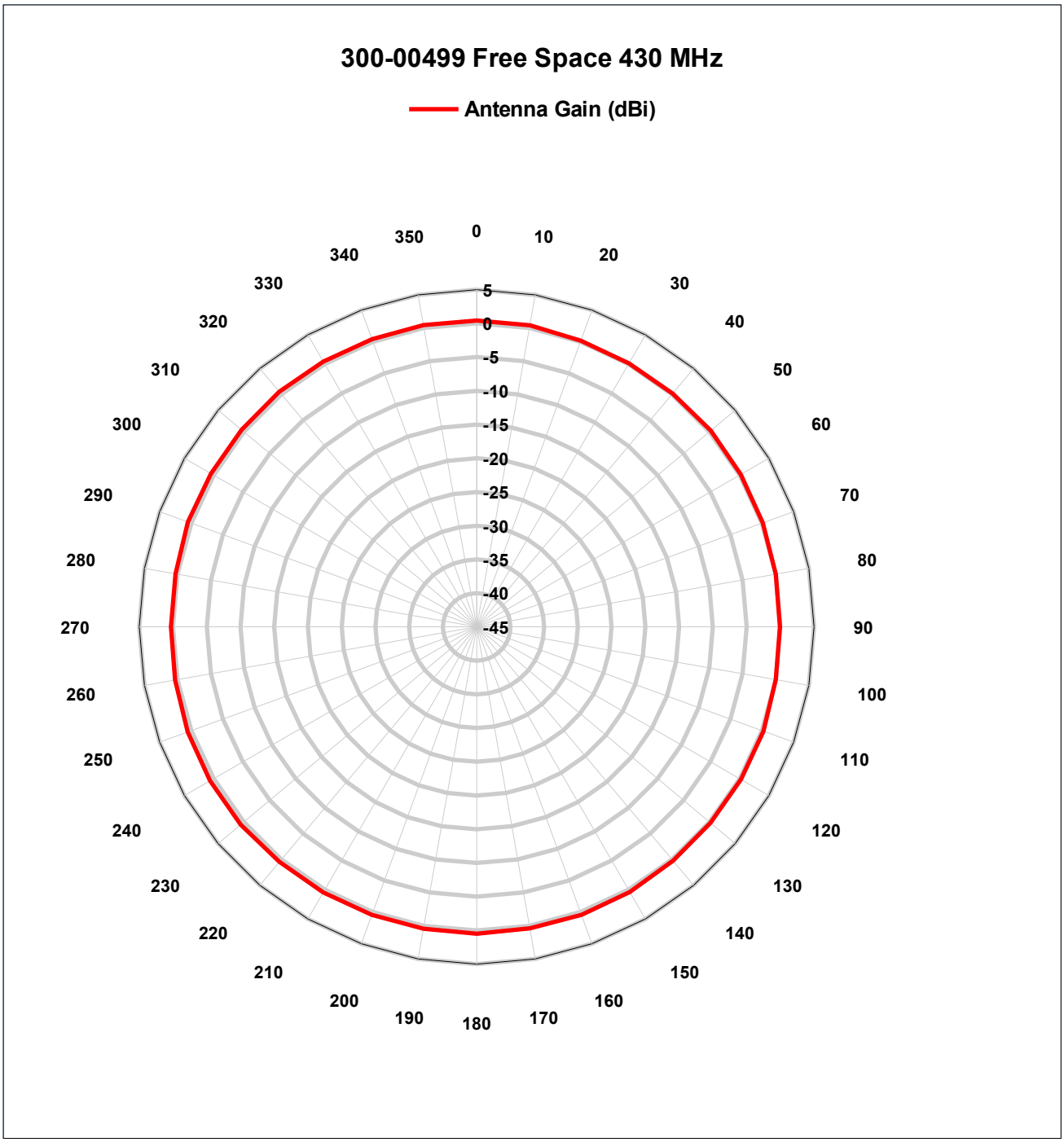
	MAX	MIN	AVG
Antenna Gain (dBi)	-0.91	-1.62	-1.20

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



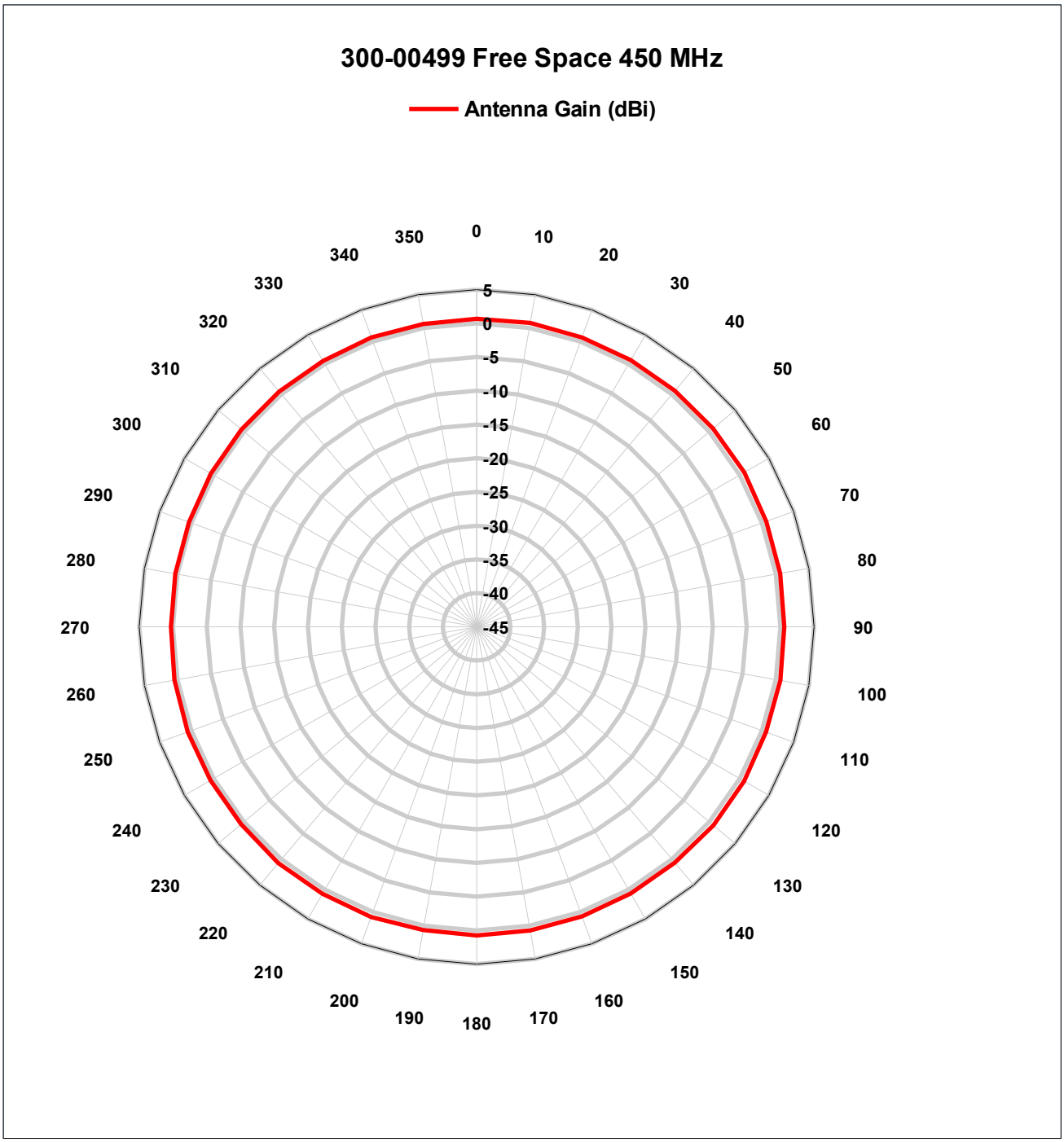
	MAX	MIN	AVG
Antenna Gain (dBi)	0.06	-0.51	-0.19

