FCC LISTED, REGISTRATION NUMBER: 905266 **IC LISTED REGISTRATION NUMBER IC 4621**	**AT4 wireless, S.A.** Parque Tecnológico de Andalucía, c/ Severo Ochoa nº 2 29590 Campanillas/ Málaga/ España Tel. 952 61 91 00 - Fax 952 61 91 13 MÁLAGA, C.I.F. A29 507 456 Registro Mercantil de Málaga,Tomo 1169, Libro 82, Folio 133, Hoja MA3729

TEST REPORT

REFERENCE STANDARD: USA FCC Part 15.249 and 15.109

CANADA RSS-210

Radio Frequency Devices. Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz, 5725 - 5875 MHz, and 24.0 - 24.25 GHz.

Radio Frequency Devices. Radiated emission limits.

Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands)

NIE ..... :	30441RET.101
Approved by (name / position & signature) ..... :	A. Llamas/RF Lab. Manager Alejandro Llamas Rodríguez Firmado digitalmente por Alejandro Llamas Rodríguez Fecha: 2009.12.23 10:59:09 +01'00' .....
Elaboration date ..... :	23/12/2009
Identification of item tested ..... :	Wireless Cycling computer
Trademark ..... :	Polar
Model and/or type reference ..... :	CS500
Serial number ..... :	---
Other identification of the product ..... :	Commercial name: CS500 FCC ID: INWT6 IC: 6248A-T6
Features ..... :	Operating frequency in the 2403-2482 MHz range, Channel Bandwidth 1 MHz, Category 3 Receiver, 3 V_{DC} supplied by lithium battery.
Description ..... :	Wireless Cycling computer for heart rate measurements, data transfer and analysis, Speed, Distance, Cadence and Power measurements and analysis for cycling performance
Applicant ..... :	POLAR ELECTRO OY.
Address ..... :	Professorintie 5, 90440 Kempele, FINLAND
CIF/NIF/Passport..... :	VAT FI02099112
Contact person:	Kari Parkkisenniemi
Telephone / Fax ..... :	+358 8 5202100
e-mail: ..... :	Kari.parkkisenniemi@polar.fi
Test samples supplier ..... :	Same as applicant
Manufacturer ..... :	Same as applicant

Test method requested .....:				
Standard .....:	USA FCC Part 15.249.			
	USA FCC Part 15.109. Receiver spurious emissions.			
	CANADA RSS-210			
Test procedure .....:	PEET041: Medidas radioeléctricas en equipos de corto alcance y rango de frecuencias entre 1 GHz y 40 GHz			
Non-standardized test method .....:	N/A			
Used instrumentation .....:				
			Last Cal. date	Cal. due date
	1.	Semianechoic Absorber Lined Chamber IR 11. BS	N.A.	N.A.
	2.	Control Chamber IR 12.BC	N.A.	N.A.
	3.	Hybrid Bilog antenna Sunol Sciences Corporation JB6	2008-10	2011-10
	4.	Antenna mast EM 1072 NMT	N.A.	N.A.
	5.	Rotating table EM 1084-4. ON	N.A.	N.A.
	6.	Double-ridge Guide Horn antenna 1-18 GHz HP 11966E	2008/03	2011/03
	7.	Double-ridge Guide Horn antenna 18-40 GHz Agilent 119665J	2008/09	2011/09
	8.	EMI Test Receiver R&S ESIB26	2009/09	2010/09
	9.	RF pre-amplifier Miteq JS4-12002600-30-5A.	2008/07	2010/07
	10.	Multi Device Controller EMCO 2090	N.A.	N.A.
	11.	Spectrum Analyzer R&S ESU40	2009/11	2011/11
	12.	RF pre-amplifier Miteq AFS5-04001300-15-10P-6.	2008/07	2010/07
	13.	RF pre-amplifier Schaffner CPA 9231.	2009/03	2011/03
	14.	Antenna tripod EMCO 11968C.	N.A.	N.A.
	15.	Spectrum analyser Agilent PSA E4440A	2008/01	2010/01
Report template No. .....:	FDT08_11			

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Competences and guarantees

Centro de Tecnología de las Comunicaciones (AT4 wireless), S.A. is a laboratory with a measurement facility in compliance with the requirements of Section 2.948 of the FCC rules and has been added to the list of facilities whose measurements data will be accepted in conjuction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Registration Number: 905266.

Centro de Tecnología de las Comunicaciones (AT4 wireless), S.A. is a laboratory with a measurement site in compliance with the requirements of RSS 212, Issue 1 (Provisional) and has been added to the list of filed sites of the Canadian Certification and Engineering Bureau. Reference File Number: IC 4621.

In order to assure the traceability to other national and international laboratories, AT4 wireless has a calibration and maintenance programme for its measurement equipment.

AT4 wireless guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at AT4 wireless at the time of performance of the test.

AT4 wireless is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of AT4 wireless.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of AT4 wireless and the Accreditation Bodies.

Uncertainty

Uncertainty (factor k=2) was calculated according to the AT4 wireless internal document PODT000.

Usage of samples

Samples undergoing test have been selected by: **the client**.

Sample M/01 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
30441/02	Cycling computer with integral antenna	CS500	---	02/12/2009

Sample M/02 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
30441/01	Cycling computer with antenna connector and dummy battery	CS500	---	02/12/2009

1. Sample M/01 has undergone following test(s).
   Radiated tests indicated in annex A.
2. Sample M/02 has undergone following test(s).
   20 dB Bandwidth indicated in annex A.

Testing period

The performed test started on 2009-12-17 and finished on 2009-12-18

The tests have been performed at AT4 wireless.

Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 23.4 ºC Max. = 24.8 ºC
Relative humidity	Min. = 35.2 % Max. = 36.3 %
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 0,5 Ω

In the semianechoic chamber (21 meters x 11 meters x 8 meters), the following limits were not exceeded during the test.

Temperature	Min. = 22.6 ºC Max. = 23.1 ºC
Relative humidity	Min. = 36.3 % Max. = 37.5 %
Air pressure	Min. = 1019 mbar Max. = 1019 mbar
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 0,5 Ω
Normal site attenuation (NSA)	< ±4 dB at 10 m distance between item under test and receiver antenna, (30 MHz to 1000 MHz)
Field homogeneity	More than 75% of illuminated surface is between 0 and 6 dB (26 MHz to 1000 MHz).

In the chamber for conducted measurements the following limits were not exceeded during the test:

Temperature	Min. = 24.7 ºC Max. = 25.3 ºC
Relative humidity	Min. = 38.3 % Max. = 39.6 %
Air pressure	Min. = 1016 mbar Max. = 1016 mbar
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 0,5 Ω

Summary

Considering the results of the performed test according to standard USA FCC Part 15.249, Part 15.109 / RSS-210, the item/s under test is **IN COMPLIANCE** with the requested specifications specified in the standard.

NOTE: The results presented in this Test Report apply only to the particular item under test established in page 1 of this document, as presented for test on the date(s) shown in section, "USAGE OF SAMPLES, TESTING PERIOD AND ENVIRONMENTAL CONDITIONS".

Remarks and comments

None.

Testing veredicts

Not applicable .....: NA

Pass.....: P

Fail .....: F

Not measured.....: NM

FCC PART 15 PARAGRAPH		VERDICT			
		NA	P	F	NM
15.249 Subclause (a)	Field strength of fundamental and harmonics emissions.		P		
15.249 Subclause (d)	Emissions radiated outside of the specific frequency bands		P		
15.109	Radiated emissions limits for receiver		P		

APPENDIX A: Test result

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TEST CONDITIONS

Power supply (V):

$V_{nominal}$ = 3.0 Vdc

Type of power supply = DC voltage supplied by lithium battery

Type of antenna = Integral antenna

Maximum Declared Gain for antenna = 1 dBi

Operating Temperature Range (ºC):

T_n = +15 to + 35

TEST FREQUENCIES:

Lowest channel: 2403 MHz

Middle channel: 2441 MHz

Highest channel: 2482 MHz

The test set-up was made in accordance to the general provisions of ANSI C63.4: 2003.

CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and it is connected to the spectrum analyser.

RADIATED MEASUREMENTS

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m for the frequency range 30 MHz-1000 MHz (30 MHz-1000 MHz Bilog antenna) and at a distance of 1m for the frequency range 1 GHz-25 GHz (1 GHz-18 GHz Double ridge horn antenna and 18 GHz-40 GHz horn antenna).

For radiated emissions in the range 1 GHz-25 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

The equipment under test was set up on a non-conductive (wooden) platform one meter above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

Section 15.215 Subclause (c) (1). 20 dB Bandwidth

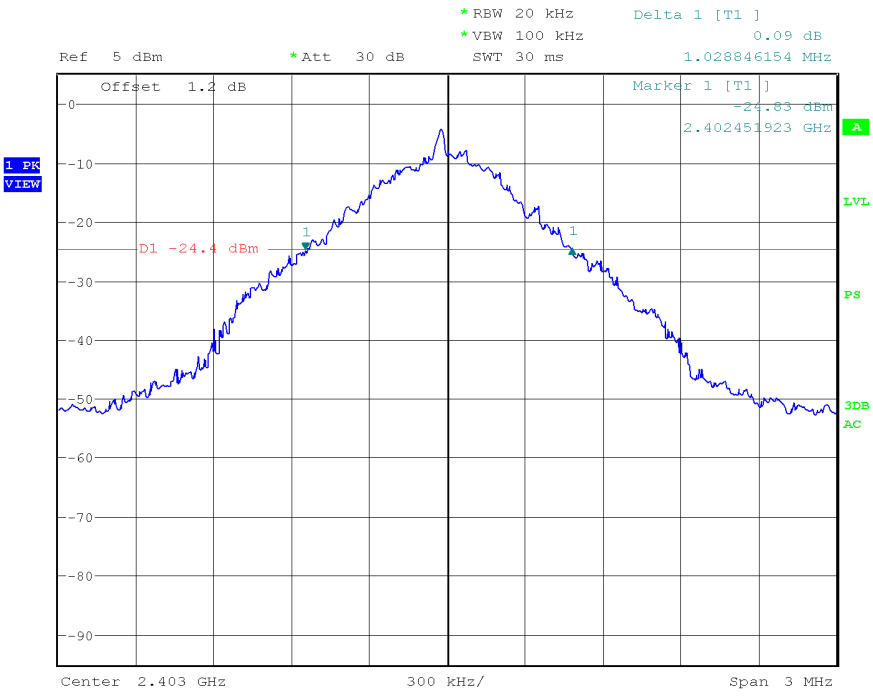
RESULTS

20 dB Bandwidth (see next 3 plots).

