



Coverage.
Performance.
Smart.

Lighthouse Series 1003840 Smart Array

Airgain Embedded Antenna Engineering Data Sheet For Lighthouse

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Revision History (Required)

Revision	Date	Note
4573-02-00-001-1 Rev1.0	May 22, 2025	Preliminary Datasheet 1.0

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Please verify with Airgain before finalizing a product design.

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1. Airgain Lighthouse - 1003840 n77 Embedded DU Smart Array

The Airgain 1003840 is a smart antenna array designed to cover frequency bands n48, n78, and most of the n77 (up to 4000MHz), and optimized for integration into the Lighthouse range of 5G repeaters. This advanced dual-polarized ($\pm 45^\circ$) array offers dynamic beam-steering, allowing directional control in five azimuth angles: 0° , $\pm 18^\circ$, and $\pm 36^\circ$.

Its electronic control is managed via a simple I2C interface, which also includes an EEPROM for self-identification, ensuring seamless integration with host systems. The array delivers exceptional performance, characterized by high gain (up to +15dBi) and minimal side lobes, making it a powerful solution for efficient 5G signal enhancement.

2. Features

The Model 1003840 smart array includes the following features:

- 3300-4000MHz (5G bands n48, n78, and most of n77)
- High gain
- Low side lobes
- 5 selectable beam directions 0° , $\pm 18^\circ$, and $\pm 36^\circ$.
- Self-identification



Figure 1: Airgain 1003840 Smart Array

3. Specifications and Interface

Absolute Maximum Ratings:

PARAMETER	SYMBOL	CONDITION	MIN	MAX	UNITS
RF Input Power	P _{in}			+38	dBm
Supply Voltage	V _{DD}		-0.5	+5.0	V
I2C Voltage	V _{CTL}		-0.5	+5.0	V
Operating Temp.	T _{opr}		-40	+85	°C
Storage Temp.	T _{stg}		-40	+85	°C
ESD	V _{ESD}	Electrostatic pulse (human body model)		3000	V

RF Characteristics:

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNITS
Frequency Range			3000		4000	MHz
Feed Impedance				50		Ω
VSWR					1.67:1	
Return Loss			12			dB
Isolation between RF ports			20	25		dB
Peak Gain		All tilt states and frequencies	10	13.5	15.0	dBi
Input Power at 0.1dB Compression Point	P _{0.1dB}				+37	dBm
2 nd Harmonics	2f ₀	P _{in} =+27dBm f ₀ =3650MHz			-70	dBc
3 rd Harmonics	3f ₀	P _{in} =+27dBm f ₀ =3650MHz			-70	dBc
Input 3 rd order intercept point	IIP3	f ₁ =3600MHz f ₂ =3700MHz f _{meas} =3650MHz P _{in} =10dBm each			+60	dBm

Antenna Characteristics:

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNITS
MIMO			2x2			
Polarization			Dual Polarization, $\pm 45^\circ$ slant			
Correlation Coefficient	ECC	Azimuth propagation model, XPR=0dB			0.2	
Azimuth Beamwidth		All tilt states and frequencies	20	27	36	$^\circ$
Peak Gain		All tilt states and frequencies	10	13.5	15.0	dBi
Elevation Beamwidth		All tilt states and frequencies	20	24	28	$^\circ$
F/B Ratio		With respect to peak	30			dB
Sidelobes		Tilt States $0^\circ, \pm 18^\circ$. With respect to peak			-25	dB
Sidelobes		Tilt States $\pm 36^\circ$. With respect to peak			-15	dB

Electrical Characteristics (DC and I²C):

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNITS
Supply Voltage	V _{DD}		2.5	3.3	5.0	V
Input Low Voltage (SCL, SDA)	V _{IL}		-0.45		0.3xV _{DD}	V
Input High Voltage (SCL, SDA)	V _{IH}		0.75xV _{DD}		5	V
Current consumption	I _{DD}	V _{DD} =3.3V		9.0	16	mA
Operating clock frequency	f _c				400	kHz
Beam control I ² C address			0x20			
EEPROM I ² C address			0x50			
EEPROM mem size			128			byte
EEPROM page size			16			byte
Data retention		T _A =55°C	200			Years
Switching time	T _{sw}			1		ms

Mechanical Characteristics:

PARAMETER	VALUE	UNITS
Size	270.0x262.0x20.5 (excluding SMA connectors)	mm
Weight	360	g
Number of RF Connectors	2	
RF Connector Type	2x SMA(F)	
Digital Interface	4 pins header, edge mounted	
Digital Connector Type	Morlinkom Technology Ltd PXWB02R104TB4 (Mates with PXH04B4B2)	
Mounting Interface	M4 Screws (x13)	
RoHS	Compliant	

Radiation beam tilt control:

The direction of the beam in the azimuth plane (assuming the nadir-zenith direction is aligned with the SMA connectors) can be electronically controlled in the range $\pm 36^\circ$.

This is done by writing to the registers of a 16bits I²C port expander (NXP PCAL6416A).

The I²C address used to control the radiation beam direction is **0x20**.

At startup it is necessary to initialize the port expander by setting all the GPIOs to “output mode”:

This is done setting to 0x00 the two configuration registers 0x06h and 0x07.

Once the port expander has been initialized, the beam direction can be set by writing to the registers 0x02 and 0x03 the values in the following table:

TILT (Nominal)	Register 0x02	Register 0x03	Sequential Writing
-36°	0xA5	0xA2	0x02 0xA5 0xA2
-18°	0xDD	0x10	0x02 0xDD 0x10
0°	0x6D	0x2B	0x02 0x6D 0x2B
+18°	0x12	0x2F	0x02 0x12 0x2F
+36°	0x64	0x65	0x02 0x64 0x65

It is also possible to use auto sequential writing feature of the port expander and write just 3 bytes, where the first byte is the address of the first register (0x02), as reported in the last column.

As at start-up the values of registers 0x02 & 0x03 do not correspond to a tilt state, it is very important to immediately set the array to one of the above states.

Note that the two ports are bound together, so the two radiation patterns are always tilted in the same direction; in other words, it is not possible to control them independently.

EEPROM:

The 1003840 array has an on-board EEPROM that contains the serial number and other information about the antenna (self-identification). The EEPROM is write-protected.