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



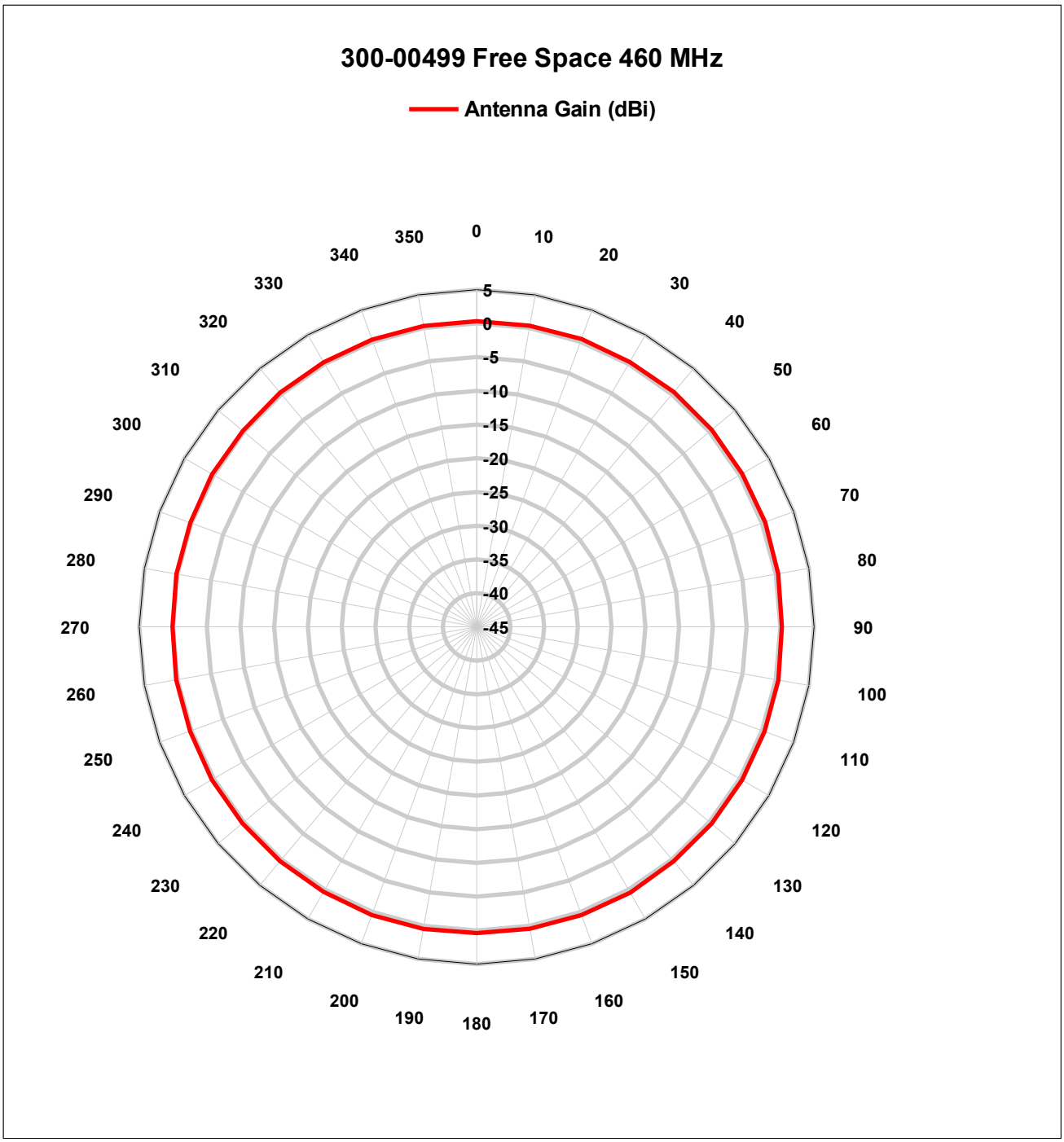
	MAX	MIN	AVG
Antenna Gain (dBi)	0.63	-0.05	0.35

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



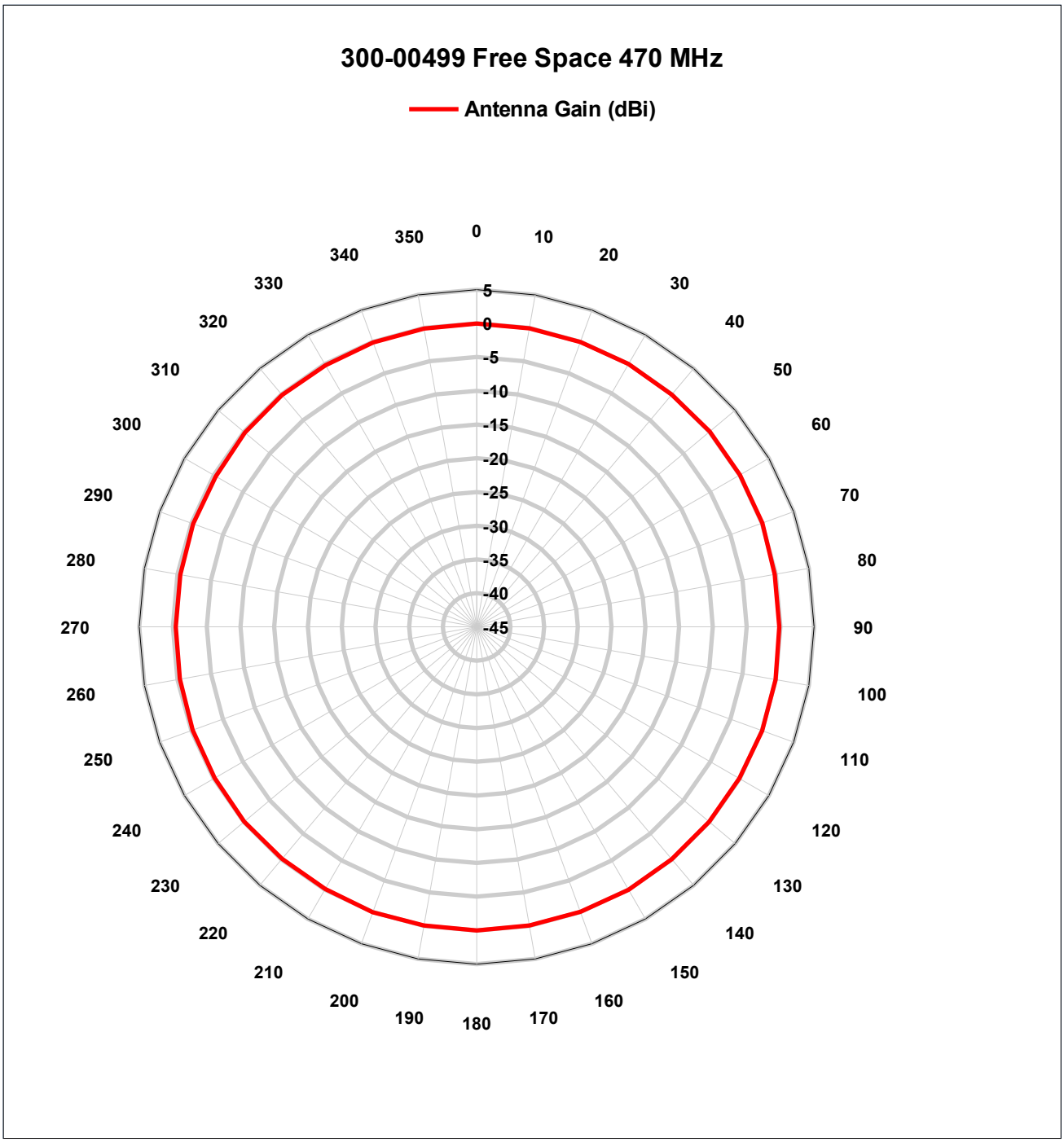
	MAX	MIN	AVG
Antenna Gain (dBi)	0.80	0.31	0.63

