FCC LISTED, REGISTRATION NUMBER: 905266 **IC LISTED REGISTRATION NUMBER** **IC 4621A-1**	**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 15.247, 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 ..... :	35012RRF.003
Approved by (name / position & signature) ..... :	A. Llamas / RF Lab. Manager
Elaboration date ..... :	2012-03-08

Alejandro Llamas Rodríguez
Firmado digitalmente por Alejandro Llamas Rodríguez
Fecha: 2012.03.08 17:54:03 +01'00'

Identification of item tested ..... :	Gateway Bluetooth – 802.15.4
Trademark ..... :	TELIT
Model and/or type reference ..... :	BG864-2.4
Serial number ..... :	141460000347, 141460000349
Other identification of the product ..... :	Commercial name: BG864-2.4 HW version: Rev2 SW version: P4.01.0001_A2.00.06 FCC ID: RI7BG864 IC ID: 5131A-BG864
Features ..... :	Gateway Bluetooth EDR– 802.15.4. Frequecy range 2410-2475 MHz, 3.7 V Rechargeable battery.
Description ..... :	Gateway Bluetooth – 802.15.4
Applicant ..... :	TELIT COMMUNICATIONS SPA
Address ..... :	Loc. Sa illetta, s.s. 195 km 2.300 09122 - Cagliari - ITALY
CIF/NIF/Passport ..... :	03711600266
Contact person:	Gianmarco Melosu
Telephone / Fax ..... :	+39 0704603246
e-mail: ..... :	Gianmarco.melosu@telit.com
Test samples supplier ..... :	Same as applicant
Manufacturer ..... :	TELIT RF TECHNOLOGIES
Address ..... :	Rue Evariste Galois – Emerald Square Bâtiment D, 06410 Sophia-Antipolis,, FRANCE
Contact person:	Xavier TATOPOULOS (xavier.tatopoulos@telit.com)
Telephone / Fax ..... :	+33.(0) 497213318

Test method requested .....:	See Standard
Standard .....:	USA FCC Part 15.247 10-01-10 Edition: Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz. USA FCC Part 15.109 10-01-10 Edition: Receiver radiated emission. CANADA RSS-210 Issue 8 (December 2010). CANADA RSS-Gen Issue 3 (December 2010). Guidelines for measurement of Digital Transmission Systems operating under section 15.247 dated March 23, 2005. FCC part 15.247 and Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum System DA 00-705 Released March 30, 2000. ANSI C63.10-2009: American National Standard for Testing Unlicensed Wireless Devices.
Test procedure .....:	PERF010
Non-standardized test method .....:	N/A
Used instrumentation .....:	

		Last Cal. date	Cal. due date
1.	Spectrum analyser Agilent PSA E4440A	2010/02	2012/02
2.	DC power supply R&S NGPE 40/40	2011/11	2014/11
3.	Semianechoic Absorber Lined Chamber IR 11. BS	N.A.	N.A.
4.	Control Chamber IR 12.BC	N.A.	N.A.
5.	Hybrid Bilog antenna Sunol Sciences Corporation JB6	2011/05	2014/05
6.	Antenna mast EM 1072 NMT	N.A.	N.A.
7.	Rotating table EM 1084-4. ON	N.A.	N.A.
8.	Double-ridge Guide Horn antenna 1-18 GHz HP 11966E	2011/05	2014/05
9.	Double-ridge Guide Horn antenna 18-40 GHz Agilent 119665J	2011/09	2014/09
10.	EMI Test Receiver R&S ESIB26	2011/11	2013/11
11.	RF pre-amplifier Miteq JS4-12002600-30-5A.	2010/07	2012/07
12.	Multi Device Controller EMCO 2090	N.A.	N.A.
13.	Spectrum Analyzer Agilent E4440A	2010/02	2012/02
14.	RF pre-amplifier Miteq AFS5-04001300-15-10P-6.	2010/07	2012/07
15.	RF pre-amplifier Schaffner CPA 9231A.	2011/06	2013/06

Report template No. .....: FDT08_12

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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 conjuction 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 composed of the following elements

Control No.	Description	Model / Type	Serial No.	Date of reception
32694/14	Equipment board with integral antennas	BG864-2.4	141460000347	05/04/2011
32694/04	Plastic housing	---	---	05/04/2011
32694/05	Battery	---	---	05/04/2011

Sample M/01 is composed of the following elements

Control No.	Description	Model / Type	Serial No.	Date of reception
32694/15	Equipment board with antenna connectors	BG864-2.4	141460000349	20/04/2011

1. Sample M/01 has undergone following test(s).
   All radiated tests indicated in appendixes A and B.
1. Sample M/02 has undergone following test(s).
   All conducted tests indicated in appendixes A and B.

Testing period

The performed test started on 2012-01-12 and finished on 2012-01-31.

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. = 23.1 ºC Max. = 23.4 ºC
Relative humidity	Min. = 45.2 % Max. = 46.4 %
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. = 21.2 ºC Max. = 21.5 ºC
Relative humidity	Min. = 39 % Max. = 40 %
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. = 22.9 ºC Max. = 24.4 ºC
Relative humidity	Min. = 43.6 % Max. = 44.3 %
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 15.109 / 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

802.15.4 2.4 GHz Radio

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		
Section 15.109 / RSS-210 2.5.	Radiated emission limits for receiver		P		

Bluetooth Radio

FCC PART 15 / RSS-210 PARAGRAPH	VERDICT			
	NA	P	F	NM
FCC 15.247 Subclause (a) (1). 20 dB Bandwidth and Carrier frequency separation / RSS-210 Clause A8.1 (b)		P		
FCC 15.247 Subclause (a) (1) (iii). Number of hopping channels / RSS-210 Clause A8.1 (d)		P		
FCC 15.247 Subclause (a) (1) (iii). Time of occupancy (Dwell Time) / RSS-210 Clause A8.1 (d)		P		
FCC 15.247 Subclause (b). Maximum peak output power (radiated) and antenna gain / RSS-210, Clause A8.4 (2)		P		
FCC 15.247 Subclause (c). Band-edge of radiated emissions (Transmitter) / RSS-210 Clauses 2.2 & A8.5		P		
FCC 15.247 Subclause (c). Emission limitations conducted (Transmitter) / RSS-210 Clauses 2.2 & A8.5		P		
FCC 15.247 Subclause (c). Emission limitations radiated (Transmitter) / RSS-210 Clauses 2.2 & A8.5		P		
FCC 15.109. Radiated emission limits for receiver / RSS-210 Clause 2.2		P		

APPENDIX A: Test results. 802.15.4 2.4 GHz Radio

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TEST CONDITIONS

Power supply (V):

$V_{nominal}$ = 3.70 Vdc

Type of power supply = DC voltage from rechargeable battery.

Type of antenna = Integral antenna.

Declared Gain for antenna = 2.2 dBi

TEST FREQUENCIES:

Lowest channel: 2410 MHz

Middle channel: 2440 MHz

Highest channel: 2475 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 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.

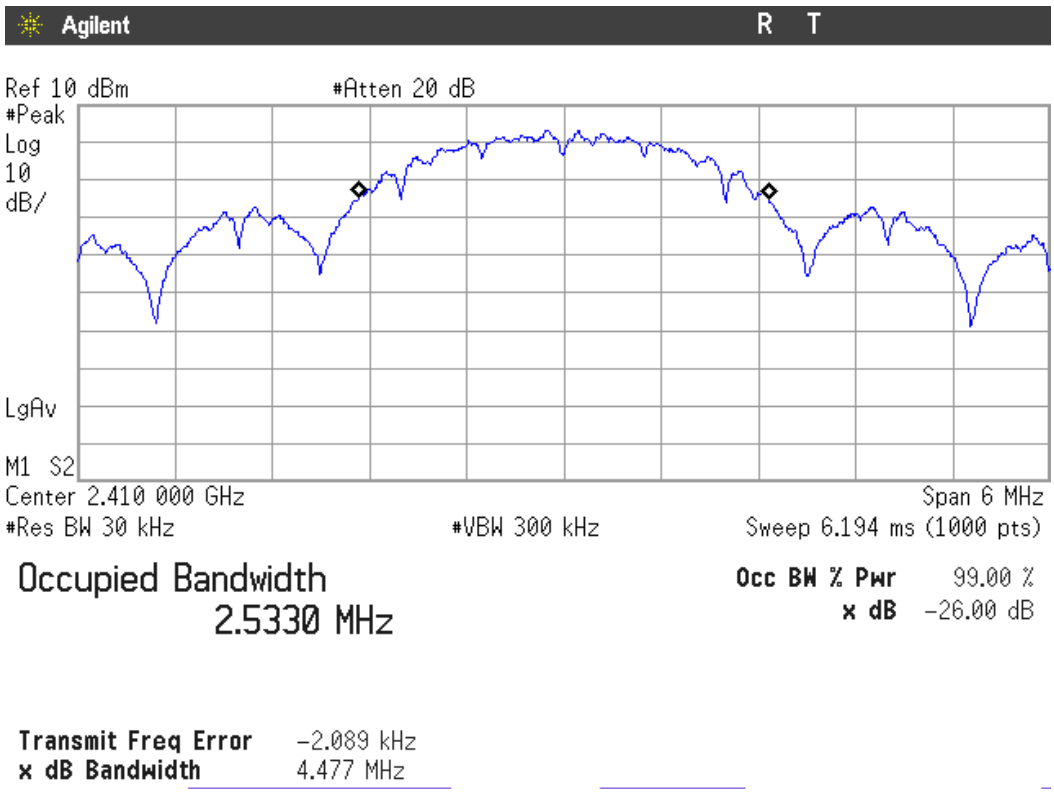
99 % and 26 dB Bandwidth

RESULTS

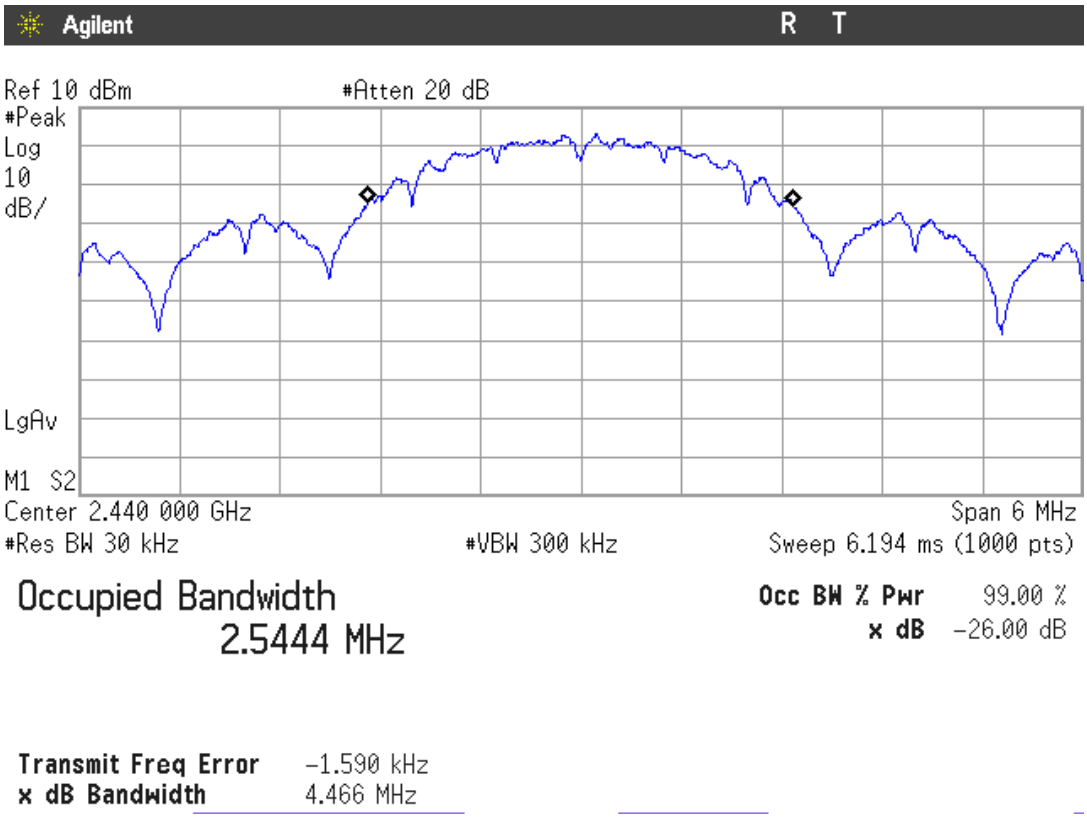
(see next plots).

	Lowest frequency 2410 MHz	Middle frequency 2440 MHz	Highest frequency 2475 MHz
99% bandwidth (MHz)	2.5330	2.5444	2.5452
26 dB bandwidth (MHz)	4.477	4.466	4.449
Measurement uncertainty (kHz)	±21.7		

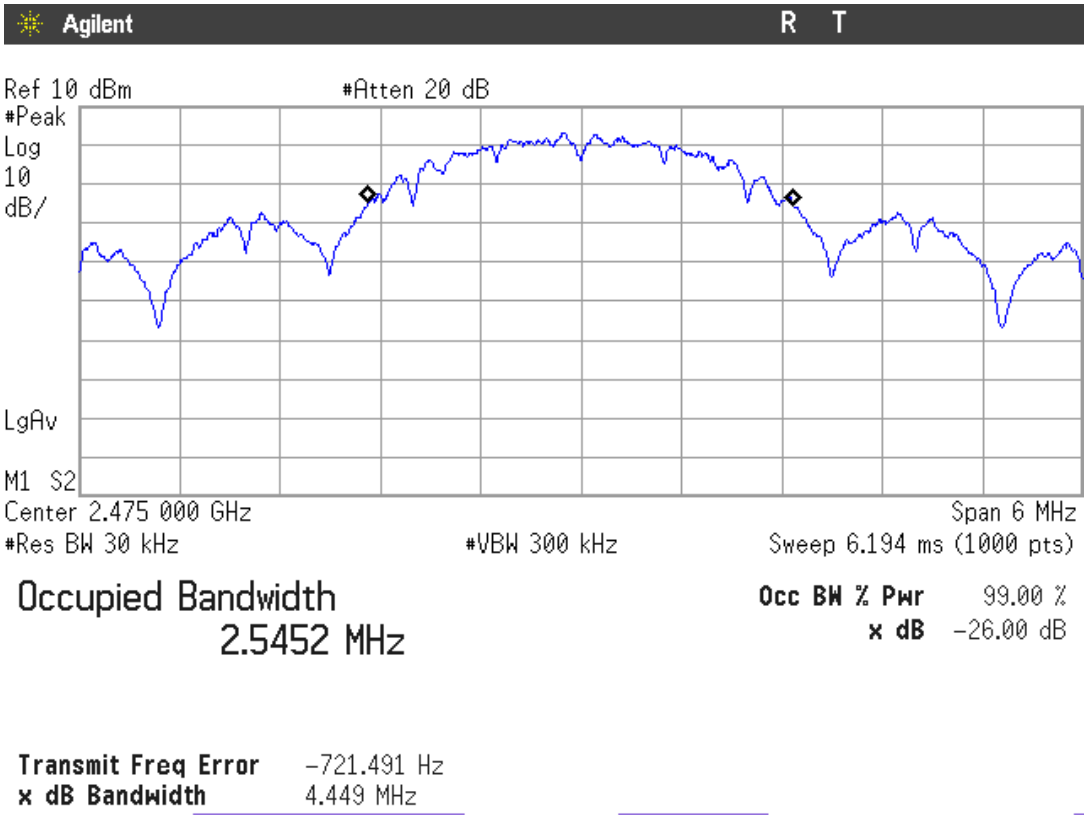
Lowest Channel



Middle Channel



Highest channel



Section 15.247 Subclause (a) (2). 6 dB Bandwidth / RSS-210 A8.2. (a)

SPECIFICATION

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

RESULTS

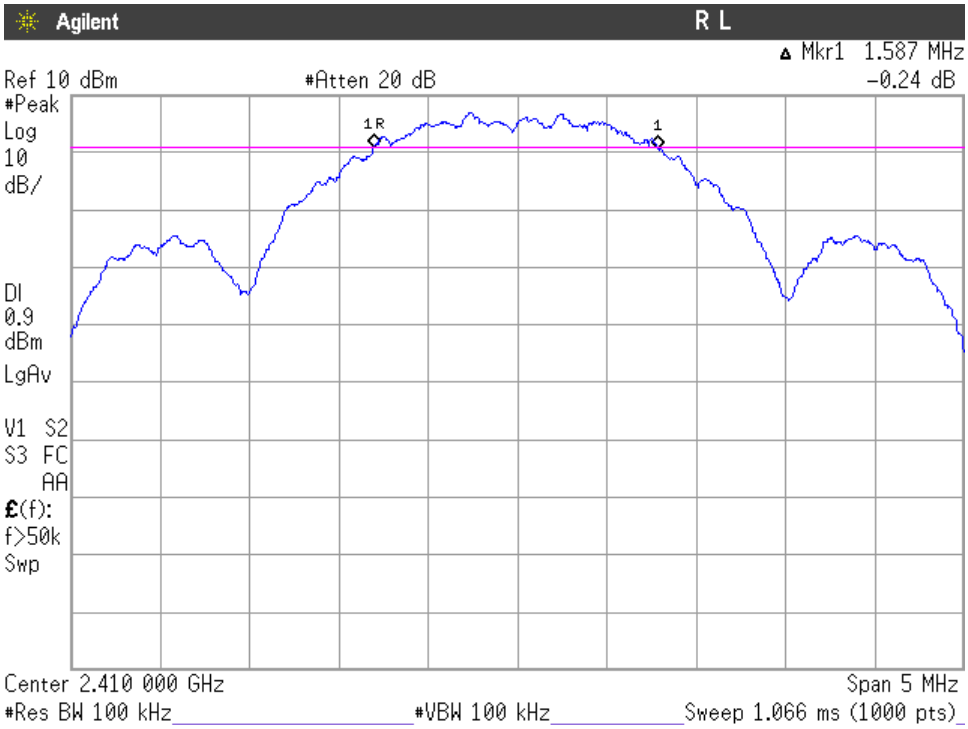
6 dB Bandwidth (see next plots).

	Lowest frequency 2410 MHz	Middle frequency 2440 MHz	Highest frequency 2475 MHz
6 dB Spectrum bandwidth (kHz)	1587	1592	1587
Measurement uncertainty (kHz)	±21.7		

Verdict: PASS

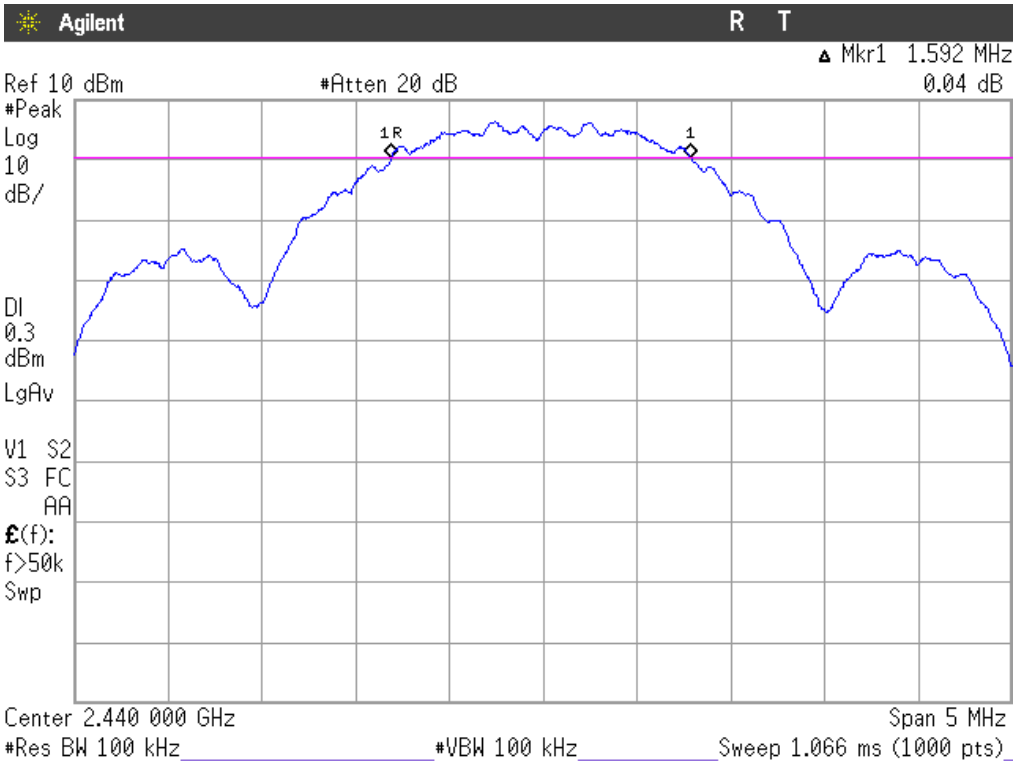
6 dB BANDWIDTH.

Lowest Channel



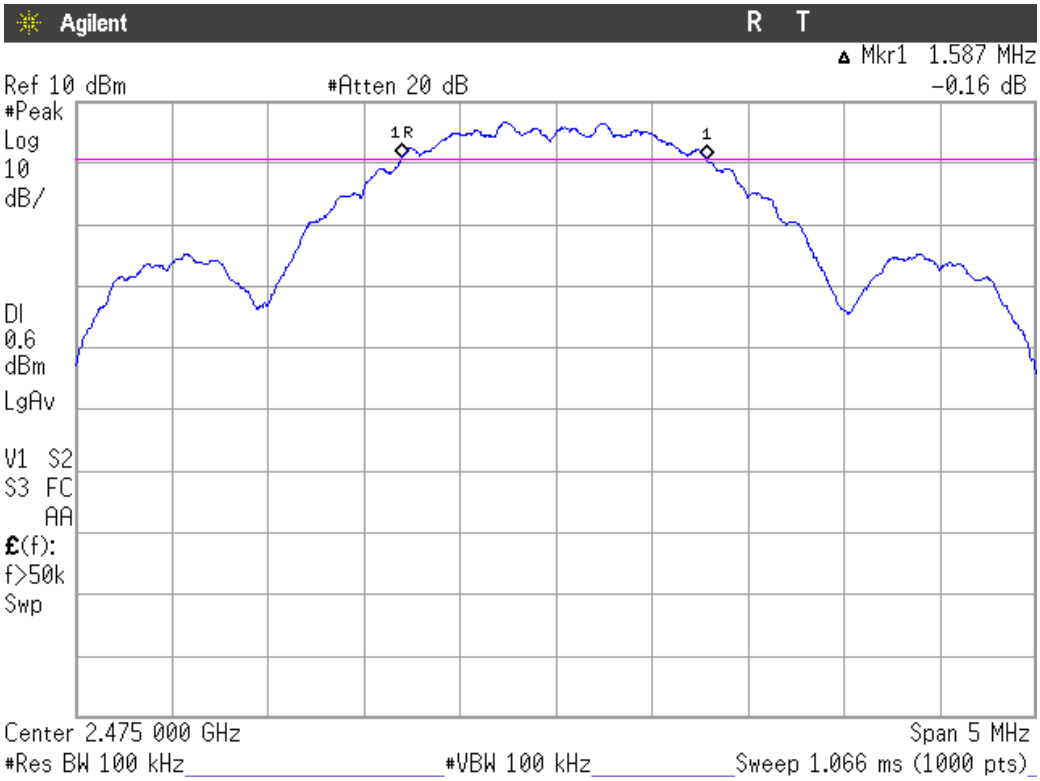
6 dB BANDWIDTH.

Middle Channel



6 dB BANDWIDTH.

Highest Channel



Section 15.247 Subclause (b). Maximum output power and antenna gain / RSS-210 A8.4. (4)

SPECIFICATION

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

RESULTS

MAXIMUM OUTPUT POWER (CONDUCTED). See next plots.

	Lowest frequency 2410 MHz	Middle frequency 2440 MHz	Highest frequency 2475 MHz
Maximum power (dBm)	11.11	10.85	11.23
Measurement uncertainty (dB)	±1.5		

The maximum declared antenna gain for this device is 2.2 dBi, therefore the maximum theoretical radiated power (EIRP) in the three measurement channels for this device is 13.43 dBm or 22.03 mW.

The actual maximum radiated power (EIRP) was measured for the lowest, middle and highest frequency.

MAXIMUM OUTPUT POWER (RADIATED). See next plots.

	Lowest frequency 2410 MHz	Middle frequency 2440 MHz	Highest frequency 2475 MHz
Maximum EIRP power (dBm)	13.60	11.90	11.40
Measurement uncertainty (dB)	±4.09		

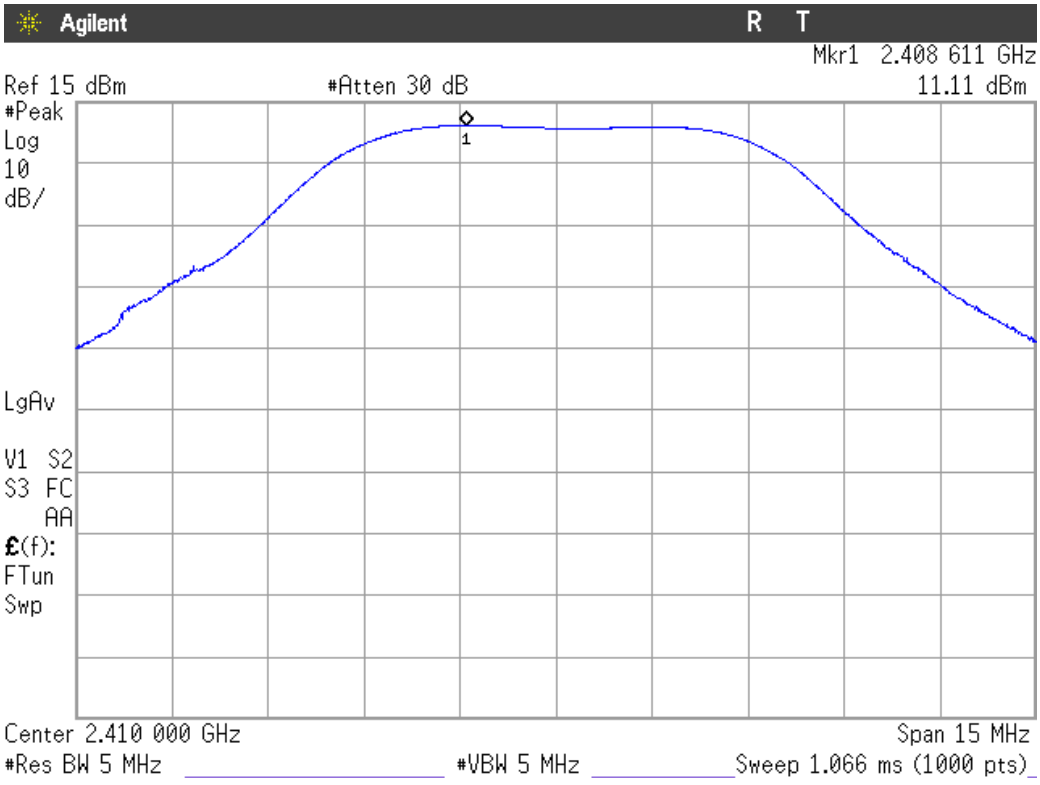
Maximum declared antenna gain: 2.2 dBi

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.

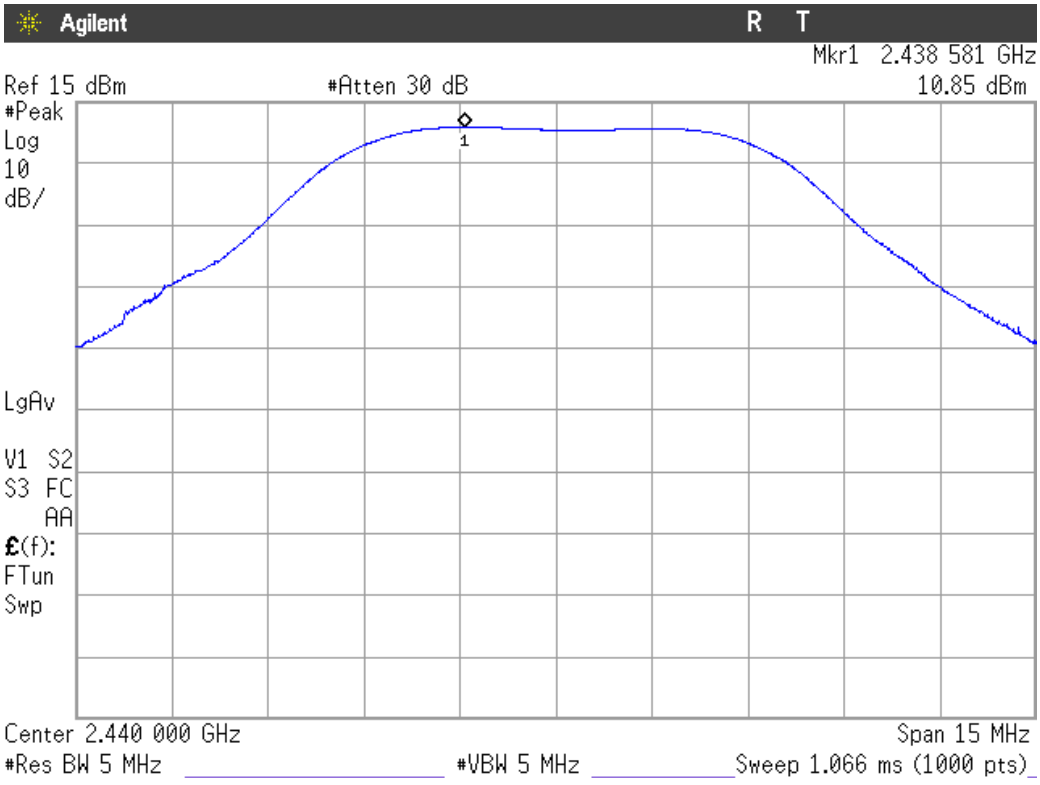
Verdict: PASS

1. CONDUCTED PEAK POWER.

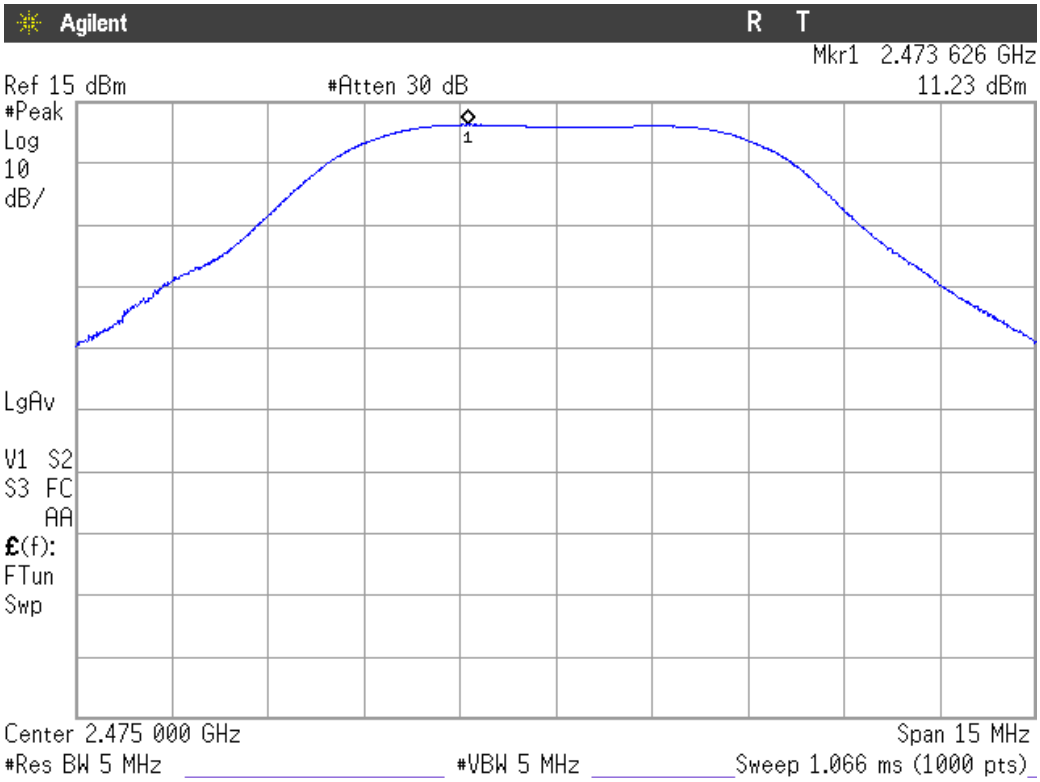
Lowest frequency



Middle frequency

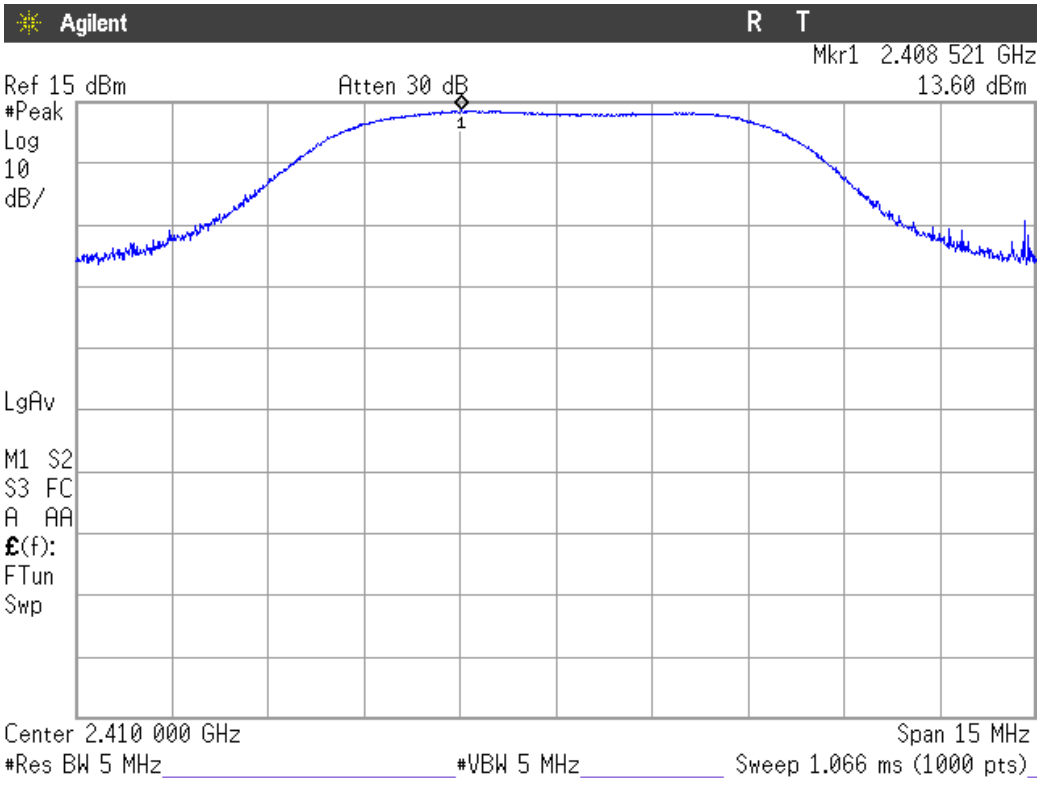


Highest frequency

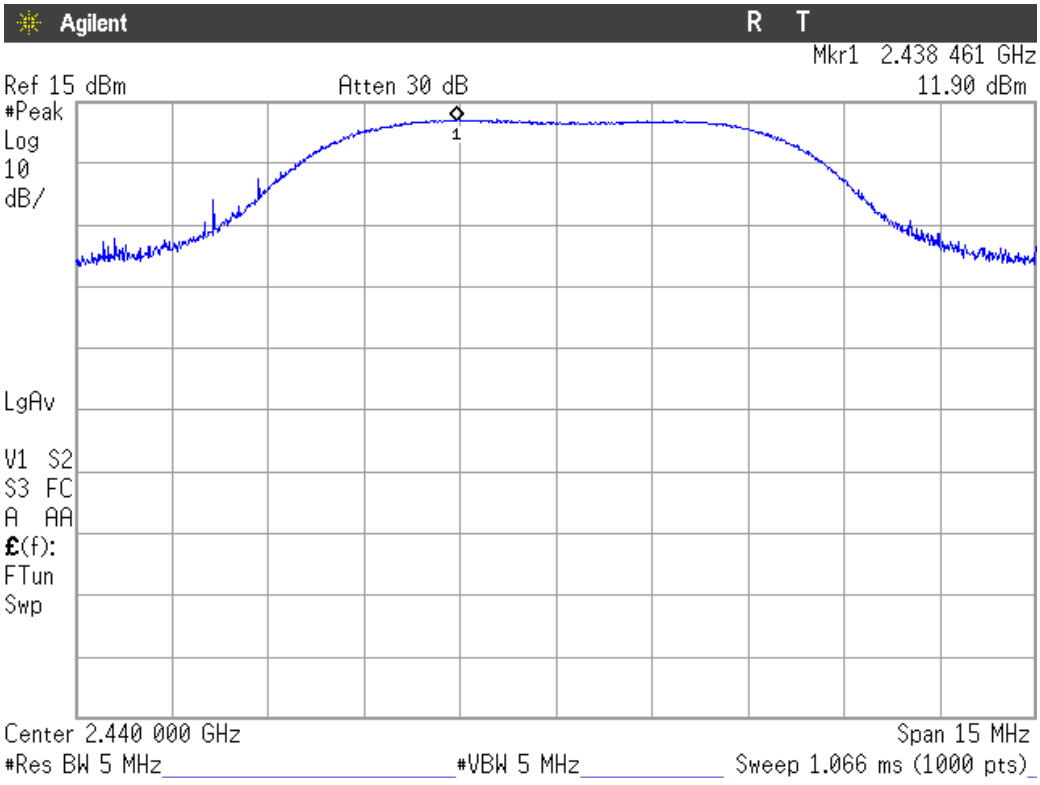


2. RADIATED PEAK POWER.

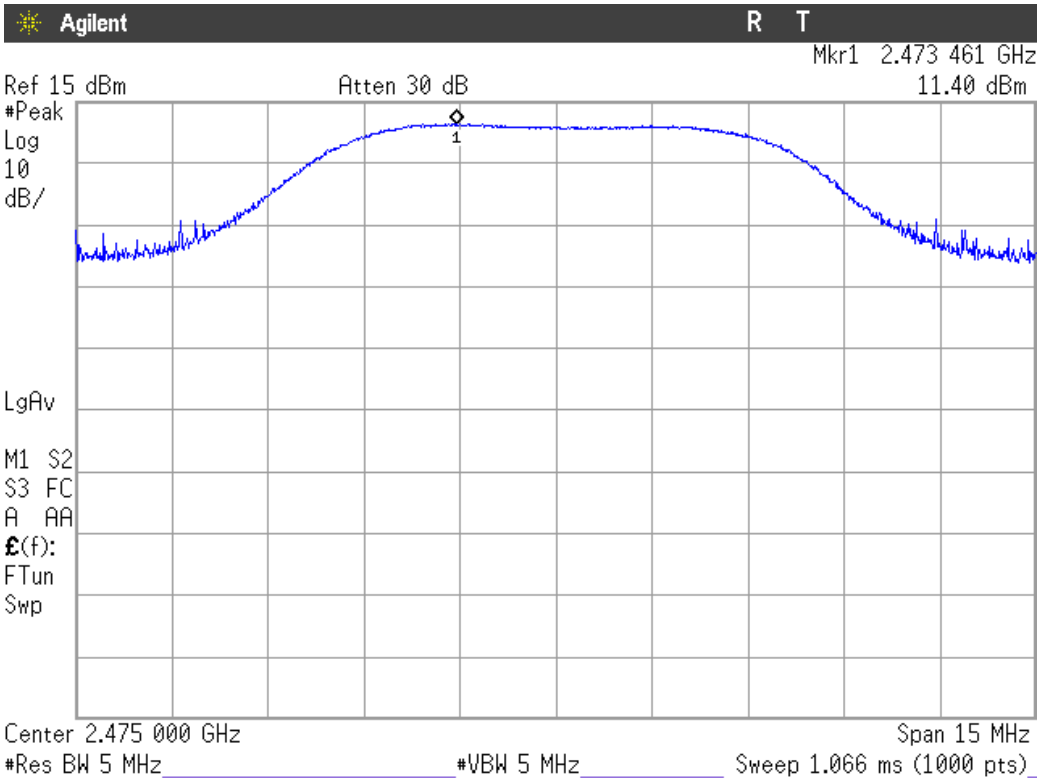
Lowest frequency



Middle frequency



Highest frequency



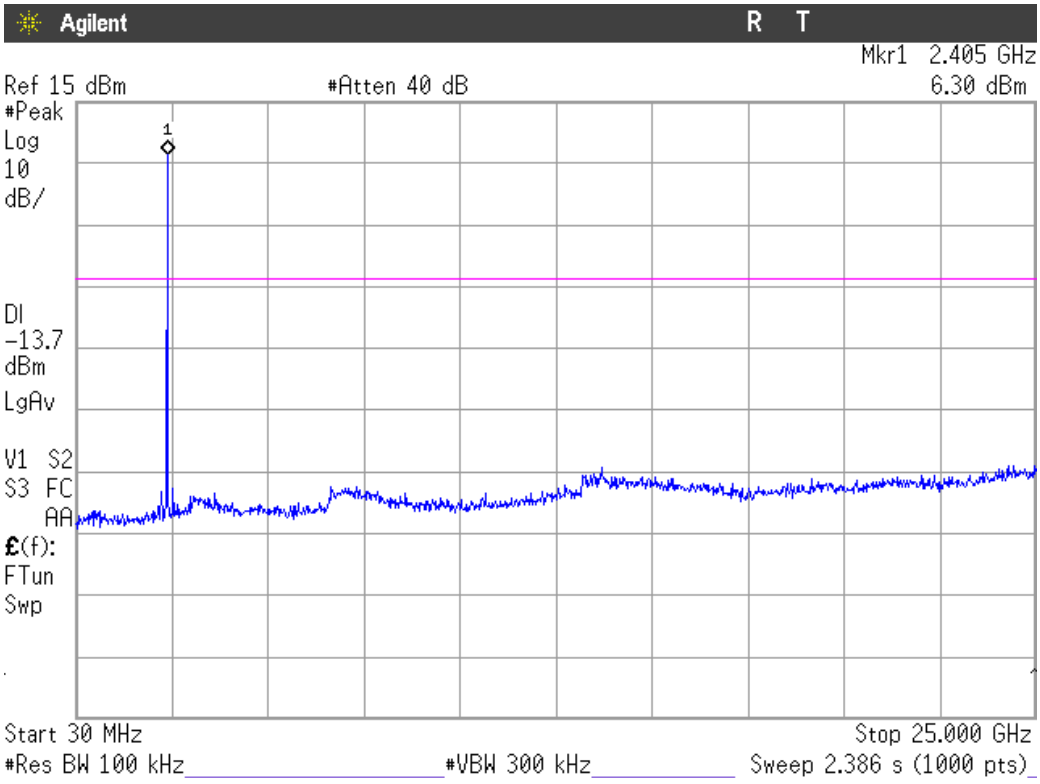
Section 15.247 Subclause (d). Emission limitations conducted (Transmitter) / RSS-210 A8.5.

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.

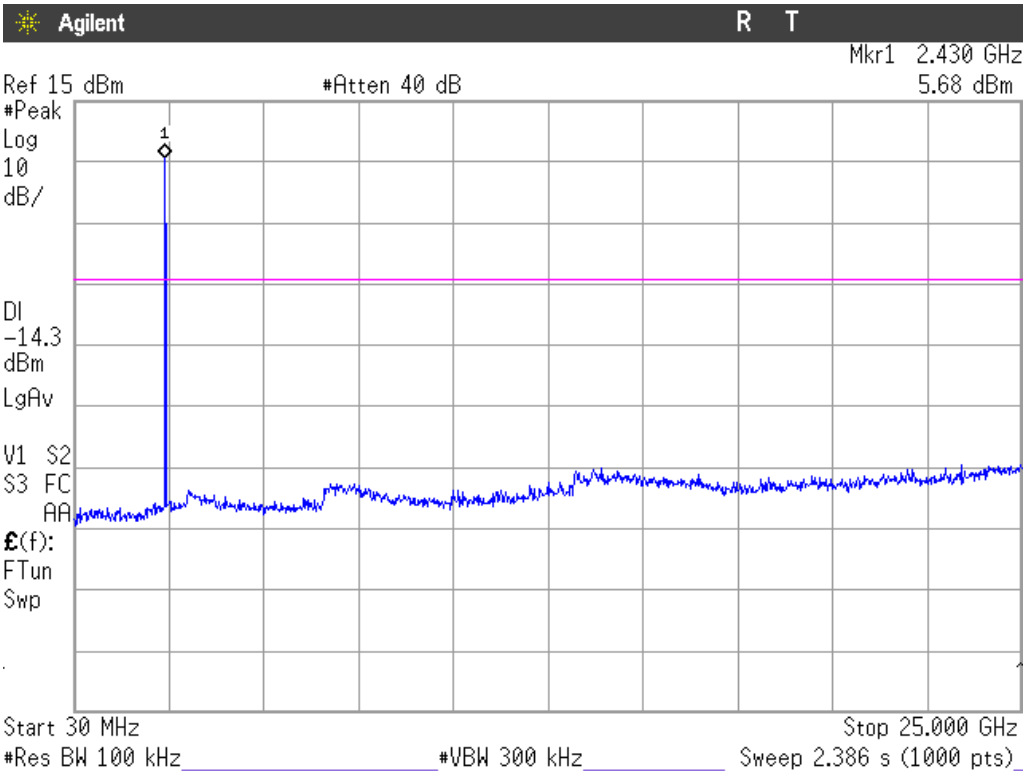
RESULTS:

Lowest Channel



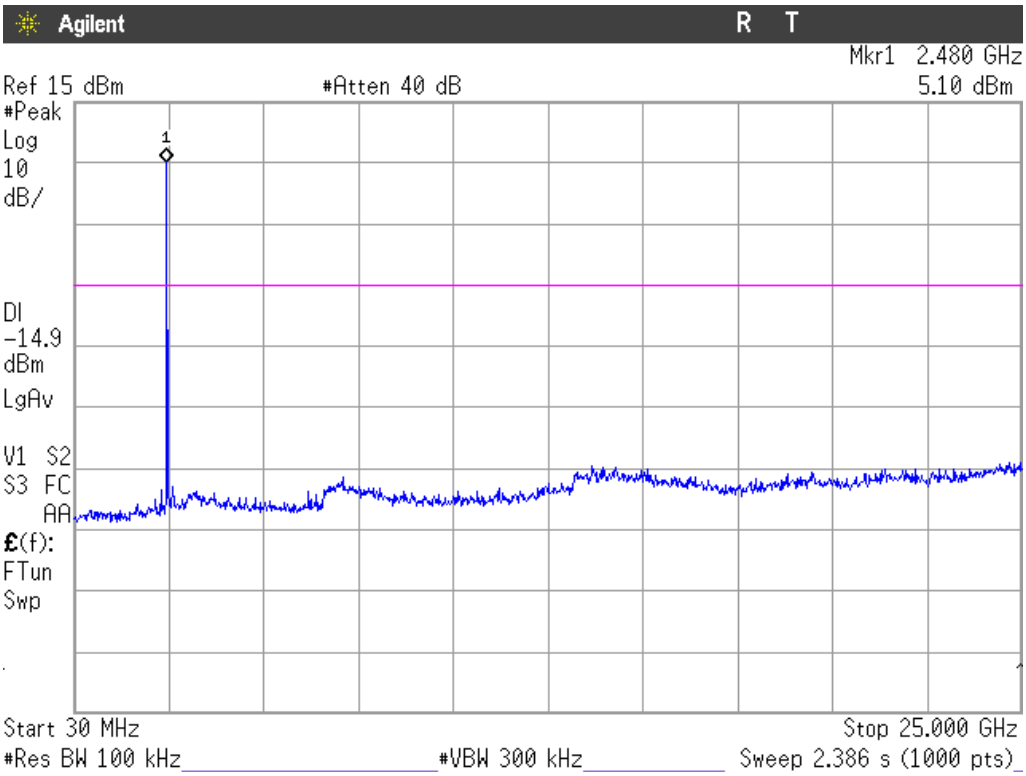
Note: The peak above the limit is the carrier frequency.

Middle Channel



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

Highest Channel



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

Verdict: PASS

Section 15.247 Subclause (d). Band-edge emissions compliance (Transmitter) / RSS-210 A8.5.

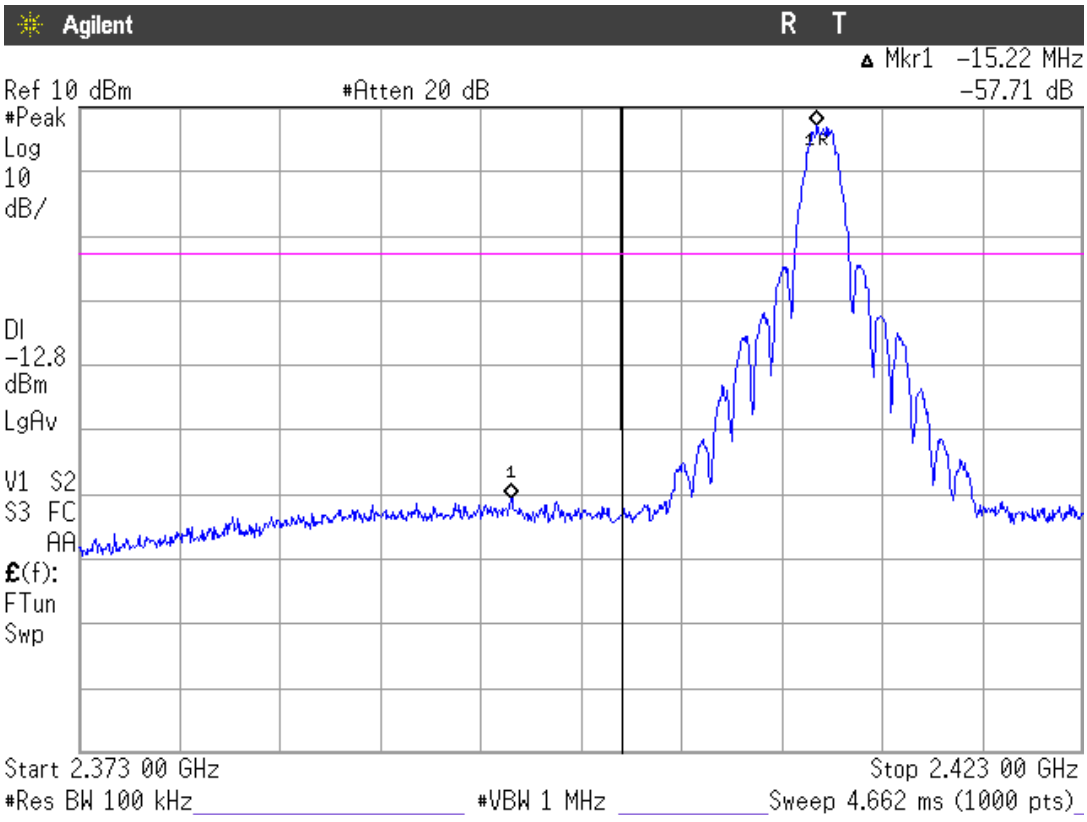
SPECIFICATION

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.

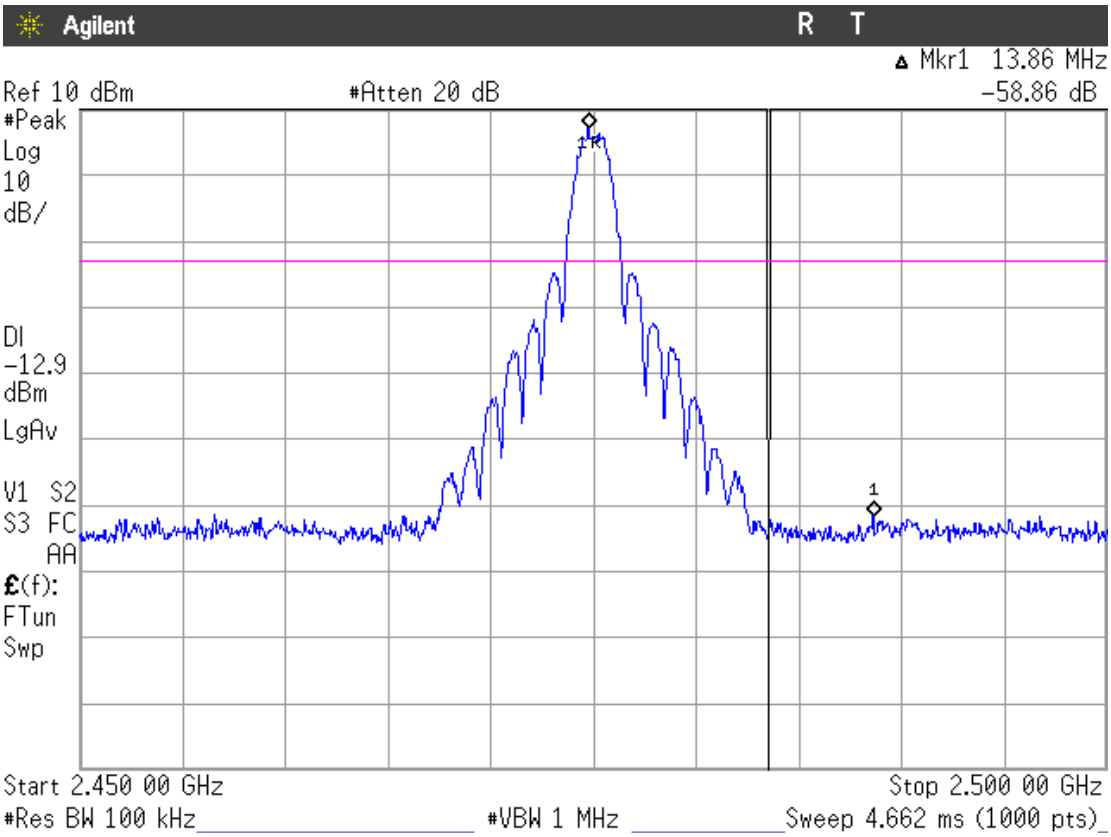
See next plot.



Verdict: PASS

2. HIGH FREQUENCY SECTION. CONDUCTED.

See next plot.



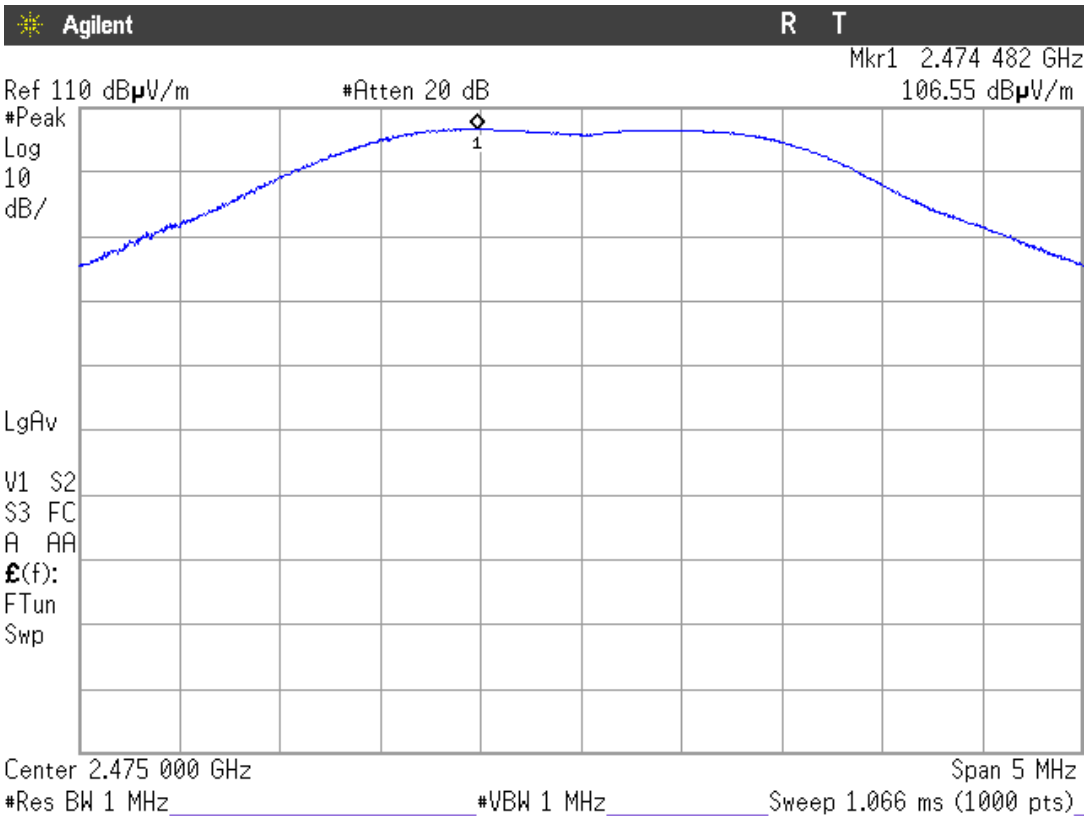
Verdict: PASS

Band-edge compliance of radiated emissions

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

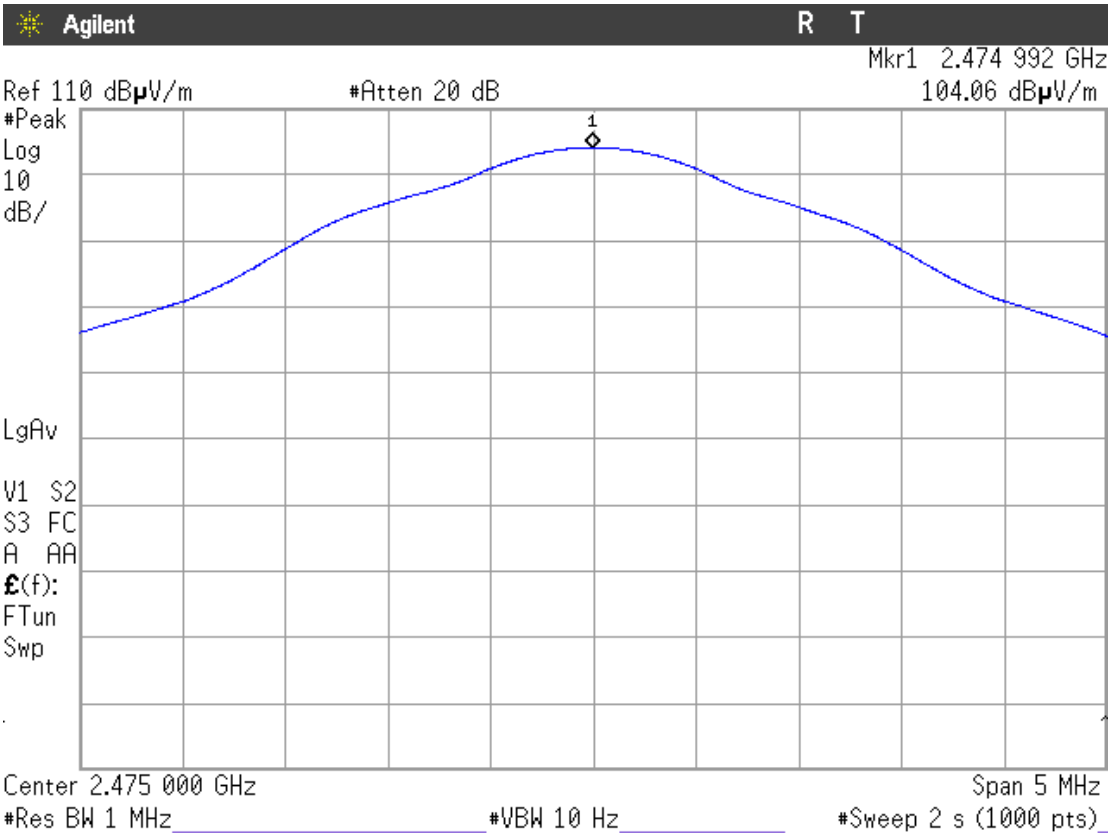
HIGHEST CHANNEL

Maximum field strength at 3 m. Peak value.



