

1.1 OTA PASSIVE Antenna Test Report

Date of Report	13/10/2025	Client's Contact person:	Jouni Lifländer
Number of pages:	20	Responsible Test engineer:	Veli-Matti Niemitalo
Testing laboratory:	Verkotan Oy Elektroniikkatie 17 90590 Oulu Finland	Client:	Haltian Oy Yrttpellontie 1 D3 90230 Oulu Finland
Tested devices	Eunoia #6, Eunoia #8, Eunoia #10, Eunoia #12		
Testing has been carried out in accordance with:	Passive measurements per customer request		
Documentation:	The test report must always be reproduced in full; reproduction of an excerpt only is subject to written approval of the testing laboratory.		
Test Results:	The test results relate only to devices specified in this document		

Date and signatures:



13.10.2025 Jani Kallankari 13.10.2025
Chief Scientist Verkotan

2. SUMMARY

2.1 Test Details

Devices under Test (DUT):

Product:	Eunoia #6
Note	-
Manufacturer info:	-
SW Info:	-
DUT number:	324
Tested Frequencies [MHz]	2300-2600 in 5 MHz steps



Figure 1 Eunoia #6 front

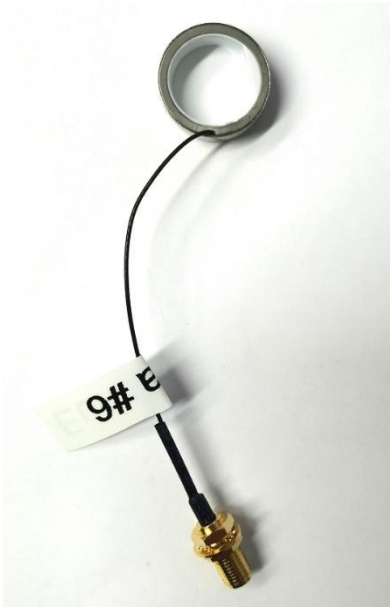


Figure 2 Eunoia #6 back

Product:	Eunoia #8
Note	-
Manufacturer info:	-
SW Info:	-
DUT number:	325
Tested Frequencies [MHz]	2300-2600 in 5 MHz steps



Figure 3 Eunoia #8 front

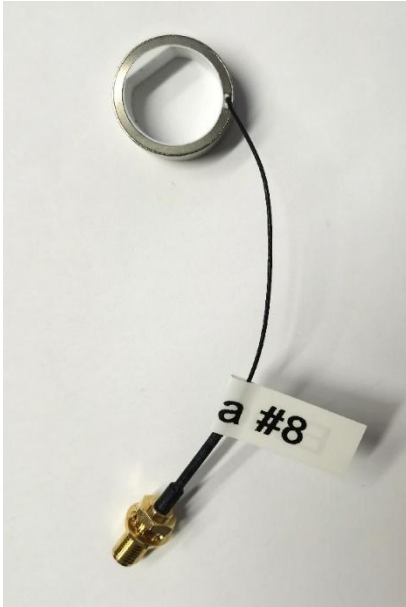


Figure 4 Eunoia #8 back

Product:	Eunoia #10
Note	-
Manufacturer info:	-
SW Info:	-
DUT number:	326
Tested Frequencies [MHz]	2300-2600 in 5 MHz steps

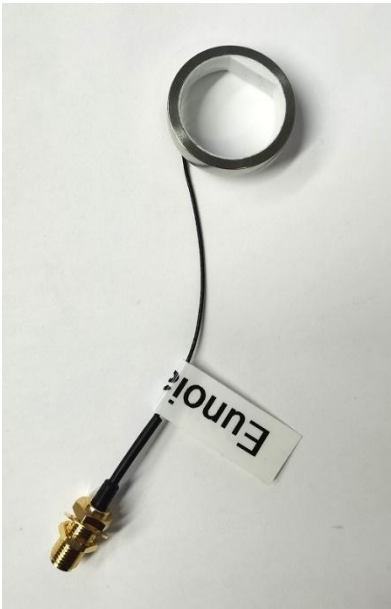


Figure 5 Eunoia #10 front

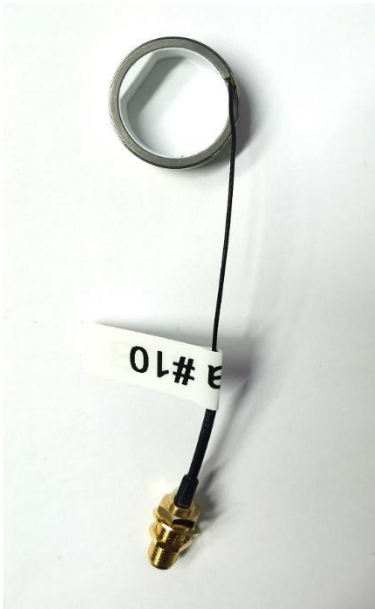


Figure 6 Eunoia #10 back

Product:	Eunoia #12
Note	-
Manufacturer info:	-
SW Info:	-
DUT number:	327
Tested Frequencies [MHz]	2300-2600 in 5 MHz steps

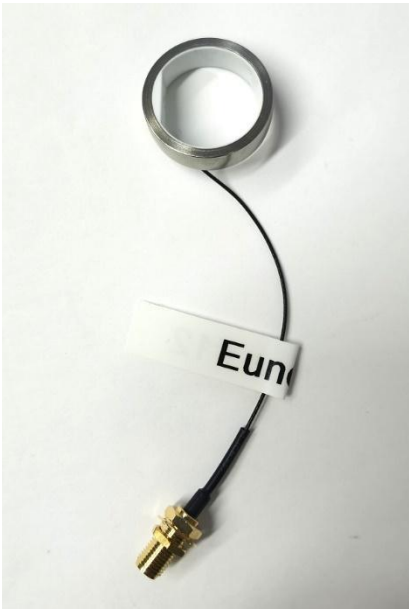


Figure 7 Eunoia #12 front



Figure 8 Eunoia #12 back

Testing information:

Testing performed:	02.10.2025
Notes:	-
Document name:	Passive_OTA_test_report_ID5993_Eunoia_13102025
Temperature °C / Humidity RH%	22±2 / 25%±10%
Measurement performed by:	Veli-Matti Niemitalo
Document history:	02.10.2025 Draft version 13.10.2025 Non-draft version

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3. TEST EQUIPMENT

Main used test equipment is listed below. For full equipment list and calibration intervals, please contact the testing laboratory.