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



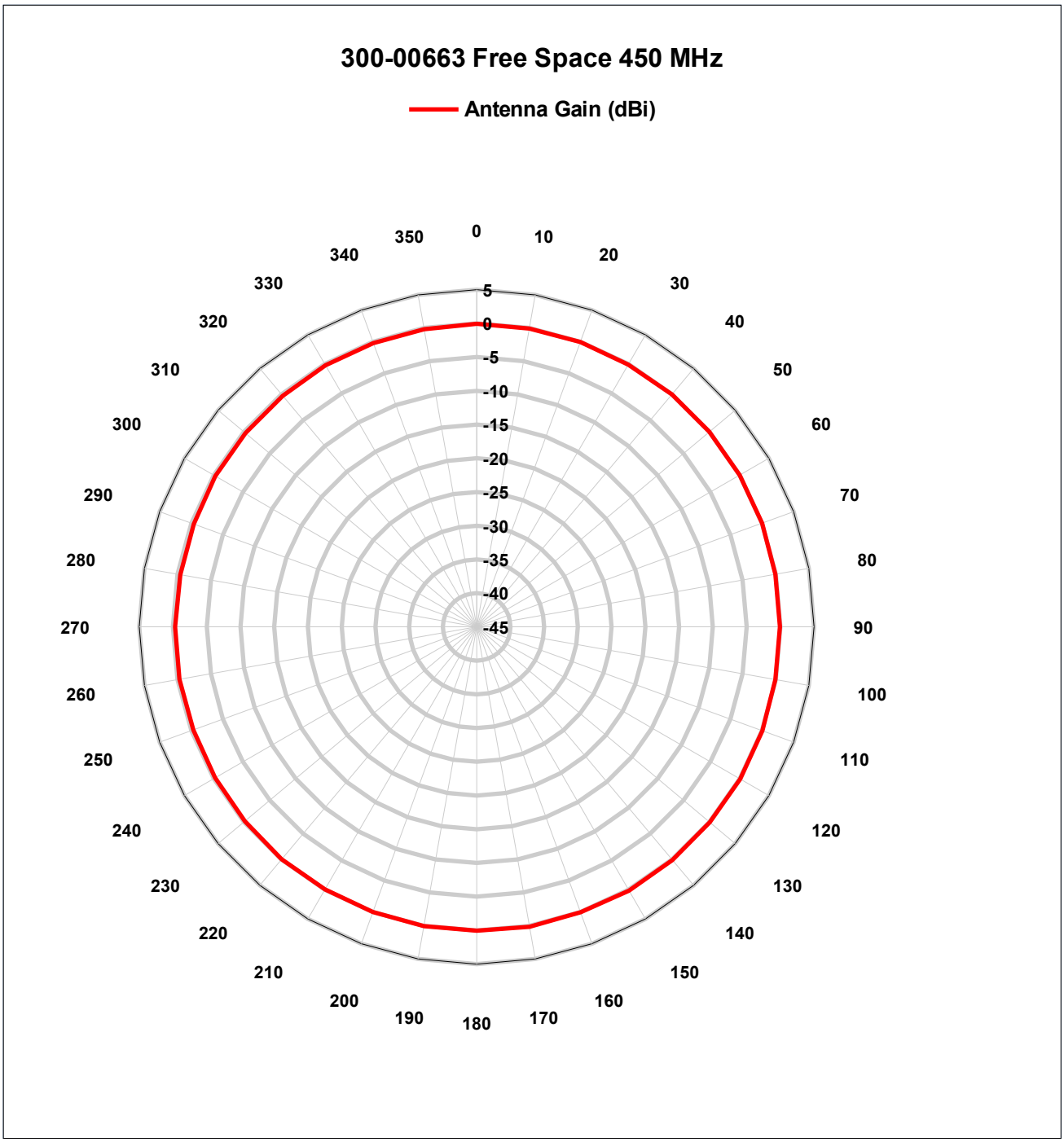
	MAX	MIN	AVG
Antenna Gain (dBi)	0.50	0.07	0.35

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



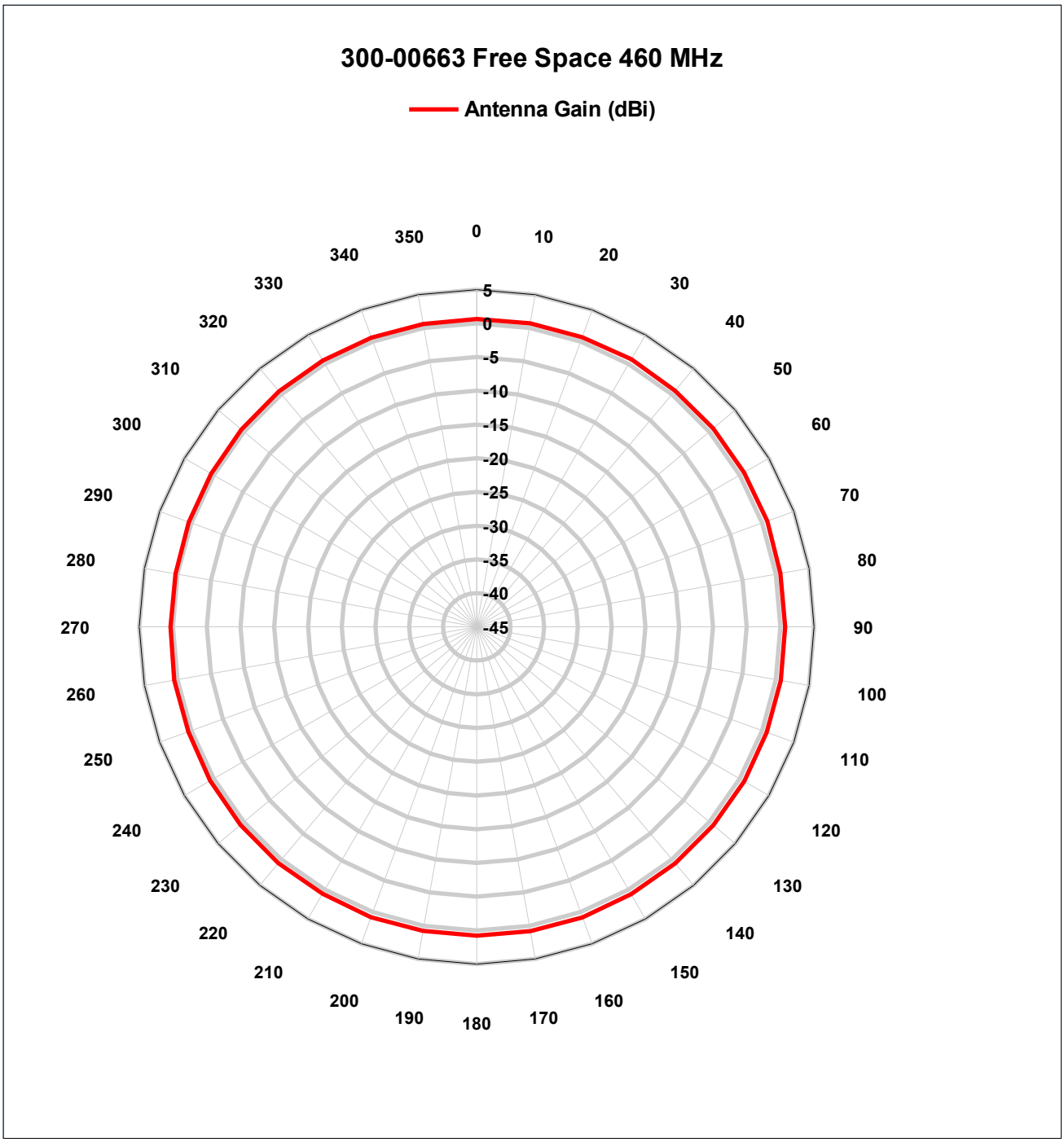
	MAX	MIN	AVG
Antenna Gain (dBi)	0.07	-0.40	-0.10

