

**FCC LISTED, REGISTRATION
NUMBER: 905266**

**IC LISTED REGISTRATION NUMBER
IC 4621**

AT4 wireless, S.A.

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Libro 82, Folio 133, Hoja MA3729

TEST REPORT

REFERENCE STANDARD:

USA FCC Part 15.247 and 15.109 / Canada RSS-210 and RSS-Gen Issue 2

NIE..... : 30747RET.001

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

Elaboration date : 2010-05-18

Identification of item tested : Radio car with Bluetooth handsfree

Trademark : Panasonic

Model and/or type reference : NTG4.5(1CD)

Serial number : 523 PA 1105A0000918 3

Other identification of the product : FCC ID: WUQ-NTG45

IC ID: 216R-NTG45

Features : Bluetooth Specification ver 2.1+EDR

Description : Radio car with a Bluetooth module which is connected to an external antenna
via antenna connector (no internal antenna is present)

Applicant : Panasonic Automotive Systems Europe GmbH

Address..... : Street Robert-Bosch-Str. 27-29, Langen 63225, Germany

CIF/NIF/Passport..... : DE813890706

Contact person: Mr. Dai Kimura

Telephone / Fax..... : +49 711 79723476 / +49 71179723488

e-mail: : kimura.dai@jp.panasonic.com

Test samples supplier : Same as applicant

Manufacturer : Same as applicant

Test method requested	See Standard					
Standard	<p>USA FCC Part 15.247 10-01-09 Edition: Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz.</p> <p>FCC part 15.247 and Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum System DA 00-705 Released March 30, 2000.</p> <p>USA FCC Part 15.109 10-01-09 Edition: Receiver radiated emission.</p> <p>Canada RSS-210 Issue 7, June 2007: Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment.</p> <p>RSS-Gen Issue 2, June 2007: General Requirements and Information for the Certification of Radiocommunication Equipment.</p>					
Test procedure	PEET034: Medidas radioeléctricas a equipos de radio de espectro ensanchado en la banda de 2,4 GHz.					
Non-standardized test method	N/A					
Used instrumentation	<u>Conducted Measurements</u>					
				Last Cal. date	Cal. due date	
1.	Spectrum analyser	Agilent	PSA E4440A	2010/02	2012/02	
2.	Bluetooth test set	Anritsu	MT8852A	N.A.	N.A.	
3.	DC power supply	R&S	NGPE 40/40	2008/11	2011/11	
	<u>Radiated Measurements</u>					
				Last Cal. date	Cal. due date	
1.	Semianechoic Absorber Lined Chamber		IR 11. BS	N.A.	N.A.	
2.	Control Chamber		IR 12.BC	N.A.	N.A.	
3.	Hybrid Bilog antenna	Sunol Sciences Corporation	JB6	2008/10	2011/10	
4.	Antenna mast		EM 1072 NMT	N.A.	N.A.	
5.	Rotating table		EM 1084-4. ON	N.A.	N.A.	
6.	Double-ridge Guide Horn antenna		1-18 GHz HP 11966E	2008/03	2011/03	
7.	Double-ridge Guide Horn antenna		18-40 GHz Agilent 119665J	2008/09	2011/09	
8.	EMI Test Receiver	R&S	ESIB26	2009/09	2011/09	
9.	RF pre-amplifier	Miteq	JS4-12002600-30-5A.	2008/07	2010/07	
10.	Multi Device Controller	EMCO	2090	N.A.	N.A.	
11.	Spectrum Analyzer	Agilent	E4440A	2010/02	2012/02	
12.	RF pre-amplifier	Miteq	AFS5-04001300-15-10P-6.	2008/07	2010/07	
13.	RF pre-amplifier	Schaffner	CPA 9231.	2009/03	2011/03	
14.	Bluetooth test set	Anritsu	MT8852A.	N.A.	N.A.	

Report template No

FDT08_11

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Competences and guarantees

AT4 wireless is a laboratory with a measurement facility in compliance with the requirements of Section 2.948 of the FCC rules and has been added to the list of facilities whose measurements data will be accepted in conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Registration Number: 905266.

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

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

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

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

General conditions

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

Uncertainty

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

PODT000: Procedimiento para el cálculo de incertidumbres de medida.

Usage of samples

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

Sample M/01 is composed of the following elements:

<u>Control N°</u>	<u>Description</u>	<u>Model</u>	<u>Serial N°</u>	<u>Date of reception</u>
30747/105	Car radio with Bluetooth	NTG4.5(1CD)	523 PA1105A0000918 3	06/04/2010
30747/82	Power supply connector	---	---	24/03/2010
30747/48	Attachable antenna	AG99D Q3	---	17/02/2010

1. Sample M/01 has undergone following test(s).
All tests indicated in appendix A.

Testing period

The performed test started on 2010-04-08 and finished on 2010-04-29.

The tests have been performed at AT4 wireless.

Environmental conditions

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

Temperature	Min. = 21.8 °C Max. = 23.9 °C
Relative humidity	Min. = 46.6 % Max. = 47.7 %
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. = 20.2 °C Max. = 21.2 °C
Relative humidity	Min. = 43 % Max. = 48 %
Air pressure	Min. = 1016 mbar Max. = 1016 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. = 23.9 °C Max. = 24.2 °C
Relative humidity	Min. = 51.3 % Max. = 52.8 %
Air pressure	Min. = 1020 mbar Max. = 1020 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 / Canada RSS-210 and RSS-Gen Issue 2, the item under test is **IN COMPLIANCE** with the requested specifications specified in the standard.

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

Remarks and comments

None.

Testing verdicts

Not applicable: NA
 Pass.....: P
 Fail: F
 Not measured.....: NM

FCC PART 15 / RSS-210 PARAGRAPH	VERDICT			
	NA	P	F	NM
FCC 15.247 Subclause (a) (1). 20 dB Bandwidth and Carrier frequency separation / RSS-210 Is. 7, Clause A8.1 (b)		P		
FCC 15.247 Subclause (a) (1) (iii). Number of hopping channels / RSS-210 Is. 7, Clause A8.1 (d)		P		
FCC 15.247 Subclause (a) (1) (iii). Time of occupancy (Dwell Time) / RSS-210 Is. 7, Clause A8.1 (d)		P		
FCC 15.247 Subclause (b). Maximum peak output power (radiated) and antenna gain / RSS-210 Is. 7, Clause A8.4 (2)		P		
FCC 15.247 Subclause (c). Band-edge of radiated emissions (Transmitter) / RSS-210 Is. 7, Clauses 2.2(b) & A8.5		P		
FCC 15.247 Subclause (c). Emission limitations conducted (Transmitter) / RSS-210 Is. 7, Clauses 2.2(b) & A8.5		P		
FCC 15.247 Subclause (c). Emission limitations radiated (Transmitter) / RSS-210 Is. 7, Clauses 2.2(b) & A8.5		P		
FCC 15.109. Radiated emission limits for receiver / RSS-210 Is. 7, Clause 2.3 & RSS-Gen Is. 2, Clause 7.2.3		P		

APPENDIX A: Test result

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TEST CONDITIONS

Power supply (V):

$$V_{\text{nominal}} = 12 \text{ Vdc}$$

Type of power supply = DC voltage from car battery.

Type of antenna = Attachable antenna.

Declared Gain for antenna (maximum) = 2.4 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: 2003.

CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and it is connected to a Bluetooth signalling unit (Bluetooth test set) and to the spectrum analyser using a 6 dB power splitter. The reading in the spectrum analyser is corrected taking into account the power splitter loss.