Type of Equipment	Type	Manufacturer	Calibration date	Calibration period	Calibration due	Purpose
Diagonal Dual Polarized Horn Measurement Antenna	114960	ETS	Included in range calibration	Included in range calibration	Included in range calibration	Probe antenna
Positioning Controller	2090	EMCO	n/a	n/a	n/a	DUT alignment
3D Positioner	Custom made	ETS-Lindgren	n/a	n/a	n/a	DUT alignment
Anechoic Chamber	4	ETS-Lindgren	12.02.2025	1 year	12.02.2026	Test range
Switching System	MSN-6TD-06-DEC-SP	American Microwave	Included in range calibration	Included in range calibration	Included in range calibration	Probe selection
Switching System	SW6AD-A61	Pulsar	Included in range calibration	Included in range calibration	Included in range calibration	Probe selection
Network Analyzer	E5071C	Agilent	21.05.2025	1 year	21.05.2026	Measurement transmitter / receiver
Dual-Ridge Horn Antenna	SH600	MVG	20.08.2020	n/a	n/a	Calibration antenna 1-9 GHz

Table 1. Antenna pattern measurement equipment, Anechoic Chamber 4

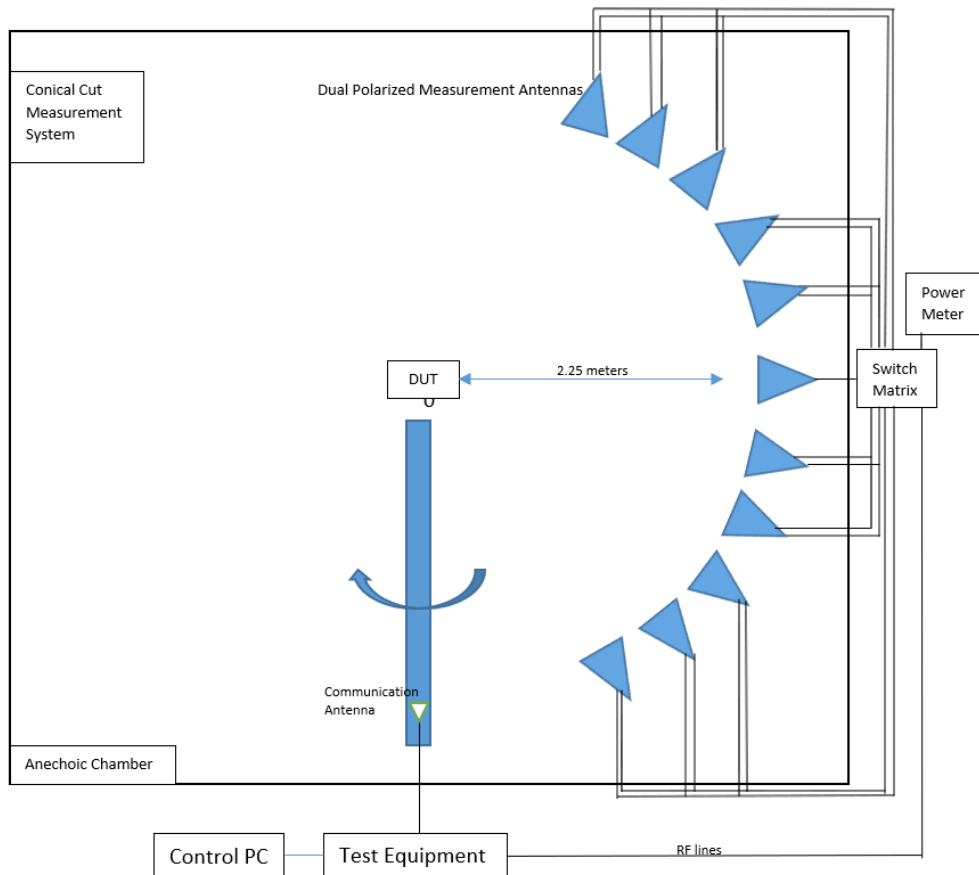


Figure 9. Laboratory 4 chamber schematic.

4. TEST SETUP

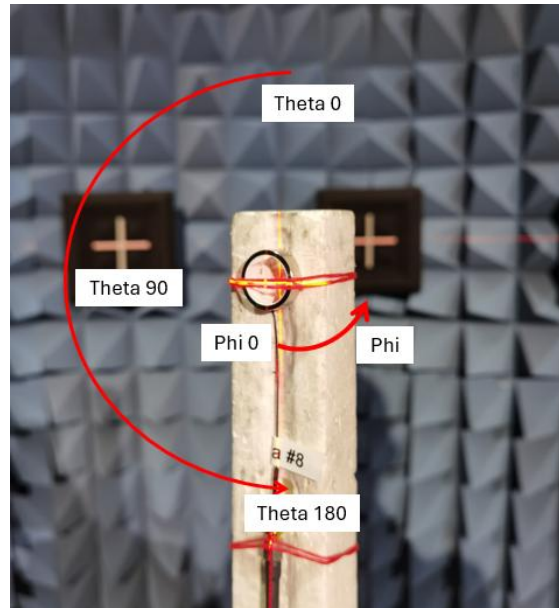


Figure 10 Eunoia #8 in FS passive measurement and coordinate system

Vertical laser in DUT setup position denotes $\phi=0$, horizontal laser denotes $\theta=90$. Theta 0 is directly up from DUT, and theta 180 is down from DUT.

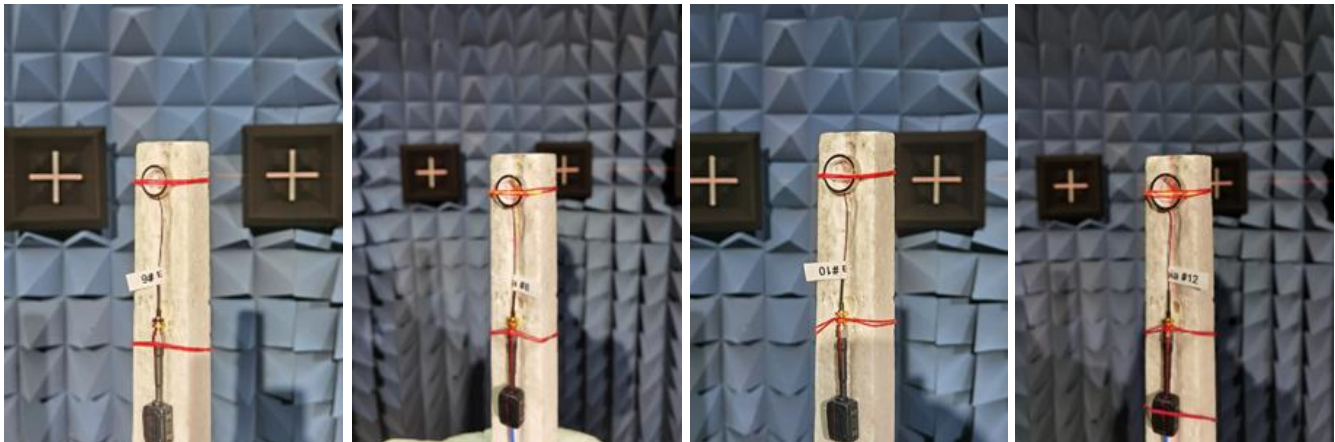


Figure 11 Free Space setup pictures: Eunoia #6, Eunoia #8, Eunoia #10, Eunoia #12

