Test Report
Antenna Efficiency and Antenna Gain for
Coupler Waveguide R-SMA 2,4 GHz

Test Laboratory:
7layers GmbH
Borsigstrasse 11
40880 Ratingen
Germany

Content:

1 PROJEKT AND RESULT SUMMARY

DUT	Coupler Waveguide R-SMA 2,4 GHz PartNo 18244327	DUT Code	DE1495003AUX39
Test Lab	7layers GmbH Borsigstr. 11 40880 Ratingen Germany	Set up	free space
		Test start	24.03.2025
Customer	H&D Wireless Connectivity AB Hanstavägen 31 164 53, Kista Sweden	Report date	03.04.2025
		Report by	Dieter Sütthoff
		Approved by	Robert Machulec
	DUT in free space		

1.1 Set up Fotos

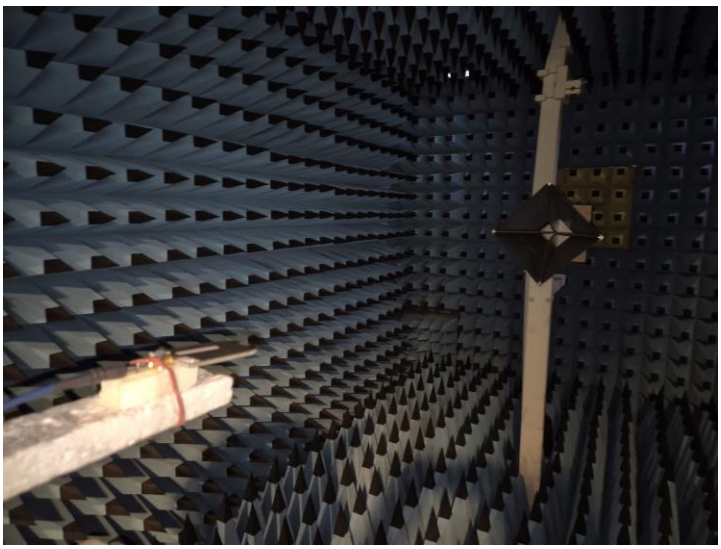


Fig. 1: Foto Set up

1.2 Antenna test results table

Frequency (MHz)	Efficiency (dB)	Peak EIRP (dBm)	Directivity (dBi)	Gain (dBi)
2412	-3.2	2.4	5.6	2.4
2437	-3.9	1.0	4.9	1.0
2472	-4.6	0.3	4.9	0.3

Fig. 2: Test results table over frequency (MHz)

2 Signatures

Responsible for Accreditation Scope: Robert Machulec

Responsible for Test Report: Dieter Sütthoff

3 BRIEF DESCRIPTION OF SETTINGS AND TEST METHOD

3.1 General

The measurement procedures are based on a 3D test of radiated performance considering both polarizations.

An antenna fully anechoic chamber was used. The DUT RF-power was feed by RF-cable form a network analyzer with CW signal with 0 dBm power. The DUT was rotated in two axes (theta/phi) in 3D room directions and tested taking into account the horizontal and vertical polarization by using a grid step size angle of Theta 15 ° and Phi 15°. A OTA Software by ETS-Lindgren: EMQuest EMQ-100was used for the measurements. The software is a windows application that provides all necessary control of instrumentation and positioners. All used cabling, connectors, and equipment that is not a part of the test system was calibrated out by means of a full two port calibration procedure of the vector network analyzer.

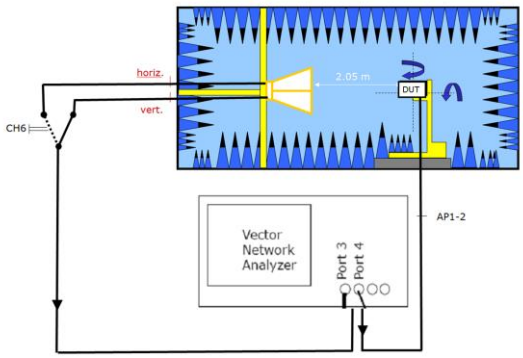


Fig. 1: Set up for antenna efficiency test

Orientation of EUT

For orientation of the EUT in the result pictures below the following photos illustrate the used orientation

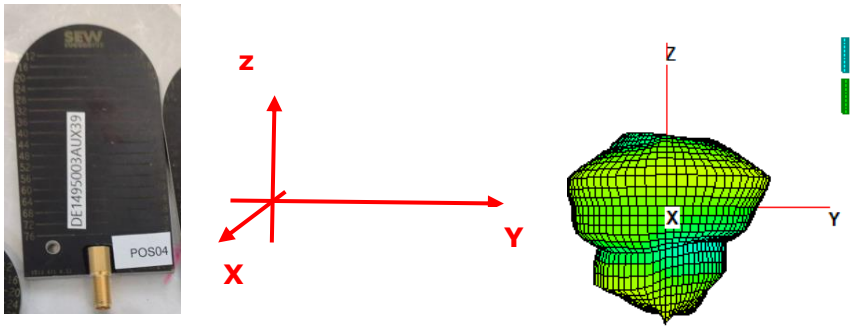


Fig. 3: Photo orientation of DUT.