RADIATED MEASUREMENTS

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

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

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

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

An additional horn antenna is used to control the equipment under test with the Bluetooth signalling unit (Bluetooth test set).

FCC Section 15.247 Subclause (a) (1) / RSS-210 Is. 7, 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	Middle frequency	Highest frequency
	2402 MHz	2441 MHz	2480 MHz
20 dB Spectrum bandwidth (kHz)	923	923	923
Measurement uncertainty (kHz)	±11		

Modulation: Π/4-DQPSK (2Mbps)

	Lowest frequency	Middle frequency	Highest frequency
	2402 MHz	2441 MHz	2480 MHz
20 dB Spectrum bandwidth (kHz)	1250	1257	1257
Measurement uncertainty (kHz)	±11		

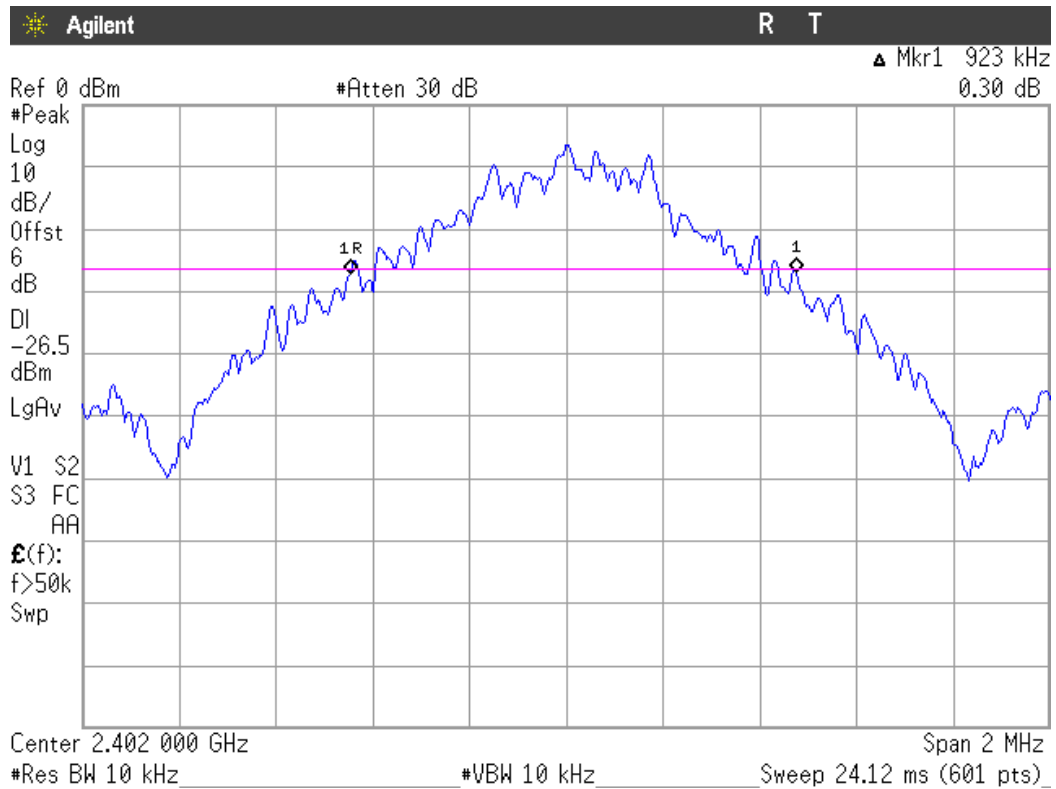
Modulation: 8-DPSK (3Mbps)

	Lowest frequency	Middle frequency	Highest frequency
	2402 MHz	2441 MHz	2480 MHz
20 dB Spectrum bandwidth (kHz)	1260	1267	1263
Measurement uncertainty (kHz)	±11		

Modulation: GFSK

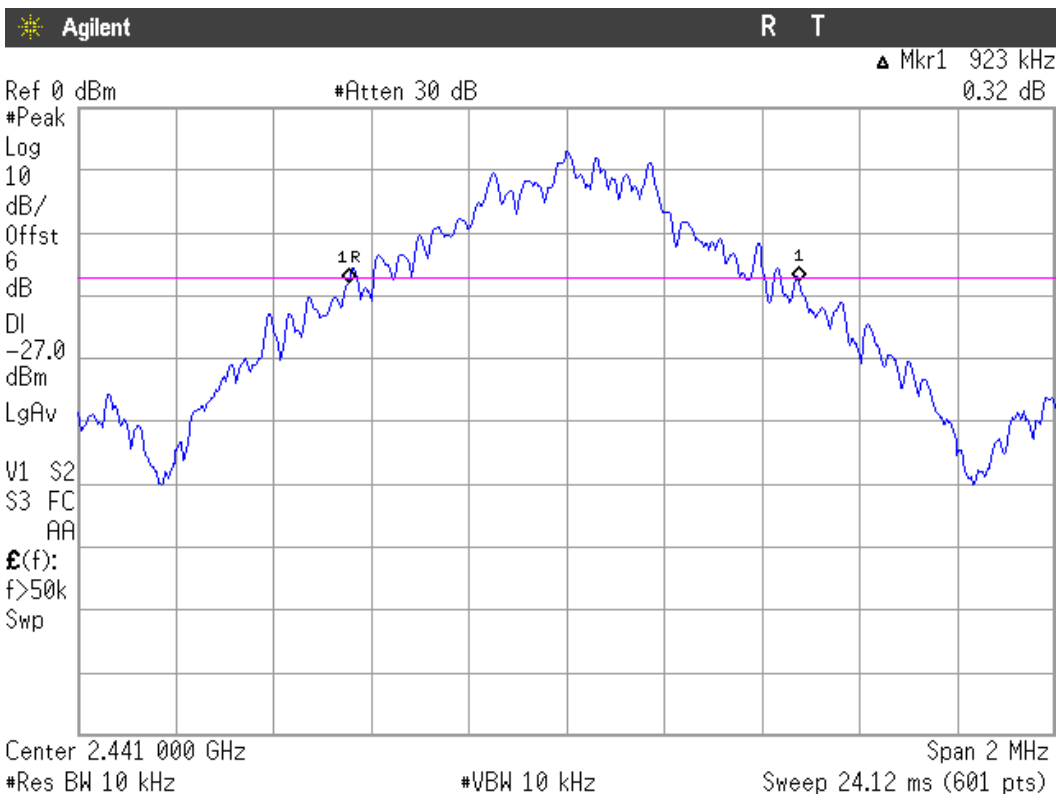
20 dB BANDWIDTH.

Lowest Channel: 2402 MHz.



