

**FCC LISTED, REGISTRATION
NUMBER: 905266**

**IC LISTED REGISTRATION NUMBER
IC 4621A-1**

AT4 wireless, S.A.

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Libro 82, Folio 133, Hoja MA3729

TEST REPORT

REFERENCE STANDARD:

USA FCC Part 15.247, 15.109

CANADA RSS-210, RSS-Gen

Radio Frequency Devices. Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz.

Licence-Exempt Radio Apparatus (All Frequency Bands): Category I Equipment.

General Requirements and Information for the Certification of Radio Apparatus.

NIE..... : 37331RRF.001

Approved by
(name / position & signature) : A. Llamas / RF Lab. Manager

Elaboration date : 2012-12-20

Identification of item tested : Heart Rate Sensor

Trademark : Polar

Model and/or type reference : X9

Serial number : ---

Other identification of the product : Commercial name: Polar H6 Heart Rate Sensor
HW version: 2.0 / SW version: R-2
FCC ID: INWX9
IC: 6248A-X9

Features : Bluetooth Low Energy V. 4.0, 3 V Lithium battery

Description : Heart Rate Sensor, HRP, HRS and Battery profile supported

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: See Standard

Standard: USA FCC Part 15.247 10-1-11 Edition: Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz.

USA FCC Part 15.209 10-1-11 Edition: Radiated emission limits; general requirements.

Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 558074 D01 DTS Meas Guidance v02 dated 10/04/2012.

CANADA RSS-210 Issue 8 (December 2010).

CANADA RSS-Gen Issue 3 (December 2010).

ANSI C63.10-2009: American National Standard for Testing Unlicensed Wireless Devices.

Test procedure: PERF034.

Non-standardized test method: N/A

Used instrumentation:

<u>Conducted Measurements</u>						
					Last Cal. date	Cal. due date
1.	Spectrum analyser	Agilent	PSA	E4440A	2012/02	2014/02
2.	DC power supply	R&S	NGPE	40/40	2011/11	2014/11

<u>Radiated Measurements</u>						
					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	2011/05	2014/05
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	2011/05	2014/05
7.	Double-ridge Guide Horn antenna			18-40 GHz Agilent 119665J	2011/09	2014/09
8.	EMI Test Receiver	R&S		ESIB26	2011/11	2013/11
9.	RF pre-amplifier	Miteq		JS4-12002600-30-5A.	2012/07	2014/07
10.	Multi Device Controller	EMCO		2090	N.A.	N.A.
11.	Spectrum Analyzer	Agilent		E4440A	2012/02	2014/02
12.	RF pre-amplifier	Miteq		AFS5-04001300-15-10P-6.	2012/07	2014/07
13.	RF pre-amplifier	Schaffner		CPA 9231A.	2011/06	2013/06

Report template No.: FDT08_14

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Competences and guarantees

AT4 wireless 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 conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Registration Number: 905266.

AT4 wireless 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 4621A-1.

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 formed by the following elements:

<u>Control No.</u>	<u>Description</u>	<u>Model</u>	<u>Serial No.</u>	<u>Date of reception</u>
37331B/02	Heart rate sensor with integral antenna (2402 MHz)	X9	---	16/11/2012
37331B/01	Heart rate sensor with integral antenna (2440 MHz)	X9	---	16/11/2012
37331B/03	Heart rate sensor with integral antenna (2480 MHz)	X9	---	16/11/2012

Sample M/02 is formed by the following elements:

<u>Control No.</u>	<u>Description</u>	<u>Model</u>	<u>Serial No.</u>	<u>Date of reception</u>
37331B/08	Heart rate sensor with antenna connector (2402 MHz)	X9	---	16/11/2012
37331B/06	Heart rate sensor with antenna connector (2440 MHz)	X9	---	16/11/2012
37331B/07	Heart rate sensor with antenna connector (2480 MHz)	X9	---	16/11/2012

Sample M/03 is formed by the following elements:

<u>Control No.</u>	<u>Description</u>	<u>Model</u>	<u>Serial No.</u>	<u>Date of reception</u>
37451/22	Heart rate sensor with antenna connector (2402 MHz)	X9	---	04/10/2012
37451/19	Heart rate sensor with antenna connector (2440 MHz)	X9	---	04/10/2012
37451/09	Heart rate sensor with antenna connector (2480 MHz)	X9	---	04/10/2012

1. Sample M/01 has undergone following test(s).
Emission limitations radiated (including Band-Edge) test indicated in appendix A.
2. Sample M/02 has undergone following test(s).
99%, 26 dB and 6 dB Bandwidth; Emission limitations conducted (including Band-Edge) tests indicated in appendix A.
3. Sample M/03 has undergone following test(s).
Maximum output power and antenna gain; Power spectral density tests indicated in appendix A.

Testing period

The performed test started on 2012-10-29 and finished on 2012-11-23

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. = 21.9 °C Max. = 23.3 °C
Relative humidity	Min. = 48.0 % Max. = 50.6 %
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. = 19.0 °C Max. = 19.4 °C
Relative humidity	Min. = 44 % Max. = 45 %
Air pressure	Min. = 1020 mbar Max. = 1020 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. = 22.5 °C Max. = 25.6 °C
Relative humidity	Min. = 44.9 % Max. = 46.2 %
Air pressure	Min. = 1019 mbar Max. = 1019 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 Parts 15.247 and 15.209 / RSS-210, the item 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 verdicts

Not applicable: NA

Pass.....: P

Fail: F

Not measured.....: NM

FCC PART 15 PARAGRAPH / RSS-210		VERDICT			
		NA	P	F	NM
Section 15.247 Subclause (a) (2) / RSS-210 A8.2. (a)	6 dB Bandwidth		P		
Section 15.247 Subclause (b) / RSS-210 A8.4. (4)	Maximum output power and antenna gain		P		
Section 15.247 Subclause (d) / RSS-210 A8.5.	Emission limitations conducted (Transmitter)		P		
Section 15.247 Subclause (d) / RSS-210 A8.5.	Band-edge emissions compliance (Transmitter)		P		
Section 15.247 Subclause (e) / RSS-210 A8.2. (b)	Power spectral density		P		
Section 15.247 Subclause (d) / RSS-210 A8.5.	Emission limitations radiated (Transmitter)		P		

APPENDIX A: Test result

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TEST CONDITIONS

Power supply (V):

$$V_{\text{nominal}} = 3.0 \text{ Vdc}$$

Type of power supply = DC voltage from Lithium battery.

Type of antenna = Integral antenna.

Declared Gain for antenna = 1.7 dBi

TEST FREQUENCIES:

Lowest channel: 2402 MHz

Middle channel: 2440 MHz

Highest channel: 2480 MHz

The test set-up was made in accordance to the general provisions of ANSI C63.4: 2009.

CONDUCTED MEASUREMENTS

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

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 360° 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.

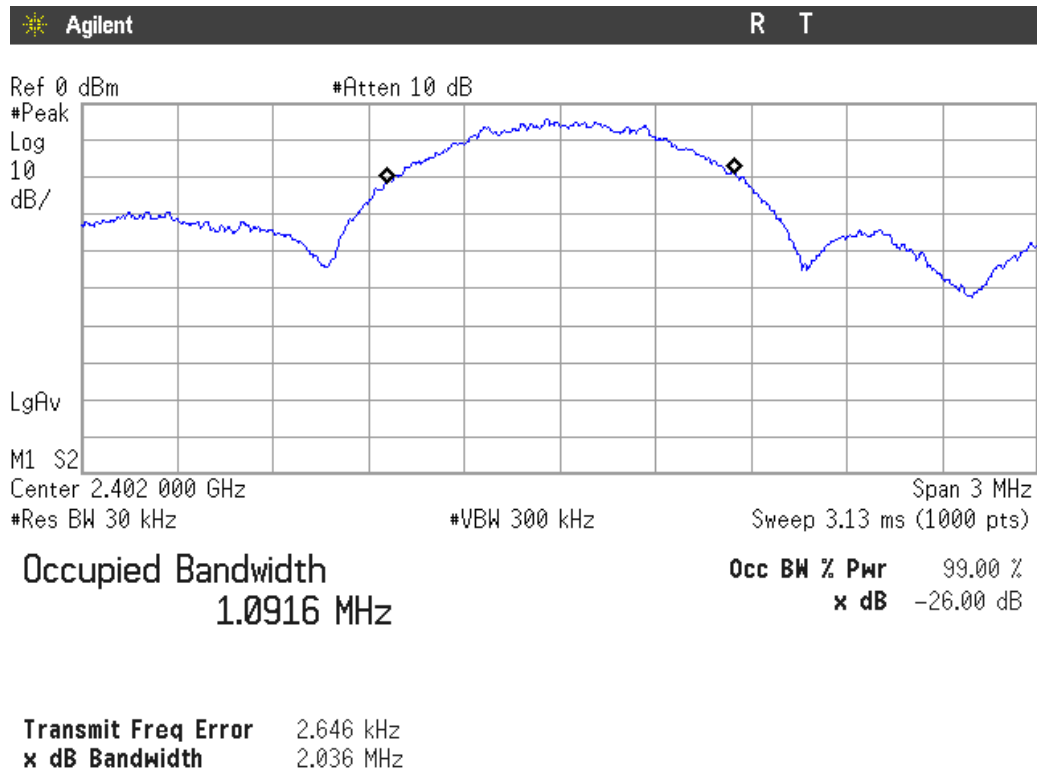
99 % and 26 dB Bandwidth

RESULTS

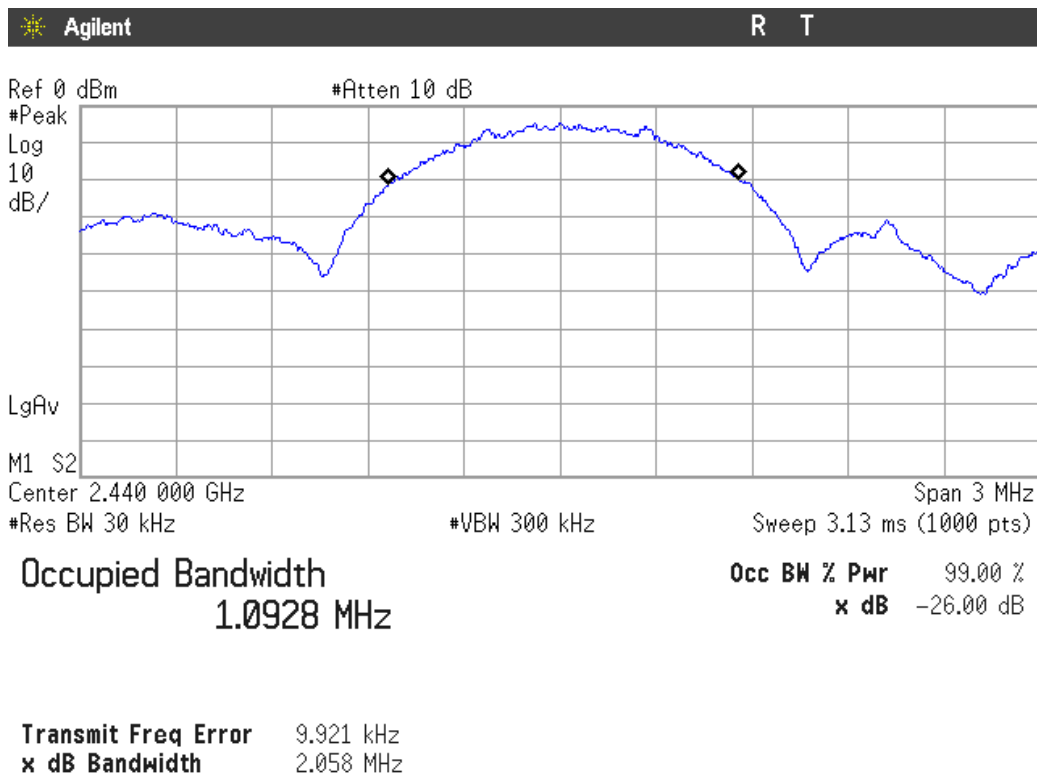
(see next plots).