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



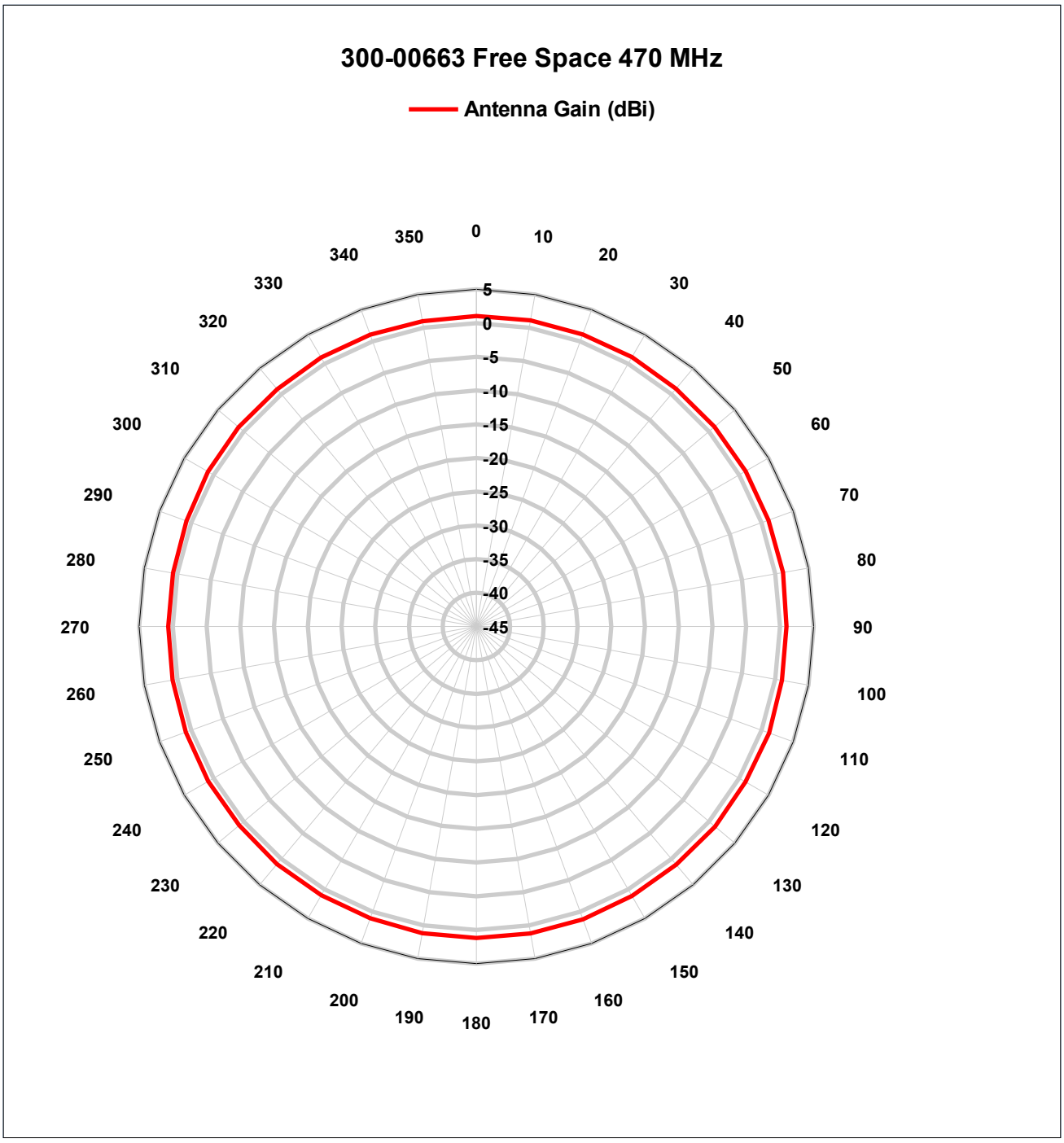
	MAX	MIN	AVG
Antenna Gain (dBi)	0.15	-0.42	-0.09

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



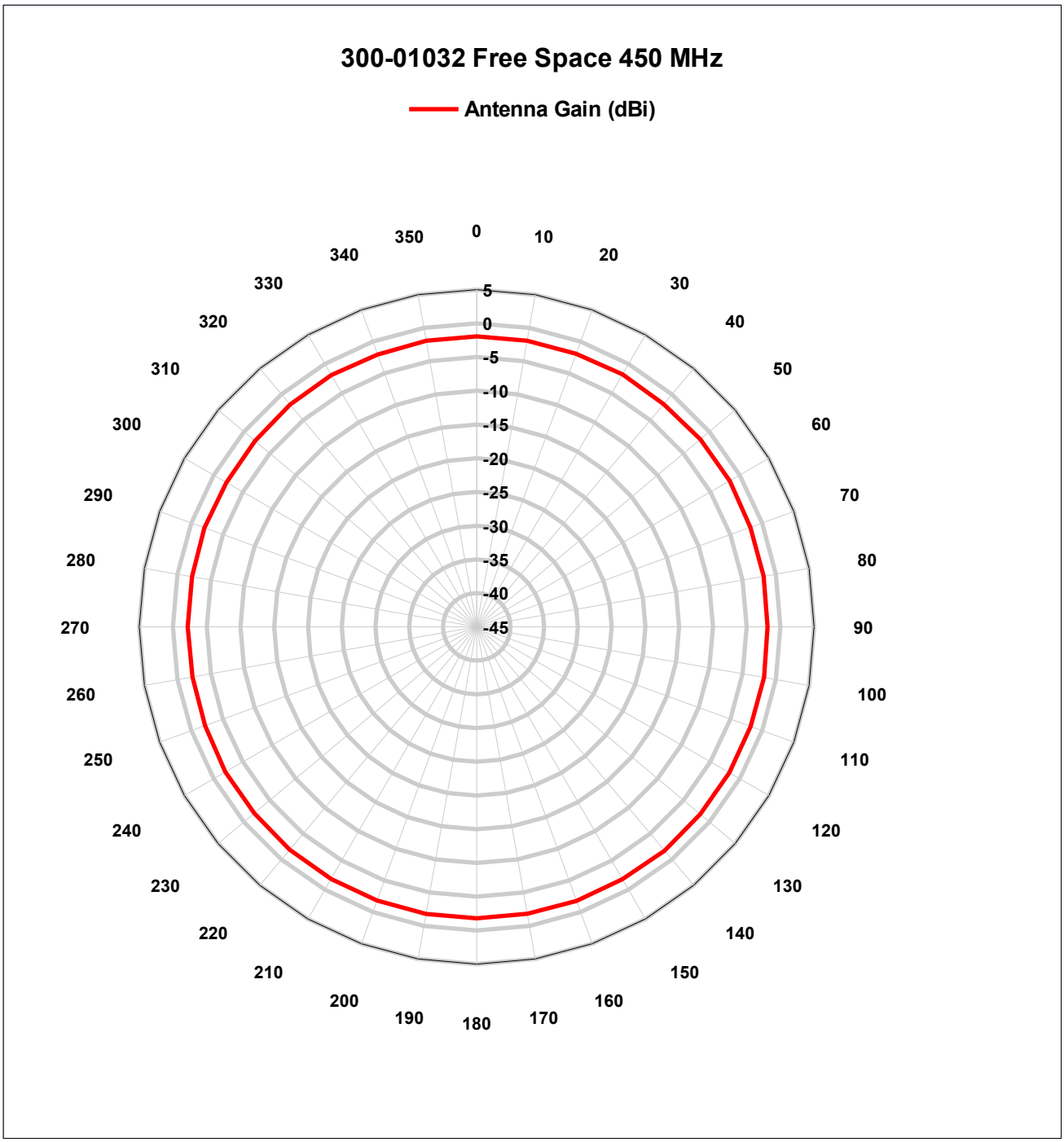
	MAX	MIN	AVG
Antenna Gain (dBi)	0.84	0.33	0.67