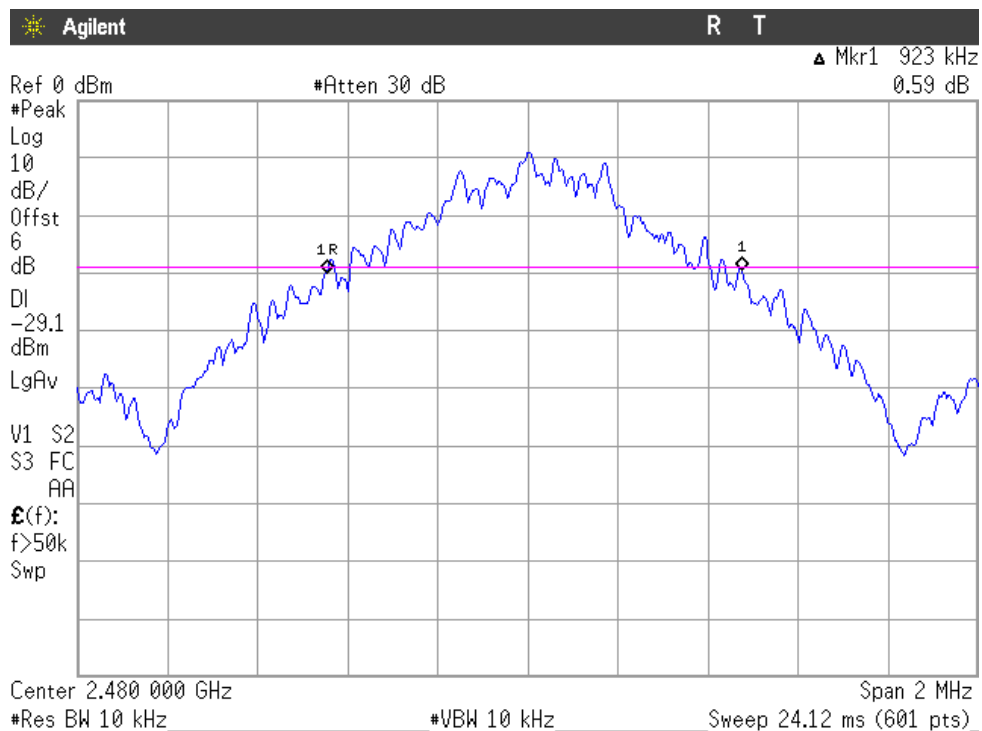
20 dB BANDWIDTH

Middle Channel: 2441 MHz.

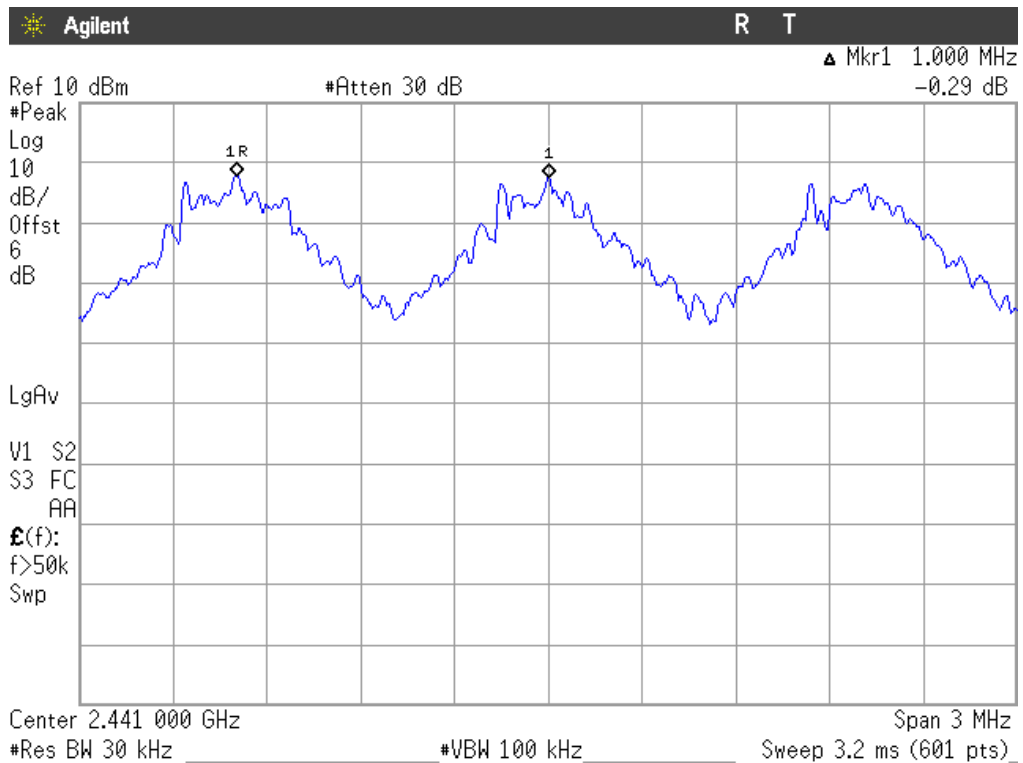


20 dB BANDWIDTH

Highest Channel: 2480 MHz.



Carrier frequency separation



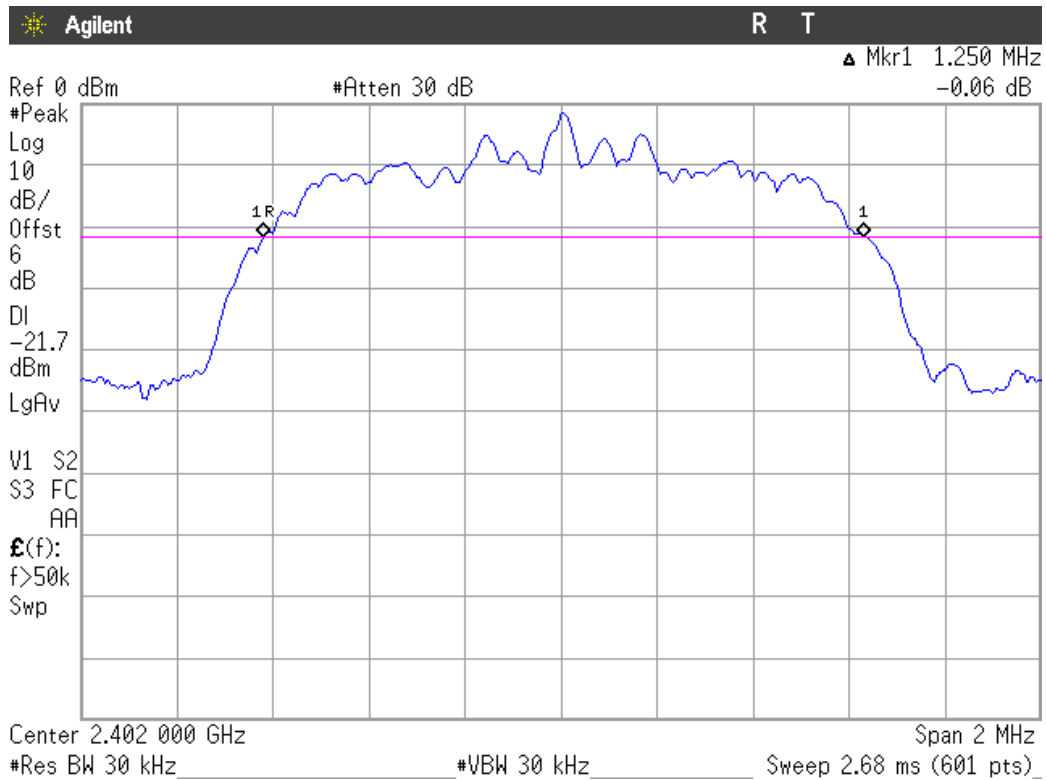
The hopping channel carrier frequencies are separated by a minimum of the 20 dB bandwidth of the hopping channel.