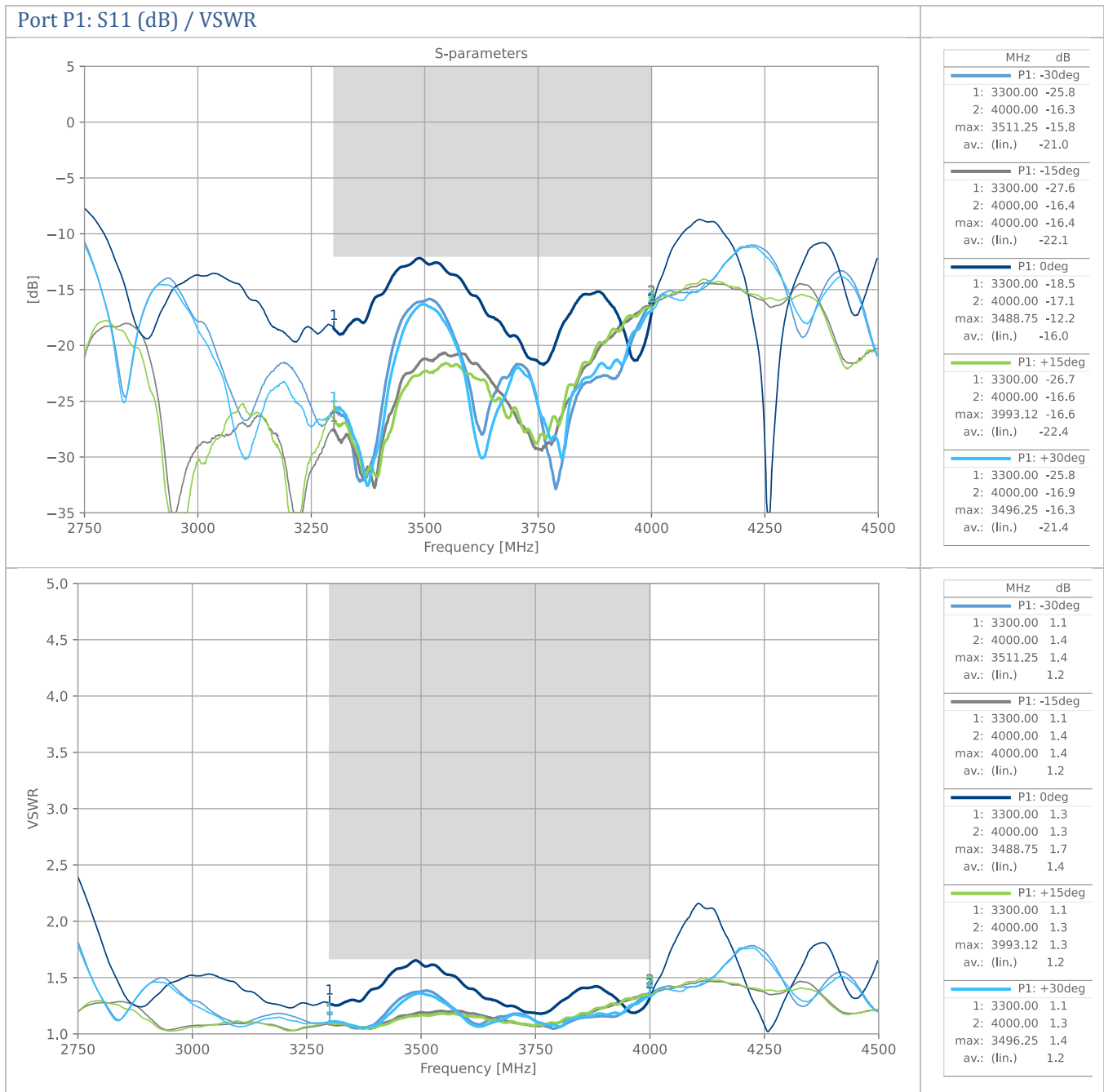
The I²C address of the EEPROM is **0x50**. Memory array: 1Kbit (128 bytes), page size: 16 bytes.

The format of the data store in the memory is as follows:

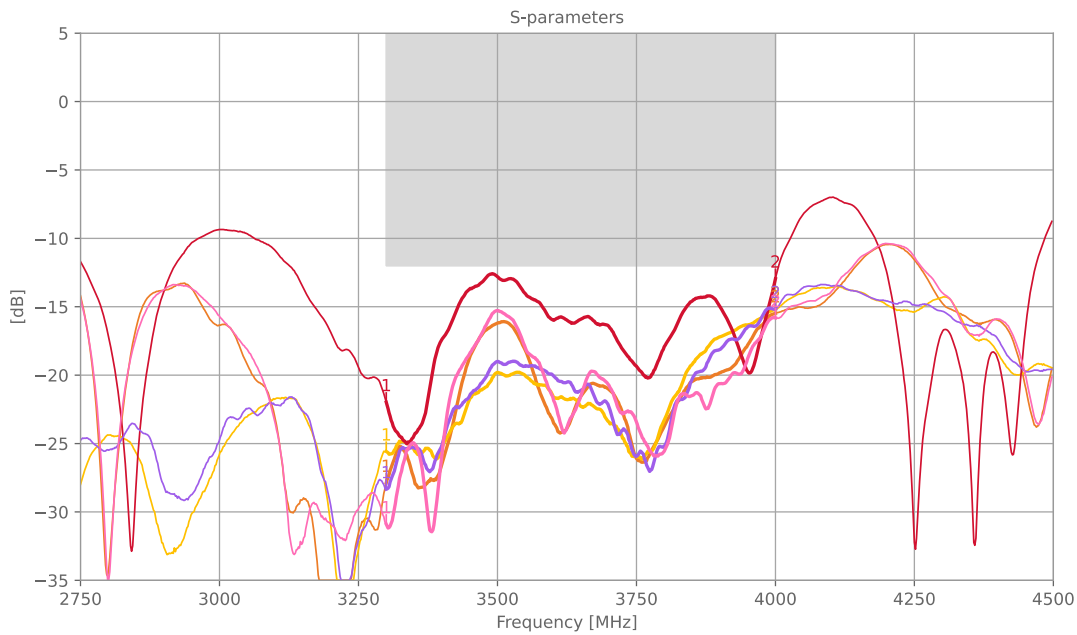
BYTE	VALUE [Hex]	VALUE [DEC]	RANGE [DEC]	DESCRIPTION (No commas)
0	0x80	128	<=128	Data length=byte containing CRC
1	0x01	1	<256	Antenna EEPROM format
2	0x0C	12	<256	Serial number - Part 1 (e.g. 12nnnnnn)
3	0x22	34	<256	Serial number - Part 2 (e.g. nn34nnnn)
4	0x38	56	<256	Serial number - Part 3 (e.g. nnnn56nn)
5	0x4E	78	<256	Serial number - Part 4 (e.g. nnnnnn78)
6	0x26	38	<256	Airgain antenna model identifier - Part 1
7	0x28	40	<256	Airgain antenna model identifier - Part 2
8	0x03	3	<256	Antenna hardware revision: A=0 B=1...
9	0x00	0	<256	Internal = 0, external=1
10	0x01	1	<256	Antenna type: 0=fixed - 1=beam switching one plane - 2=beam switching two planes
11	0x02	2	<256	Number of ports
12	0x01	1	<256	Number of frequency bands
13	0x00	0	<100	Frequency band 1: start frequency x 1e4 MHz (e.g. 00nnnn)
14	0x21	33	<100	Frequency band 1: start frequency x 1e2 MHz (e.g. nn24nn)
15	0x00	0	<100	Frequency band 1: start frequency x 1e0 MHz (e.g. nnnn96)
16	0x00	0	<100	Frequency band 1: stop frequency x 1e4 MHz (e.g. 00nnnn)
17	0x28	40	<100	Frequency band 1: stop frequency x 1e2 MHz (e.g. nn26nn)
18	0x00	0	<100	Frequency band 1: stop frequency x 1e0 MHz (e.g. nnnn90)
19	0x05	5	<256	Number of beam states in azimuth plane
20	0x01	1	<256	Number of beam states in elevation plane
21	0x00	0	<256	Not used
22	0x00	0	<256	Not used
...				
126	0x00	0	<256	Not used
127	0xF3	243	<256	CRC-8/OPENSAFETY (Poly=0x2F Init=0x00)