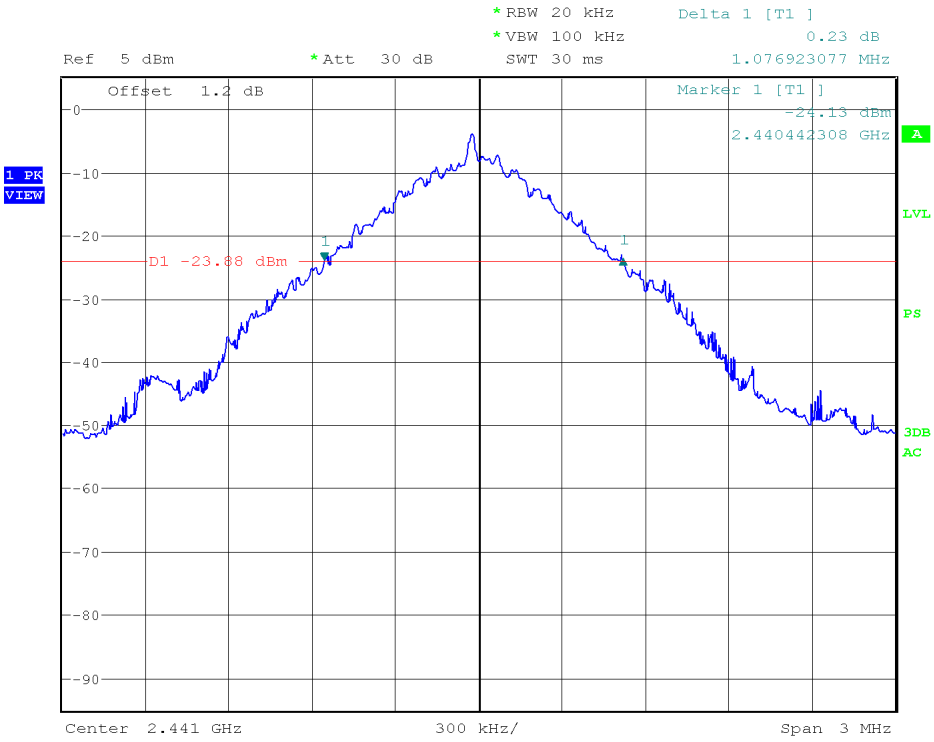
	Lowest frequency 2403 MHz	Middle frequency 2441 MHz	Highest frequency 2482 MHz
20 dB Spectrum bandwidth (kHz)	1028.84	1076.92	1086.53
Measurement uncertainty (kHz)	±11		

20 dB BANDWIDTH.

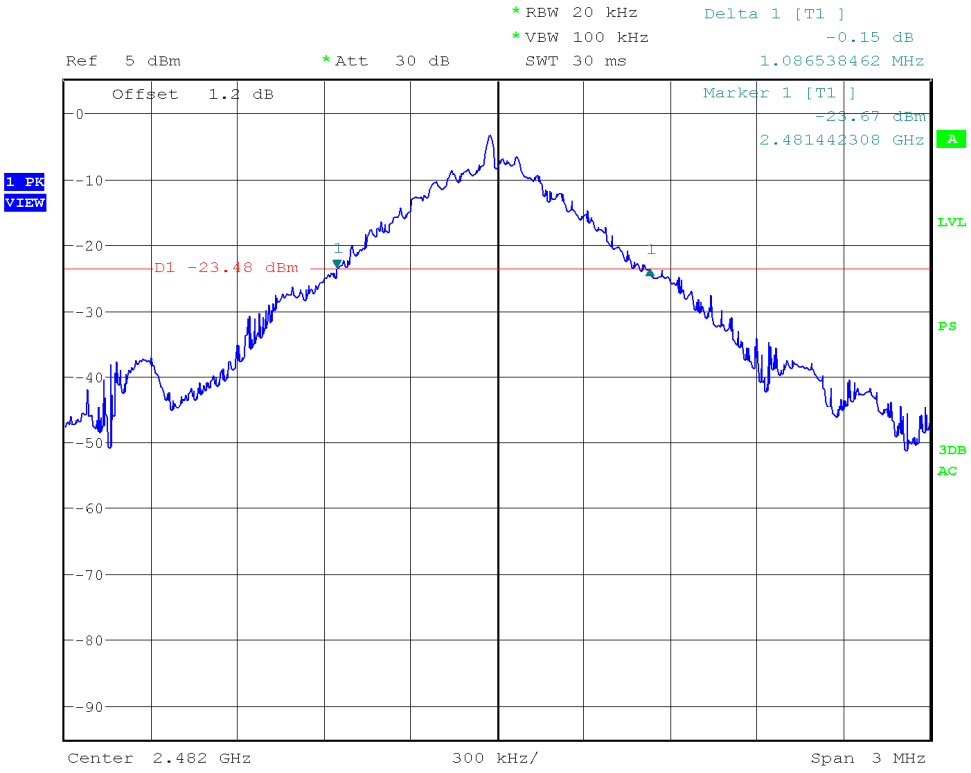
Lowest Channel: 2403 MHz.



Middle Channel: 2441 MHz.



Highest Channel: 2482 MHz.



Section 15.249 Subclause (a). Field strength of Fundamental

SPECIFICATION

The field strength of emissions from intentional radiators shall comply with the following

Fundamental frequency (MHz)	Field strength of fundamental (mV/m)	Field strength (dBµV/m)	Measurement distance (m)
902 - 928	50	93.98	3
2400 – 2483.5	50	93.98	3
5725 - 5875	50	93.98	3
24000-24250	250	107.96	3

for frequencies above 1000 MHz, the above field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

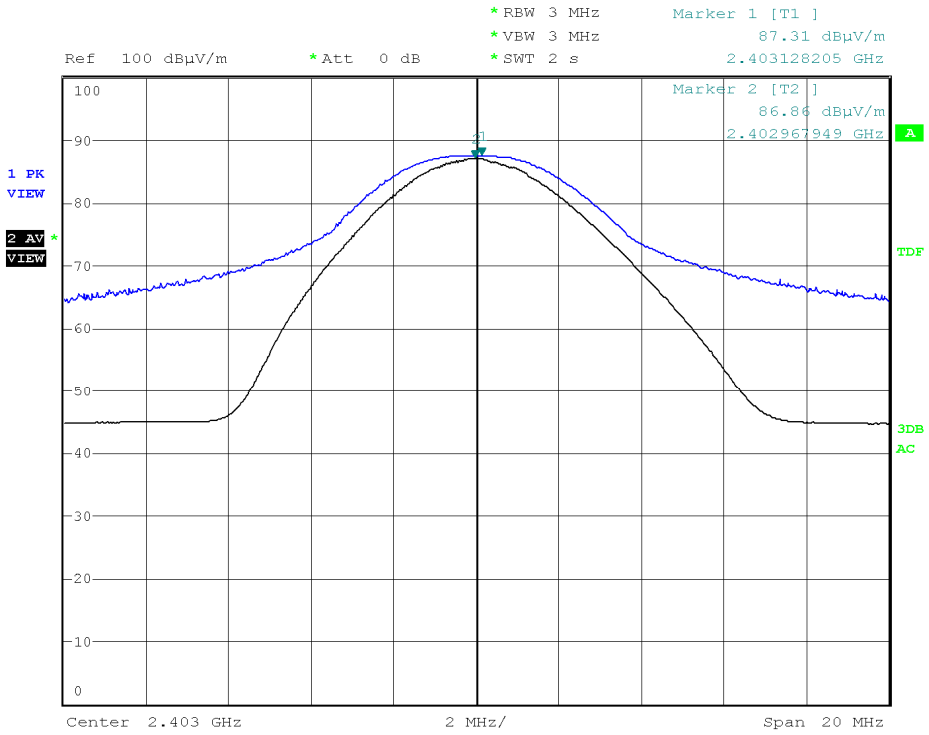
RESULTS

	Lowest frequency 2403 MHz	Middle frequency 2441 MHz	Highest frequency 2482 MHz
Field strength (dBµV/m) average	86.86	88.57	89.12
Field strength (dBµV/m) peak	87.31	89.07	89.50
Measurement uncertainty (dB)	±4.0		

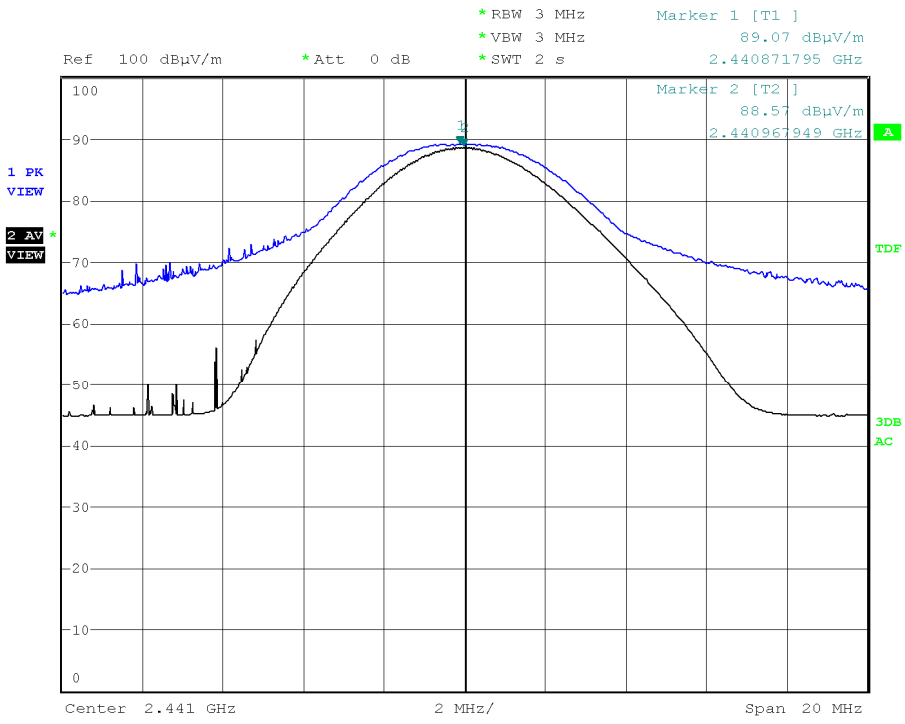
Verdict: PASS

FIELD STRENGTH

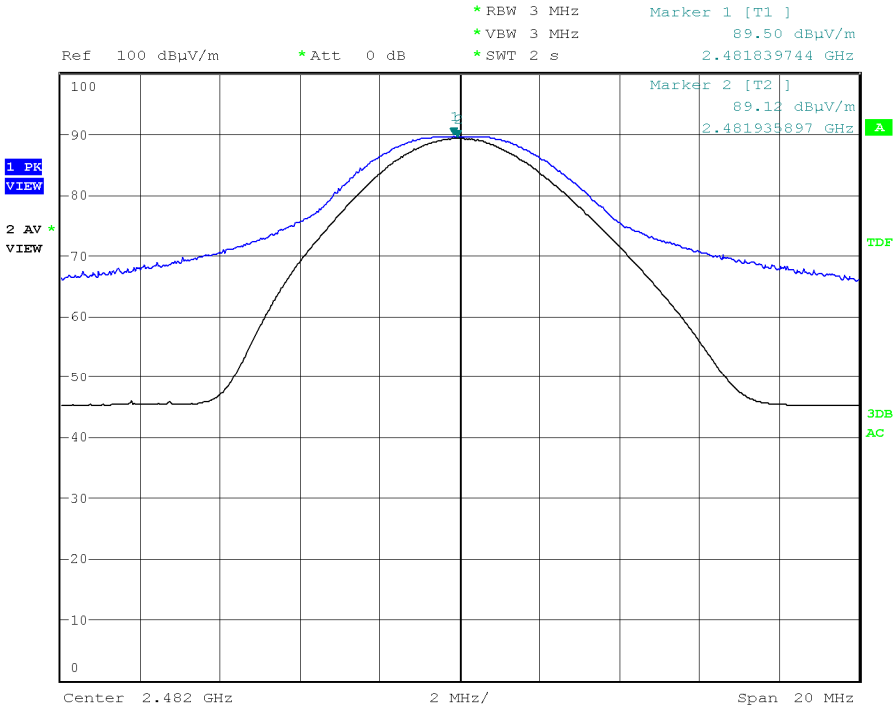
Lowest Channel: 2403 MHz.