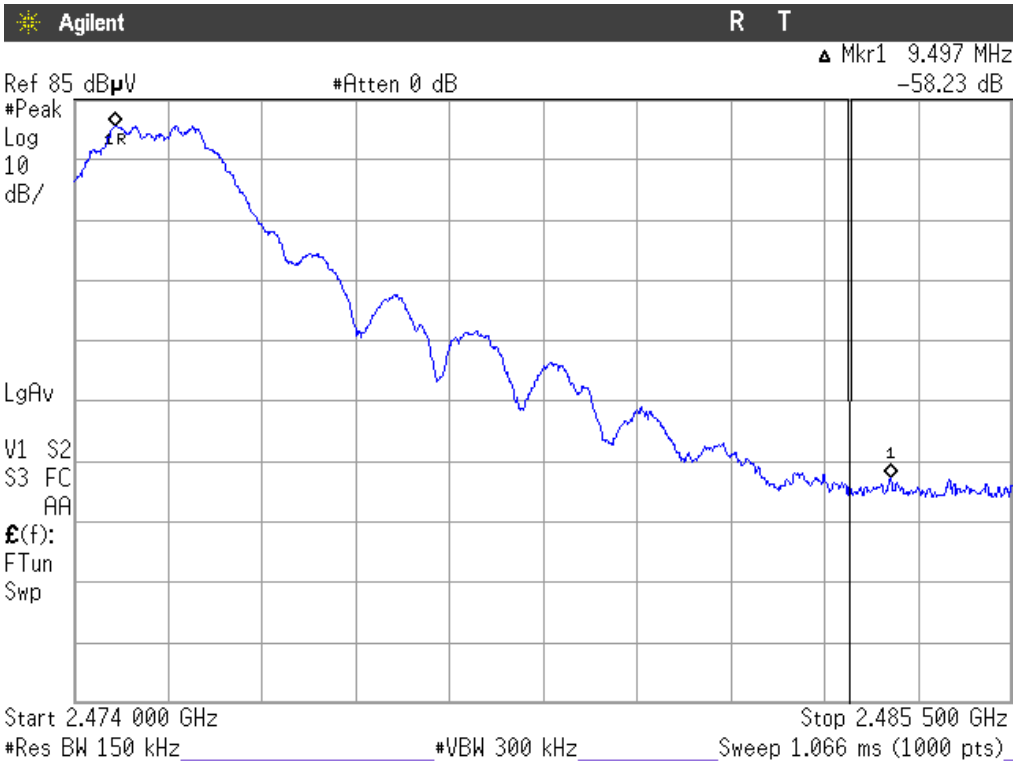
Note: The correction factor is already included in the spectrum analyzer as a transducer factor so that the marker shows directly the field strength level.

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
104.06 dBµV/m	58.23 dB	45.83	54 dBµV/m

Fundamental max. Peak value 3 m	Delta value	Calculated value 3 m	Limit
106.55 dBµV/m	58.23 dB	48.32	74 dBµV/m

Verdict: PASS

Section 15.247 Subclause (e). Power spectral density / RSS-210 A8.2. (b)

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

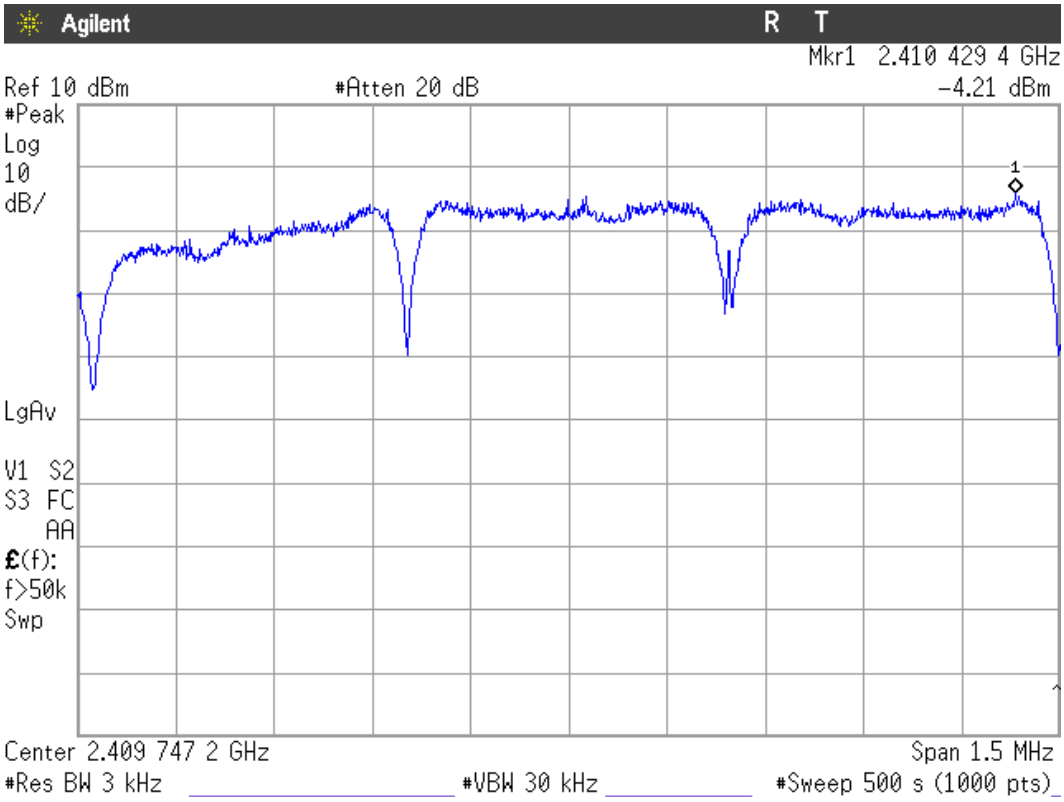
Power spectral density (see next plots).

	Lowest frequency 2410 MHz	Middle frequency 2440 MHz	Highest frequency 2475 MHz
Power spectral density (dBm) in 3 kHz bandwidth	-4.21	-4.61	-4.36
Measurement uncertainty (dB)	±1.5		

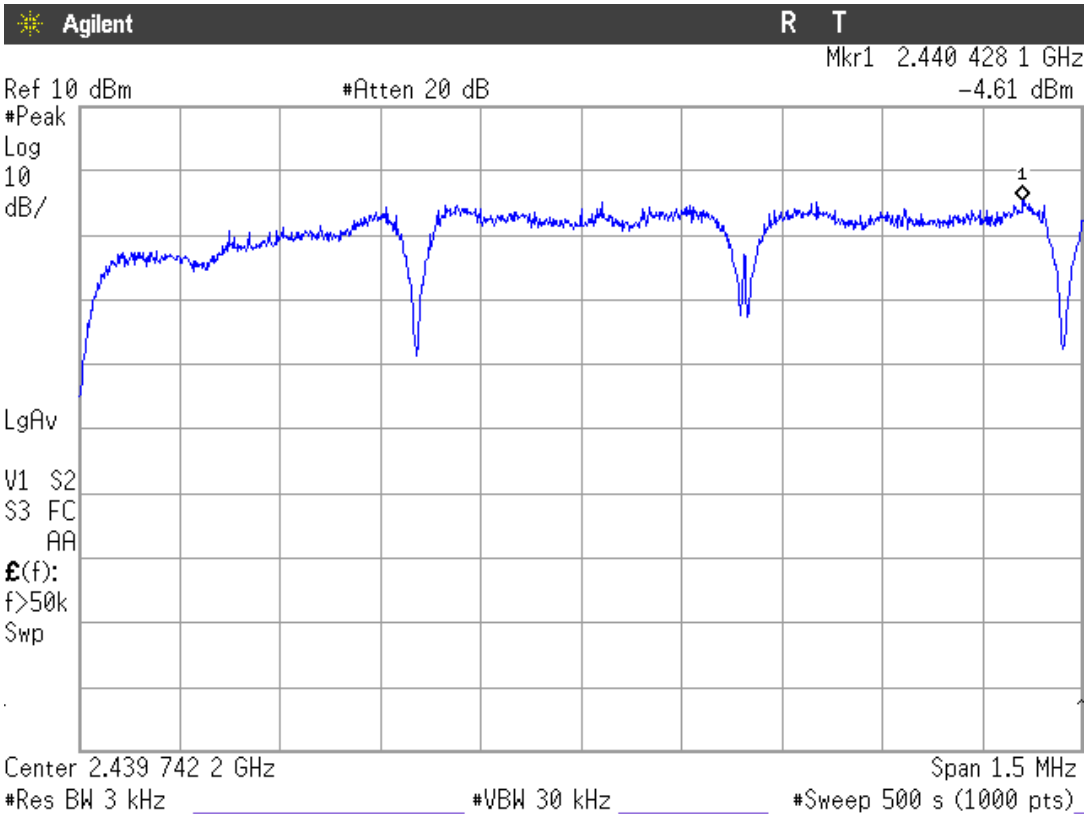
Verdict: PASS

Power spectral density.

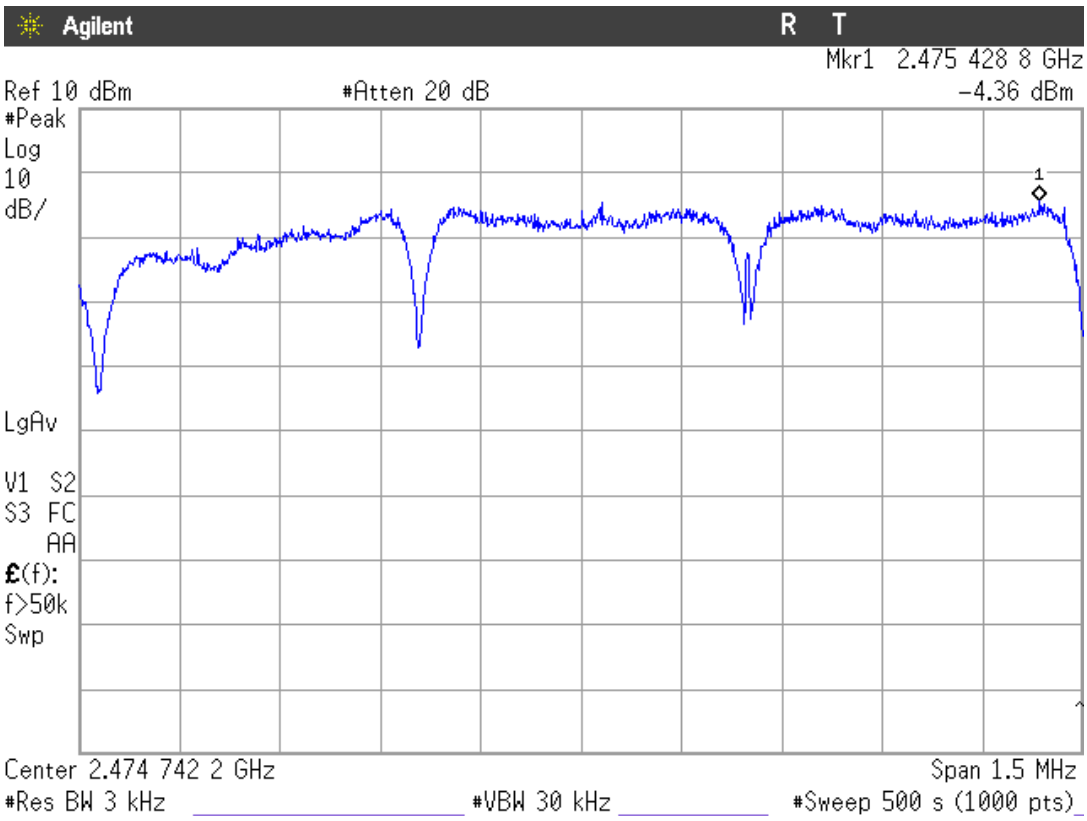
Lowest Channel



Middle Channel



Highest Channel



Section 15.247 Subclause (d). Emission limitations radiated (Transmitter) / RSS-210 A8.5.

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 (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 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 in all the range.

Frequency range 1 GHz-25 GHz

1. CHANNEL: LOWEST (2410 MHz).

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
2.09022	V	Peak	50.68	± 4.09
2.09022	V	Average	43.28	± 4.09
2.11821	V	Peak	52.93	± 4.09
2.11821	V	Average	46.46	± 4.09
2.26175	V	Peak	56.58	± 4.09
2.26175	V	Average	51.40	± 4.09
2.26605	V	Peak	56.52	± 4.09
2.26605	V	Average	51.19	± 4.09
2.55383	V	Peak	52.39	± 4.09
2.55383	V	Average	44.79	± 4.09
2.55860	V	Peak	52.75	± 4.09
2.55860	V	Average	44.45	± 4.09
4.81907	V	Peak	52.18	± 4.09
4.81907	V	Average	48.04	± 4.09
4.82082	V	Peak	52.19	± 4.09
4.82082	V	Average	48.17	± 4.09
7.22877	V	Peak	48.57	± 4.09
7.22877	V	Average	41.65	± 4.09
7.23172	V	Peak	48.72	± 4.09
7.23172	V	Average	41.89	± 4.09
9.63823	V	Peak	56.84	± 4.09
9.63823	V	Average	50.59	± 4.09
9.64250	V	Peak	56.60	± 4.09
9.64250	V	Average	50.65	± 4.09

2. CHANNEL: MIDDLE (2440 MHz).

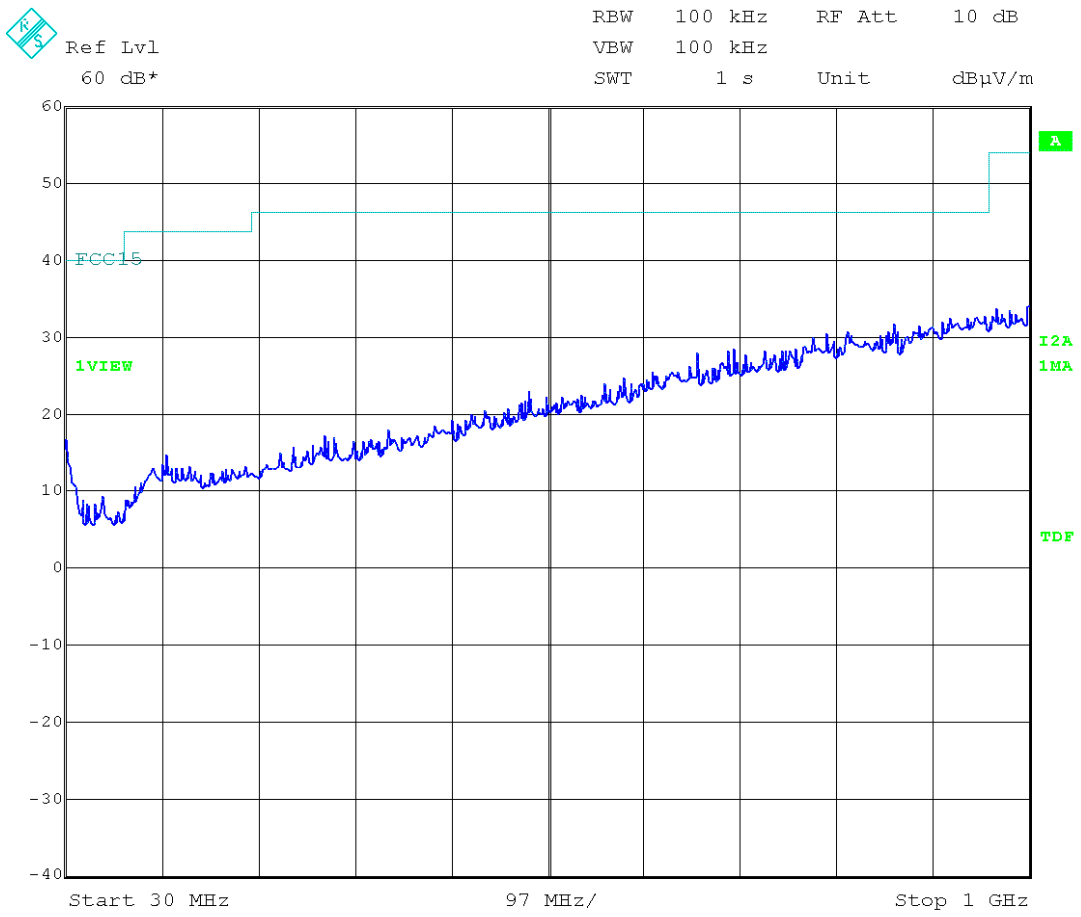
Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
2.07235	V	Peak	49.86	± 4.09
2.07235	V	Average	41.74	± 4.09
2.13653	V	Peak	49.75	± 4.09
2.13653	V	Average	42.33	± 4.09
2.16788	V	Peak	49.40	± 4.09
2.16788	V	Average	41.80	± 4.09
2.18402	V	Peak	49.81	± 4.09
2.18402	V	Average	42.22	± 4.09
2.311735	V	Peak	44.78	± 4.09
2.311735	V	Average	37.10	± 4.09
4.87917	V	Peak	52.01	± 4.09
4.87917	V	Average	46.57	± 4.09
4.88092	V	Peak	52.33	± 4.09
4.88092	V	Average	46.71	± 4.09
7.31867	V	Peak	48.05	± 4.09
7.31867	V	Average	41.06	± 4.09
7.32135	V	Peak	48.57	± 4.09
7.32135	V	Average	41.19	± 4.09
9.75767	V	Peak	56.57	± 4.09
9.75767	V	Average	50.85	± 4.09
9.76125	V	Peak	56.77	± 4.09
9.76125	V	Average	50.58	± 4.09

3. CHANNEL: HIGHEST (2475 MHz).

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
2.02274	V	Peak	51.63	± 4.09
2.02274	V	Average	44.38	± 4.09
2.02721	V	Peak	51.52	± 4.09
2.02721	V	Average	44.21	± 4.09
2.17515	V	Peak	53.46	± 4.09
2.17515	V	Average	48.14	± 4.09
2.31472	V	Peak	49.85	± 4.09
2.31472	V	Average	38.02	± 4.09
2.32305	V	Peak	54.50	± 4.09
2.32305	V	Average	49.24	± 4.09
2.32677	V	Peak	54.30	± 4.09
2.32677	V	Average	49.01	± 4.09
2.33482	V	Peak	44.79	± 4.09
2.33482	V	Average	37.72	± 4.09
2.34732	V	Peak	44.72	± 4.09
2.34732	V	Average	35.90	± 4.09
4.94112	V	Peak	49.39	± 4.09
4.94112	V	Average	44.43	± 4.09
4.95087	V	Peak	49.08	± 4.09
4.95087	V	Average	43.73	± 4.09
7.42340	V	Peak	48.89	± 4.09
7.42340	V	Average	42.11	± 4.09
7.42616	V	Peak	49.93	± 4.09
7.42616	V	Average	41.91	± 4.09
9.89802	V	Peak	58.31	± 4.09
9.89802	V	Average	53.07	± 4.09
9.90190	V	Peak	58.36	± 4.09
9.90190	V	Average	53.31	± 4.09

Verdict: PASS

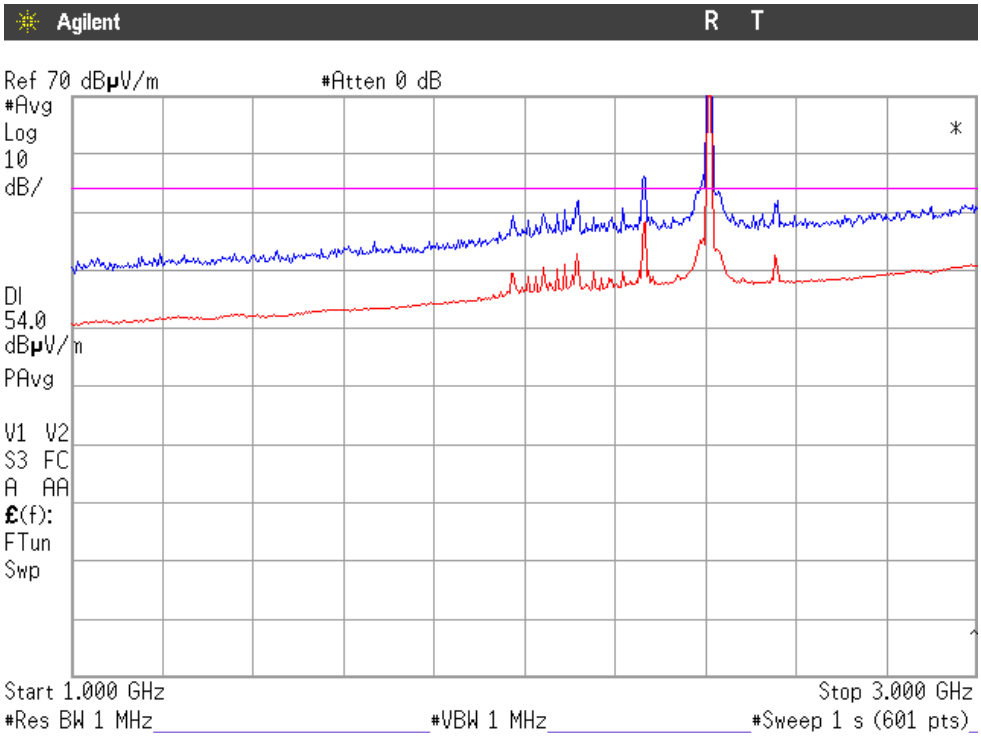
FREQUENCY RANGE 30 MHz-1000 MHz.



(This plot is valid for all three channels).

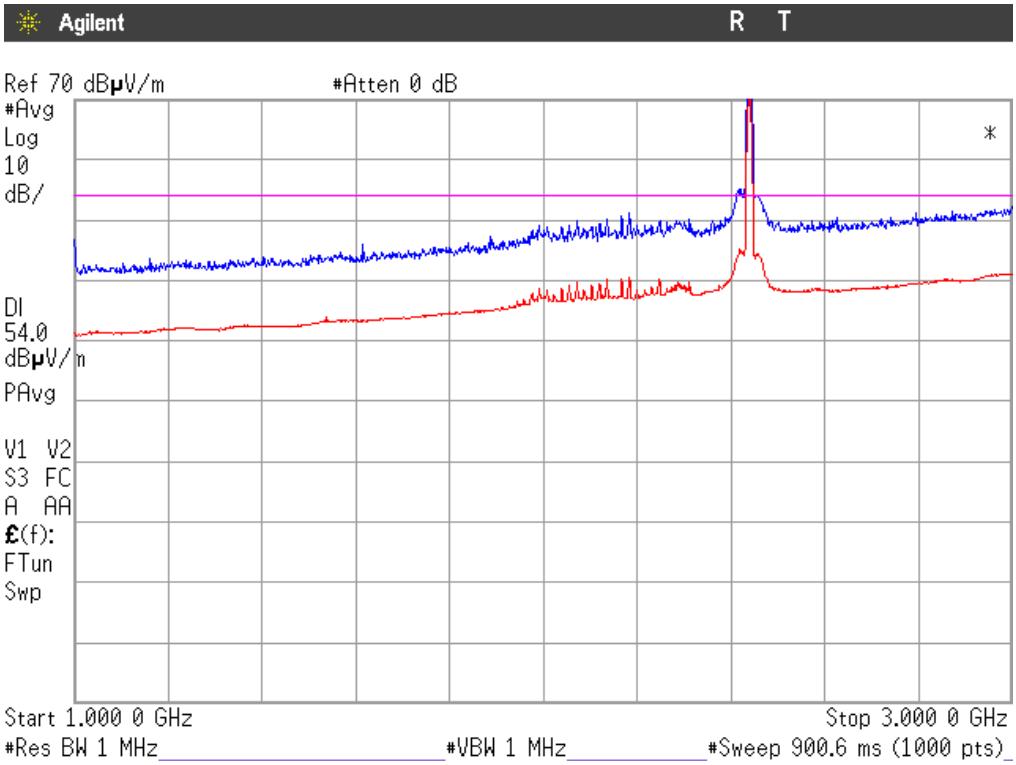
FREQUENCY RANGE 1 GHz to 3 GHz.

CHANNEL: Lowest (2410 MHz).



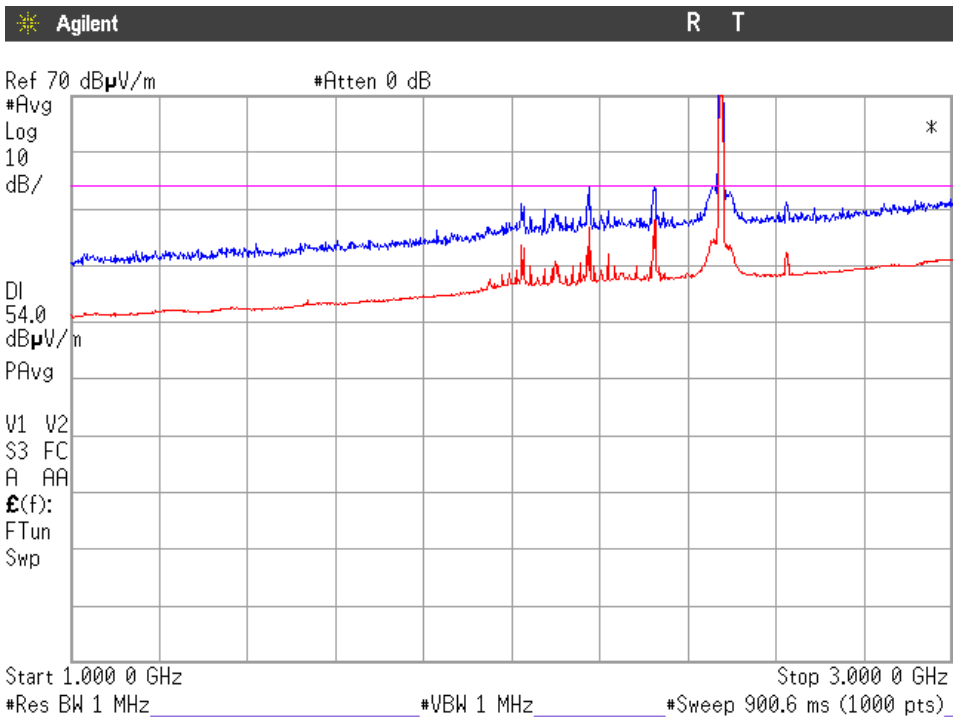
Note: The peak shown in the plot above the limit is the carrier frequency.

CHANNEL: Middle (2440 MHz).



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

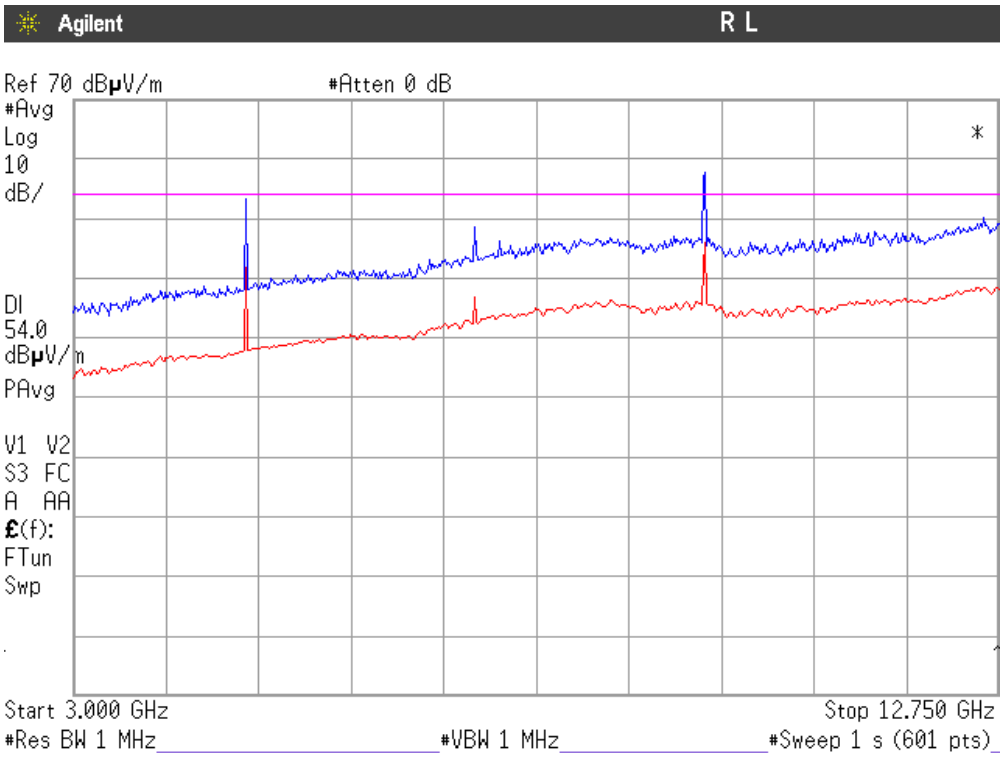
CHANNEL: Highest (2475 MHz).



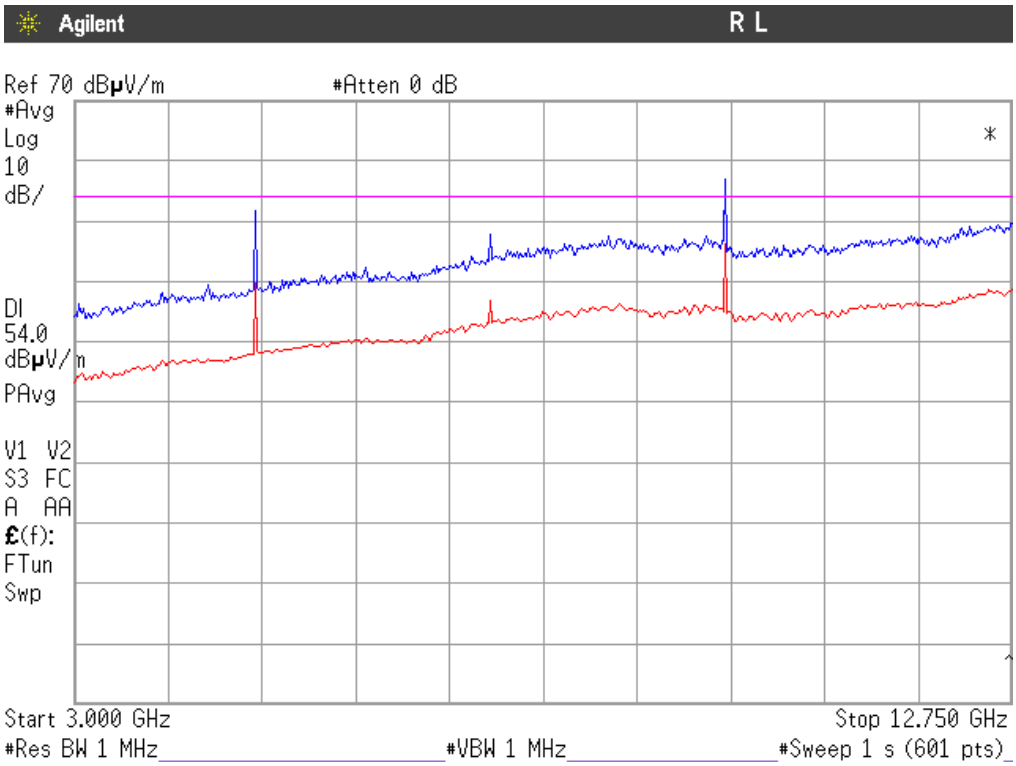
Note: The peak shown in the plot above the limit is the carrier frequency.

FREQUENCY RANGE 3 GHz to 12.75 GHz.

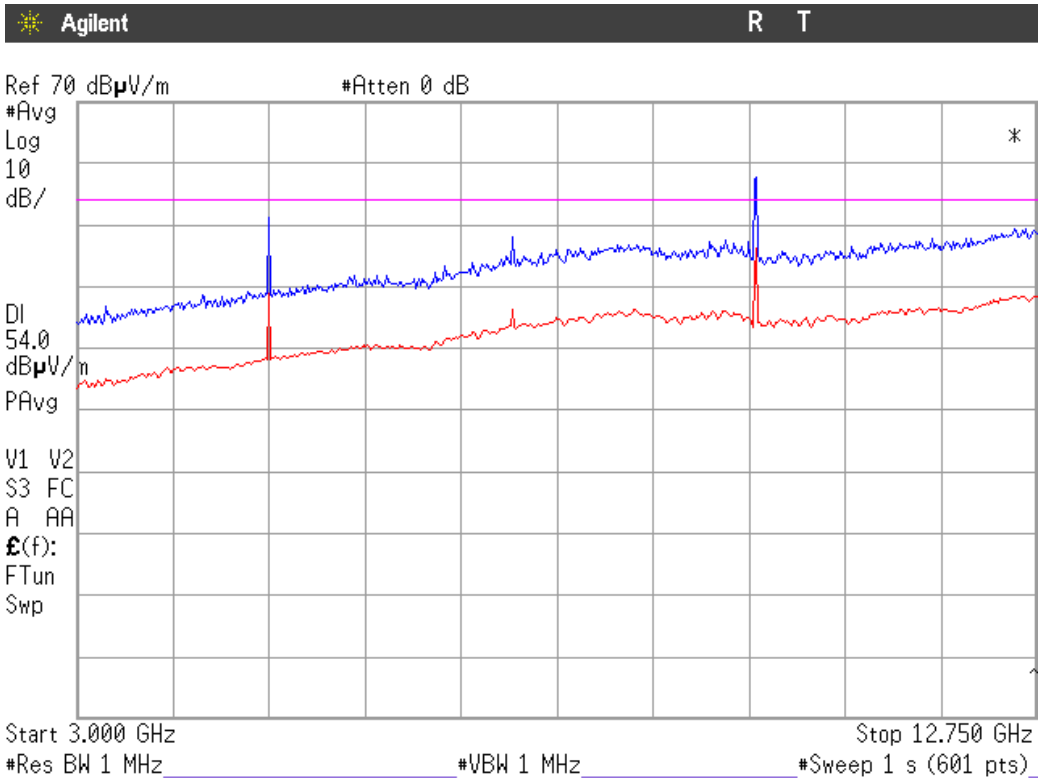
CHANNEL: Lowest (2410 MHz).



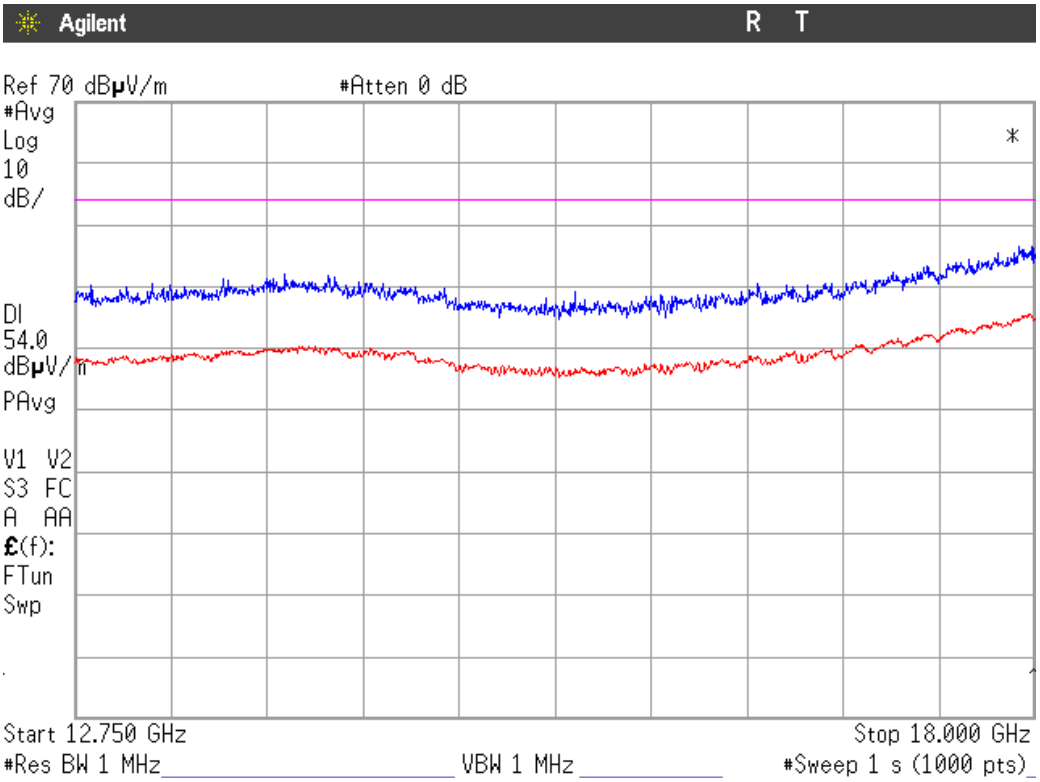
CHANNEL: Middle (2440 MHz).



CHANNEL: Highest (2475 MHz).

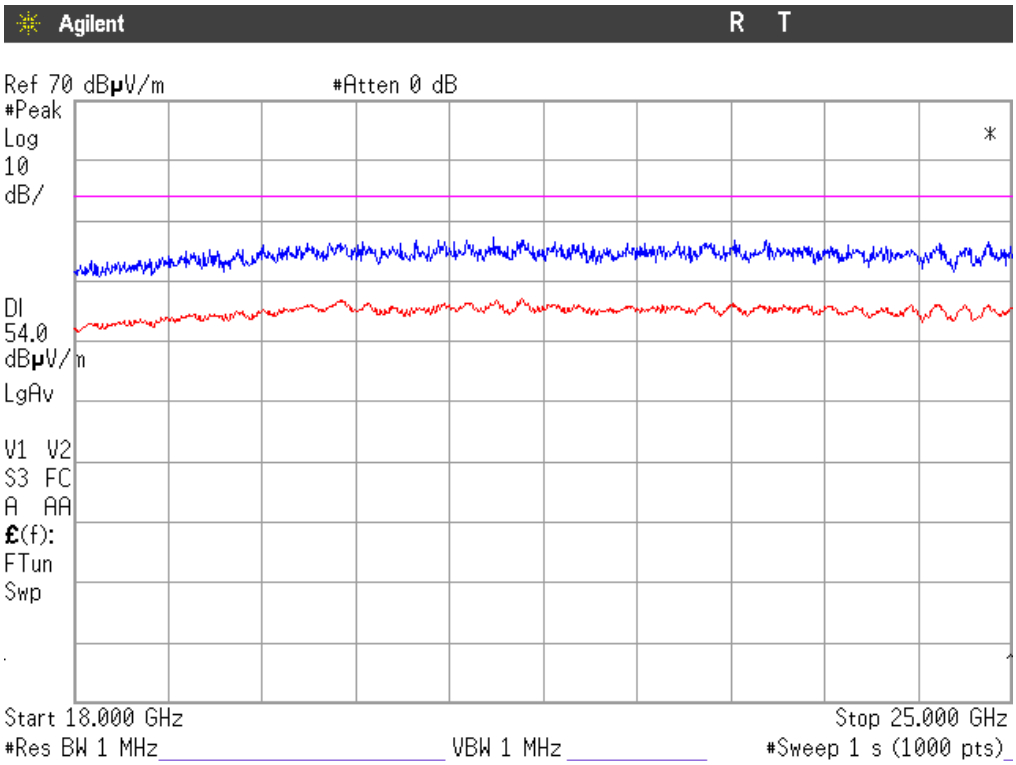


FREQUENCY RANGE 12.75 GHz to 18 GHz.



(This plot is valid for all three channels).

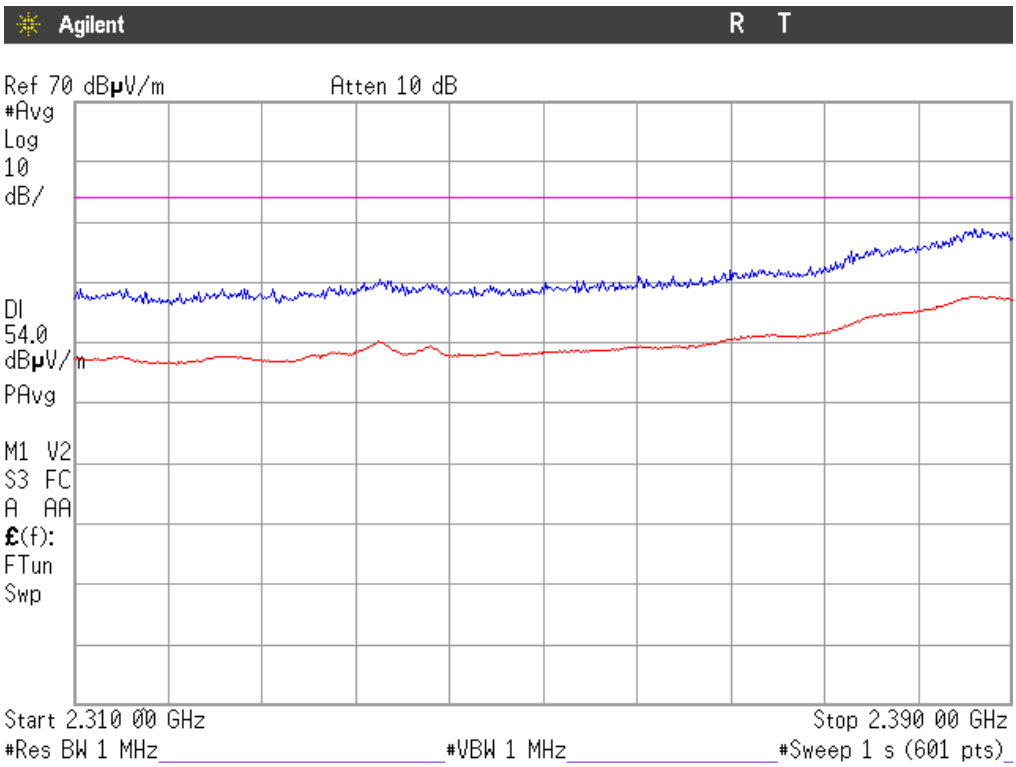
FREQUENCY RANGE 18 GHz to 25 GHz.



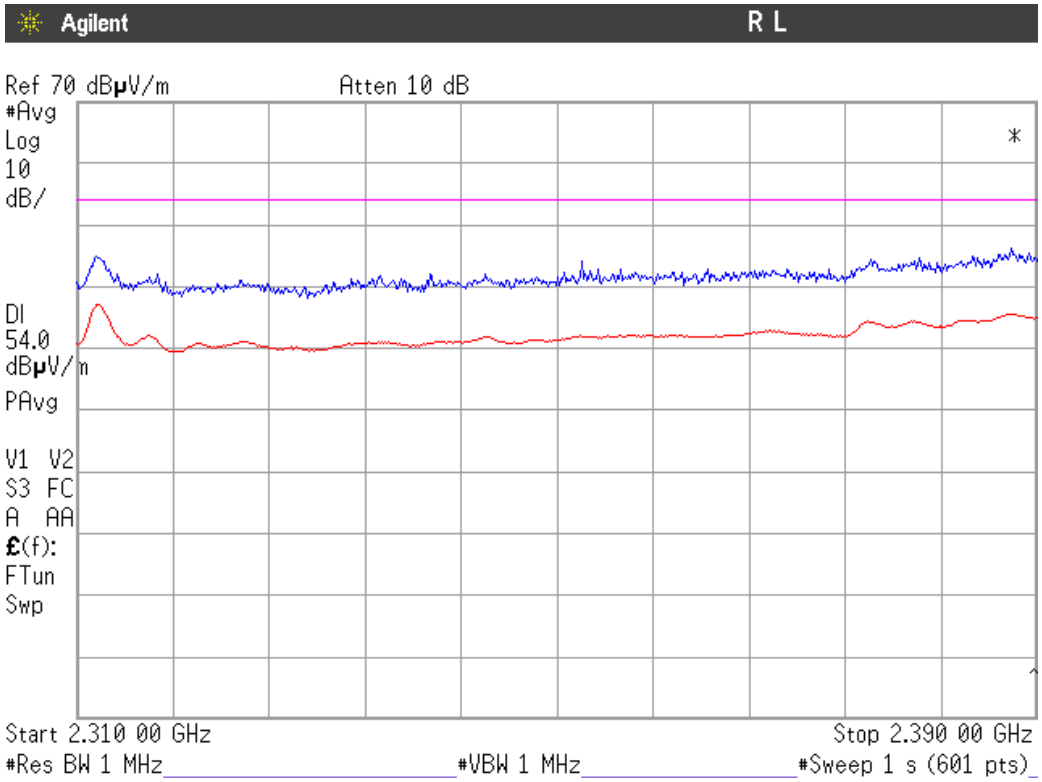
(This plot is valid for all three channels).

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

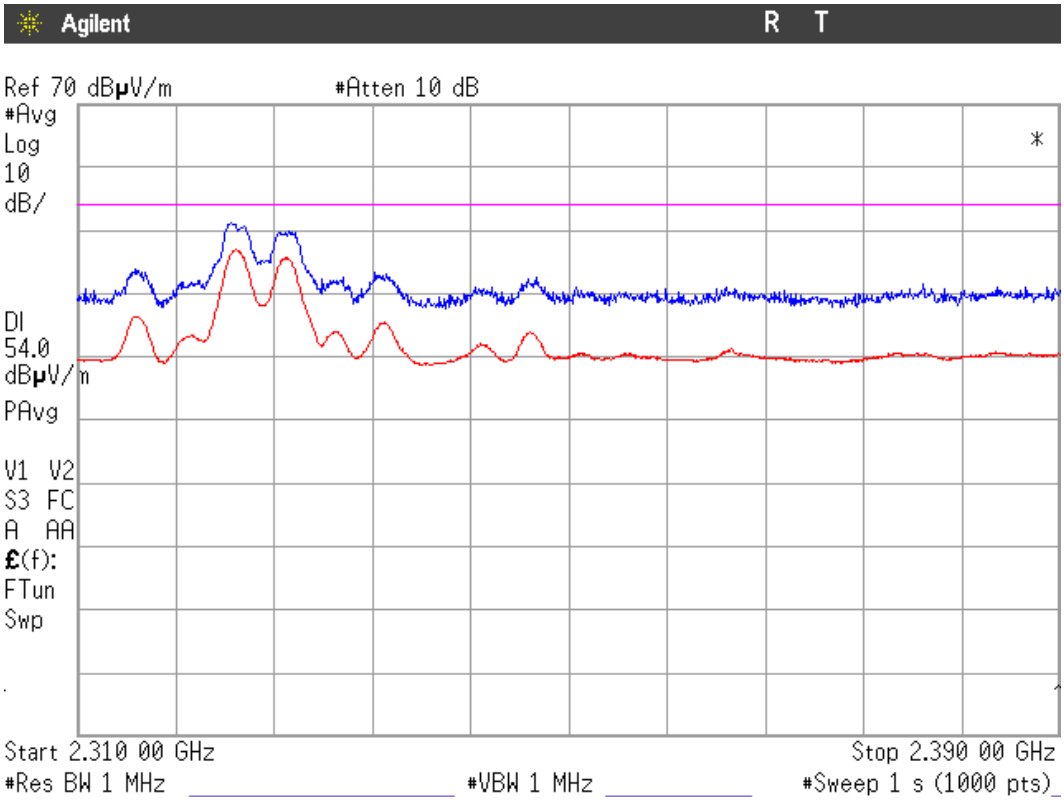
CHANNEL: Lowest (2410 MHz).



CHANNEL: Middle (2440 MHz).

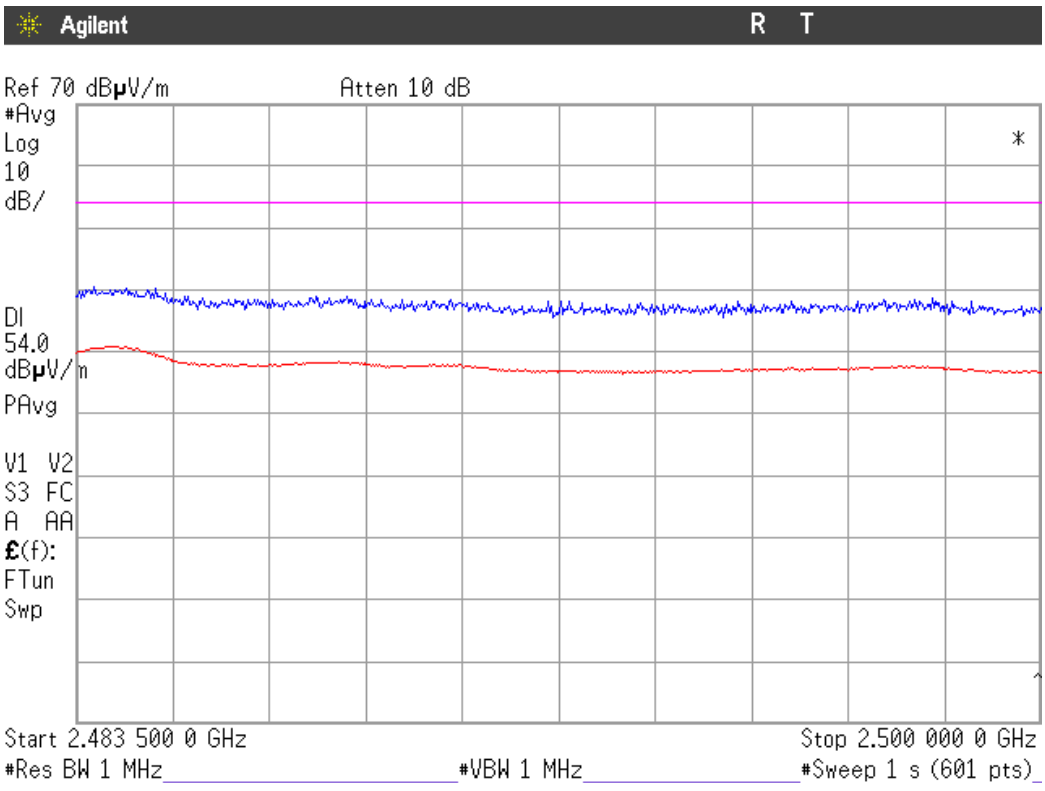


CHANNEL: Highest (2475 MHz).

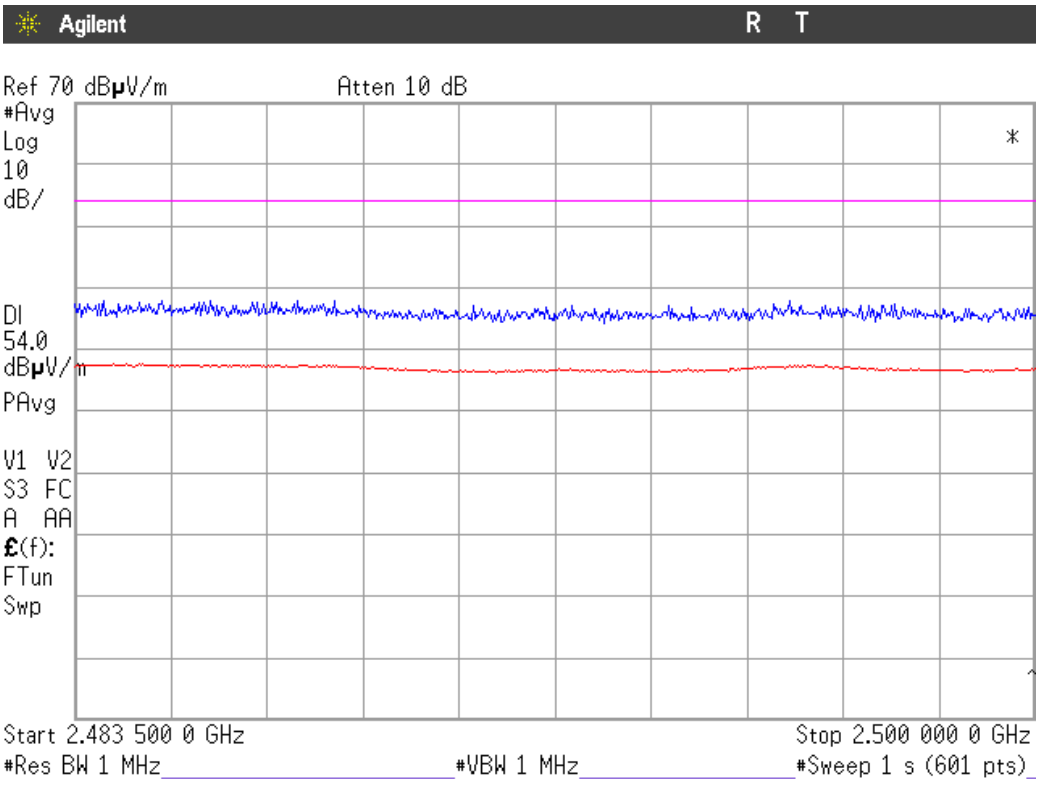


FREQUENCY RANGE 2.4835 GHz to 2.5 GHz. (RESTRICTED BAND)

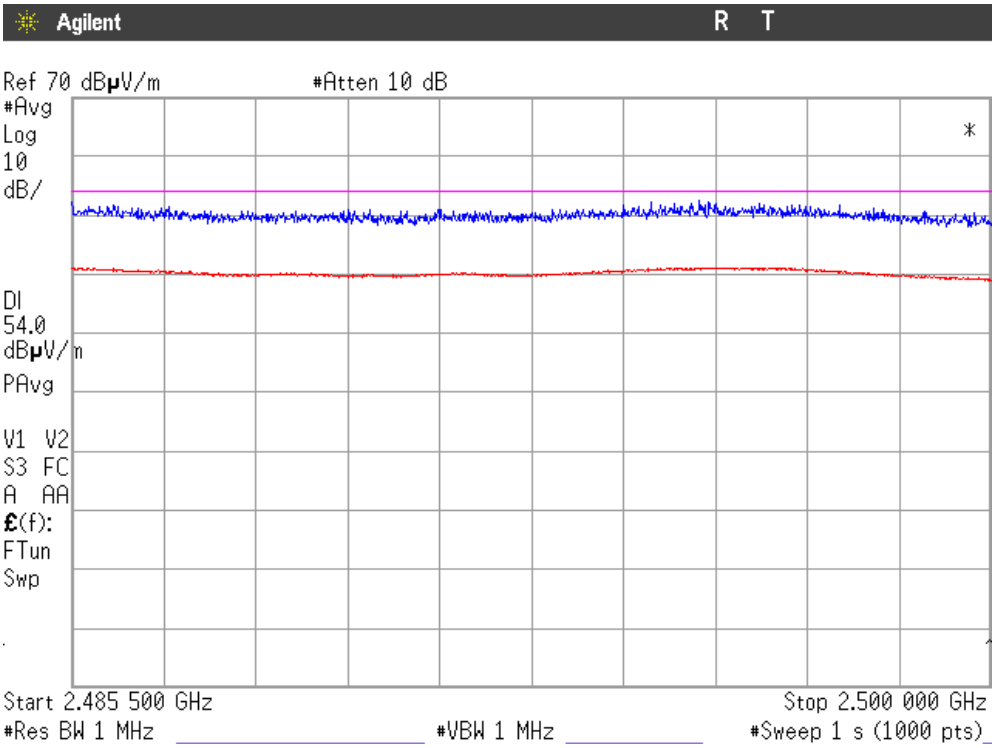
CHANNEL: Lowest (2410 MHz).



CHANNEL: Middle (2440 MHz).



CHANNEL: Highest (2475 MHz).



Section 15.109. Receiver spurious radiation / RSS-210 2.5.

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.

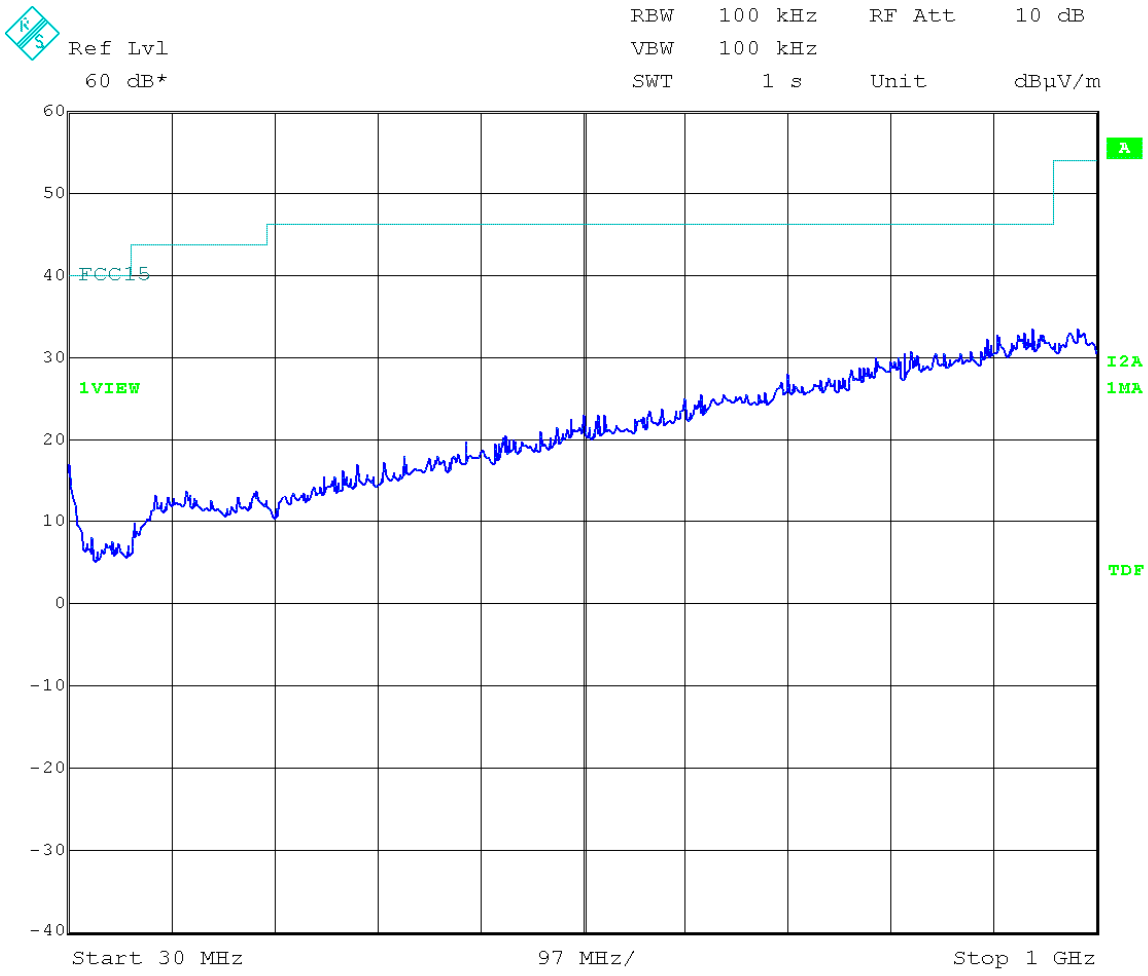
No spurious signals were found in all the range.