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



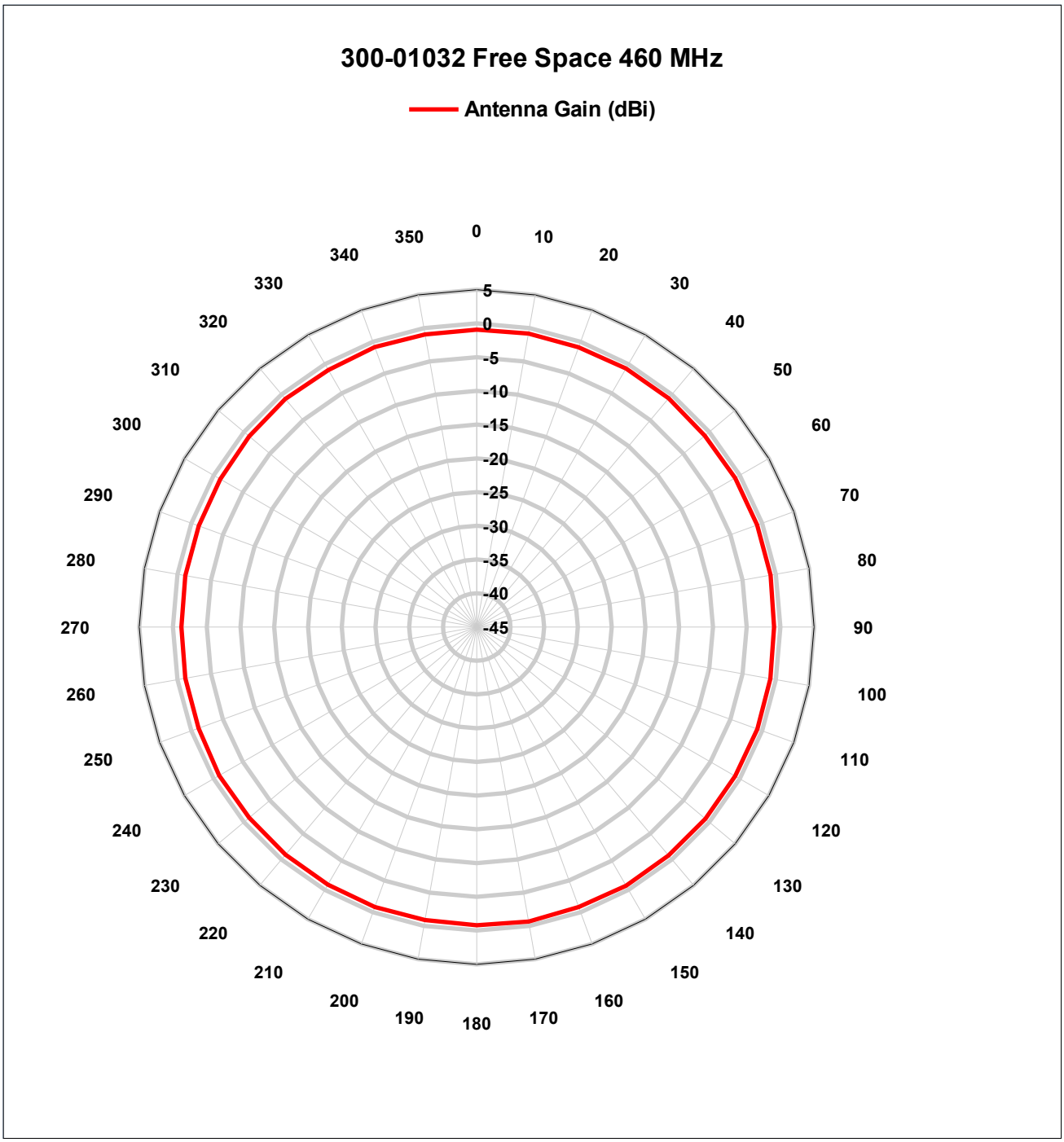
	MAX	MIN	AVG
Antenna Gain (dBi)	1.22	0.66	1.03

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



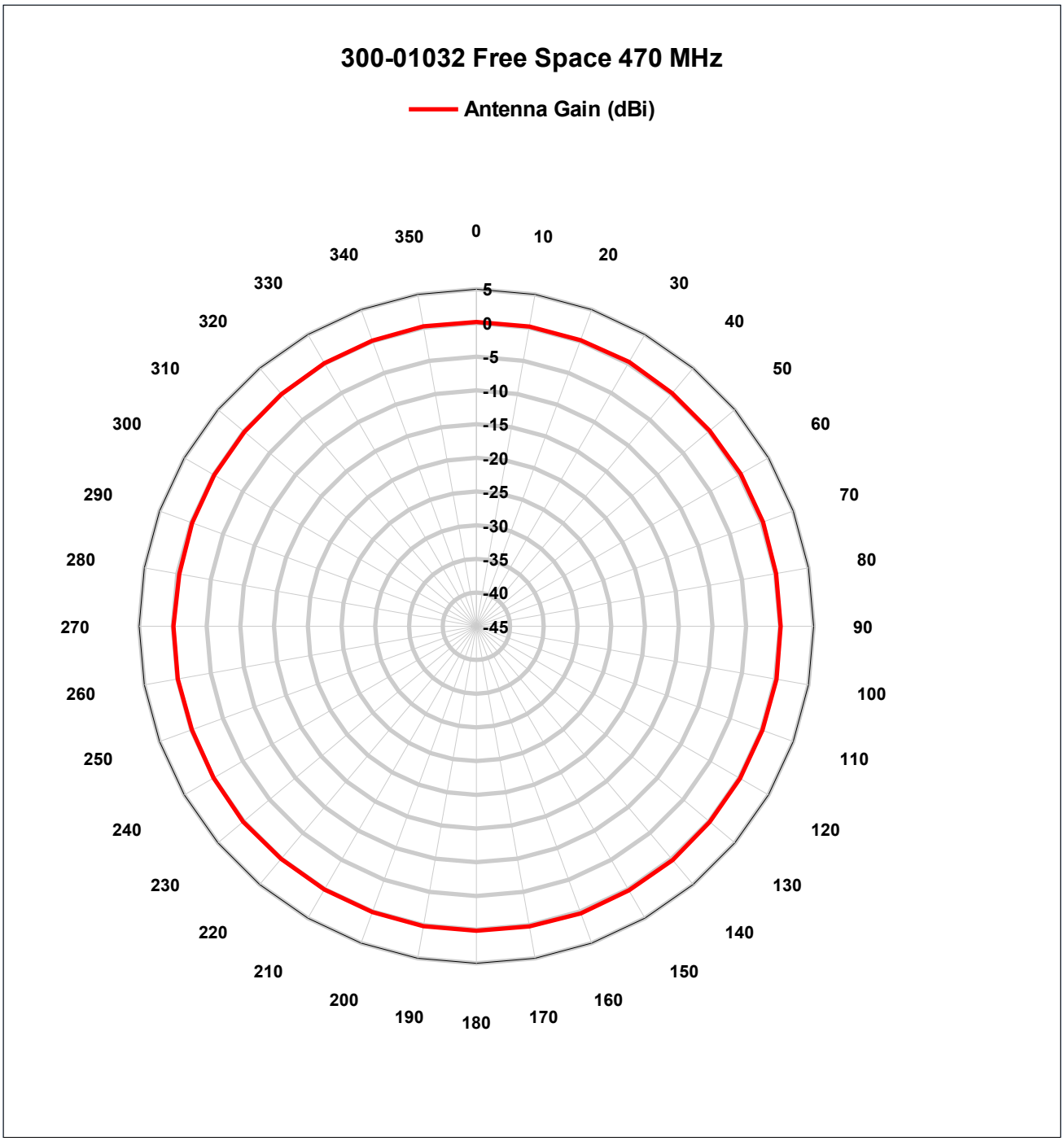
	MAX	MIN	AVG
Antenna Gain (dBi)	-1.69	-2.23	-1.91