	Lowest frequency 2402 MHz	Middle frequency 2440 MHz	Highest frequency 2480 MHz
99% bandwidth (MHz)	1.09	1.09	1.09
26 dB bandwidth (MHz)	2.04	2.06	2.39
Measurement uncertainty (kHz)	±21.7		

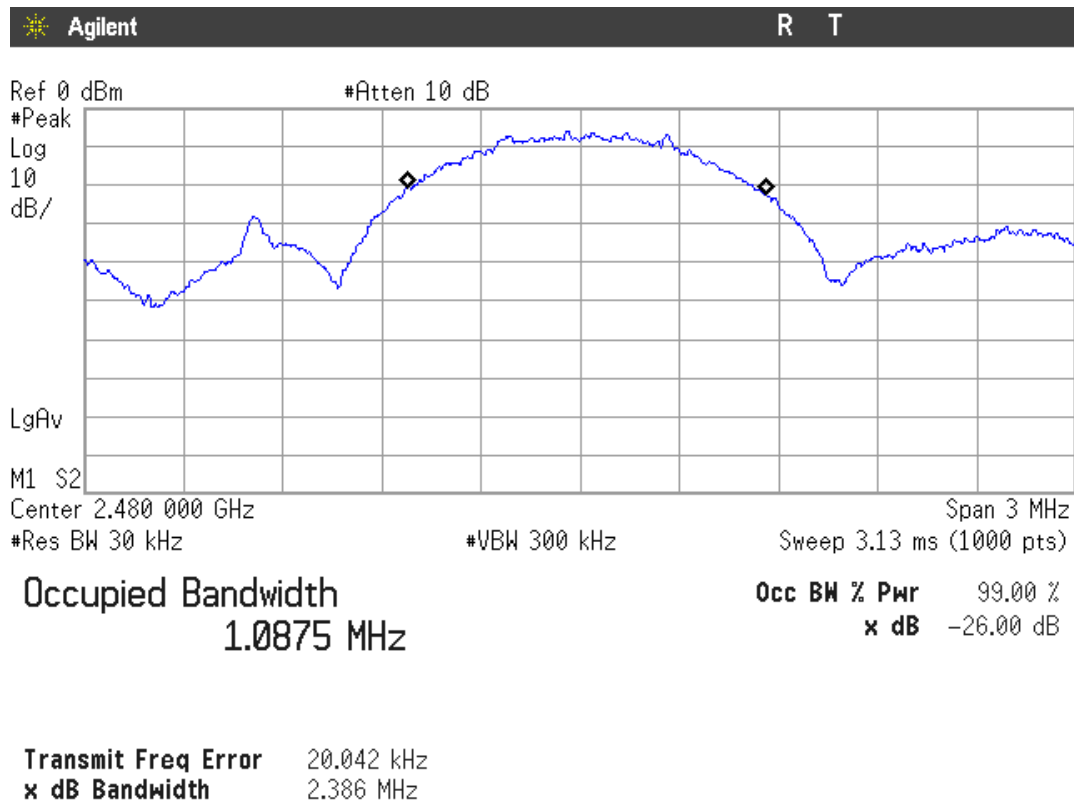
Lowest Channel



Middel Channel



Highest channel



Section 15.247 Subclause (a) (2). 6 dB Bandwidth

SPECIFICATION

The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS

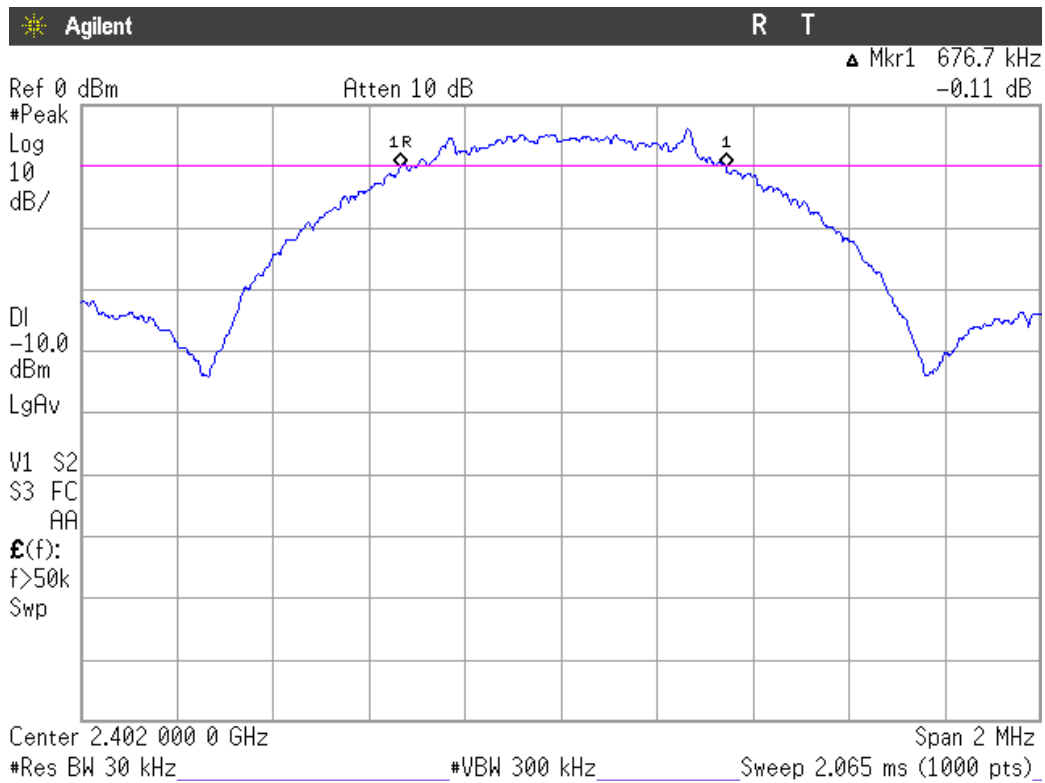
6 dB Bandwidth (see next plots).

	Lowest frequency	Middle frequency	Highest frequency
	2402 MHz	2440 MHz	2480 MHz
6 dB Spectrum bandwidth (kHz)	676.7	706.7	672.7
Measurement uncertainty (kHz)	±21.7		

Verdict: PASS

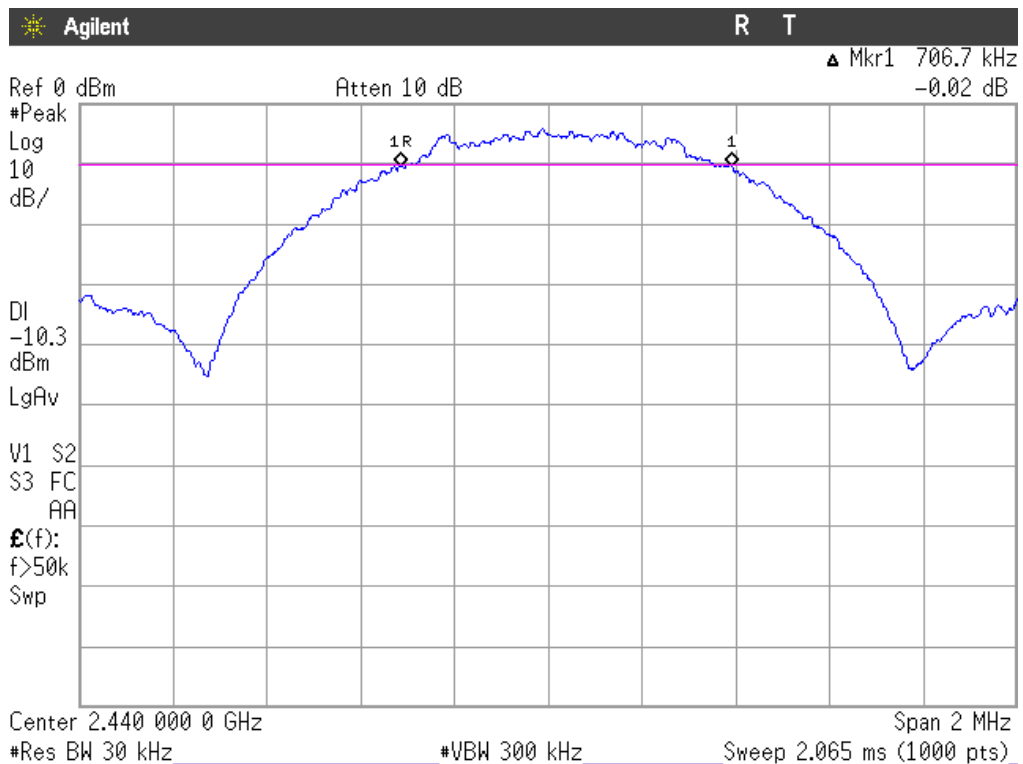
6 dB BANDWIDTH.

Lowest Channel



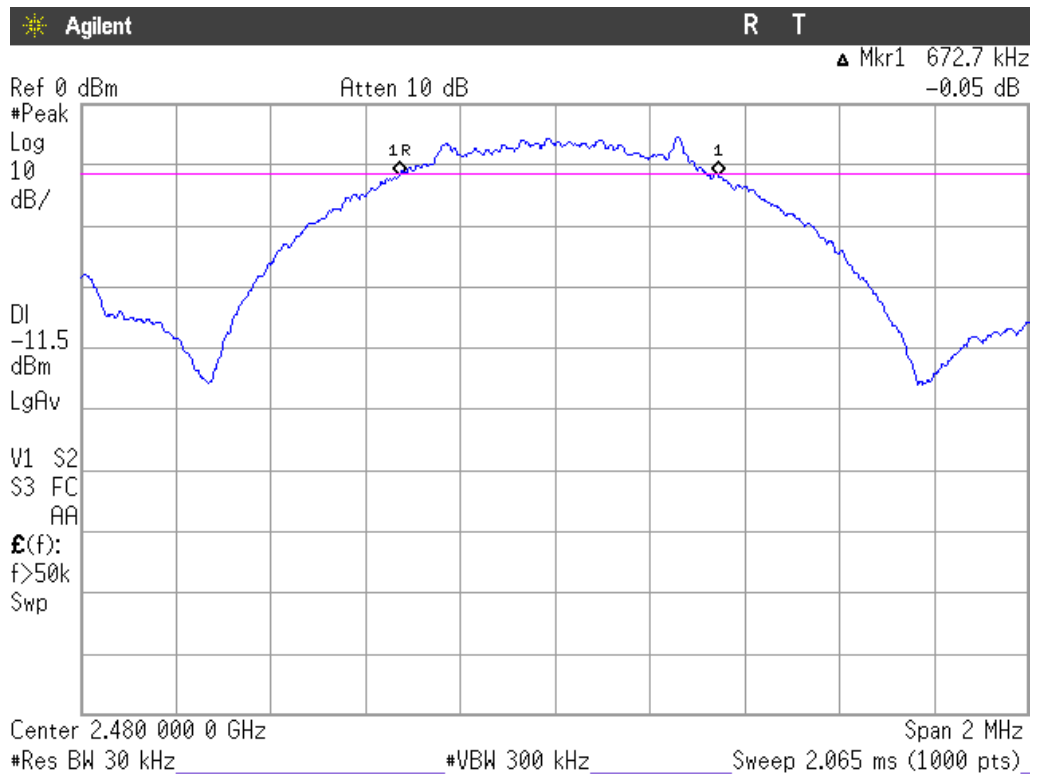
6 dB BANDWIDTH.

Middle Channel



6 dB BANDWIDTH.

Highest Channel



Section 15.247 Subclause (b). Maximum output power and antenna gain

SPECIFICATION

For systems using digital modulation in the 2400-2483.5 MHz band: 1 watt (30 dBm).

RESULTS

The maximum Peak Conducted Output Power was measured using the method according to point 8.1.1. Option 1 of Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 558074 D01 DTS Meas Guidance v02 dated 10/04/2012.

MAXIMUM OUTPUT POWER. See next plots.

Maximum declared antenna gain: 1.7 dBi

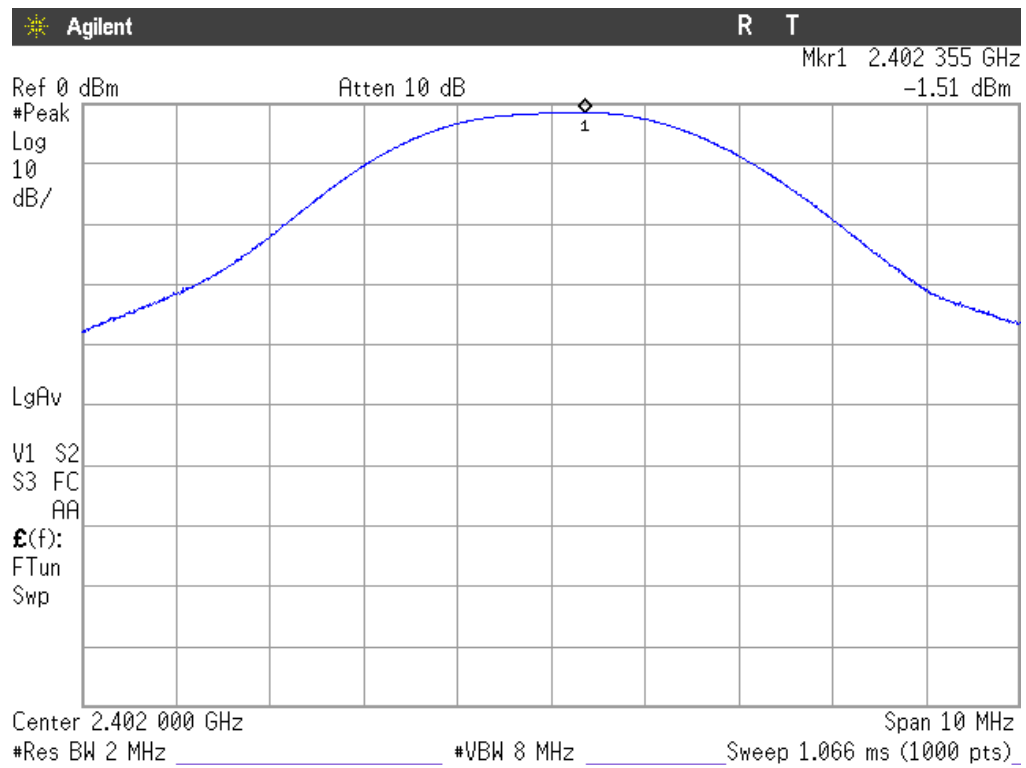
	Lowest frequency 2402 MHz	Middle frequency 2440 MHz	Highest frequency 2480 MHz
Maximum conducted power (dBm)	-1.51	-1.75	-2.31
Maximum EIRP power (dBm)	0.19	-0.05	-0.61
Measurement uncertainty (dB)	±1.5		

The maximum directional gain of the antenna is less than 6 dBi and therefore the maximum output power is not required to be reduced from the stated values.