Frequency range 1 GHz-25 GHz.

No spurious signals were found in all the range.

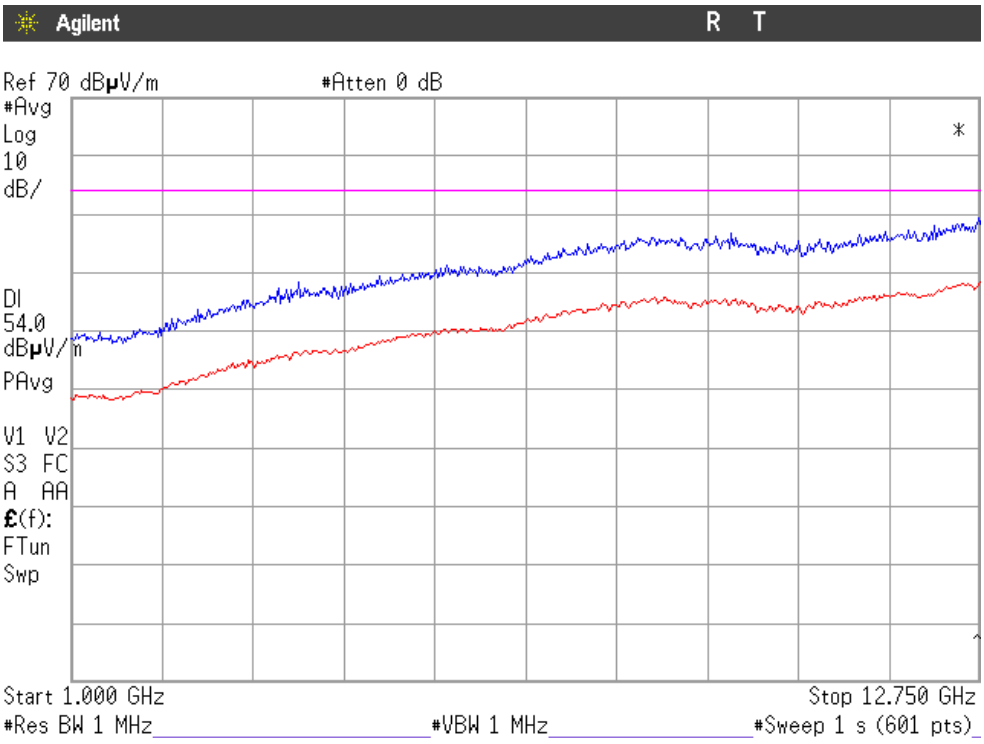
Verdict: PASS.

FREQUENCY RANGE 30 MHz-1000 MHz.



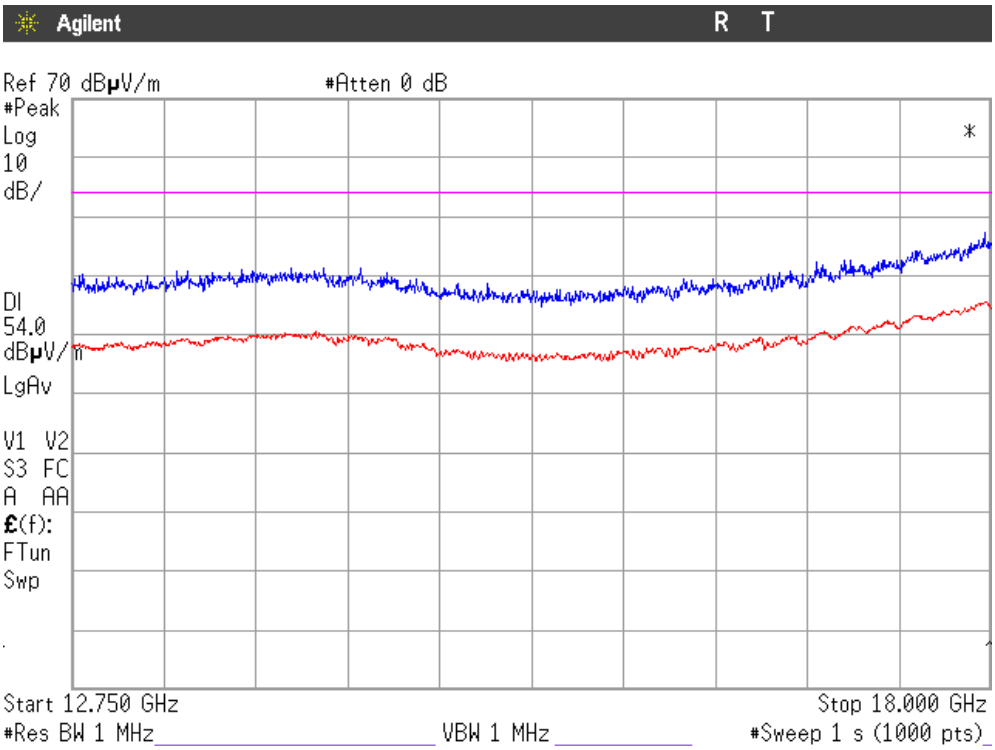
(This plot is valid for all three channels).

FREQUENCY RANGE 1 GHz-12.75 GHz.



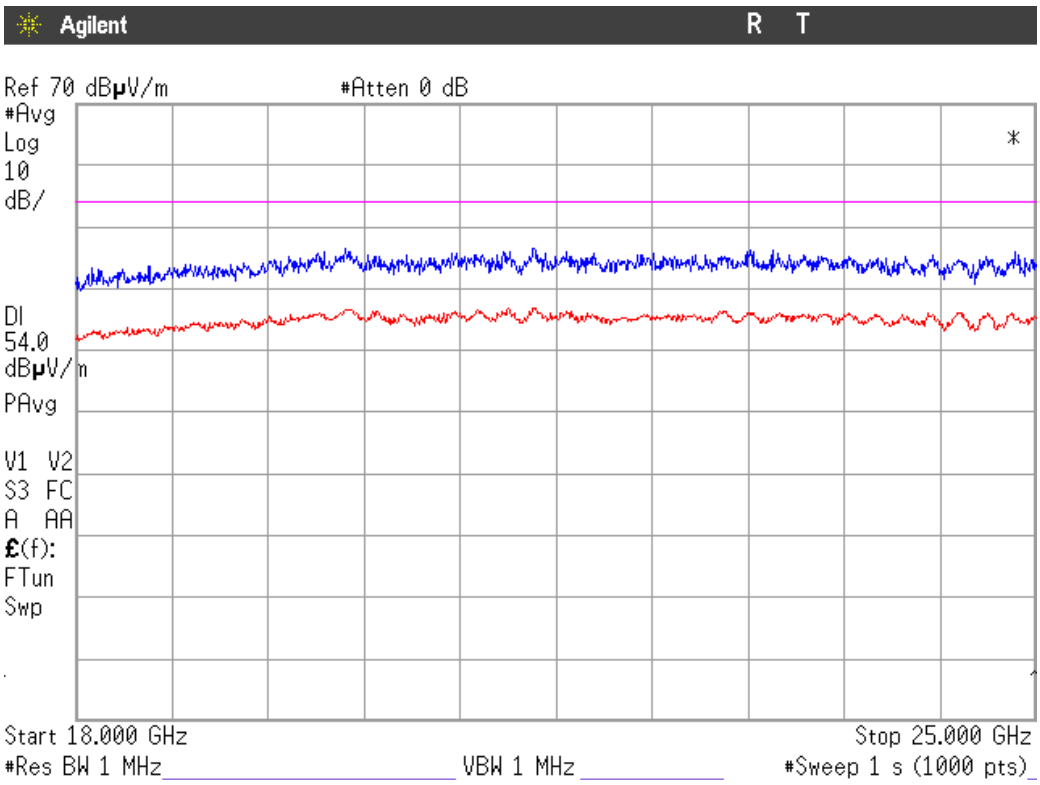
(This plot is valid for all three channels).

FREQUENCY RANGE 12.75 GHz-18 GHz.



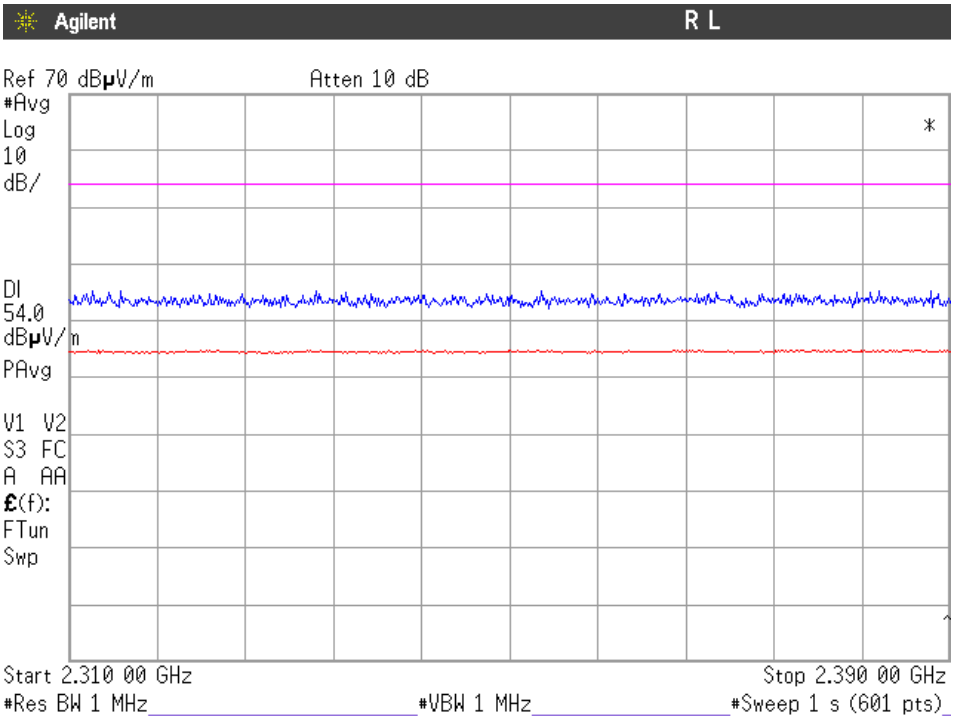
(This plot is valid for all three channels).

FREQUENCY RANGE 18 GHz-25 GHz.



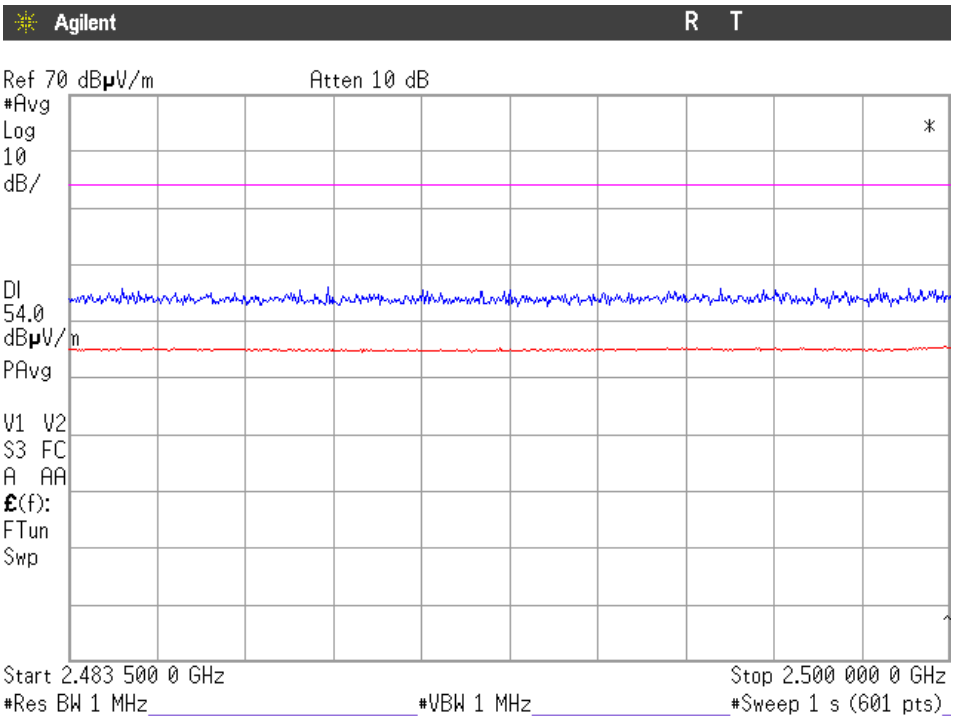
(This plot is valid for all three channels).

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).

APPENDIX B: Test results. Bluetooth Radio

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TEST CONDITIONS

Power supply (V):

$V_{nominal}$ = 3.7 Vdc

Type of power supply = DC voltage from rechargeable battery.

Type of antenna = Integral antenna.

Declared Gain for antenna (maximum) = 2.2 dBi

TEST FREQUENCIES:

Lowest channel: 2402 MHz

Middle channel: 2441 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 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.

FCC Section 15.247 Subclause (a) (1) / RSS-210 Clause A8.1 (b). 20 dB Bandwidth and Carrier frequency separation

SPECIFICATION

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

RESULTS

(See next plots)

Modulation: GFSK

	Lowest frequency 2402 MHz	Middle frequency 2441 MHz	Highest frequency 2480 MHz
20 dB Spectrum bandwidth (kHz)	926.9	922.9	924.9
Measurement uncertainty (kHz)	±11		

Modulation: Π/4-DQPSK (2Mbps)

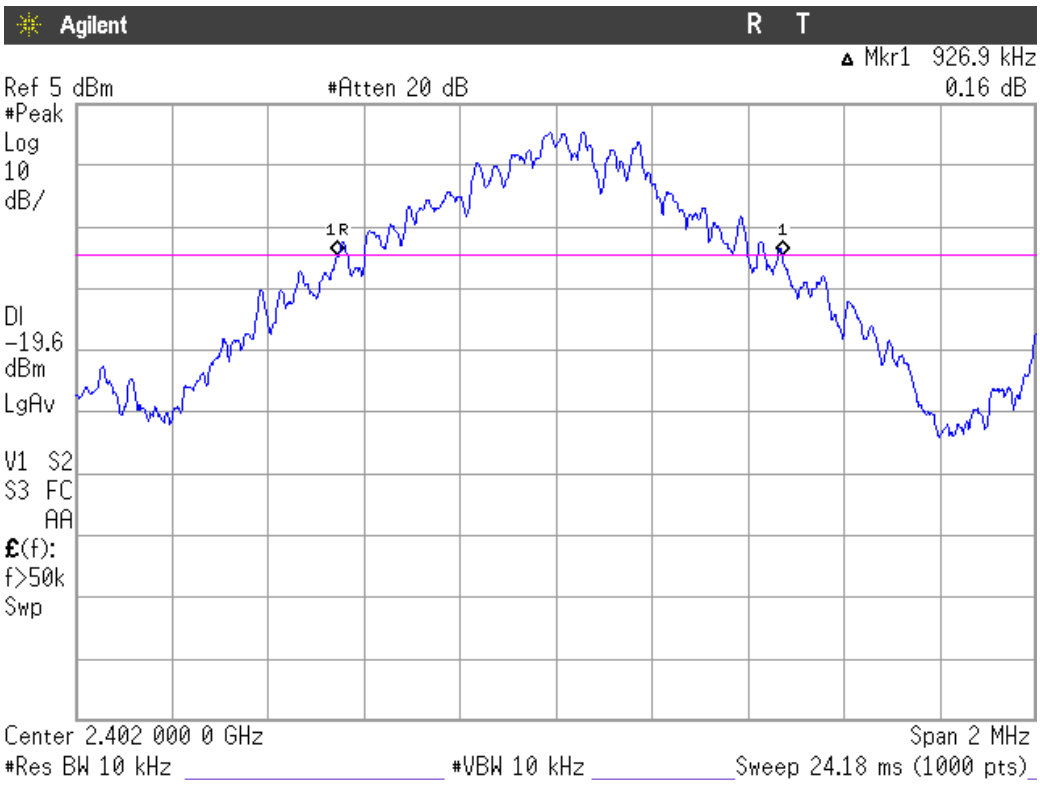
	Lowest frequency 2402 MHz	Middle frequency 2441 MHz	Highest frequency 2480 MHz
20 dB Spectrum bandwidth (kHz)	1211.2	1223.2	1223.2
Measurement uncertainty (kHz)	±11		

Modulation: 8-DPSK (3Mbps)

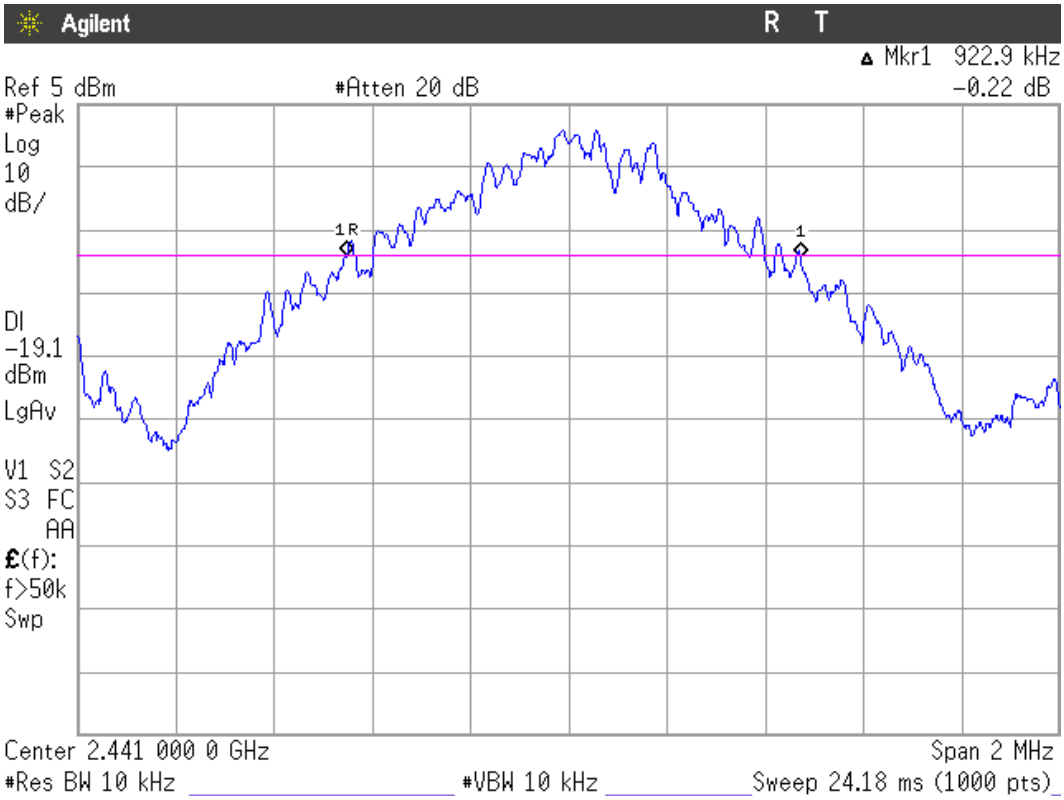
	Lowest frequency 2402 MHz	Middle frequency 2441 MHz	Highest frequency 2480 MHz
20 dB Spectrum bandwidth (kHz)	1255.3	1257.3	1257.3
Measurement uncertainty (kHz)	±11		

Modulation: GFSK

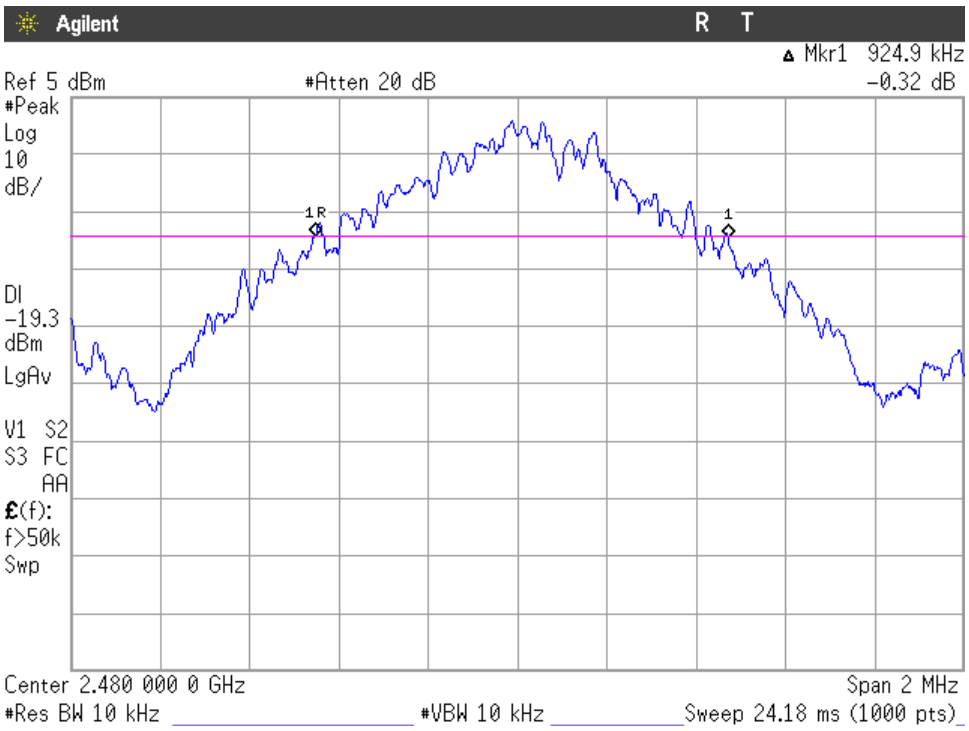
20 dB BANDWIDTH. Lowest Channel: 2402 MHz.



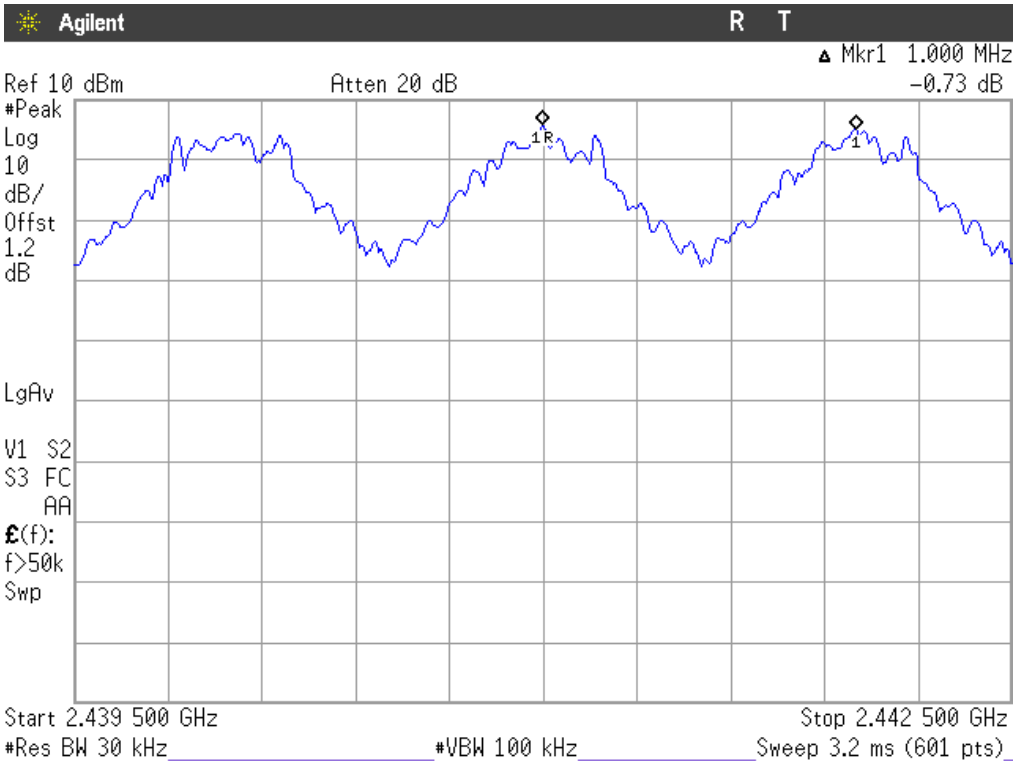
20 dB BANDWIDTH Middle Channel: 2441 MHz.



20 dB BANDWIDTH Highest Channel: 2480 MHz.



Carrier frequency separation

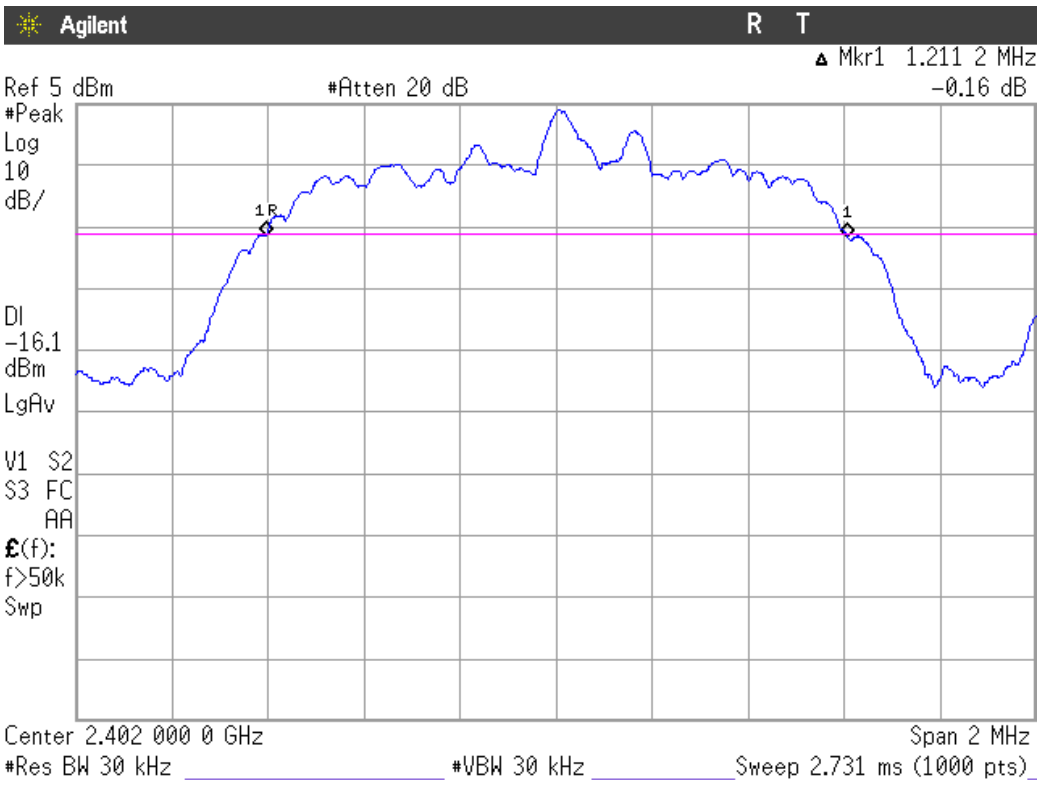


The hopping channel carrier frequencies are separated by a minimum of the 20 dB bandwidth of the hopping channel.

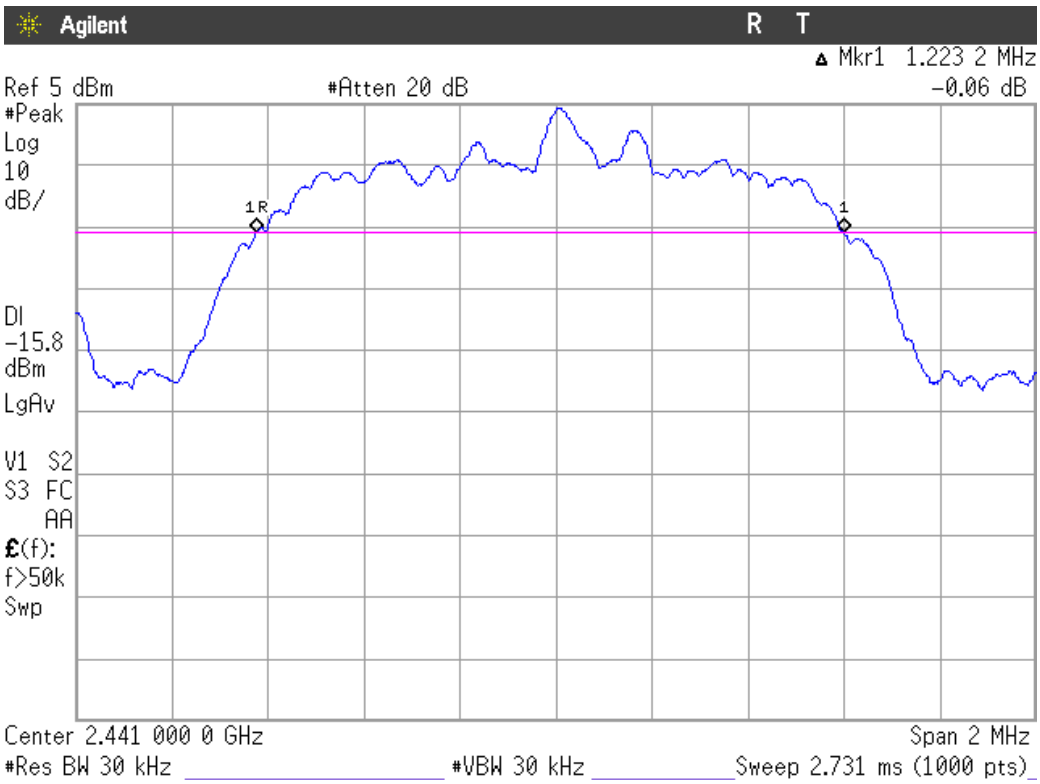
Verdict: PASS

Modulation: Π/4-DQPSK

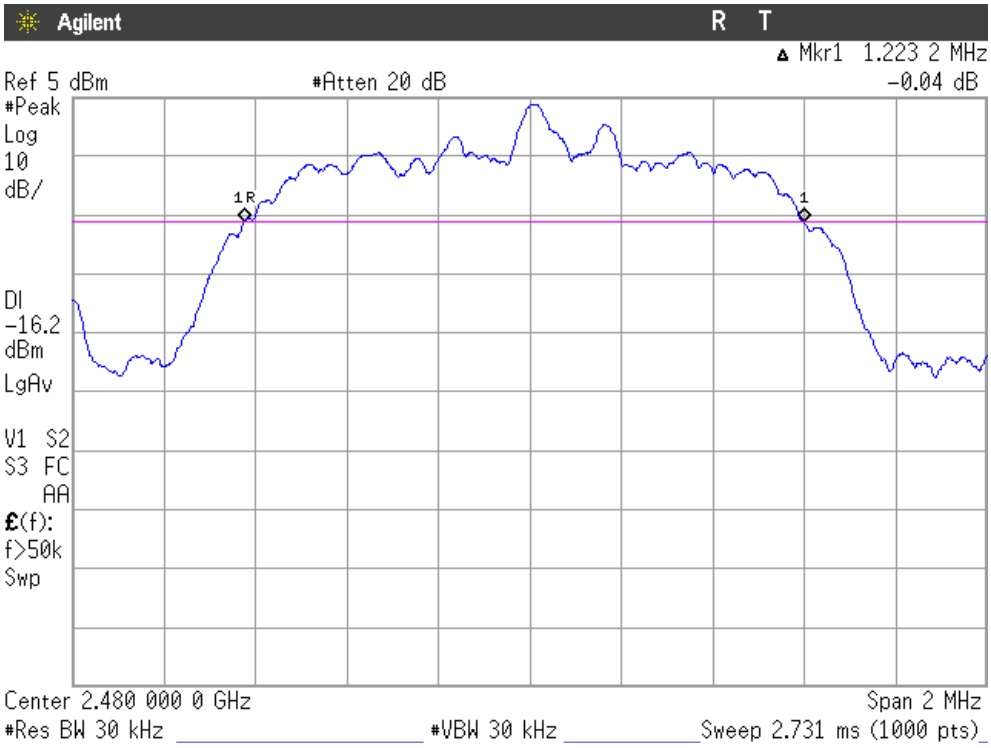
20 dB BANDWIDTH. Lowest Channel: 2402 MHz.



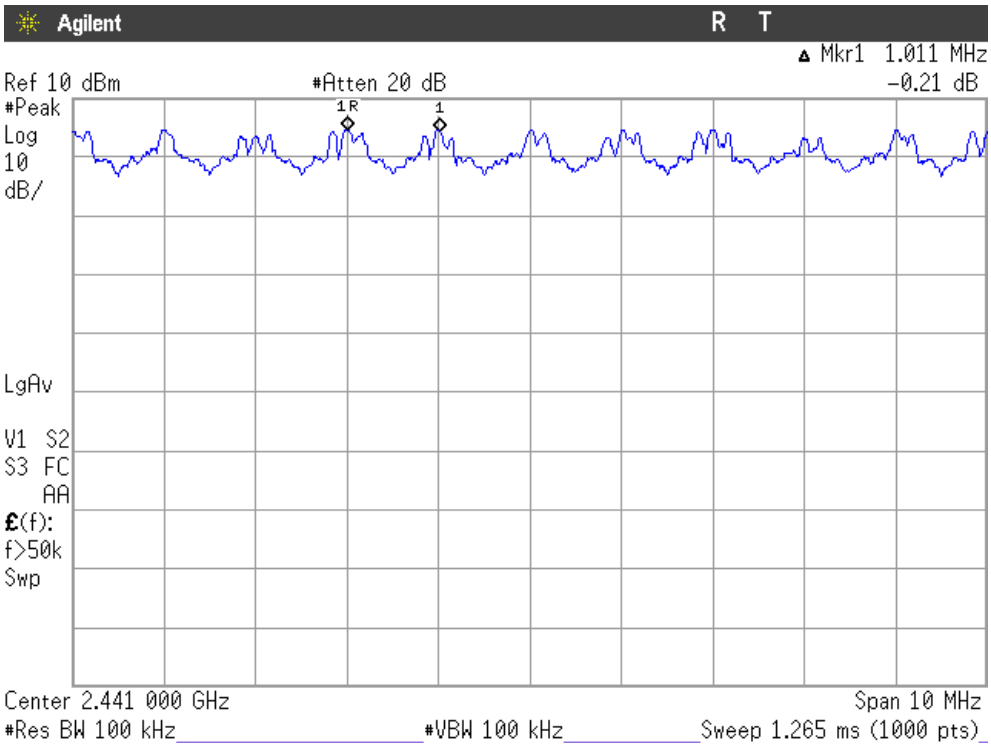
20 dB BANDWIDTH Middle Channel: 2441 MHz.



20 dB BANDWIDTH Highest Channel: 2480 MHz.



Carrier frequency separation

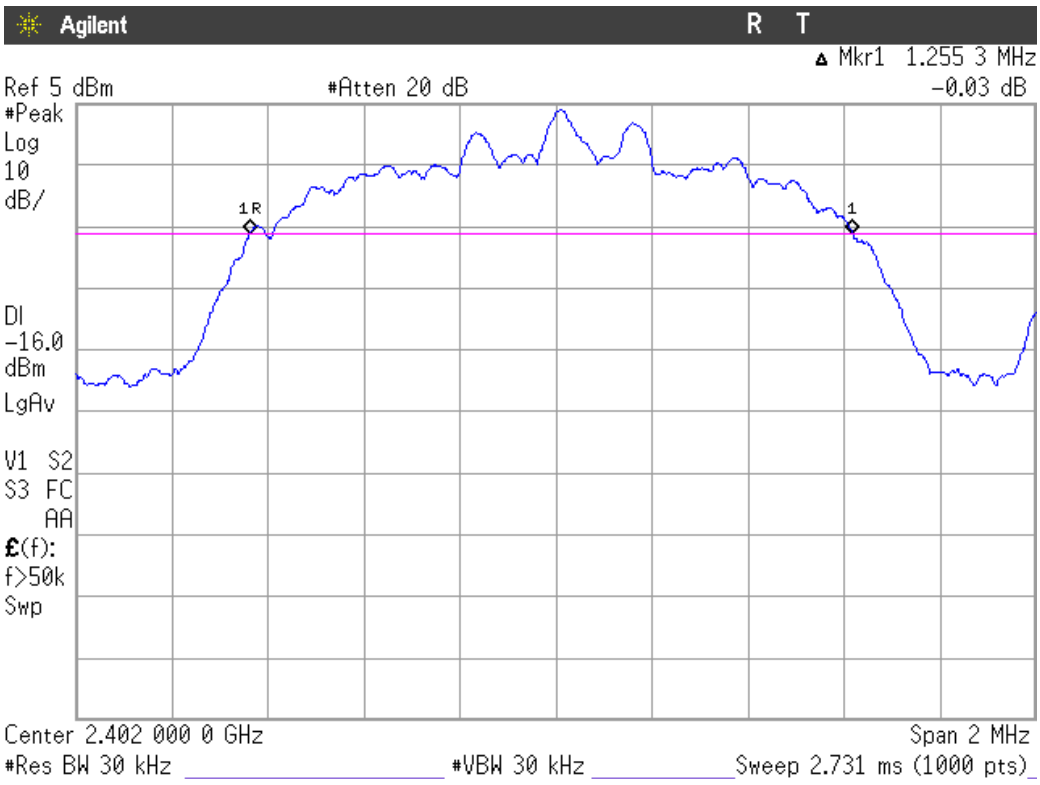


The hopping channel carrier frequencies are separated by a minimum of the two-thirds of the 20 dB bandwidth of the hopping channel

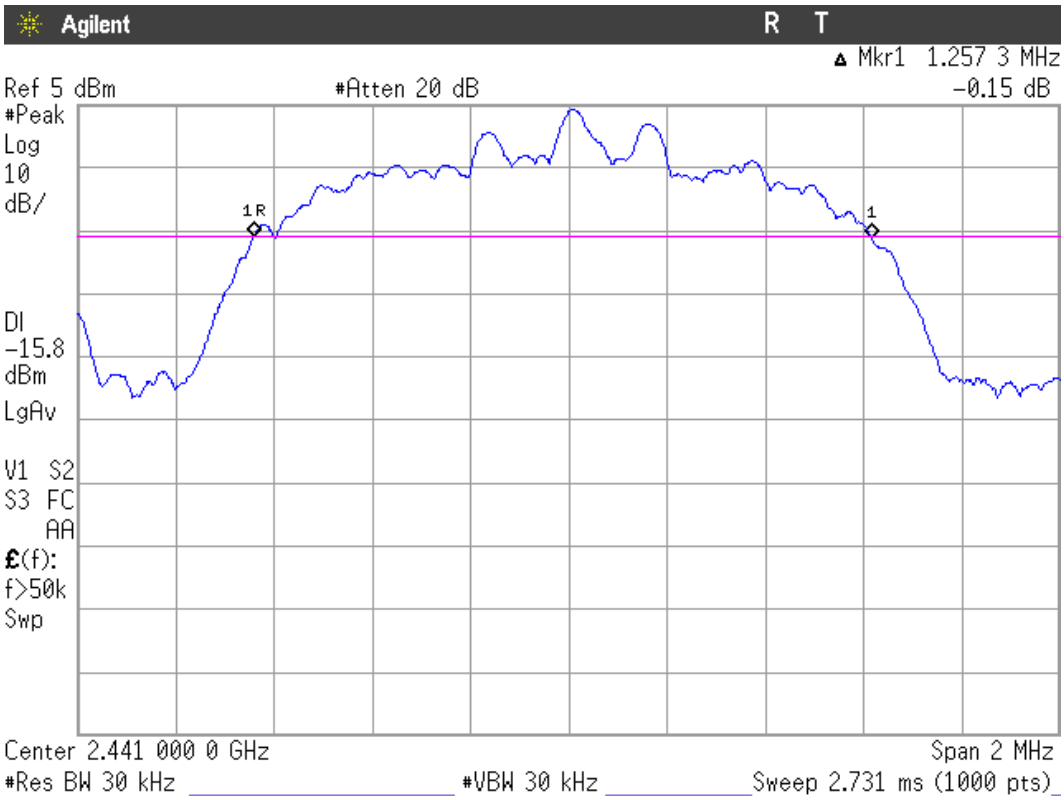
Verdict: PASS

Modulation: 8-DPSK

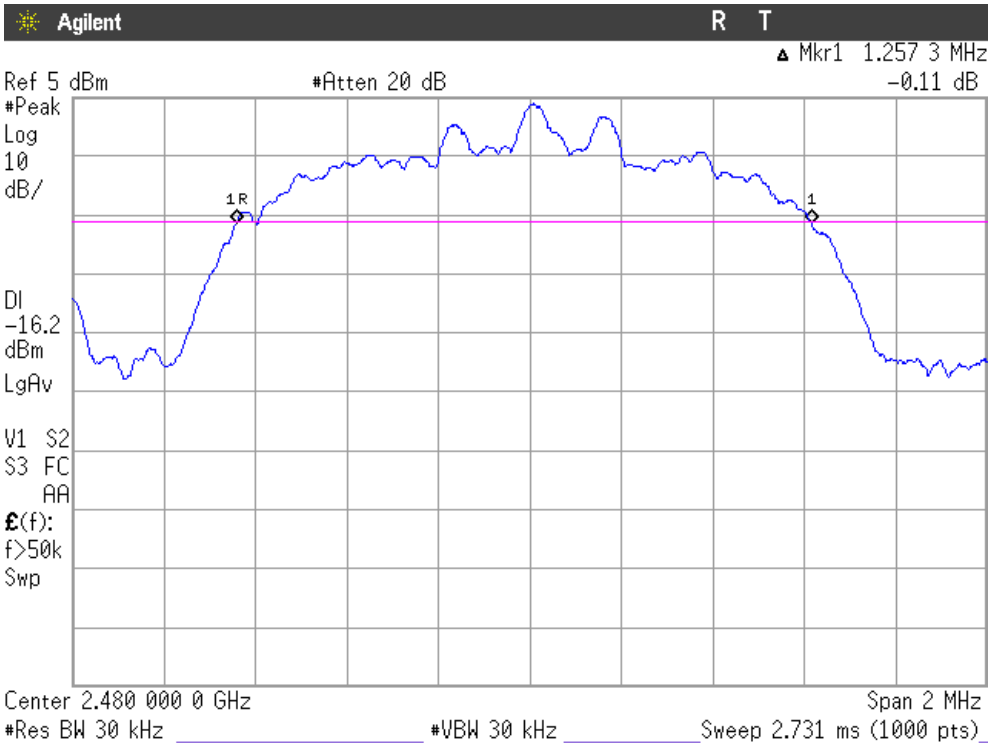
20 dB BANDWIDTH Lowest Channel: 2402 MHz.



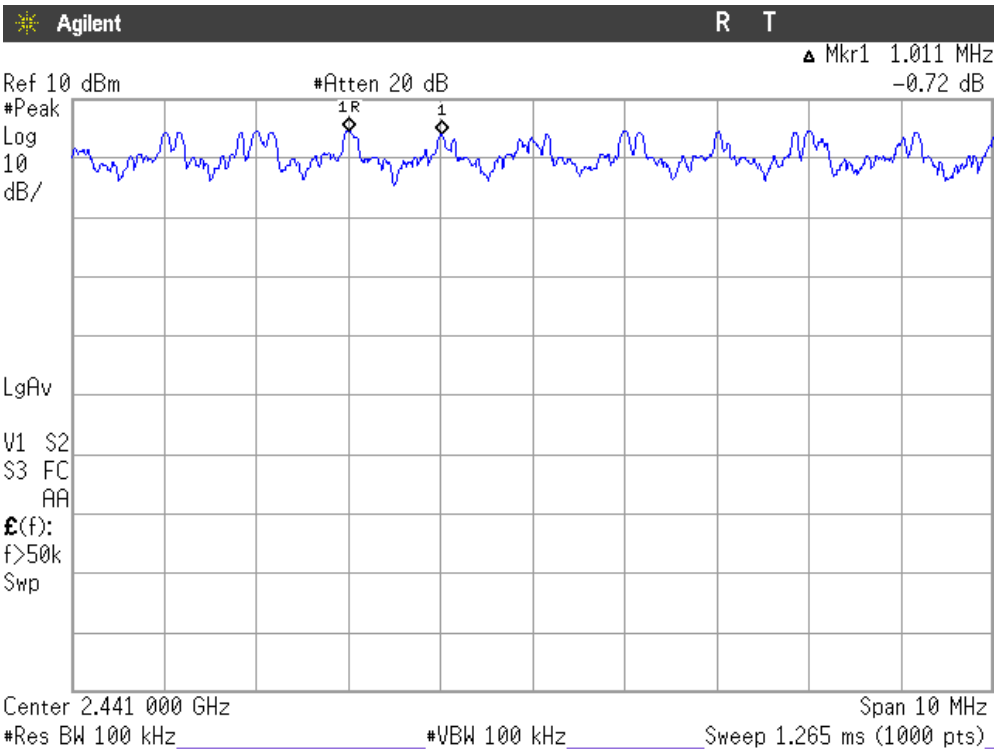
20 dB BANDWIDTH Middle Channel: 2441 MHz.



20 dB BANDWIDTH Highest Channel: 2480 MHz.



Carrier frequency separation



The hopping channel carrier frequencies are separated by a minimum of the two-thirds of the 20 dB bandwidth of the hopping channel.

Verdict: PASS

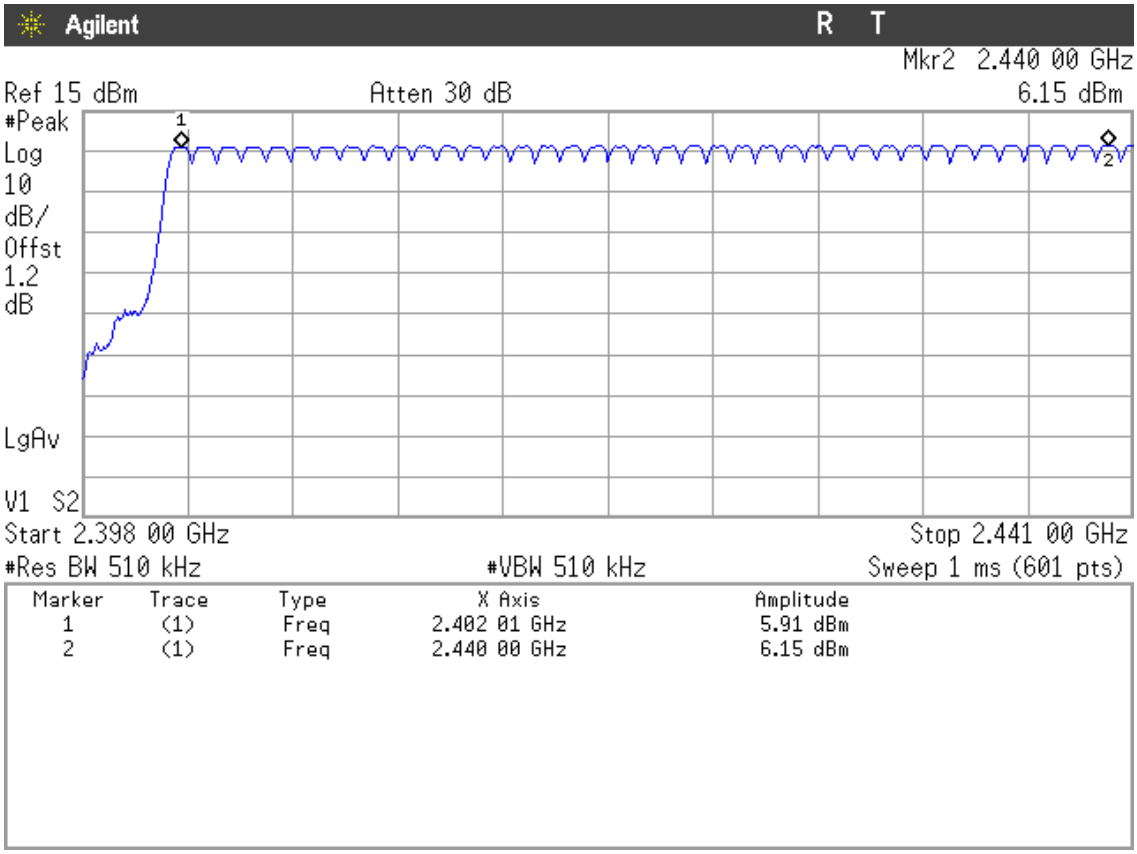
SPECIFICATION

Frequency hopping system in the 2400-2483.5 MHz band shall use at least 15 channels.

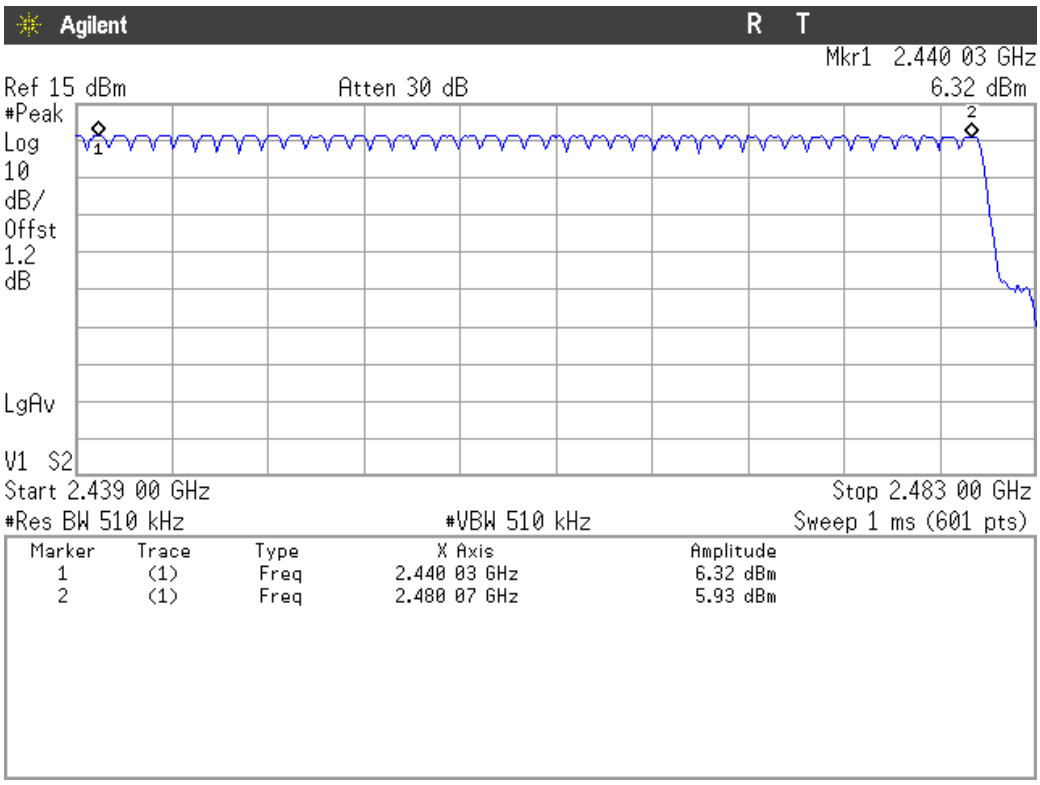
RESULTS

The number of hopping channels is 79 for all three modes (see next plots).

Modulation: GFSK



Number of hopping frequencies: 39

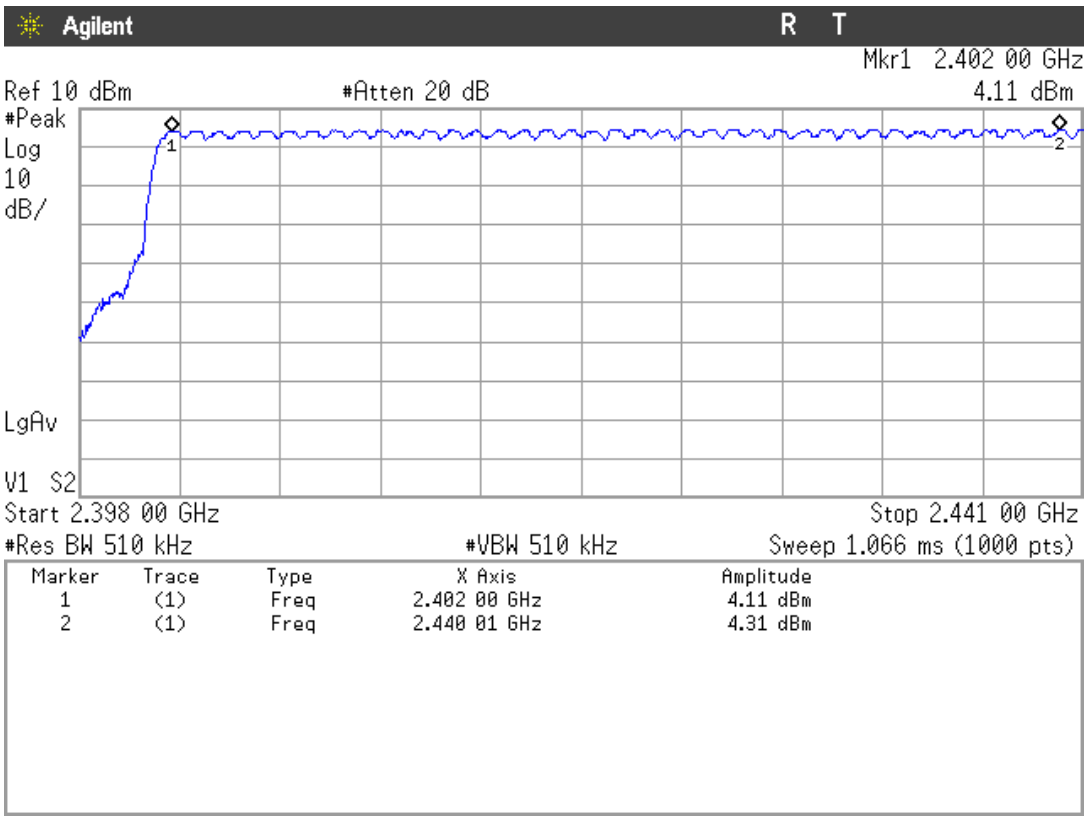


Number of hopping frequencies: 40

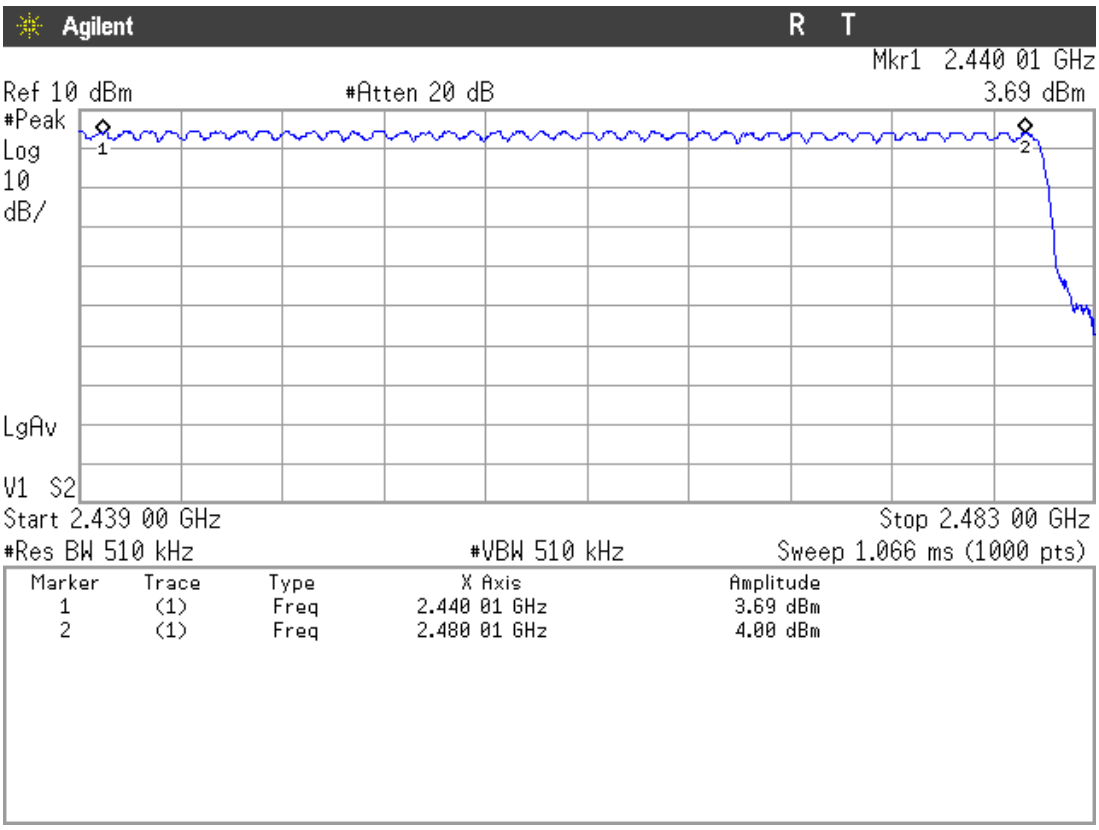
Total number of hopping frequencies: 79

Verdict: PASS

Modulation: Π/4-DQPSK



Number of hopping frequencies: 39

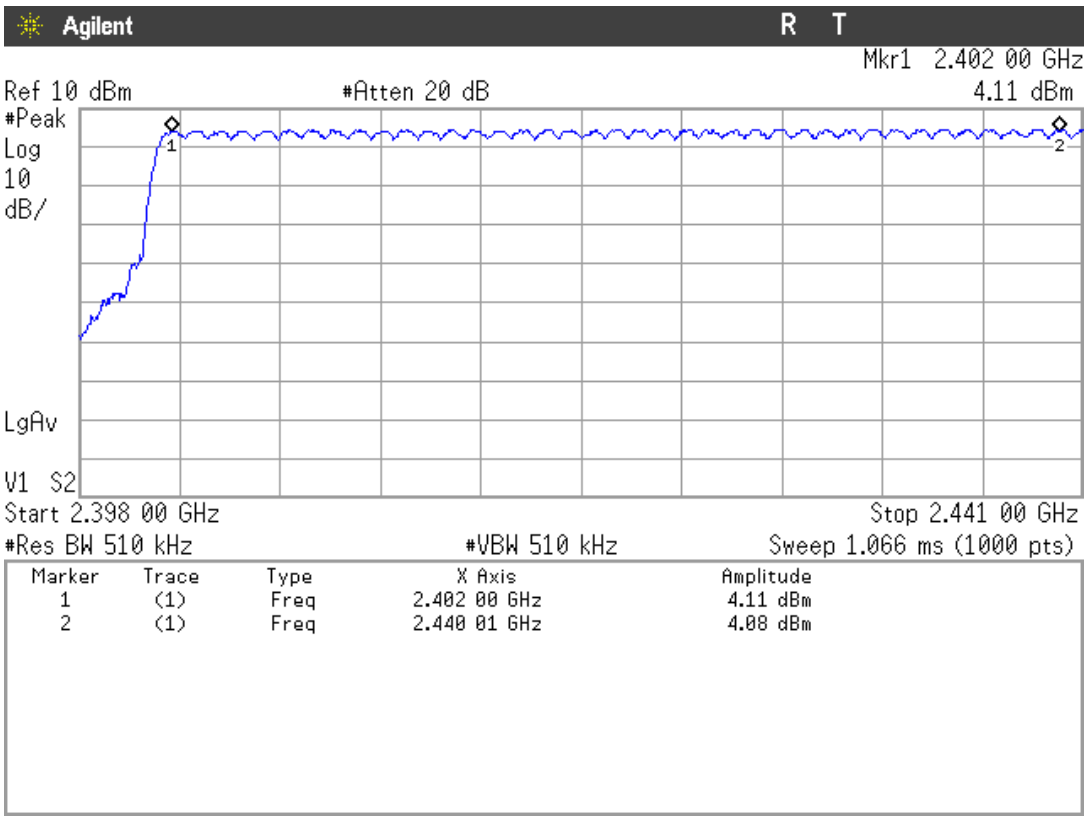


Number of hopping frequencies: 40

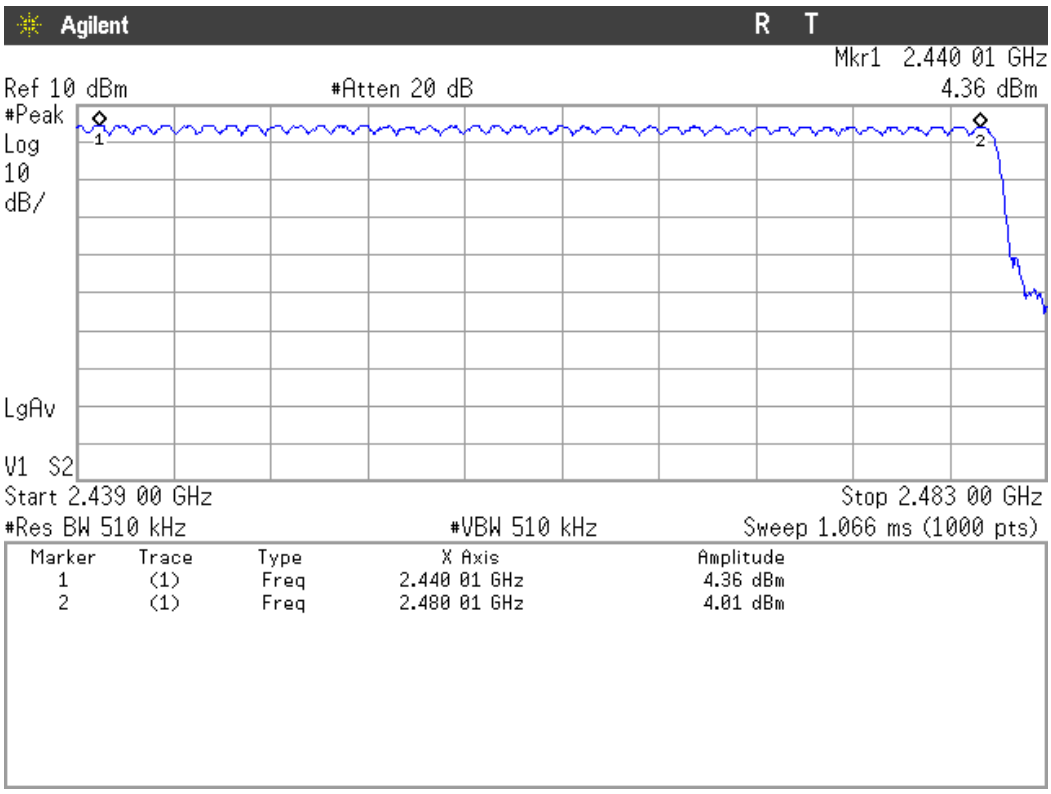
Total number of hopping frequencies: 79

Verdict: PASS

Modulation: 8-DPSK



Number of hopping frequencies: 39



Number of hopping frequencies: 40

Total number of hopping frequencies: 79

Verdict: PASS

FCC Section 15.247 Subclause (a) (1) (iii) / RSS-210 Clause A8.1 (d). Time of occupancy (Dwell Time)

SPECIFICATION

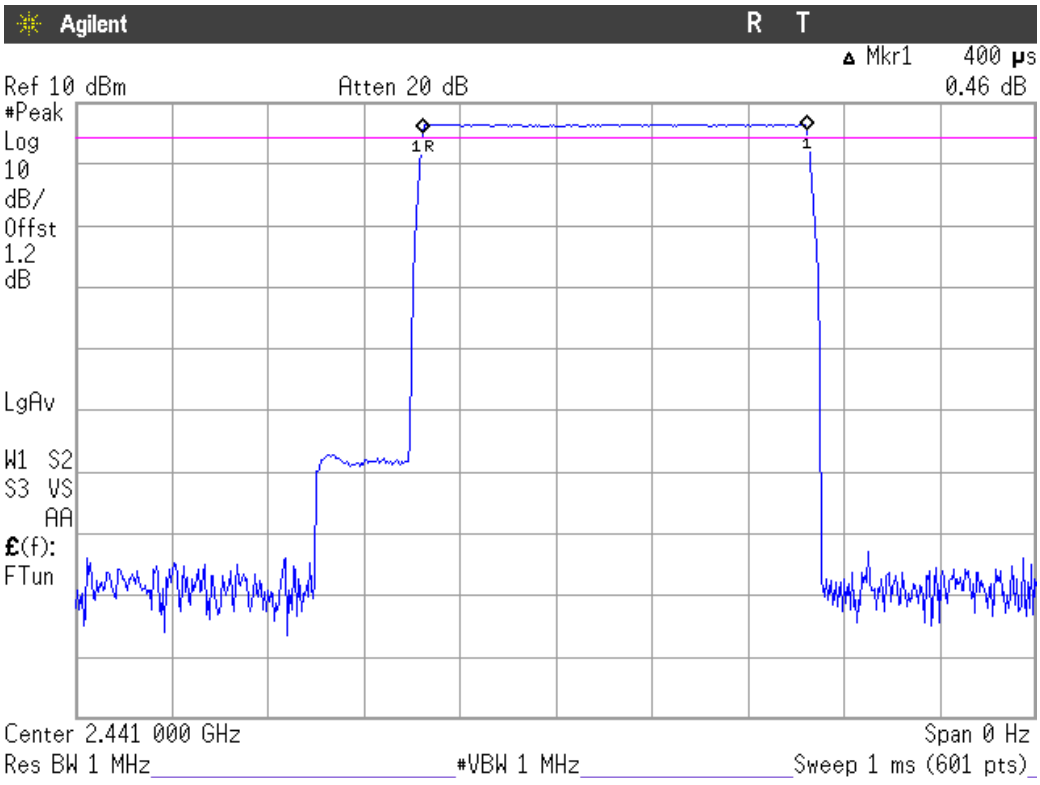
The average time of occupancy on any channel shall not be greater than 0.4 seconds (400 ms) within a period of 0.4 seconds multiplied by the number of hopping channels employed = 0.4 x 79= 31.6 seconds.