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



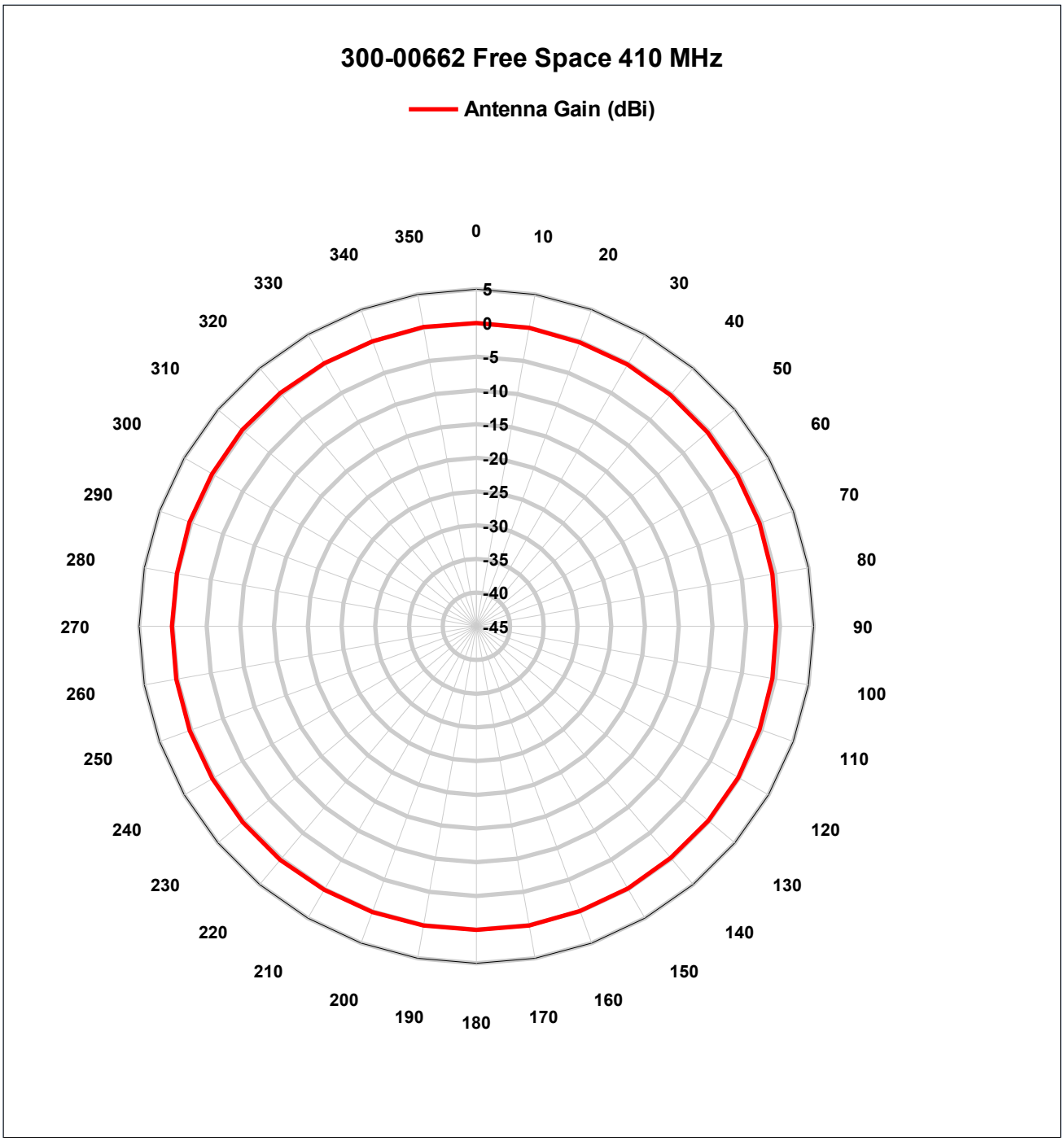
	MAX	MIN	AVG
Antenna Gain (dBi)	-0.66	-1.25	-0.89

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



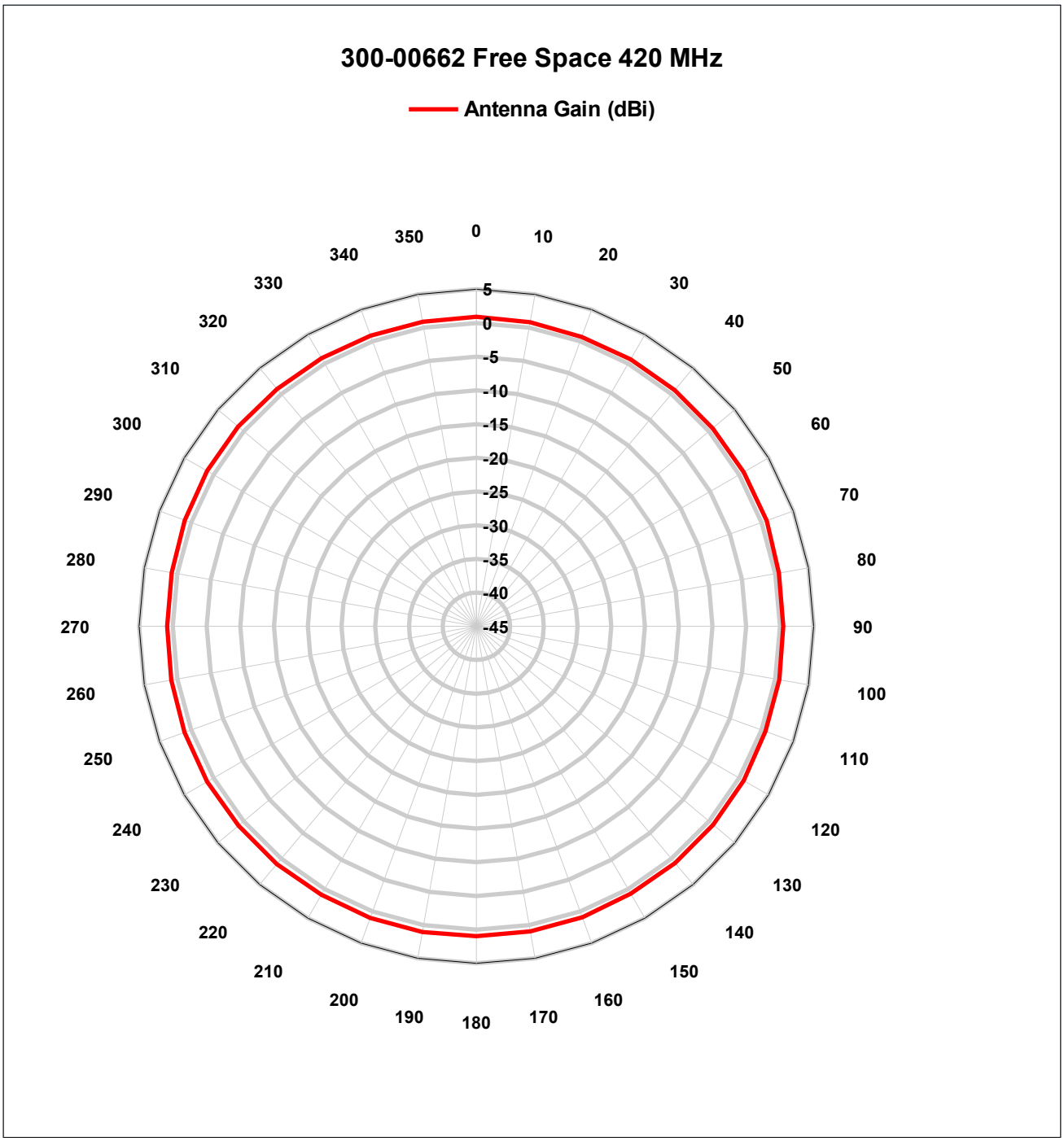
	MAX	MIN	AVG
Antenna Gain (dBi)	0.32	-0.26	0.10