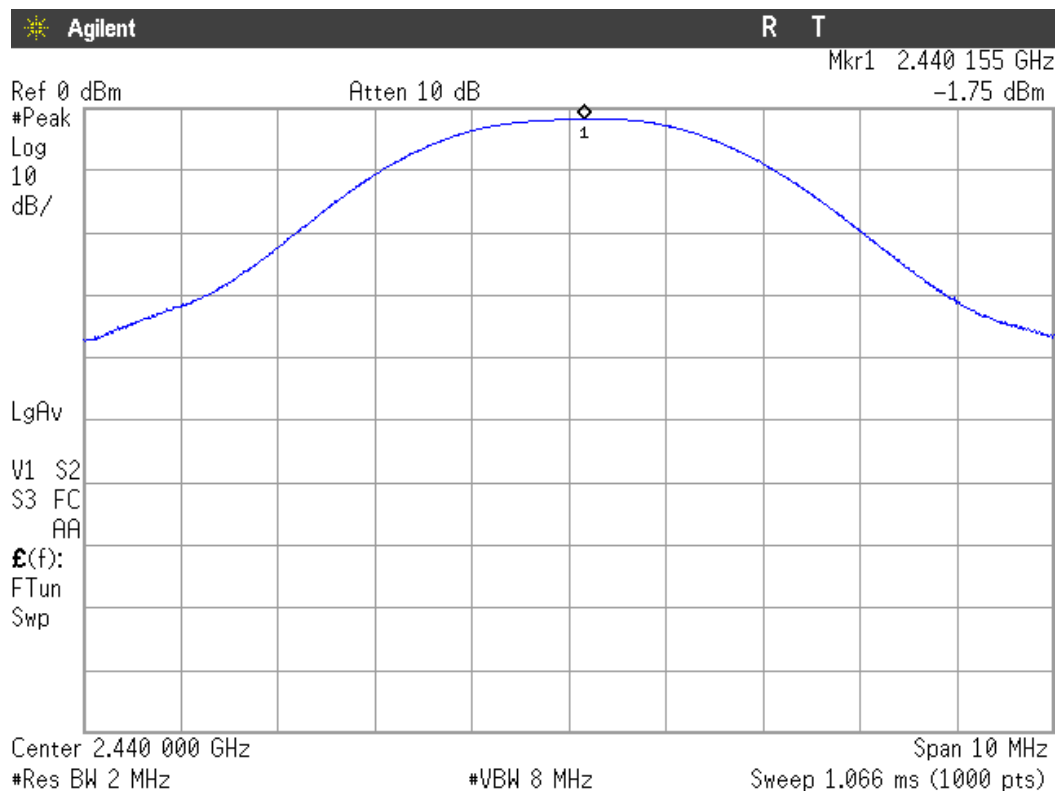
Verdict: PASS

1. MAXIMUM CONDUCTED PEAK POWER.

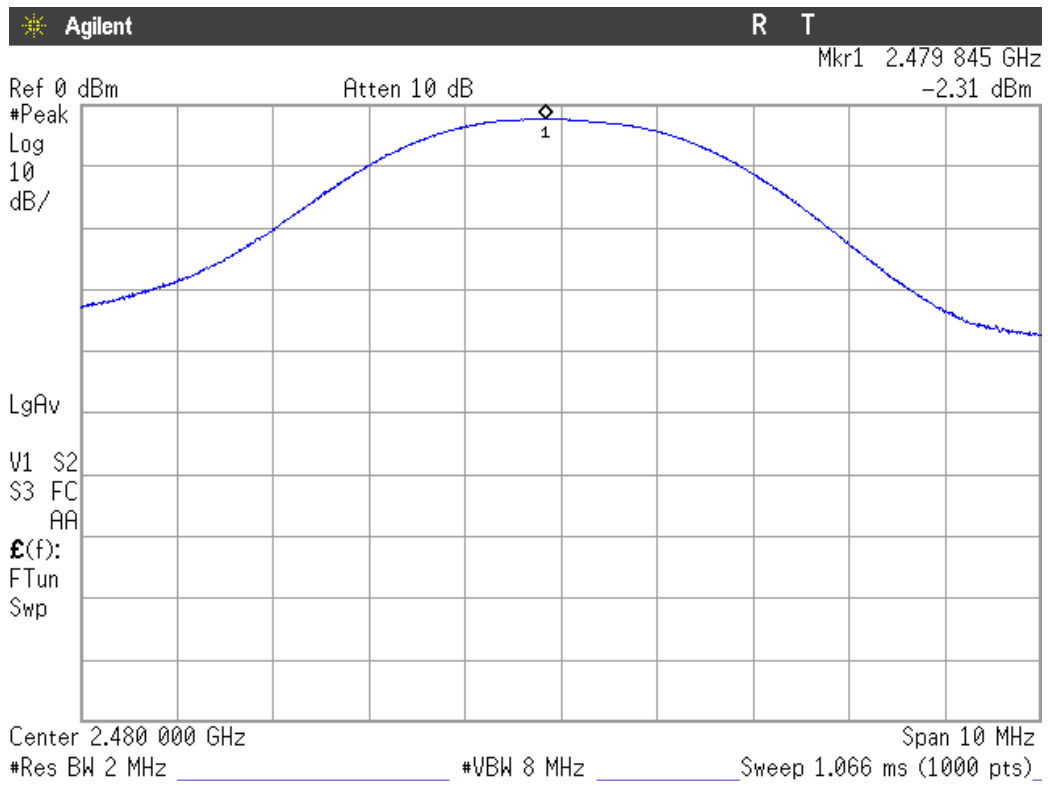
Lowest frequency



Middle frequency



Highest frequency



Section 15.247 Subclause (d). Emission limitations conducted (Transmitter)

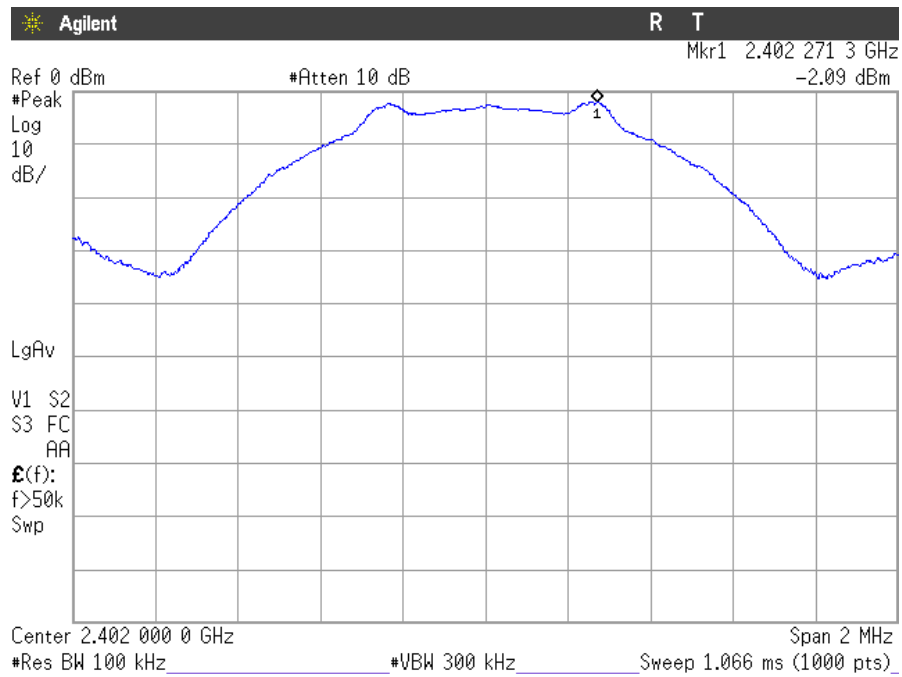
SPECIFICATION

In any 100 kHz bandwidth outside the frequency band in which the digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

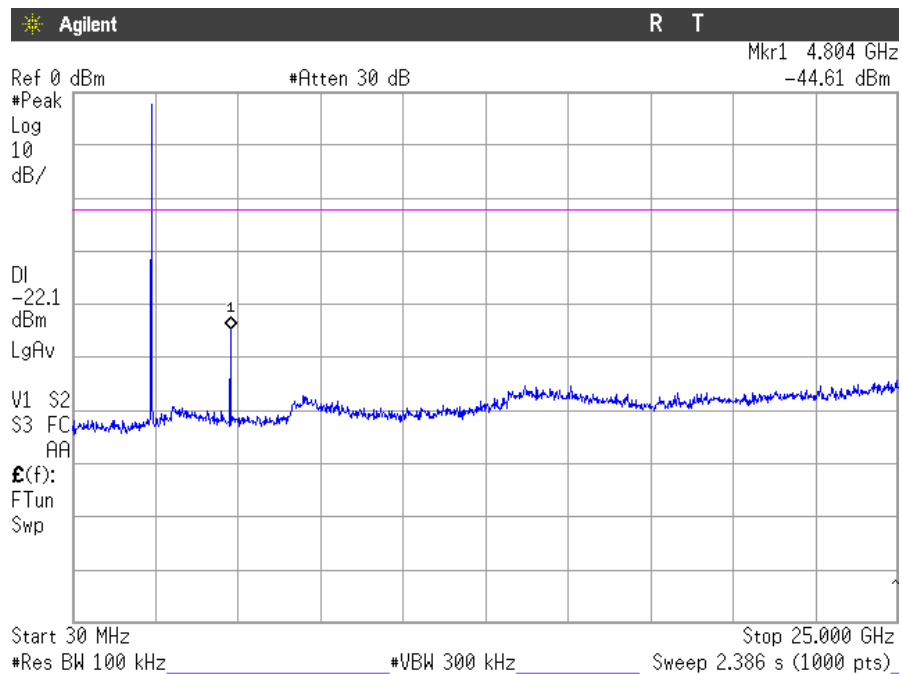
RESULTS:

Lowest Channel

Reference Level Measurement



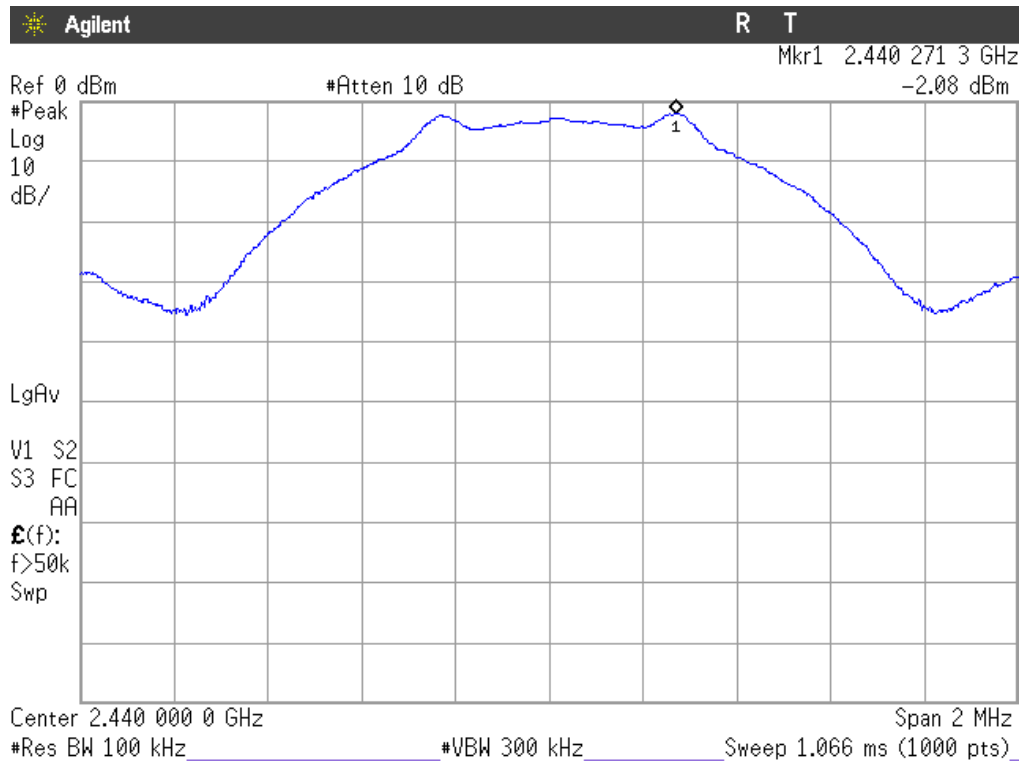
Unwanted Emissions Level Measurement



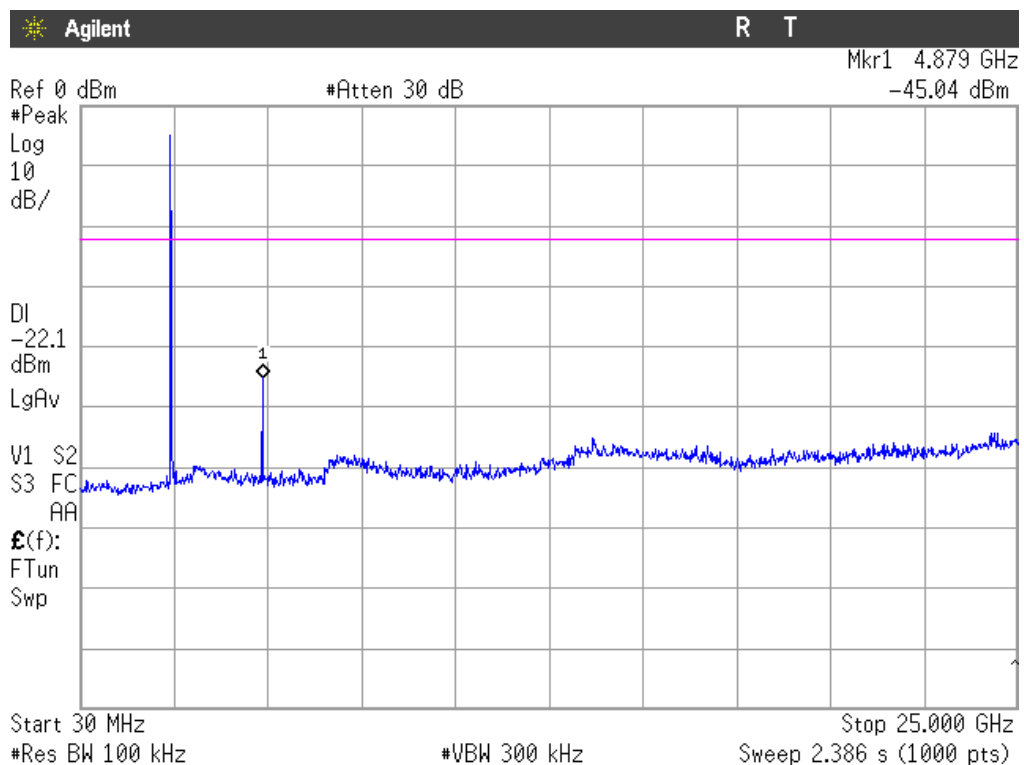
Note: The peak above the limit is the carrier frequency.

Middle Channel

Reference Level Measurement



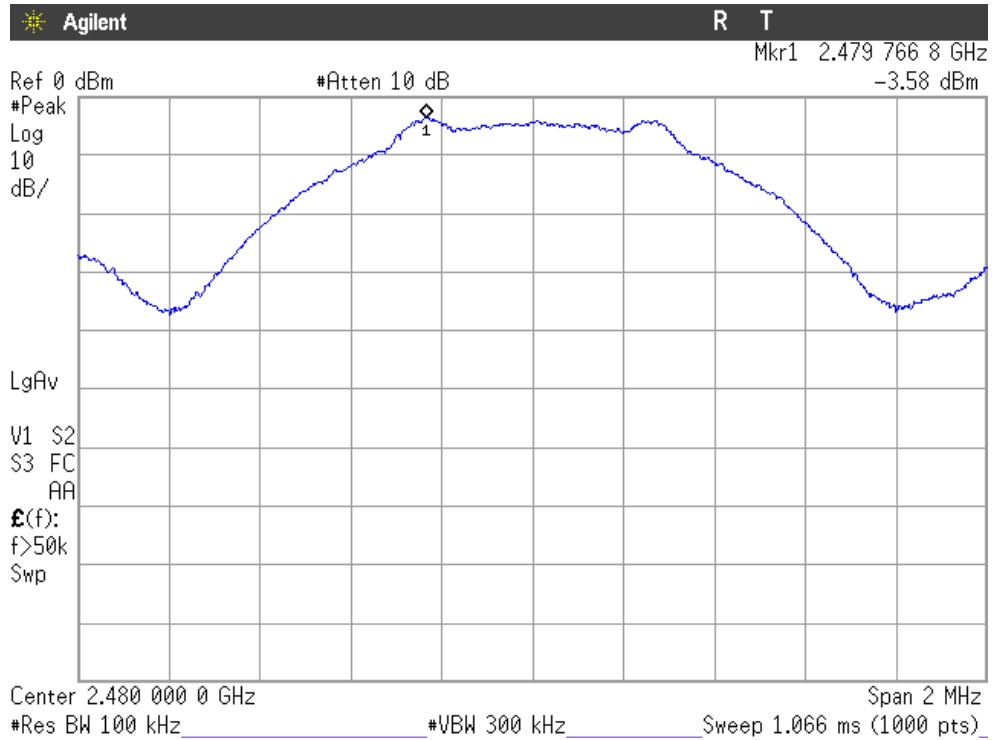
Unwanted Emissions Level Measurement



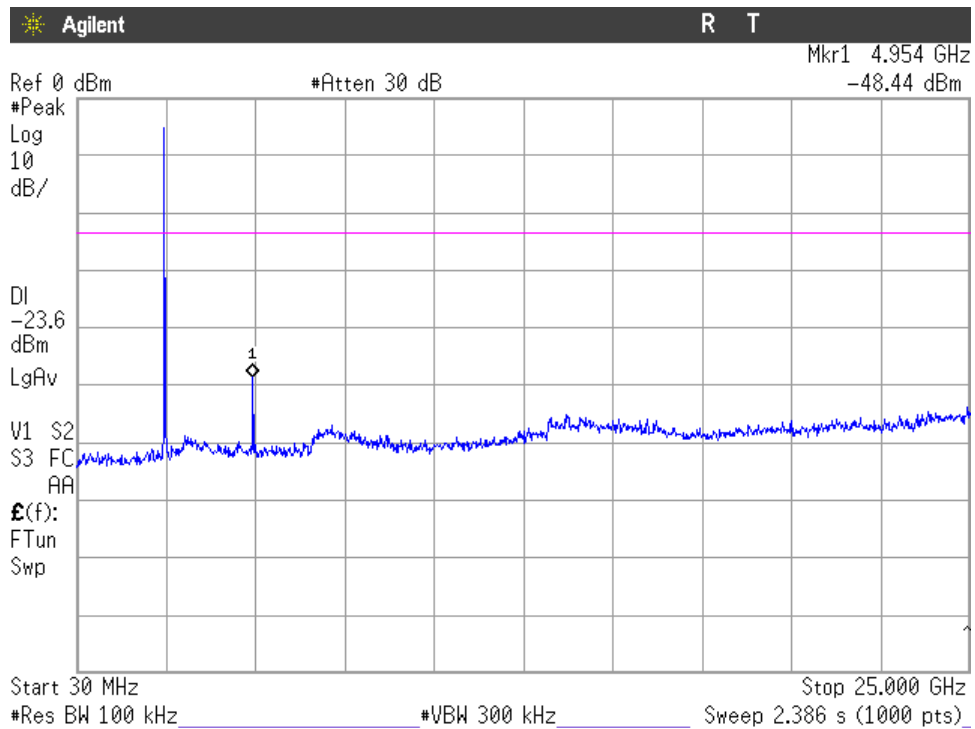
Note: The peak above the limit is the carrier frequency.

Highest Channel

Reference Level Measurement



Unwanted Emissions Level Measurement



Note: The peak above the limit is the carrier frequency.

Verdict: PASS

Section 15.247 Subclause (d). Band-edge emissions compliance (Transmitter)

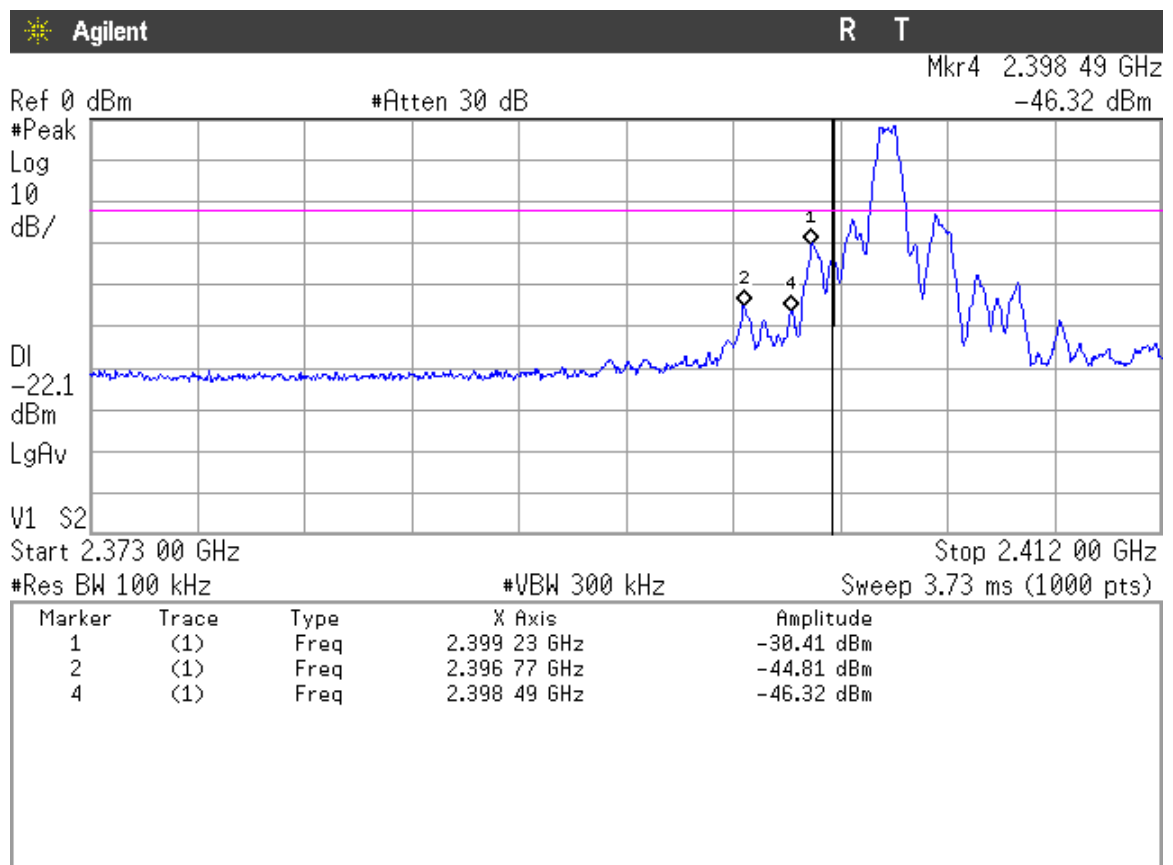
SPECIFICATION

Emissions outside the frequency band in which the intentional radiator is operating shall be at least 20dB below the highest level of the desired power.

RESULTS:

1. LOW FREQUENCY SECTION. CONDUCTED.

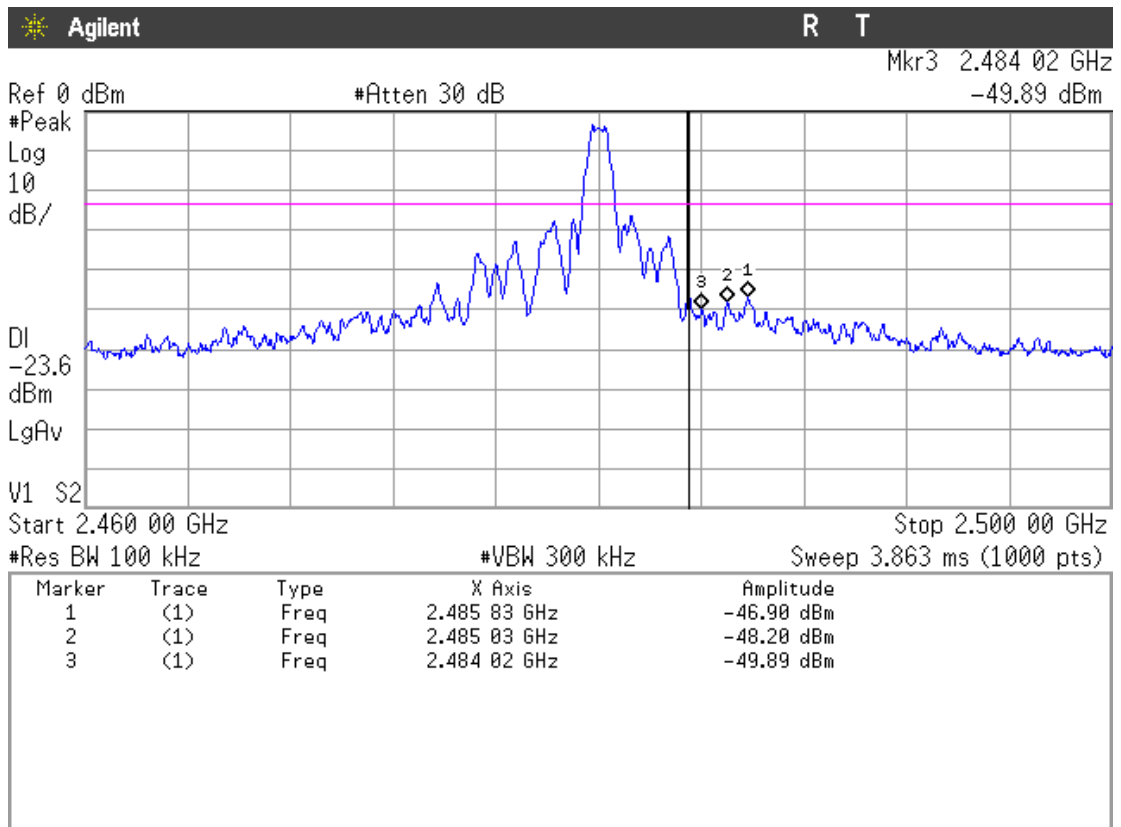
See next plot.