RESULTS

Modulation: GFSK

1. TIME OF OCCUPANCY (DWELL TIME) FOR PACKET TYPE DH1.

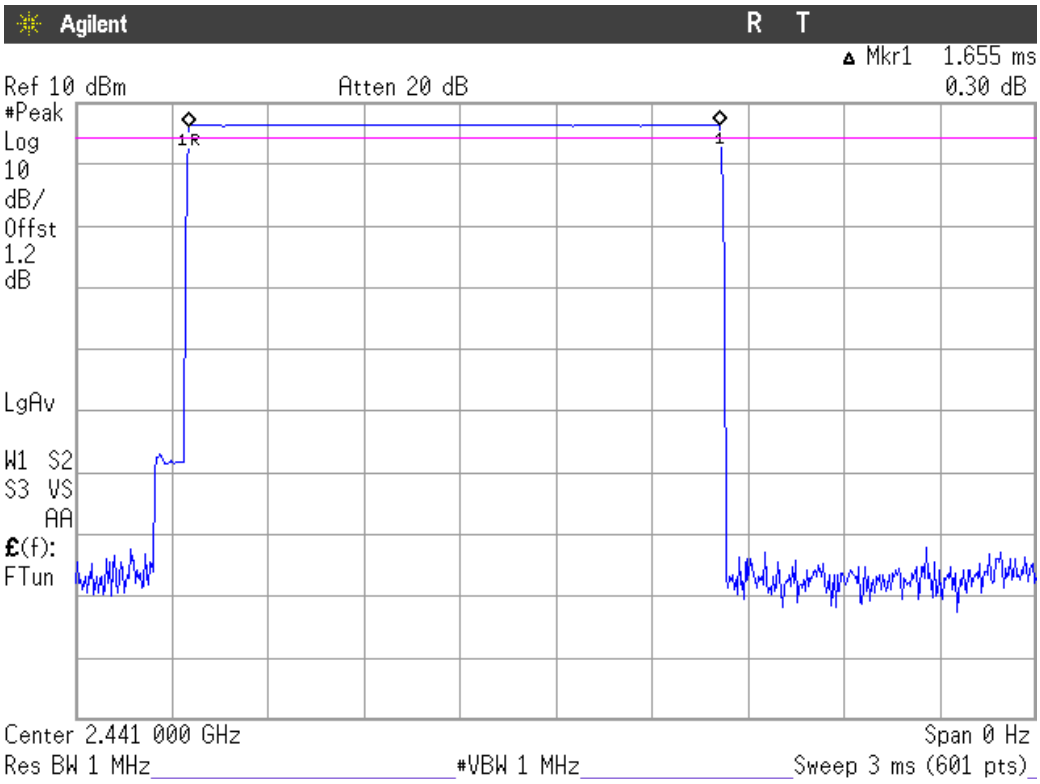
The system makes worst case 1600 hops per second or 1 time slot has a length of 625µs with 79 channels. A DH1 Packet need 1 time slot for transmitting and 1 time slot for receiving. Then the system makes worst case 1600/2 = 800 hops per second with 79 channels. So you have each channel 800/79 = 10.13 times per second and so for a period of 0.4 x 79 = 31.6 seconds you have 10.13 x 31.6 = 320.11 times of appearance.
Each Tx-time per appearance is 400 µs (see next plot).
So we have 320.11 x 400 µs = 128.04 ms per 31.6 seconds.



Verdict: PASS

2. TIME OF OCCUPANCY (DWELL TIME) FOR PACKET TYPE DH3.

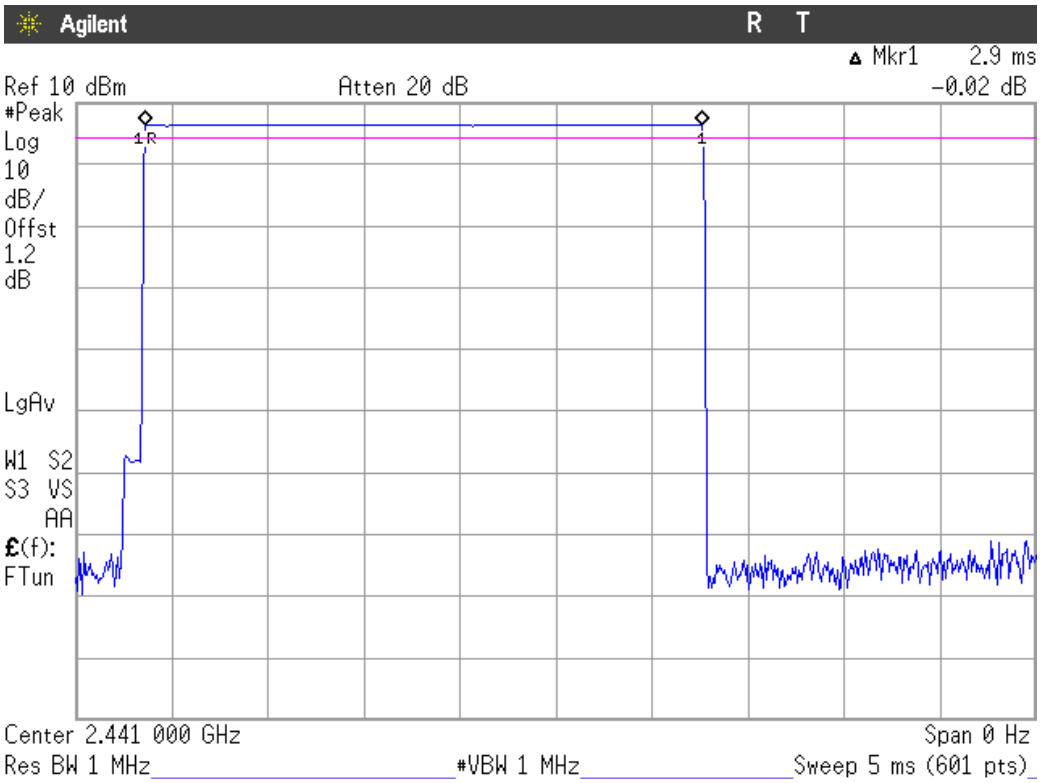
A DH3 Packet needs 3 time slots for transmitting and 1 time slot for receiving. Then the system makes worst case 1600/4 = 400 hops per second with 79 channels. So you have each channel 400/79 = 5.1 times per second and so for a period of 0.4 x 79 = 31.6 seconds you have 5.1 x 31.6 = 161.16 times of appearance.
Each Tx-time per appearance is 1.655 ms (see next plot).
So we have 161.16 x 1.655 ms = 266.72 ms per 31.6 seconds.



Verdict: PASS

3. TIME OF OCCUPANCY (DWELL TIME) FOR PACKET TYPE DH5.

A DH5 Packet needs 5 time slots for transmitting and 1 time slot for receiving. Then the system makes worst case 1600/6 = 266.67 hops per second with 79 channels. So you have each channel 266.67/79 = 3.37 times per second and so for a period of 0.4 x 79 = 31.6 seconds you have 3.37 x 31.6 = 106.49 times of appearance.
Each Tx-time per appearance is 2.90 ms (see next plot).
So we have 106.49 x 2.90 ms = 308.82 ms per 31.6 seconds.

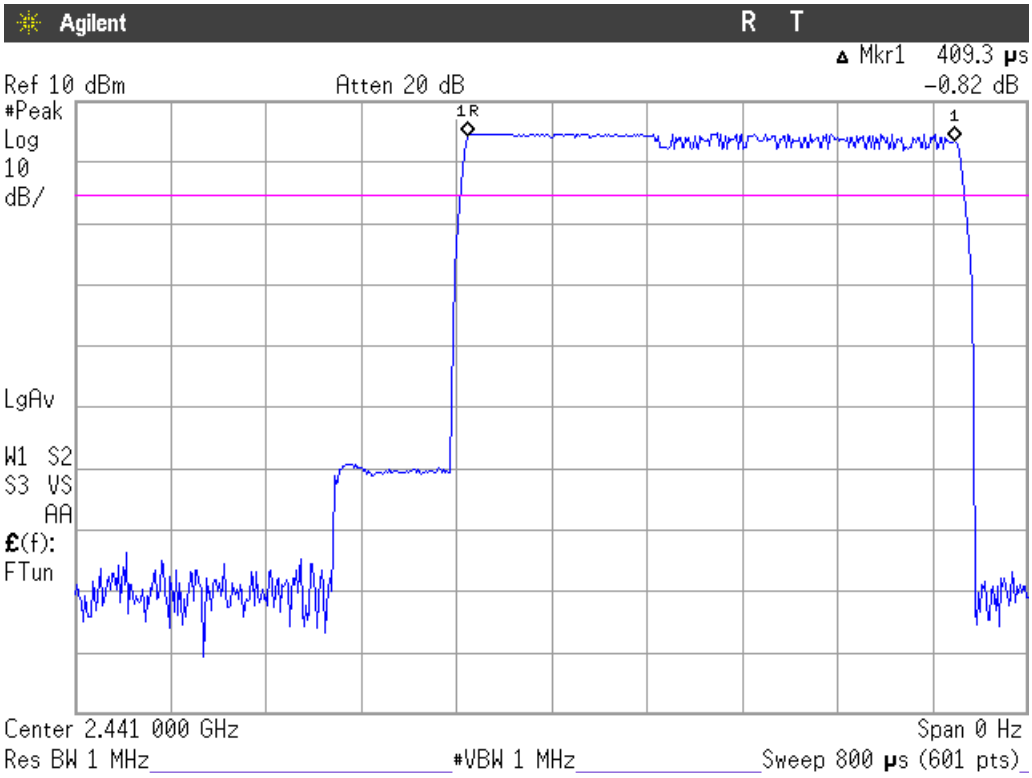


Verdict: PASS

Modulation: Π/4-DQPSK

1. TIME OF OCCUPANCY (DWELL TIME) FOR PACKET TYPE DH1.

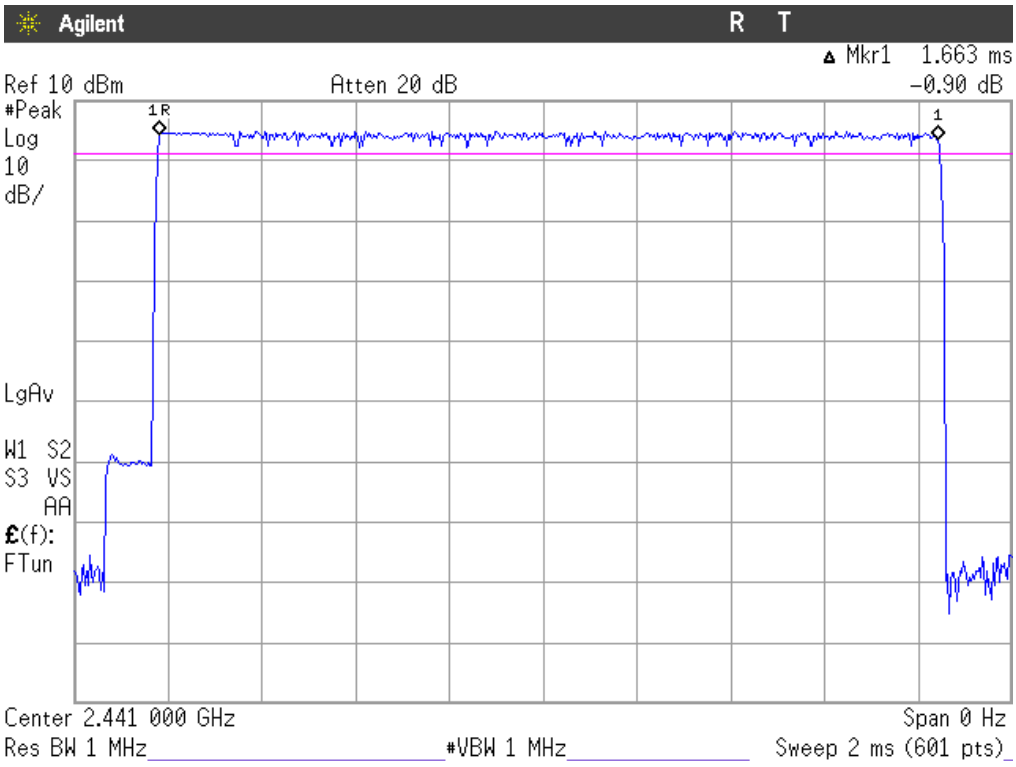
The system makes worst case 1600 hops per second or 1 time slot has a length of 625µs with 79 channels. A DH1 Packet need 1 time slot for transmitting and 1 time slot for receiving. Then the system makes worst case 1600/2 = 800 hops per second with 79 channels. So you have each channel 800/79 = 10.13 times per second and so for a period of 0.4 x 79 = 31.6 seconds you have 10.13 x 31.6 = 320.11 times of appearance.
Each Tx-time per appearance is 409.3 µs (see next plot).
So we have 320.11 x 409.3 µs =131.02 ms per 31.6 seconds.



Verdict: PASS

2. TIME OF OCCUPANCY (DWELL TIME) FOR PACKET TYPE DH3.

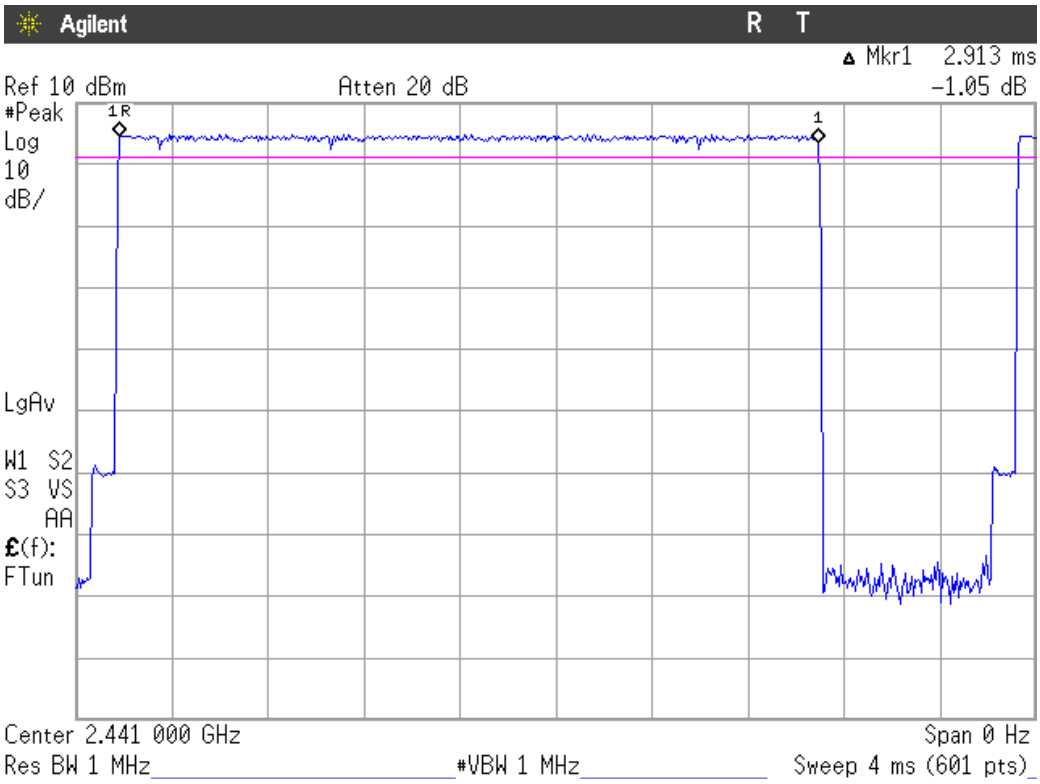
A DH3 Packet needs 3 time slots for transmitting and 1 time slot for receiving. Then the system makes worst case 1600/4 = 400 hops per second with 79 channels. So you have each channel 400/79 = 5.1 times per second and so for a period of 0.4 x 79 = 31.6 seconds you have 5.1 x 31.6 = 161.16 times of appearance.
Each Tx-time per appearance is 1.663 ms (see next plot).
So we have 161.16 x 1.663 ms = 268.01 ms per 31.6 seconds.



Verdict: PASS

3. TIME OF OCCUPANCY (DWELL TIME) FOR PACKET TYPE DH5.

A DH5 Packet needs 5 time slots for transmitting and 1 time slot for receiving. Then the system makes worst case 1600/6 = 266.67 hops per second with 79 channels. So you have each channel 266.67/79 = 3.37 times per second and so for a period of 0.4 x 79 = 31.6 seconds you have 3.37 x 31.6 = 106.49 times of appearance.
Each Tx-time per appearance is 2.913 ms (see next plot).
So we have 106.49 x 2.913 ms = 310.20 ms per 31.6 seconds.

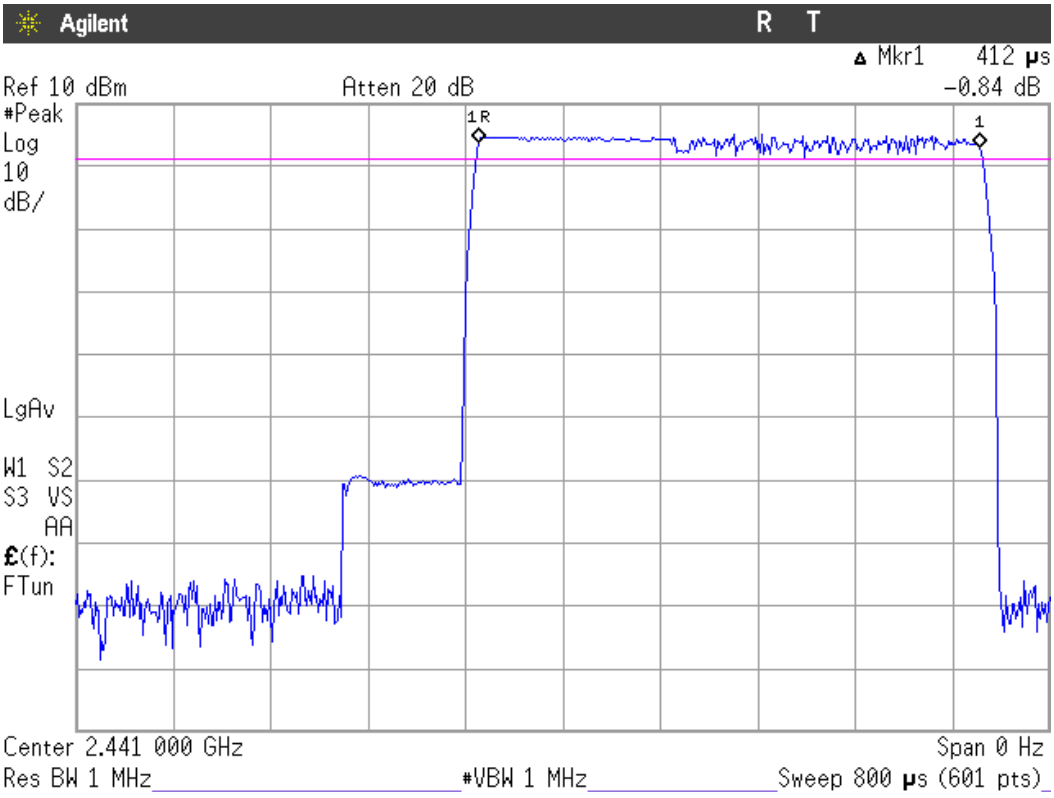


Verdict: PASS

Modulation: 8-DPSK

1. TIME OF OCCUPANCY (DWELL TIME) FOR PACKET TYPE DH1.

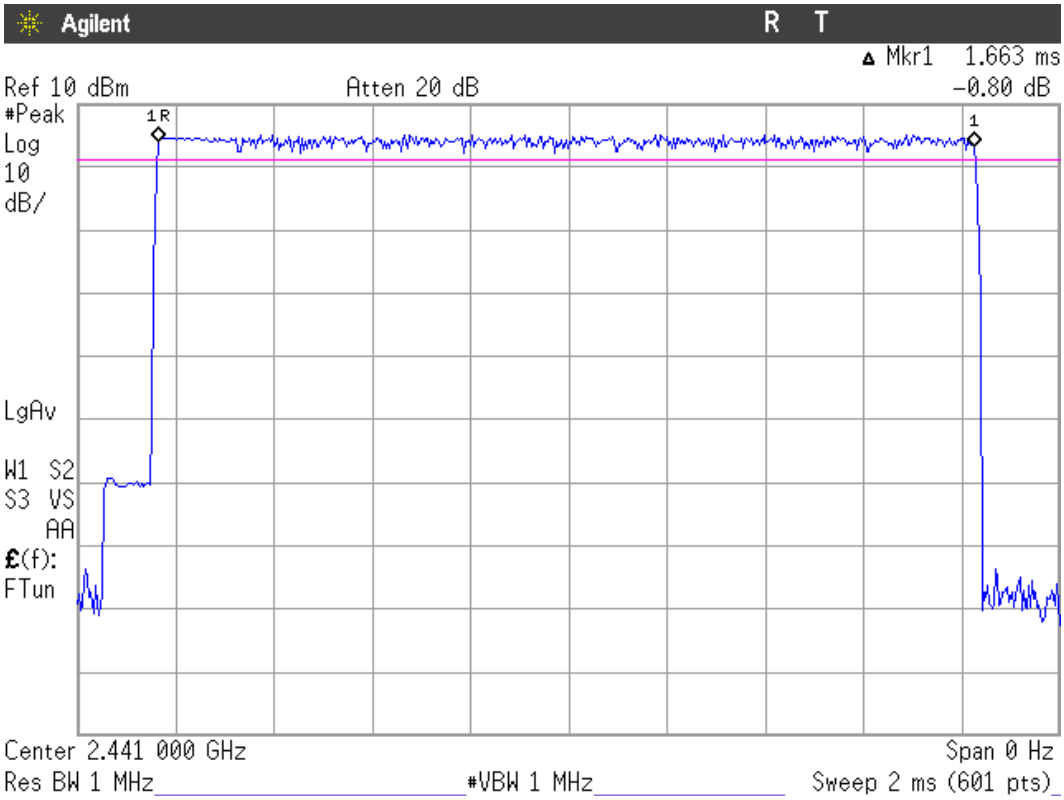
The system makes worst case 1600 hops per second or 1 time slot has a length of 625µs with 79 channels. A DH1 Packet need 1 time slot for transmitting and 1 time slot for receiving. Then the system makes worst case 1600/2 = 800 hops per second with 79 channels. So you have each channel 800/79 = 10.13 times per second and so for a period of 0.4 x 79 = 31.6 seconds you have 10.13 x 31.6 = 320.11 times of appearance.
Each Tx-time per appearance is 412 µs (see next plot).
So we have 320.11 x 412 µs =131.88 ms per 31.6 seconds.



Verdict: PASS

2. TIME OF OCCUPANCY (DWELL TIME) FOR PACKET TYPE DH3.

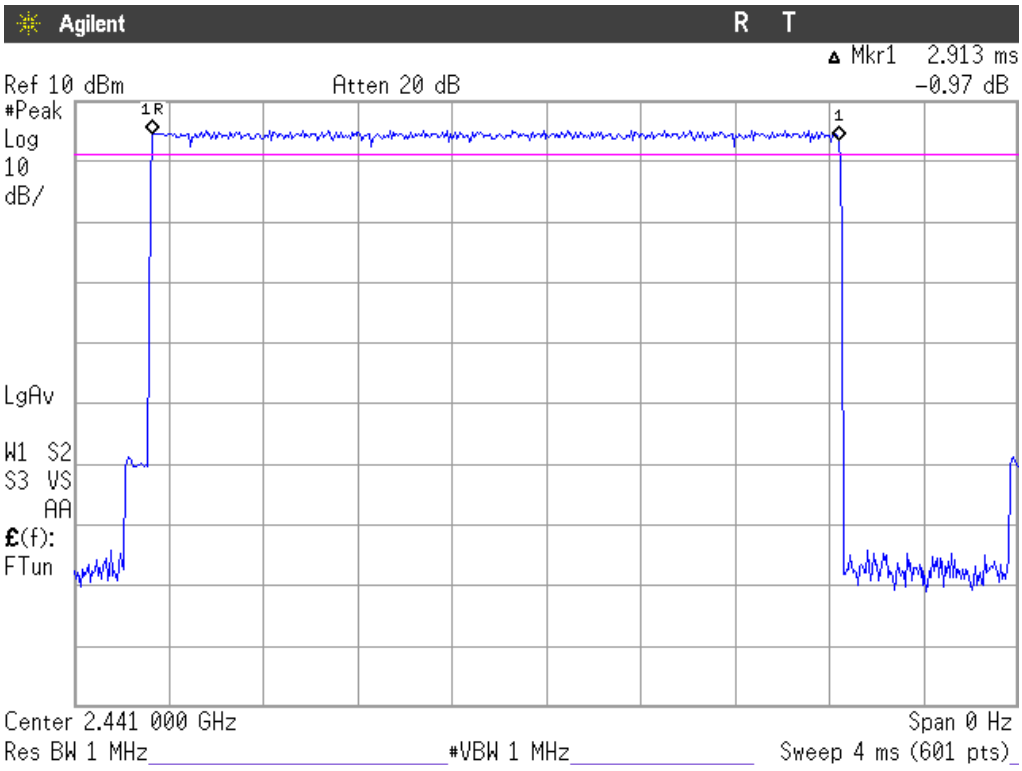
A DH3 Packet needs 3 time slots for transmitting and 1 time slot for receiving. Then the system makes worst case 1600/4 = 400 hops per second with 79 channels. So you have each channel 400/79 = 5.1 times per second and so for a period of 0.4 x 79 = 31.6 seconds you have 5.1 x 31.6 = 161.16 times of appearance.
Each Tx-time per appearance is 1.663 ms (see next plot).
So we have 161.16 x 1.663 ms = 268.01 ms per 31.6 seconds.



Verdict: PASS

3. TIME OF OCCUPANCY (DWELL TIME) FOR PACKET TYPE DH5.

A DH5 Packet needs 5 time slots for transmitting and 1 time slot for receiving. Then the system makes worst case 1600/6 = 266.67 hops per second with 79 channels. So you have each channel 266.67/79 = 3.37 times per second and so for a period of 0.4 x 79 = 31.6 seconds you have 3.37 x 31.6 = 106.49 times of appearance.
Each Tx-time per appearance is 2.913 ms (see next plot).
So we have 106.49 x 2.913 ms = 310.20 ms per 31.6 seconds.



Verdict: PASS

FCC Section 15.247 Subclause (b) / RSS-210 Clause A8.4 (2). Maximum peak output power and antenna gain

SPECIFICATION

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels: 1 watt (30 dBm).

RESULTS

MAXIMUM PEAK OUTPUT POWER (CONDUCTED). See next plots.

Modulation: GFSK

	Lowest frequency 2402 MHz	Middle frequency 2441 MHz	Highest frequency 2480 MHz
Maximum peak power (dBm)	6.43	6.77	6.54
Measurement uncertainty (dB)	±1.5		

The maximum declared antenna gain for this device is 2.2 dBi, therefore the maximum theoretical peak radiated power (EIRP) in the three measurement channels for this device is 8.97 dBm or 7.89 mW.

The actual peak radiated power (EIRP) was measured for the lowest, middle and highest frequency (see next plots).

Modulation: Π/4-DQPSK (2Mbps)

	Lowest frequency 2402 MHz	Middle frequency 2441 MHz	Highest frequency 2480 MHz
Maximum peak power (dBm)	5.12	5.42	5.11
Measurement uncertainty (dB)	±1.5		

The maximum declared antenna gain for this device is 2.2 dBi, therefore the maximum theoretical peak radiated power (EIRP) in the three measurement channels for this device is 7.62 dBm or 5.78 mW.
The actual peak radiated power (EIRP) was measured for the lowest, middle and highest frequency (see next plots).

Modulation: 8-DPSK (3Mbps)

	Lowest frequency 2402 MHz	Middle frequency 2441 MHz	Highest frequency 2480 MHz
Maximum peak power (dBm)	5.47	5.66	5.38
Measurement uncertainty (dB)	±1.5		

The maximum declared antenna gain for this device is 2.2 dBi, therefore the maximum theoretical peak radiated power (EIRP) in the three measurement channels for this device is 7.86 dBm or 6.11 mW.

The actual peak radiated power (EIRP) was measured for the lowest, middle and highest frequency (see next plots).

MAXIMUM PEAK OUTPUT POWER (RADIATED).

Modulation: GFSK

	Lowest frequency 2402 MHz	Middle frequency 2441 MHz	Highest frequency 2480 MHz
Maximum EIRP peak power (dBm)	4.54	4.44	3.26
Measurement uncertainty (dB)	±4.09		

Modulation: Π/4-DQPSK (2 Mbps)

	Lowest frequency 2402 MHz	Middle frequency 2441 MHz	Highest frequency 2480 MHz
Maximum EIRP peak power (dBm)	2.75	2.43	1.84
Measurement uncertainty (dB)	±4.09		

Modulation: 8-DPSK (3Mbps)

	Lowest frequency 2402 MHz	Middle frequency 2441 MHz	Highest frequency 2480 MHz
Maximum EIRP peak power (dBm)	3.27	2.58	1.95
Measurement uncertainty (dB)	±4.09		

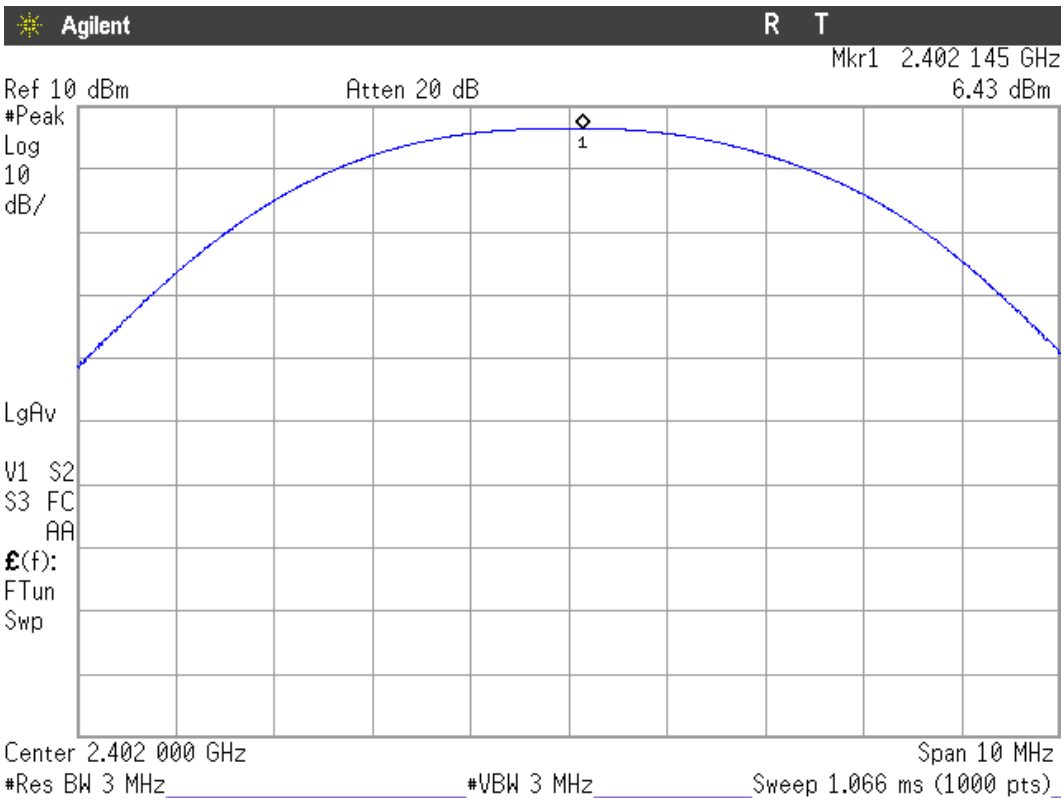
Declared peak gain: 2.2 dBi

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.

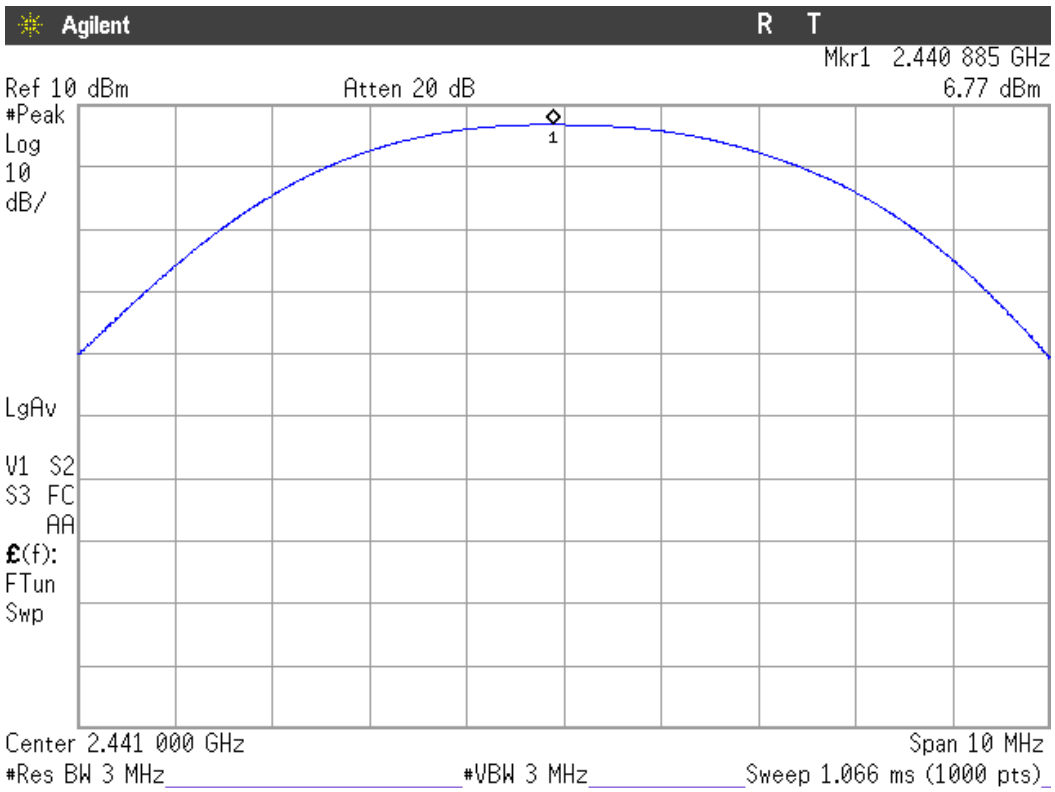
Verdict: PASS

PEAK OUTPUT POWER (CONDUCTED).

Modulation: GFSK Lowest Channel: 2402 MHz.

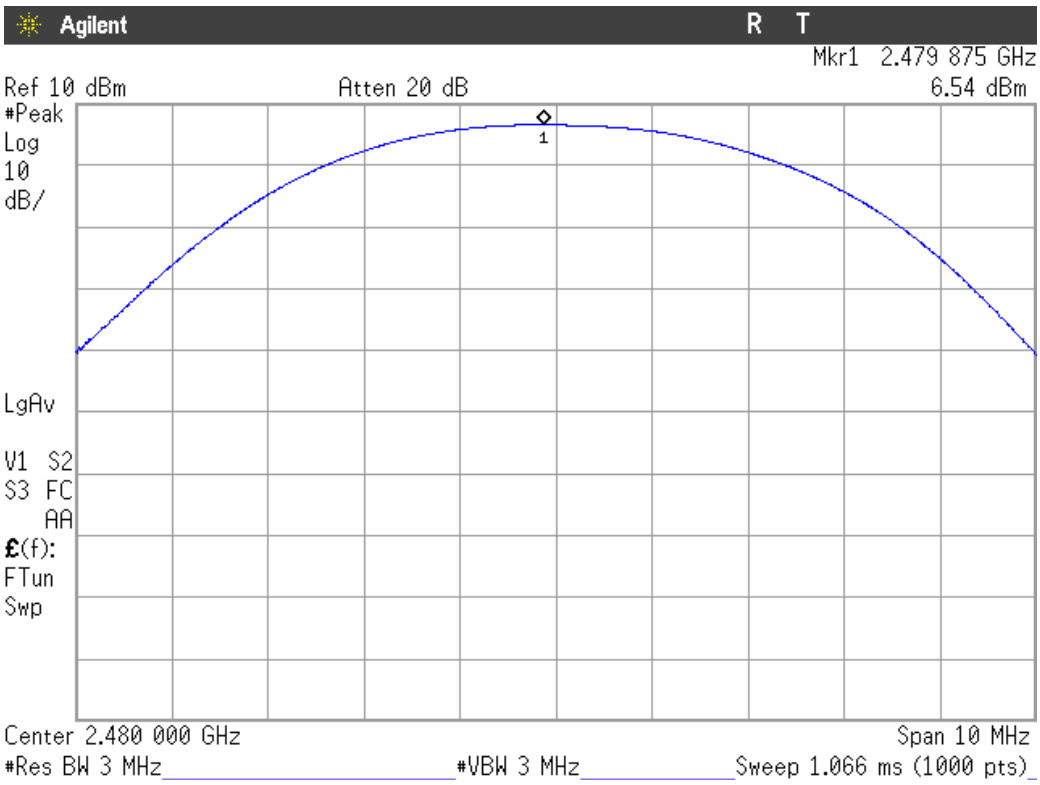


Modulation: GFSK Middle Channel: 2441 MHz.

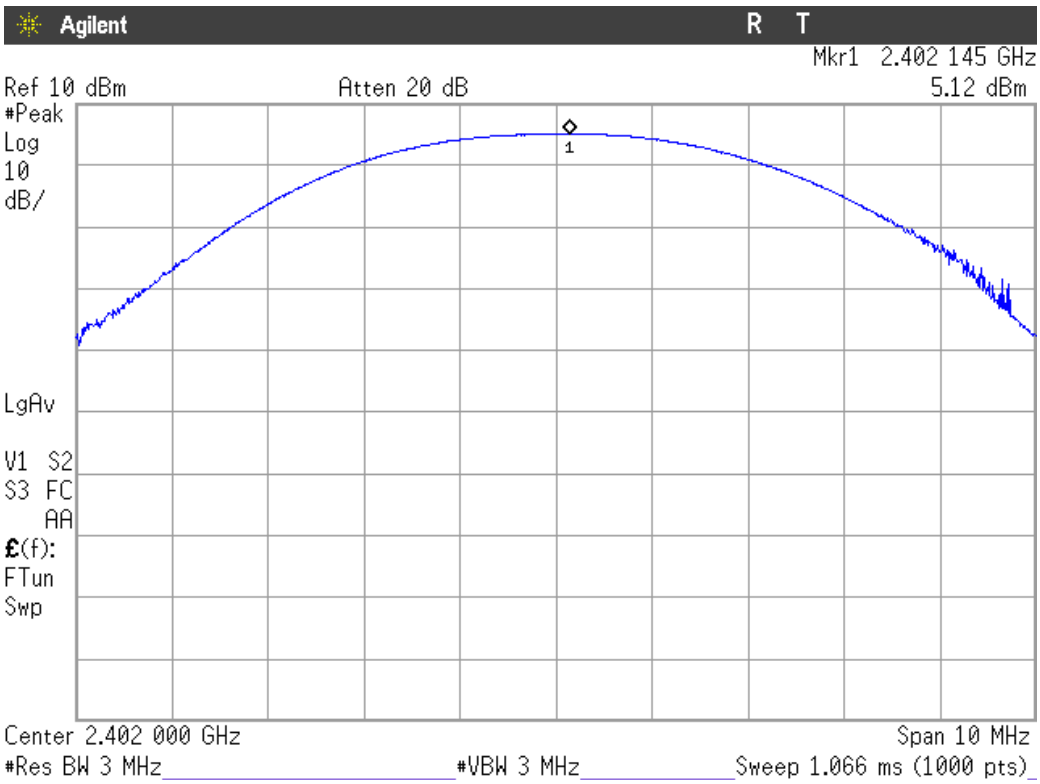


PEAK OUTPUT POWER (CONDUCTED).

Modulation: GFSK Highest Channel: 2480 MHz.

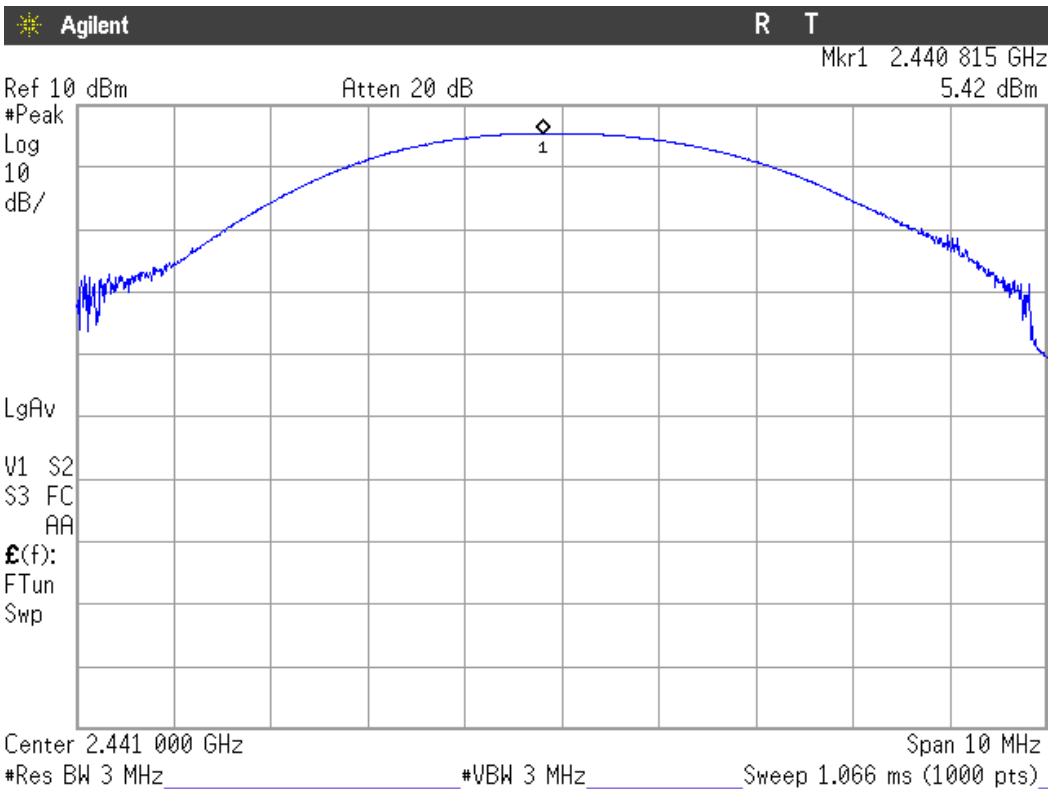


Modulation: Π/4-DQPSK Lowest Channel: 2402 MHz

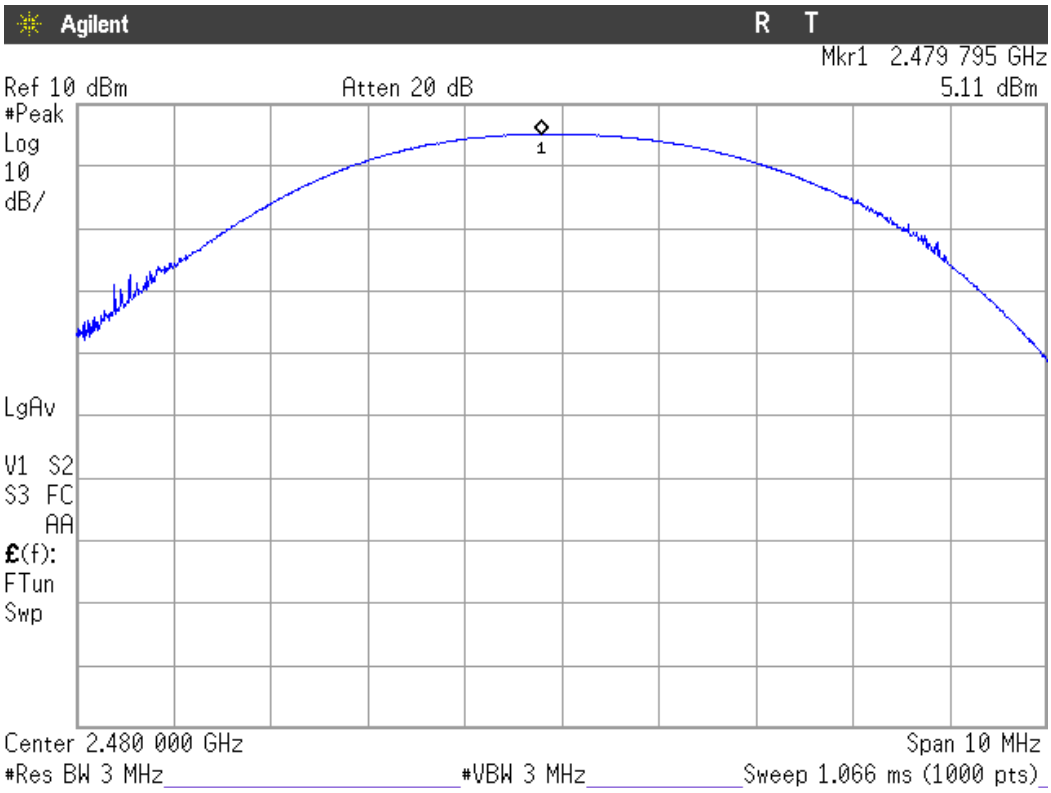


PEAK OUTPUT POWER (CONDUCTED)

Modulation: Π/4-DQPSK Middle Channel: 2441 MHz.

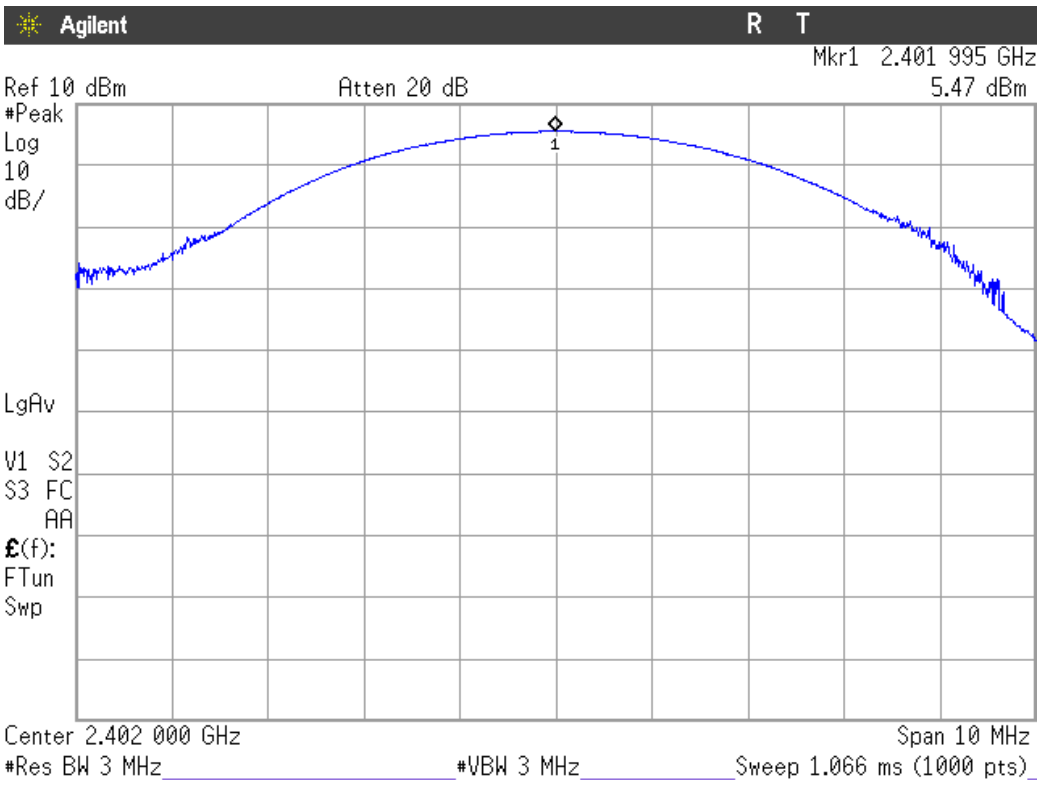


Modulation: Π/4-DQPSK Highest Channel: 2480 MHz.

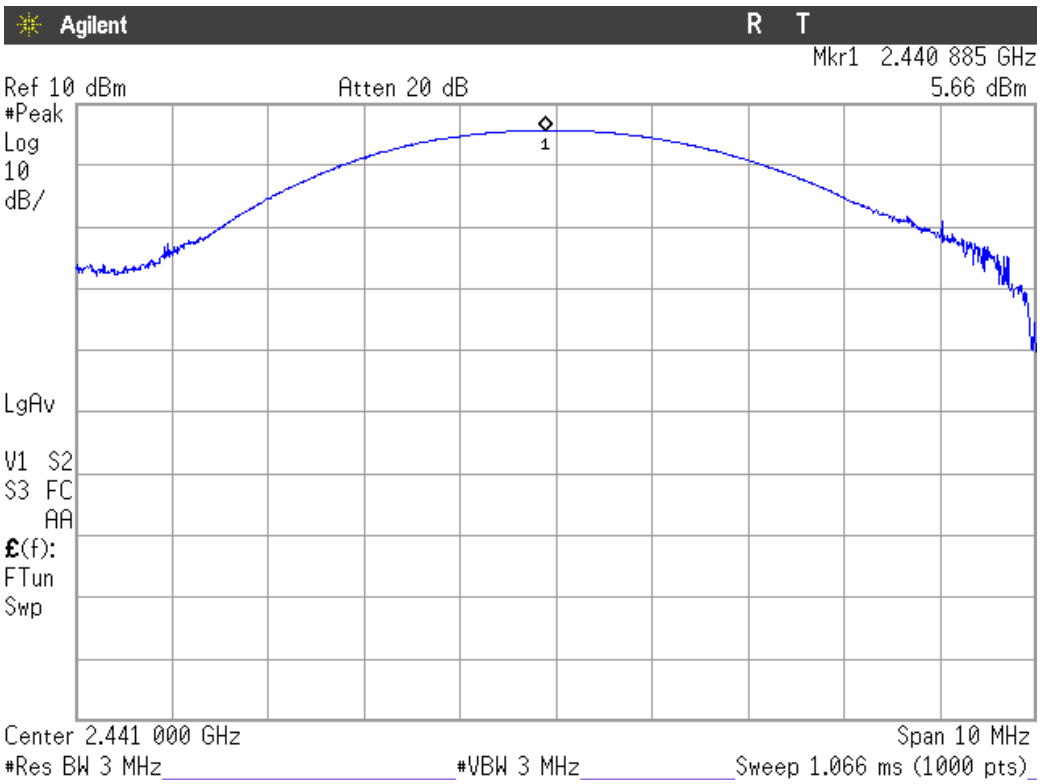


PEAK OUTPUT POWER (CONDUCTED).

Modulation: 8-DPSK Lowest Channel: 2402 MHz

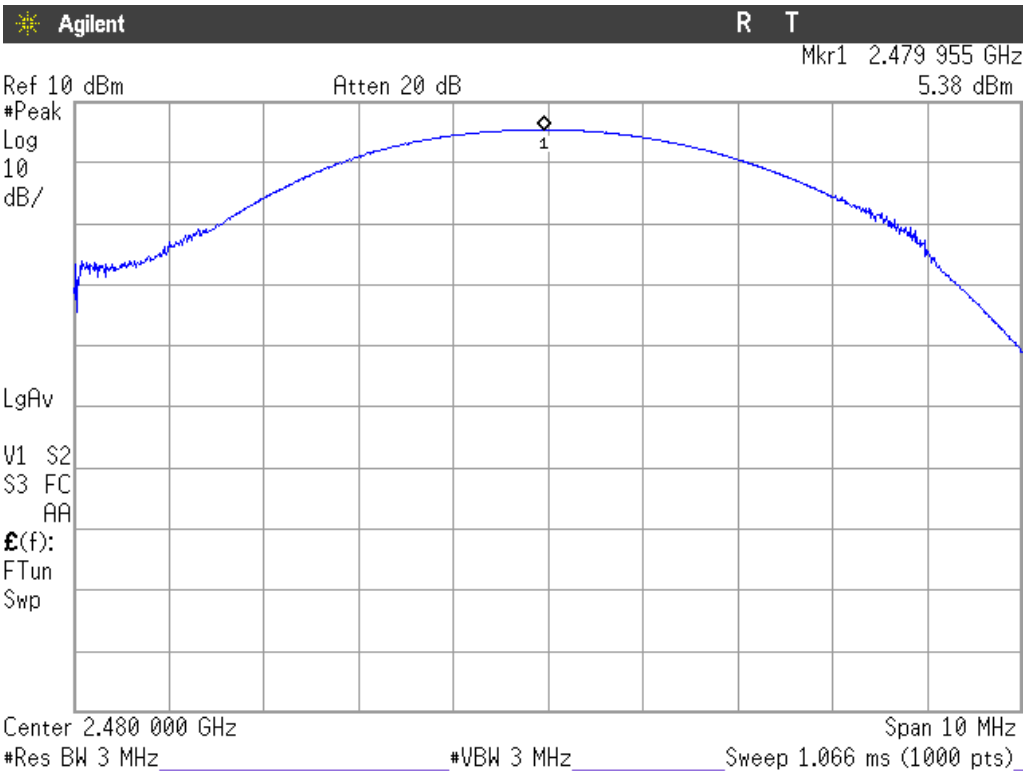


Modulation: 8-DPSK Middle Channel: 2441 MHz.