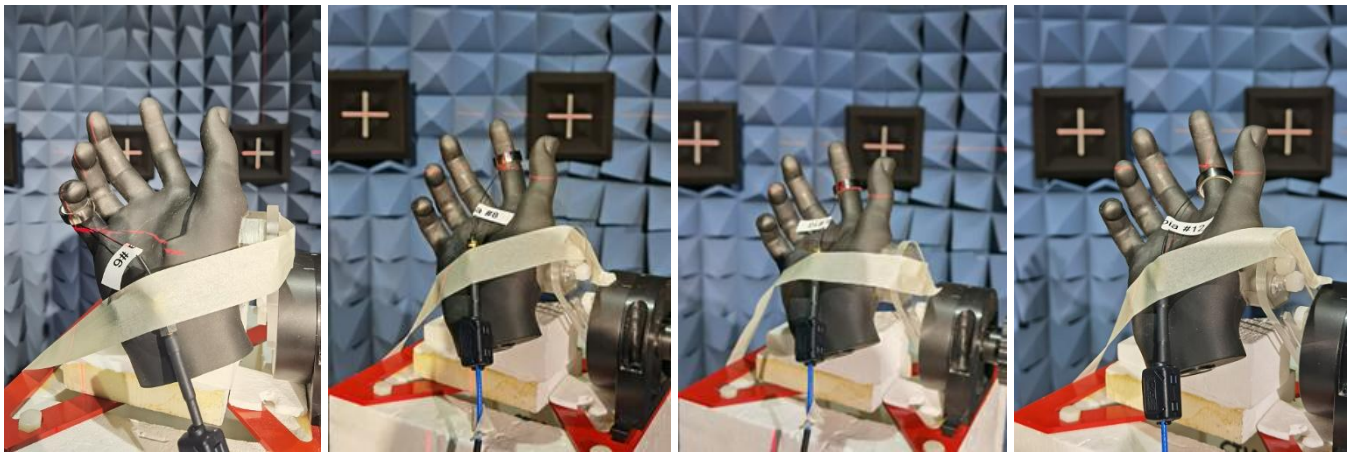


Figure 12 Hand phantom setup pictures: Eunoia #6, Eunoia #8, Eunoia #10, Eunoia #12

5. RESULTS

5.1 Passive OTA measurements

5.1.1 Maximum Gain, Free Space

Max Gain [dBi]					Max Gain [dBi]				
Frequency [MHz]	Eunoia #6	Eunoia #8	Eunoia #10	Eunoia #12	Frequency [MHz]	Eunoia #6	Eunoia #8	Eunoia #10	Eunoia #12
2300	-15.5	-3.7	-4.9	-5.1	2455	-17.6	-7.3	-8.9	-8.7
2305	-15.5	-3.6	-4.8	-5.1	2460	-17.7	-7.5	-9.0	-8.8
2310	-15.6	-3.7	-5.0	-5.2	2465	-17.6	-7.6	-9.1	-8.9
2315	-15.6	-3.8	-5.1	-5.3	2470	-17.3	-7.5	-9.0	-8.8
2320	-15.6	-3.9	-5.3	-5.2	2475	-17.3	-7.5	-8.9	-8.7
2325	-15.7	-4.0	-5.4	-5.3	2480	-17.0	-7.5	-8.8	-8.7
2330	-15.9	-4.3	-5.5	-5.6	2485	-16.9	-7.5	-8.9	-8.7
2335	-16.1	-4.5	-5.7	-5.8	2490	-16.6	-7.4	-8.8	-8.7
2340	-16.1	-4.6	-5.8	-6.0	2495	-16.5	-7.4	-8.8	-8.7
2345	-16.1	-4.6	-5.9	-6.1	2500	-16.7	-7.5	-8.9	-8.8
2350	-16.3	-4.7	-6.0	-6.3	2505	-16.8	-7.7	-9.1	-8.9
2355	-16.7	-5.0	-6.3	-6.6	2510	-16.7	-7.7	-9.1	-8.9
2360	-16.8	-5.2	-6.5	-6.7	2515	-16.7	-7.7	-9.1	-8.8
2365	-17.0	-5.3	-6.7	-6.7	2520	-16.8	-7.9	-9.1	-9.0
2370	-17.0	-5.4	-6.7	-6.9	2525	-17.0	-8.2	-9.3	-9.2
2375	-17.2	-5.6	-6.9	-7.1	2530	-17.1	-8.3	-9.5	-9.4
2380	-17.3	-5.8	-7.2	-7.2	2535	-17.0	-8.2	-9.5	-9.5
2385	-17.2	-5.7	-7.2	-7.2	2540	-17.0	-8.3	-9.4	-9.6
2390	-17.1	-5.7	-7.1	-7.2	2545	-17.1	-8.4	-9.5	-9.7
2395	-17.2	-5.8	-7.2	-7.4	2550	-17.3	-8.4	-9.6	-9.7
2400	-17.2	-5.9	-7.4	-7.4	2555	-17.5	-8.5	-9.7	-9.7
2405	-17.4	-6.0	-7.7	-7.4	2560	-17.5	-8.6	-9.6	-9.8
2410	-17.5	-6.1	-7.8	-7.5	2565	-17.6	-8.7	-9.7	-10.0
2415	-17.7	-6.3	-7.9	-7.7	2570	-17.8	-8.8	-9.8	-10.1
2420	-17.8	-6.6	-8.2	-7.9	2575	-18.0	-8.9	-10.0	-10.3
2425	-17.9	-6.8	-8.4	-8.1	2580	-18.3	-9.1	-10.2	-10.6
2430	-17.8	-6.8	-8.4	-8.2	2585	-18.5	-9.2	-10.3	-10.9
2435	-17.8	-7.0	-8.4	-8.4	2590	-18.7	-9.2	-10.5	-10.9
2440	-17.7	-7.1	-8.5	-8.6	2595	-18.9	-9.2	-10.5	-10.9
2445	-17.6	-7.1	-8.7	-8.6	2600	-19.2	-9.4	-10.7	-11.2
2450	-17.6	-7.2	-8.8	-8.6					

Table 2 Maximum Gain, Free Space

5.1.2 Maximum Gain, Finger

	Max Gain [dBi]					Max Gain [dBi]			
Frequency [MHz]	Eunoia #6	Eunoia #8	Eunoia #10	Eunoia #12	Frequency [MHz]	Eunoia #6	Eunoia #8	Eunoia #10	Eunoia #12
2300	-20.7	-13.0	-12.9	-13.5	2455	-20.5	-15.8	-16.0	-16.1
2305	-20.9	-13.0	-12.7	-13.5	2460	-20.5	-15.9	-16.0	-16.2
2310	-21.2	-13.1	-12.7	-13.9	2465	-20.3	-15.9	-16.0	-16.3
2315	-21.2	-13.3	-13.0	-14.3	2470	-20.1	-15.9	-16.0	-16.3
2320	-21.3	-13.5	-13.4	-14.5	2475	-20.0	-15.9	-16.0	-16.4
2325	-21.4	-13.6	-13.8	-14.9	2480	-19.8	-15.6	-16.1	-16.5
2330	-21.4	-14.0	-14.1	-15.3	2485	-19.8	-15.4	-16.0	-16.5
2335	-21.7	-14.3	-14.4	-15.5	2490	-19.8	-15.4	-15.8	-16.5
2340	-21.8	-14.6	-14.5	-15.7	2495	-19.9	-15.5	-15.7	-16.5
2345	-21.6	-14.8	-14.4	-15.9	2500	-20.0	-16.0	-15.8	-16.8
2350	-21.5	-15.0	-14.5	-16.2	2505	-20.1	-16.2	-16.1	-17.0
2355	-21.4	-15.3	-14.8	-16.9	2510	-20.1	-16.3	-16.2	-17.0
2360	-21.2	-15.4	-15.1	-16.9	2515	-20.0	-16.5	-16.2	-17.1
2365	-21.0	-15.6	-15.5	-16.9	2520	-20.2	-16.4	-16.3	-17.4
2370	-20.8	-15.8	-15.9	-17.0	2525	-20.4	-16.4	-16.1	-17.8
2375	-20.7	-16.0	-16.5	-17.2	2530	-20.5	-16.3	-15.8	-17.8
2380	-20.6	-16.1	-17.0	-17.0	2535	-20.5	-16.3	-15.4	-17.7
2385	-20.4	-16.0	-17.0	-16.7	2540	-20.6	-16.7	-15.3	-18.1
2390	-20.3	-15.9	-16.8	-16.3	2545	-20.7	-17.4	-15.6	-18.7
2395	-20.4	-16.0	-16.8	-16.4	2550	-20.8	-17.4	-16.1	-18.9
2400	-20.3	-15.9	-16.9	-16.2	2555	-20.7	-17.5	-16.6	-19.2
2405	-20.2	-15.8	-16.7	-16.1	2560	-20.7	-17.7	-16.9	-19.5
2410	-20.2	-15.7	-16.3	-16.0	2565	-20.7	-18.0	-16.9	-19.6
2415	-20.2	-15.9	-16.1	-16.1	2570	-20.6	-18.2	-16.8	-19.7
2420	-20.4	-16.2	-16.3	-16.3	2575	-20.4	-18.1	-16.7	-20.0
2425	-20.3	-16.2	-16.6	-16.3	2580	-20.3	-18.1	-16.7	-20.3
2430	-20.3	-16.1	-16.7	-16.1	2585	-20.3	-18.0	-16.9	-20.4
2435	-20.4	-16.1	-16.5	-16.3	2590	-20.2	-17.9	-17.5	-20.4
2440	-20.5	-16.0	-16.2	-16.4	2595	-20.1	-17.8	-17.6	-20.4
2445	-20.5	-15.9	-16.2	-16.3	2600	-20.1	-18.0	-17.6	-20.5
2450	-20.5	-15.9	-16.1	-16.1					