Verdict: PASS

2. HIGH FREQUENCY SECTION. CONDUCTED.

See next plot.



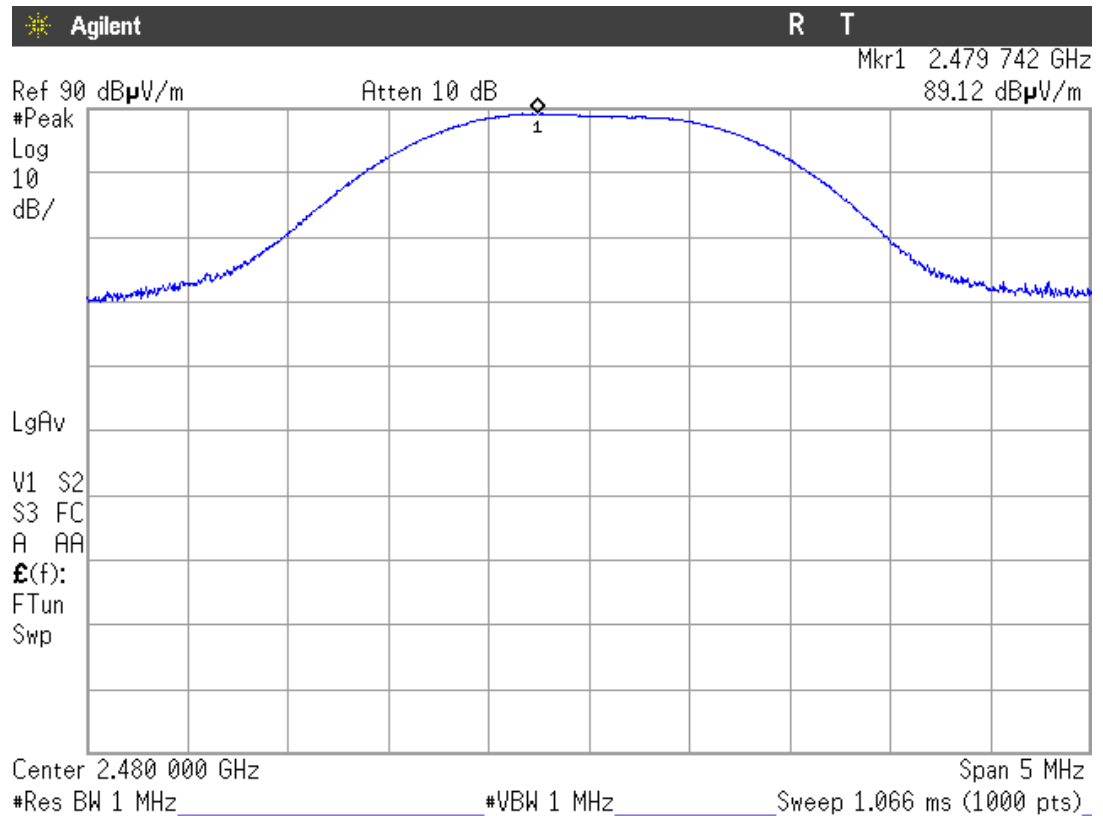
Verdict: PASS

Band-edge compliance of radiated emissions

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

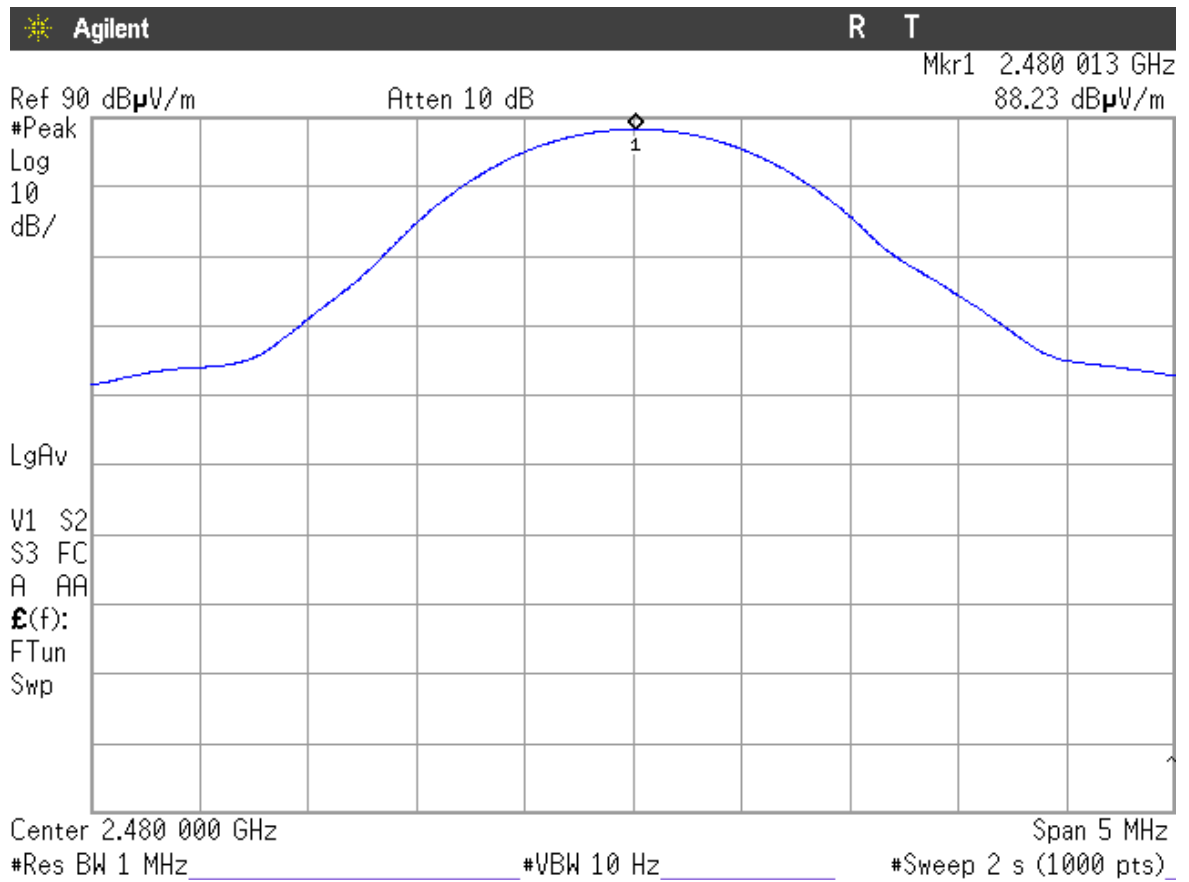
HIGHEST CHANNEL

Maximum field strength at 3 m. Peak value.



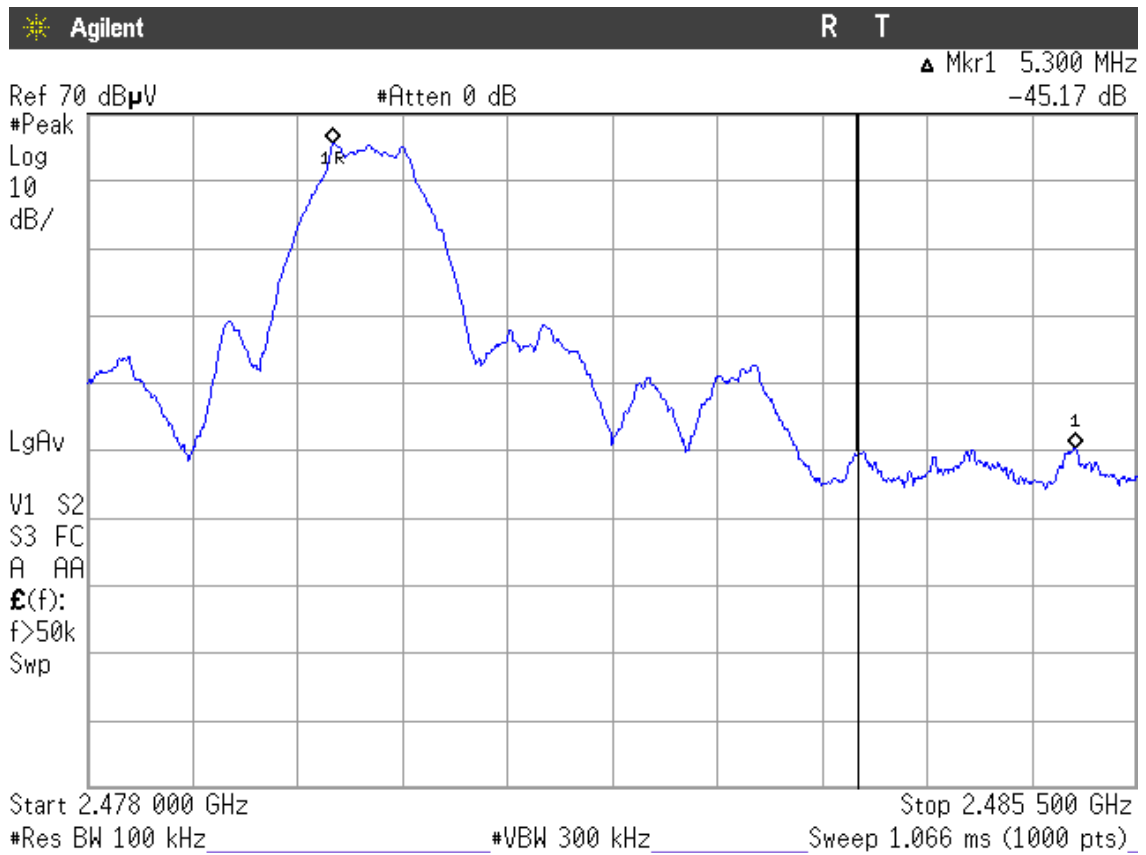
Note: The correction factor is already included in the spectrum analyzer as a transducer factor so that the marker shows directly the field strength level.

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
88.23 dB μ V/m	45.17 dB	43.06	54 dB μ V/m

Fundamental max. Peak value 3 m	Delta value	Calculated value 3 m	Limit
89.12 dB μ V/m	45.17 dB	43.95	74 dB μ V/m

Verdict: PASS

Section 15.247 Subclause (e). Power spectral density

SPECIFICATION

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

RESULTS

The maximum power spectral density level was measured using the method according to point 9.1. Option 1 of Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 558074 D01 DTS Meas Guidance v02 dated 10/04/2012.