4. S-parameters

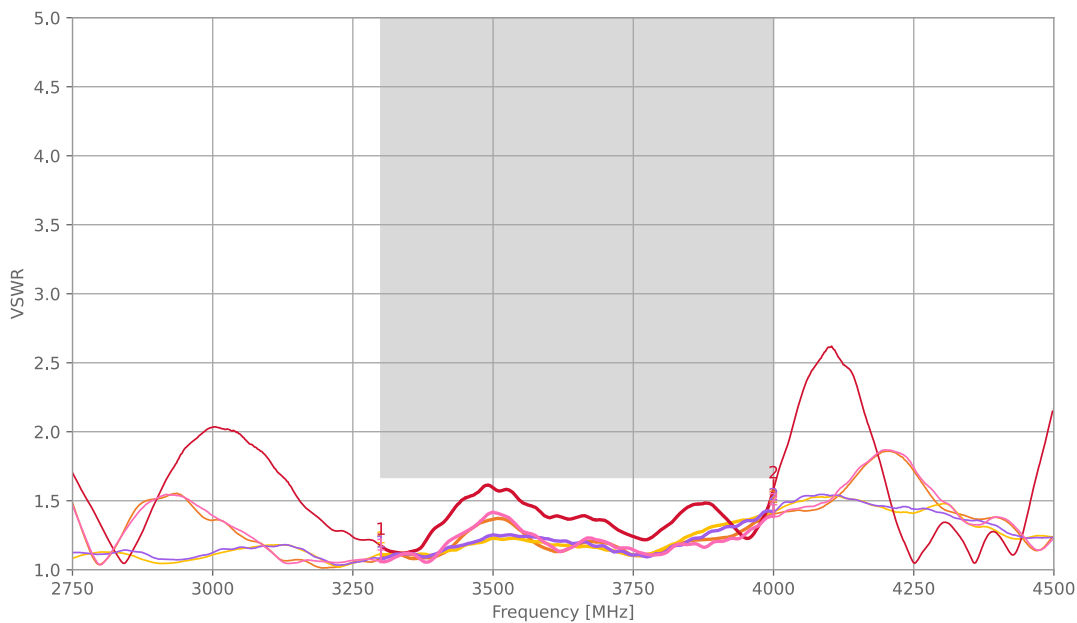
Measured at the SMA connectors of the array.



Port P2: S22 (dB) / VSWR

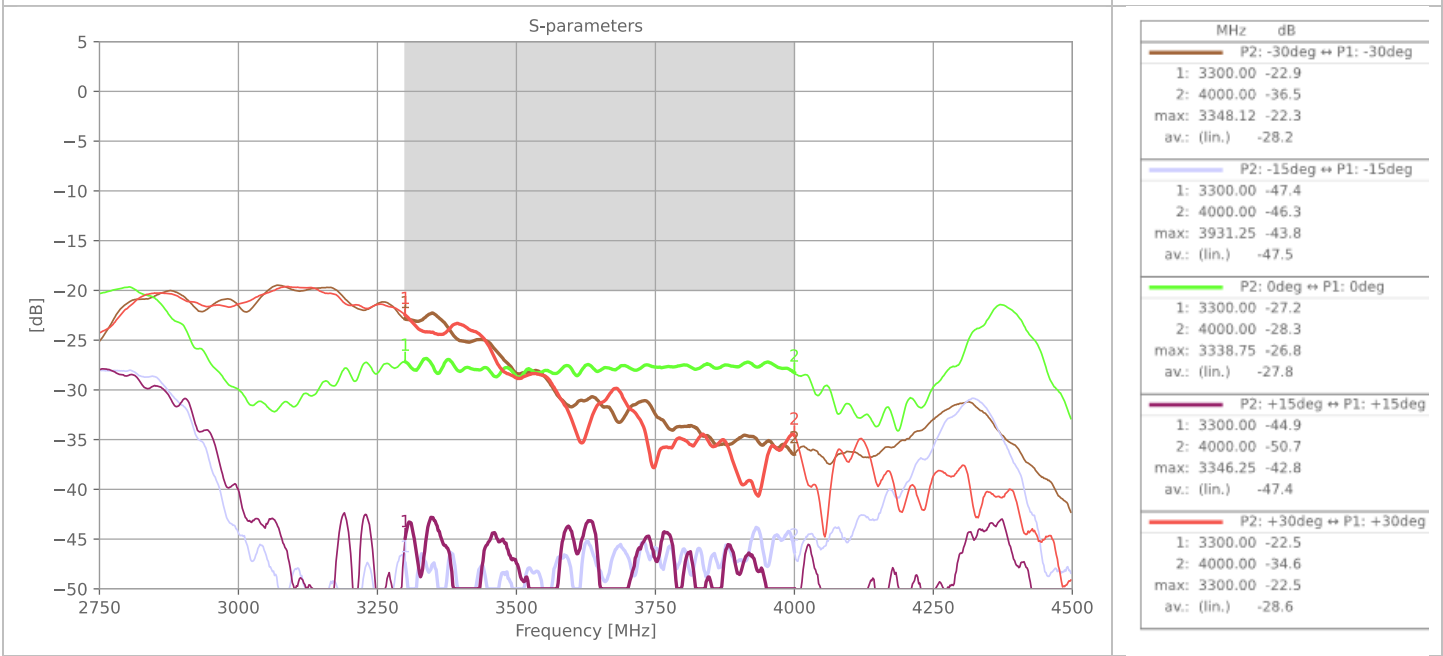


MHz	dB
P2: -30deg	
1: 3300.00	-27.9
2: 4000.00	-15.5
max: 4000.00	-15.5
av.: (lin.)	-20.2
P2: -15deg	
1: 3300.00	-25.6
2: 4000.00	-15.2
max: 4000.00	-15.2
av.: (lin.)	-20.4
P2: 0deg	
1: 3300.00	-22.0
2: 4000.00	-12.9
max: 3490.62	-12.6
av.: (lin.)	-16.0
P2: +15deg	
1: 3300.00	-28.3
2: 4000.00	-15.2
max: 3989.38	-15.1
av.: (lin.)	-20.3
P2: +30deg	
1: 3300.00	-30.9
2: 4000.00	-15.8
max: 3498.12	-15.3
av.: (lin.)	-20.1



MHz	dB
P2: -30deg	
1: 3300.00	1.1
2: 4000.00	1.4
max: 4000.00	1.4
av.: (lin.)	1.2
P2: -15deg	
1: 3300.00	1.1
2: 4000.00	1.4
max: 4000.00	1.4
av.: (lin.)	1.2
P2: 0deg	
1: 3300.00	1.2
2: 4000.00	1.6
max: 3490.62	1.6
av.: (lin.)	1.4
P2: +15deg	
1: 3300.00	1.1
2: 4000.00	1.4
max: 3989.38	1.4
av.: (lin.)	1.2
P2: +30deg	
1: 3300.00	1.1
2: 4000.00	1.4
max: 3498.12	1.4
av.: (lin.)	1.2

Coupling: S21 (dB)



5. Radiation Patterns

Radiation patterns for the Airgain 1003840 were measured using the following reference frame. Polarization $+45^\circ$ means that the electric vector direction is rotated $+45^\circ$ from the vertical direction (Z-axis) when looking the array from the front (+X direction); in other words, it is aligned with the $(0, -1, +1)$ vector. Likewise, the -45° polarization is aligned with the $(0, +1, +1)$ vector.