Verdict: PASS

Modulation: $\Pi/4$ -DQPSK

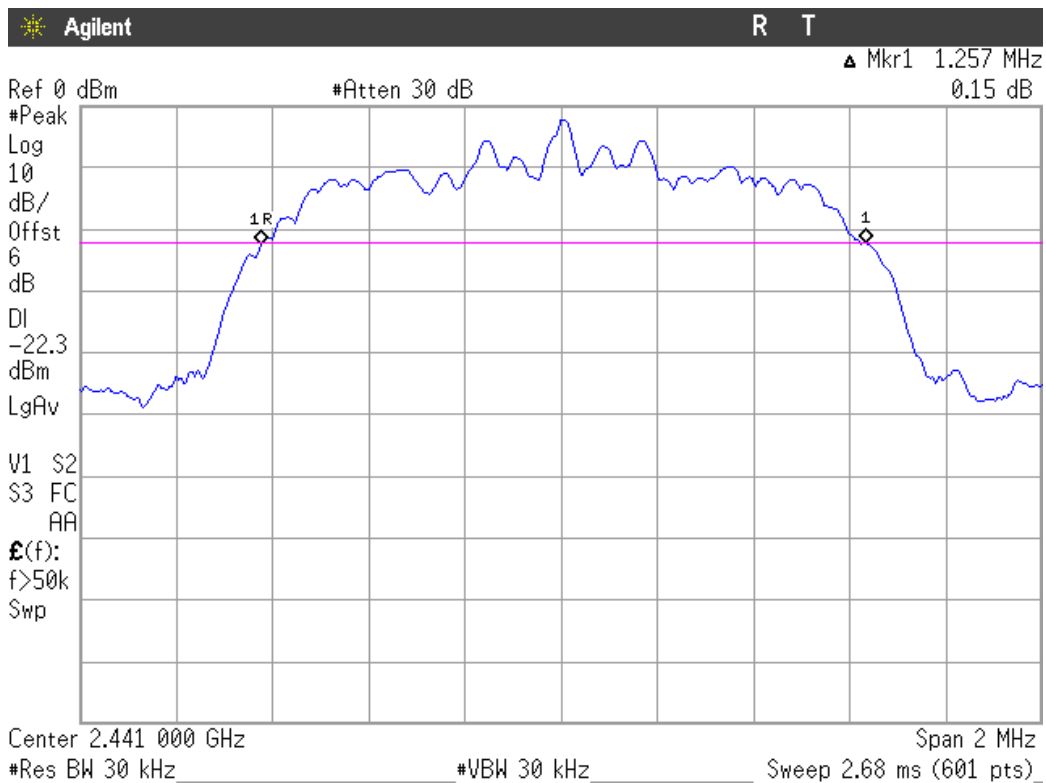
20 dB BANDWIDTH.

Lowest Channel: 2402 MHz.



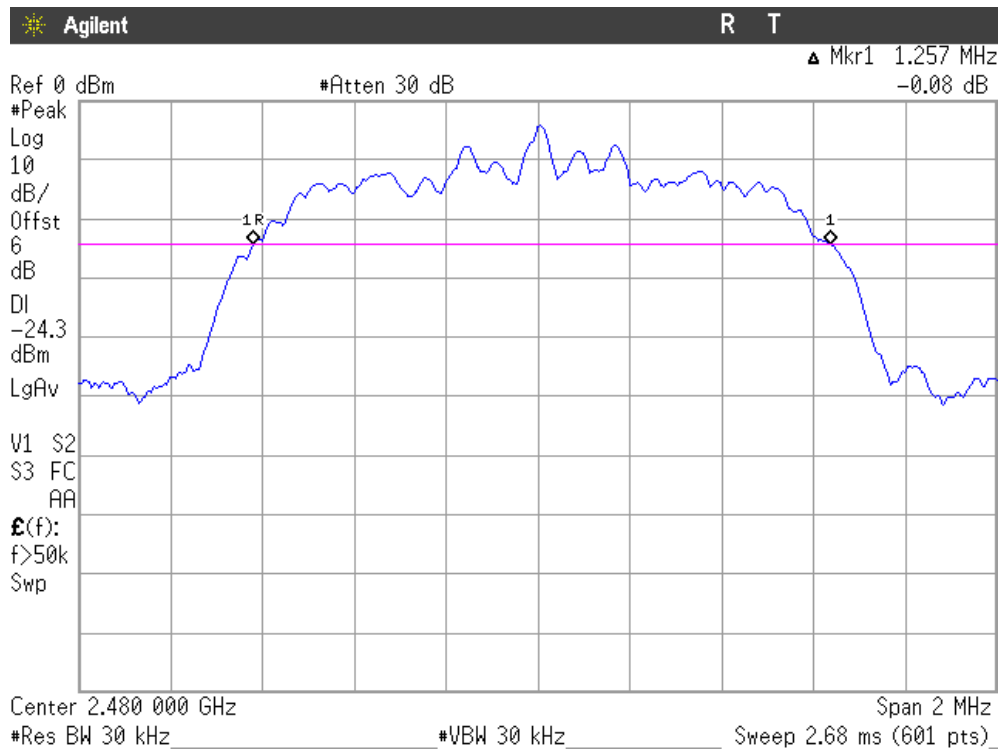
20 dB BANDWIDTH

Middle Channel: 2441 MHz.

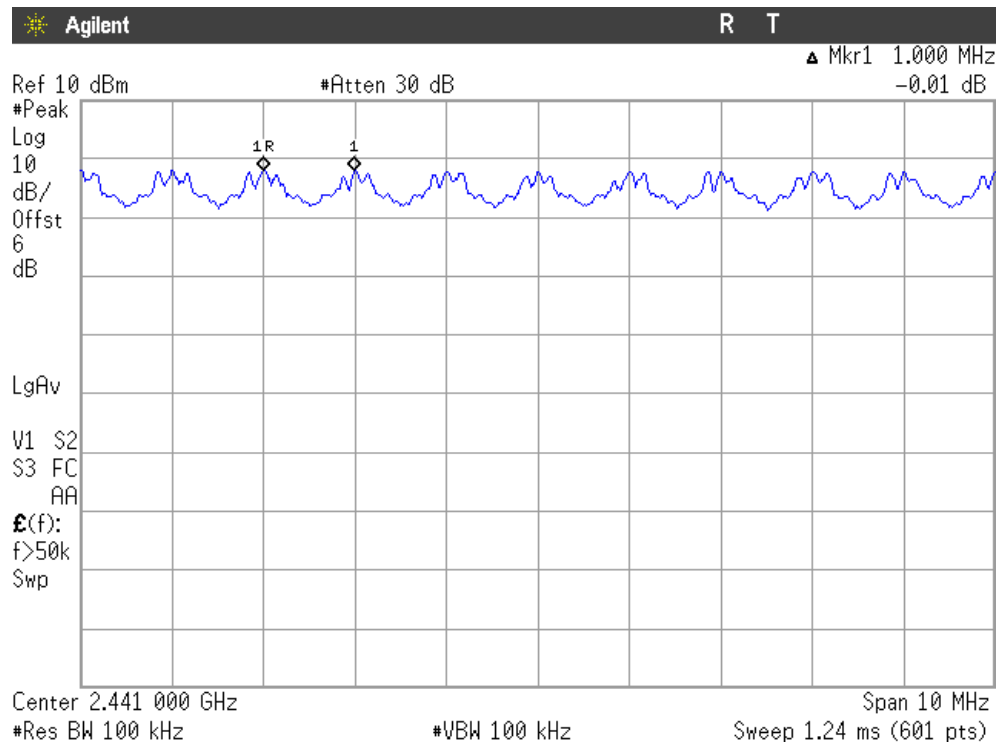


20 dB BANDWIDTH

Highest Channel: 2480 MHz.