Middle Channel: 2441 MHz.



Highest Channel: 2482 MHz.



Section 15.249 Subclause (a) and (d). Radiated emissions (Transmitter)

SPECIFICATION

The field strength of harmonics from intentional radiators shall comply with the following

Fundamental frequency (MHz)	Field strength of fundamental (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
902 - 928	500	54	3
2400 – 2483.5	500	54	3
5725 - 5875	500	54	3
24000-24250	2500	67.96	3

Emissions radiated outside of the specific frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of fundamental or to the general radiated emission limits specified in section 15.209:

Frequency Range (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	300
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 25000	500	54	3

Whichever is the lesser attenuation

RESULTS:

The situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

All tests were performed in a semi-anechoic chamber at a distance of 3 m for the frequency range 30 MHz-1000 MHz and at distance of 1m for the frequency range 1 GHz-25 GHz.

The field strength is calculated by adding correction factor to the measured level from the spectrum analyser. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in the three operating channels.

Frequency range 1 GHz-25 GHz

1. CHANNEL: LOWEST (2403 MHz).

Spurious frequency (MHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
4805.8752	V	Peak	48.82	± 4.0
4805.8752	V	Average	34.18	± 4.0

2. CHANNEL: MIDDLE (2441 MHz).

Spurious frequency (MHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
4882.1302	V	Peak	48.94	± 4.0
4882.1302	V	Average	35.18	± 4.0

3. CHANNEL: HIGHEST (2482 MHz).

Spurious frequency (MHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
4963.1254	V	Peak	49.10	± 4.0
4963.1254	V	Average	34.89	± 4.0

Maximum level inside the restricted band 2483.5-2500 MHz:

Spurious frequency (MHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
2485.5000	H	Peak	65.08	± 4.0
2485.5000	H	Average	41.79	± 4.0

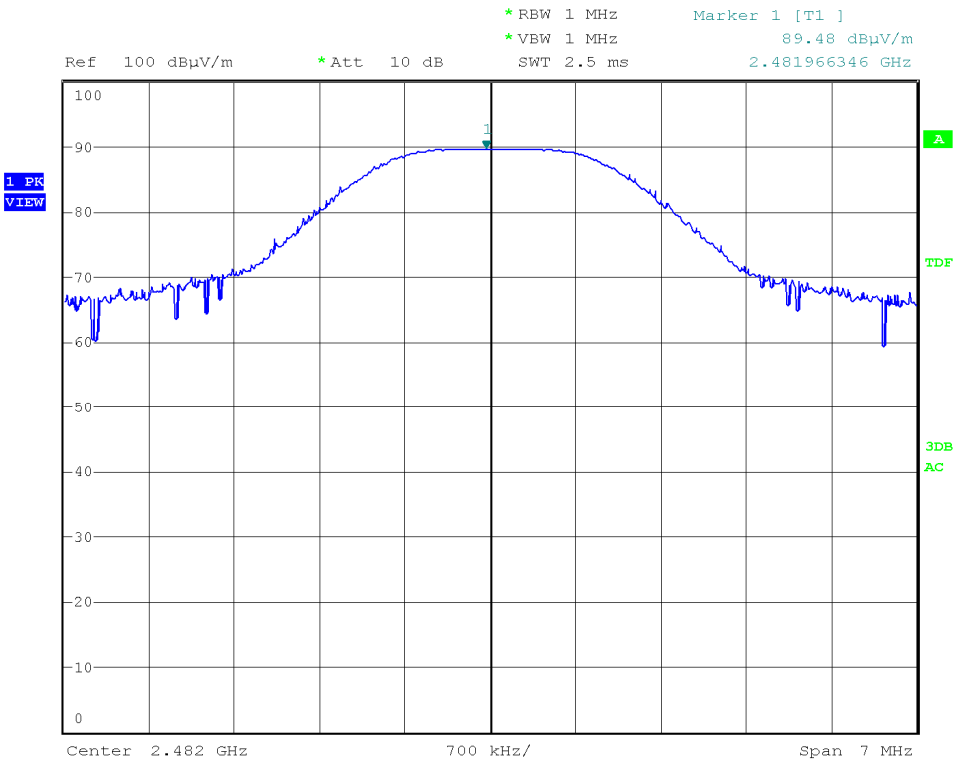
Verdict: PASS

Band-edge compliance of radiated emissions at restricted band 2483.5-2500 MHz

Maximum peak and average field strength of fundamental emission at 3 m distance

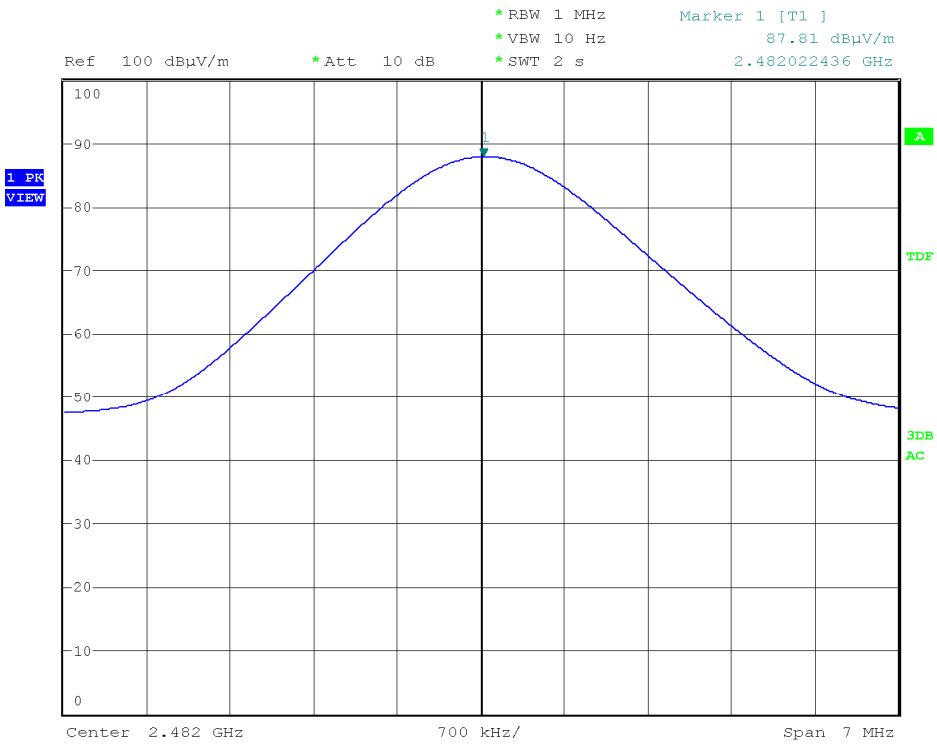
HIGHEST CHANNEL (2482 MHz):

Maximum field strength at 3 m. Peak value.



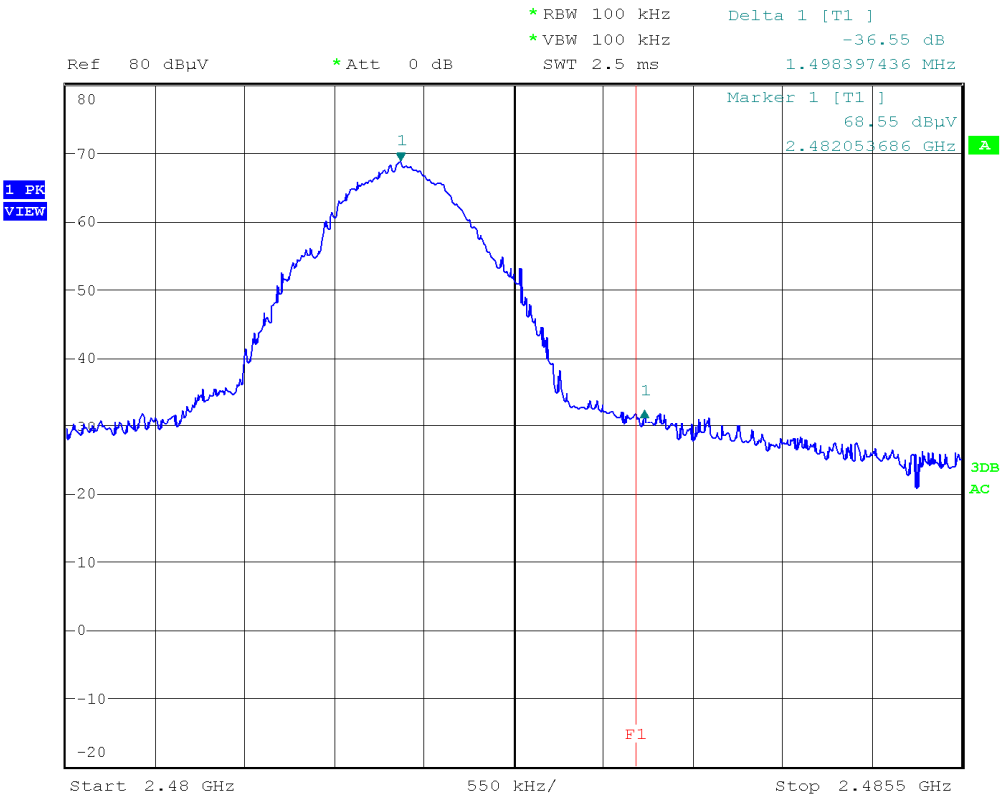
Note: The correction factor is already included in the spectrum analyzer as a transducer factor so that the marker shows directly the field strength level.

Maximum field strength at 3 m. Average value.



Note: The correction factor is already included in the spectrum analyzer as a transducer factor so that the marker shows directly the field strength level.

BAND-EDGE COMPLIANCE. RADIATED. Marker-Delta Method.