Table 3 Maximum Gain, Finger

5.1.3 Efficiency, Free Space

	Efficiency [dB]					Efficiency [dB]			
Frequency [MHz]	Eunoia #6	Eunoia #8	Eunoia #10	Eunoia #12	Frequency [MHz]	Eunoia #6	Eunoia #8	Eunoia #10	Eunoia #12
2300	-24.9	-12.4	-14.0	-13.6	2455	-24.5	-15.5	-17.0	-16.2
2305	-24.8	-12.4	-14.0	-13.5	2460	-24.6	-15.7	-17.0	-16.4
2310	-24.9	-12.5	-14.2	-13.7	2465	-24.5	-15.7	-17.1	-16.4
2315	-25.0	-12.7	-14.3	-13.8	2470	-24.4	-15.7	-17.1	-16.3
2320	-24.8	-12.7	-14.5	-13.7	2475	-24.4	-15.7	-17.0	-16.3
2325	-24.7	-12.7	-14.5	-13.7	2480	-24.3	-15.8	-17.0	-16.4
2330	-24.8	-12.8	-14.5	-13.8	2485	-24.3	-15.8	-17.1	-16.4
2335	-24.8	-12.9	-14.7	-13.9	2490	-24.3	-15.8	-17.2	-16.4
2340	-24.8	-13.0	-14.8	-14.0	2495	-24.2	-15.9	-17.1	-16.4
2345	-24.7	-13.1	-14.9	-14.1	2500	-24.3	-16.0	-17.2	-16.6
2350	-24.8	-13.2	-15.0	-14.3	2505	-24.4	-16.1	-17.3	-16.6
2355	-25.0	-13.5	-15.2	-14.5	2510	-24.4	-16.1	-17.4	-16.6
2360	-24.9	-13.6	-15.4	-14.6	2515	-24.4	-16.2	-17.4	-16.6
2365	-24.9	-13.7	-15.5	-14.6	2520	-24.5	-16.3	-17.4	-16.8
2370	-24.8	-13.7	-15.4	-14.7	2525	-24.6	-16.5	-17.5	-17.0
2375	-24.8	-13.9	-15.5	-14.9	2530	-24.7	-16.6	-17.7	-17.1
2380	-24.8	-14.0	-15.7	-14.9	2535	-24.7	-16.6	-17.7	-17.1
2385	-24.6	-13.9	-15.7	-14.8	2540	-24.8	-16.7	-17.7	-17.2
2390	-24.4	-13.9	-15.7	-14.8	2545	-25.0	-16.9	-17.8	-17.4
2395	-24.5	-14.1	-15.8	-15.0	2550	-25.1	-16.9	-17.9	-17.4
2400	-24.5	-14.2	-16.0	-15.1	2555	-25.1	-17.0	-17.9	-17.4
2405	-24.5	-14.3	-16.2	-15.1	2560	-25.2	-17.1	-17.9	-17.6
2410	-24.4	-14.3	-16.2	-15.2	2565	-25.4	-17.2	-18.1	-17.7
2415	-24.4	-14.5	-16.2	-15.3	2570	-25.4	-17.3	-18.2	-17.7
2420	-24.5	-14.7	-16.5	-15.5	2575	-25.5	-17.3	-18.2	-17.8
2425	-24.5	-14.8	-16.6	-15.6	2580	-25.6	-17.4	-18.3	-17.9
2430	-24.4	-14.8	-16.6	-15.6	2585	-25.7	-17.5	-18.4	-17.9
2435	-24.5	-15.1	-16.6	-15.8	2590	-25.7	-17.5	-18.5	-17.9
2440	-24.6	-15.3	-16.8	-16.1	2595	-25.8	-17.5	-18.5	-18.0
2445	-24.6	-15.4	-17.0	-16.1	2600	-25.9	-17.6	-18.6	-18.1
2450	-24.6	-15.5	-17.1	-16.2					