Carrier frequency separation



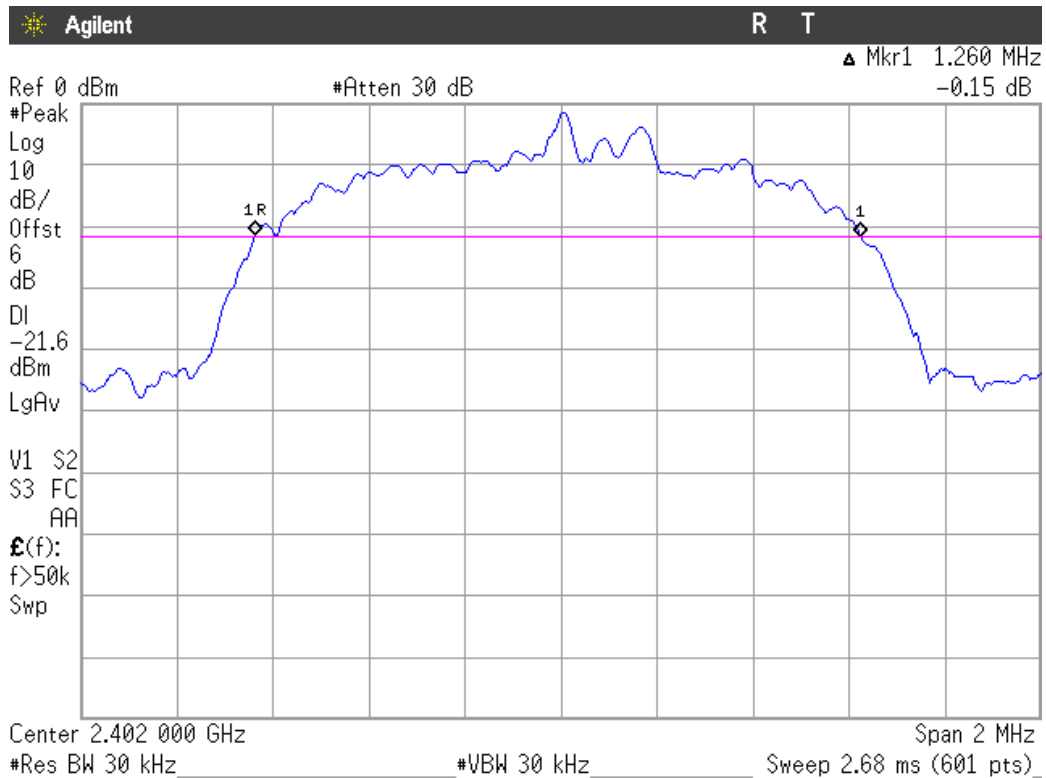
The hopping channel carrier frequencies are separated by a minimum of the two-thirds of the 20 dB bandwidth of the hopping channel

Verdict: PASS

Modulation: 8-DPSK

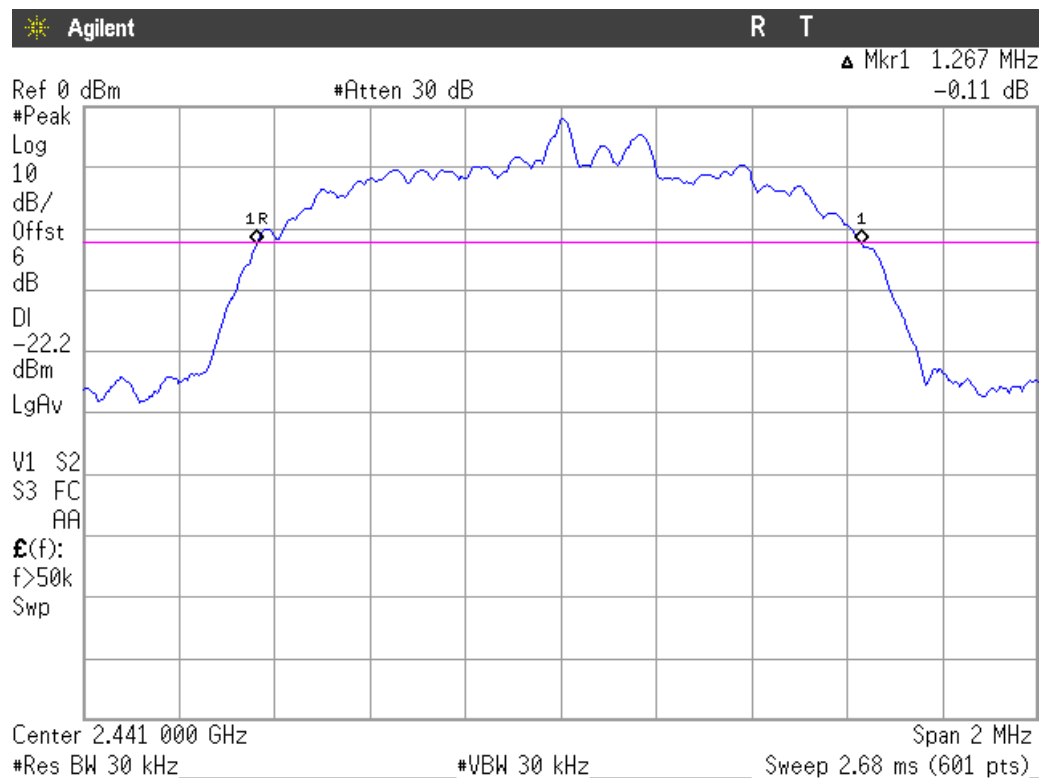
20 dB BANDWIDTH

Lowest Channel: 2402 MHz.



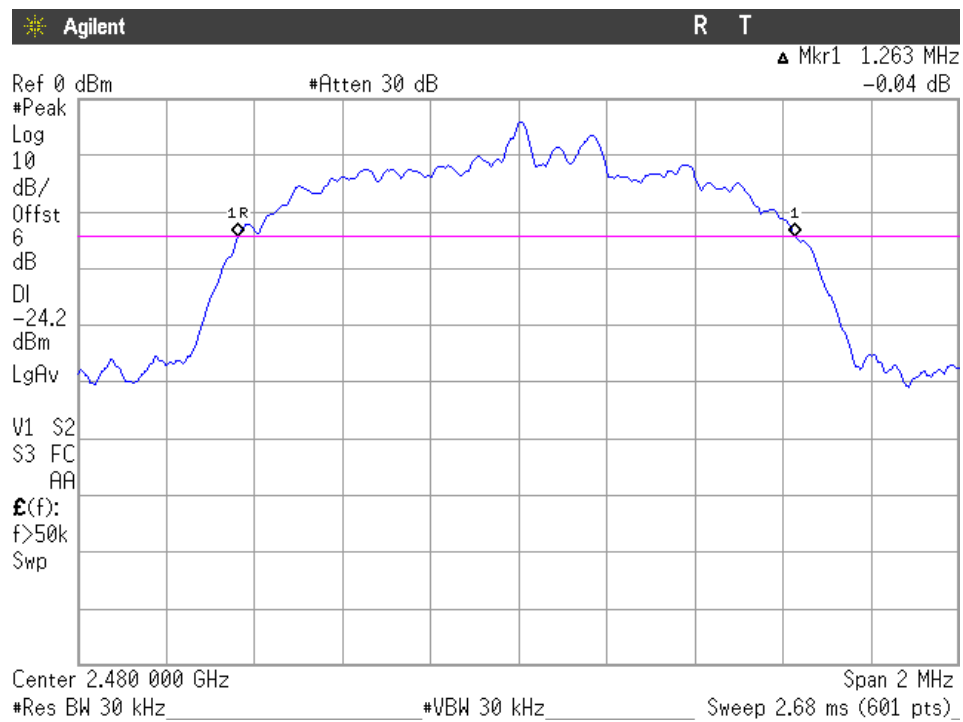
20 dB BANDWIDTH

Middle Channel: 2441 MHz.