Note: No correction is applied for this relative measurement.

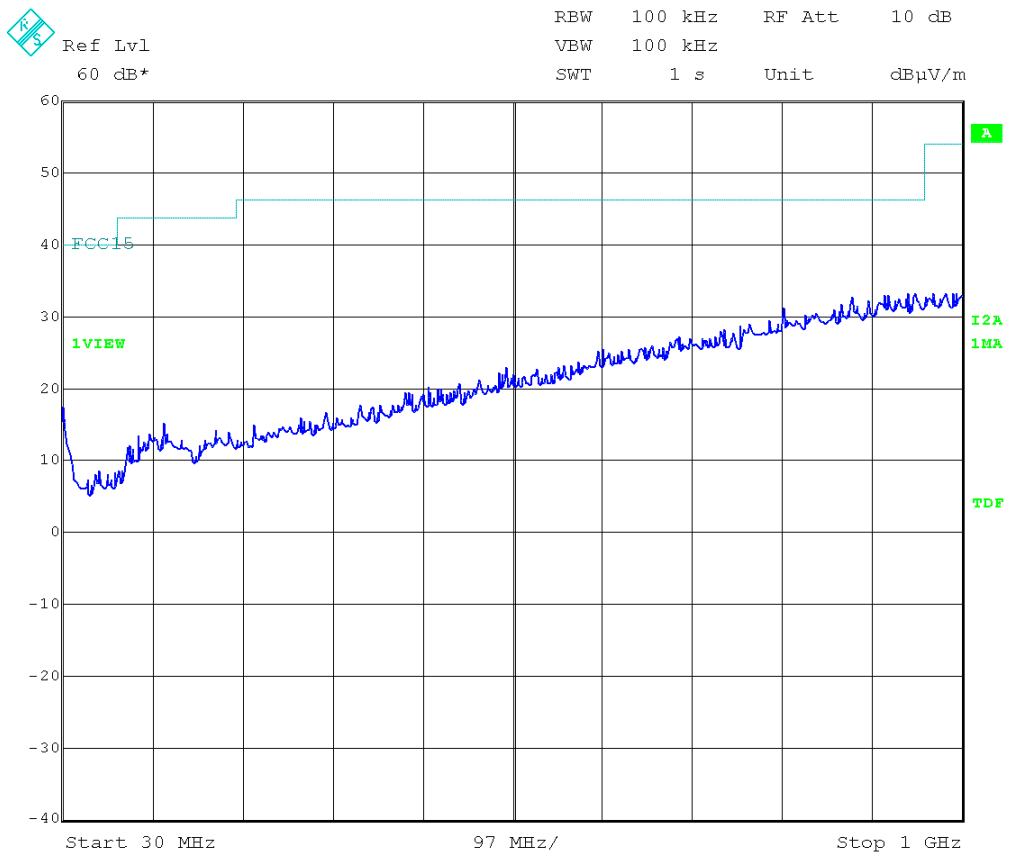
Band edge compliance of radiated emissions

Fundamental max. average value 3 m	Delta value	Calculated value 3 m	Limit
87.81 dBµV/m	36.55 dB	51.26 dBµV/m	54 dBµV/m

Fundamental max. Peak value 3 m	Delta value	Calculated value 3 m	Limit
89.48 dBµV/m	36.55 dB	52.93 dBµV/m	74 dBµV/m

Verdict: PASS

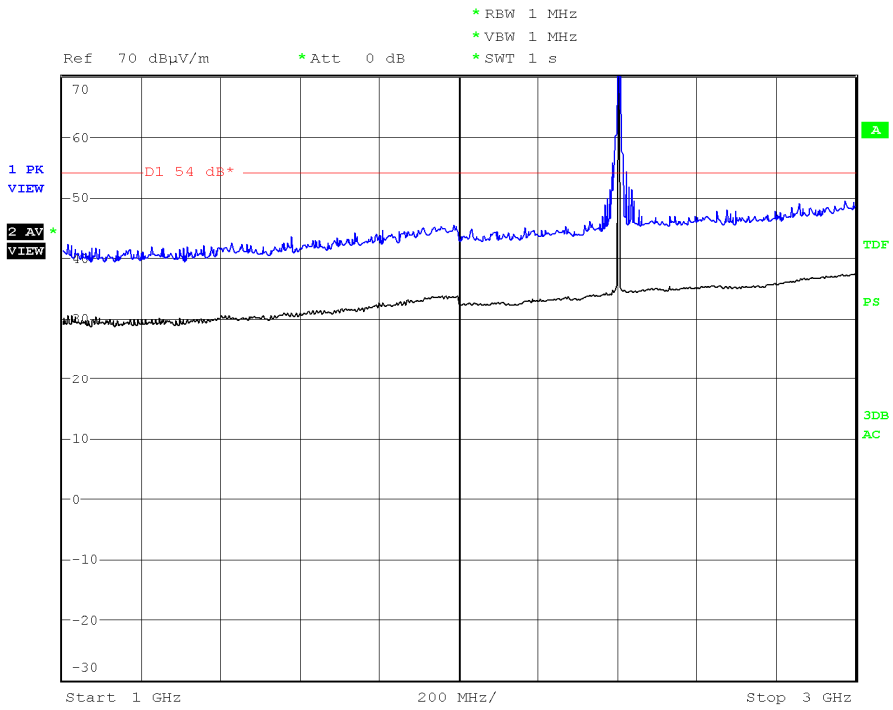
FREQUENCY RANGE 30 MHz-1000 MHz.



(This plot is valid for all three channels).

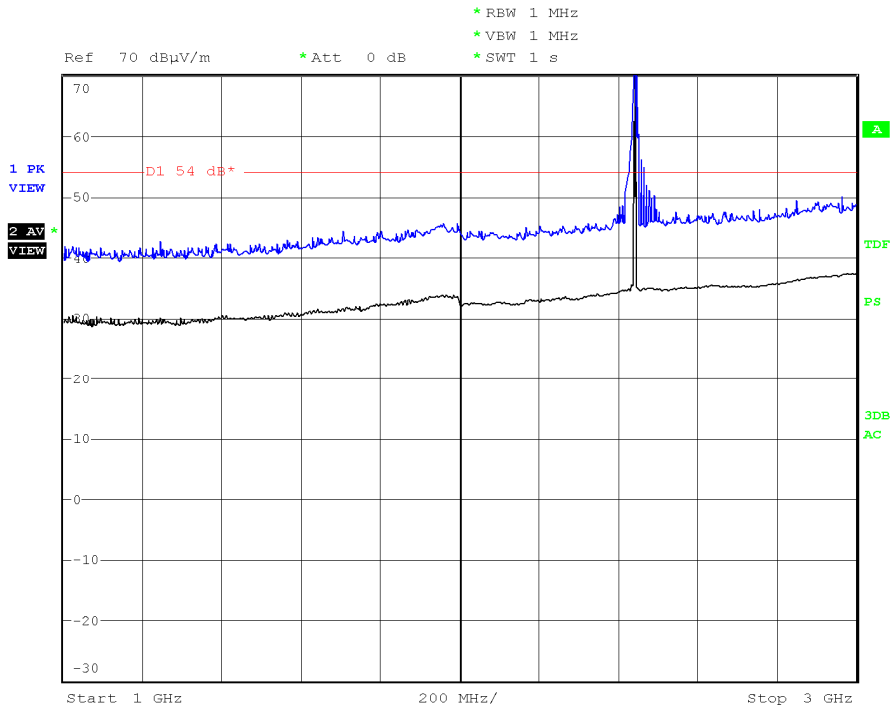
FREQUENCY RANGE 1 GHz to 3 GHz.

CHANNEL: Lowest (2403 MHz).



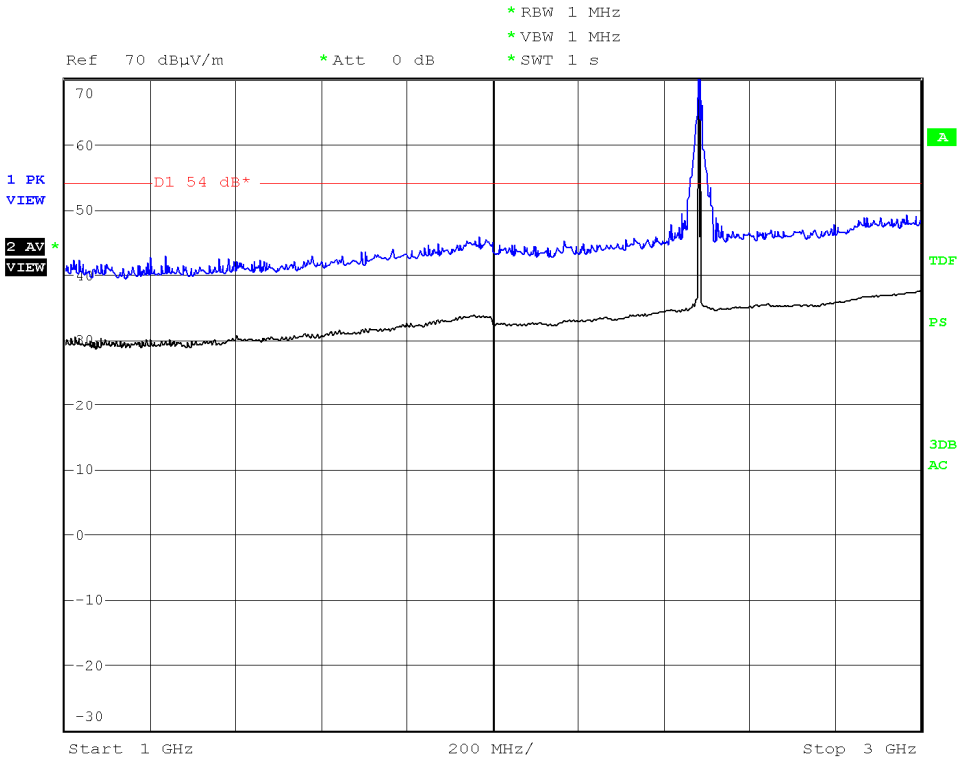
Note: The peak shown in the plot is the carrier frequency.

CHANNEL: Middle (2441 MHz).



Note: The peak shown in the plot is the carrier frequency.