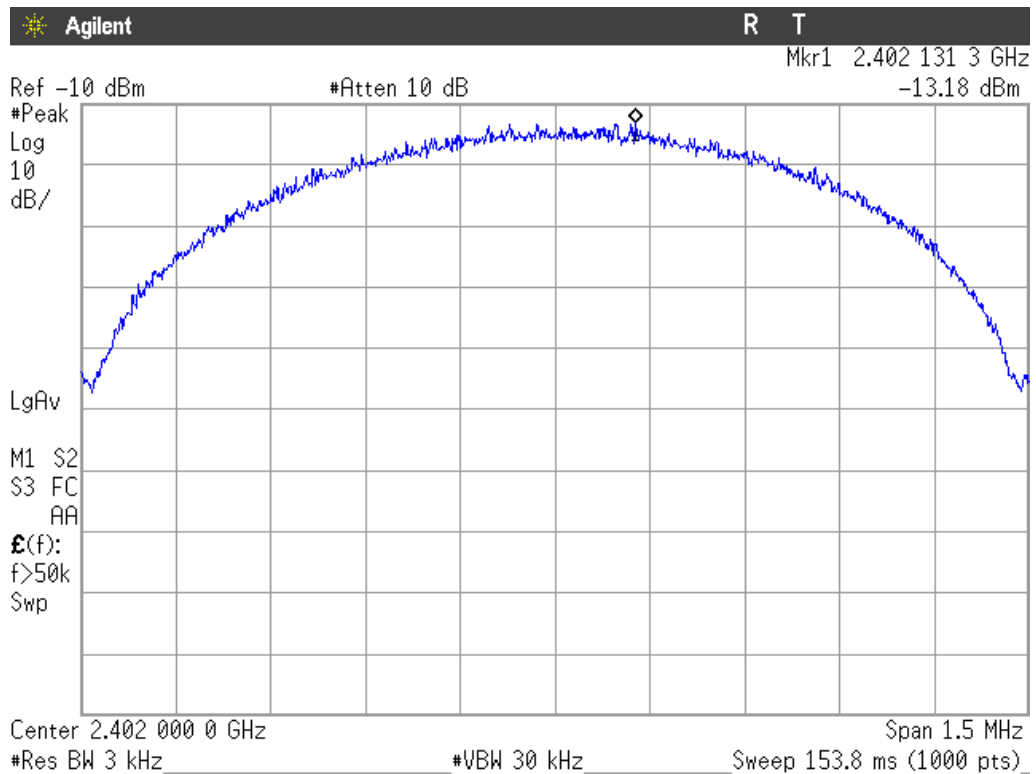
Power spectral density (see next plots).

	Lowest frequency 2402 MHz	Middle frequency 2440 MHz	Highest frequency 2480 MHz
Power spectral density (dBm) in 3 kHz bandwidth	-13.18	-13.64	-14.79
Measurement uncertainty (dB)	±1.5		

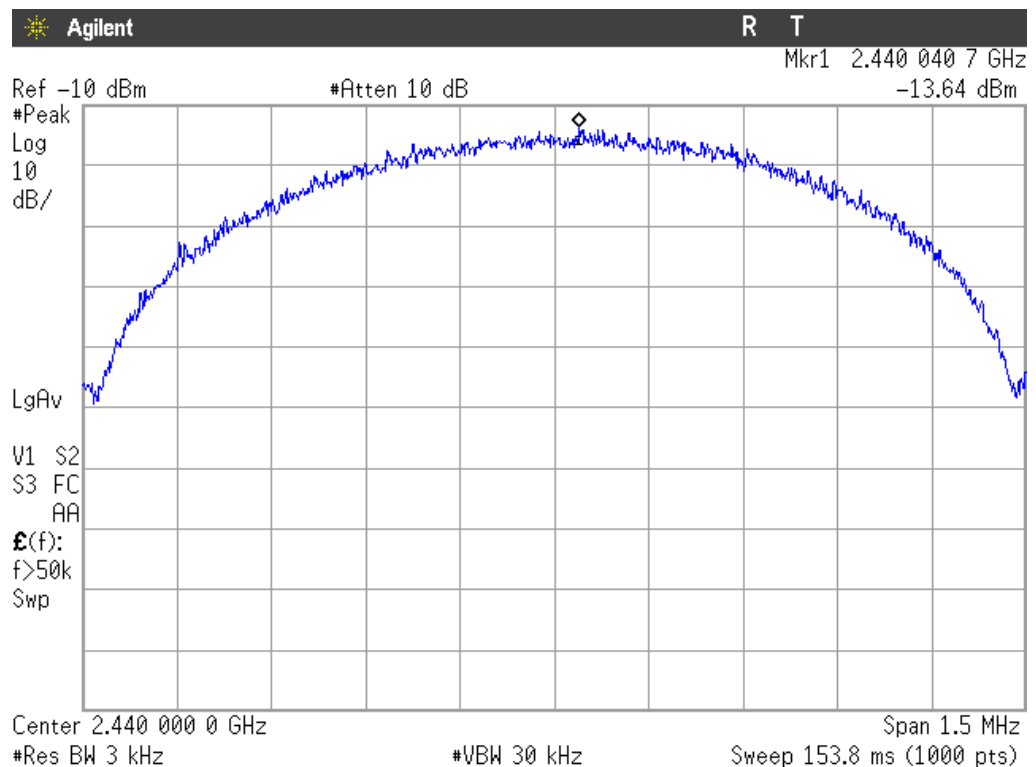
Verdict: PASS

Power spectral density.

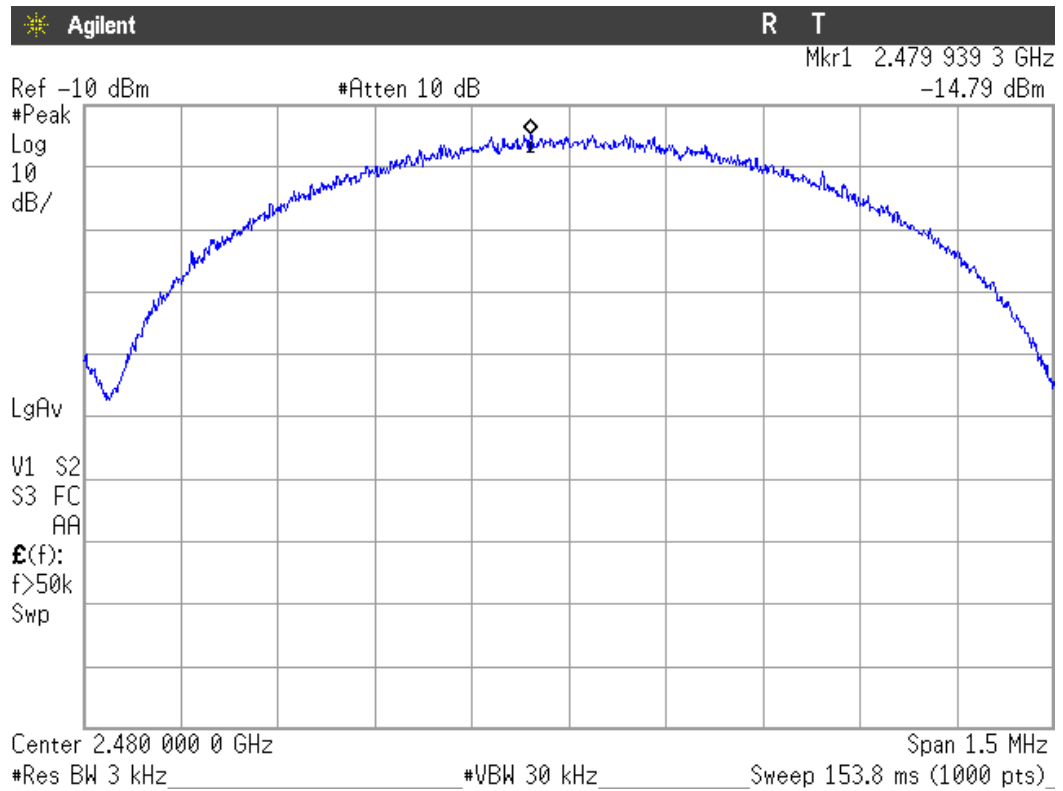
Lowest Channel



Middle Channel



Highest Channel



Section 15.247 Subclause (d). Emission limitations radiated (Transmitter)

SPECIFICATION

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)):

Frequency Range (MHz)	Field strength ($\mu\text{V/m}$)	Field strength ($\text{dB}\mu\text{V/m}$)	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 360° 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 analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

The equipment transmits continuously in the selected channel so it is not necessary a duty cycle correction factor.

Frequency range 30 MHz-1000 MHz.

No spurious signals were found for the three operating channels.

Frequency range 1 GHz-25 GHz

1. CHANNEL: LOWEST (2402 MHz).

All peak values are below the average limit.

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dB μ V/m)	Measurement Uncertainty (dB)
4.806066	H	Peak	50.83	± 4.09

2. CHANNEL: MIDDLE (2440 MHz).

All peak values are below the average limit.

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dB μ V/m)	Measurement Uncertainty (dB)
4.882002	H	Peak	49.05	± 4.09

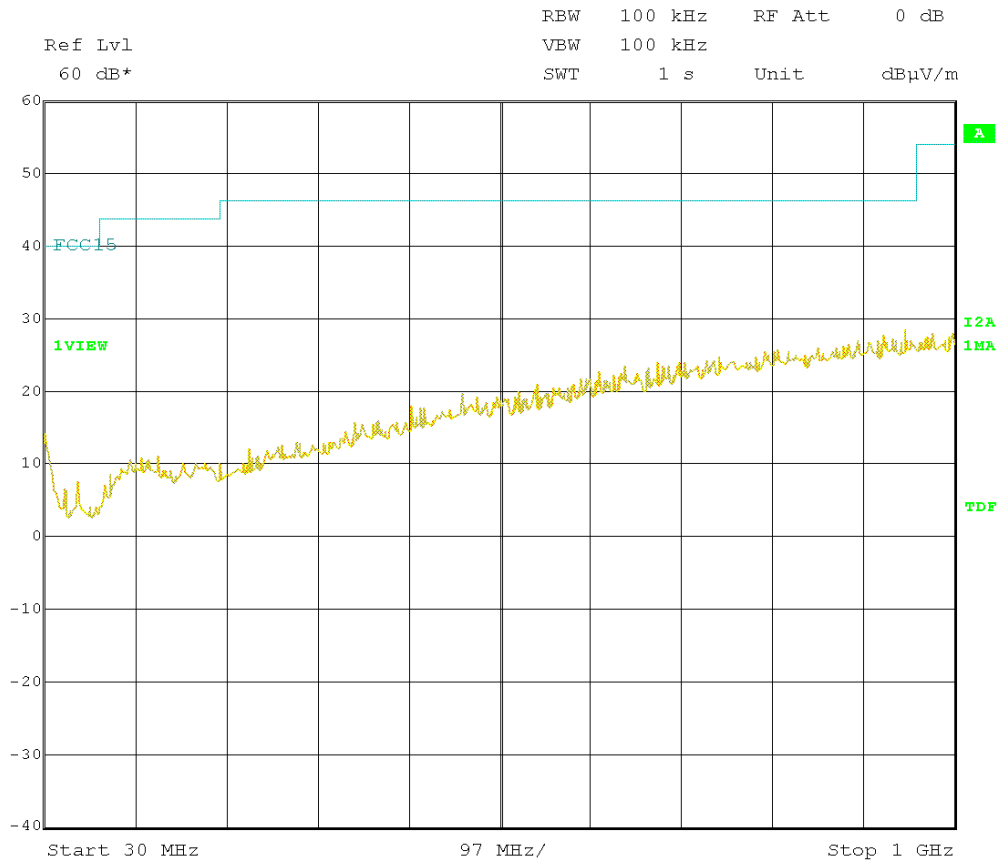
3. CHANNEL: HIGHEST (2480 MHz).

All peak values are below the average limit.

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dB μ V/m)	Measurement Uncertainty (dB)
2.483500	H	Peak	50.99	± 4.09
4.958138	H	Peak	47.24	± 4.09

Verdict: PASS

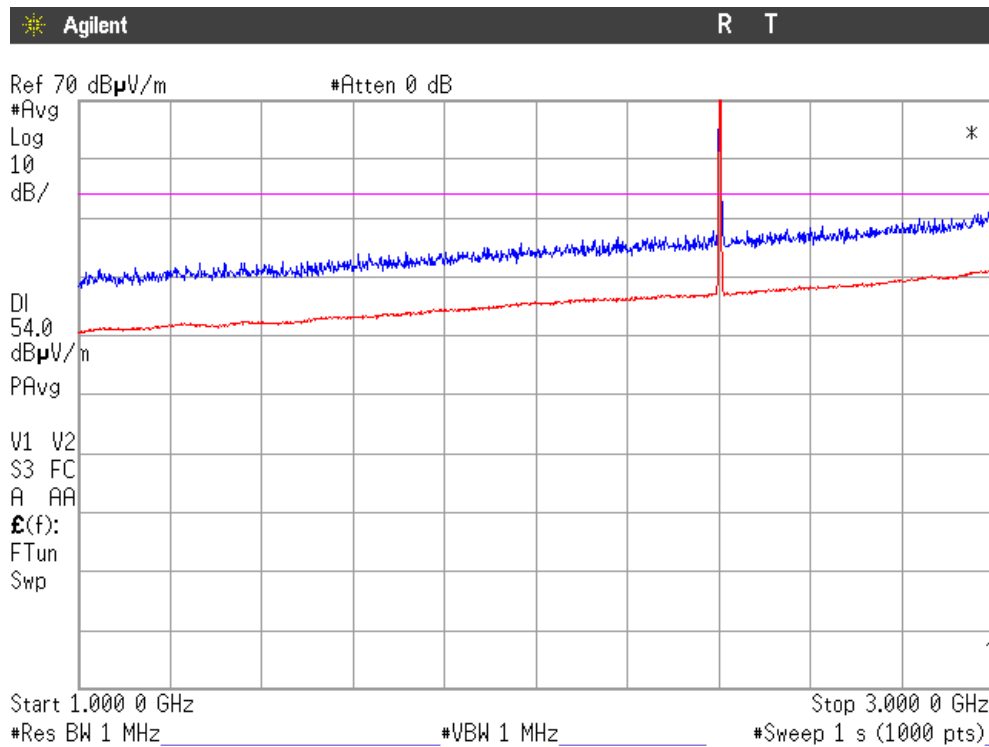
FREQUENCY RANGE 30 MHz-1000 MHz.