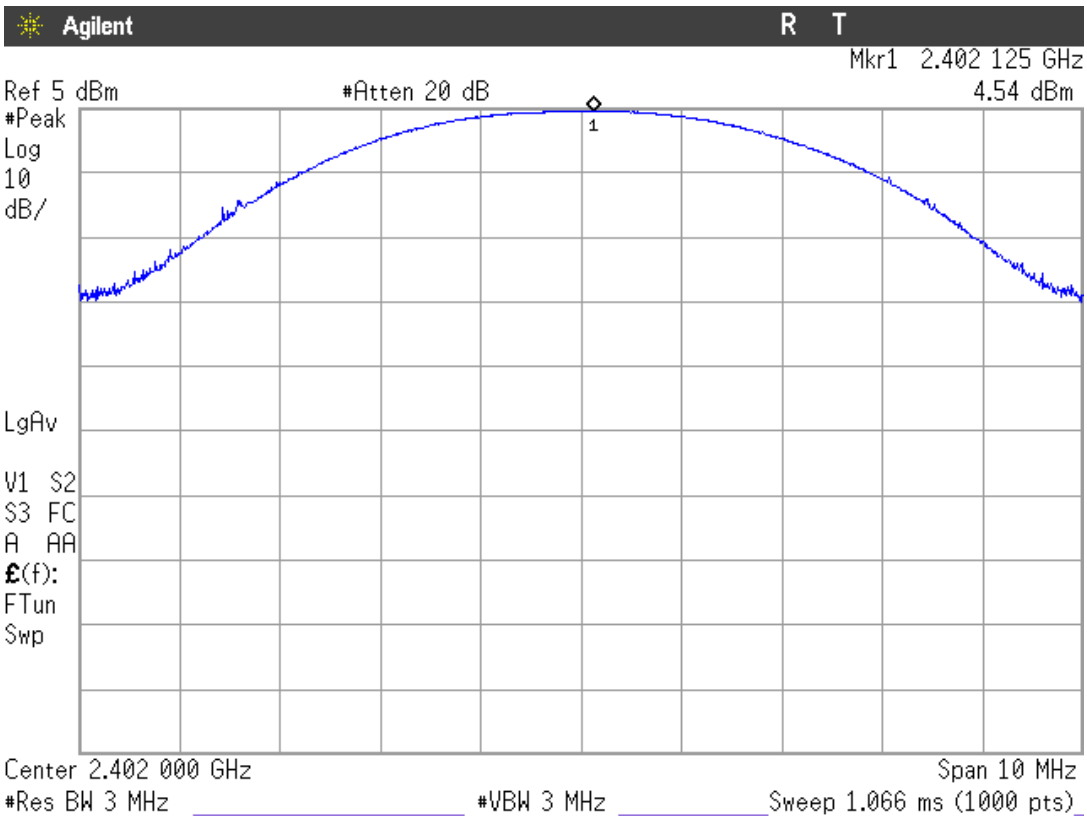
PEAK OUTPUT POWER (CONDUCTED).

Modulation: 8-DPSK Highest Channel: 2480 MHz.

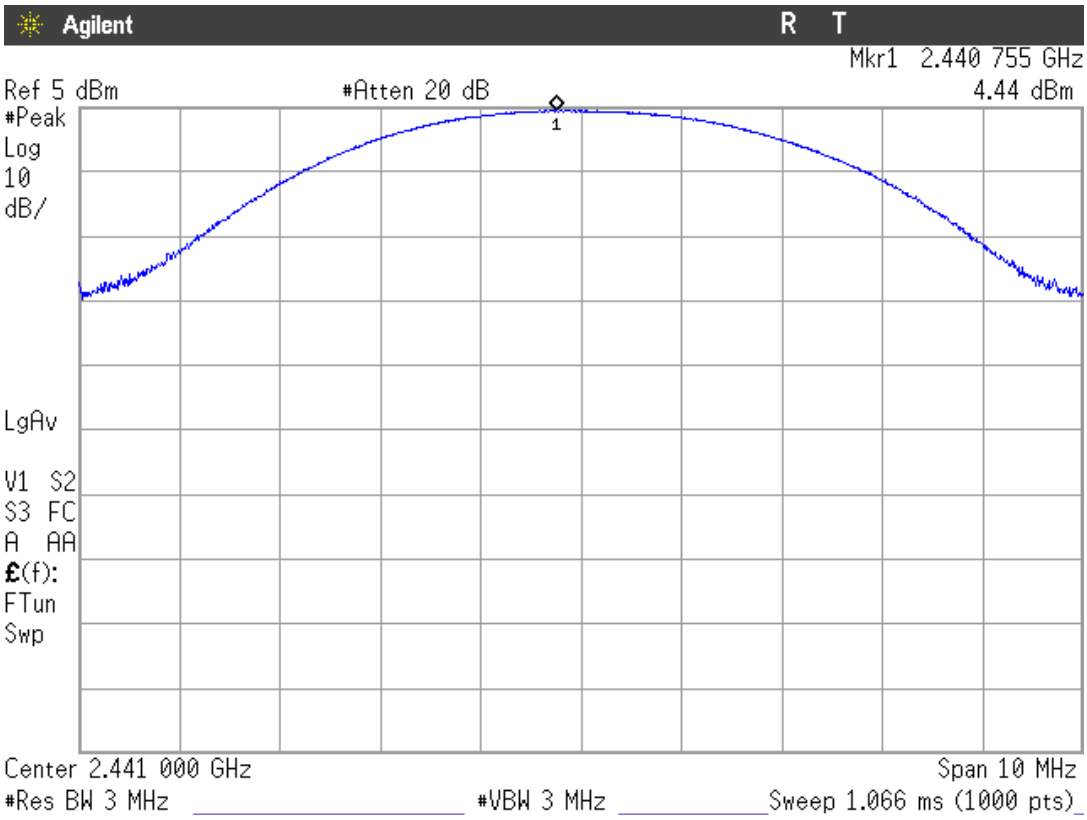


PEAK OUTPUT POWER (RADIATED).

Modulation: GFSK Lowest Channel: 2402 MHz.

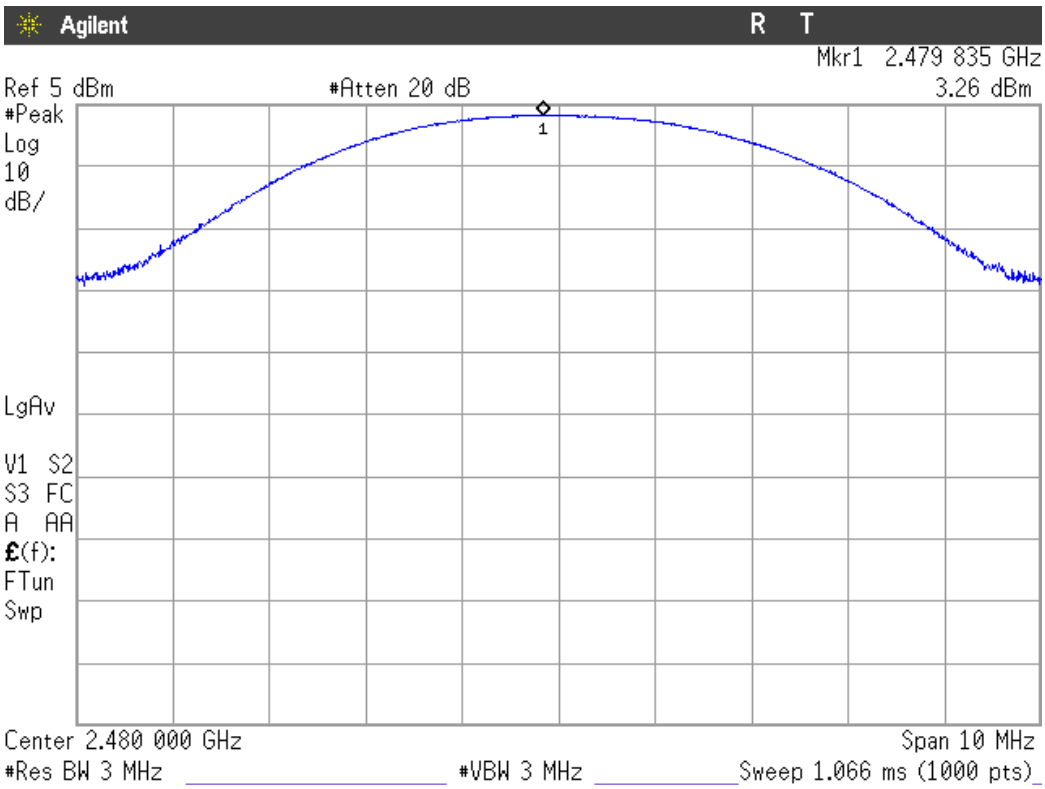


Modulation: GFSK Middle Channel: 2441 MHz.

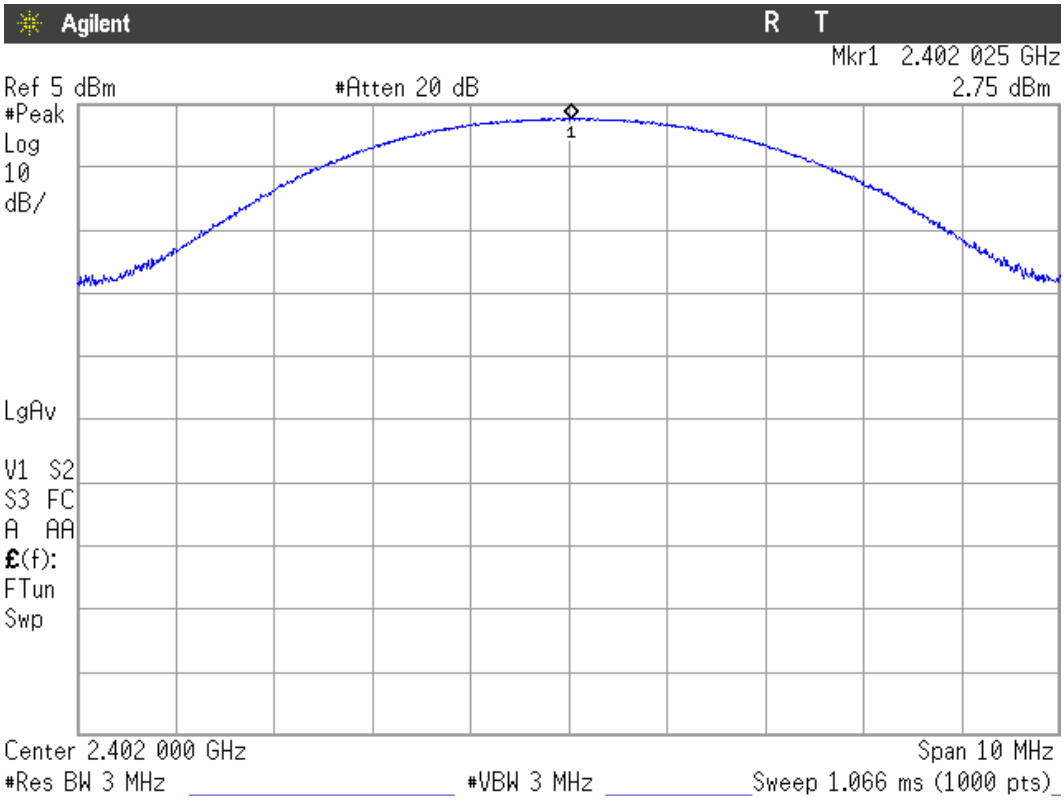


PEAK OUTPUT POWER (RADIATED).

Modulation: GFSK Highest Channel: 2480 MHz.

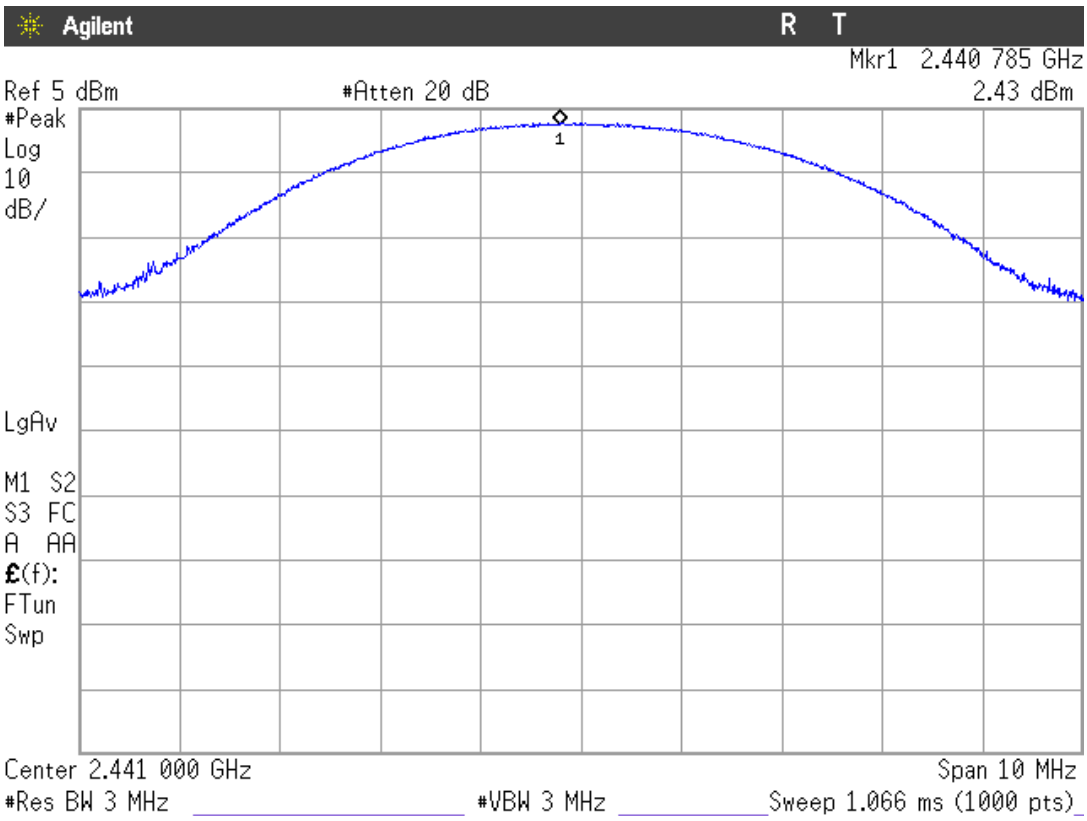


Modulation: Π/4-DQPSK Lowest Channel: 2402 MHz.

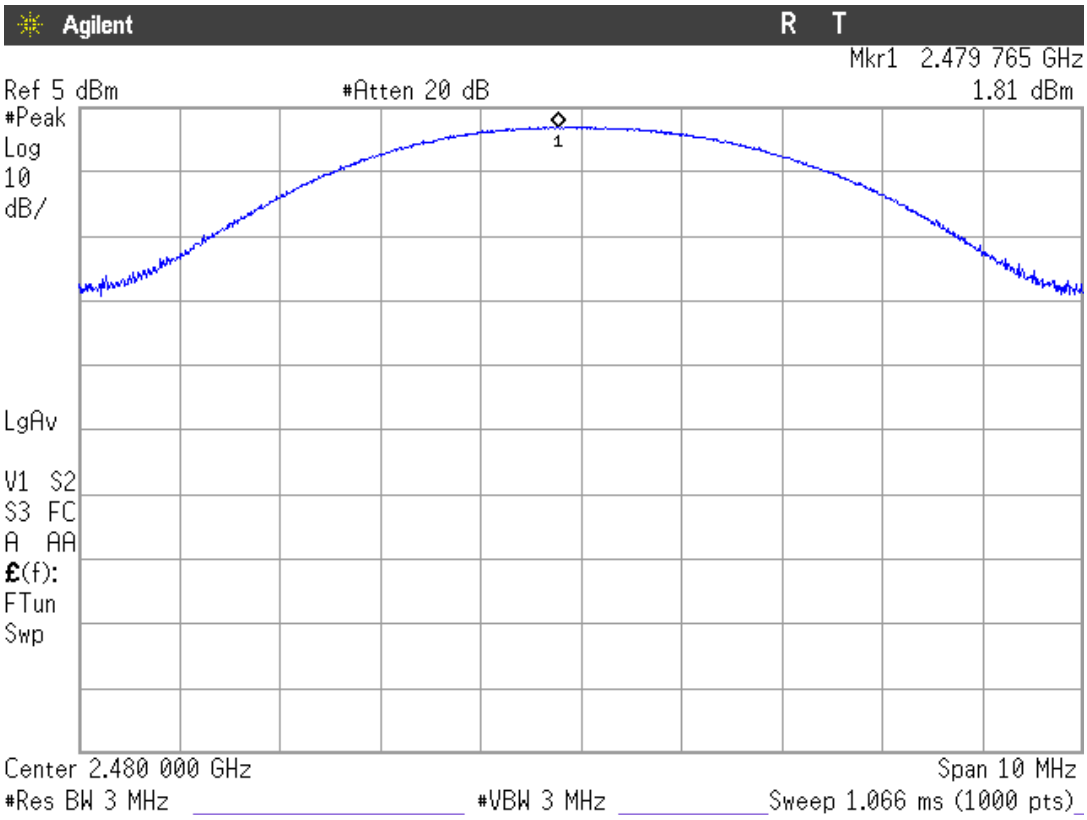


PEAK OUTPUT POWER (RADIATED).

Modulation: Π/4-DQPSK Middle Channel: 2441 MHz.

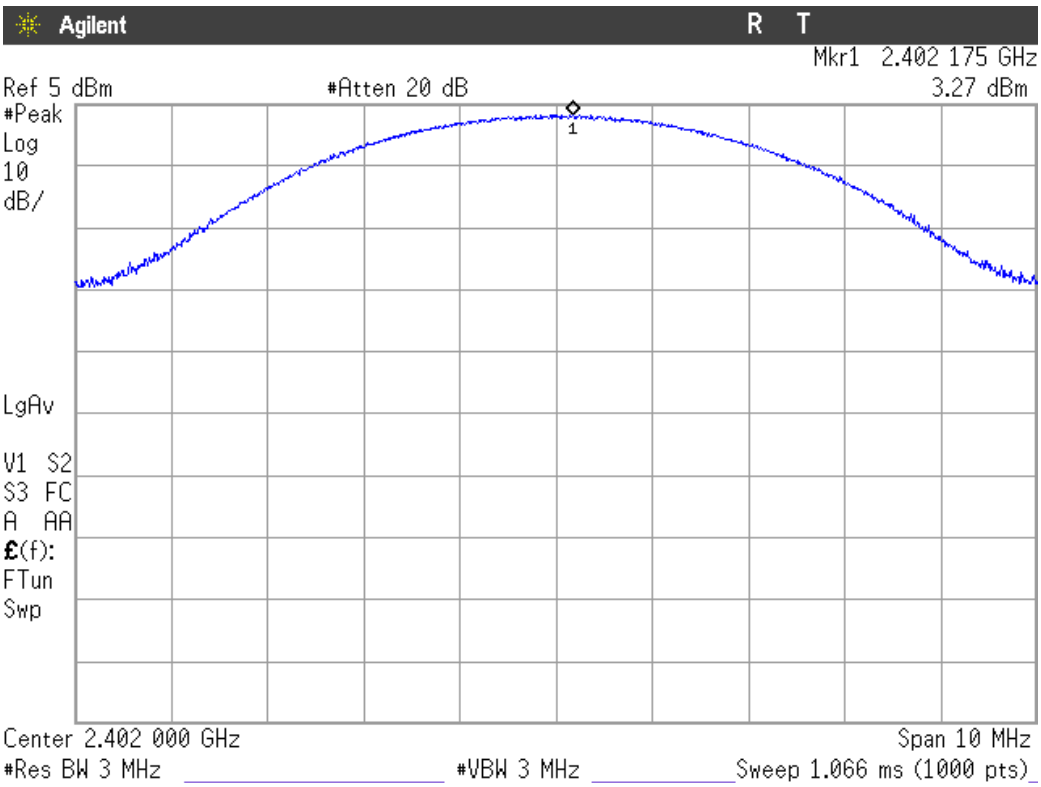


Modulation: Π/4-DQPSK Highest Channel: 2480 MHz.

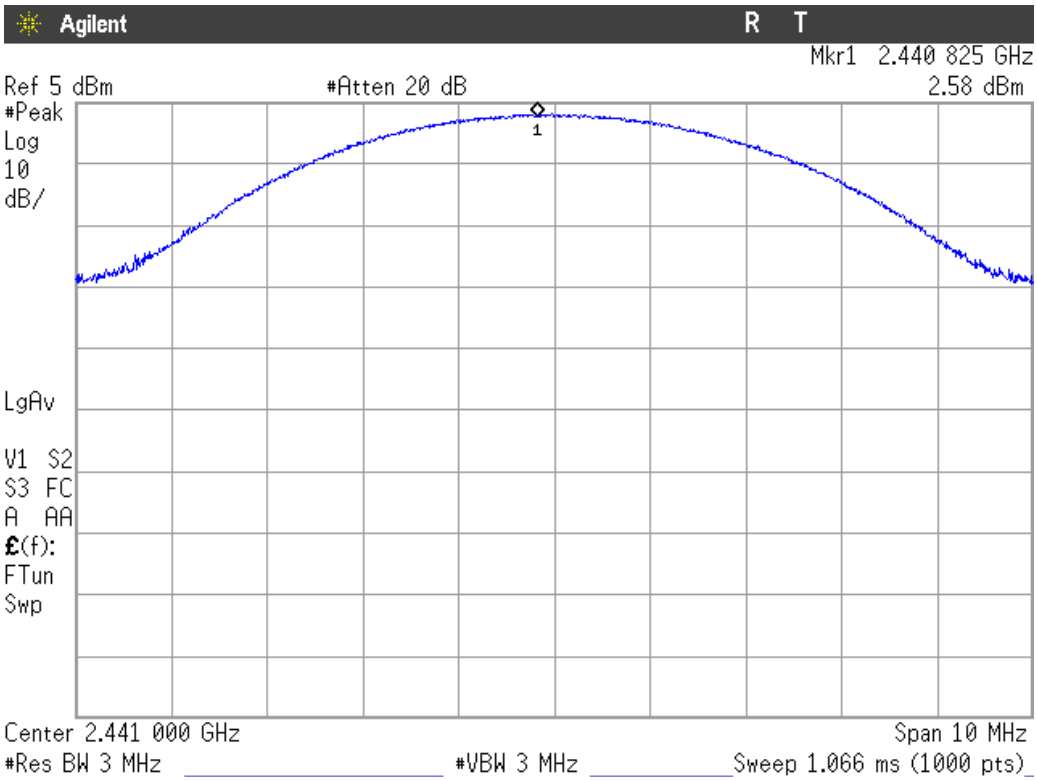


PEAK OUTPUT POWER (RADIATED).

Modulation: 8-DPSK Lowest Channel: 2402 MHz.

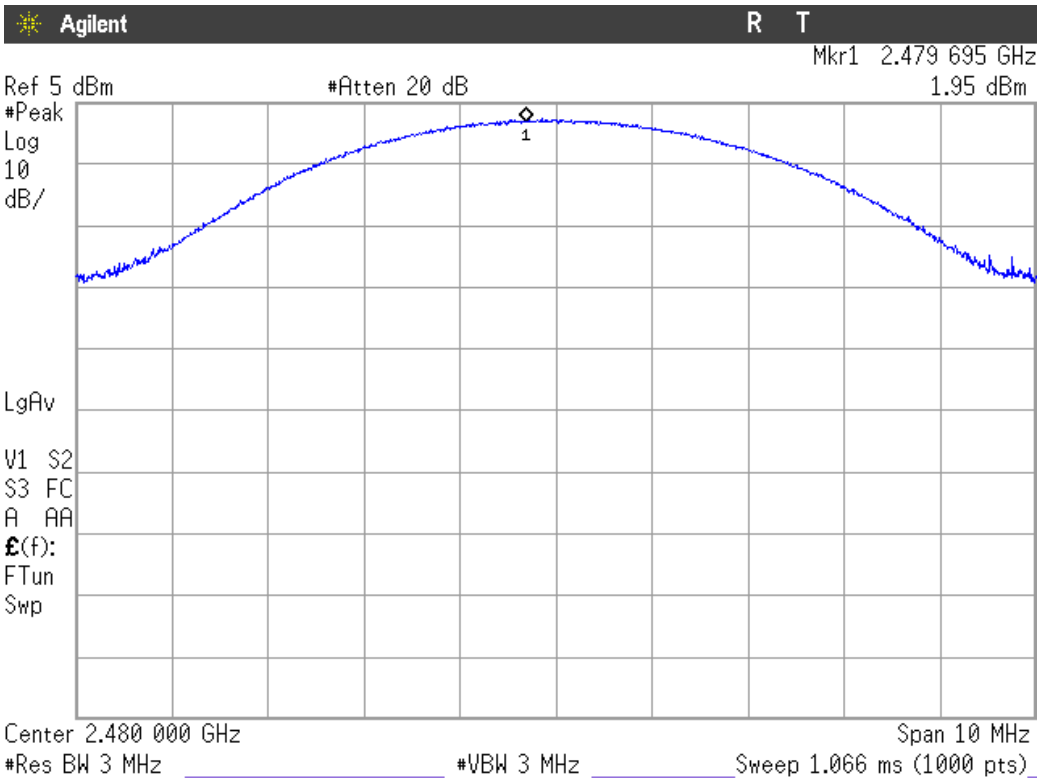


Modulation: 8-DPSK Middle Channel: 2441 MHz.



PEAK OUTPUT POWER (RADIATED).

Modulation: 8-DPSK Highest Channel: 2480 MHz.



FCC Section 15.247 Subclause (d) / RSS-210 Clauses 2.2 & A8.5. Band-edge compliance of conducted emissions (Transmitter)

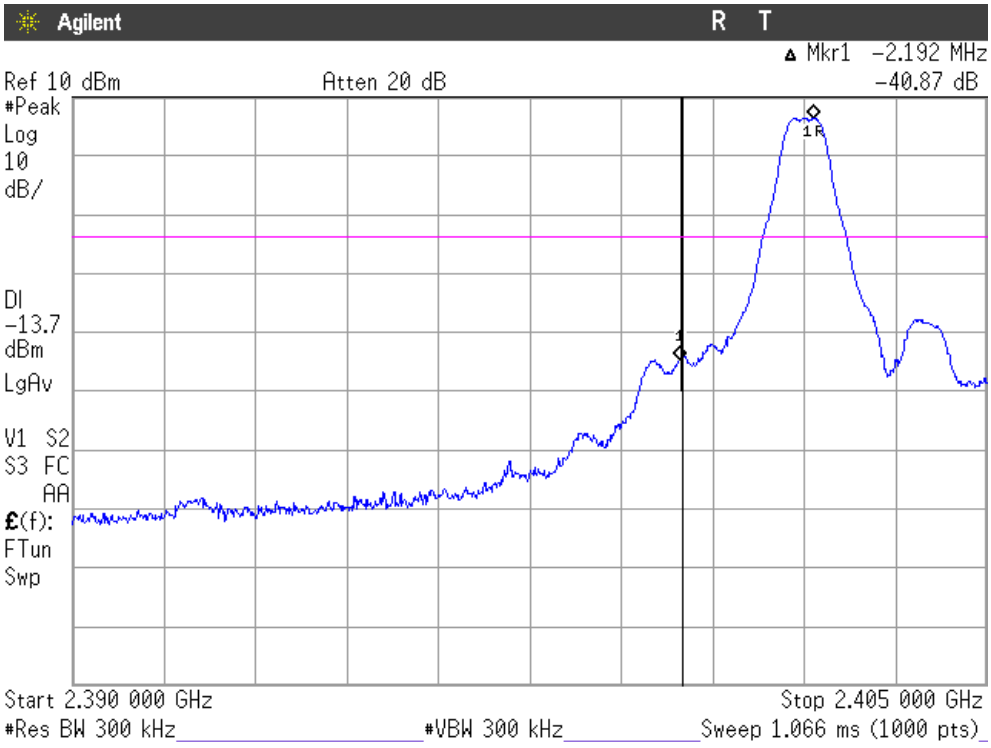
SPECIFICATION

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:

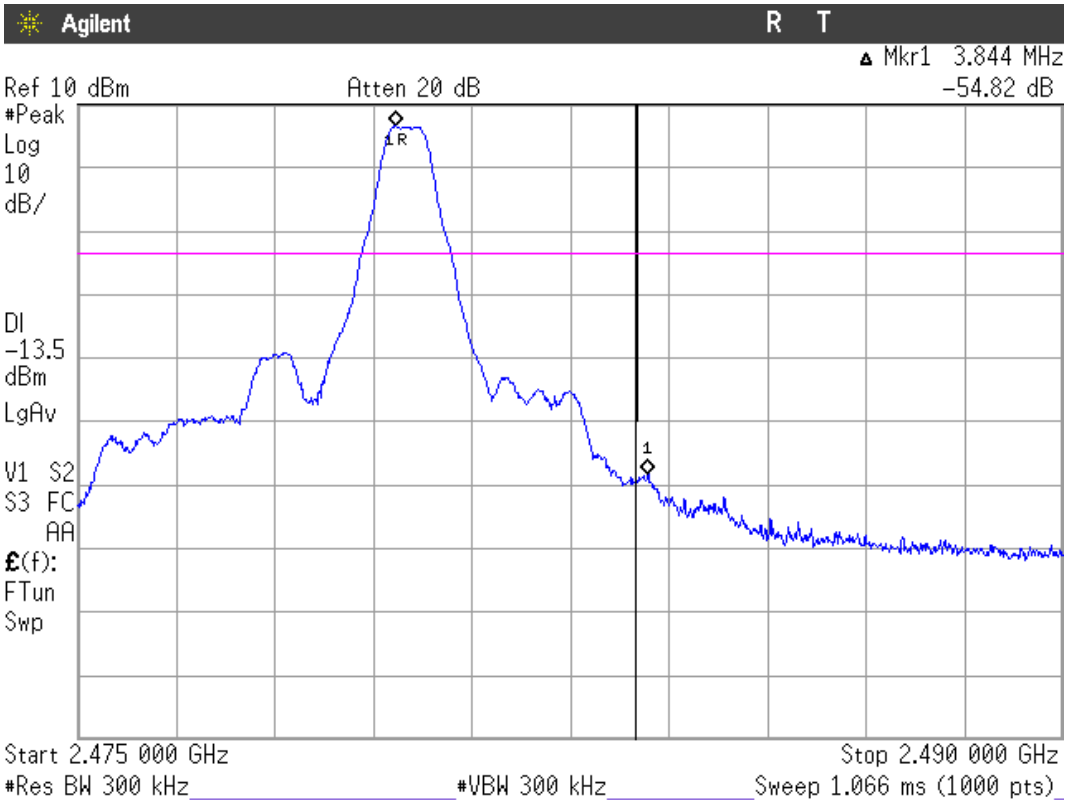
Modulation: GFSK

1. LOW FREQUENCY SECTION 2402 MHz (HOPPING OFF). See next plot.



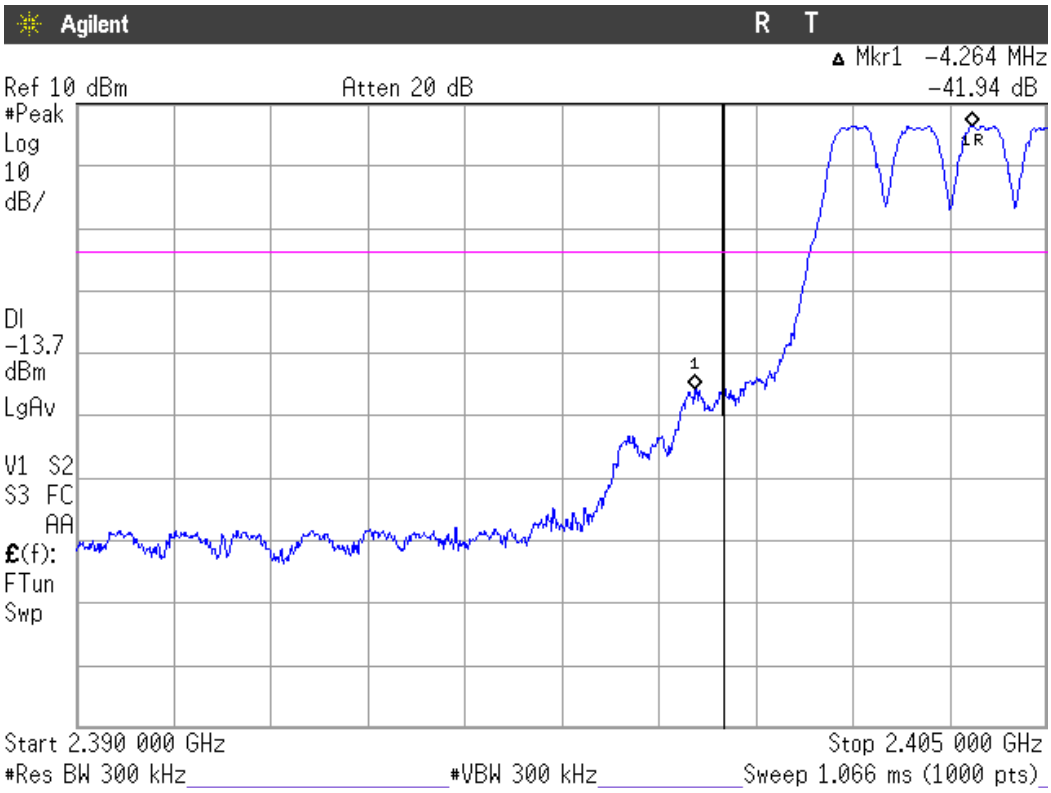
Verdict: PASS

2. HIGH FREQUENCY SECTION 2480 MHz (HOPPING OFF). See next plot.



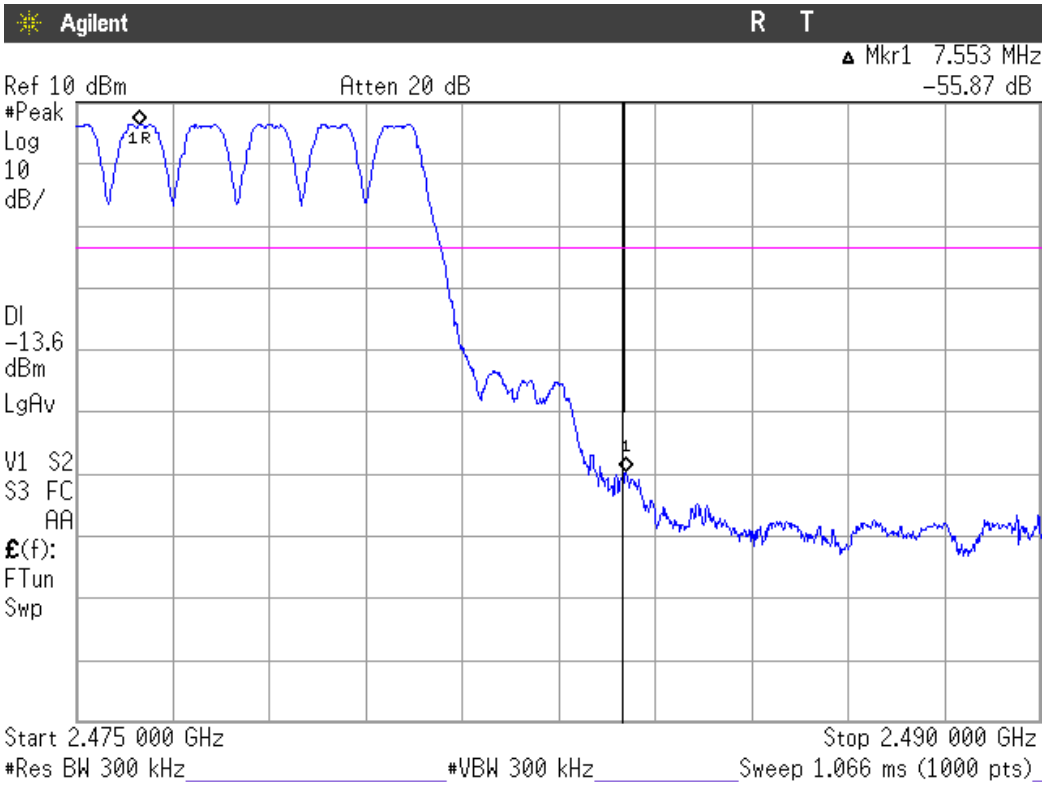
Verdict: PASS

3. LOW FREQUENCY SECTION (HOPPING ON). See next plot.



Verdict: PASS

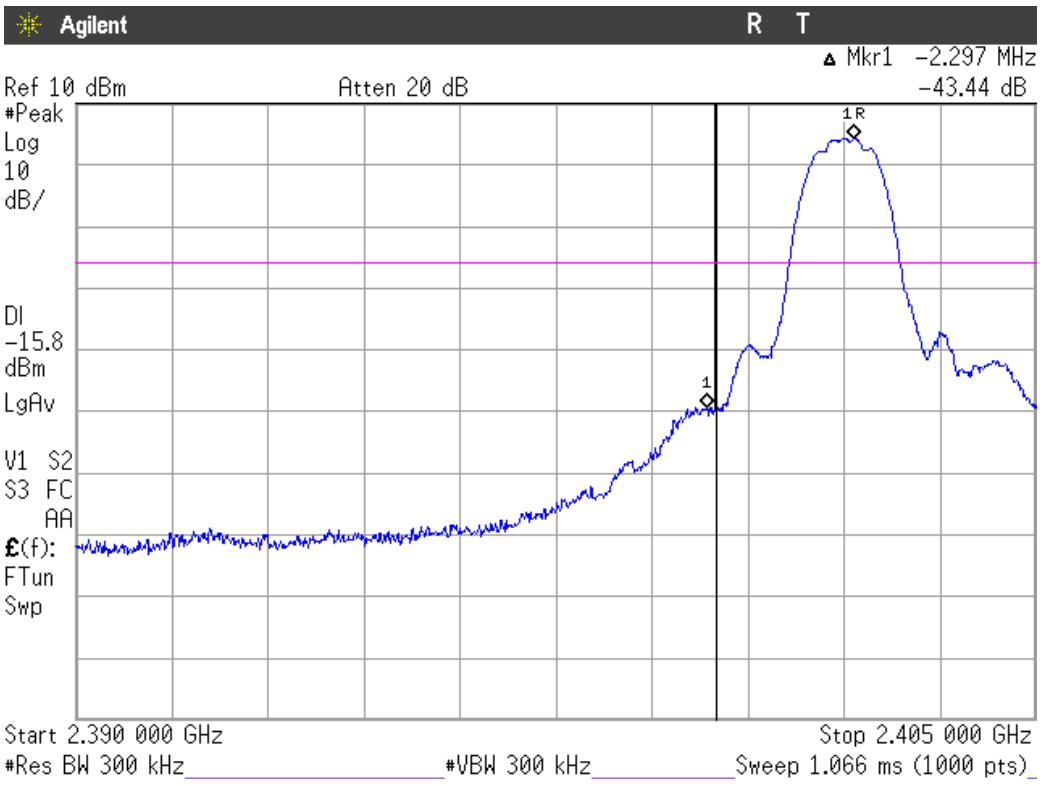
4. HIGH FREQUENCY SECTION (HOPPING ON). See next plot.



Verdict: PASS

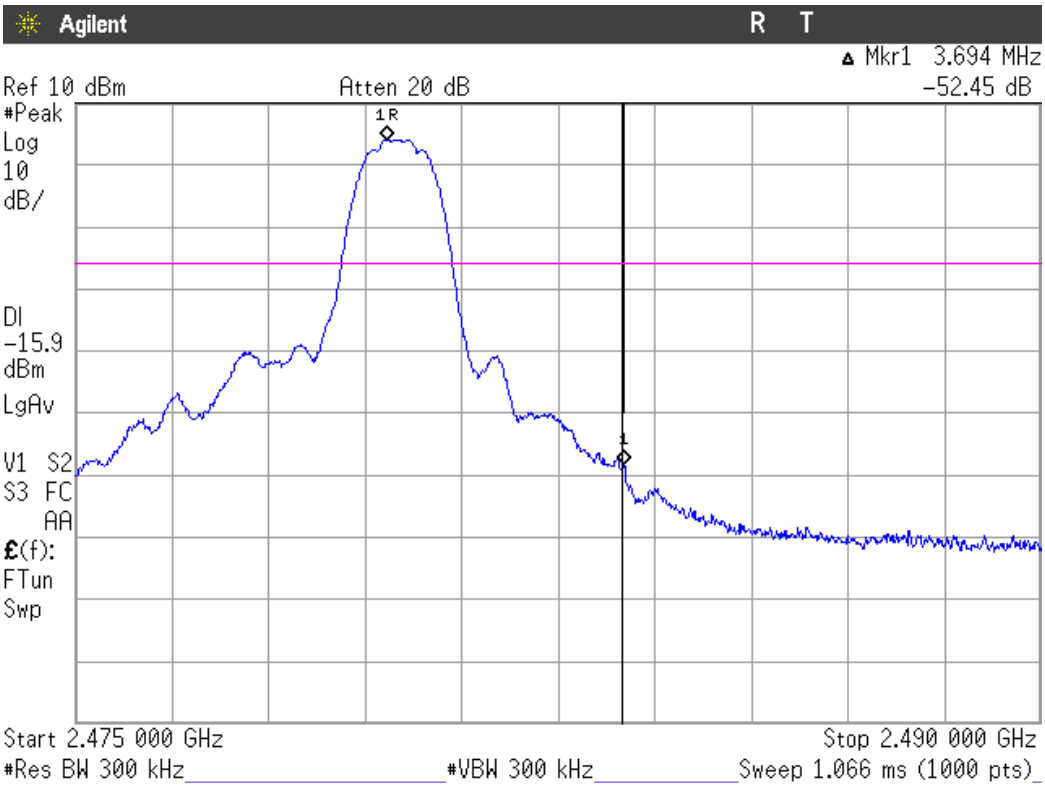
Modulation: Π/4-DQPSK

1. LOW FREQUENCY SECTION 2402 MHz (HOPPING OFF). See next plot.



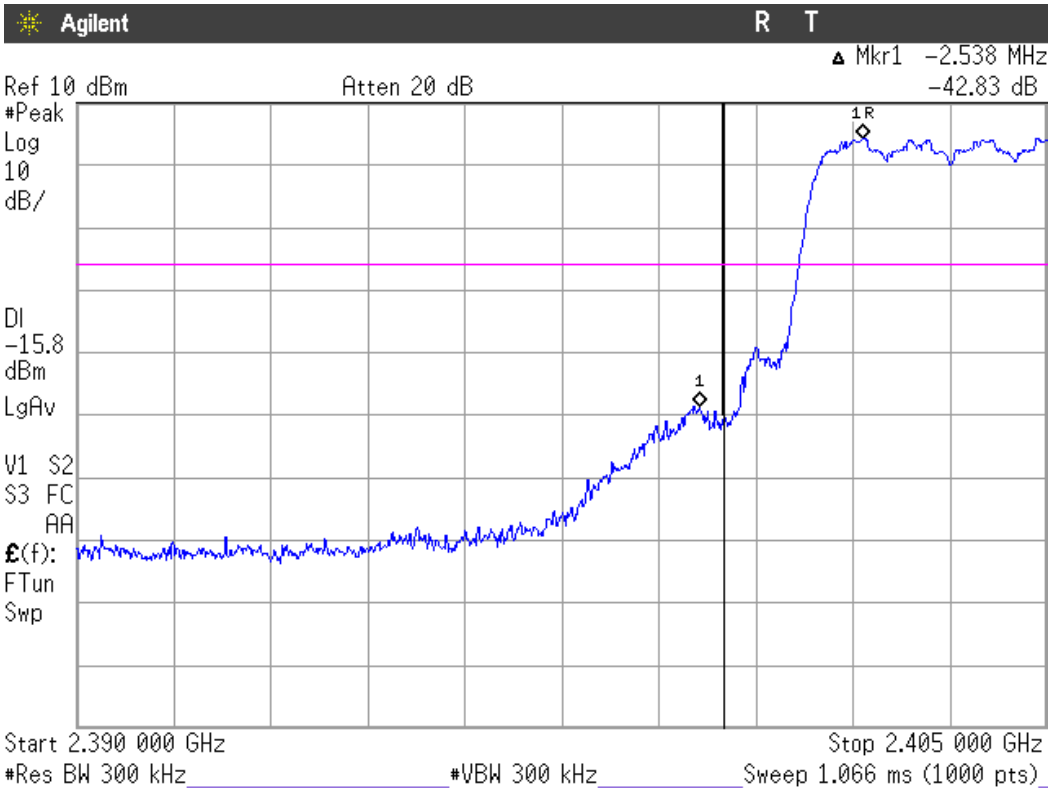
Verdict: PASS

2. HIGH FREQUENCY SECTION 2480 MHz (HOPPING OFF). See next plot.



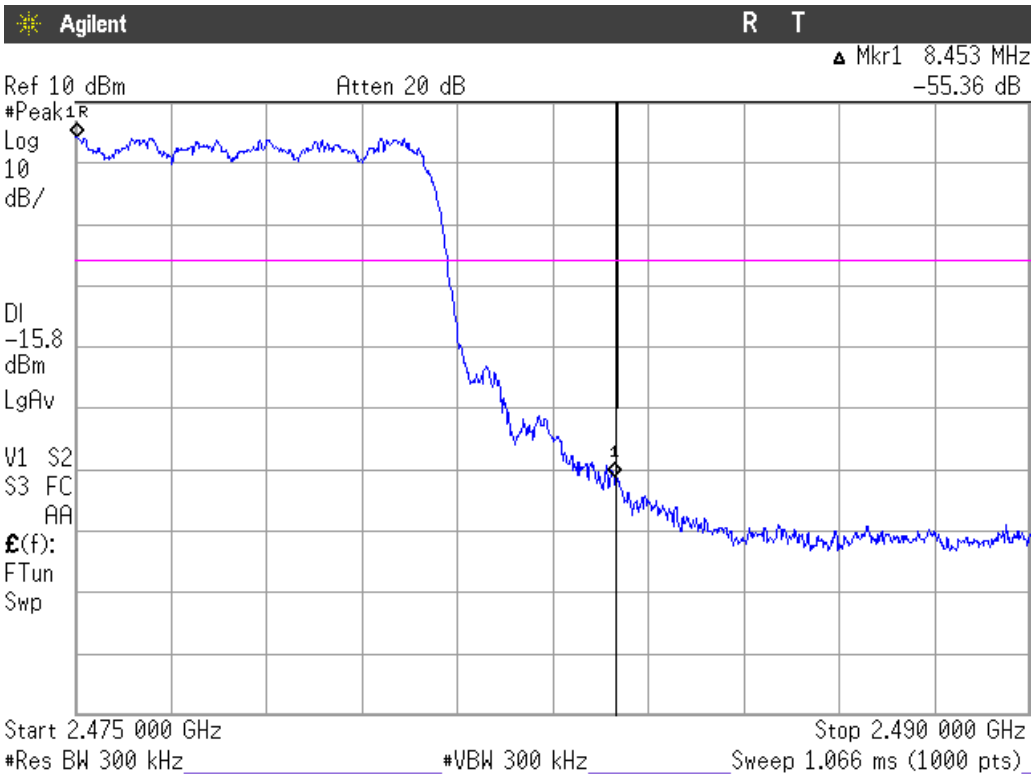
Verdict: PASS

3. LOW FREQUENCY SECTION (HOPPING ON). See next plot.



Verdict: PASS

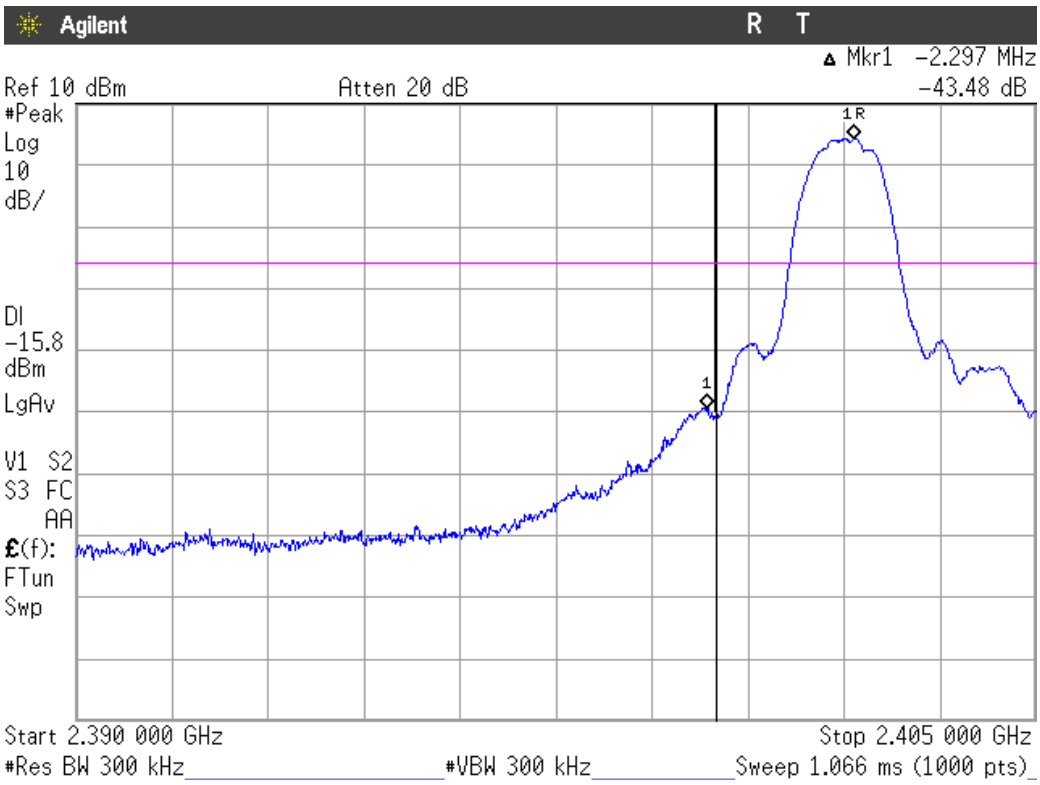
4. HIGH FREQUENCY SECTION (HOPPING ON). See next plot.



Verdict: PASS

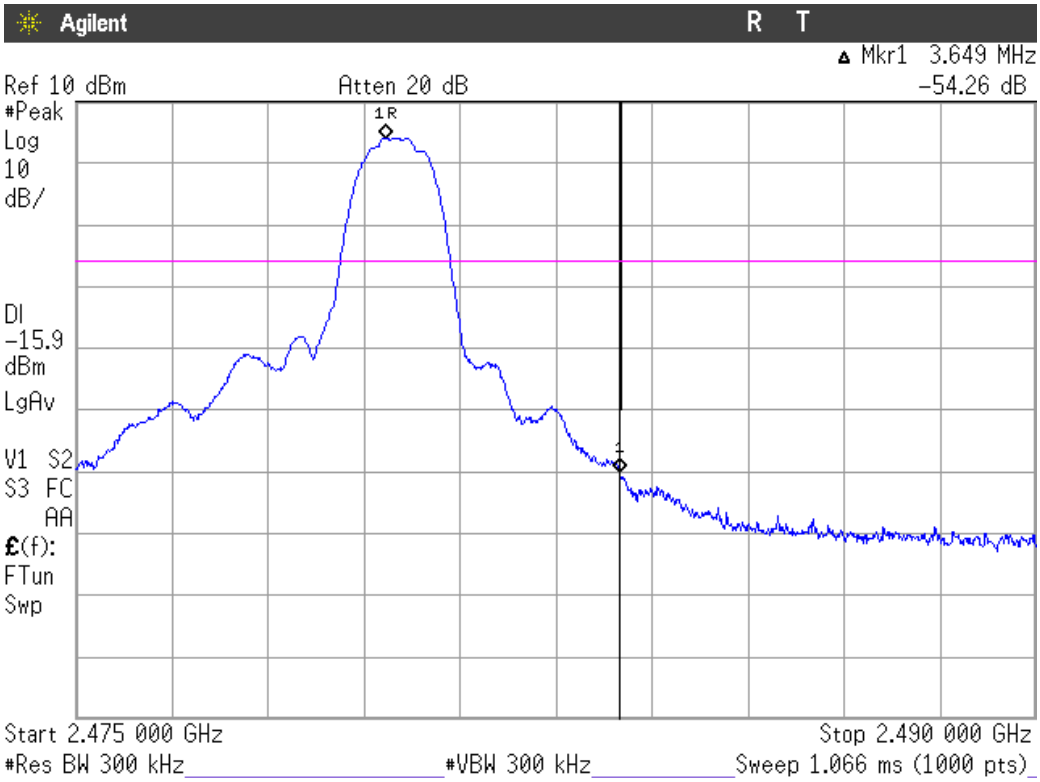
Modulation: 8-DPSK

1. LOW FREQUENCY SECTION 2402 MHz (HOPPING OFF). See next plot.



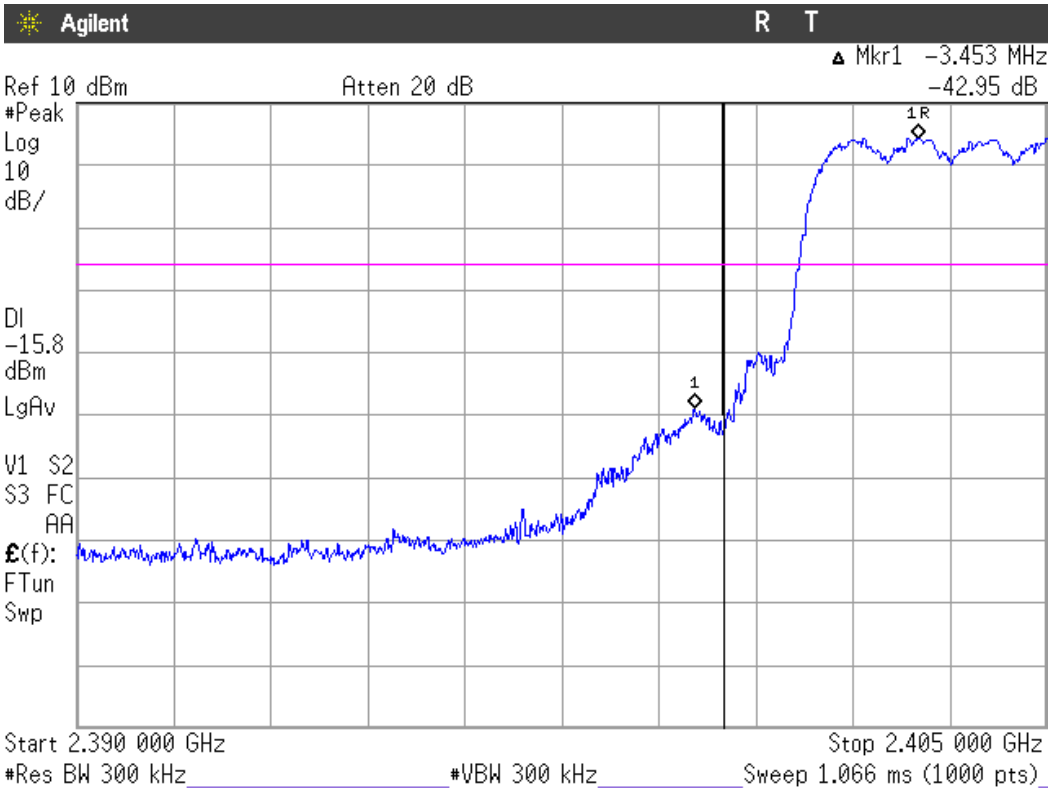
Verdict: PASS

2. HIGH FREQUENCY SECTION 2480 MHz (HOPPING OFF). See next plot.



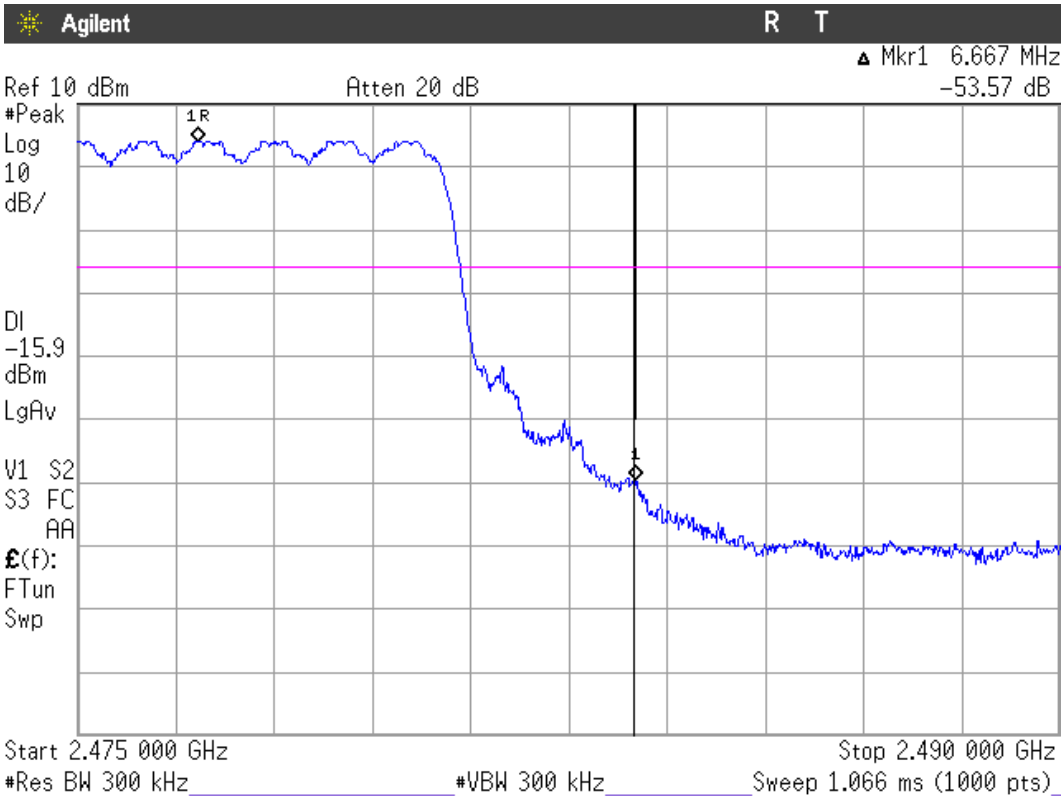
Verdict: PASS

3. LOW FREQUENCY SECTION (HOPPING ON). See next plot.



Verdict: PASS

4. HIGH FREQUENCY SECTION (HOPPING ON). See next plot.



Verdict: PASS

FCC Section 15.247 Subclause (d) / RSS-210 Clauses 2.2 & A8.5. Band-edge compliance of radiated emissions (Transmitter)

SPECIFICATION:

Emissions outside the frequency band in which the intentional radiator is operating shall be at least 20 dB below the highest level of the desired power. Attenuation below the general field strength limits specified in RSS-Gen is not required.