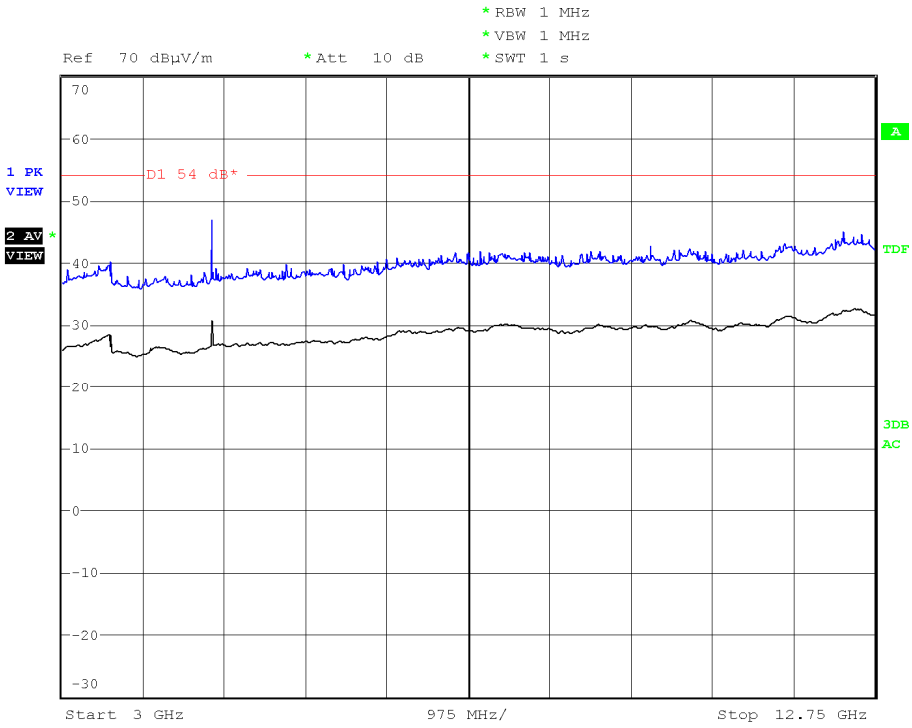
CHANNEL: Highest (2482 MHz).



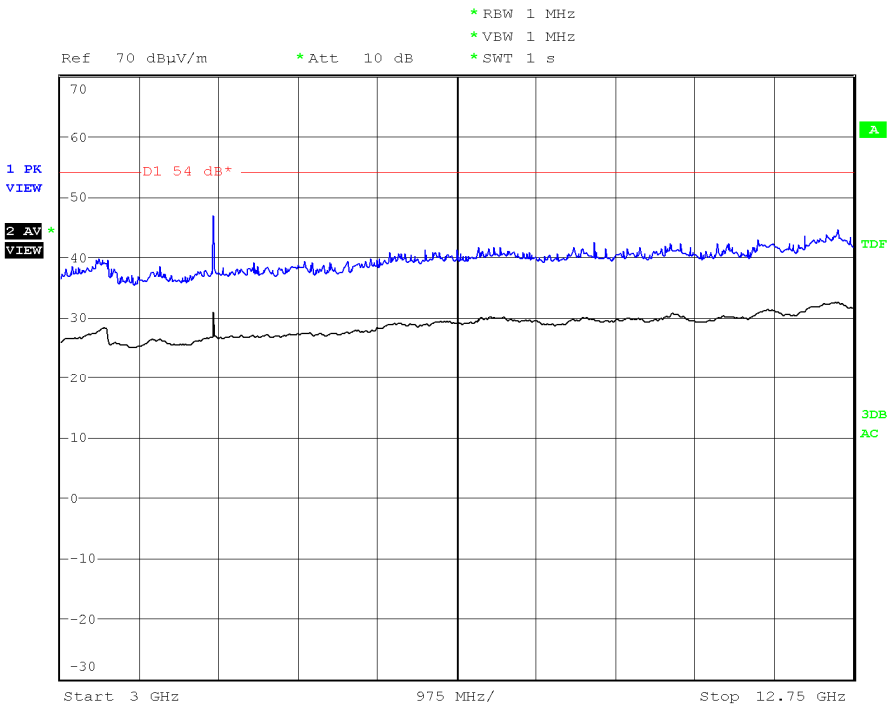
Note: The peak shown in the plot is the carrier frequency.

FREQUENCY RANGE 3 GHz to 12.75 GHz.

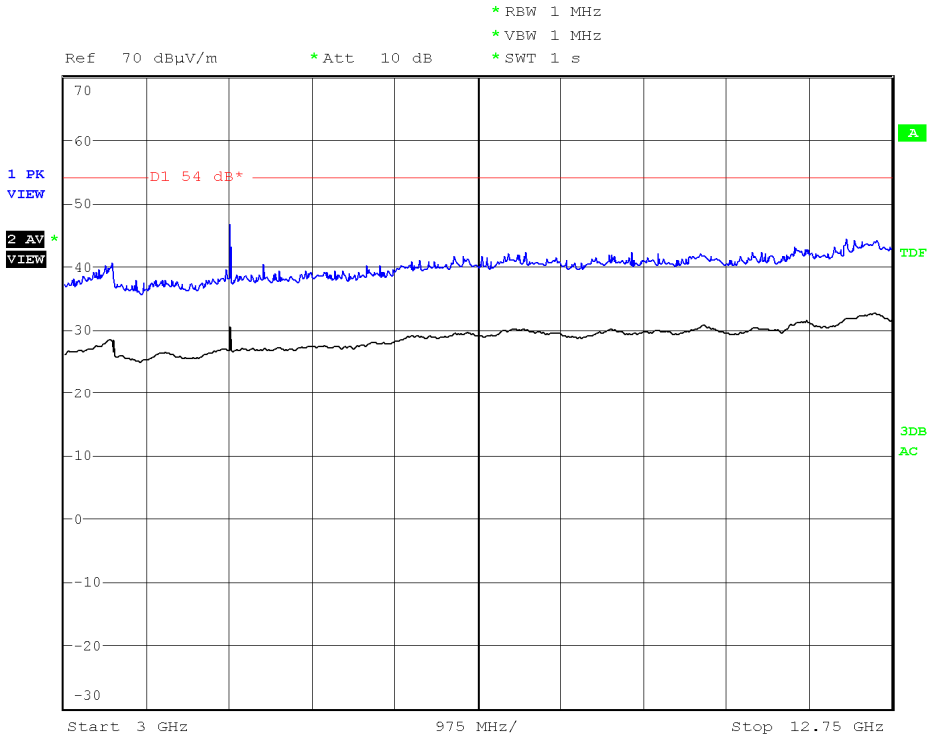
CHANNEL: Lowest (2403 MHz).



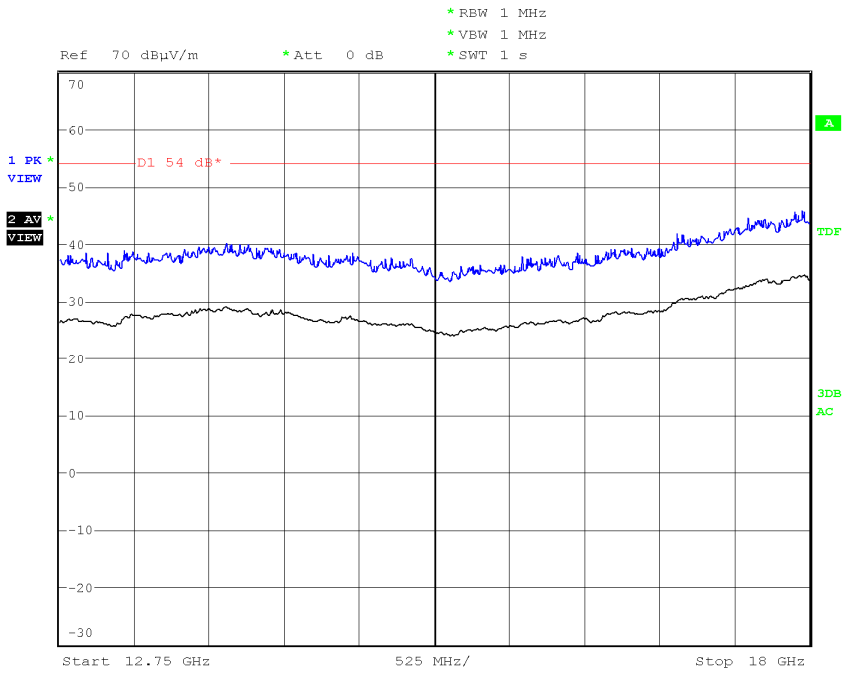
CHANNEL: Middle (2441 MHz).



CHANNEL: Highest (2482 MHz).

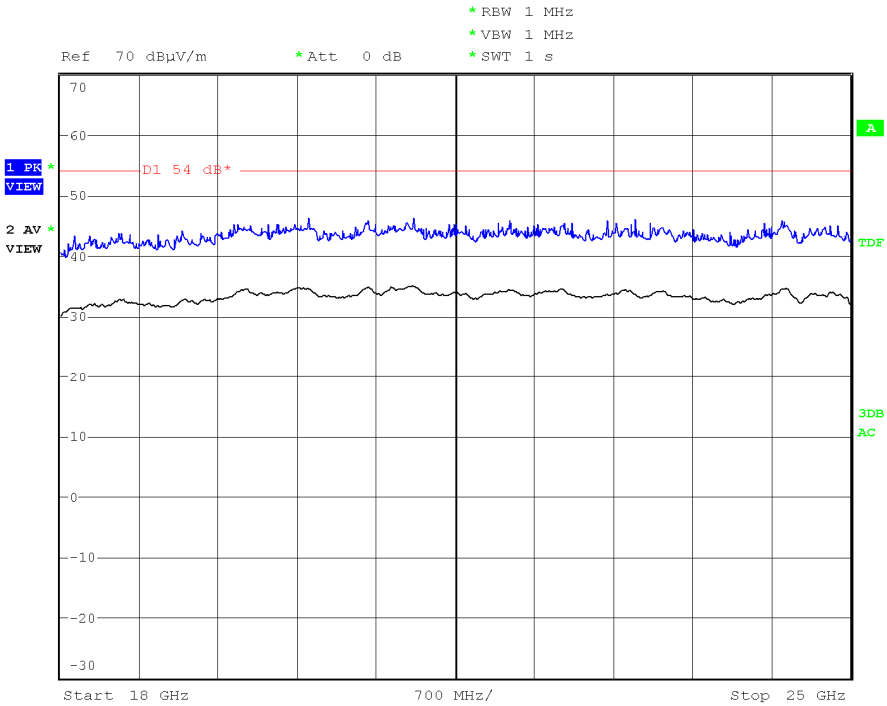


FREQUENCY RANGE 12.75 GHz to 18 GHz.



(This plot is valid for all three channels).