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



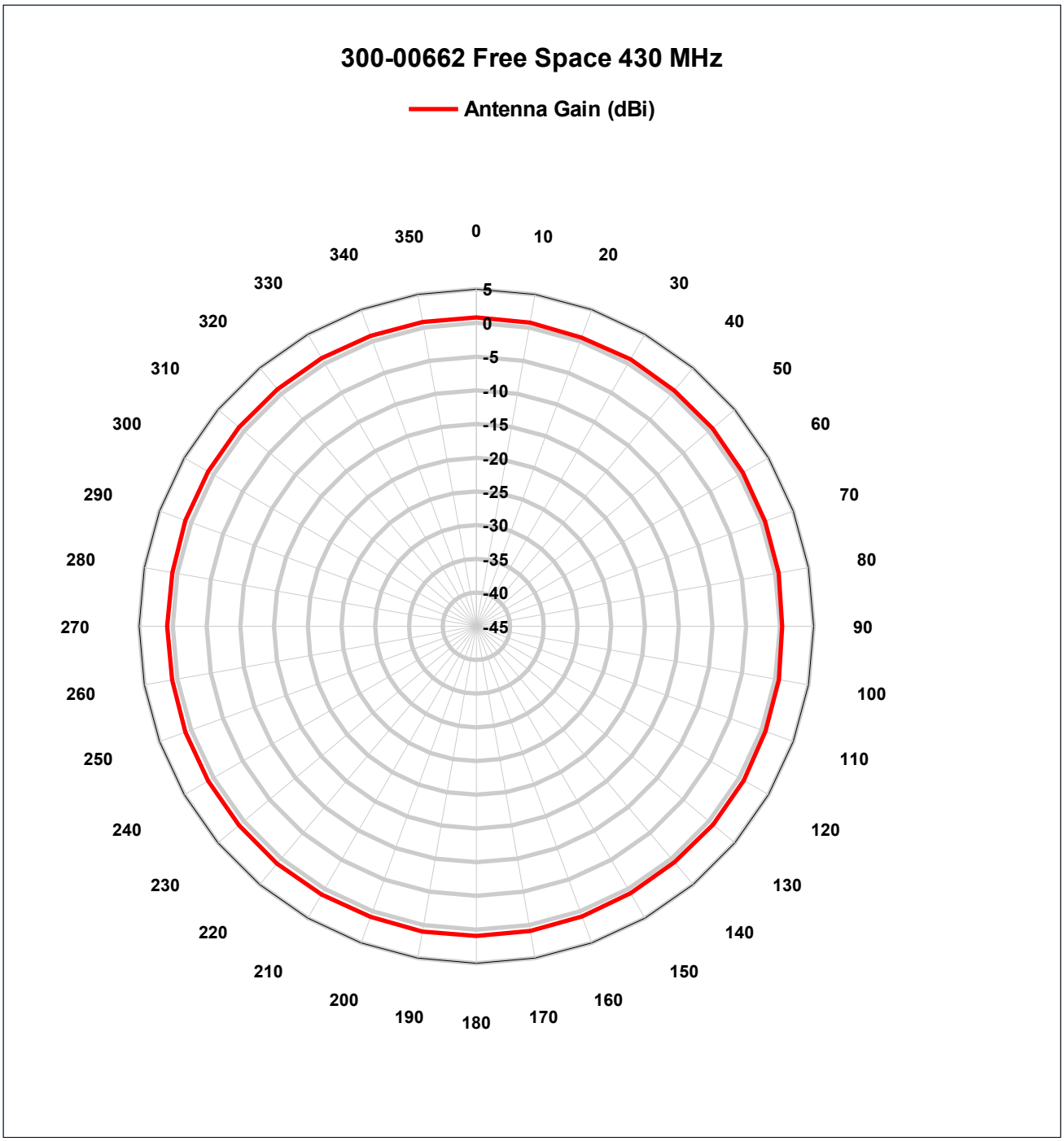
	MAX	MIN	AVG
Antenna Gain (dBi)	0.33	-0.53	-0.02

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



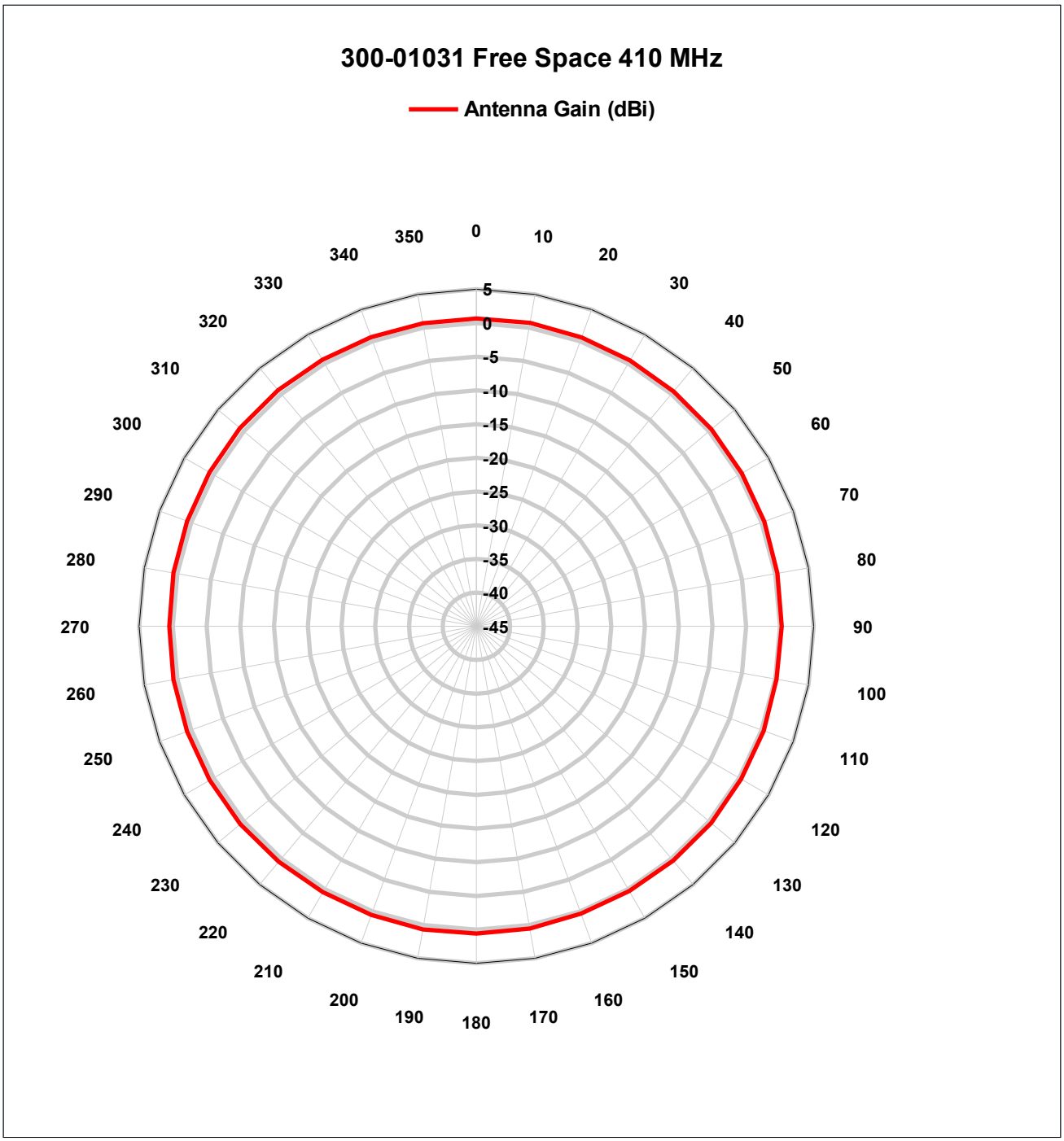
	MAX	MIN	AVG
Antenna Gain (dBi)	1.12	0.49	0.87