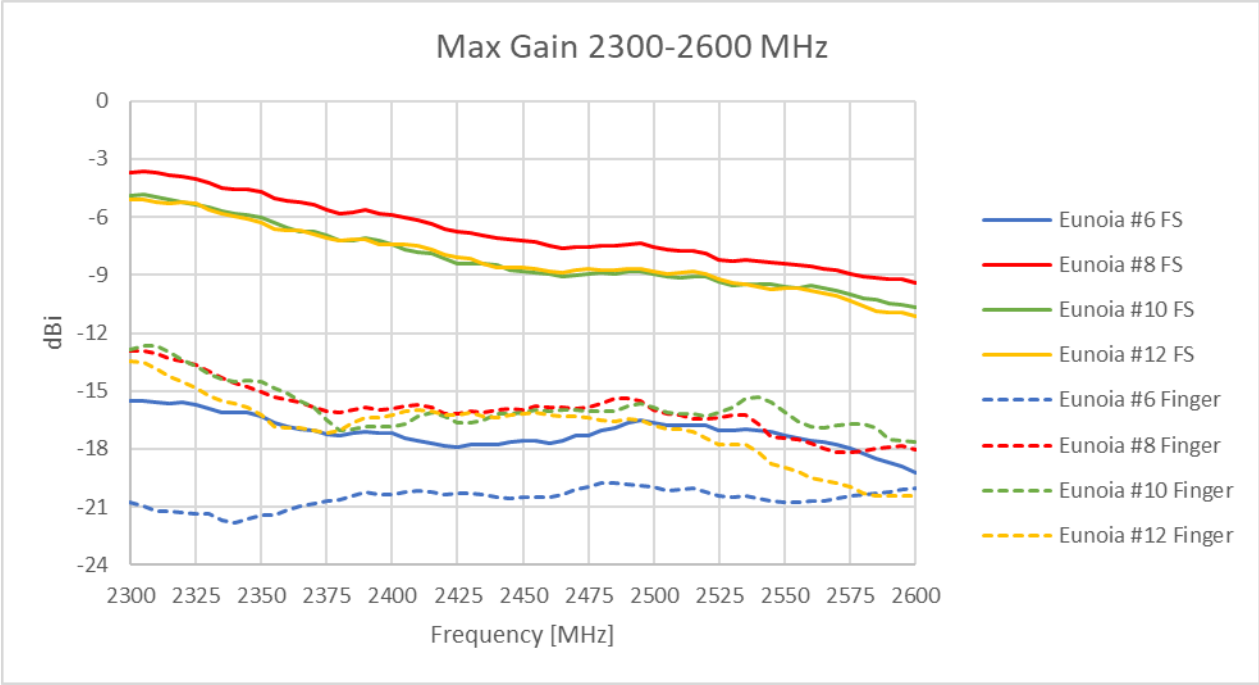
Table 4 Efficiency, Free space

5.1.4 Efficiency, Finger

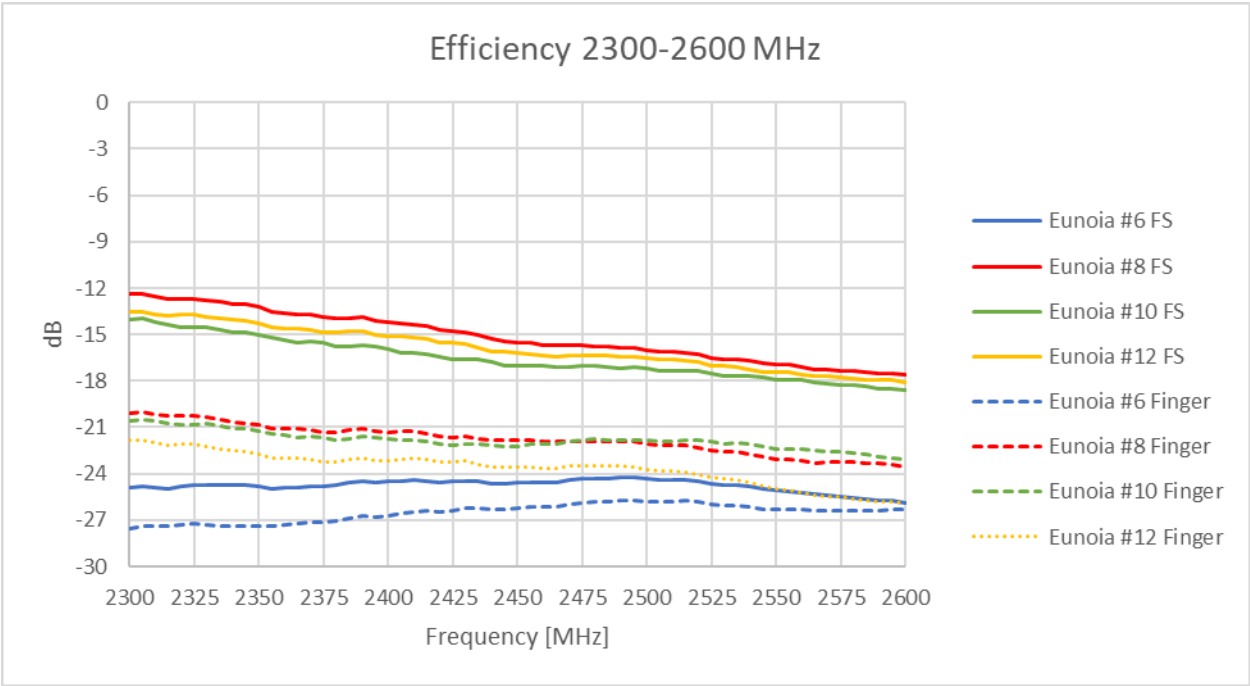
	Efficiency [dB]					Efficiency [dB]			
Frequency [MHz]	Eunoia #6	Eunoia #8	Eunoia #10	Eunoia #12	Frequency [MHz]	Eunoia #6	Eunoia #8	Eunoia #10	Eunoia #12
2300	-27.5	-20.1	-20.5	-21.8	2455	-26.2	-21.8	-22.1	-23.6
2305	-27.4	-20.0	-20.5	-21.8	2460	-26.2	-21.9	-22.1	-23.7
2310	-27.4	-20.2	-20.6	-22.0	2465	-26.1	-21.9	-22.0	-23.6
2315	-27.4	-20.3	-20.7	-22.2	2470	-26.0	-21.9	-21.9	-23.5
2320	-27.3	-20.2	-20.8	-22.1	2475	-25.9	-21.9	-21.9	-23.5
2325	-27.2	-20.3	-20.8	-22.1	2480	-25.8	-21.9	-21.8	-23.5
2330	-27.3	-20.4	-20.8	-22.2	2485	-25.8	-21.9	-21.9	-23.5
2335	-27.4	-20.5	-20.9	-22.4	2490	-25.8	-21.9	-21.8	-23.5
2340	-27.4	-20.6	-21.1	-22.5	2495	-25.7	-21.9	-21.8	-23.6
2345	-27.4	-20.7	-21.1	-22.6	2500	-25.8	-22.1	-21.8	-23.7
2350	-27.4	-20.9	-21.2	-22.7	2505	-25.8	-22.1	-21.9	-23.8
2355	-27.4	-21.1	-21.4	-23.0	2510	-25.8	-22.1	-21.9	-23.8
2360	-27.3	-21.1	-21.5	-23.0	2515	-25.8	-22.1	-21.9	-23.9
2365	-27.2	-21.1	-21.6	-23.0	2520	-25.8	-22.3	-21.8	-24.1
2370	-27.1	-21.2	-21.6	-23.1	2525	-26.0	-22.5	-21.9	-24.3
2375	-27.1	-21.3	-21.7	-23.2	2530	-26.1	-22.6	-22.1	-24.4
2380	-27.1	-21.3	-21.8	-23.3	2535	-26.1	-22.6	-22.0	-24.4
2385	-26.9	-21.2	-21.7	-23.1	2540	-26.2	-22.7	-22.1	-24.6
2390	-26.7	-21.1	-21.6	-23.0	2545	-26.3	-22.9	-22.2	-24.8
2395	-26.8	-21.3	-21.7	-23.2	2550	-26.3	-23.0	-22.4	-25.0
2400	-26.7	-21.3	-21.8	-23.2	2555	-26.3	-23.1	-22.4	-25.0
2405	-26.6	-21.3	-21.9	-23.1	2560	-26.3	-23.2	-22.4	-25.2
2410	-26.5	-21.3	-21.9	-23.0	2565	-26.4	-23.3	-22.5	-25.4
2415	-26.4	-21.4	-21.9	-23.1	2570	-26.4	-23.3	-22.6	-25.5
2420	-26.5	-21.6	-22.1	-23.2	2575	-26.4	-23.2	-22.6	-25.5
2425	-26.4	-21.6	-22.1	-23.2	2580	-26.4	-23.2	-22.7	-25.6
2430	-26.3	-21.6	-22.1	-23.2	2585	-26.4	-23.3	-22.8	-25.8
2435	-26.3	-21.7	-22.0	-23.4	2590	-26.4	-23.3	-22.9	-25.8
2440	-26.3	-21.9	-22.1	-23.6	2595	-26.3	-23.4	-23.0	-25.8
2445	-26.3	-21.9	-22.3	-23.6	2600	-26.3	-23.5	-23.1	-25.9
2450	-26.3	-21.8	-22.2	-23.6					