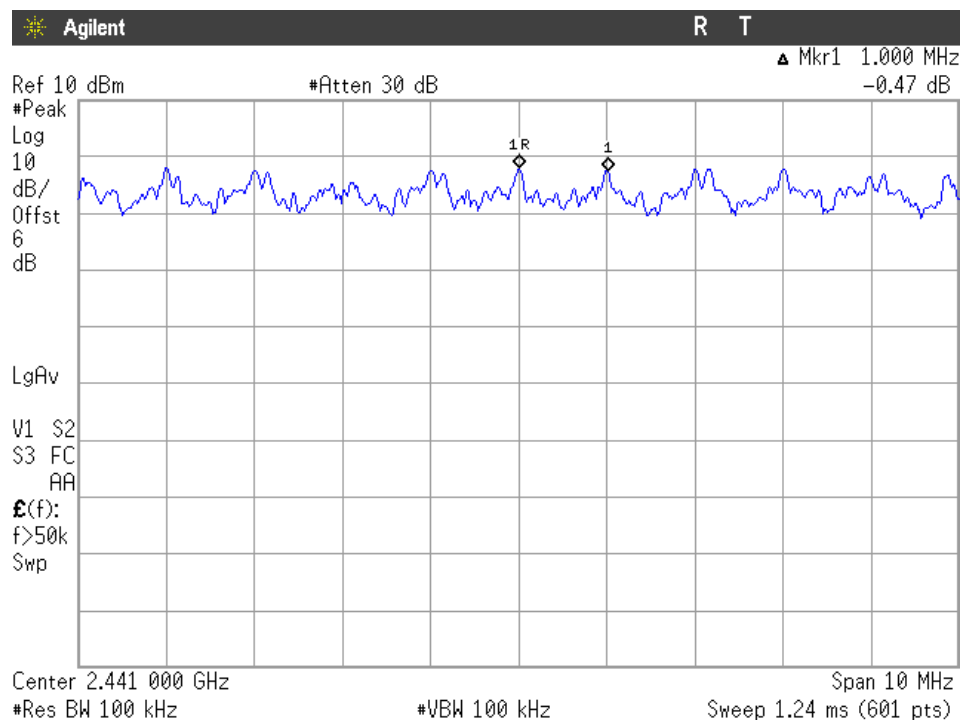


20 dB BANDWIDTH

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

FCC Section 15.247 Subclause (a) (1) (iii) / RSS-210 Is. 7, Clause A8.1 (d). Number of hopping channels