(This plot is valid for all three channels).

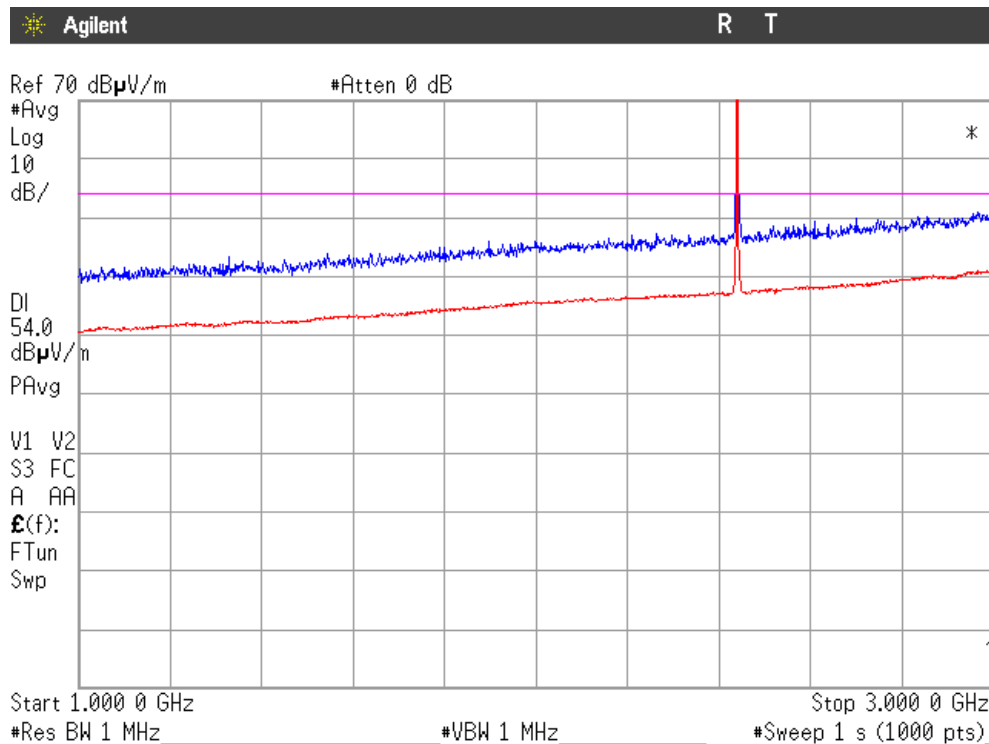
FREQUENCY RANGE 1 GHz to 3 GHz.

CHANNEL: Lowest (2402 MHz).



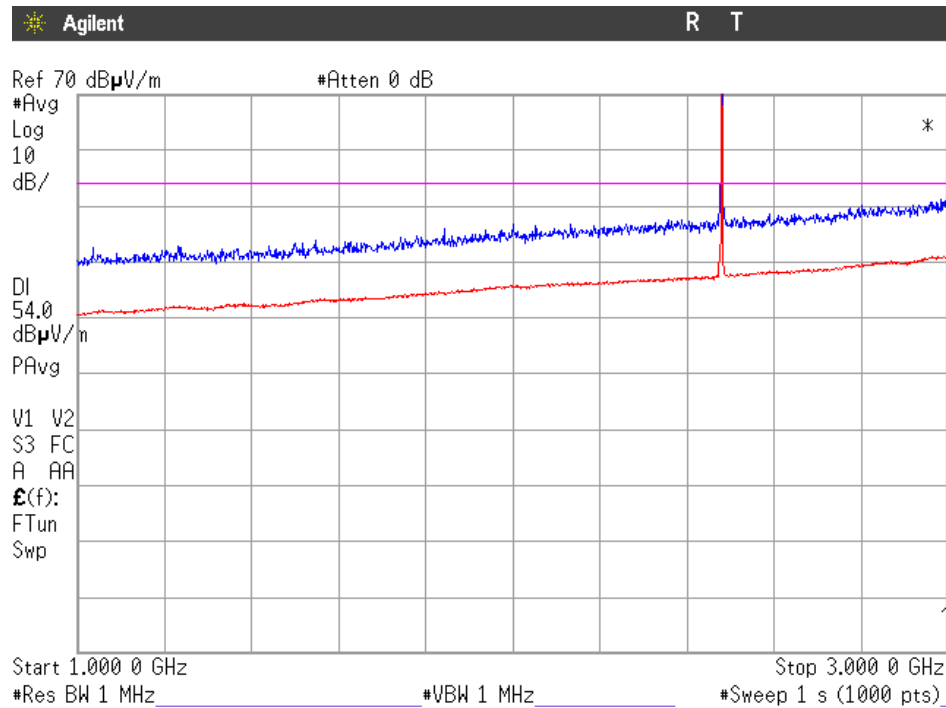
Note: The peak shown in the plot above the limit is the carrier frequency.

CHANNEL: Middle (2440 MHz).



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

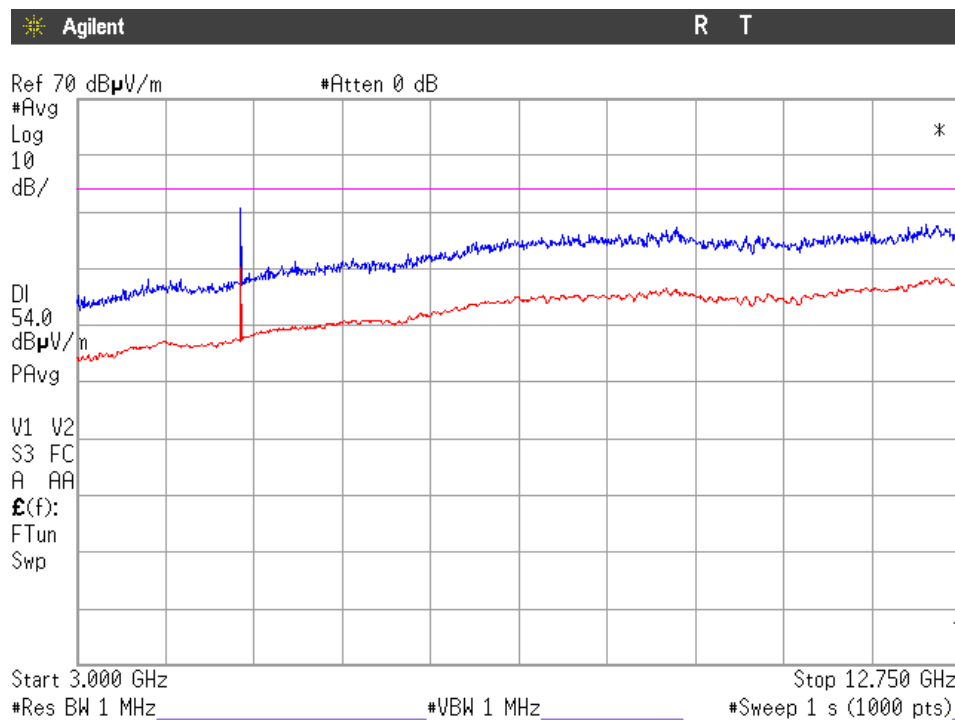
CHANNEL: Highest (2480 MHz).



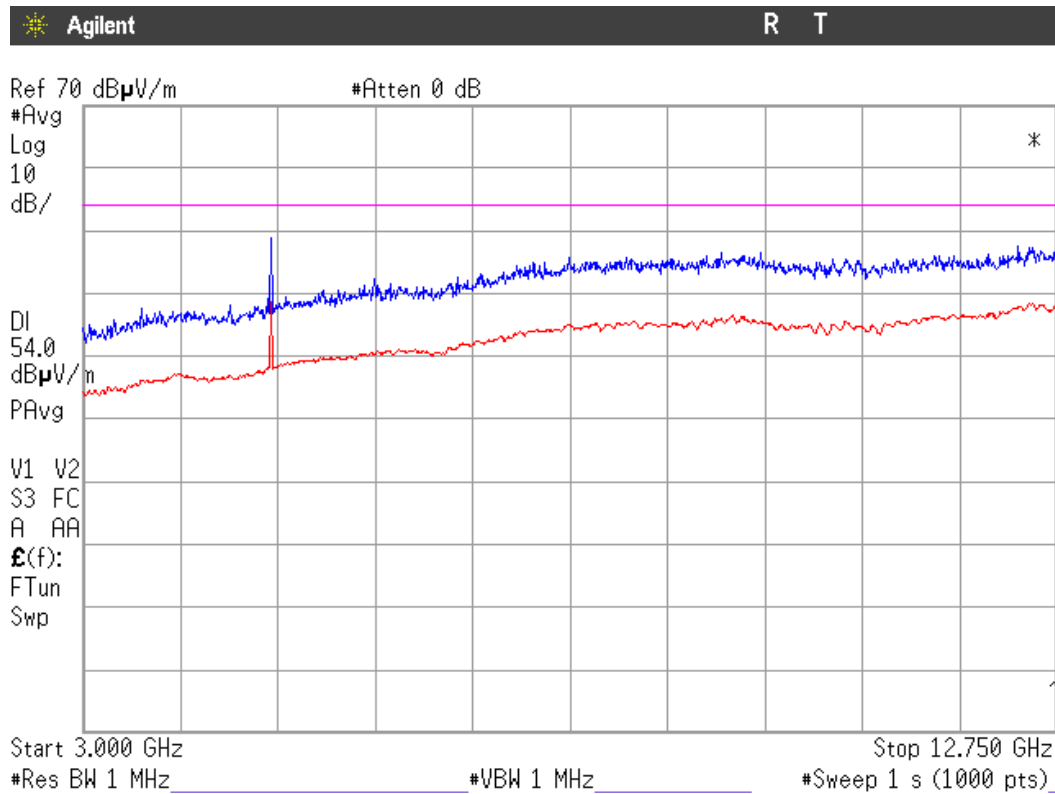
Note: The peak shown in the plot above the limit is the carrier frequency.

FREQUENCY RANGE 3 GHz to 12.75 GHz.

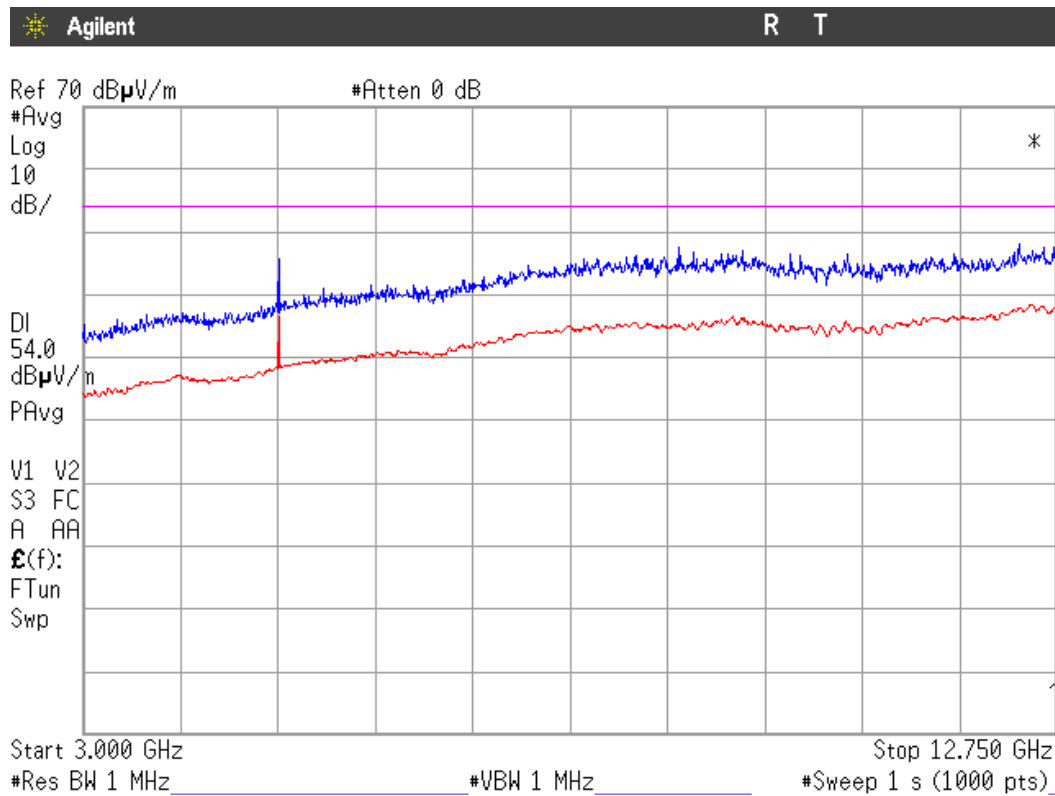
CHANNEL: Lowest (2402 MHz).