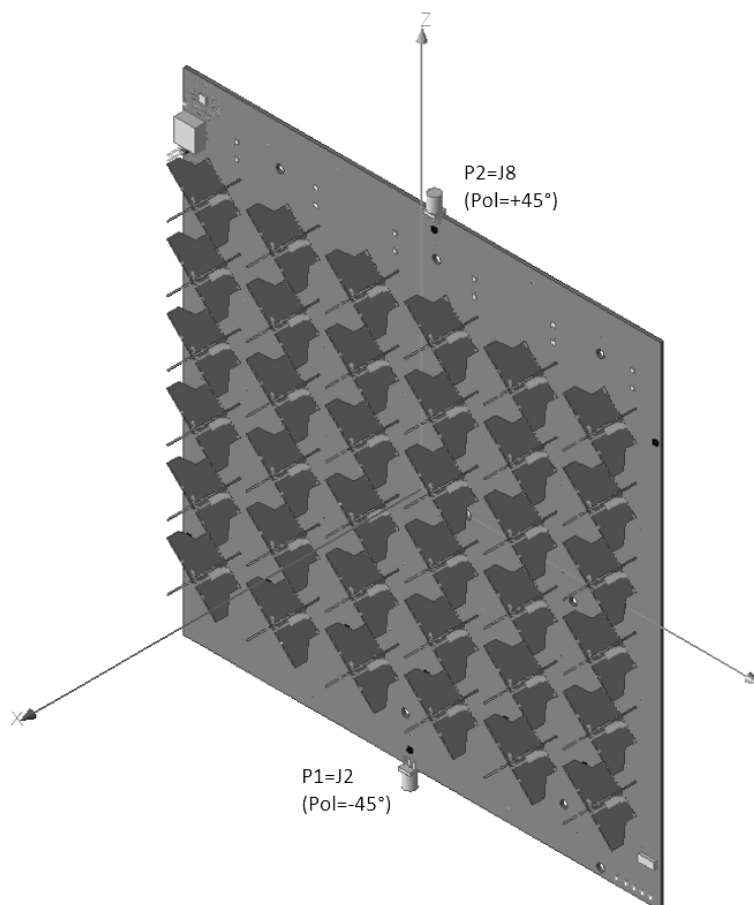


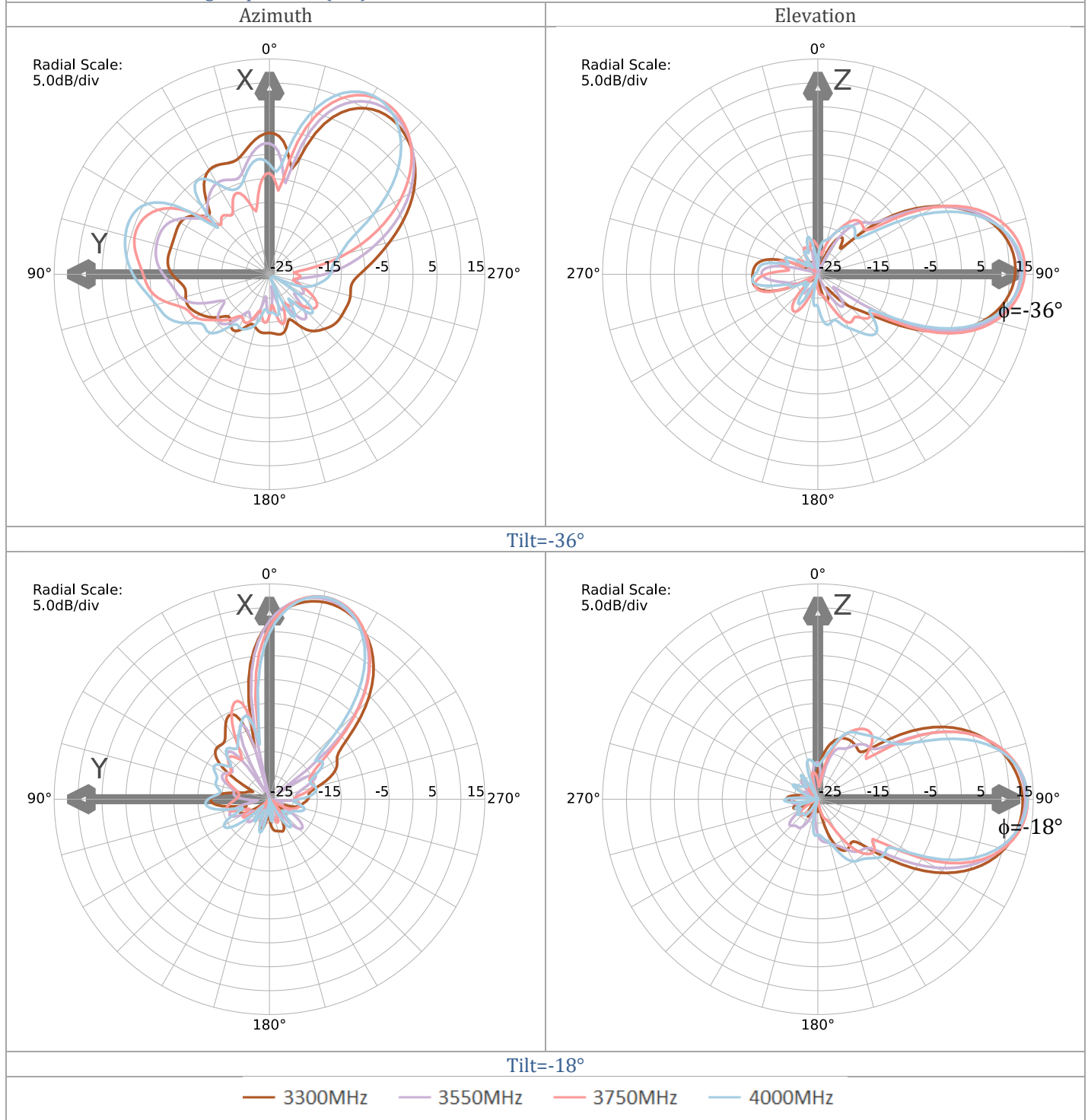
Figure 2: Measurement axes for 1003840 Array. Beam tilt plane is XY (Azimuth).