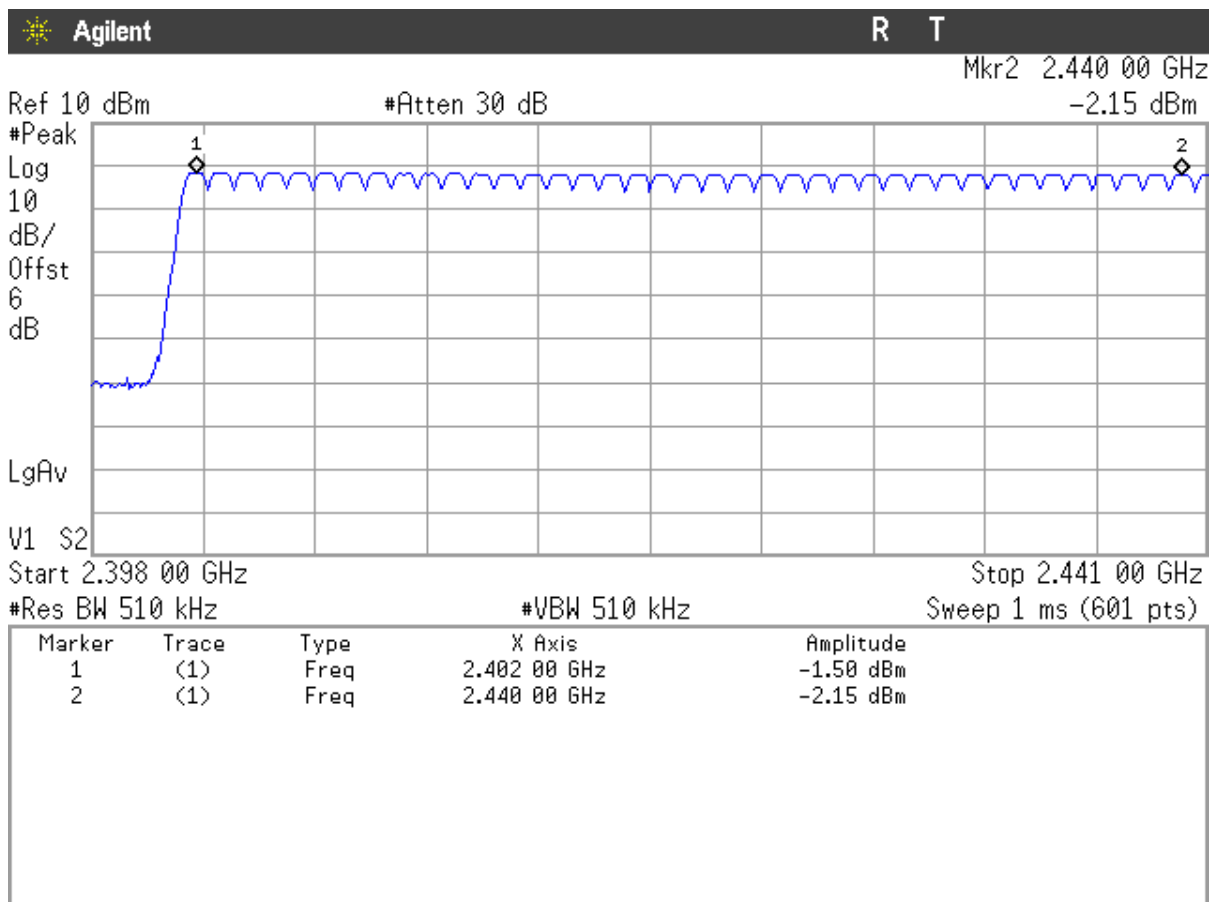
SPECIFICATION

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

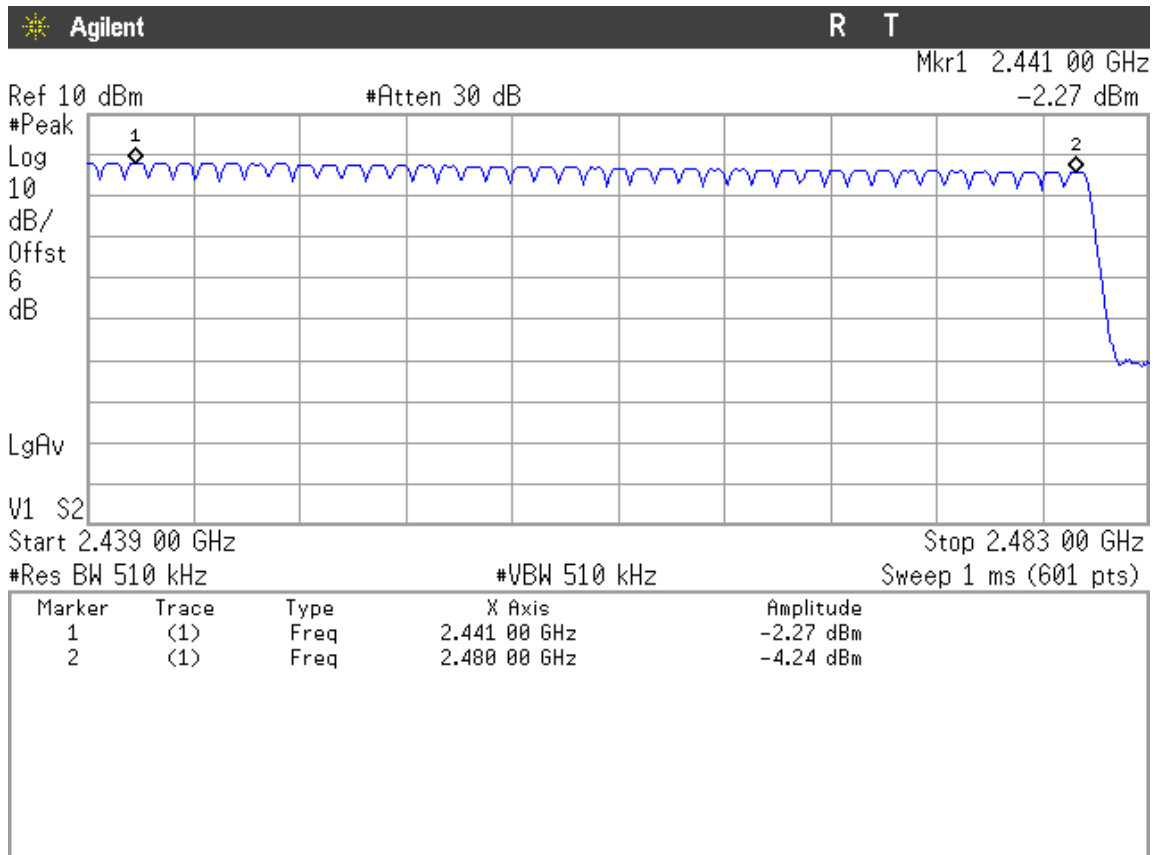
RESULTS

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

Modulation: GFSK



Number of hopping frequencies: 39

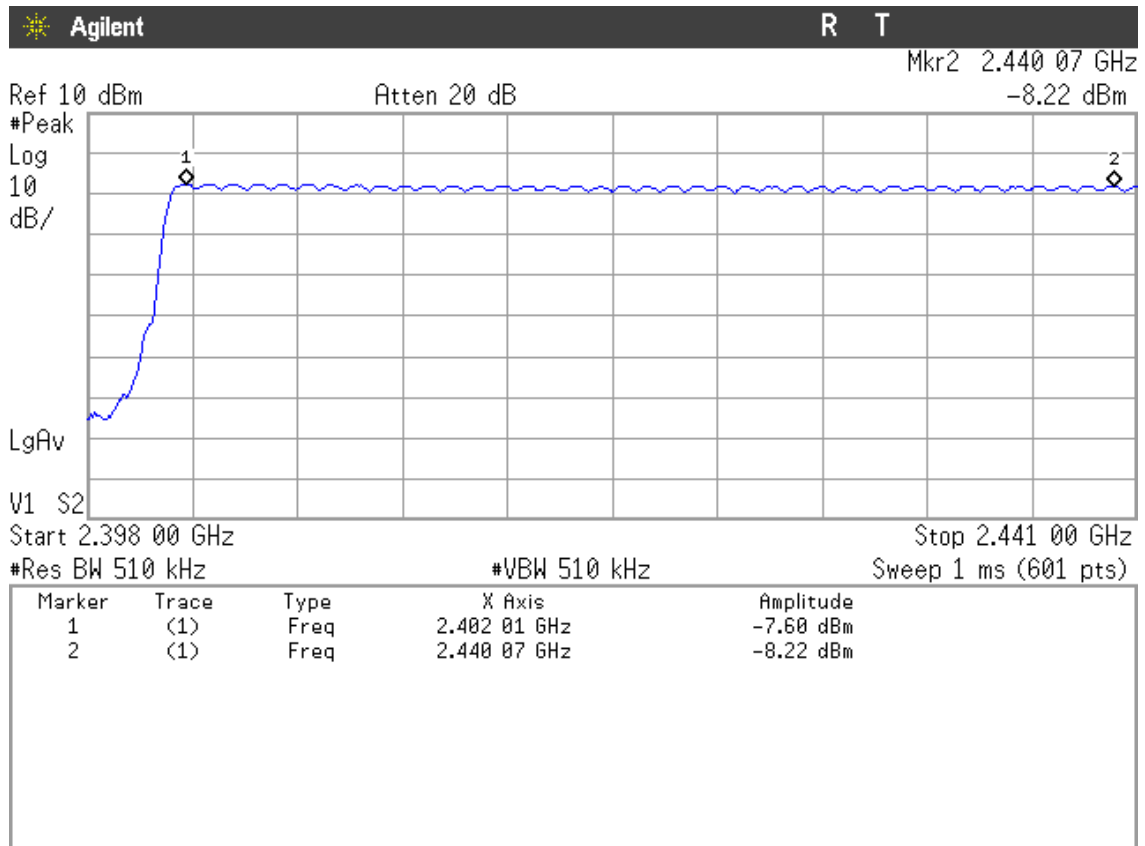


Number of hopping frequencies: 40

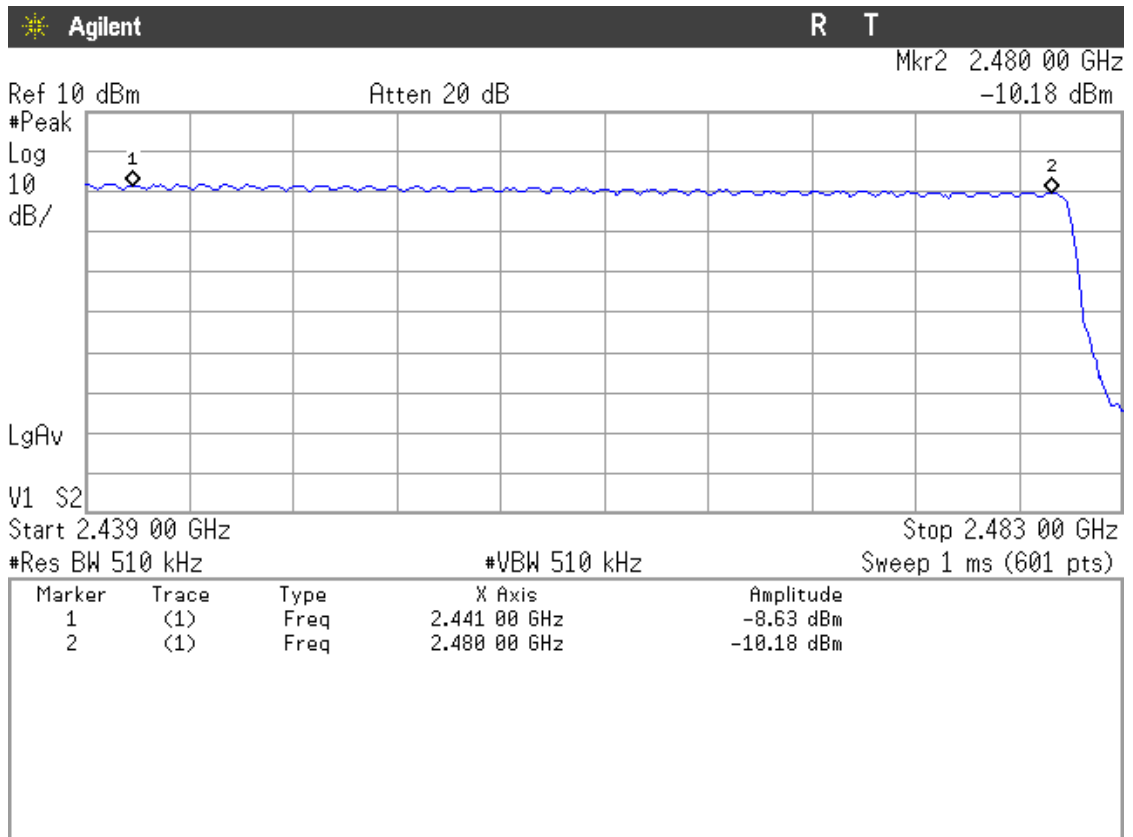