Table 5 Efficiency, Finger

5.1.5 Maximum gain (graph)



5.1.6 Efficiency (graph)



6. ANTENNA PATTERNS

6.1 Free Space

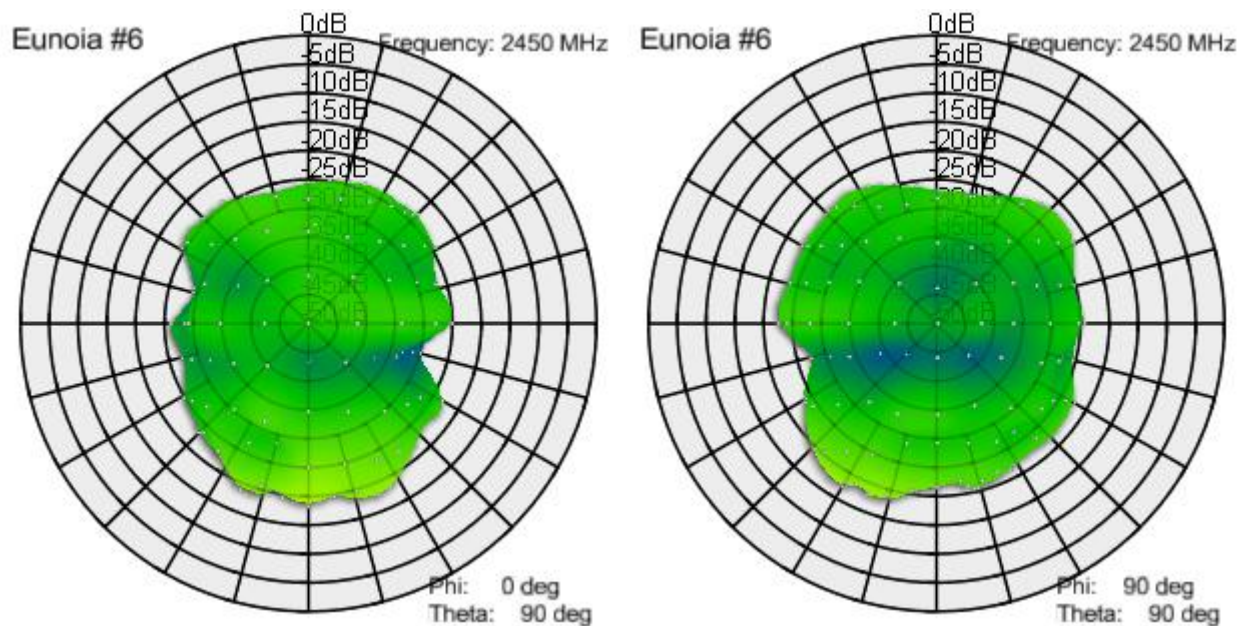


Figure 13 Antenna pattern at 2450 MHz, Eunoia #6, FS

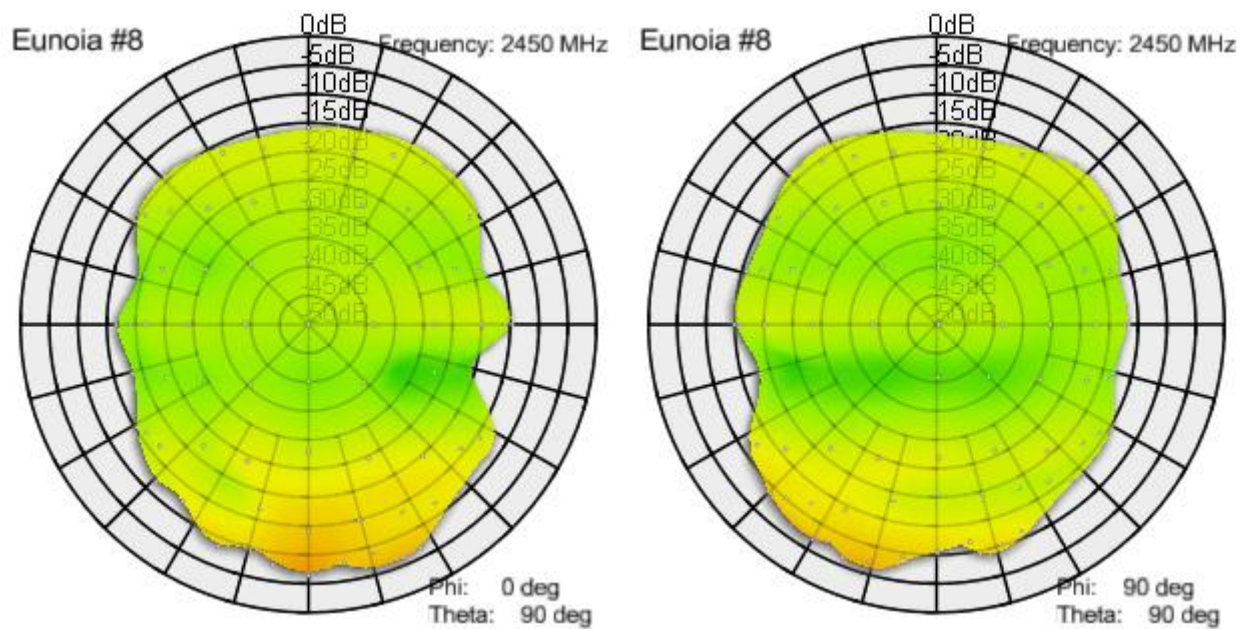


Figure 14 Antenna pattern at 2450 MHz, Eunoia #8, FS