3.2 Equipement list

VNA:	E5071B by Agilent	SN: MY42200813
Calibration kit	85035E by Agilent,	
	open: 85033-60012,	SN: 006776
	load: 85033-60010,	SN: 006464
	short: 85033-60014,	SN: 006070
Antenna:	Dual polarized horn ETS3164-03 by ETS	SN 00052619

3.3 Key specifications and uncertainties

Frequency range: 400 MHz – 6 GHz
Measurement distance: 2.05 m

4 DEFINITIONS:

3GPP	3rd Generation Partnership Project
CTIA	Cellular Telecommunications & Internet Association
OTA	Over The Air
DUT	Device under test
FS	Free space

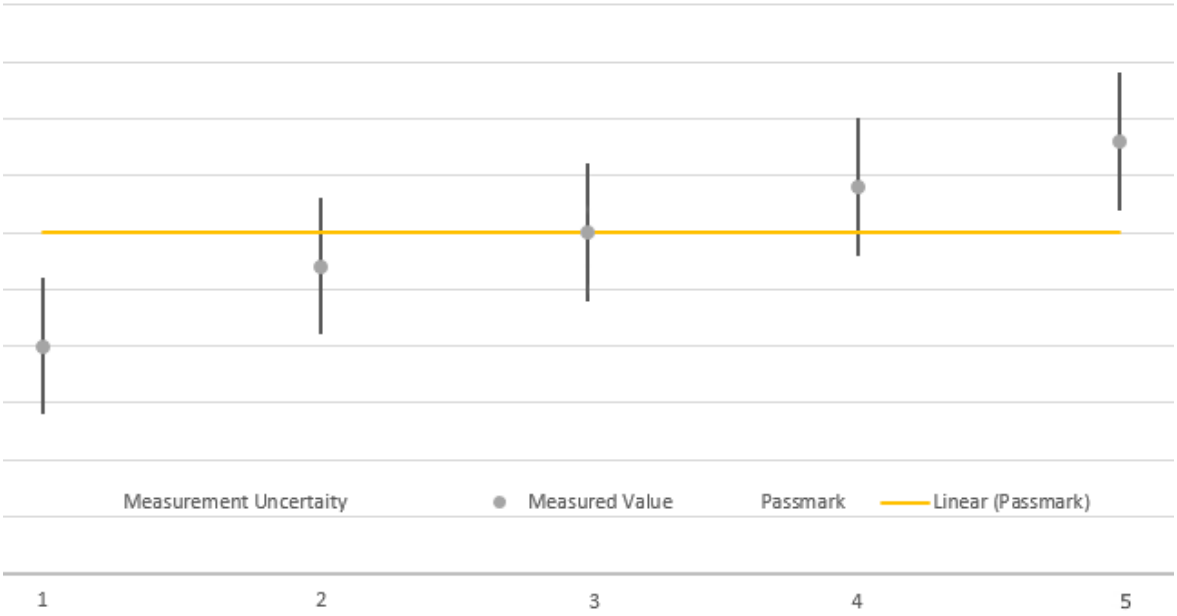
Measurement uncertainties

Test Configuration	OTA 7Layers Germany uncertainty [dB]	CTIA requirement [dB]
Free Space TRP	±1.7	± 2.0 dB

Tab. 1: Measurement uncertainties are valid for full 3D measurement results.

Standard specific table with the measurement uncertainties of the used parameters

The measurement uncertainties for all parameters are calculated with an expansion factor (coverage factor) k = 1.96. This means, that the true value is in the corresponding interval with a probability of 95 %.



The verdicts in this test report are given according the above diagram:

Case	Measured Value	Uncertainty Range	Verdict
1	below pass mark	below pass mark	Passed
2	below pass mark	within pass mark	Passed
3	on pass mark	within pass mark	Passed
4	above pass mark	within pass mark	Failed
5	above pass mark	above pass mark	Failed

That means, the laboratory applies, as decision rule, the so-called shared risk principle.

Depending on the used test resource and the performed test case the uncertainty is in a given range, allowing to fulfil the test requirements. Detailed documentation is available at 7layers GmbH.

Following to KBA approval relevant requirement, only the measured value is taken for the decision.

5 REFERENCES AND STANDARDS USED

[1] CTIA: "CTIA-01.20-Test-Methodology-SISO-Anechoic-Chamber", Revision 6.0.3, 02/2022

[2] 3GPP TS 34.114: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; User Equipment (UE) / Mobile Station (MS) Over The Air (OTA) antenna performance; Conformance testing", (Release 11), Version V11.3.0, January 2013.