RESULTS:

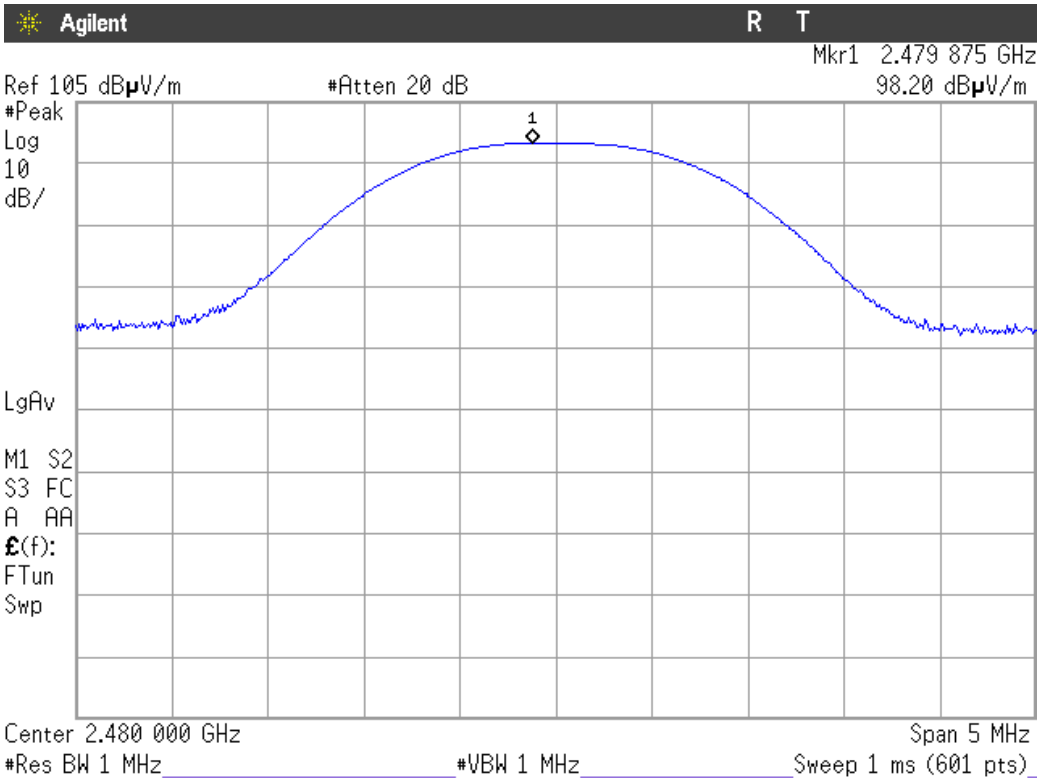
Band-edge compliance of radiated emissions

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

HIGHEST CHANNEL (2480 MHz):

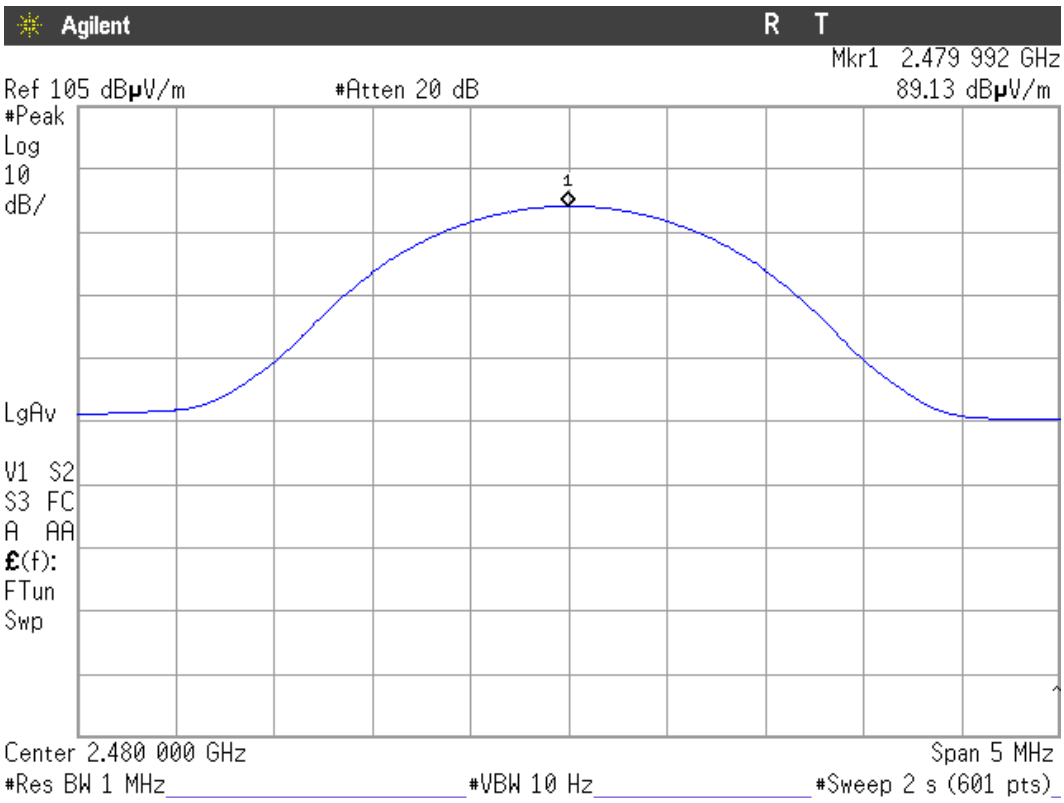
Modulation: GFSK

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.

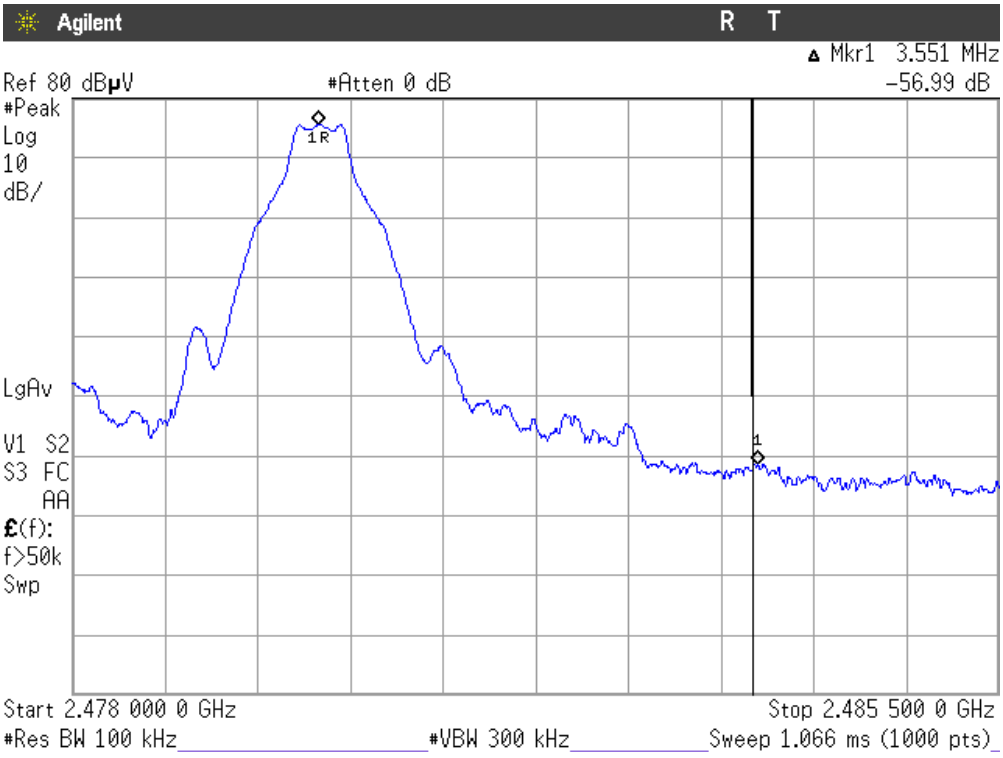
Maximum field strength at 3 m. Average value.



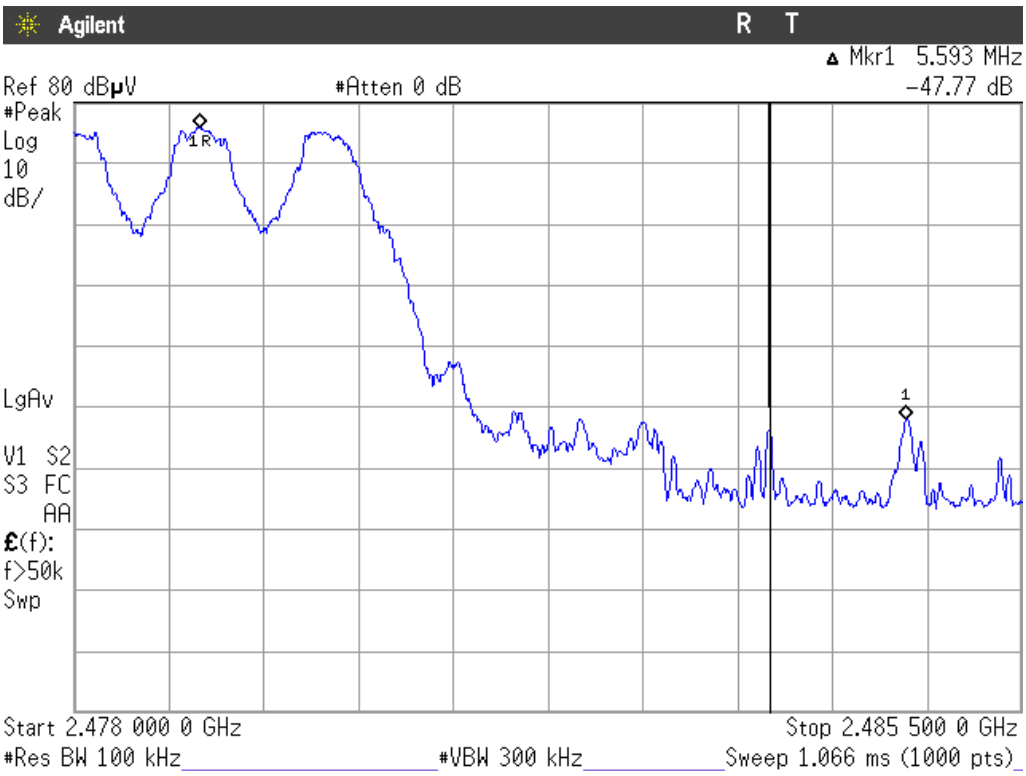
Note: The correction factor is already included in the spectrum analyzer as a transducer factor so that the marker shows directly the field strength level.

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

Single carrier



Hopping mode



Note: No correction is applied for this relative measurement.

Band edge compliance of radiated emissions

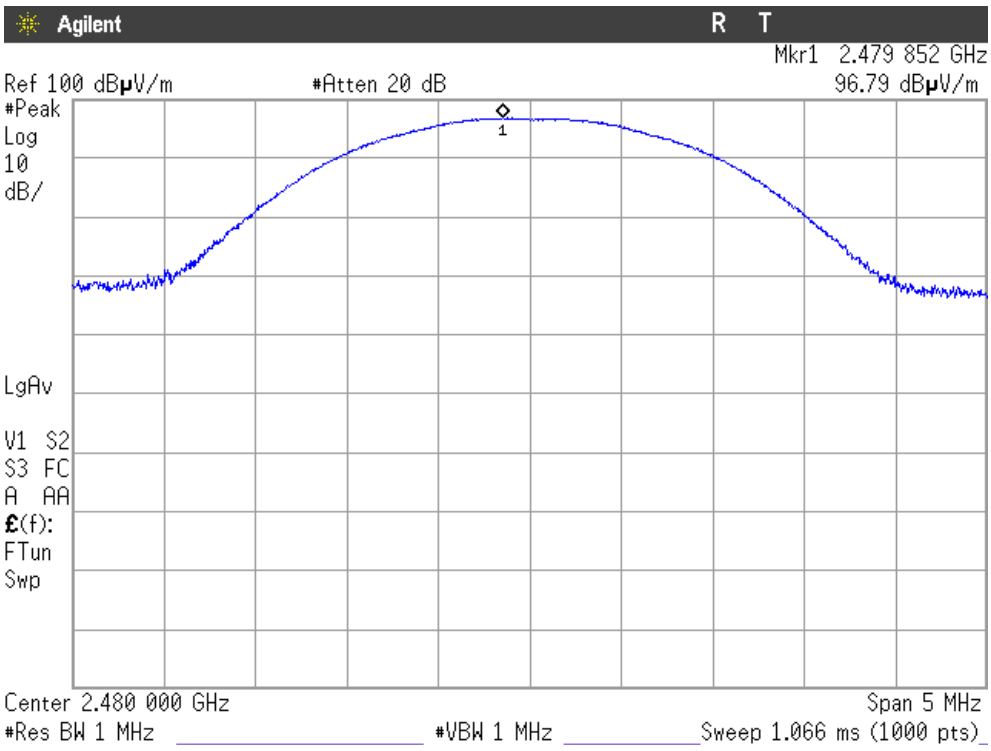
Fundamental max. average value 3 m	Delta value	Calculated value 3 m	Limit
89.13 dBµV/m	56.99 dB (single carrier) 47.77 dB (hopping mode)	32.14 dBµV/m (single carrier) 41.36 dBµV/m (hopping mode)	54 dBµV/m

Fundamental max. Peak value 3 m	Delta value	Calculated value 3 m	Limit
98.20 dBµV/m	56.99 dB (single carrier) 47.77 dB (hopping mode)	41.21 dBµV/m (single carrier) 50.43 dBµV/m (hopping mode)	74 dBµV/m

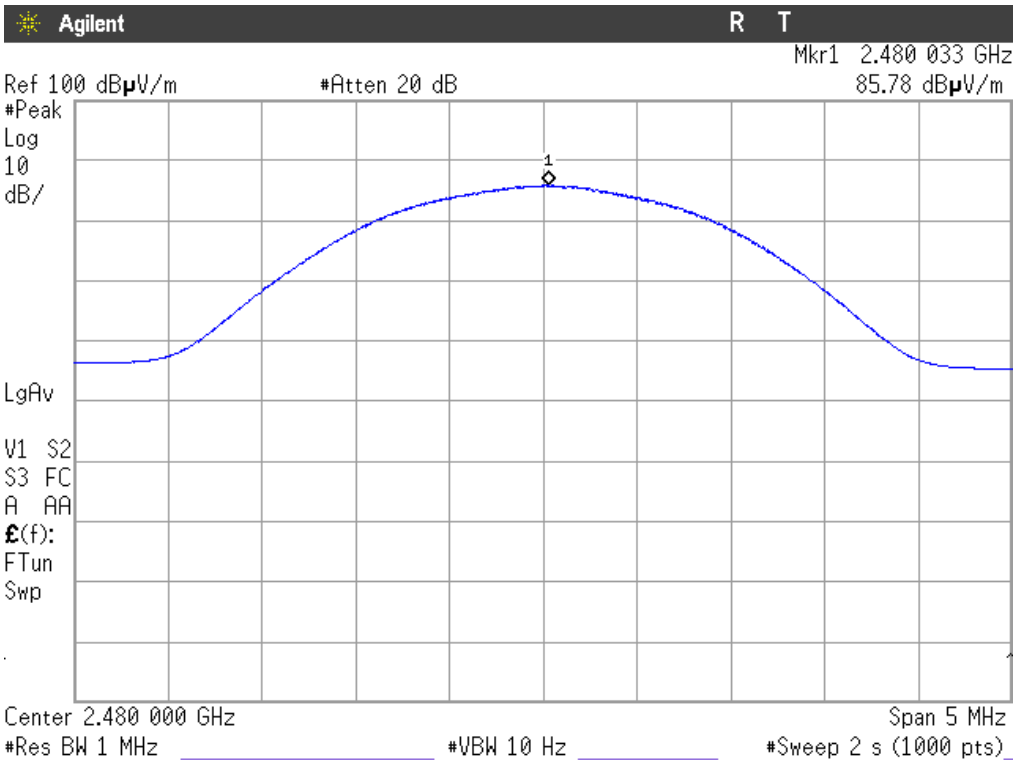
Verdict: PASS

Modulation: Π/4-DQPSK

Maximum field strength at 3 m. Peak value.



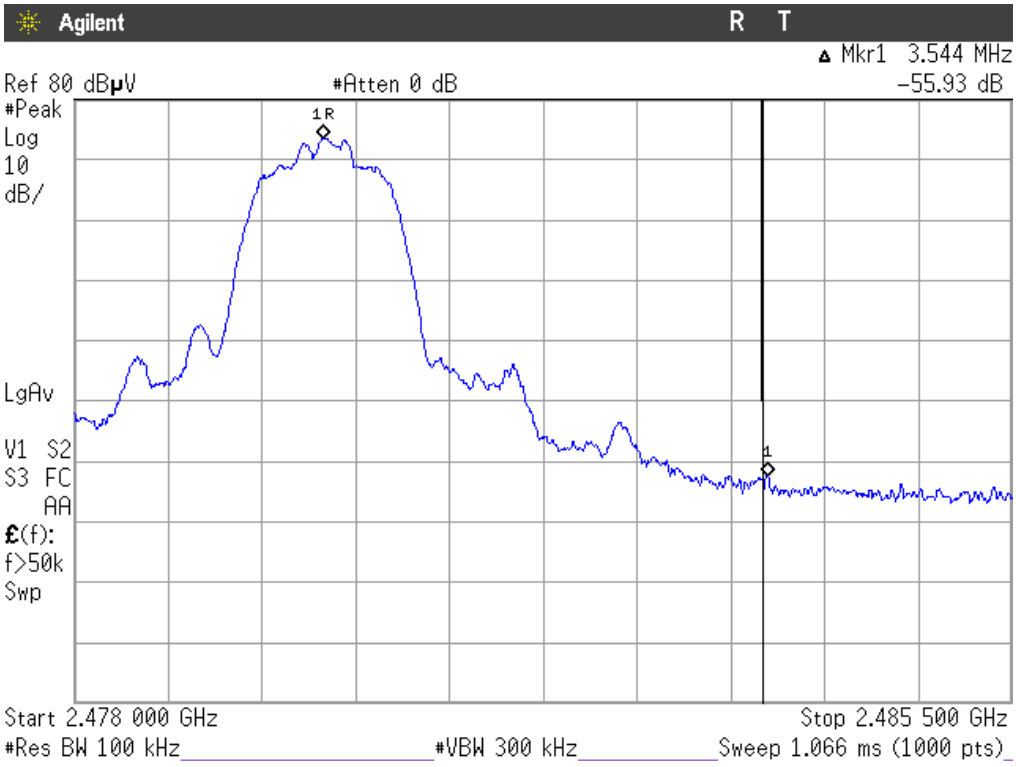
Maximum field strength at 3 m. Average value.



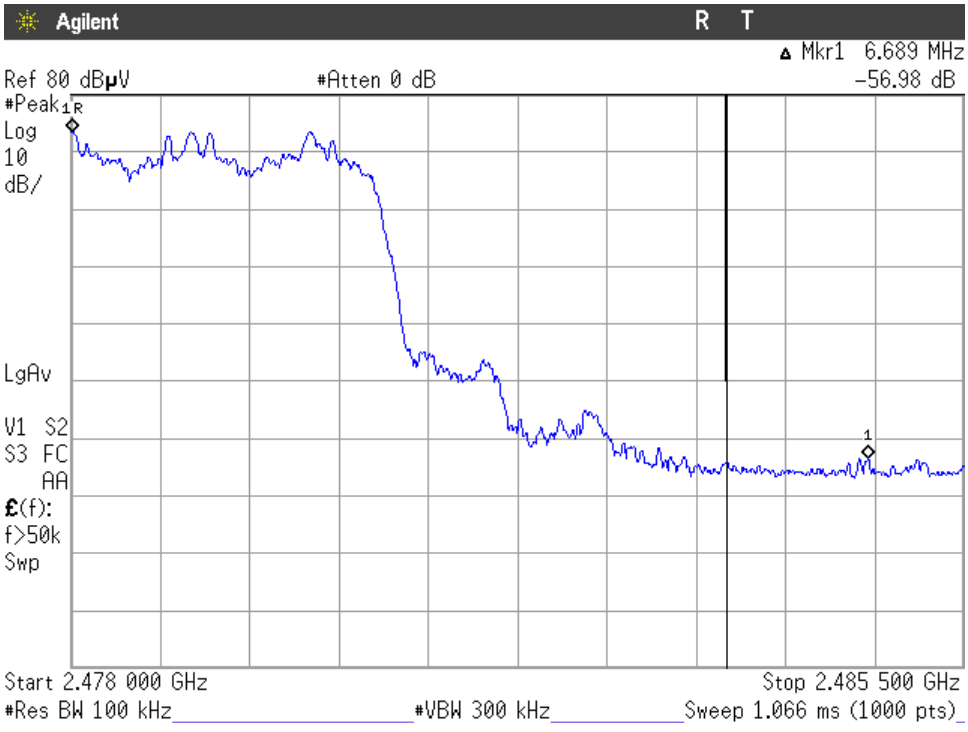
Note: The correction factor is already included in the spectrum analyzer as a transducer factor so that the marker shows directly the field strength level.

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

Single carrier



Hopping mode



Note: No correction is applied for this relative measurement.

Band edge compliance of radiated emissions

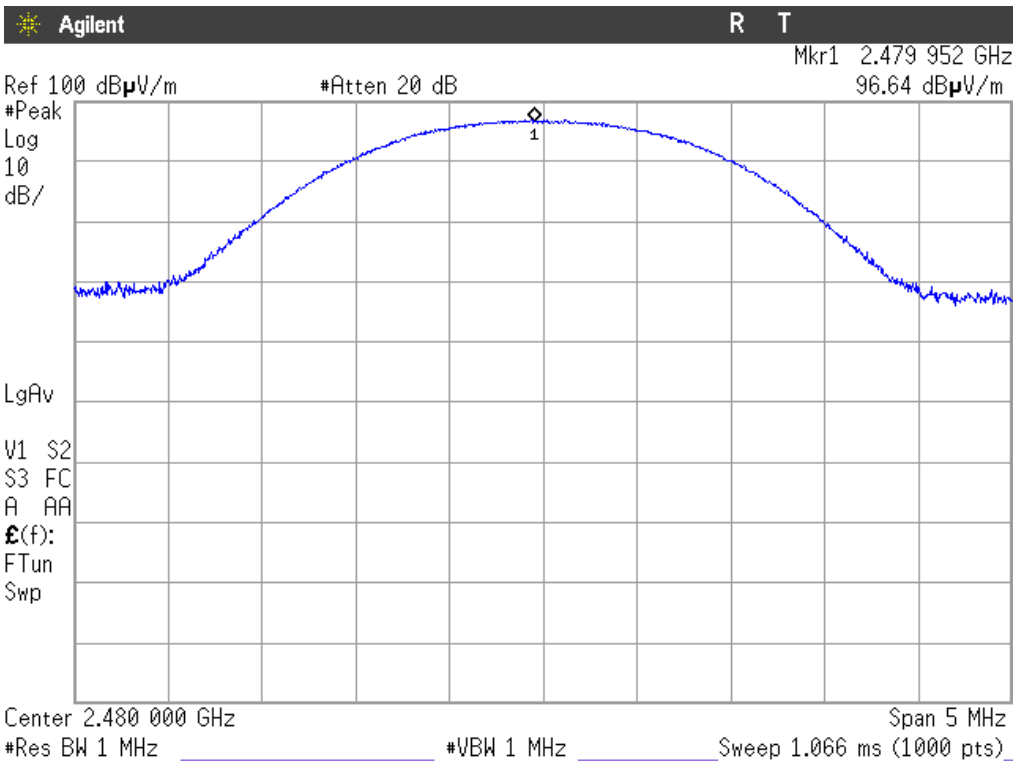
Fundamental max. average value 3 m	Delta value	Calculated value 3 m	Limit
85.78 dBµV/m	55.93 dB (single carrier) 56.98 dB (hopping mode)	29.85 dBµV/m (single carrier) 28.80 dBµV/m (hopping mode)	54 dBµV/m

Fundamental max. Peak value 3 m	Delta value	Calculated value 3 m	Limit
96.79 dBµV/m	55.93 dB (single carrier) 56.98 dB (hopping mode)	40.86 dBµV/m (single carrier) 39.81 dBµV/m (hopping mode)	74 dBµV/m

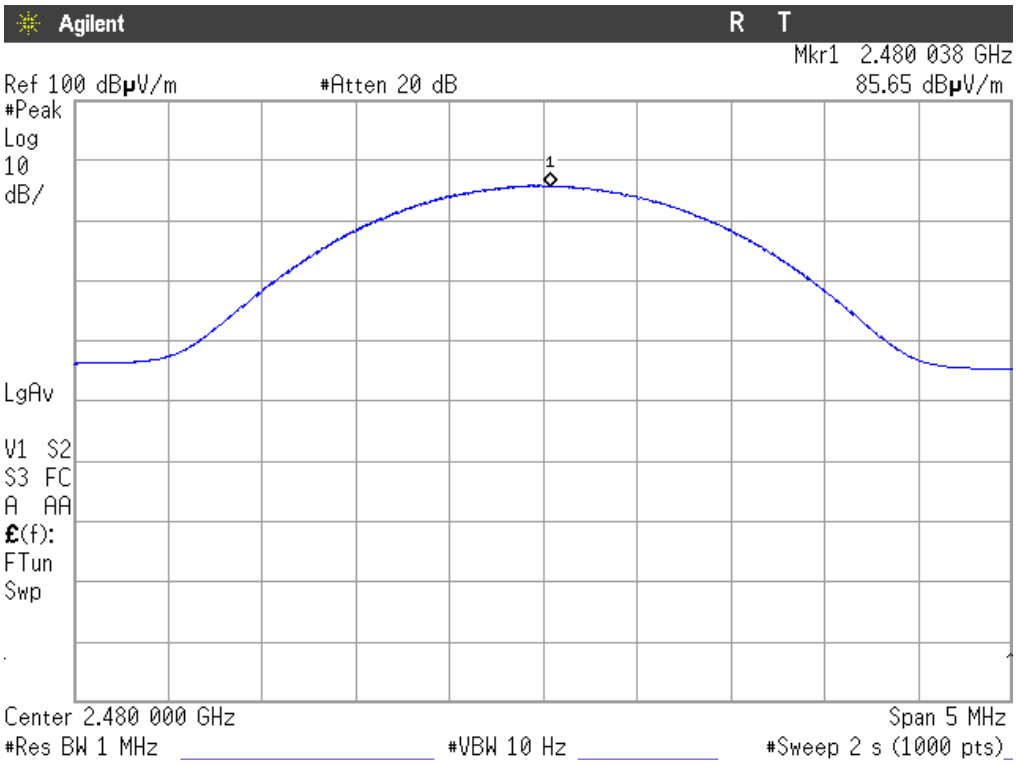
Verdict: PASS

Modulation: 8-DPSK

Maximum field strength at 3 m. Peak value.



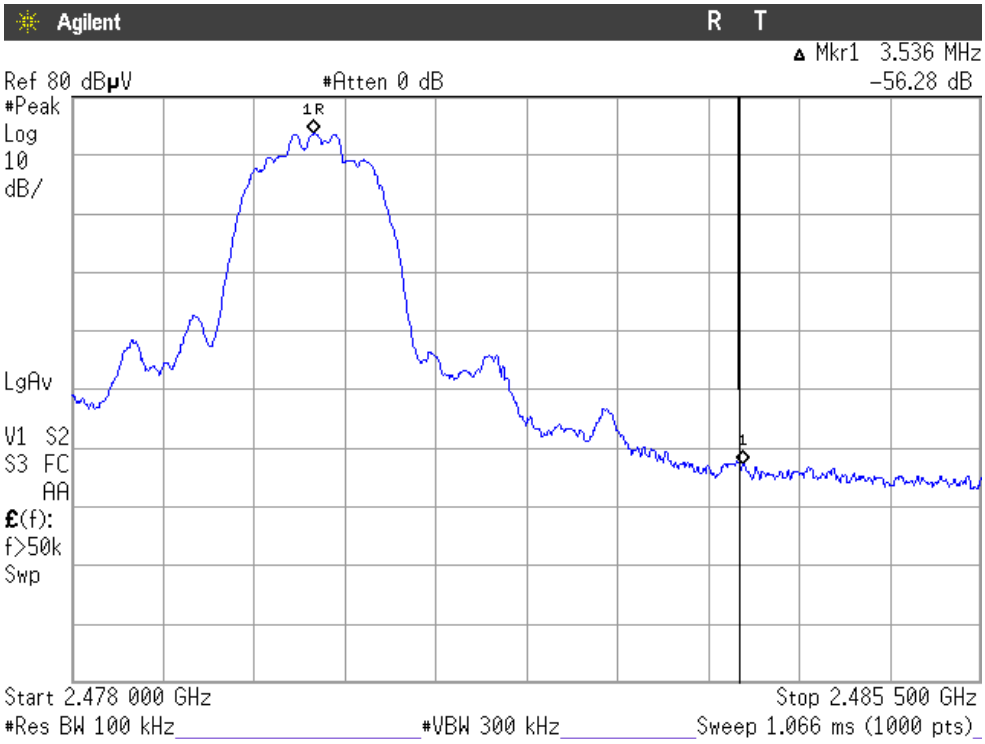
Maximum field strength at 3 m. Average value.



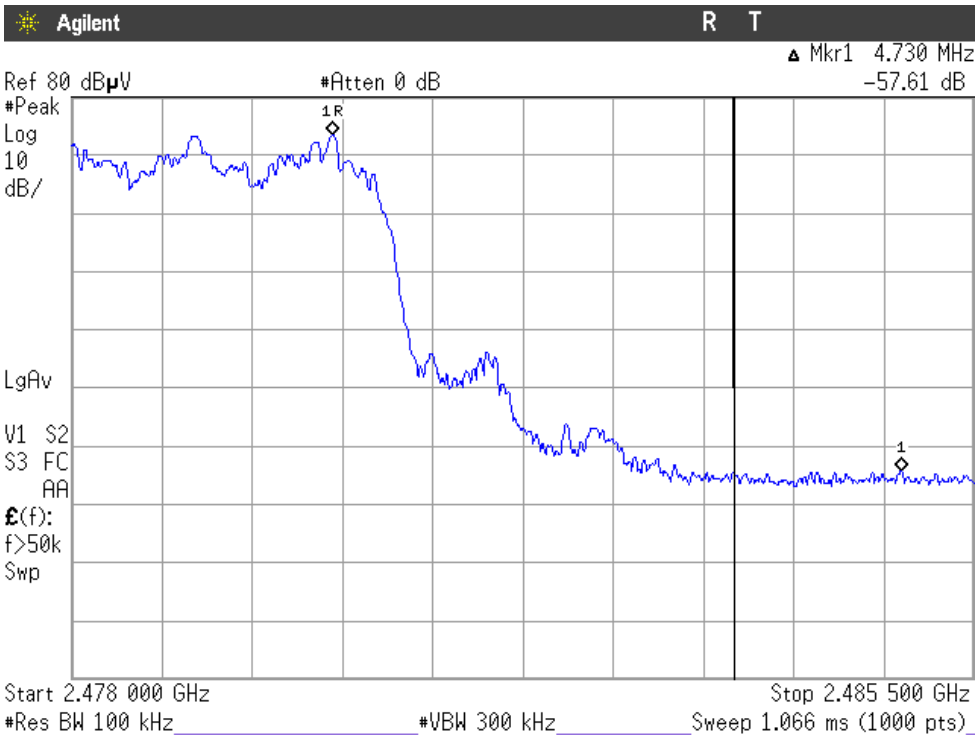
Note: The correction factor is already included in the spectrum analyzer as a transducer factor so that the marker shows directly the field strength level.

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

Single carrier



Hopping mode



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
85.65 dBµV/m	56.28 dB (single carrier) 57.61 dB (hopping mode)	29.37 dBµV/m (single carrier) 28.04 dBµV/m (hopping mode)	54 dBµV/m

Fundamental max. Peak value 3 m	Delta value	Calculated value 3 m	Limit
96.64 dBµV/m	56.28 dB (single carrier) 57.61 dB (hopping mode)	40.36 dBµV/m (single carrier) 39.03 dBµV/m (hopping mode)	74 dBµV/m

Verdict: PASS

FCC Section 15.247 Subclause (d) / RSS-210 Clause A8.5. Emission limitations conducted (Transmitter)

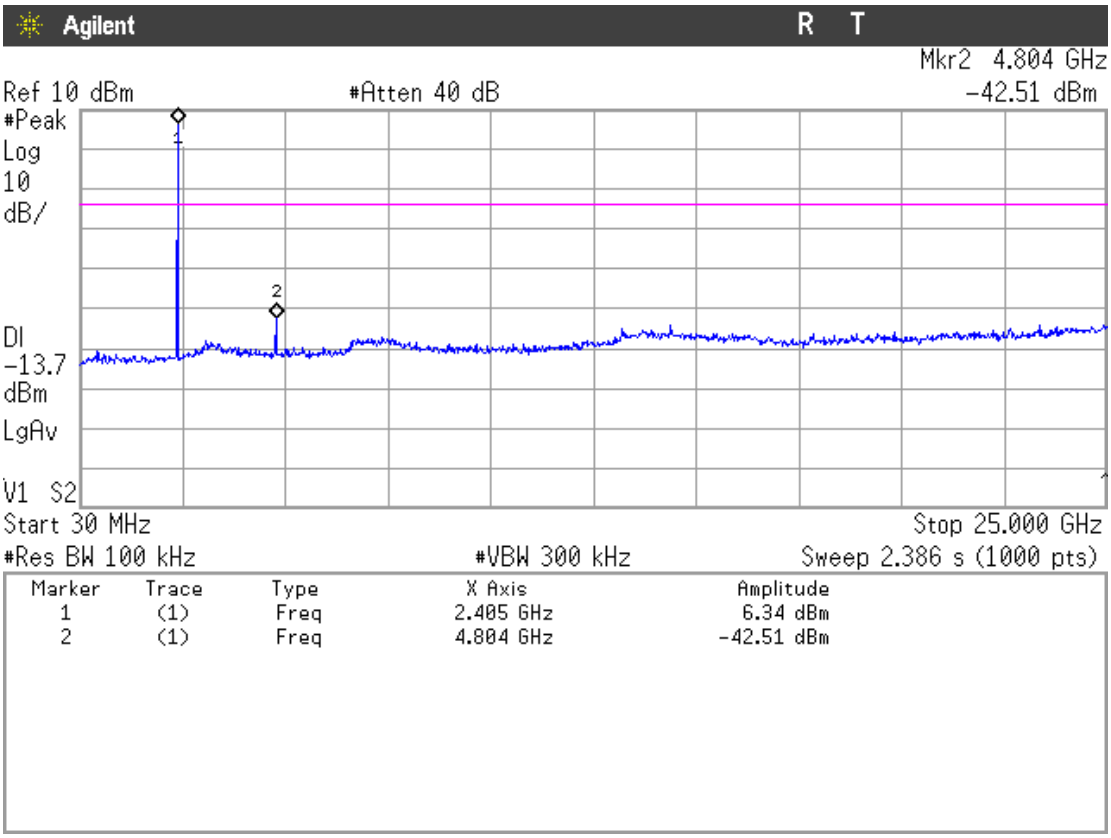
SPECIFICATION

In any 100 kHz bandwidths outside the frequency band in which the 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:

Modulation: GFSK

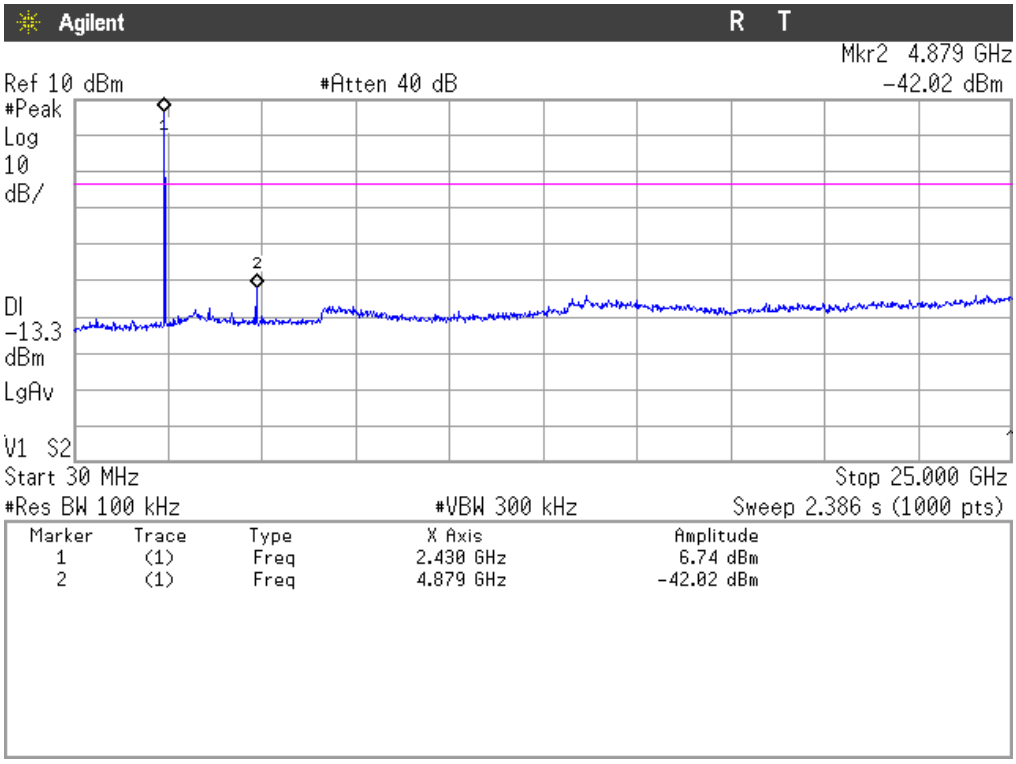
1. LOWEST CHANNEL (2402 MHz): 30 MHz-25 GHz (see next plot).



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

Verdict: PASS

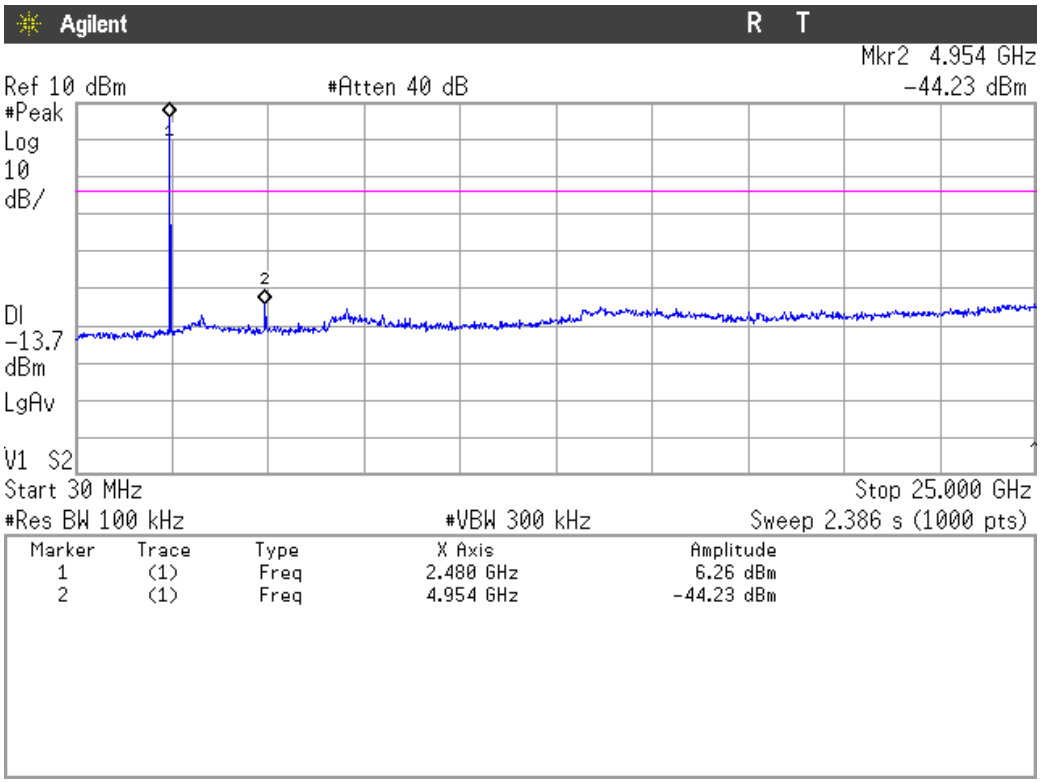
2. MIDDLE CHANNEL (2441 MHz): 30 MHz-25 GHz (see next plot).



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

Verdict: PASS

3. HIGH CHANNEL (2480 MHz): 30 MHz-25 GHz (see next plot).

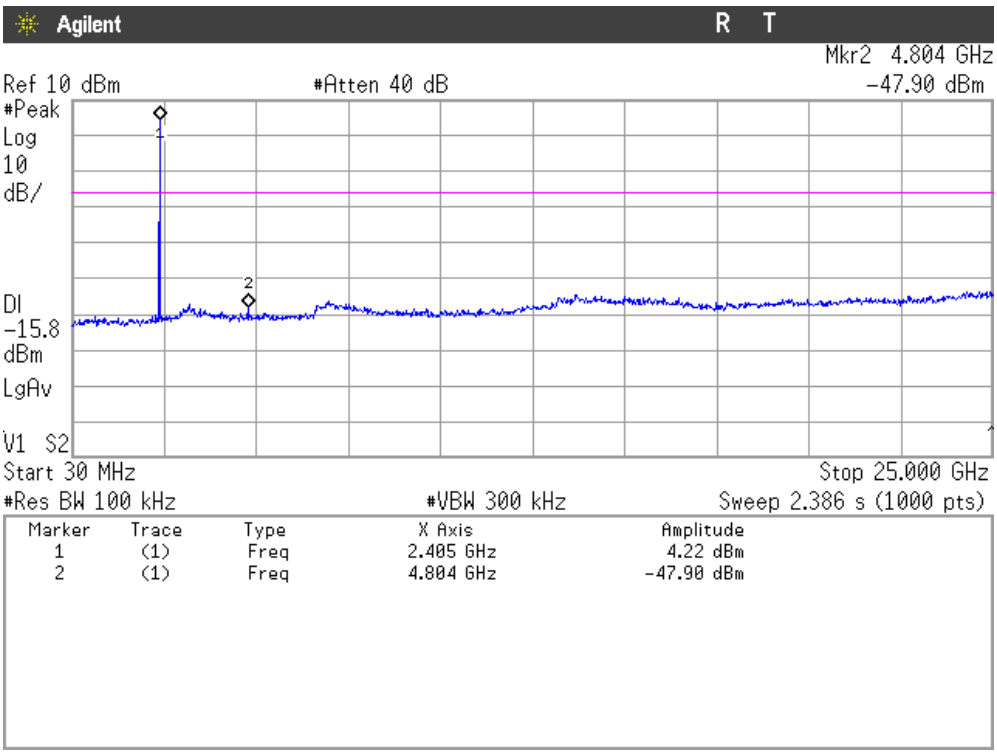


Note: The peak above the limits is the carrier frequency.

Verdict: PASS

Modulation: Π/4-DQPSK

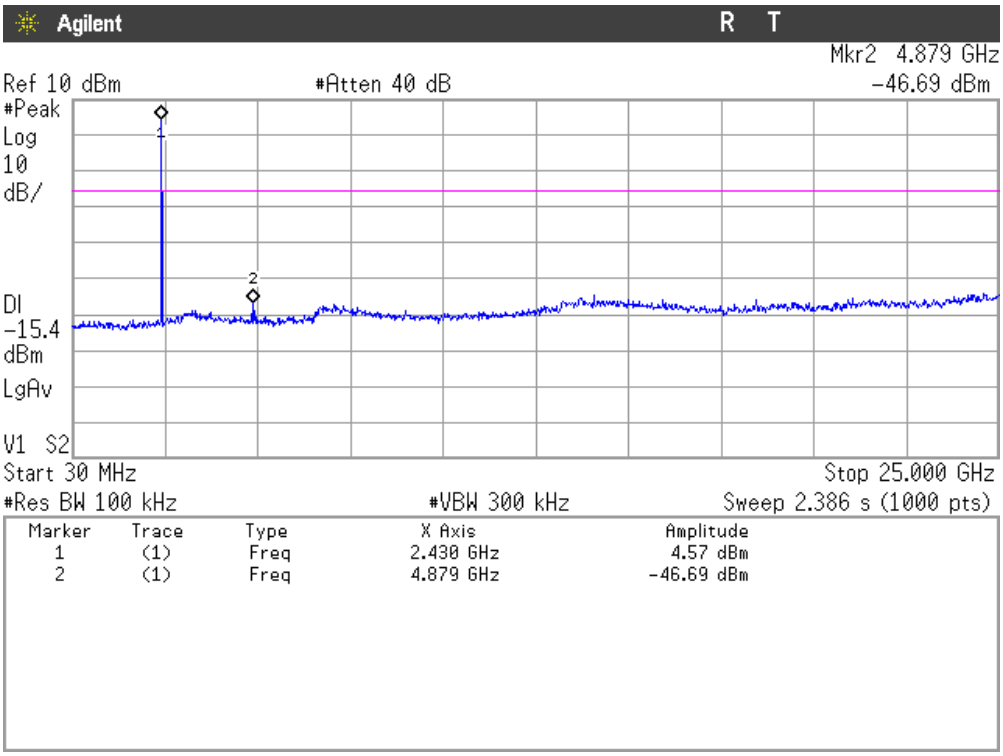
1. LOWEST CHANNEL (2402 MHz): 30 MHz-25 GHz (see next plot).



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

Verdict: PASS

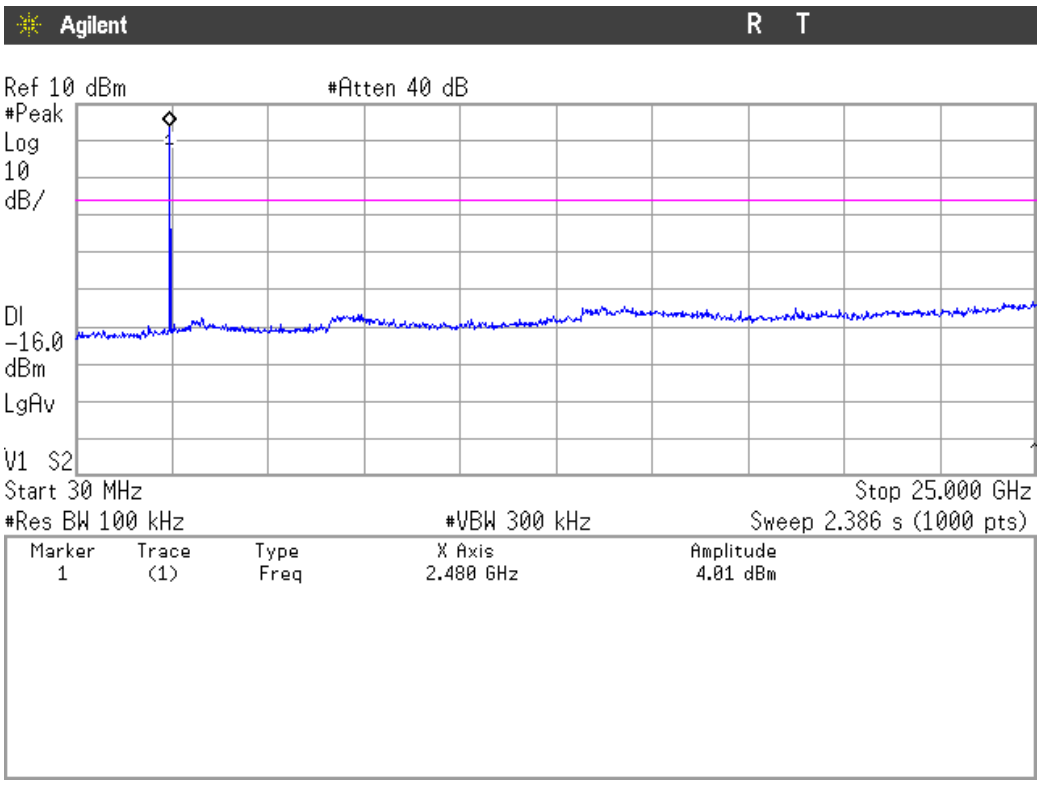
2. MIDDLE CHANNEL (2441 MHz): 30 MHz-25 GHz (see next plot).



Note: The peaks above the limits are the carrier frequencies.

Verdict: PASS

3. HIGH CHANNEL (2480 MHz): 30 MHz-25 GHz (see next plot).

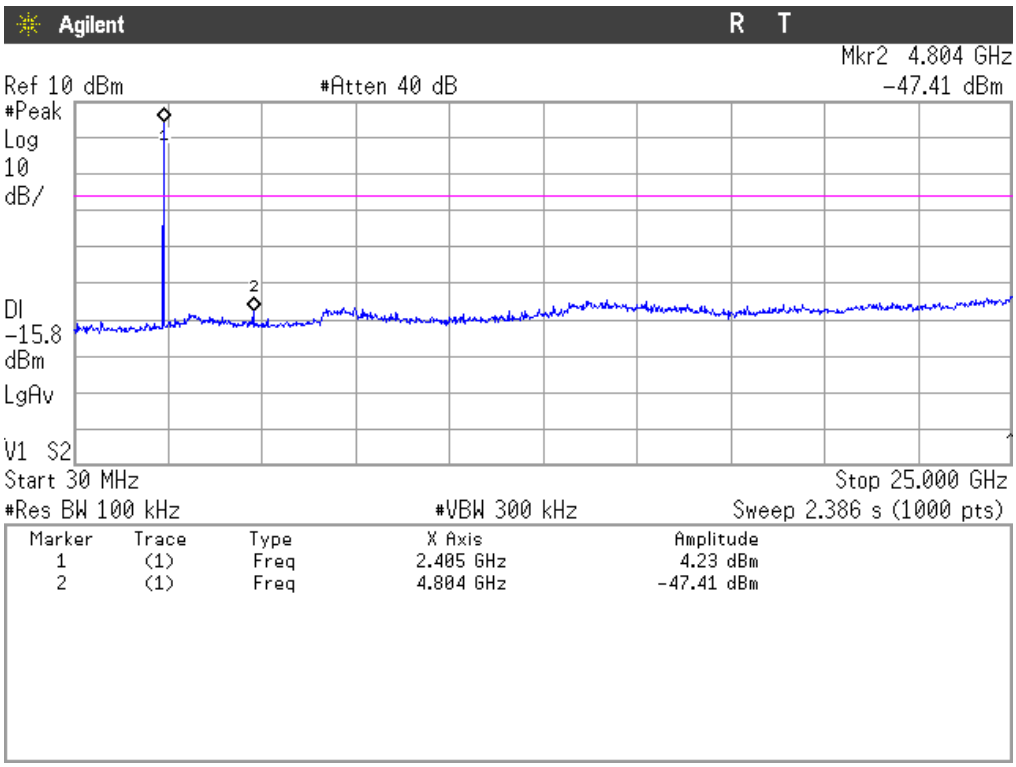


Note: The peak above the limit is the carrier frequency.

Verdict: PASS

Modulation: 8-DPSK

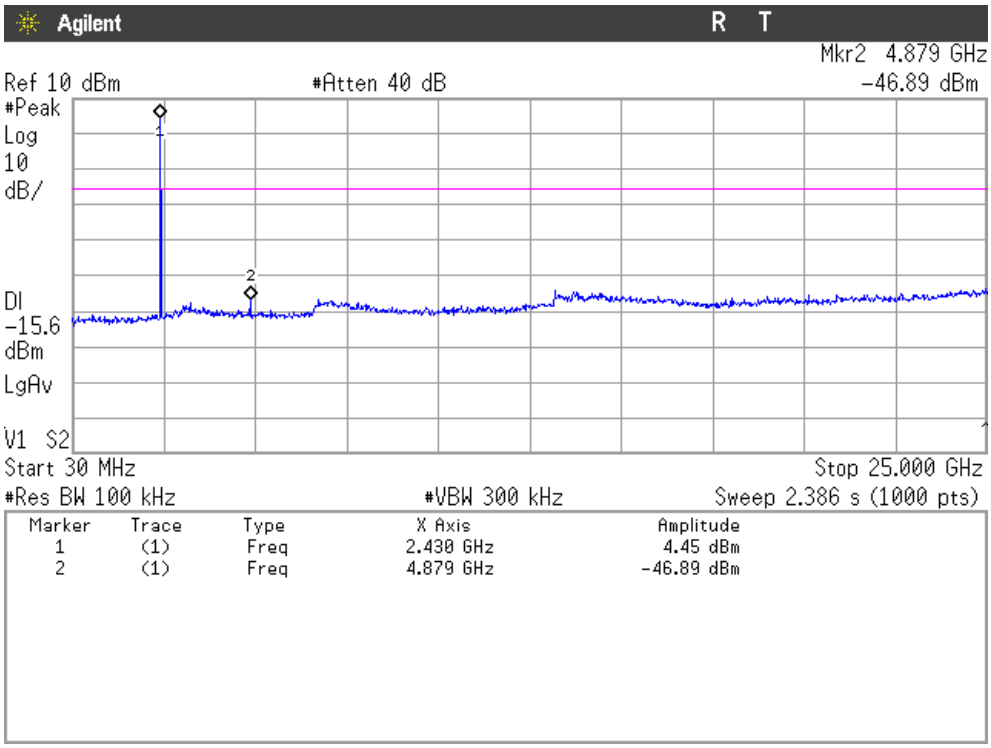
1. LOWEST CHANNEL (2402 MHz): 30 MHz-25 GHz (see next plot).



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

Verdict: PASS

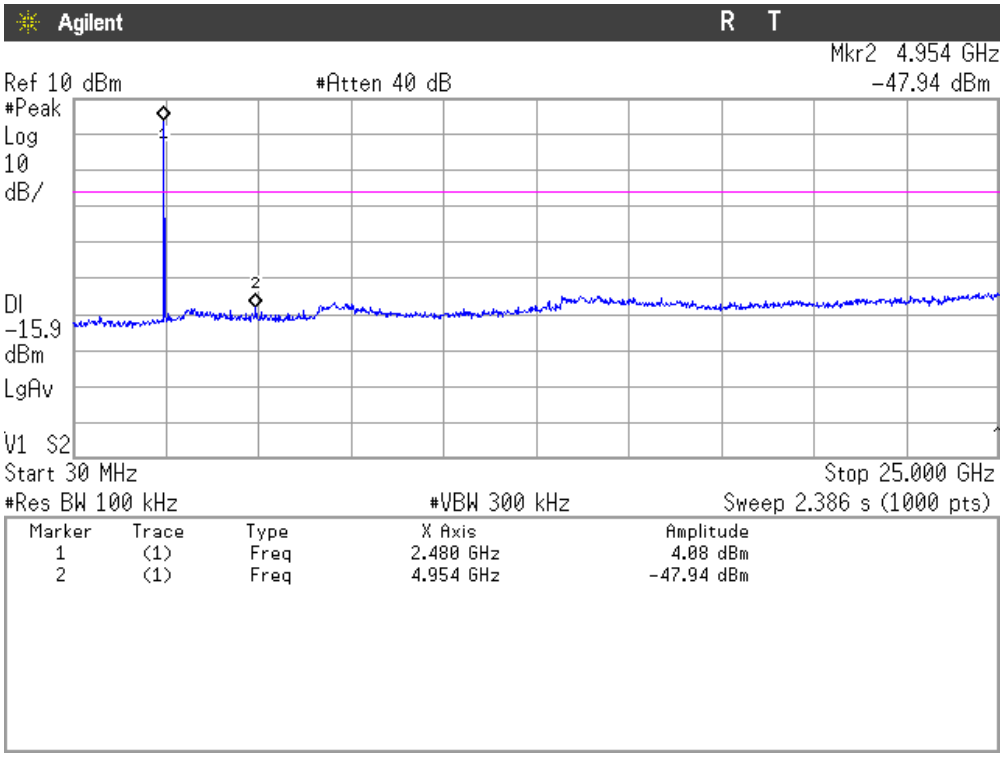
2. MIDDLE CHANNEL (2441 MHz): 30 MHz-25 GHz (see next plot).



Note: The peaks above the limit are the carrier frequencies.

Verdict: PASS

3. HIGH CHANNEL (2480 MHz): 30 MHz-25 GHz (see next plot).



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

Verdict: PASS

FCC Section 15.247 Subclause (d) / RSS-210 Clauses 2.2. & A8.5. 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 (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 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 in all the range for all three channels and all modulation modes.