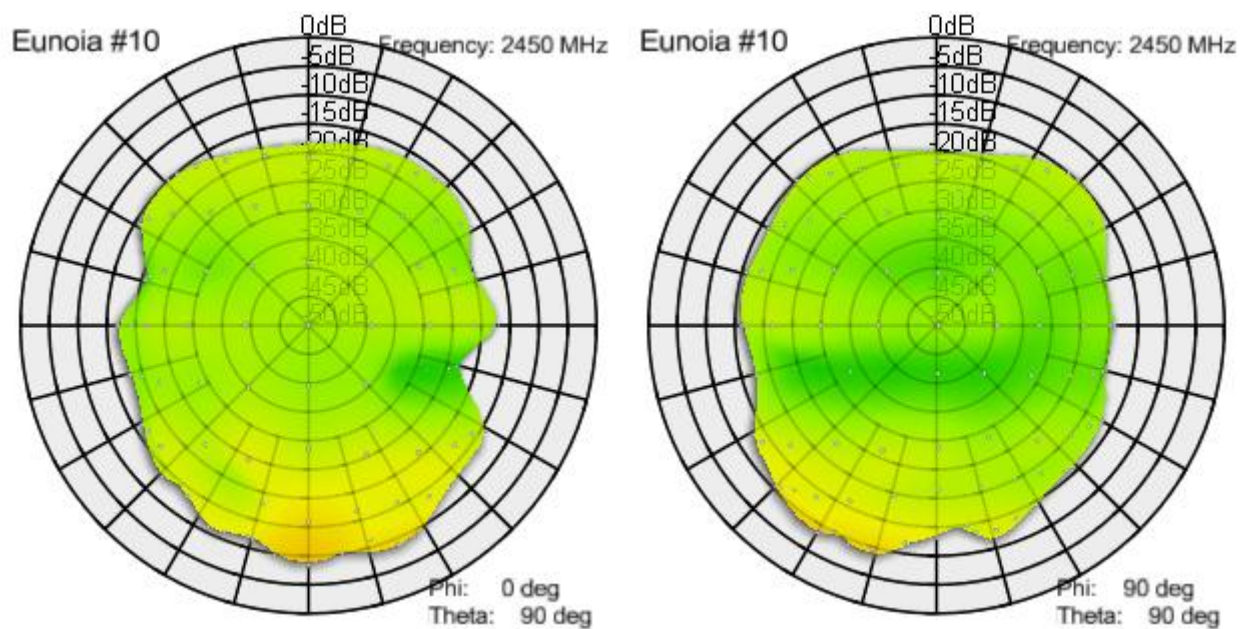


Figure 15 Antenna pattern at 2450 MHz, Eunoia #10, FS

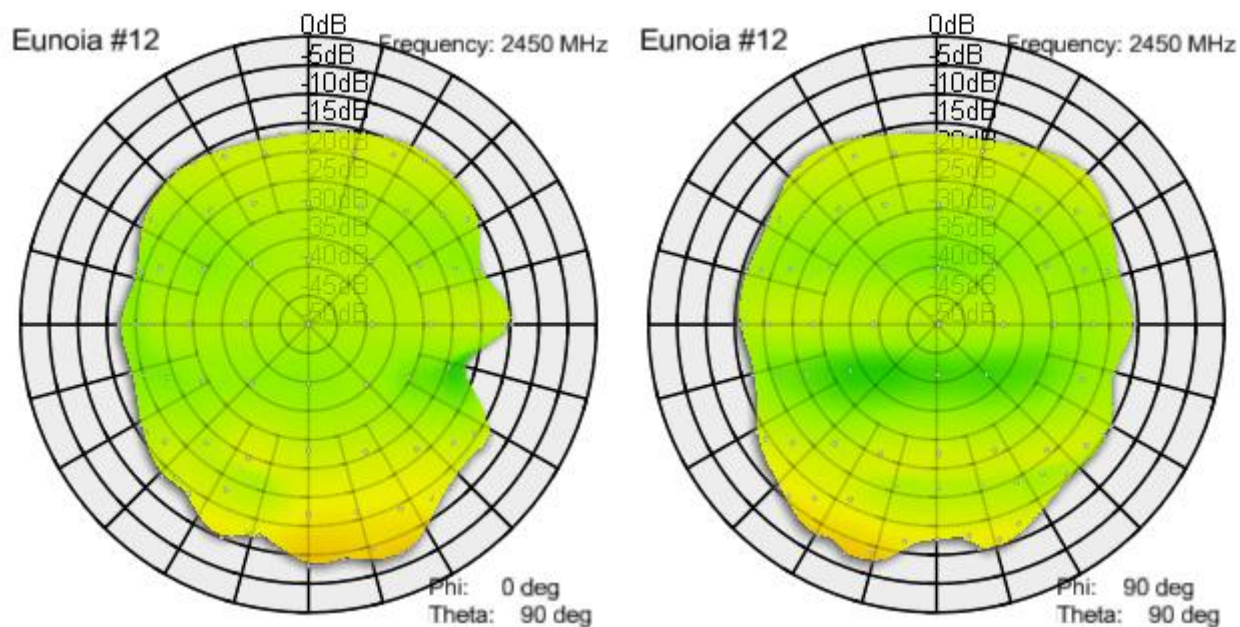


Figure 16 Antenna pattern at 2450 MHz, Eunoia #12, FS

6.2 Finger

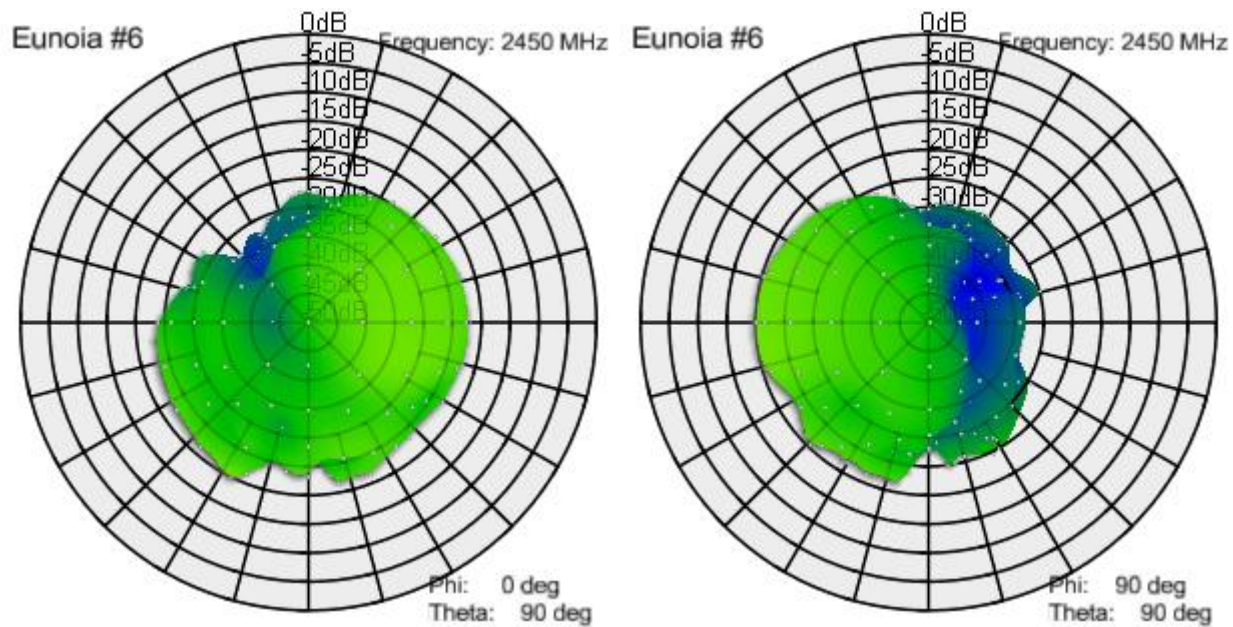


Figure 17 Antenna pattern at 2450 MHz, Eunoia #6, Finger