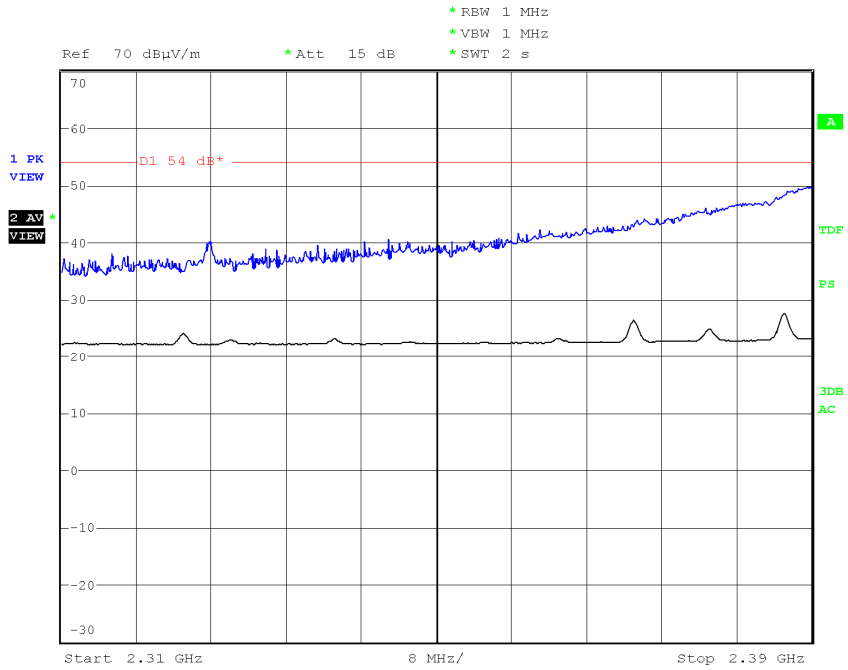
FREQUENCY RANGE 18 GHz to 25 GHz.



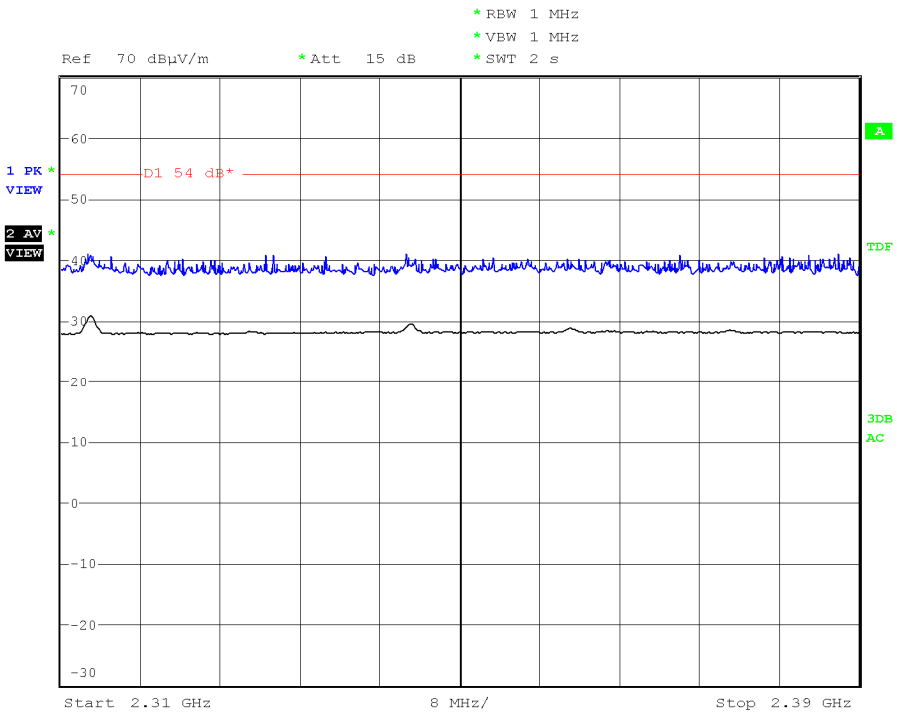
(This plot is valid for all three channels).

FREQUENCY RANGE 2.31 GHz to 2.39 GHz. (RESTRICTED BAND)

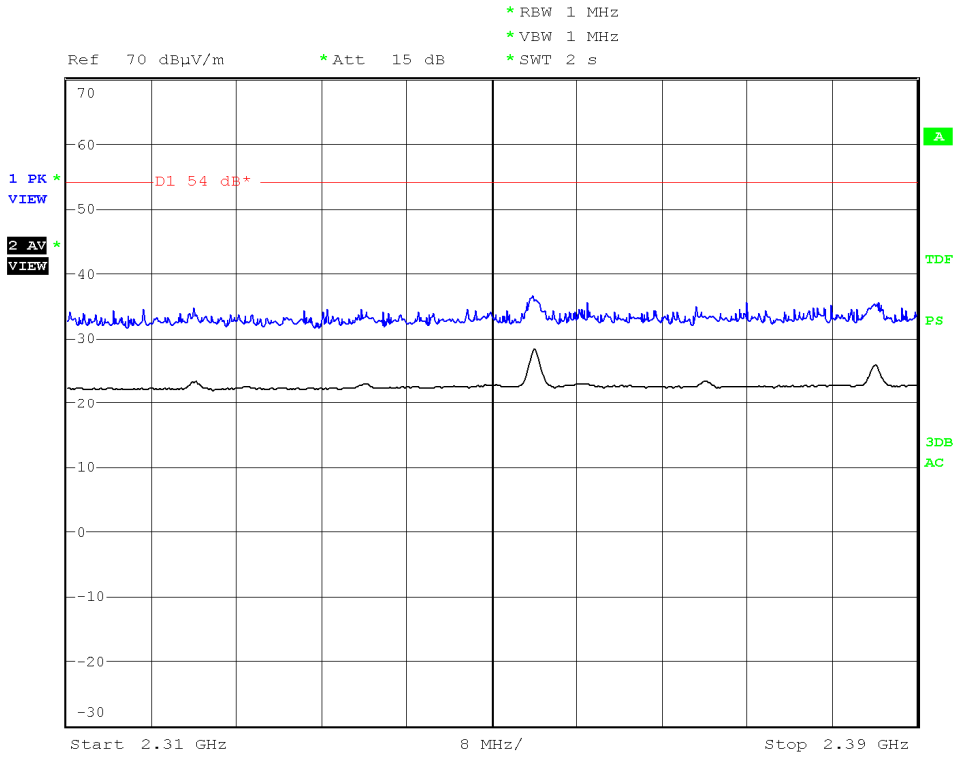
CHANNEL: Lowest (2403 MHz).



CHANNEL: Middle (2441 MHz).

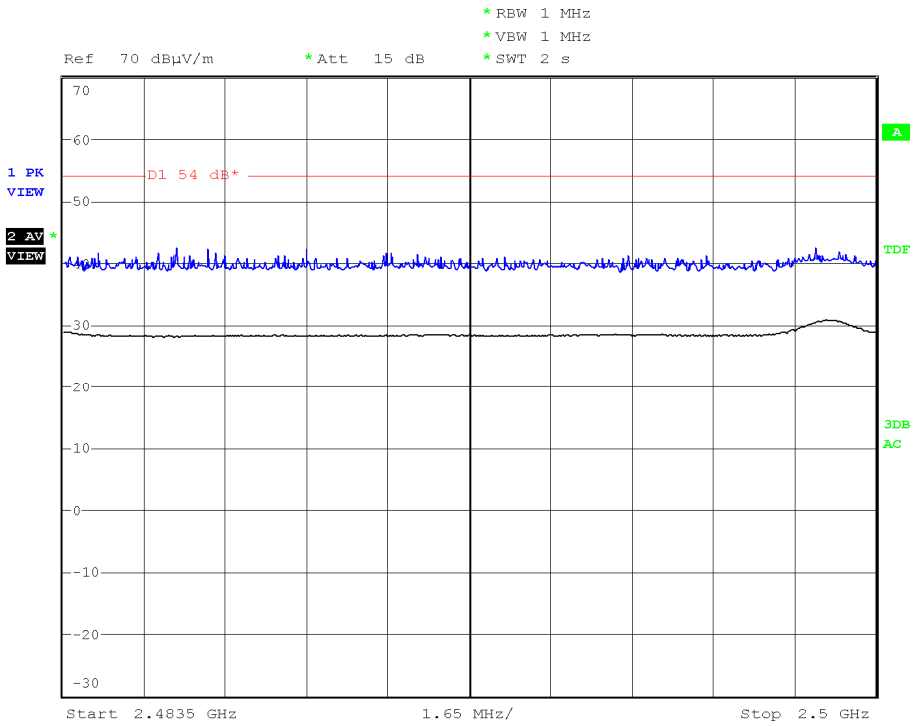


CHANNEL: Highest (2482 MHz).

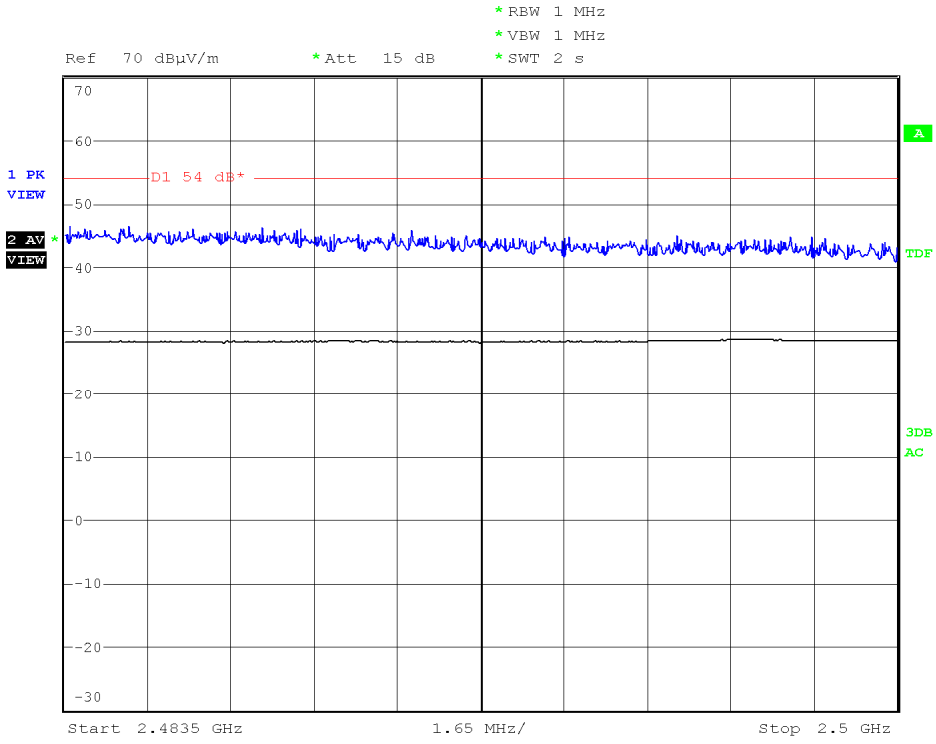


FREQUENCY RANGE 2.4835 GHz to 2.5 GHz. (RESTRICTED BAND)