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



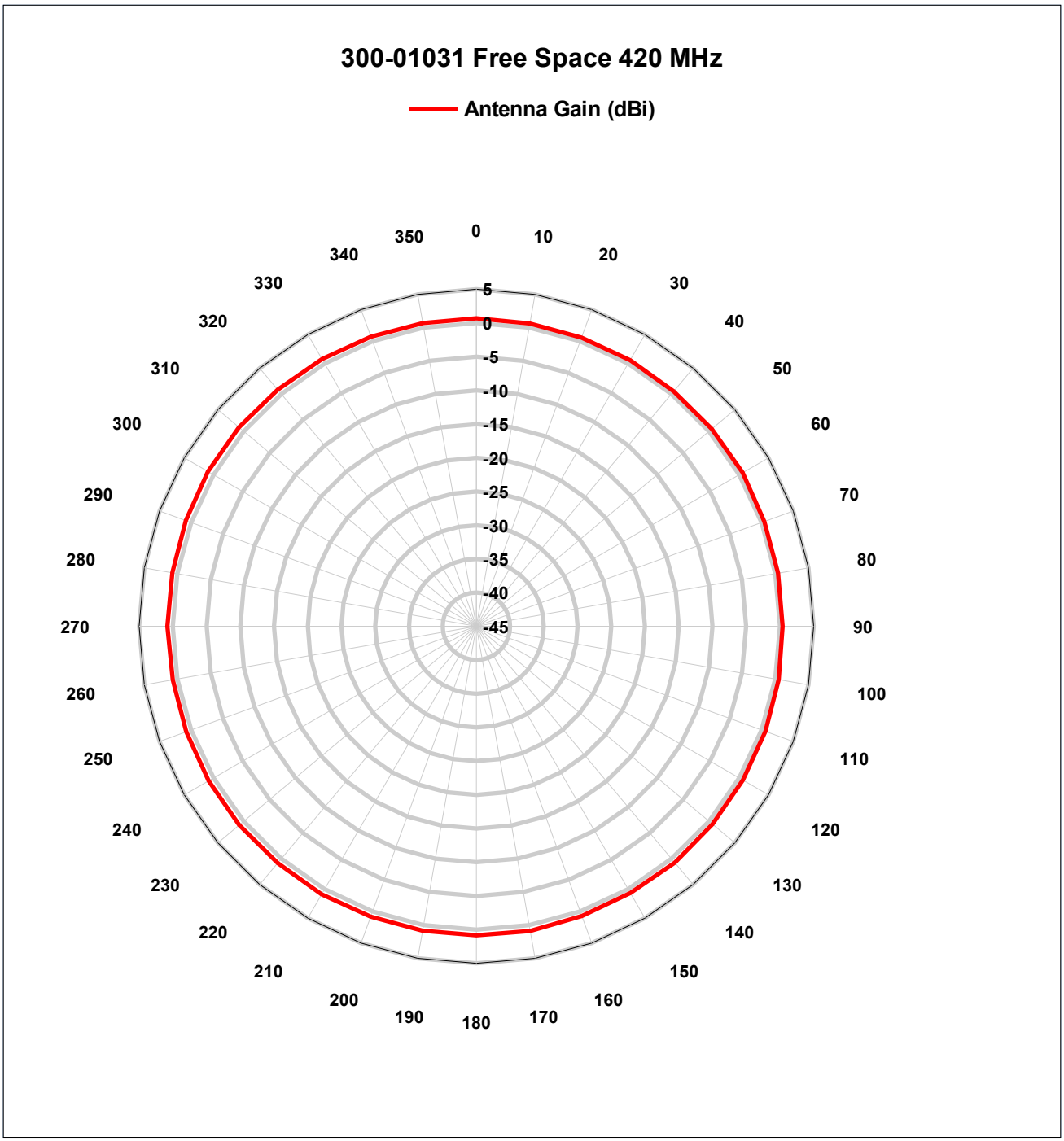
	MAX	MIN	AVG
Antenna Gain (dBi)	0.99	0.35	0.78

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



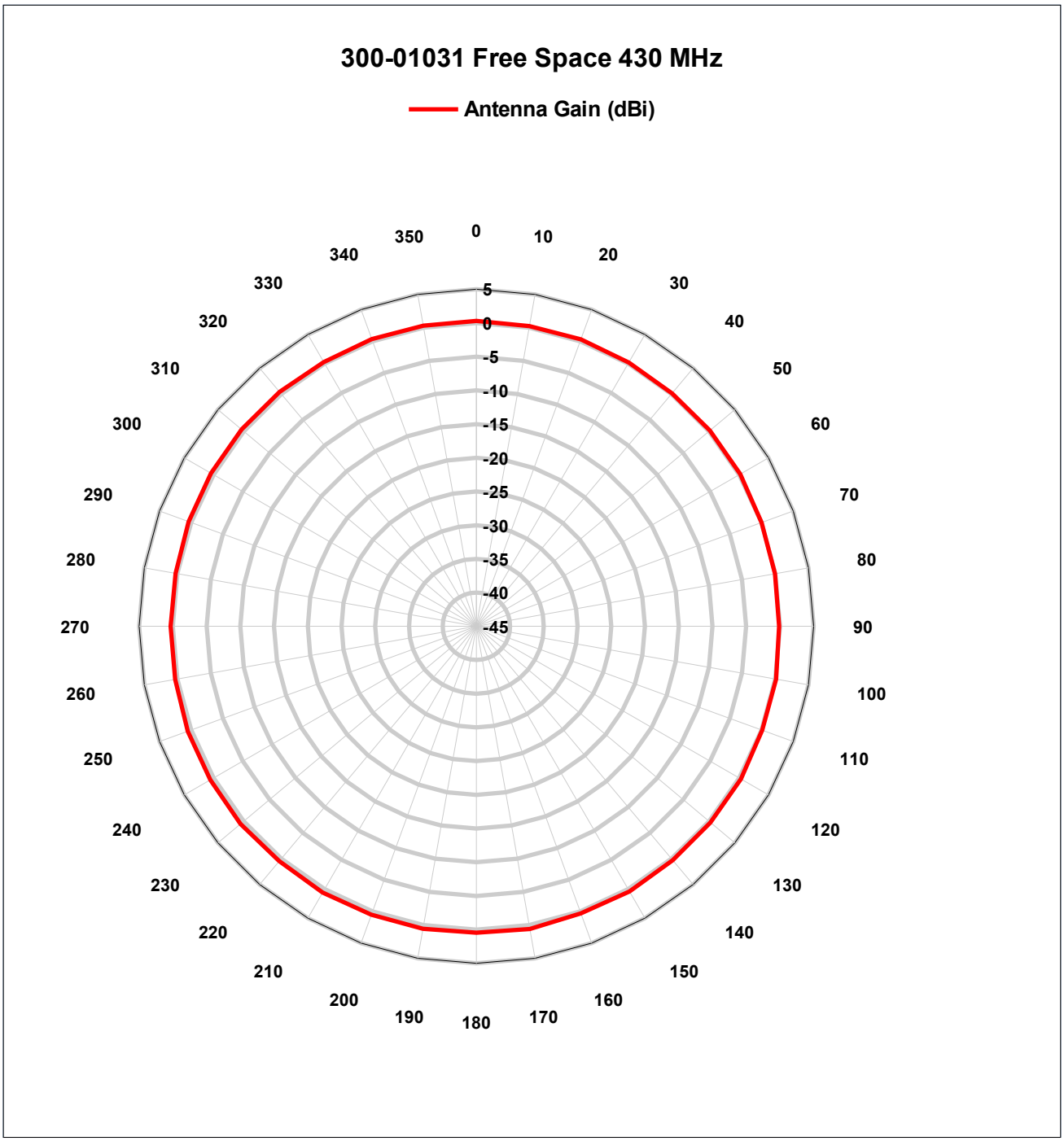
	MAX	MIN	AVG
Antenna Gain (dBi)	0.76	0.18	0.54

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



	MAX	MIN	AVG
Antenna Gain (dBi)	0.95	0.38	0.71

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



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

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

Photos

The following pages show various photographs taken during the testing.

Photo 1: Radiated Emissions : Polar plot measurement setup

Photo 2: Radiated Emissions : Helical Antenna

Photo 3: Radiated Emissions : Quarter Wave Antenna