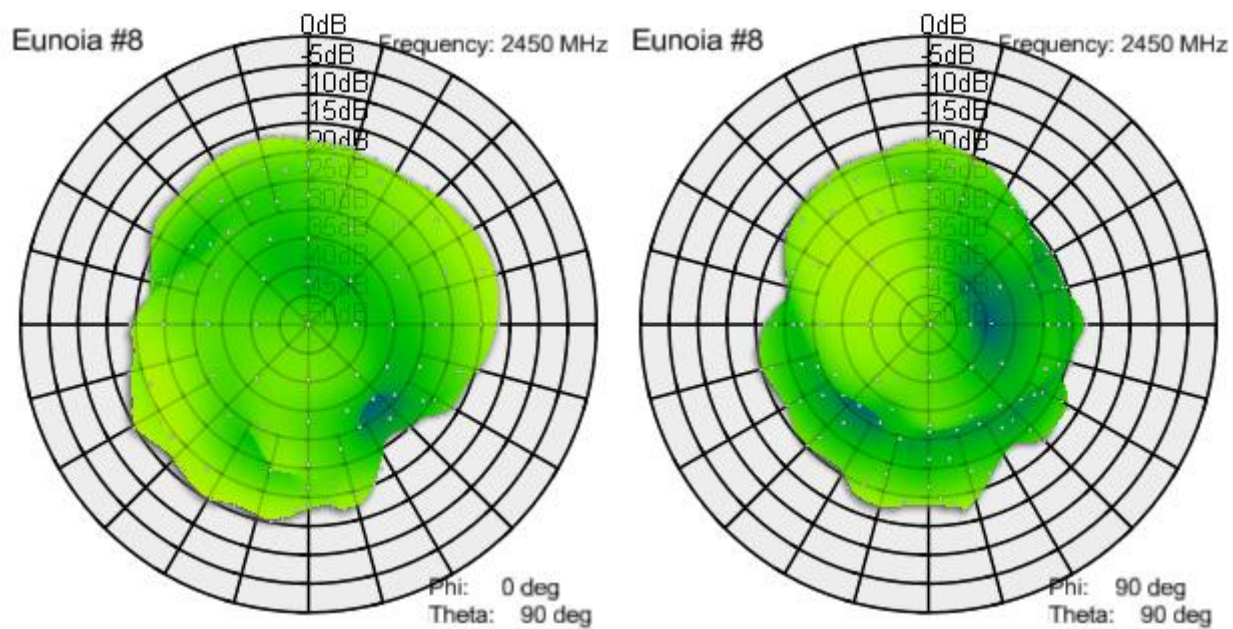


Figure 18 Antenna pattern at 2450 MHz, Eunoia #8, Finger

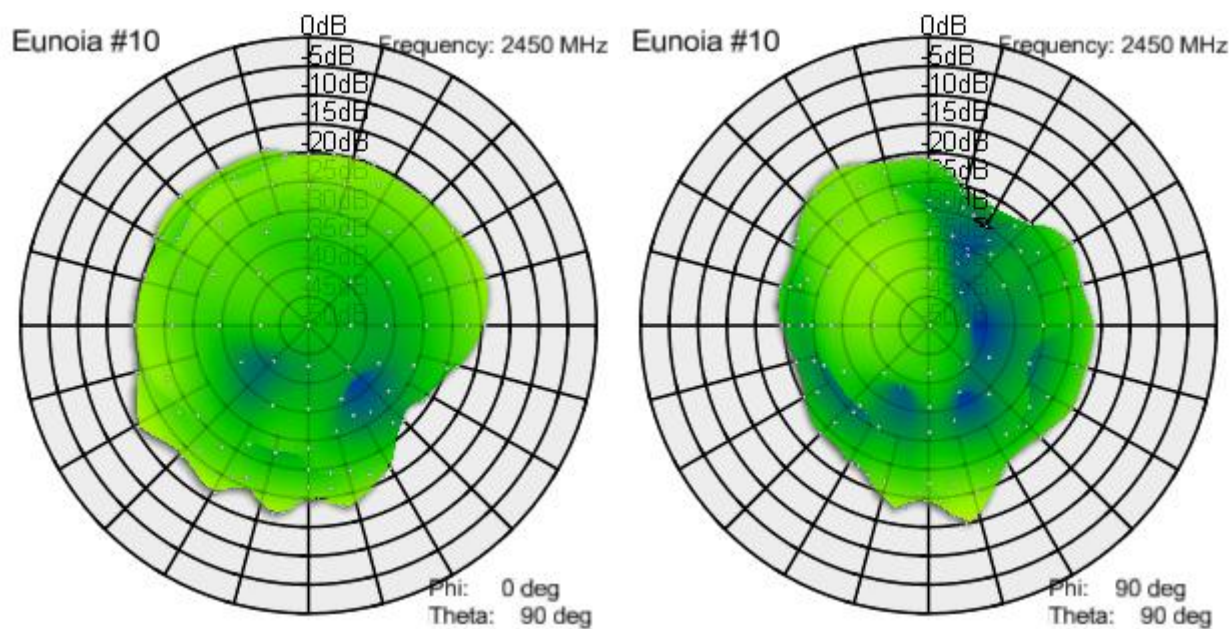


Figure 19 Antenna pattern at 2450 MHz, Eunoia #10, Finger

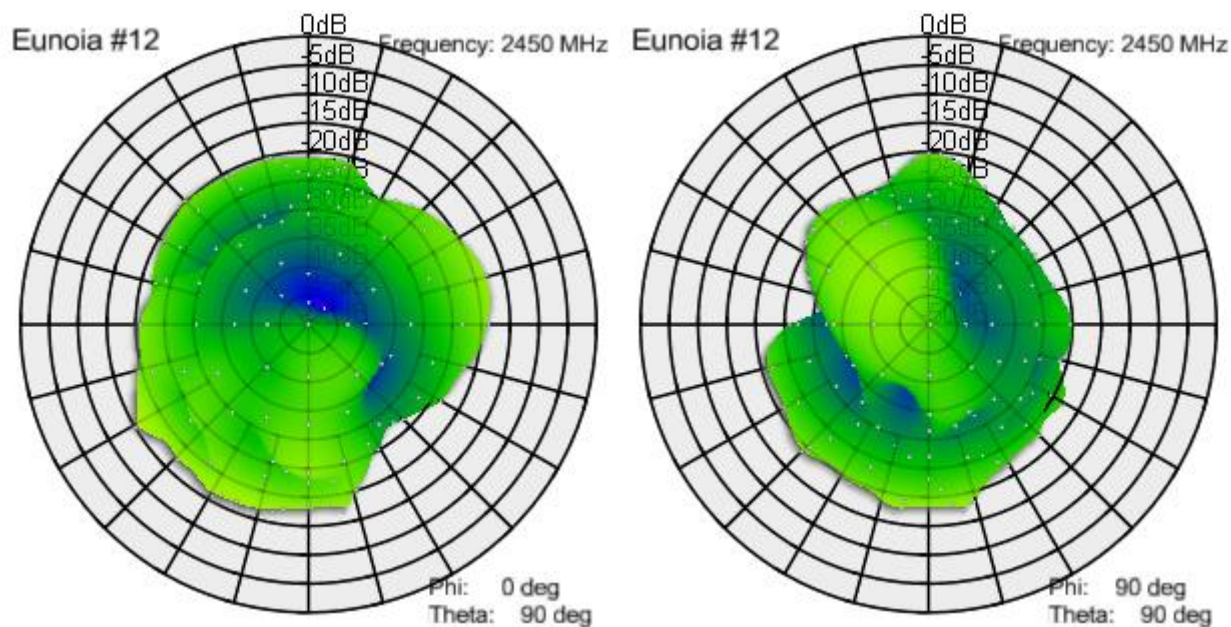


Figure 20 Antenna pattern at 2450 MHz, Eunoia #12, Finger