Typical Peak gain:

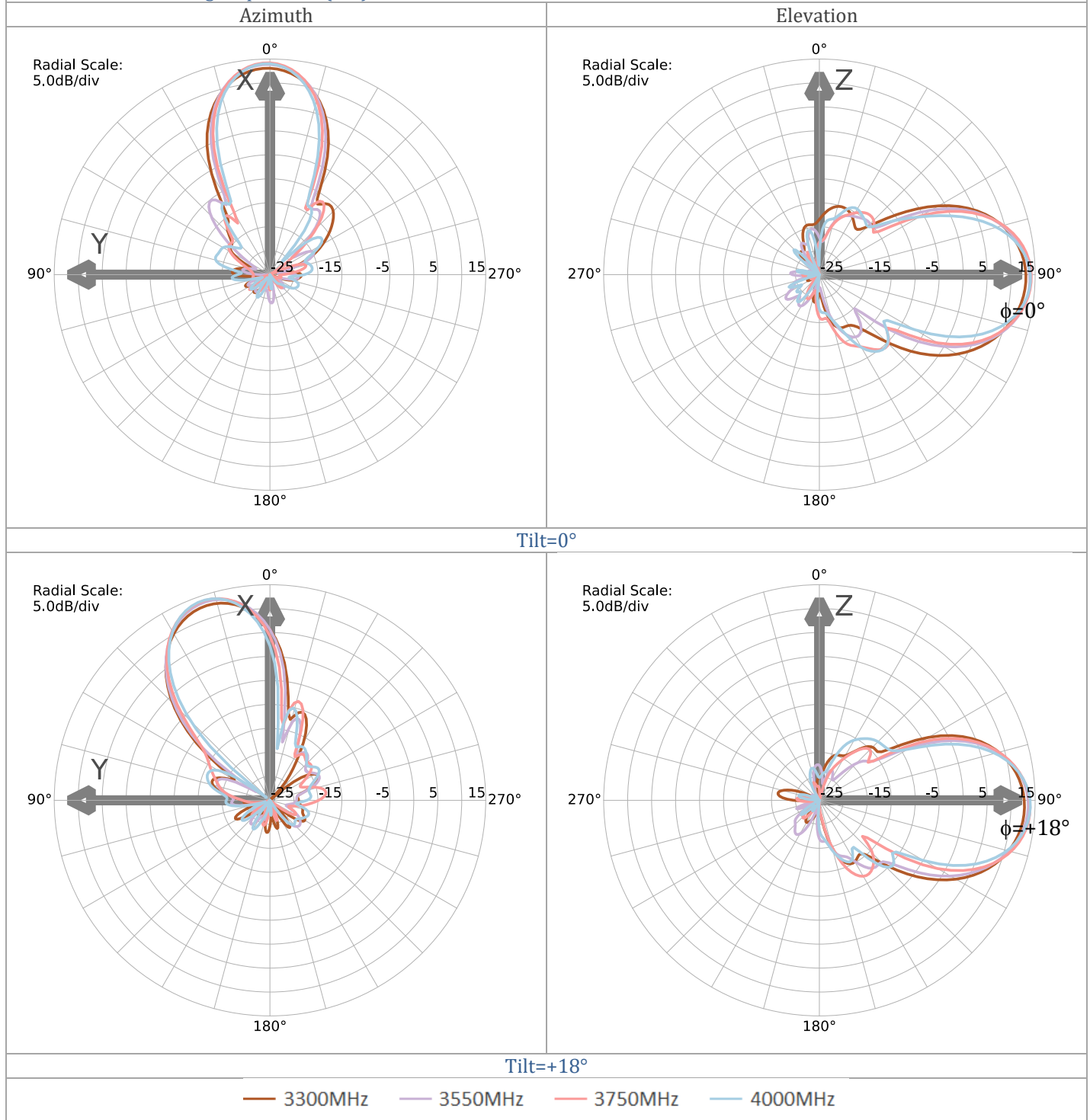
P1	PEAK GAIN [dBi] FOR EACH TILT STATE				
[MHz]	-36°	-18°	0°	+18°	+36°
3300	10.3	13.1	13.2	13.4	11.4
3350	11.0	13.1	13.4	13.4	11.9
3400	11.5	13.0	13.5	13.3	12.3
3450	11.6	13.1	13.6	13.3	12.2
3500	11.7	13.3	13.8	13.5	12.2
3550	12.0	13.6	14.0	13.8	12.5
3600	12.5	14.0	14.2	14.2	12.8
3650	13.0	14.3	14.4	14.4	13.1
3700	13.4	14.4	14.6	14.5	13.4
3750	13.8	14.4	14.6	14.5	13.7
3800	14.0	14.4	14.7	14.4	13.9
3850	13.9	14.4	14.7	14.4	13.8
3900	13.9	14.4	14.8	14.5	13.8
3950	14.0	14.6	14.9	14.6	13.9
4000	14.0	14.7	14.9	14.8	13.9

P2	PEAK GAIN [dBi] FOR EACH TILT STATE				
[MHz]	-36°	-18°	0°	+18°	+36°
3300	11.7	13.1	13.3	12.9	10.7
3350	12.1	13.2	13.4	13.0	11.2
3400	12.4	13.3	13.4	13.1	11.6
3450	12.5	13.3	13.4	13.2	11.7
3500	12.5	13.5	13.6	13.5	11.9
3550	12.8	13.8	14.0	13.7	12.3
3600	13.3	14.0	14.4	13.9	12.8
3650	13.6	14.1	14.6	14.1	13.2
3700	13.8	14.1	14.6	14.1	13.5
3750	13.9	14.2	14.5	14.1	13.7
3800	13.8	14.3	14.4	14.2	13.6
3850	13.6	14.5	14.5	14.4	13.6
3900	13.8	14.6	14.8	14.6	13.7
3950	14.1	14.7	15.0	14.7	14.0
4000	14.0	14.6	14.8	14.6	14.1

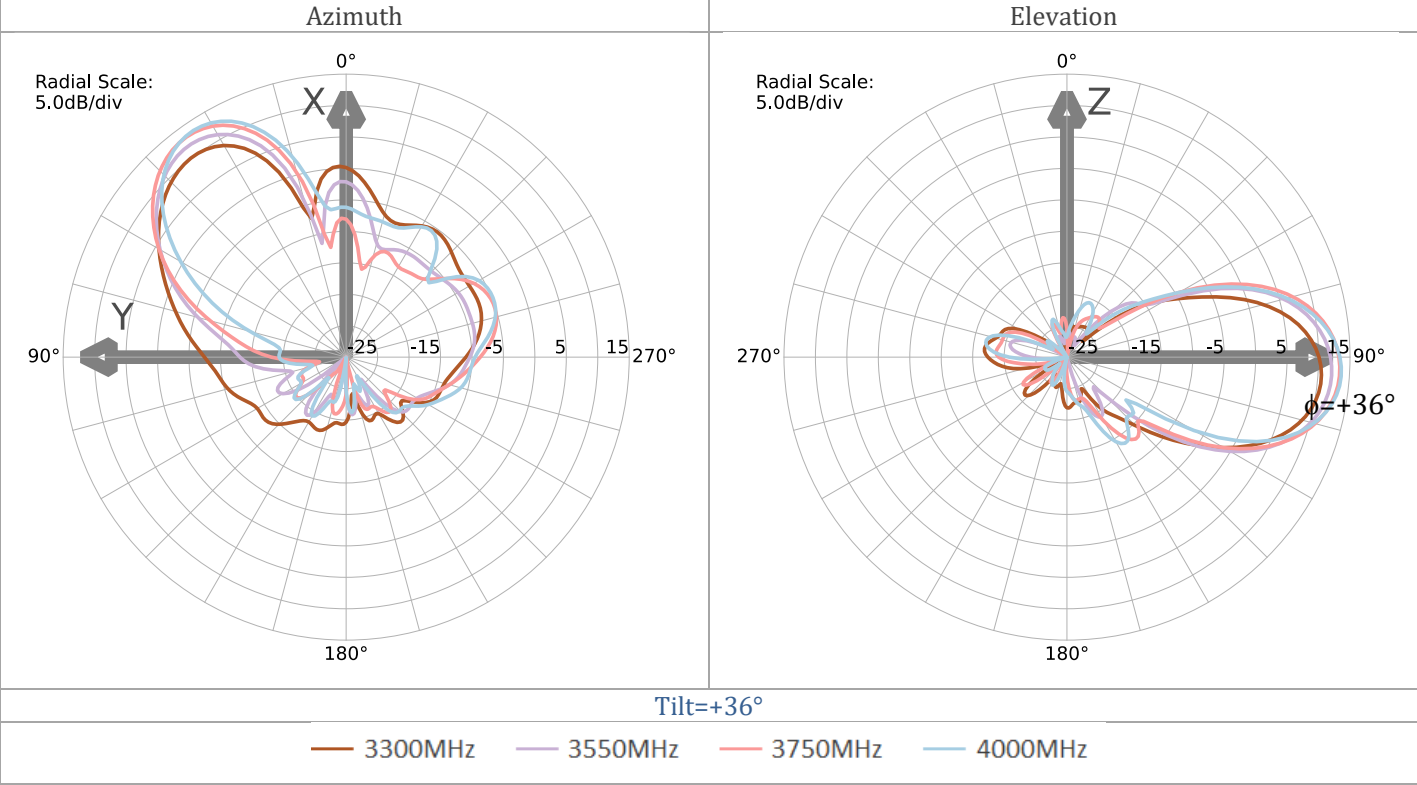
Port P1: 2D radiation gain patterns (dBi)