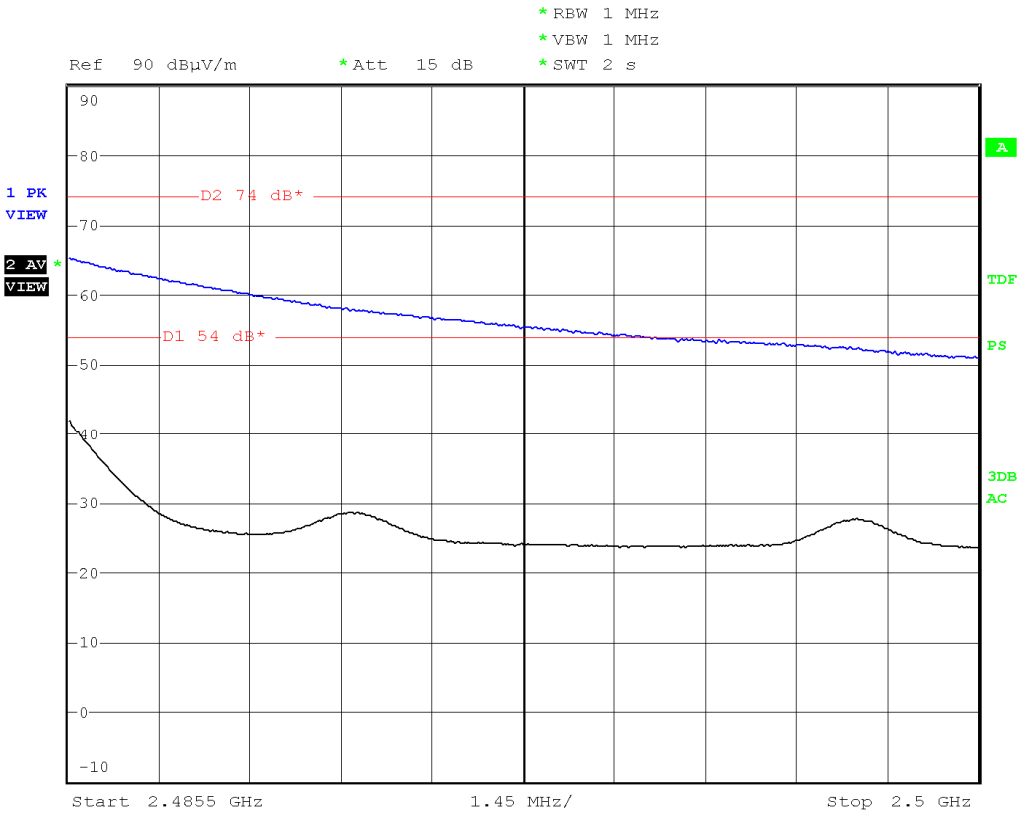
CHANNEL: Lowest (2403 MHz).



CHANNEL: Middle (2441 MHz).



CHANNEL: Highest (2482 MHz).



Section 15.109. Receiver spurious radiation

SPECIFICATION

The field strength shall not exceed the following values:

Frequency Range (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	300
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 25000	500	54	3

The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

RESULTS:

The situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

All tests were performed in a semi-anechoic chamber at a distance of 3 m for the frequency range 30 MHz-1000 MHz and at distance of 1m for the frequency range 1 GHz-25 GHz.

The field strength is calculated by adding correction factor to the measured level from the spectrum analyser. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in the three operating channels.

Frequency range 1 GHz-25 GHz

1. CHANNEL: LOWEST (2403 MHz).

Spurious frequency (MHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
2748.6058	V	Peak	48.66	± 4.0
2748.6058	V	Average	46.89	± 4.0

2. CHANNEL: MIDDLE (2441 MHz).

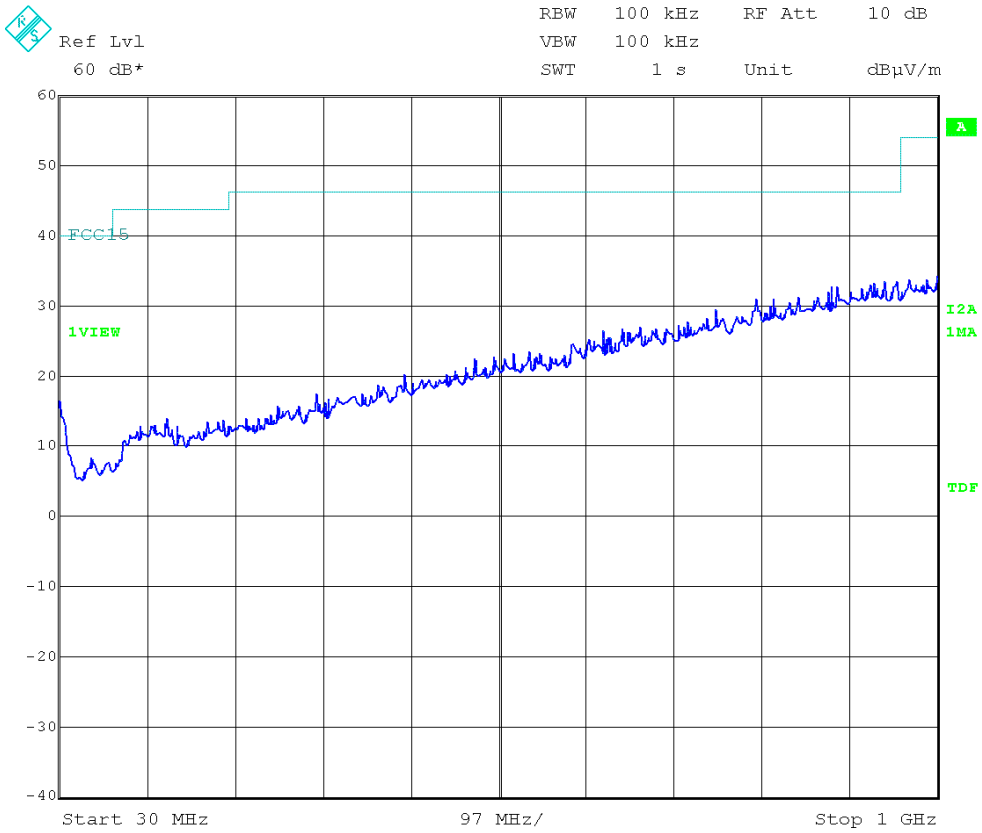
Spurious frequency (MHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
2791.9872	V	Peak	48.93	± 4.0
2791.9872	V	Average	48.17	± 4.0

3. CHANNEL: HIGHEST (2482 MHz).

Spurious frequency (MHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
2838.8942	V	Peak	47.03	± 4.0
2838.8942	V	Average	46.05	± 4.0

Verdict: PASS.

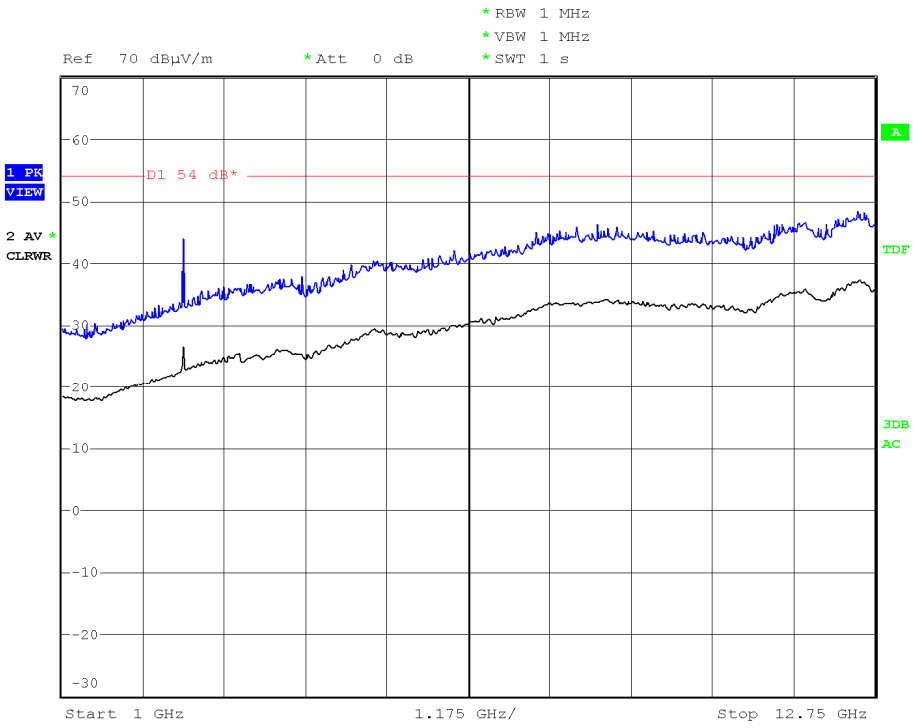
FREQUENCY RANGE 30 MHz-1000 MHz.



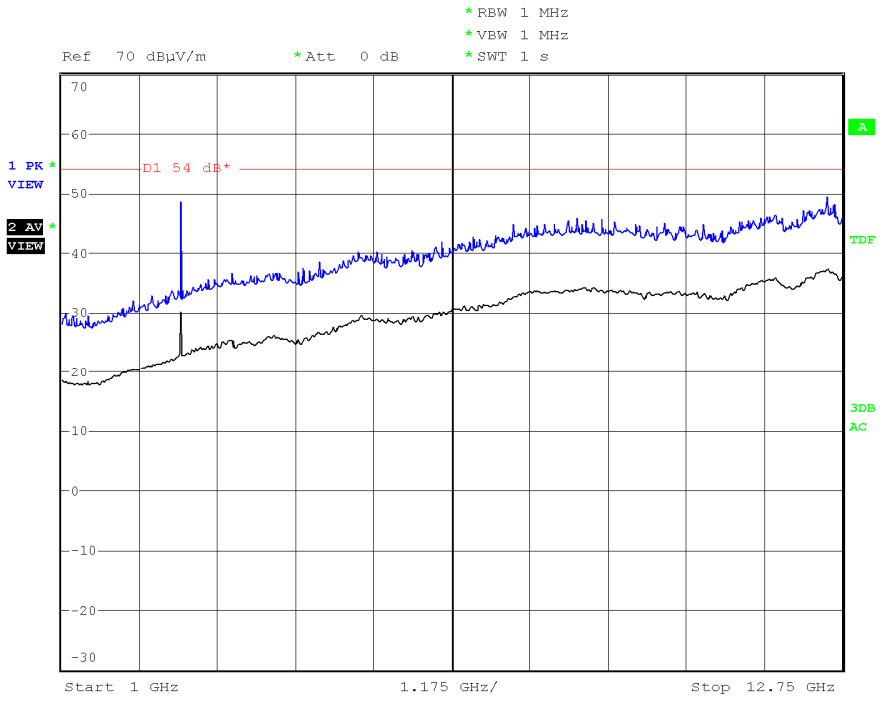
(This plot is valid for all three channels).

FREQUENCY RANGE 1 GHz-12.75 GHz.