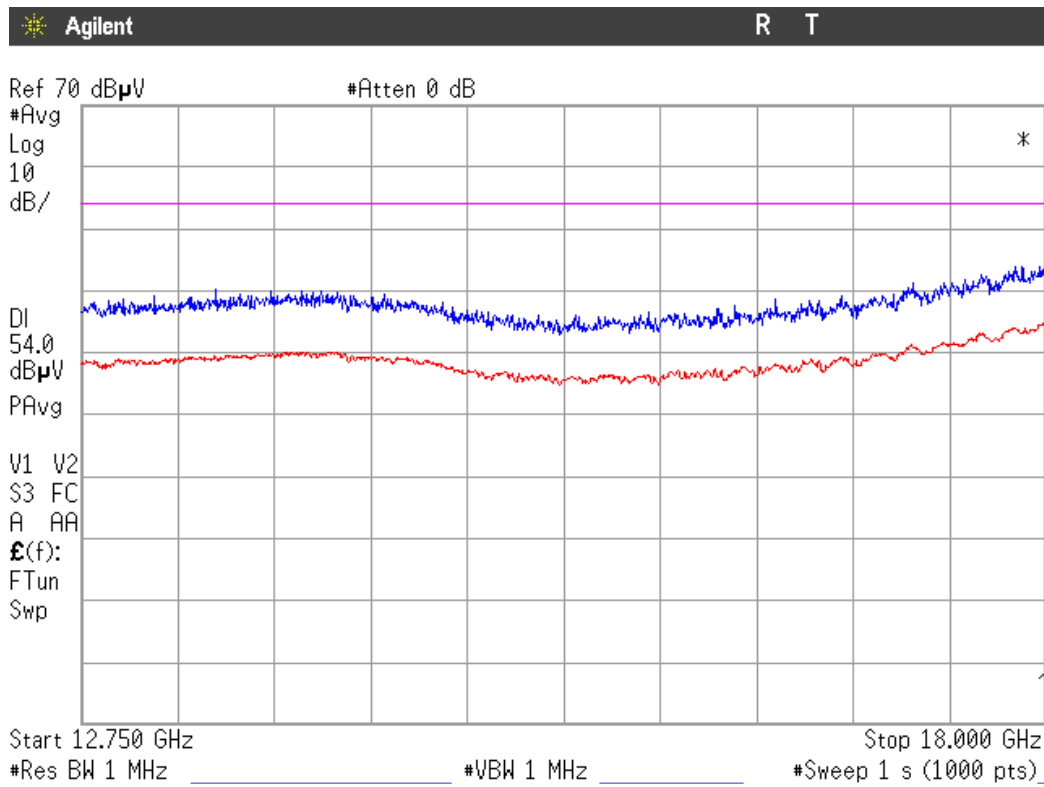
CHANNEL: Middle (2440 MHz).



CHANNEL: Highest (2480 MHz).

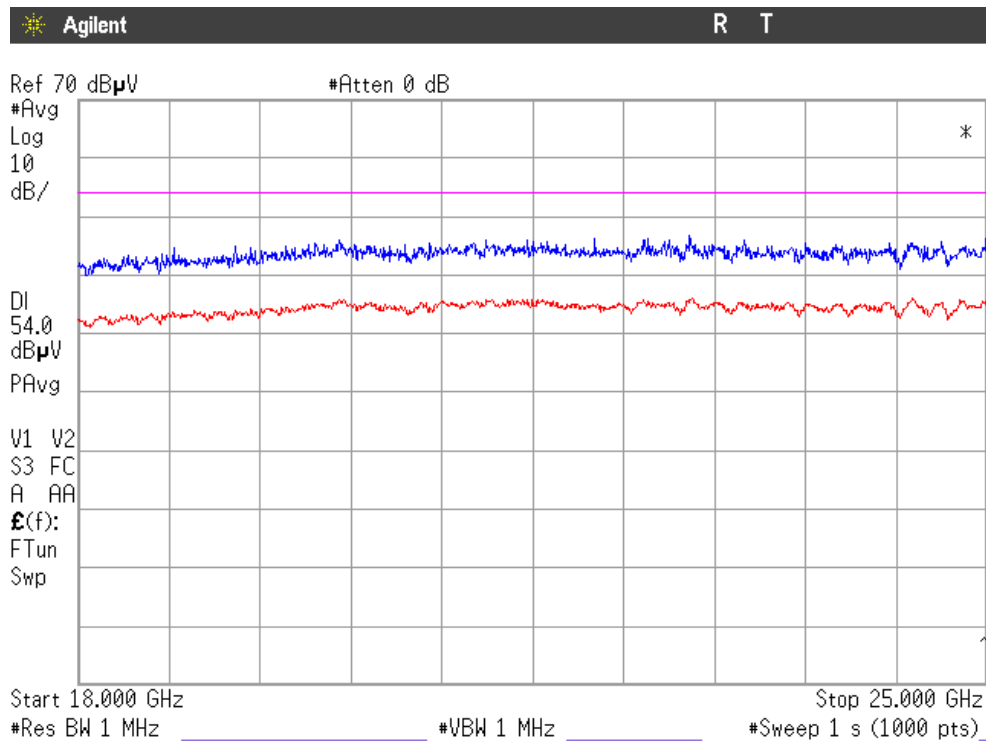


FREQUENCY RANGE 12.75 GHz to 18 GHz.



(This plot is valid for all three channels).

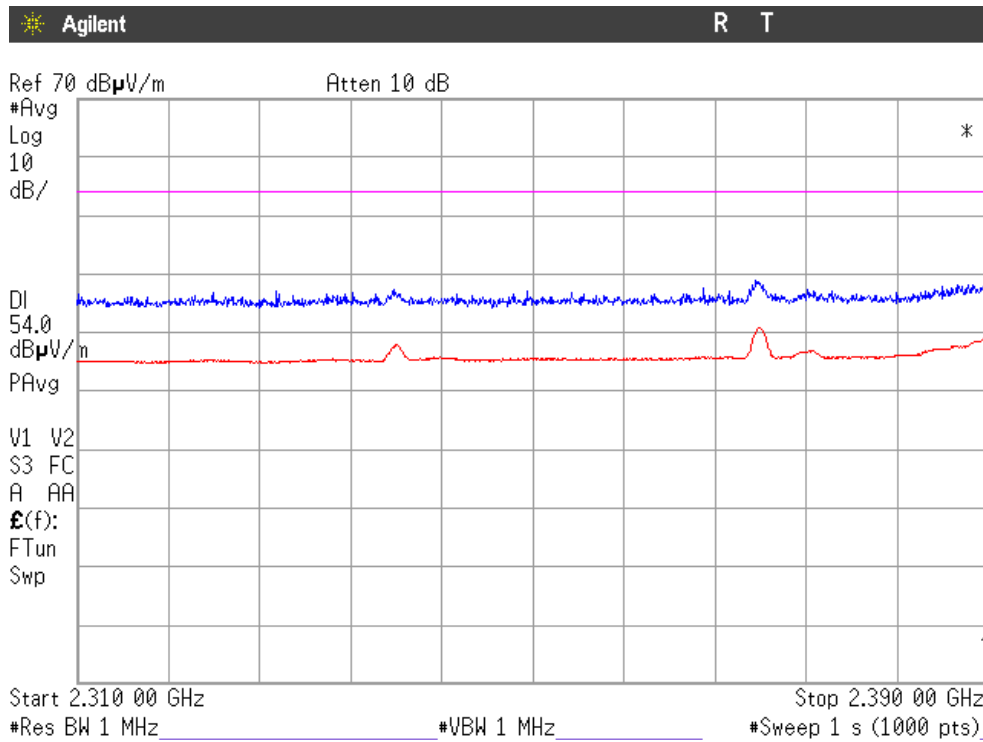
FREQUENCY RANGE 18 GHz to 25 GHz.



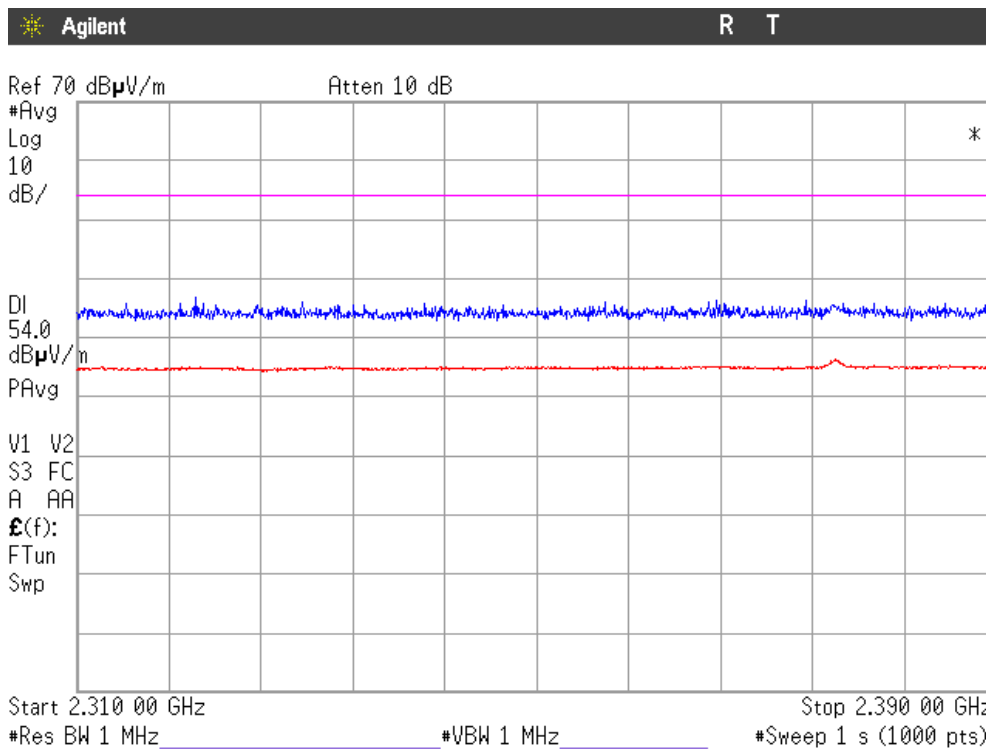
(This plot is valid for all three channels).

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

CHANNEL: Lowest (2402 MHz).



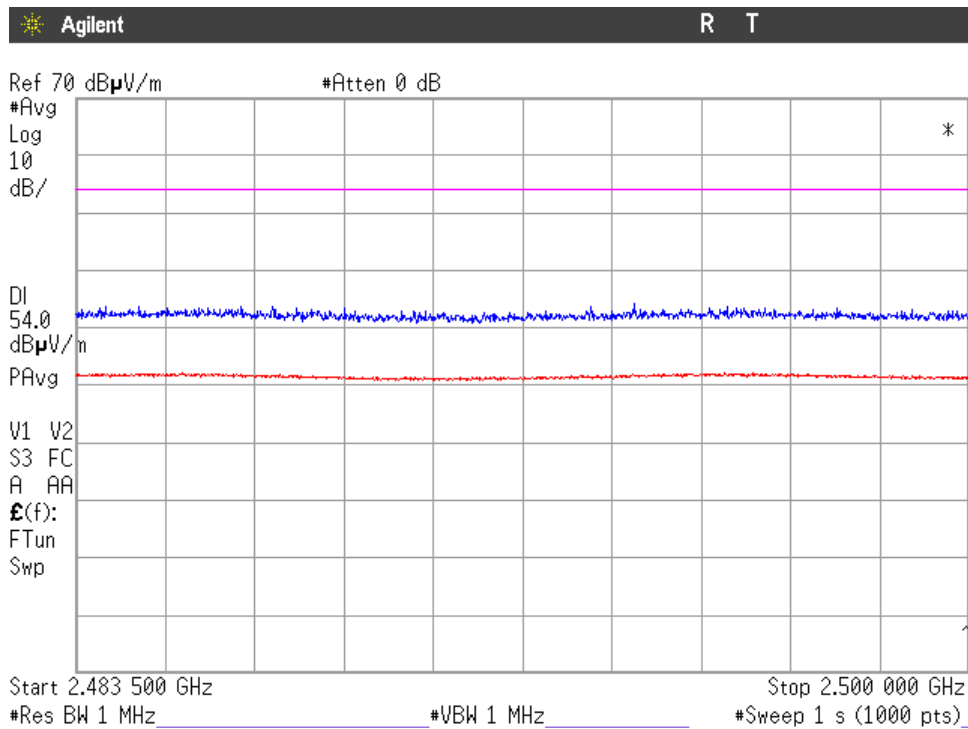
CHANNEL: Middle (2440 MHz) and Highest (2480 MHz).



(This plot is valid for middle and highest channels).

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

CHANNEL: Lowest (2402 MHz) and middle (2440 MHz).



(This plot is valid for lowest and middle channels).

CHANNEL: Highest (2480 MHz).