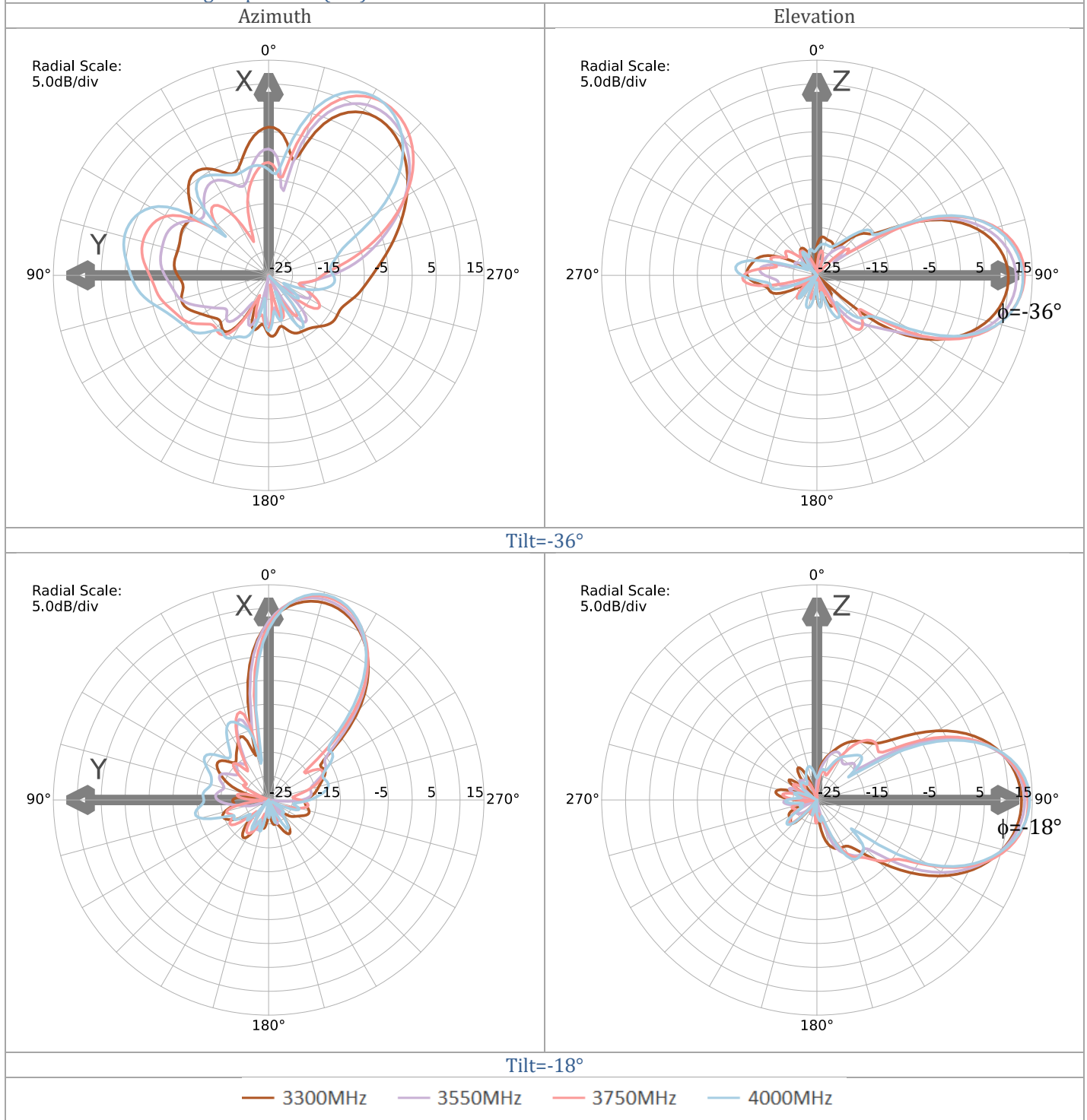
Port P1: 2D radiation gain patterns (dBi)



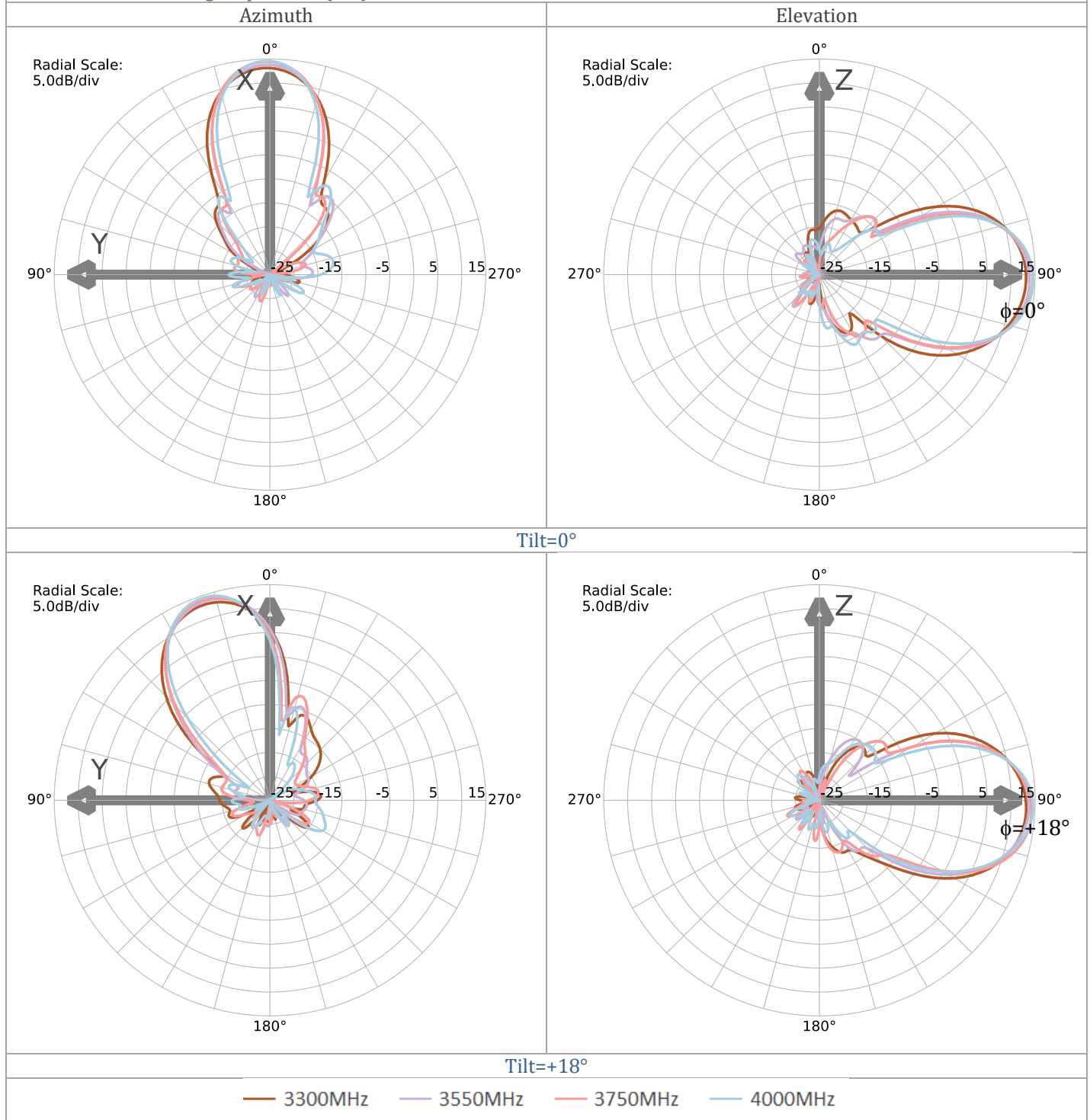
Port P1: 2D radiation gain patterns (dBi)