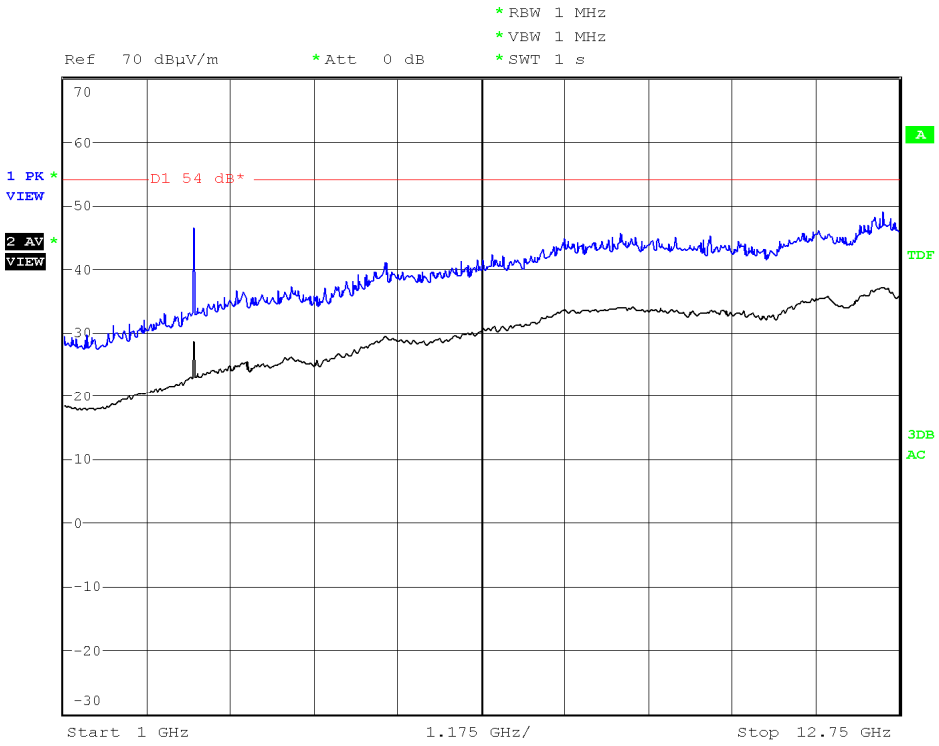
CHANNEL: Lowest (2403 MHz).



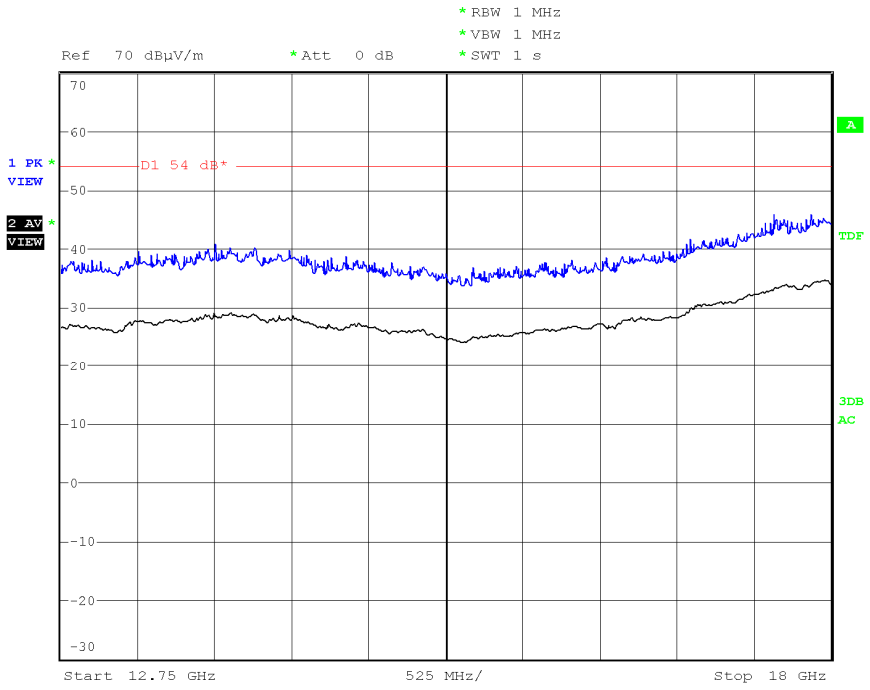
CHANNEL: Middle (2441 MHz).



CHANNEL: Highest (2482 MHz).

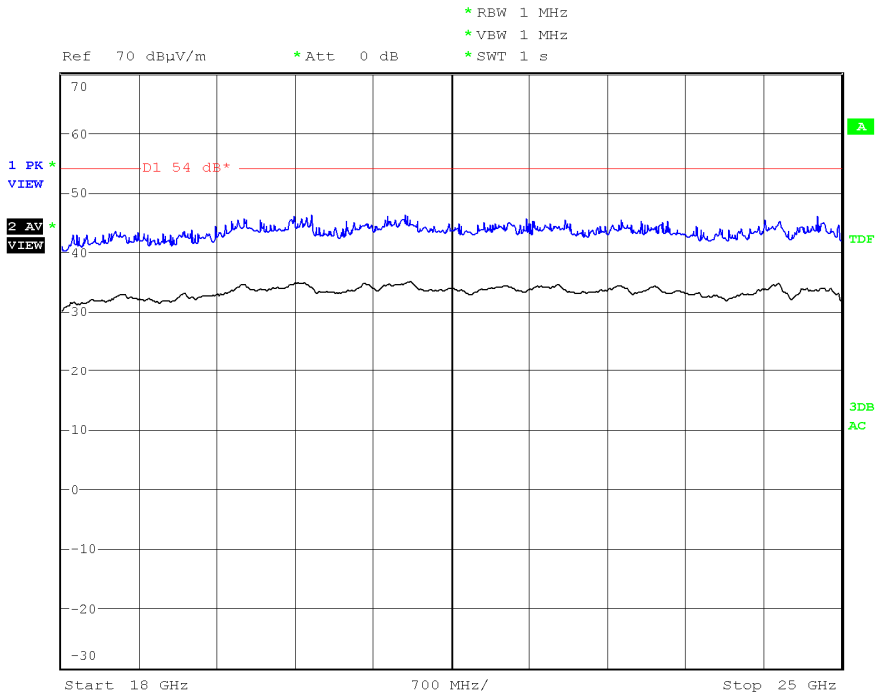


FREQUENCY RANGE 12.75 GHz-18 GHz.



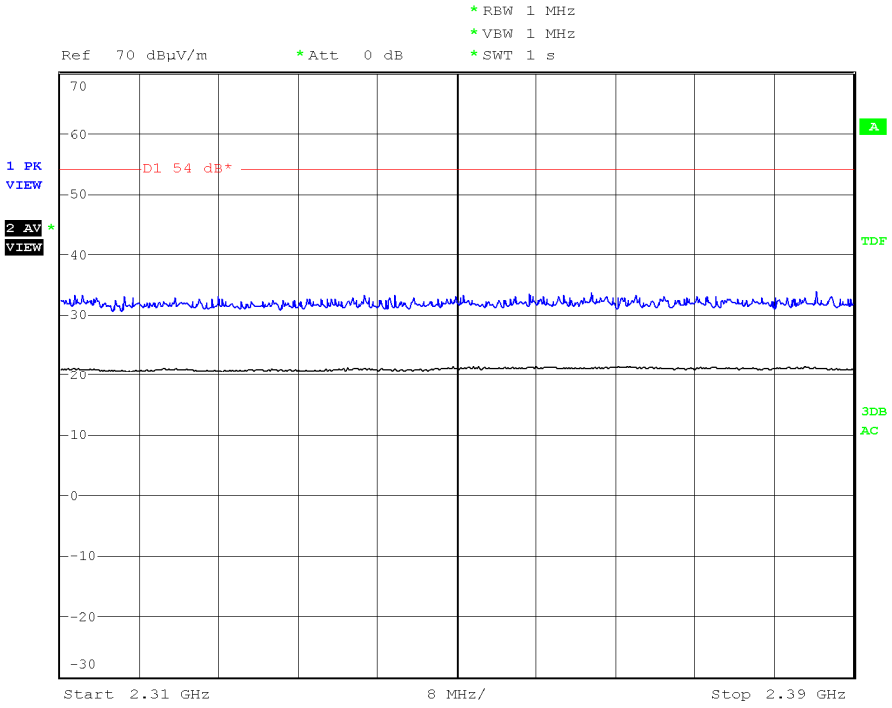
(This plot is valid for all three channels).

FREQUENCY RANGE 18 GHz-25 GHz.



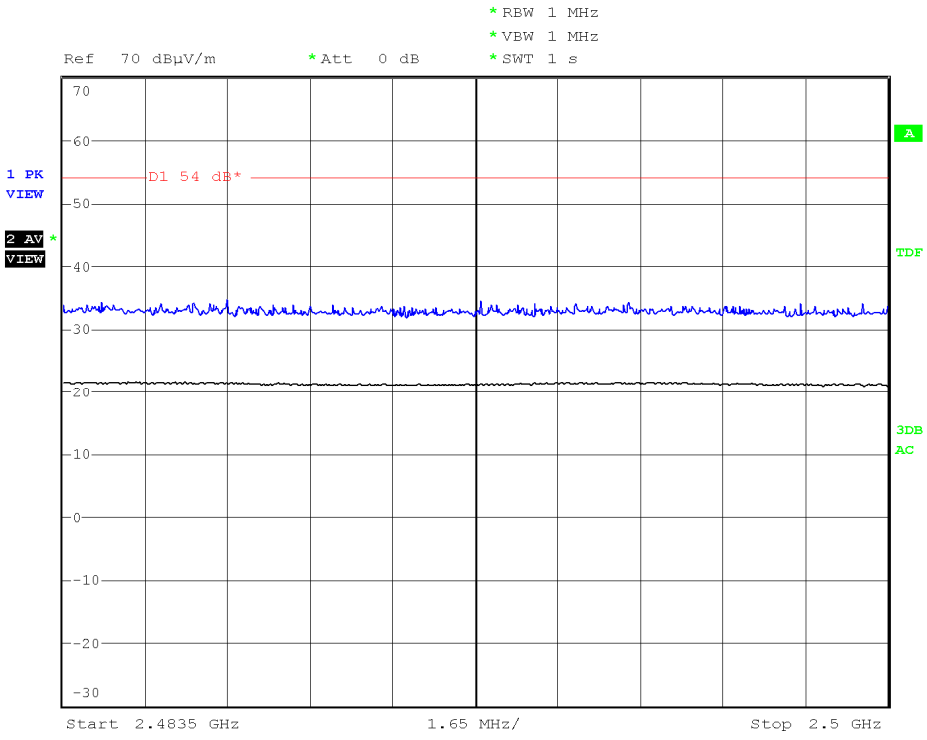
(This plot is valid for all three channels).

FREQUENCY RANGE 2.31 GHz to 2.39 GHz. (RESTRICTED BAND)



(This plot is valid for all three channels).

FREQUENCY RANGE 2.4835 GHz to 2.5 GHz. (RESTRICTED BAND)



(This plot is valid for all three channels).