Frequency range 1 GHz-25 GHz

Modulation: GFSK

1. CHANNEL: LOWEST (2402 MHz).

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
4.80497	V	Peak	58.60	± 4.09
4.80497	V	Average	47.85	± 4.09

2. CHANNEL: MIDDLE (2441 MHz).

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
2.38832	V	Peak	41.82	± 4.09
2.38832	V	Average	36.04	± 4.09
2.49336	V	Peak	40.65	± 4.09
2.49336	V	Average	34.44	± 4.09
4.88197	V	Peak	58.87	± 4.09
4.88197	V	Average	47.04	± 4.09

3. CHANNEL: HIGHEST (2480 MHz).

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
4.96007	V	Peak	58.17	± 4.09
4.96007	V	Average	52.45	± 4.09

Verdict: PASS

Modulation: Π/4-DQPSK

1. CHANNEL: LOWEST (2402 MHz).

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
4.80395	V	Peak	53.15	± 4.09
4.80395	V	Average	37.84	± 4.09

2. CHANNEL: MIDDLE (2441 MHz).

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
4.88197	V	Peak	53.27	± 4.09
4.88197	V	Average	37.13	± 4.09

3. CHANNEL: HIGHEST (2480 MHz).

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
4.95989	V	Peak	52.89	± 4.09
4.95989	V	Average	39.18	± 4.09

Verdict: PASS

Modulation: 8-DPSK

1. CHANNEL: LOWEST (2402 MHz).

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
4.80399	V	Peak	52.68	± 4.09
4.80399	V	Average	37.80	± 4.09

2. CHANNEL: MIDDLE (2441 MHz).

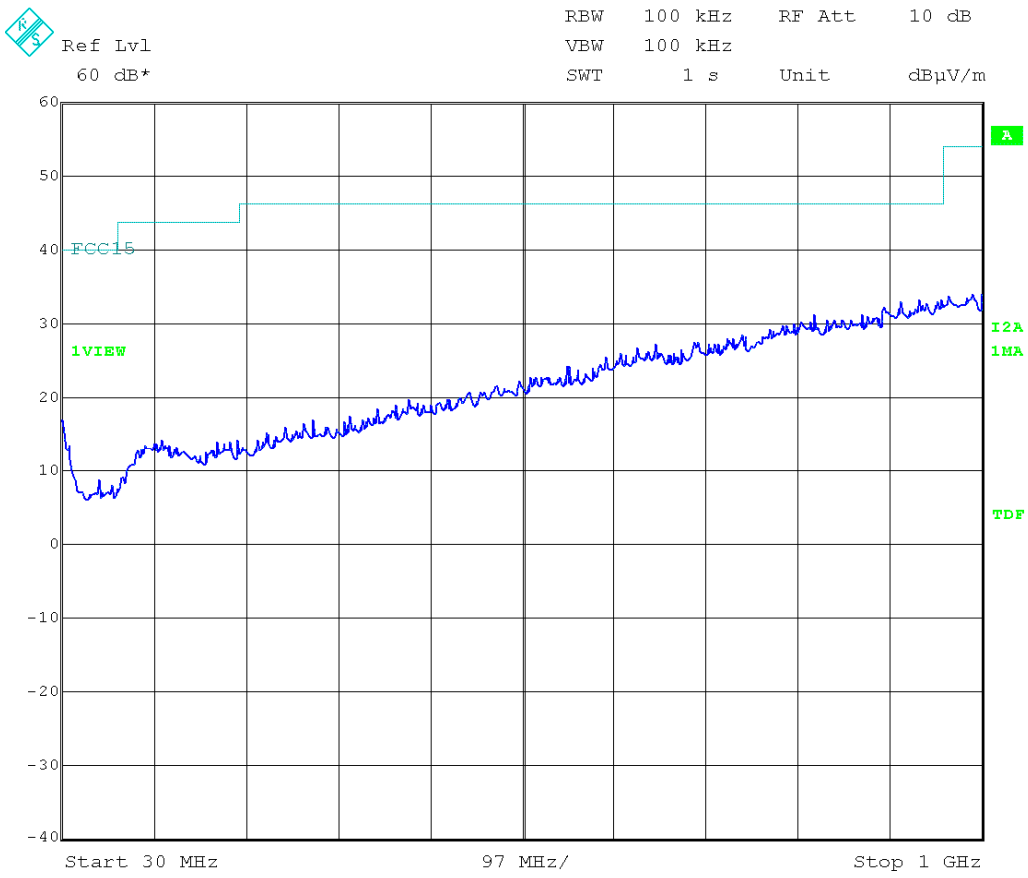
Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
4.88201	V	Peak	52.91	± 4.09
4.88201	V	Average	38.12	± 4.09

3. CHANNEL: HIGHEST (2480 MHz).

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
4.95993	V	Peak	52.98	± 4.09
4.95993	V	Average	39.63	± 4.09

Verdict: PASS

FREQUENCY RANGE 30 MHz-1000 MHz.

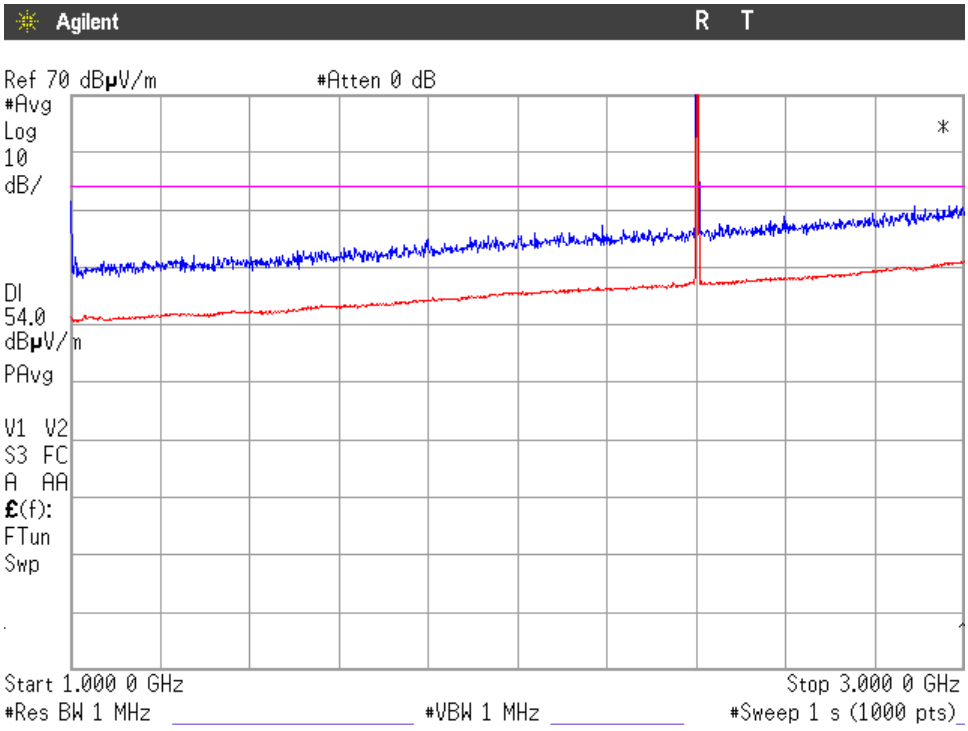


(This plot is valid for all three channels and all modulation modes).

FREQUENCY RANGE 1 GHz to 3 GHz.

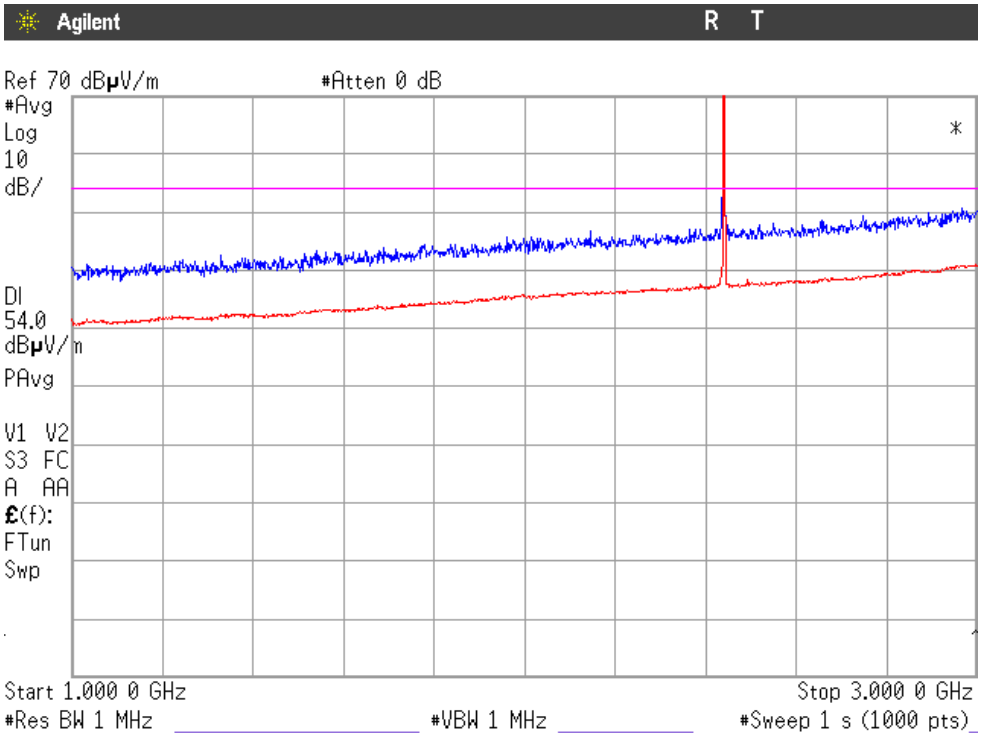
Modulation: GFSK

CHANNEL: Lowest (2402 MHz).



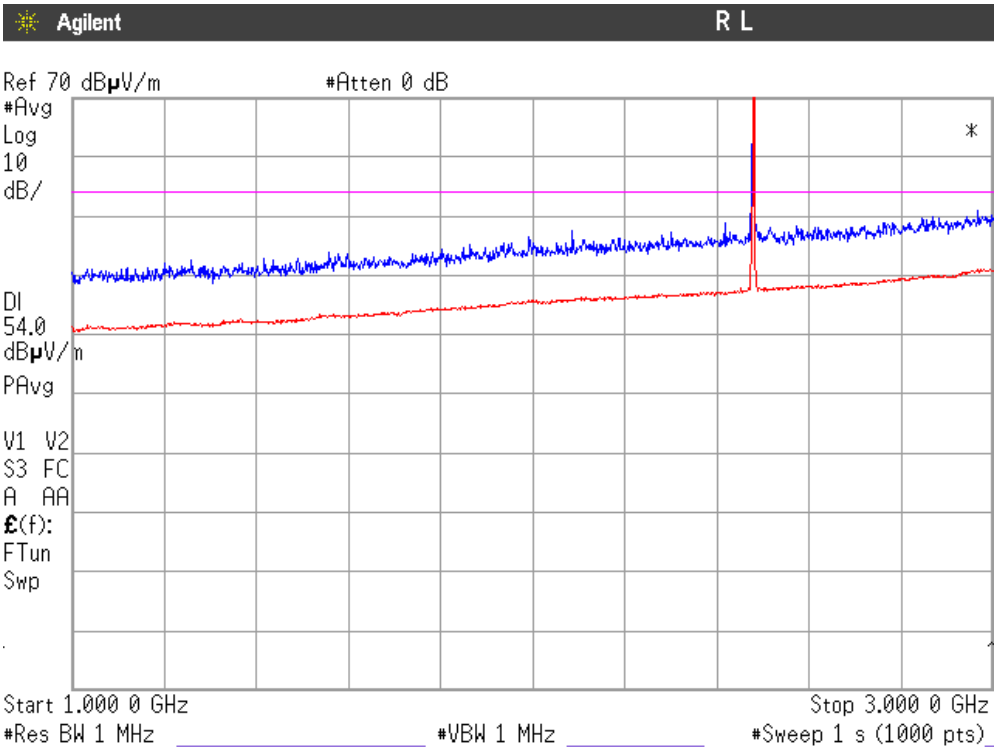
Note: The peak shown in the plot is the carrier frequency.

CHANNEL: Middle (2441 MHz).



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

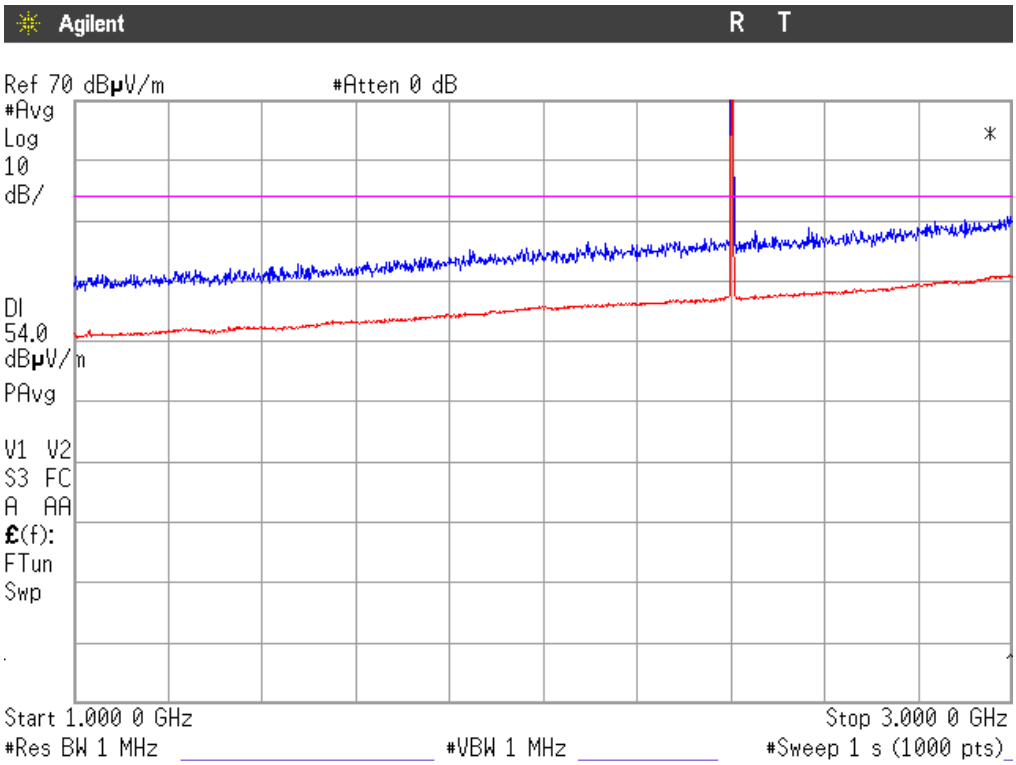
CHANNEL: Highest (2480 MHz).



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

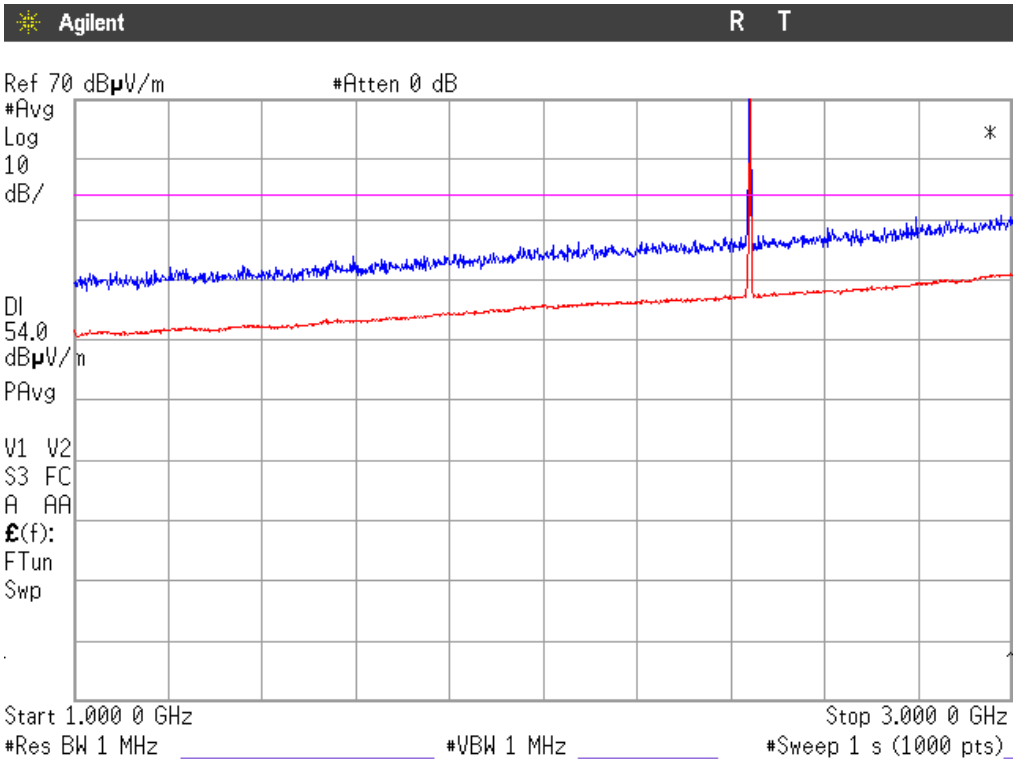
Modulation: Π/4-DQPSK

CHANNEL: Lowest (2402 MHz).



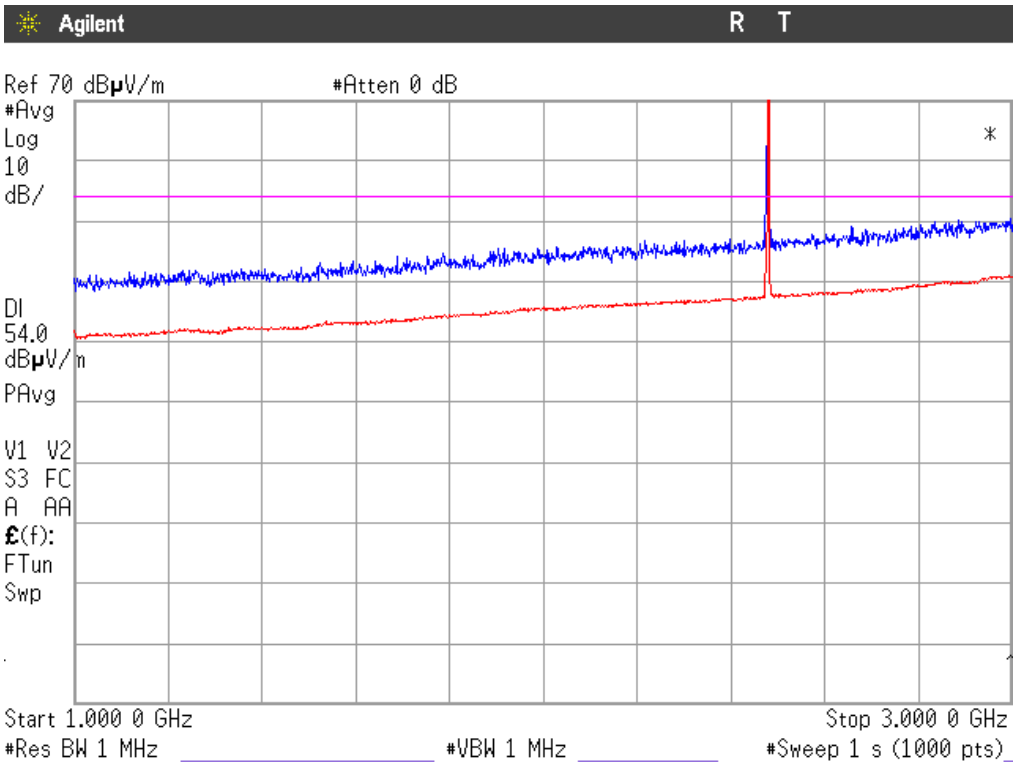
Note: The peak shown in the plot is the carrier frequency.

CHANNEL: Middle (2441 MHz).



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

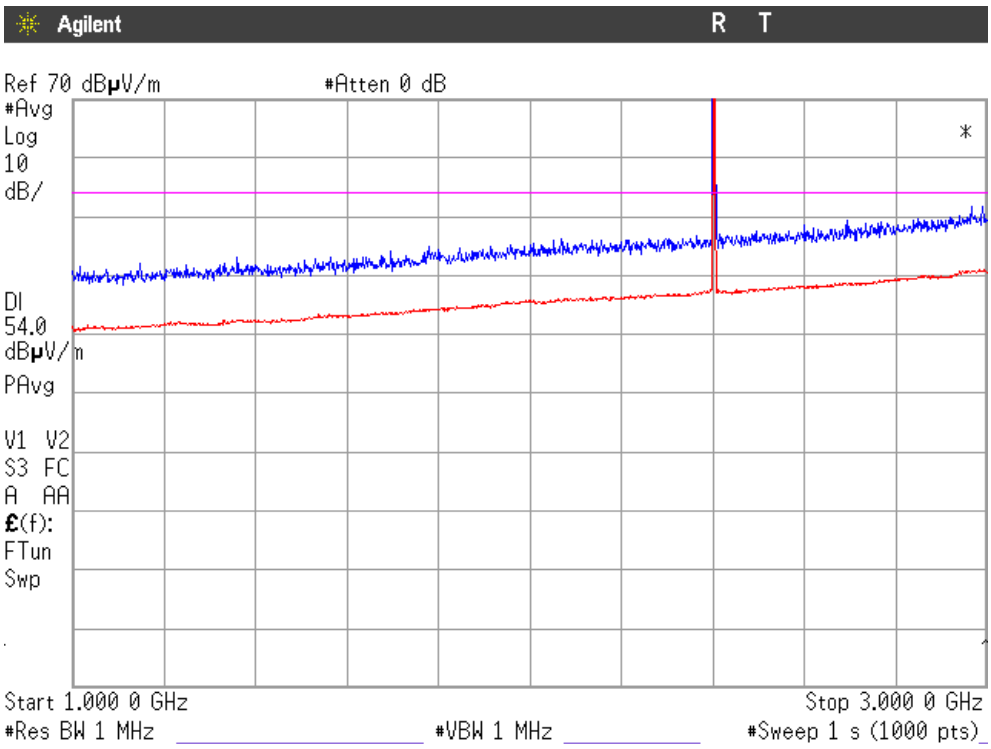
CHANNEL: Highest (2480 MHz).



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

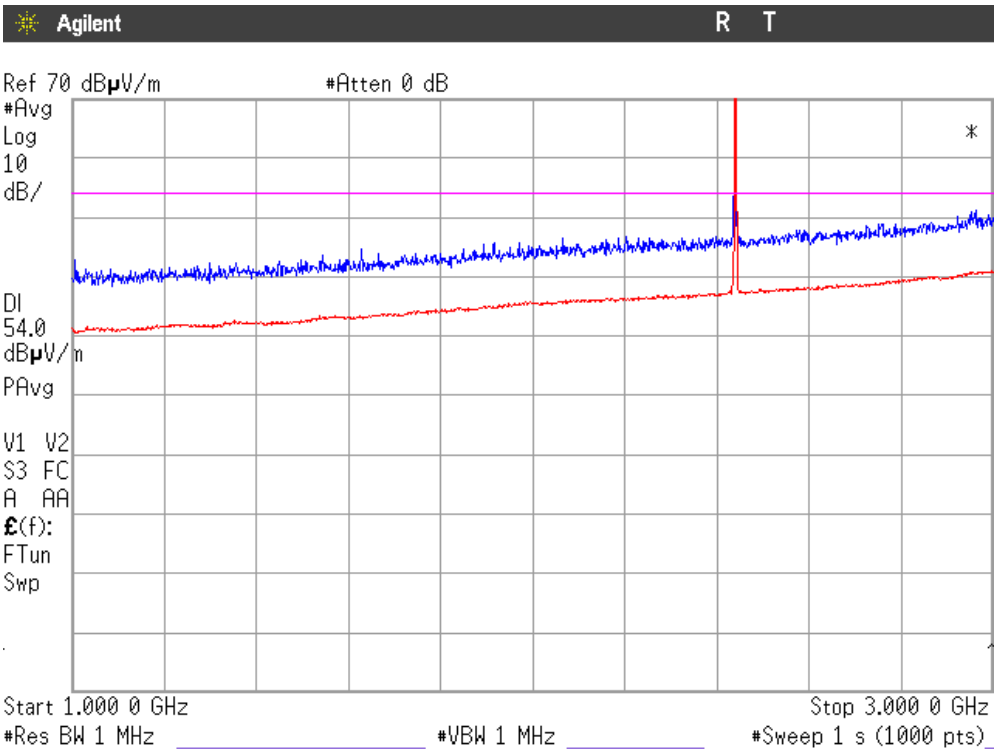
Modulation: 8-DPSK

CHANNEL: Lowest (2402 MHz).



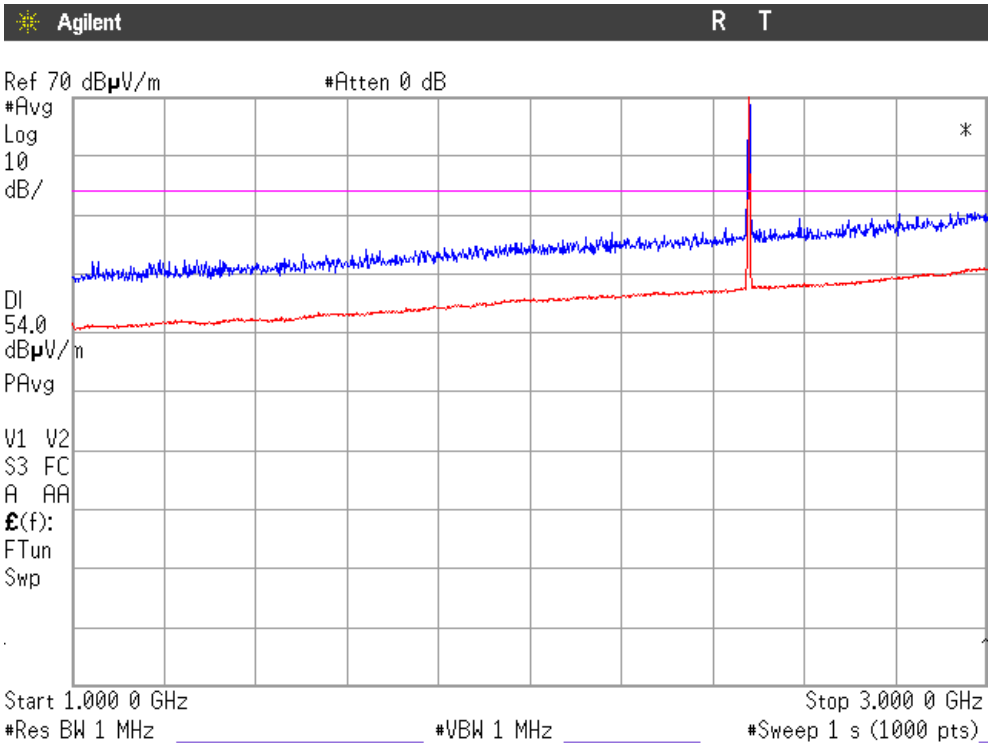
Note: The peak shown in the plot is the carrier frequency.

CHANNEL: Middle (2441 MHz).



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

CHANNEL: Highest (2480 MHz).

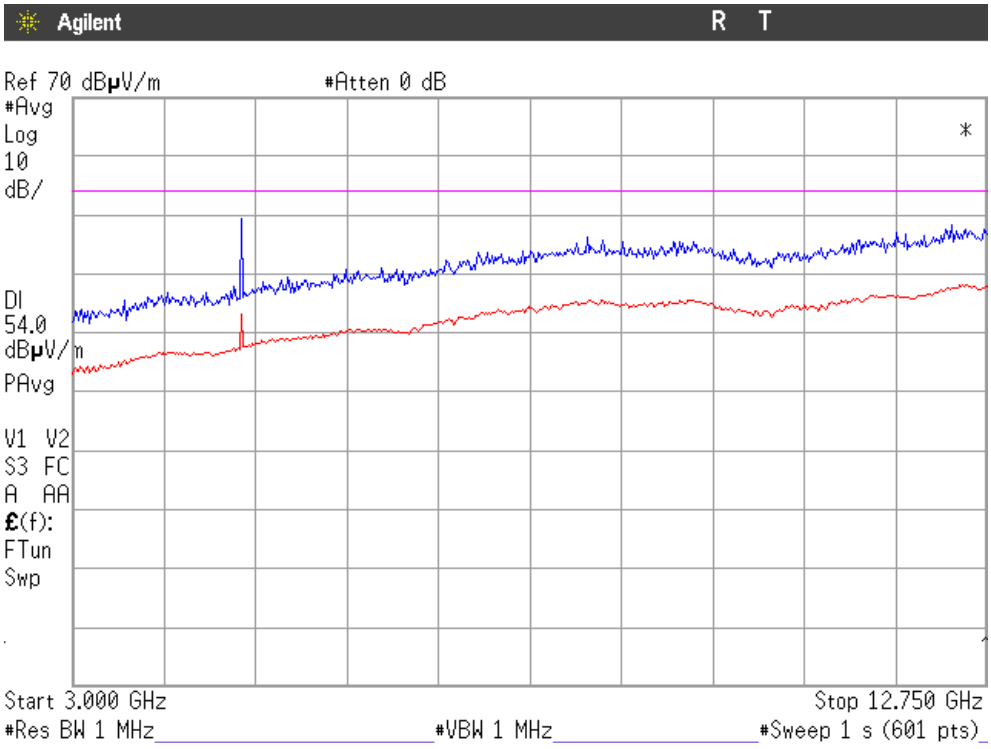


Note: The peak shown in the plot is the carrier frequency.

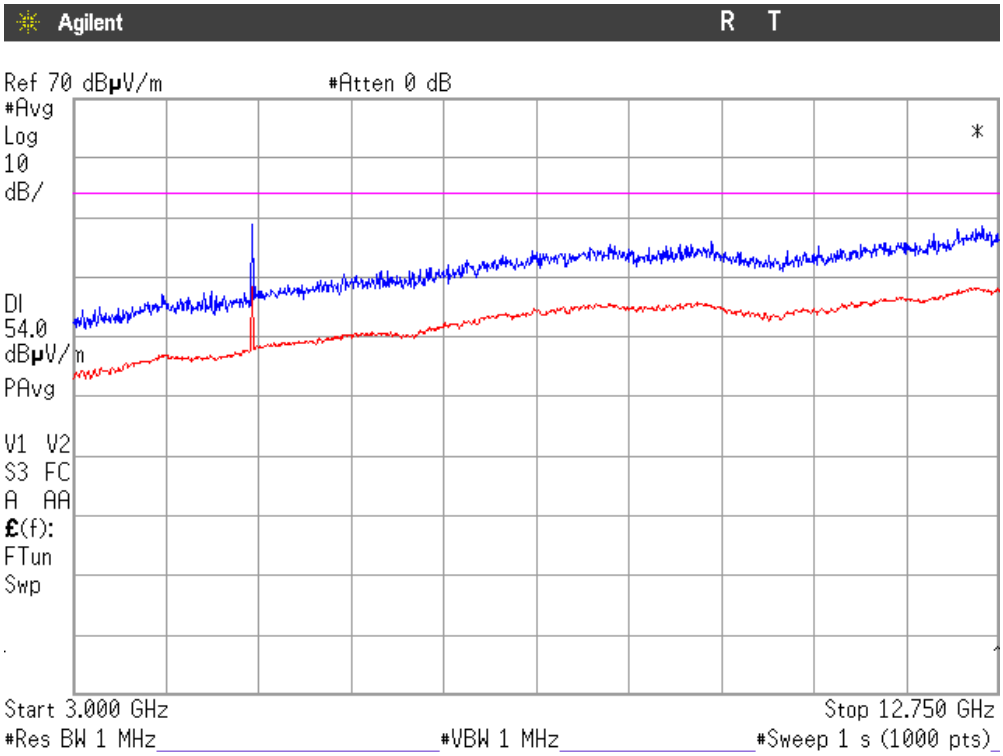
FREQUENCY RANGE 3 GHz to 12.75 GHz.

Modulation: GFSK

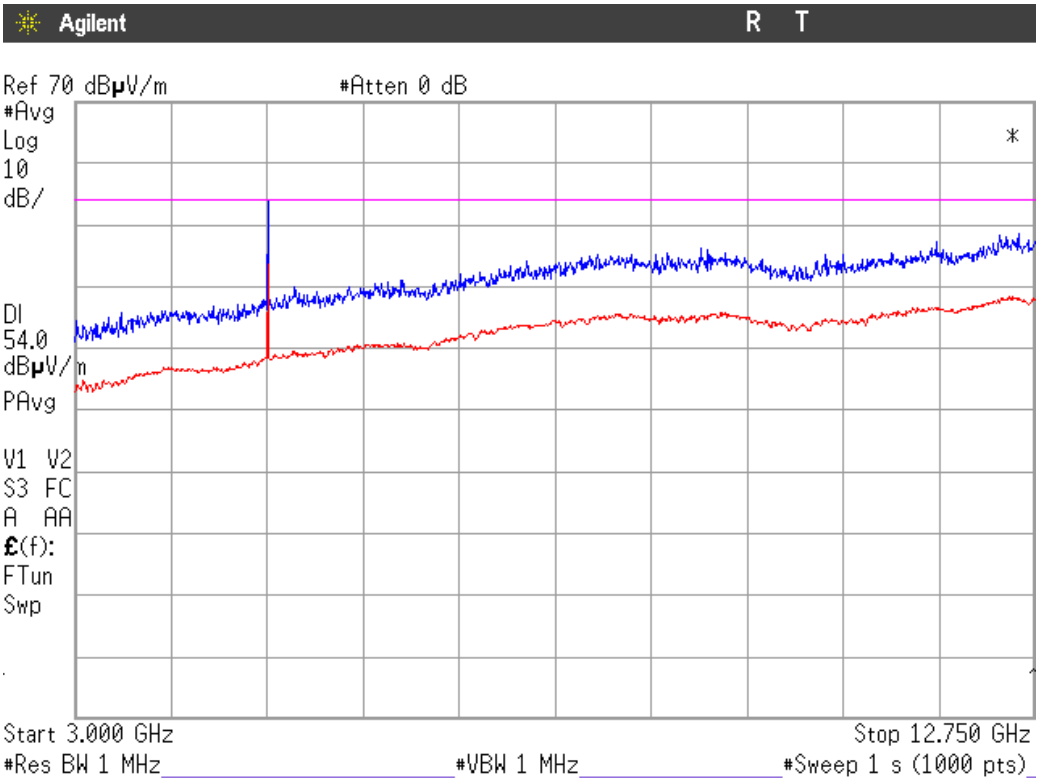
CHANNEL: Lowest (2402 MHz).



CHANNEL: Middle (2441 MHz).

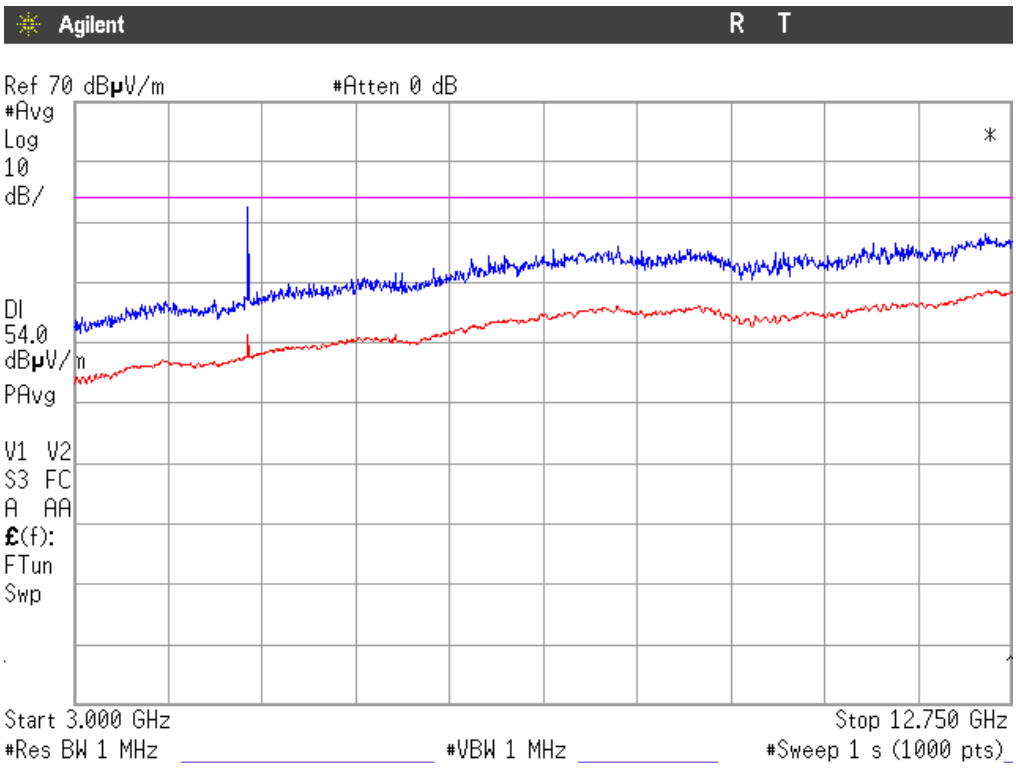


CHANNEL: Highest (2480 MHz).

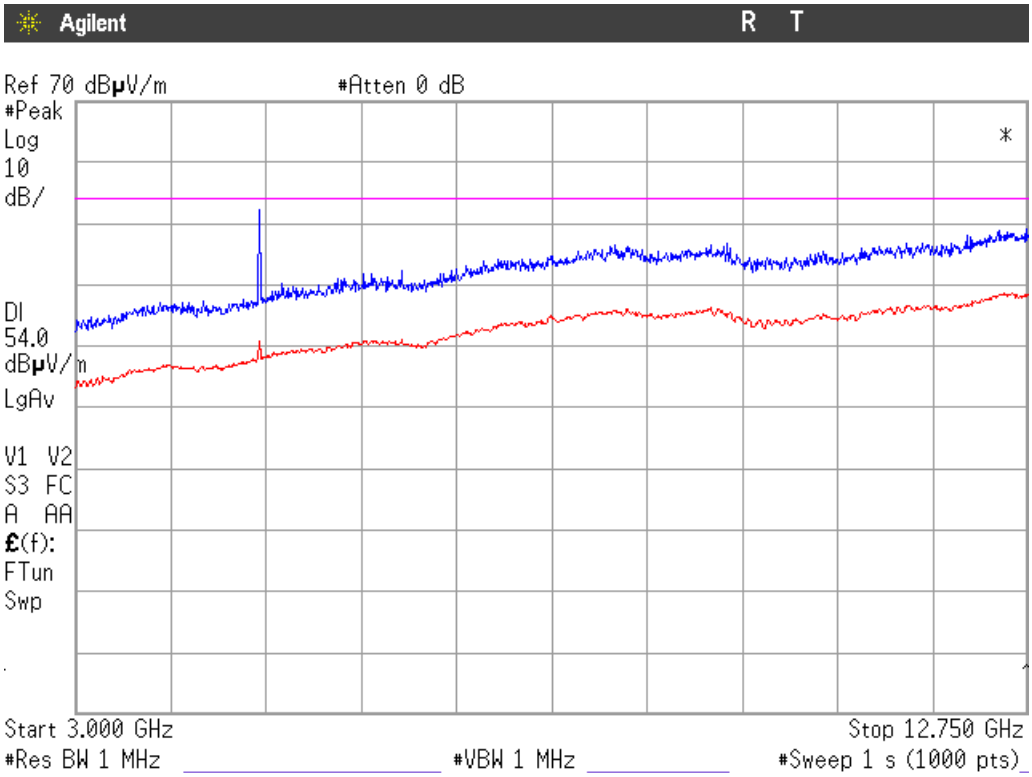


Modulation: Π/4-DQPSK

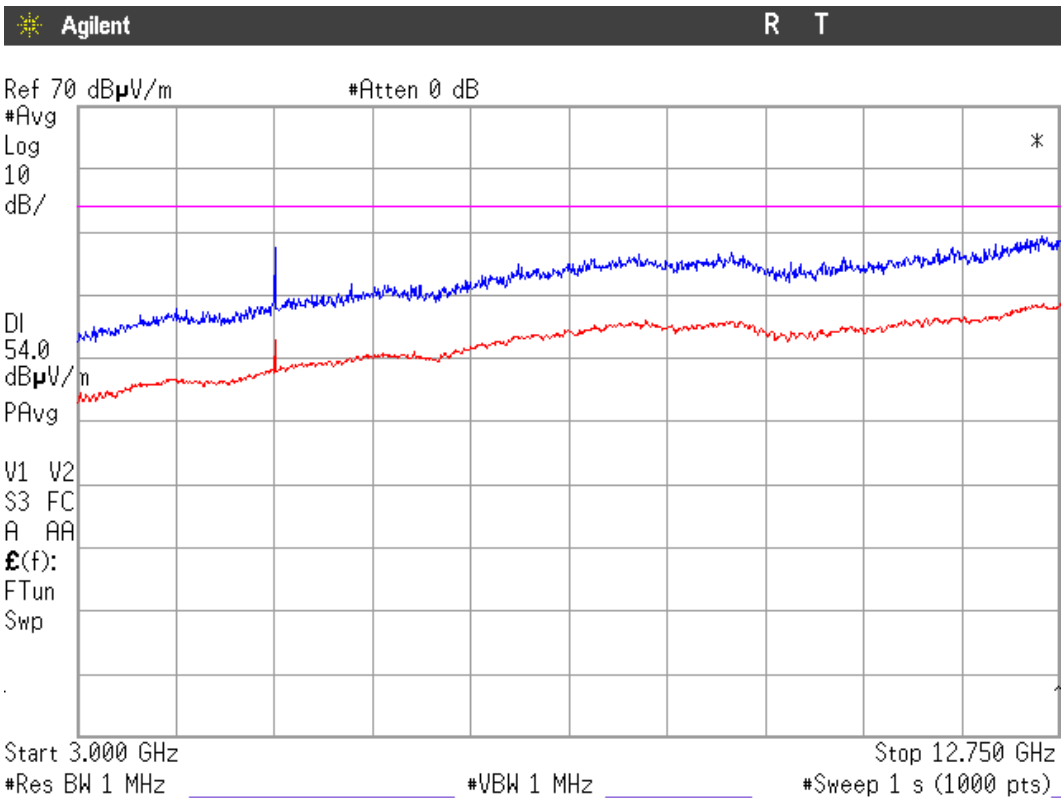
CHANNEL: Lowest (2402 MHz).



CHANNEL: Middle (2441 MHz).

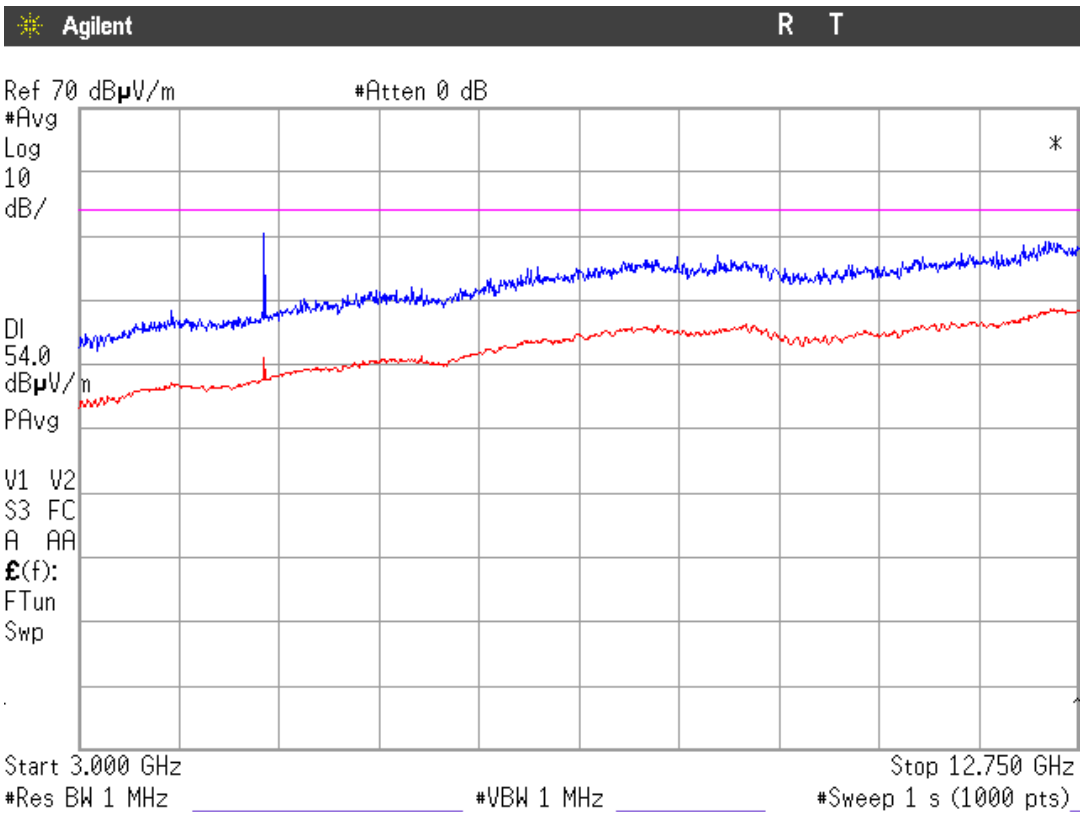


CHANNEL: Highest (2480 MHz).

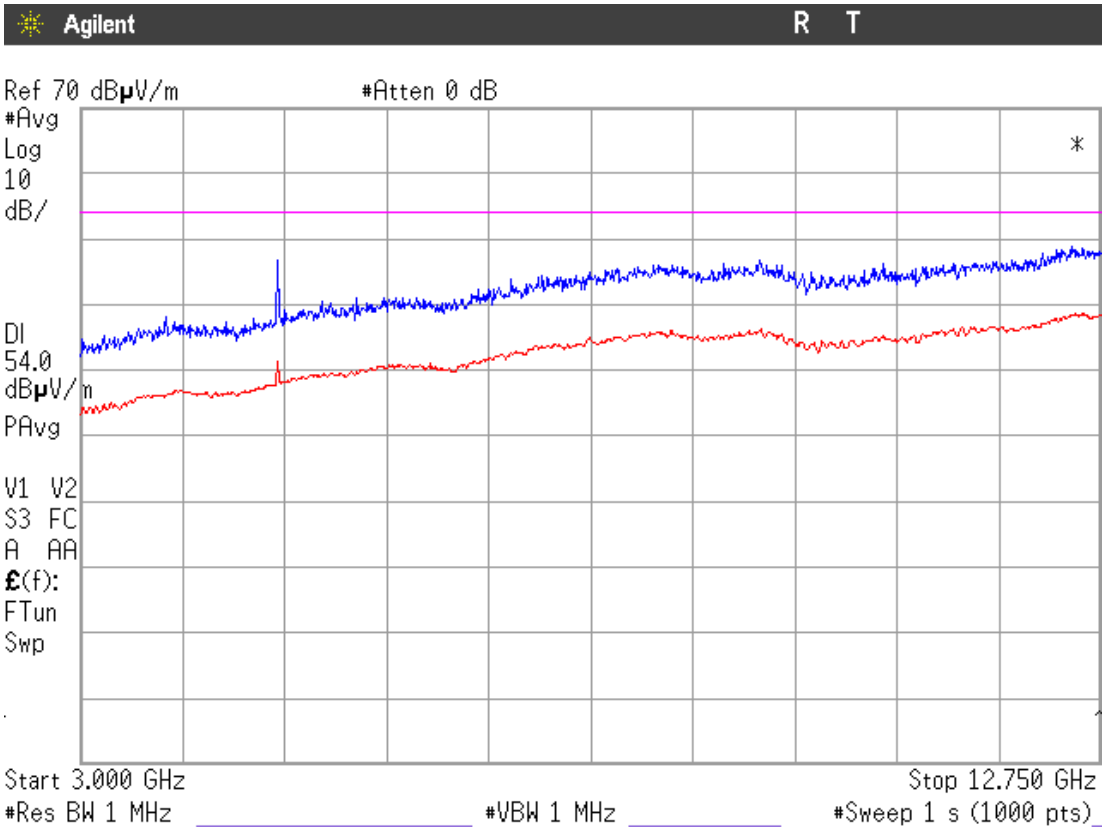


Modulation: 8-DPSK

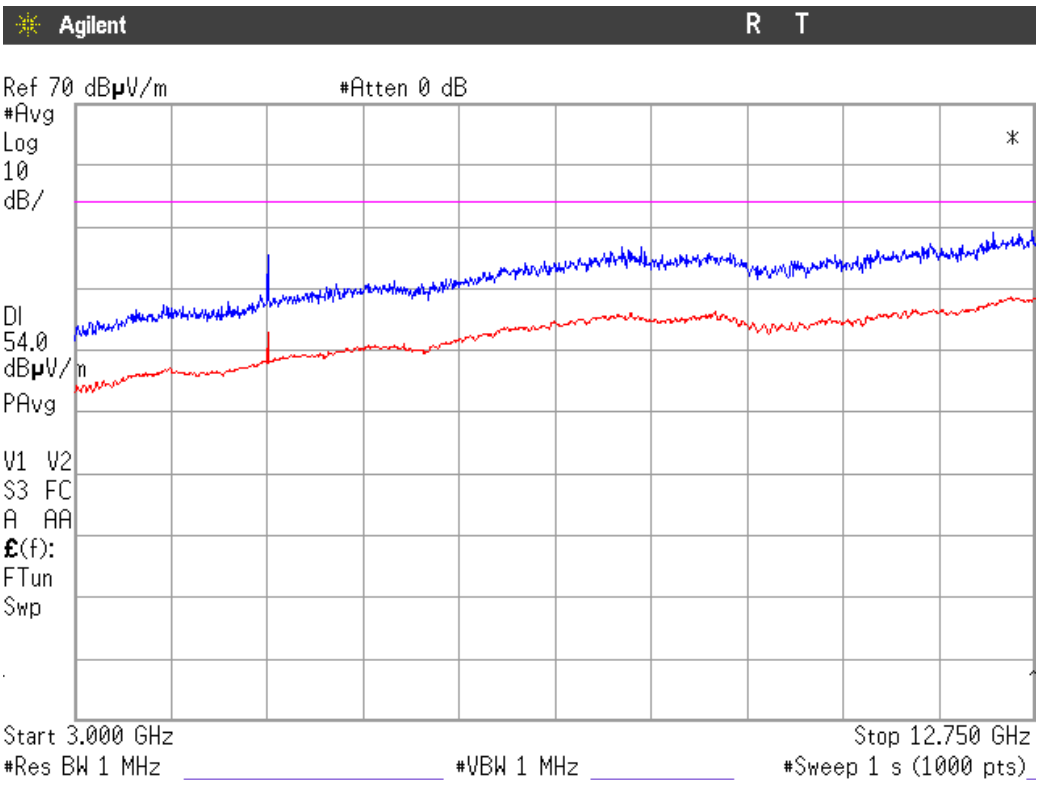
CHANNEL: Lowest (2402 MHz).



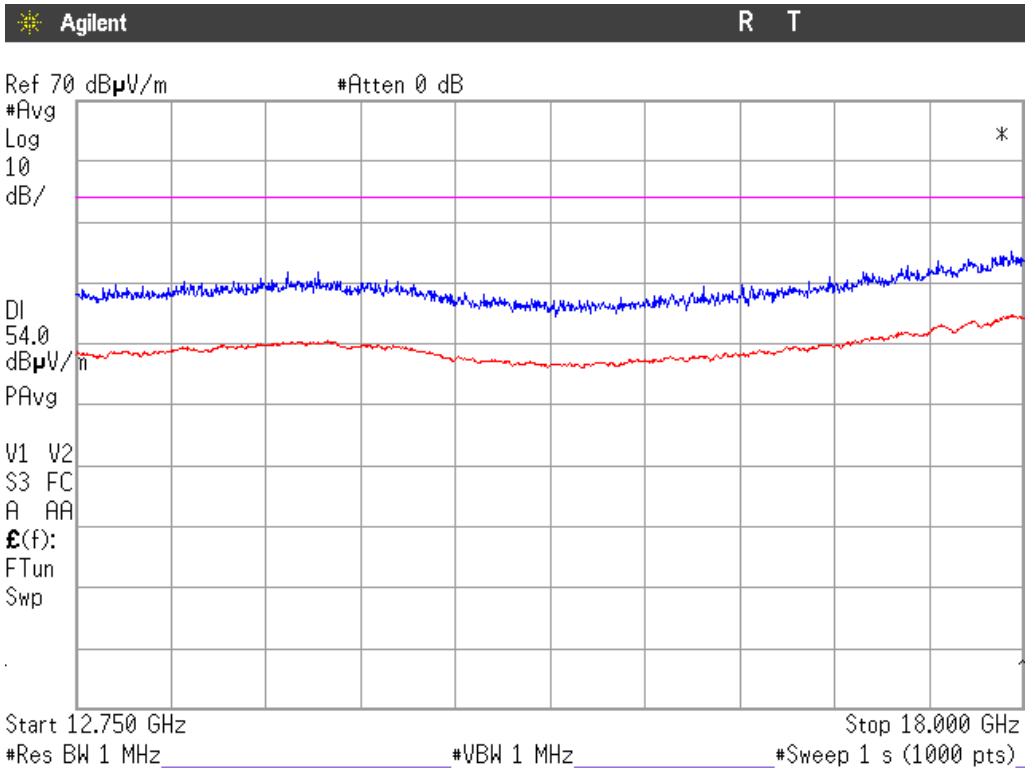
CHANNEL: Middle (2441 MHz).



CHANNEL: Highest (2480 MHz).

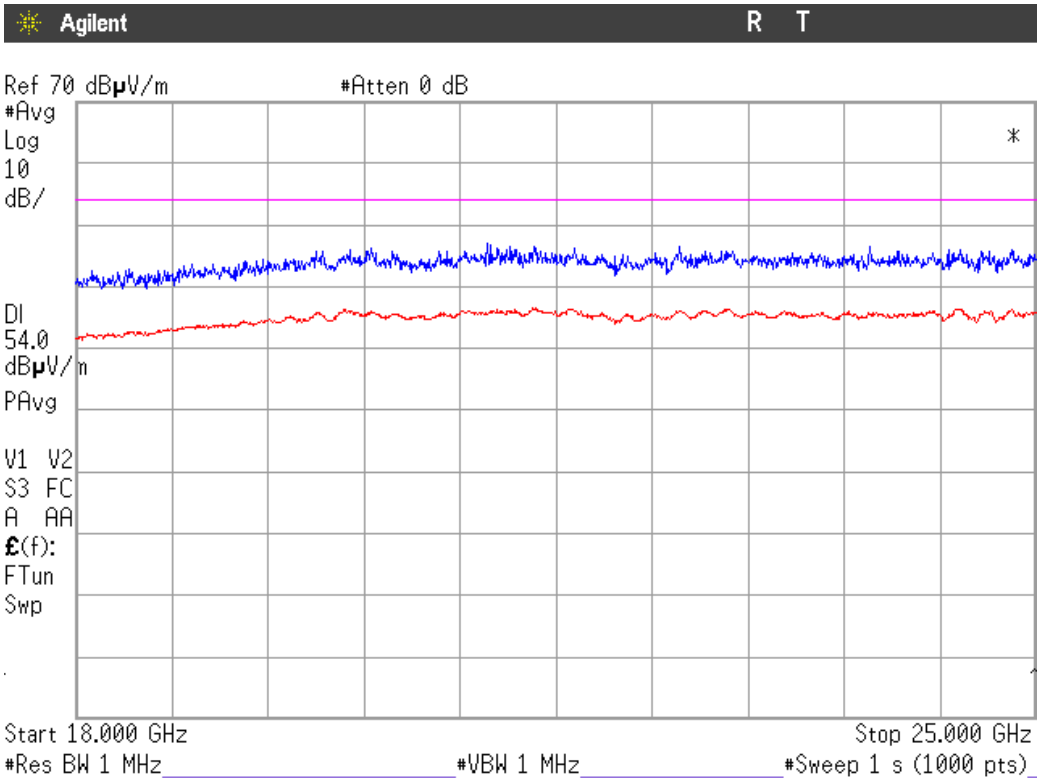


FREQUENCY RANGE 12.75 GHz to 18 GHz.



(This plot is valid for all three channels and all modulation modes).

FREQUENCY RANGE 18 GHz to 25 GHz.

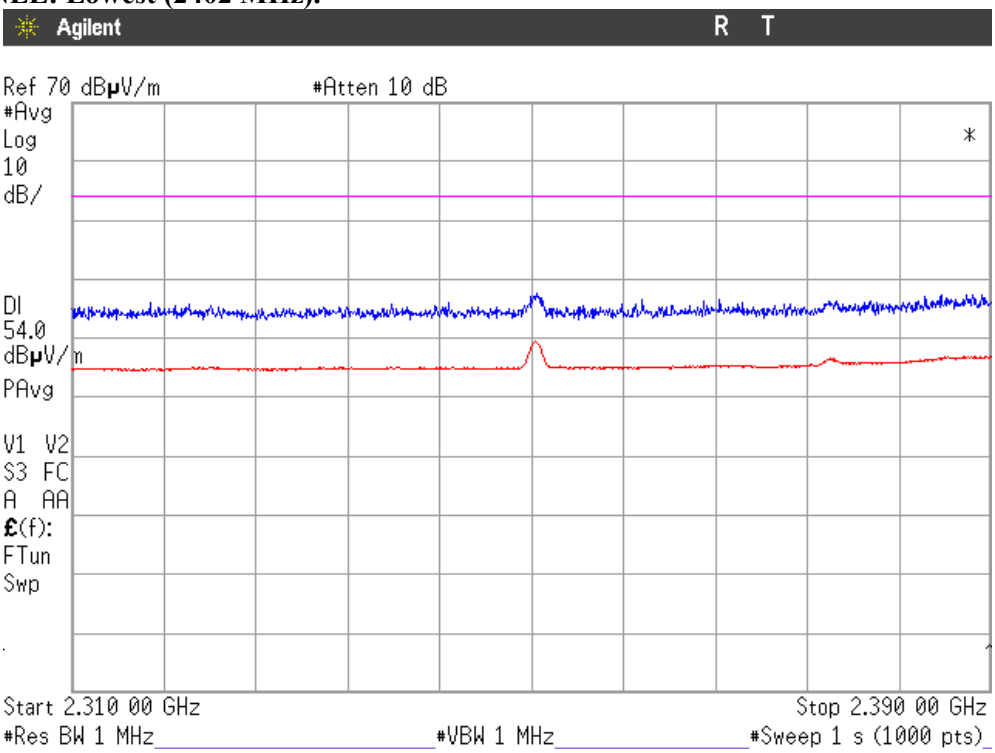


(This plot is valid for all three channels and all modulation modes).

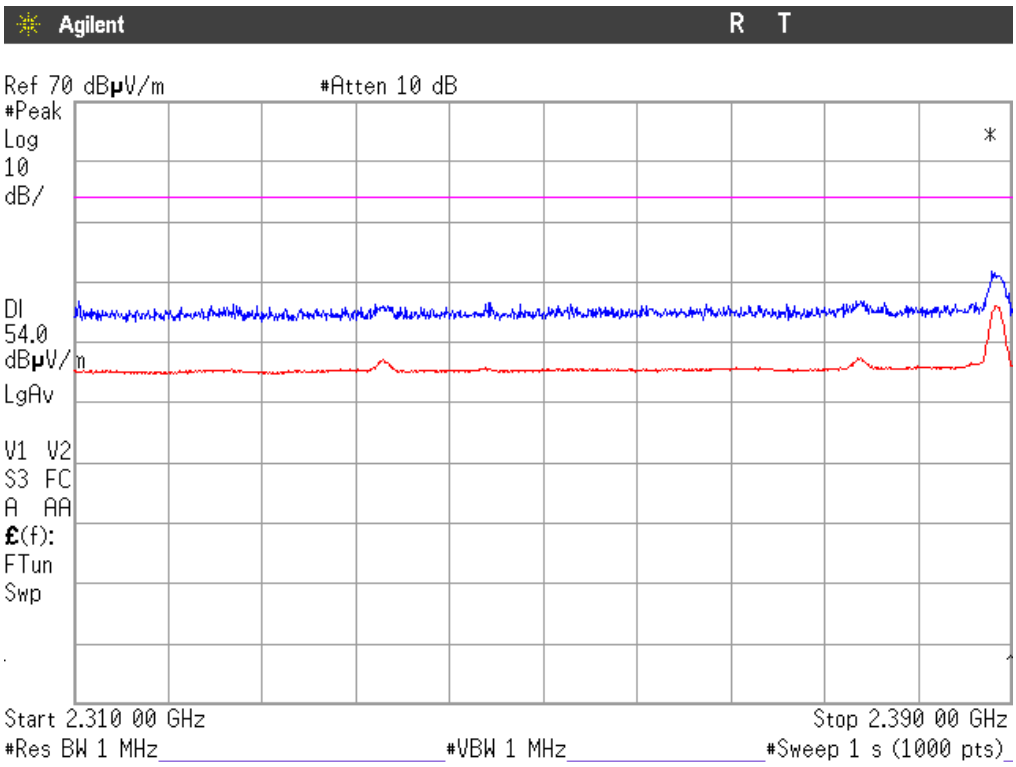
FREQUENCY RANGE 2.31 GHz to 2.39 GHz. (RESTRICTED BAND)

Modulation: GFSK

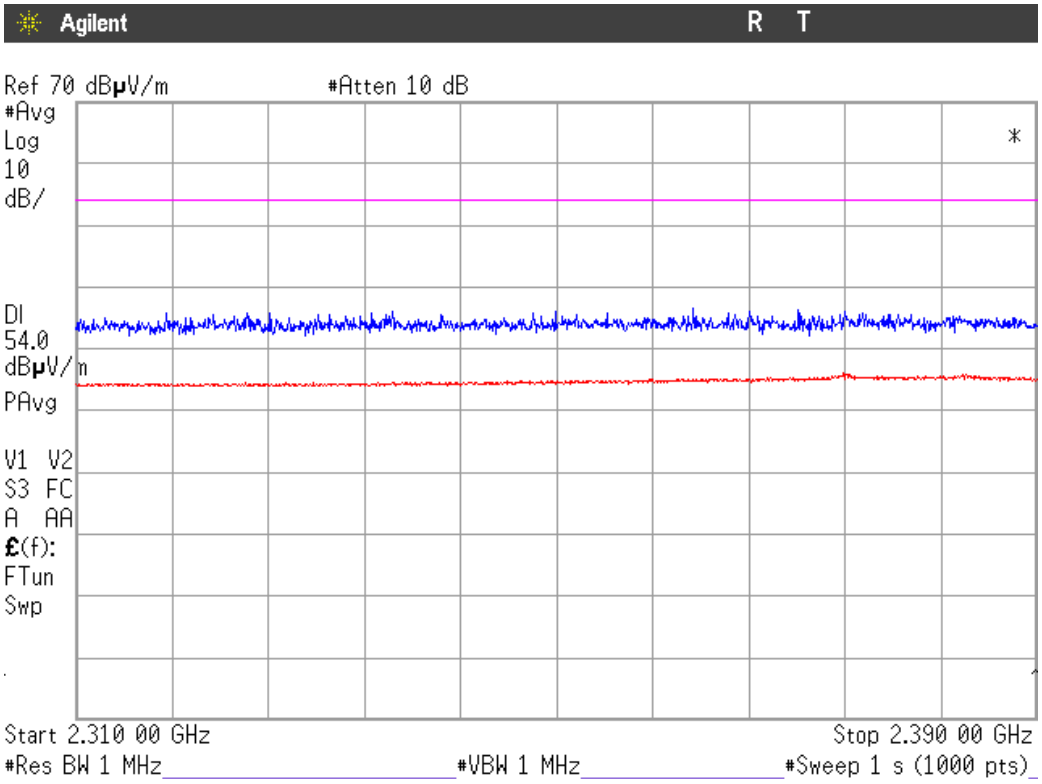
CHANNEL: Lowest (2402 MHz).