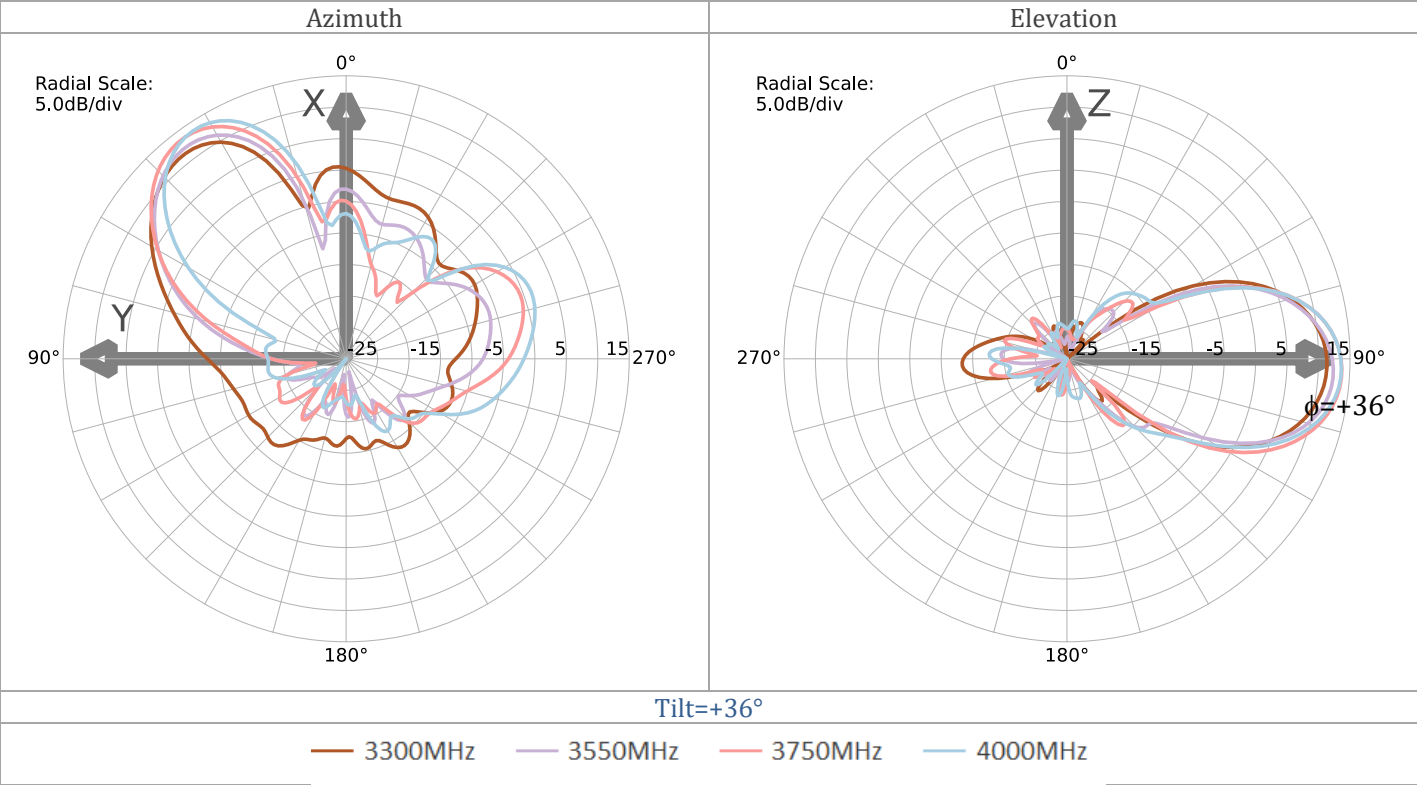
Port P2: 2D radiation gain patterns (dBi)