[3] 7layers document: "7layers Germany OTA Measurement Uncertainties", Version November 2024.

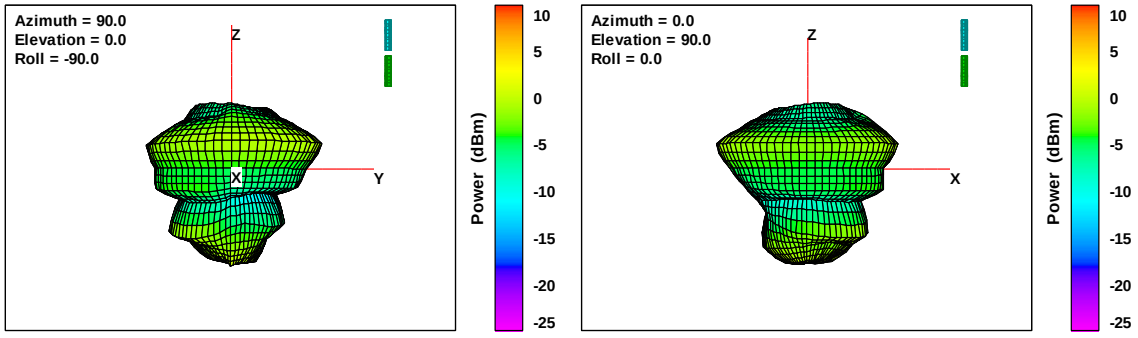
6 DETAILED RADIATED TEST RESULTS

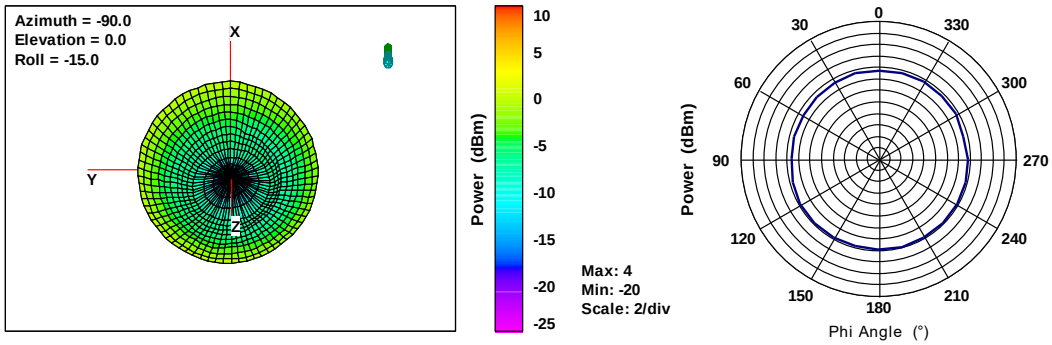
6.1 Test results, antenna pattern at 2412 / 2437 / 2472 MHz

Temperature: 24.3
Humidity: 30
Teast start: 26/03/2025

Frequency (MHz)	Efficiency (dB)	Peak EIRP (dBm)	Directivity (dBi)	Gain (dBi)
2412	-3.2	2.4	5.6	2.4
2437	-3.9	1.0	4.9	1.0
2472	-4.6	0.3	4.9	0.3

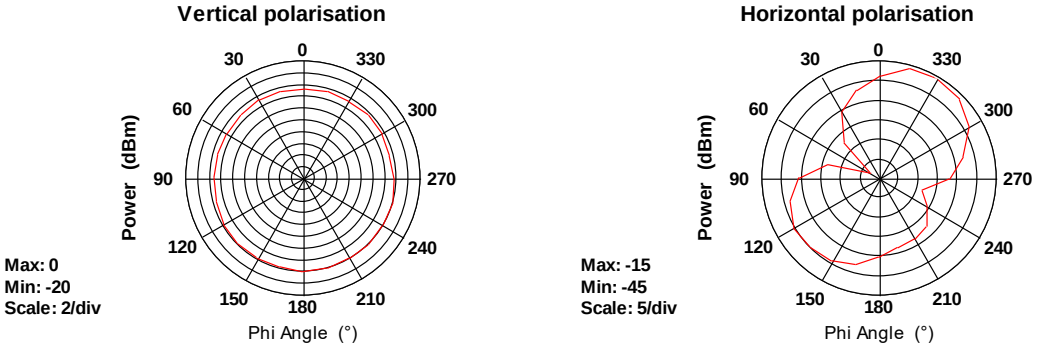
Total pattern (horizontal + vertical polarisation) @ 2437 MHz:





Theta = 90°

Fig. 4: Test results Total pattern @ 2437 MHz



Theta = 90°

Fig. 5: Test results vertical and horizontal polarization pattern 2437 MHz