CHANNEL: Middle (2441 MHz).

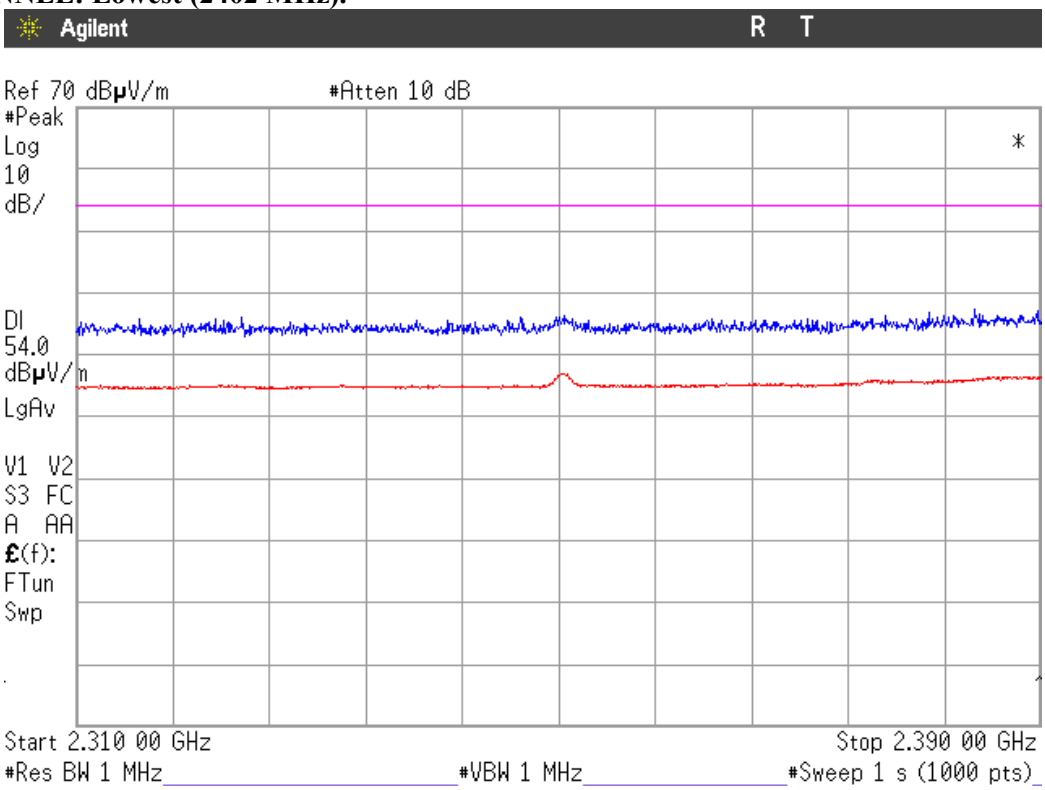


CHANNEL: Highest (2480 MHz).

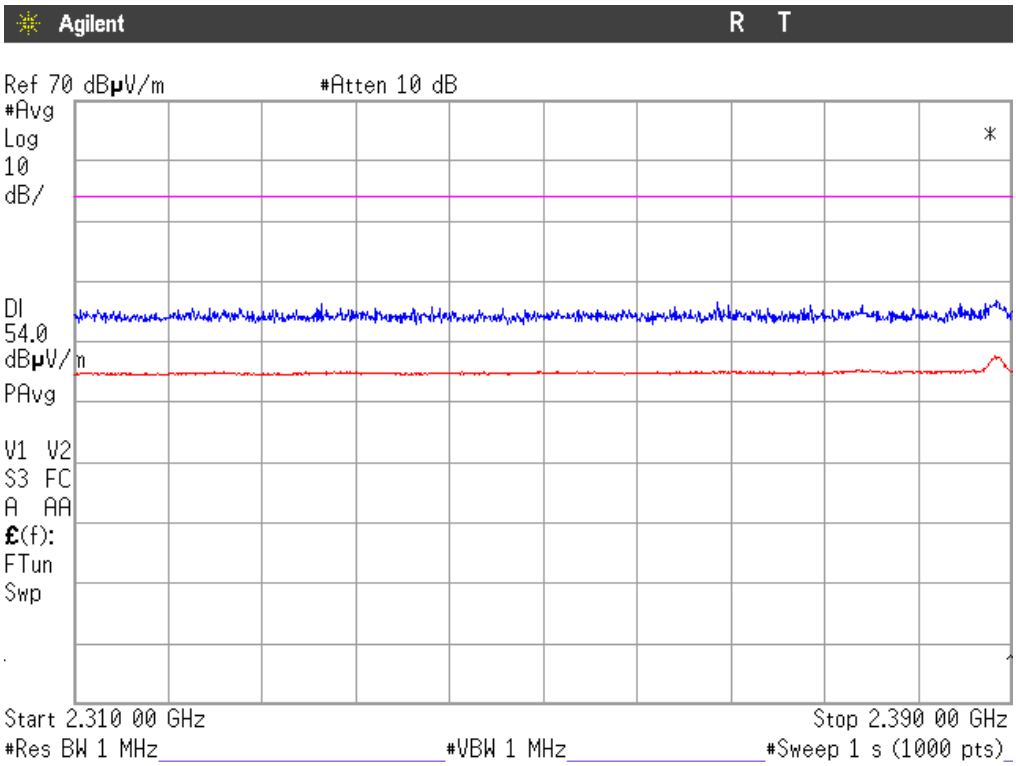


Modulation: Π/4-DQPSK

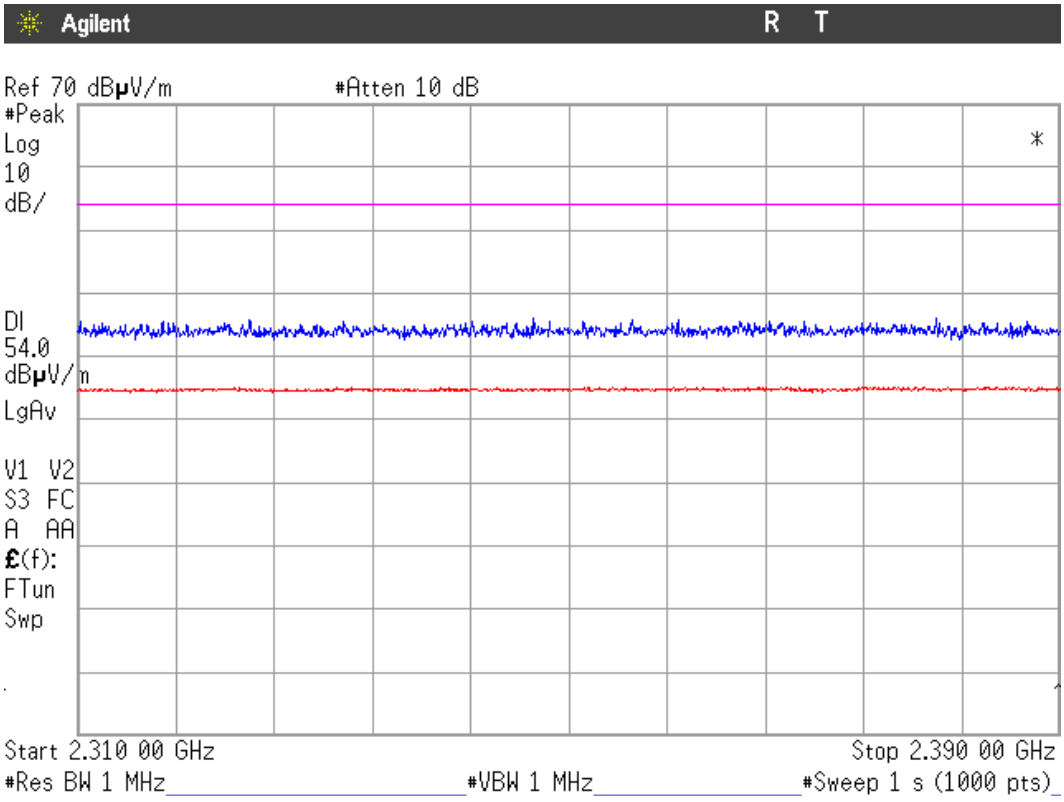
CHANNEL: Lowest (2402 MHz).



CHANNEL: Middle (2441 MHz).

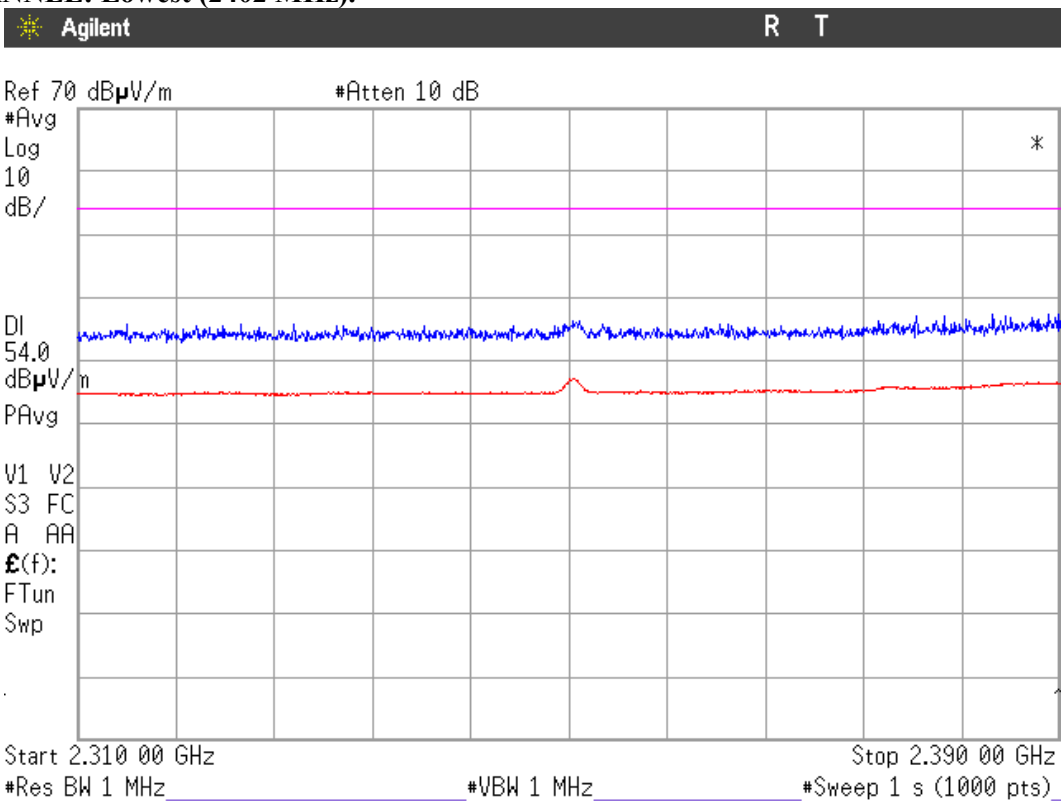


CHANNEL: Highest (2480 MHz).

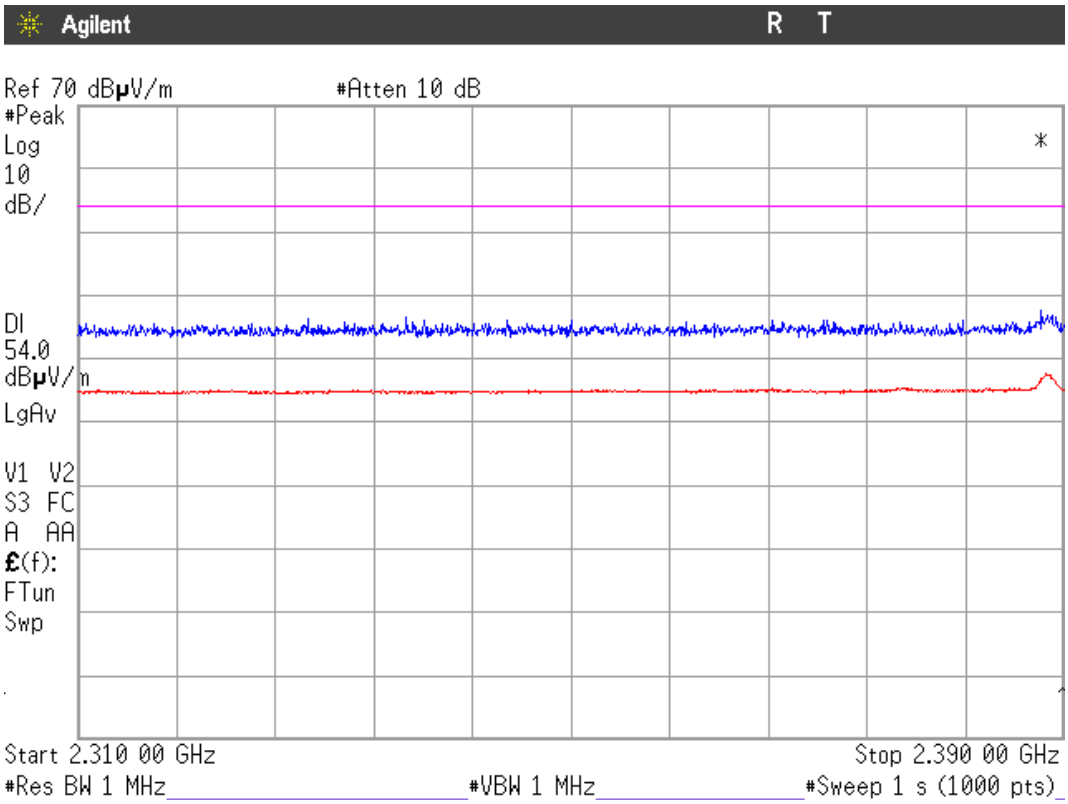


Modulation: 8-DPSK

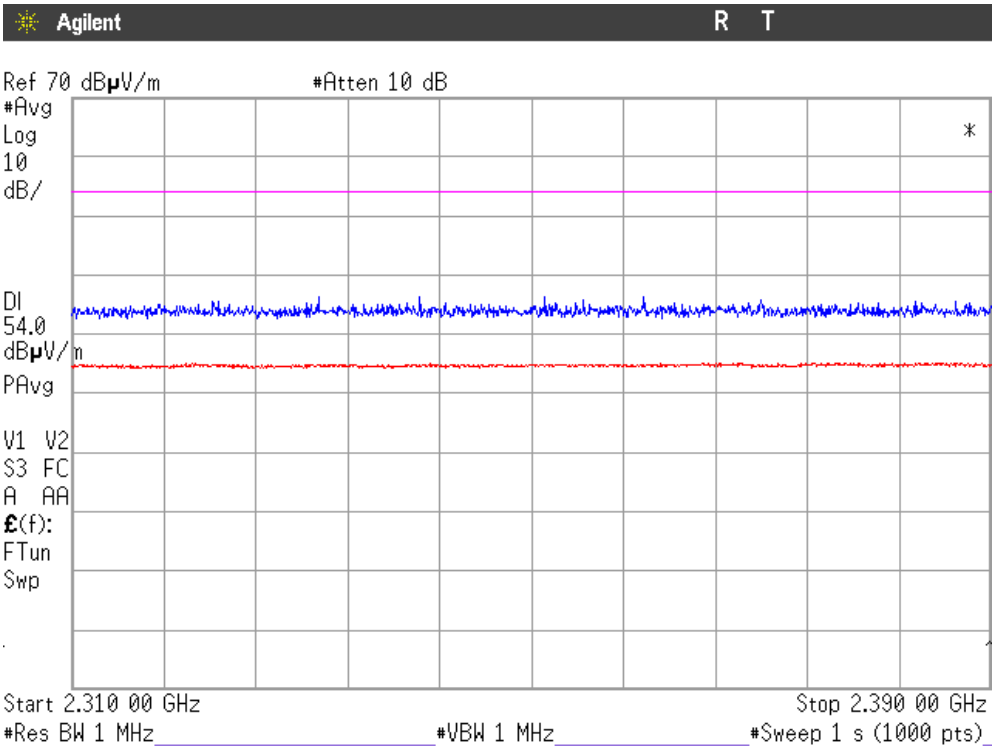
CHANNEL: Lowest (2402 MHz).



CHANNEL: Middle (2441 MHz).



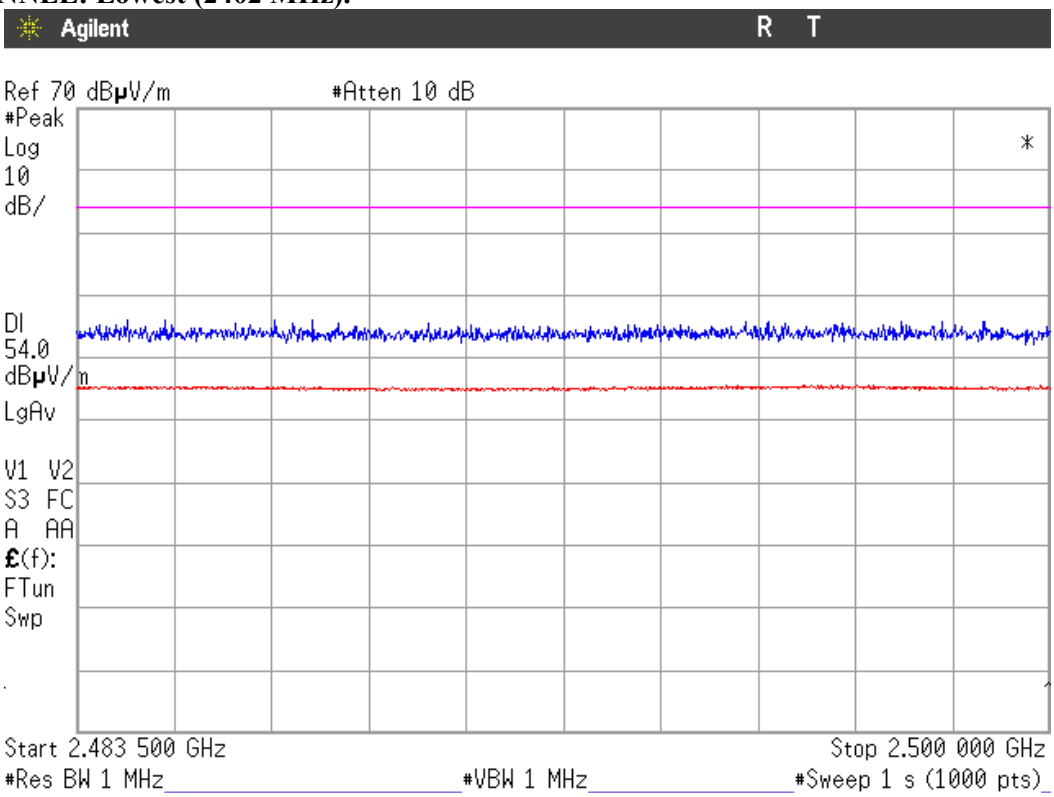
CHANNEL: Highest (2480 MHz).



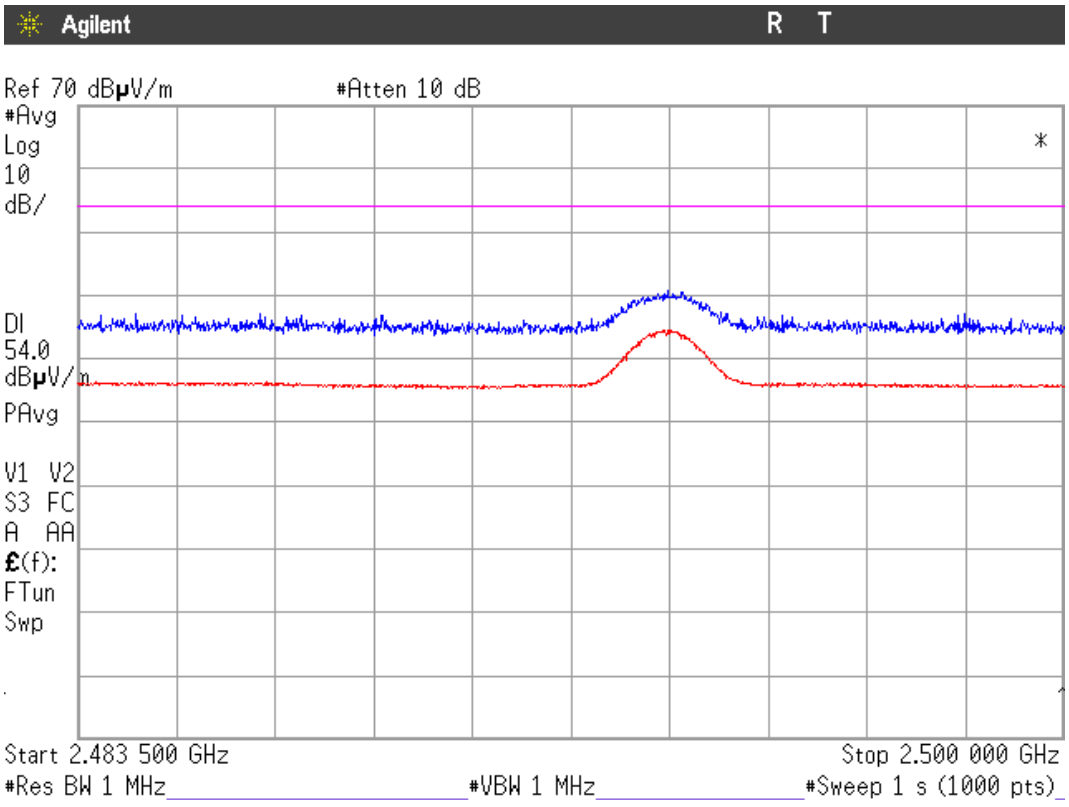
FREQUENCY RANGE 2.4835 GHz to 2.5 GHz. (RESTRICTED BAND)

Modulation: GFSK

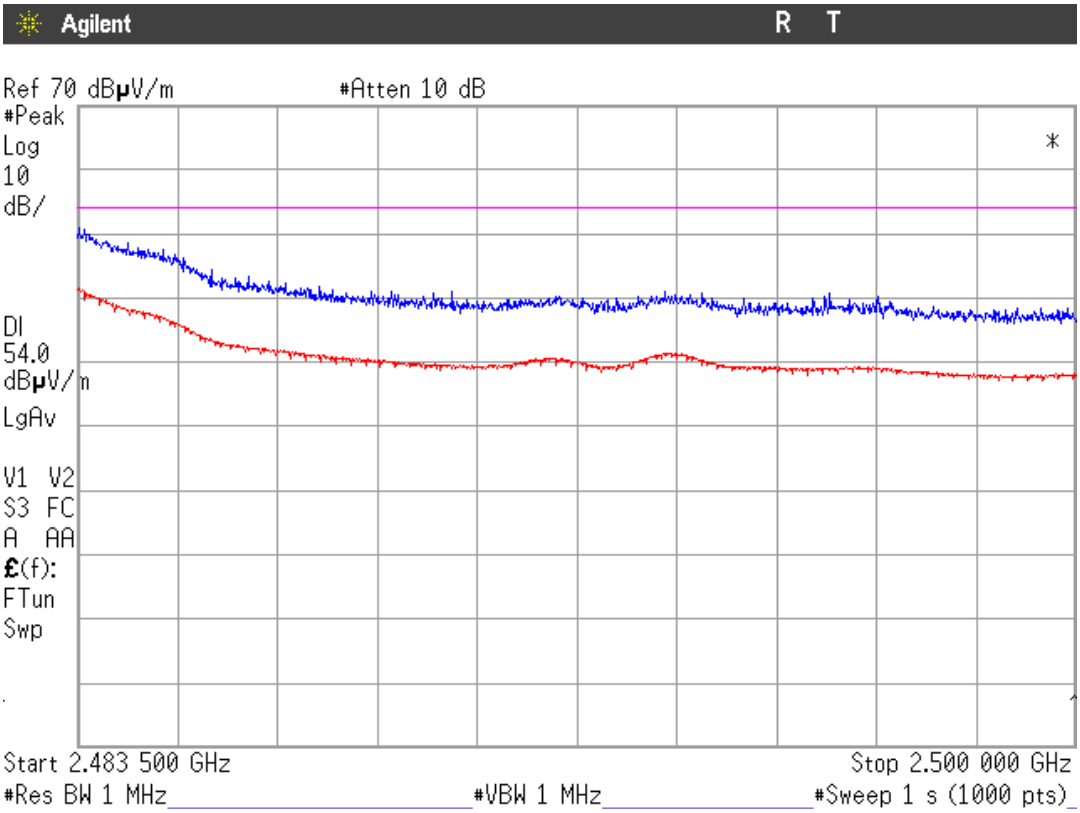
CHANNEL: Lowest (2402 MHz).



CHANNEL: Middle (2441 MHz).

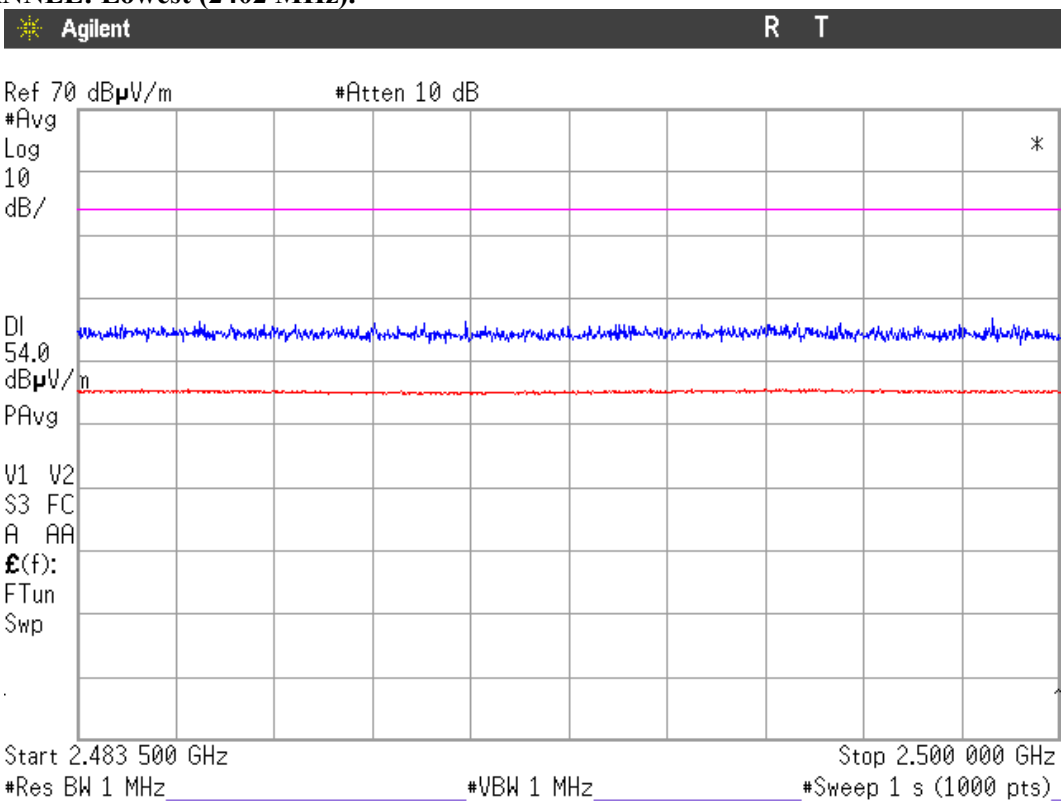


CHANNEL: Highest (2480 MHz).

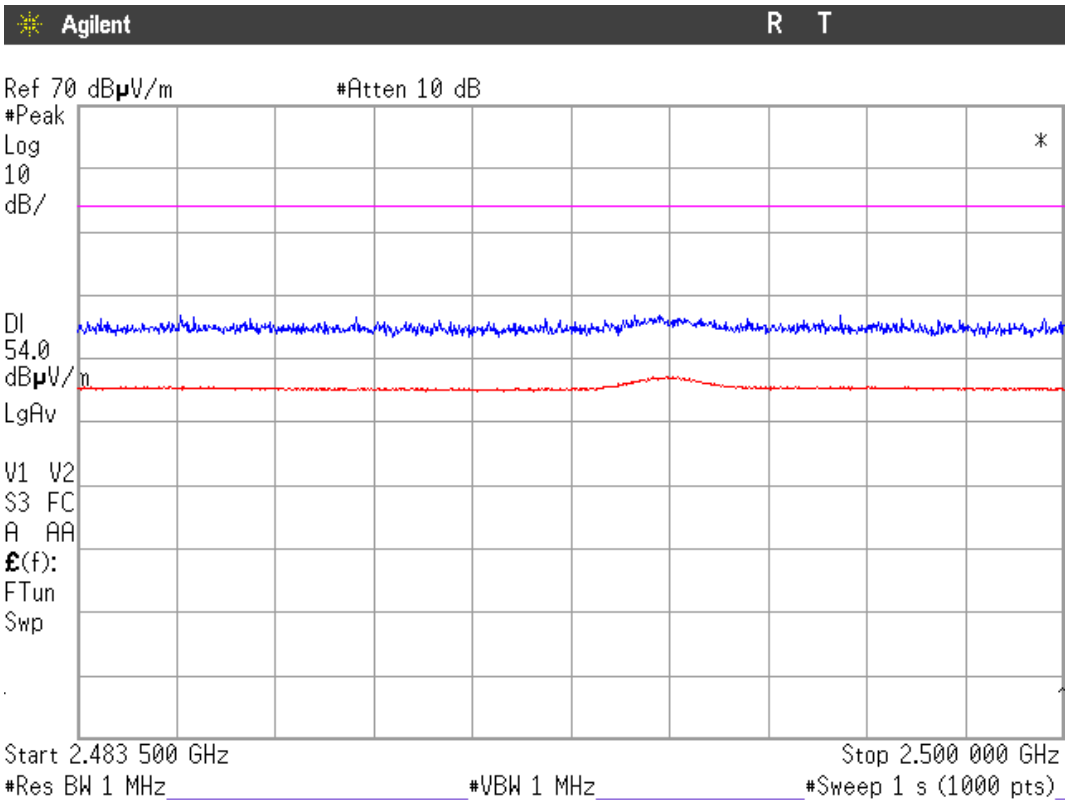


Modulation: Π/4-DQPSK

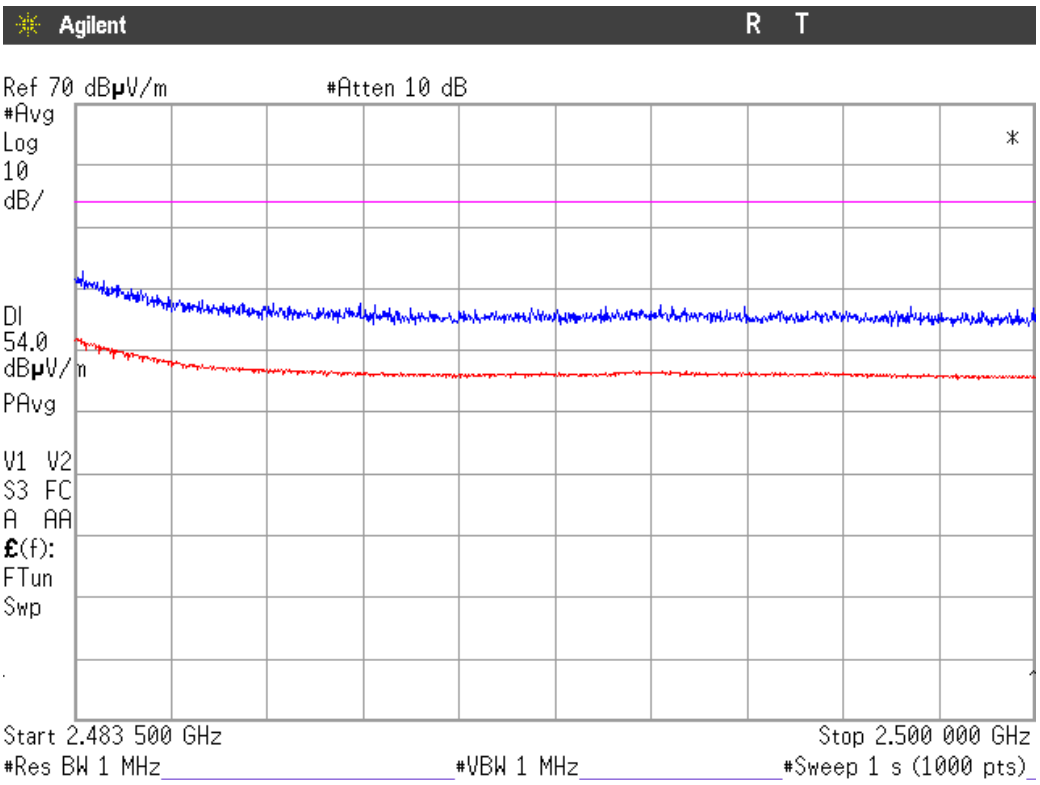
CHANNEL: Lowest (2402 MHz).



CHANNEL: Middle (2441 MHz).

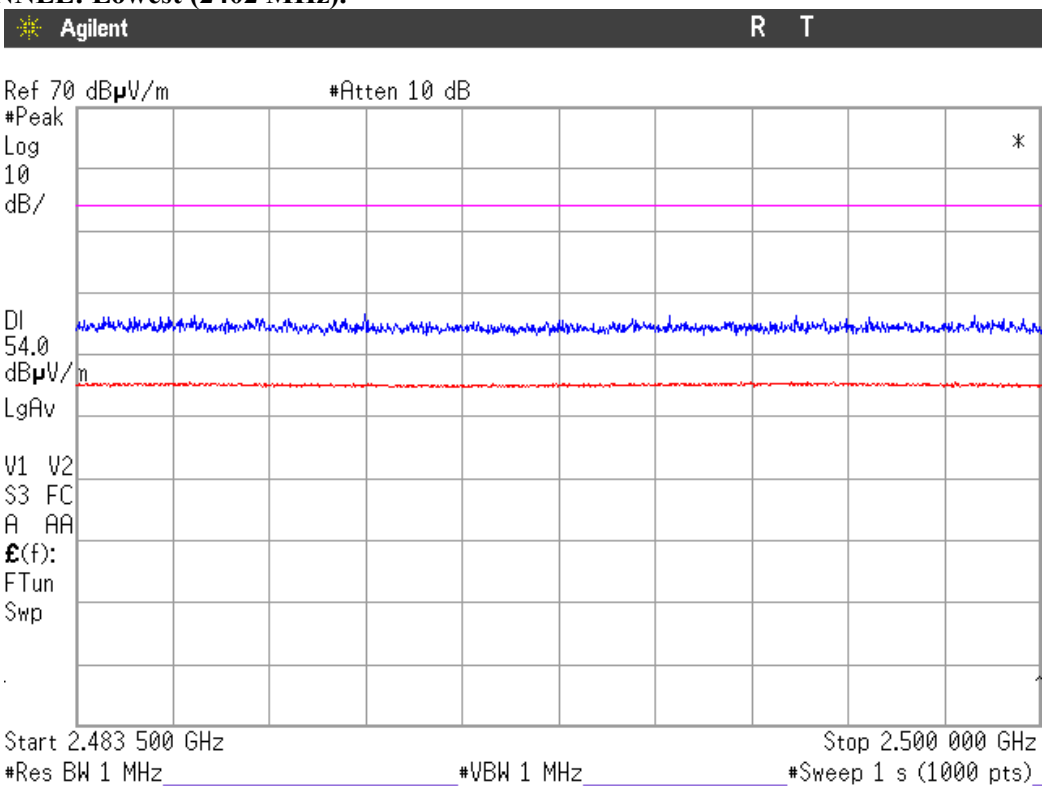


CHANNEL: Highest (2480 MHz).

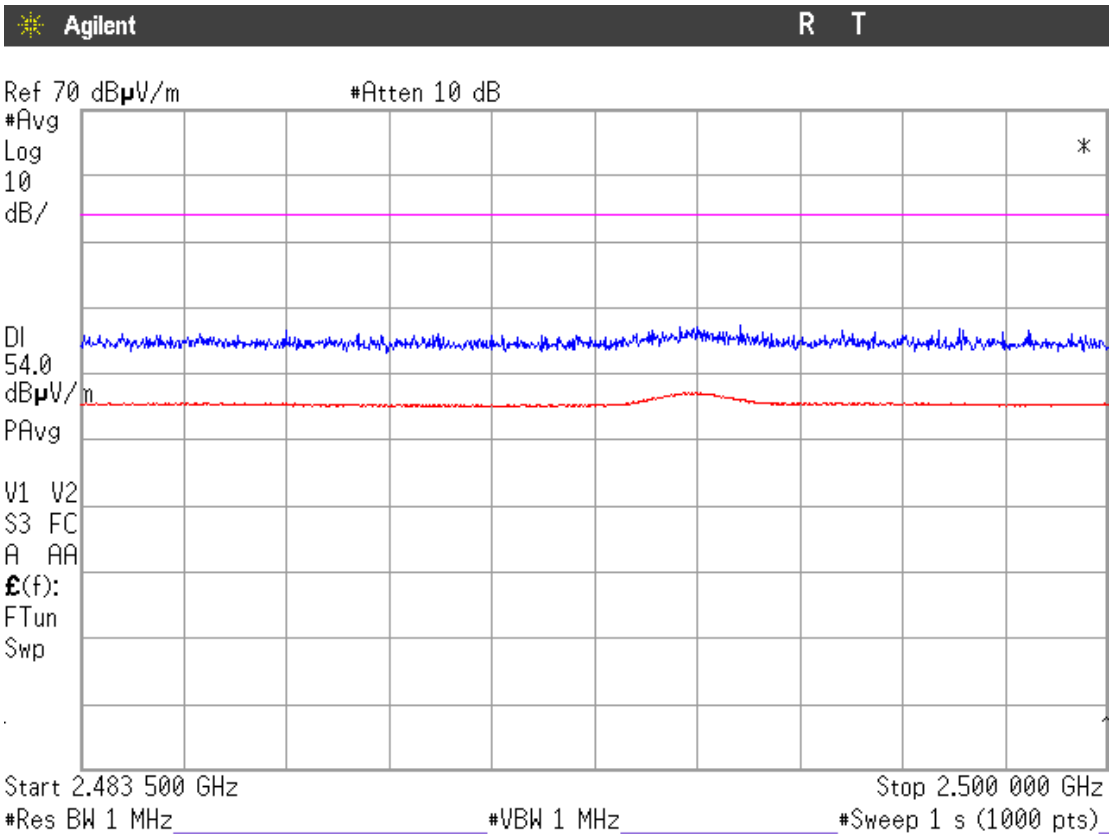


Modulation: 8-DPSK

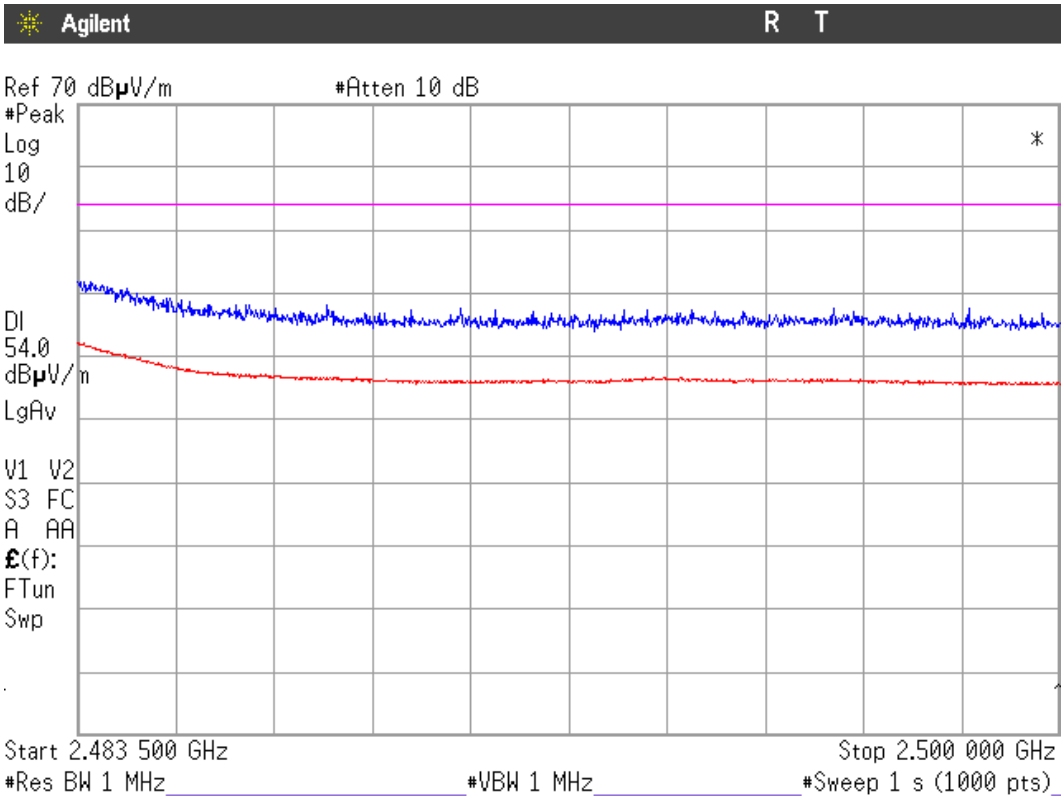
CHANNEL: Lowest (2402 MHz).



CHANNEL: Middle (2441 MHz).



CHANNEL: Highest (2480 MHz).



FCC Section 15.109 / RSS-210 Clause 2.2. 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.

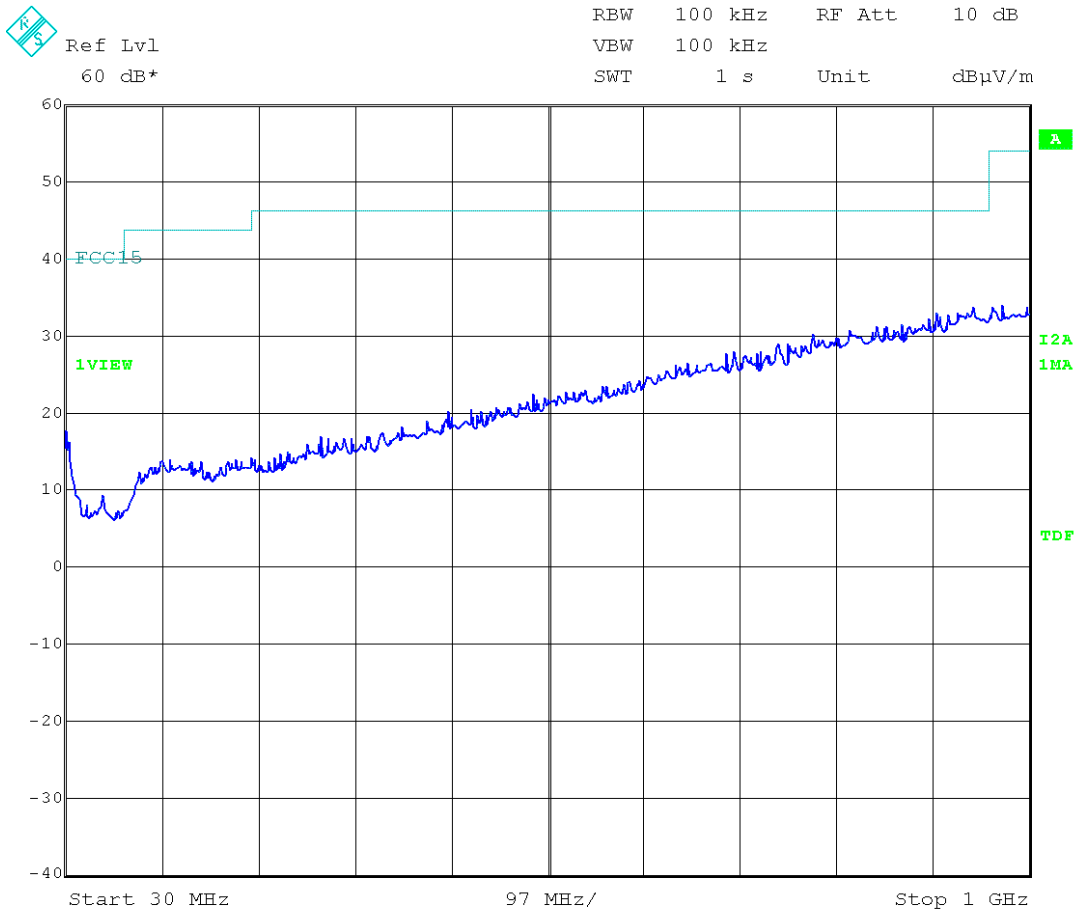
No spurious signals were found in all the range.

Frequency range 1 GHz-25 GHz.

No spurious signals were found in all the range.

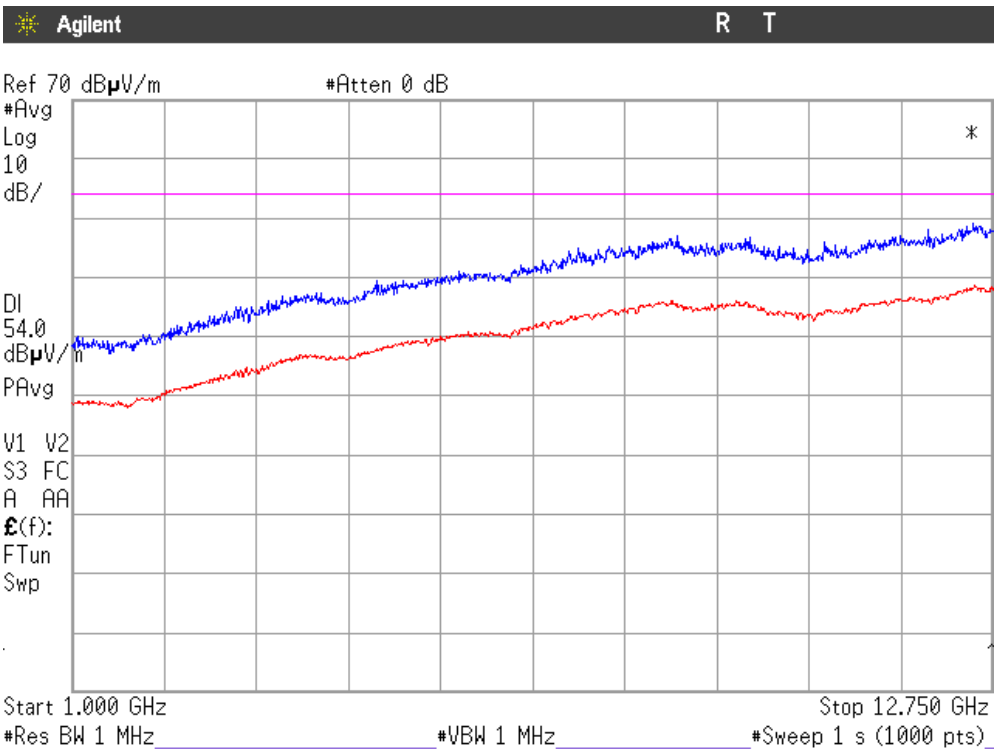
Verdict: PASS.

FREQUENCY RANGE 30 MHz-1000 MHz.



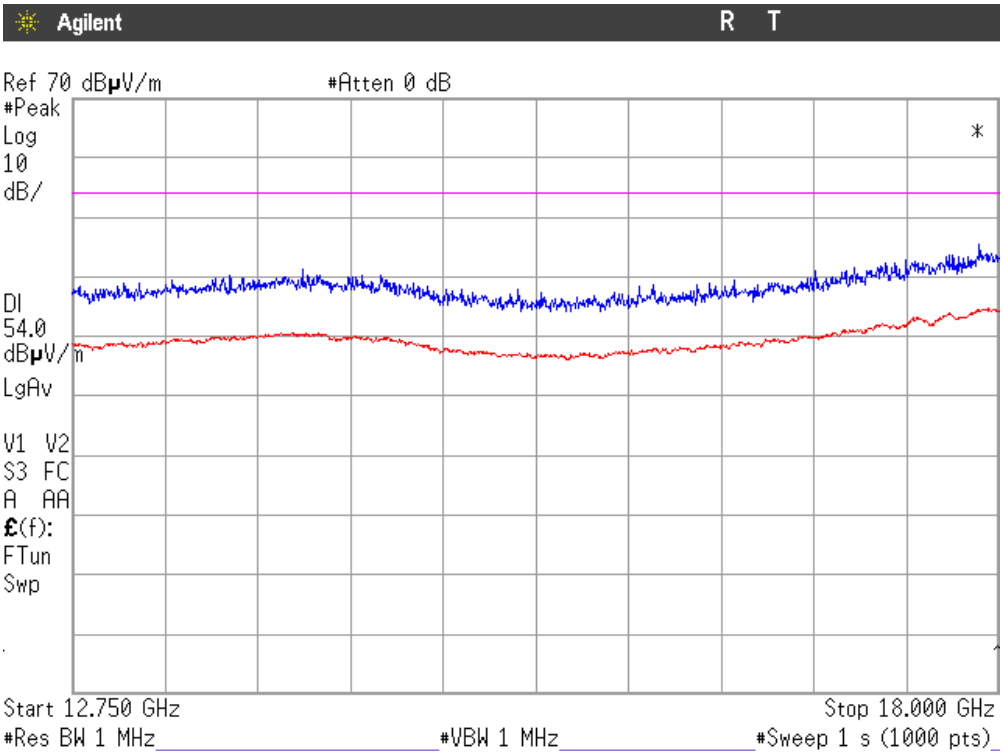
(This plot is valid for all three channels).

FREQUENCY RANGE 1 GHz-12.75 GHz.



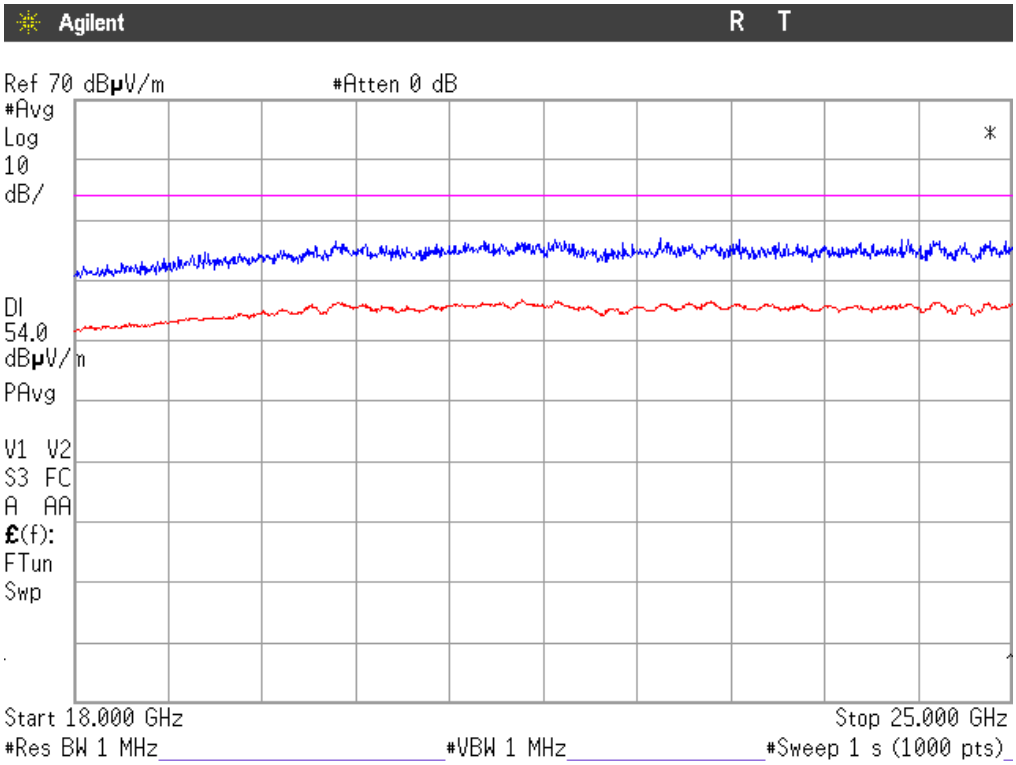
(This plot is valid for all three channels).

FREQUENCY RANGE 12.75 GHz-18 GHz.



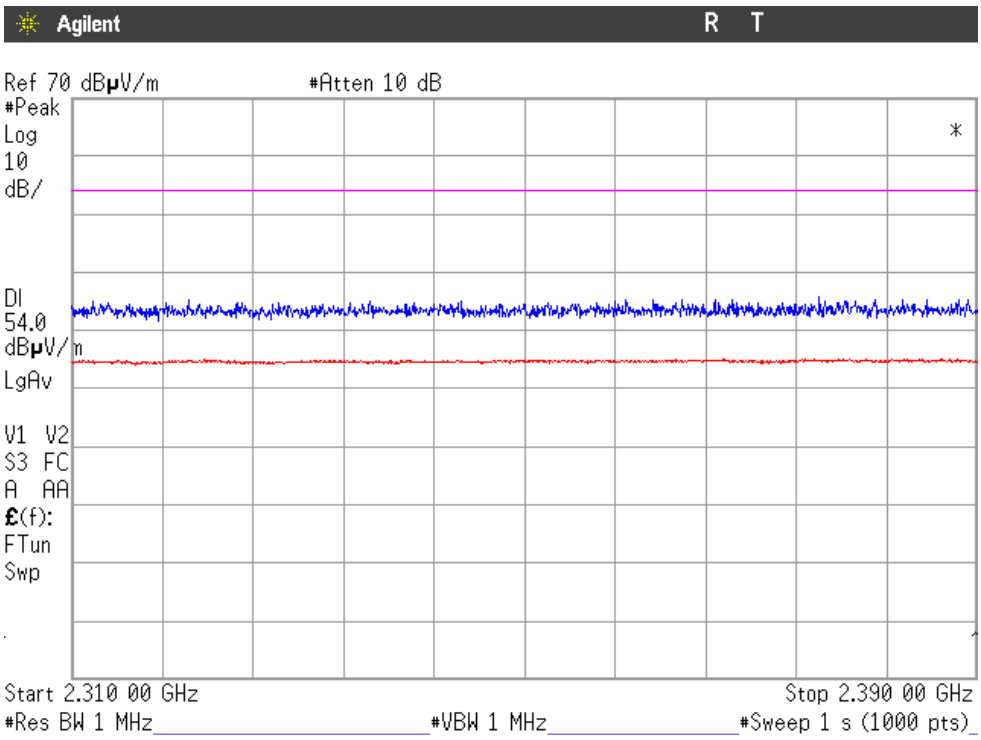
(This plot is valid for all three channels).

FREQUENCY RANGE 18 GHz-25 GHz.



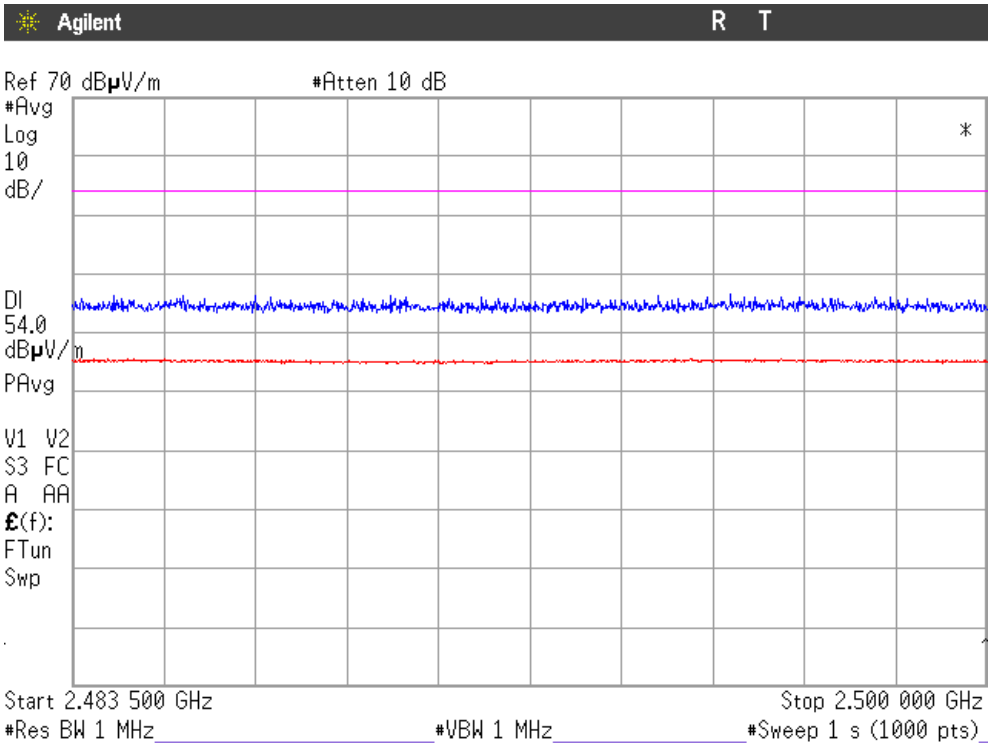
(This plot is valid for all three channels).

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).