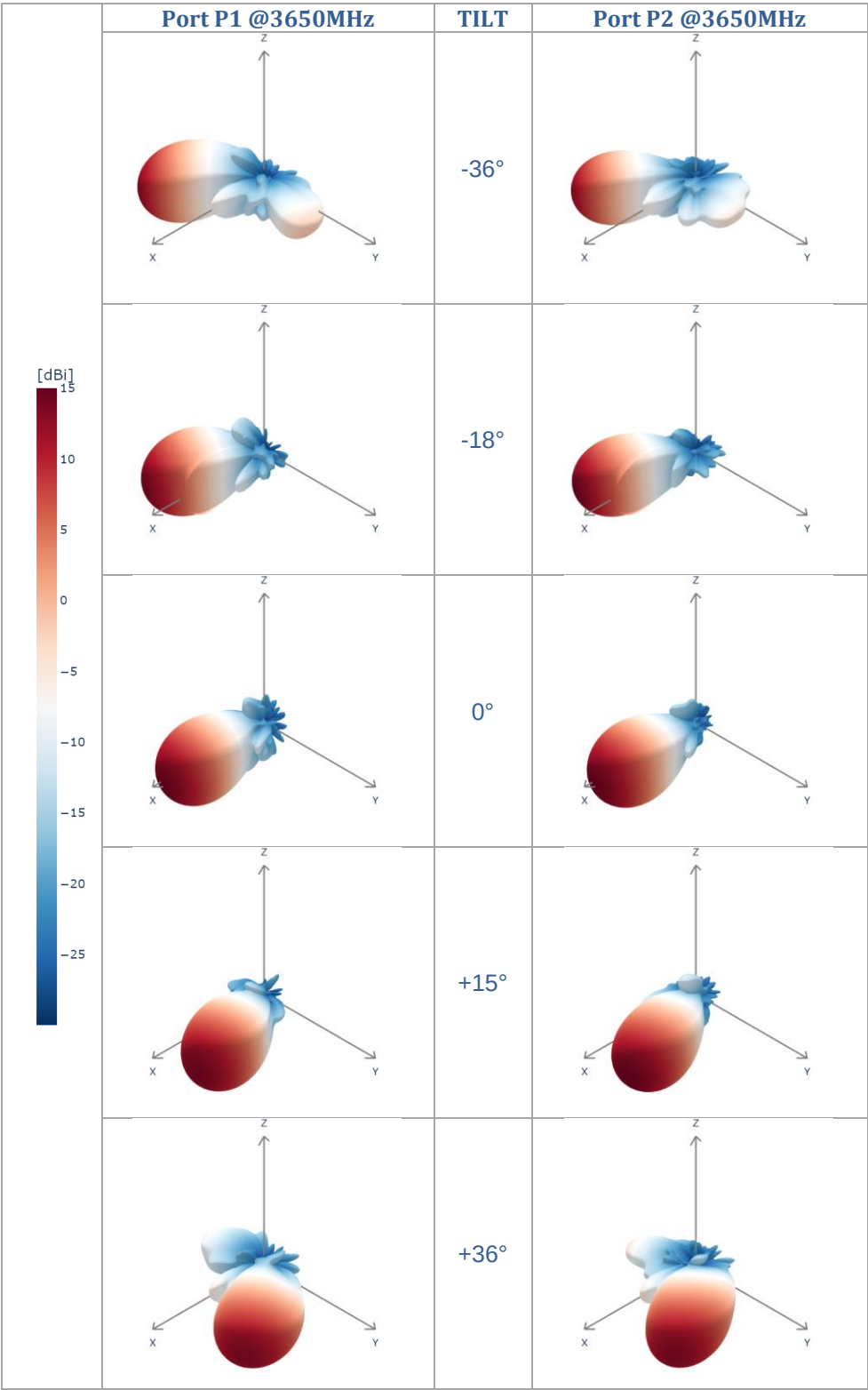
Port P2: 2D radiation gain patterns (dBi)



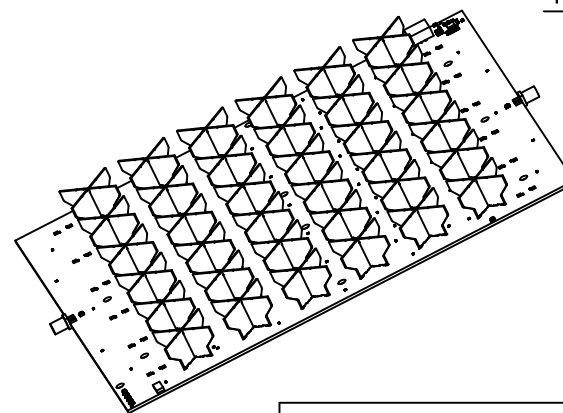
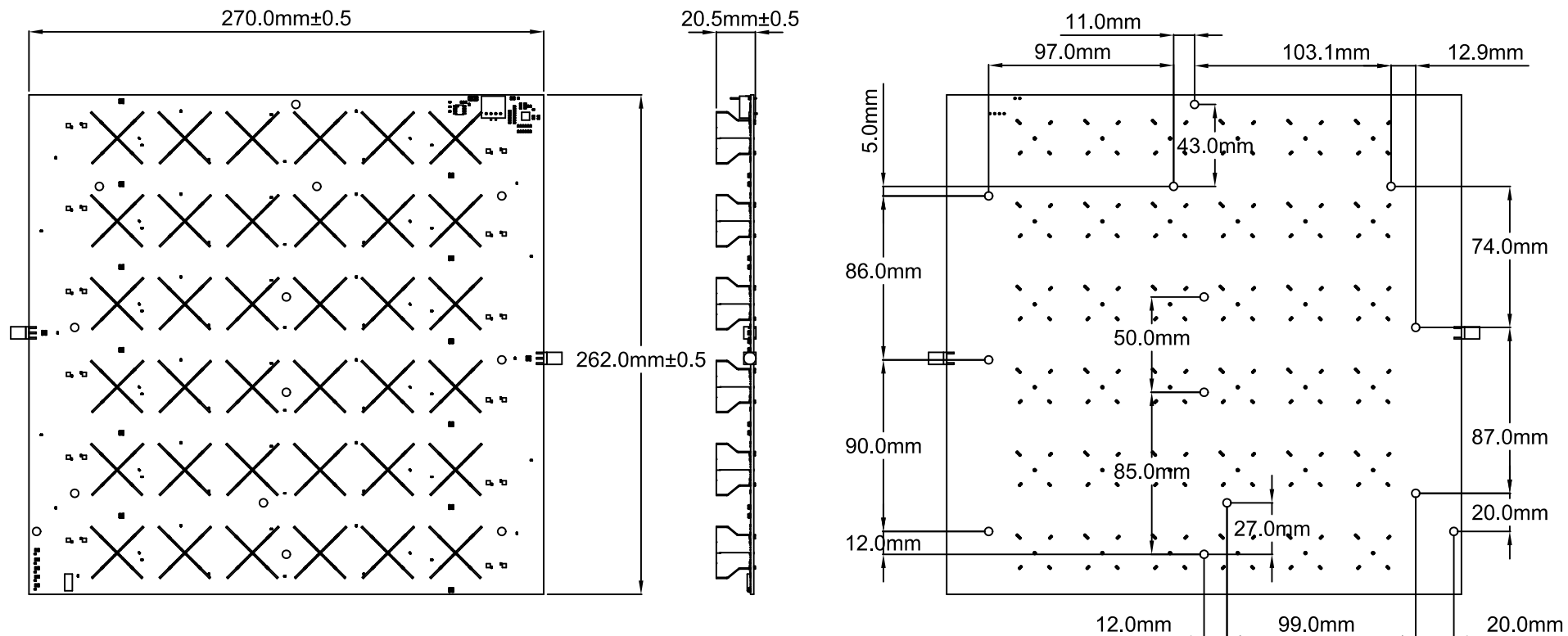
Port P2: 2D radiation gain patterns (dBi)



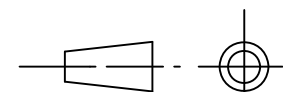
3D Radiation Patterns – Realized gain:



REV	DESCRIPTION	BY	DATE
A	Initial Design	BWU	22/MAY/2025



DRAWING STYLE



Notes:

- The processes used to assemble this antenna shall comply with the following specifications ,unless otherwise specified.
- 1.Solder:use lead free solder if applies for lead free soldering process to assemble the antenna , unless otherwise specified.
- 2.See the bom file: 1003840 - Lighthouse DU 6x6 Antenna BOM - Rev 1.3
- 3.Unless otherwise specified dimension, tolerances are +/-0.2mm

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PCB No. 4573-12-00-001-1	Project PROFILE EMBEDDED ANTENNA				
Drawn by BWU	Date 22/MAY/2025	Title 1003840_ASSY			
Checked by	Date	Size B	Number 4573-07-00-001-3		Rev. A
Approved by	Date	Layer		Scale	
		File		Sheet 1 of 1	