Total number of hopping frequencies: 79

Verdict: PASS

Modulation: $\Pi/4$ -DQPSK



Number of hopping frequencies: 39

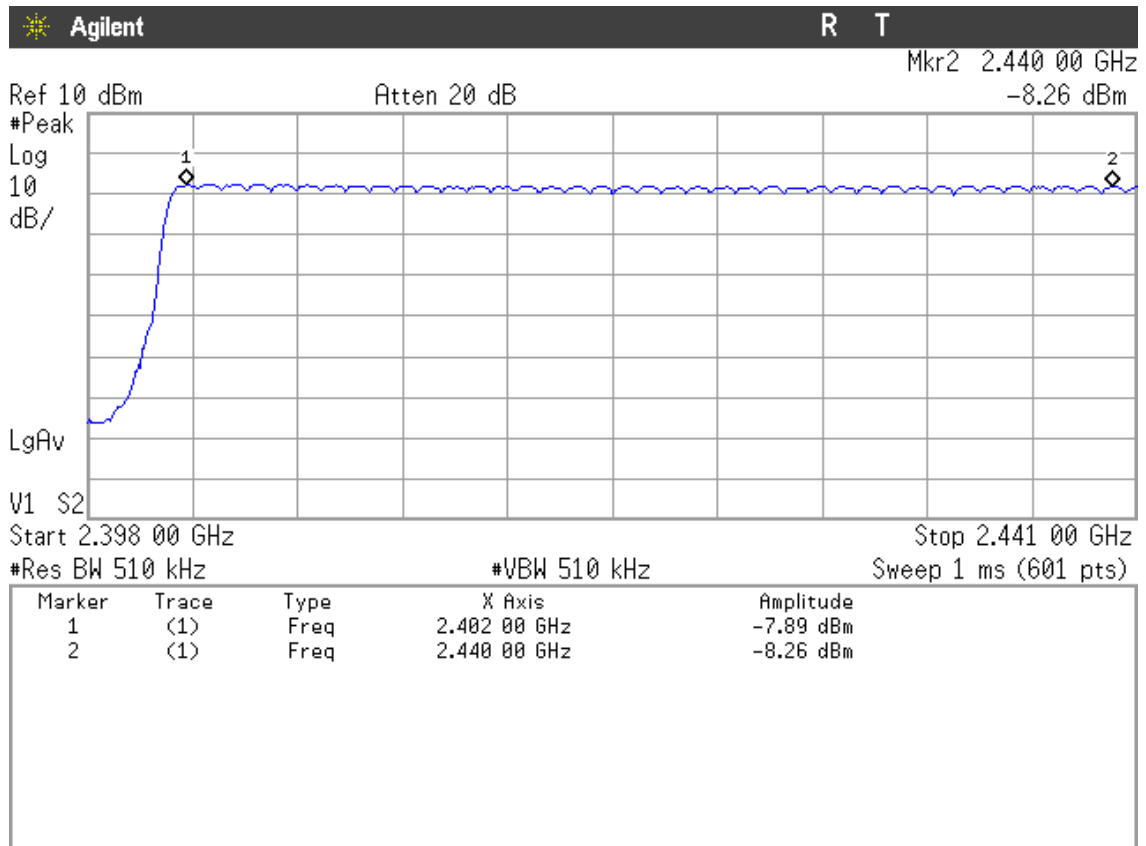


Number of hopping frequencies: 40

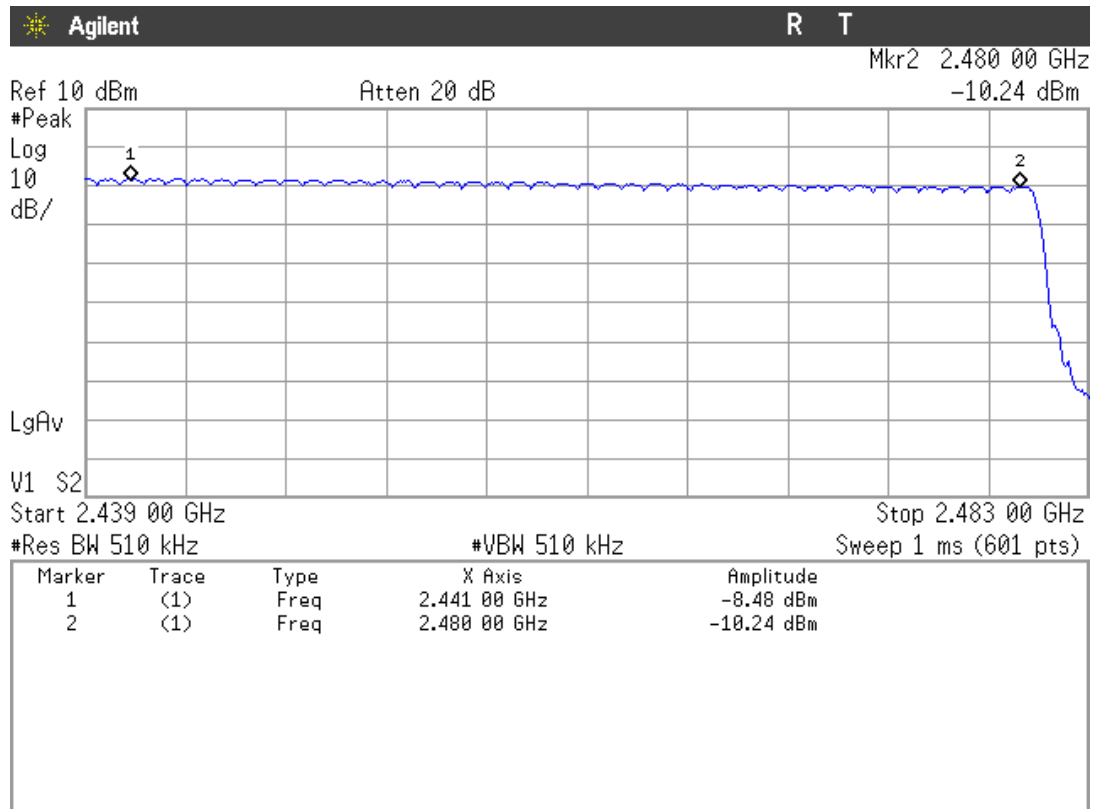
Total number of hopping frequencies: 79

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 Is. 7, 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 = $0.4 \times 79 = 31.6$ seconds.

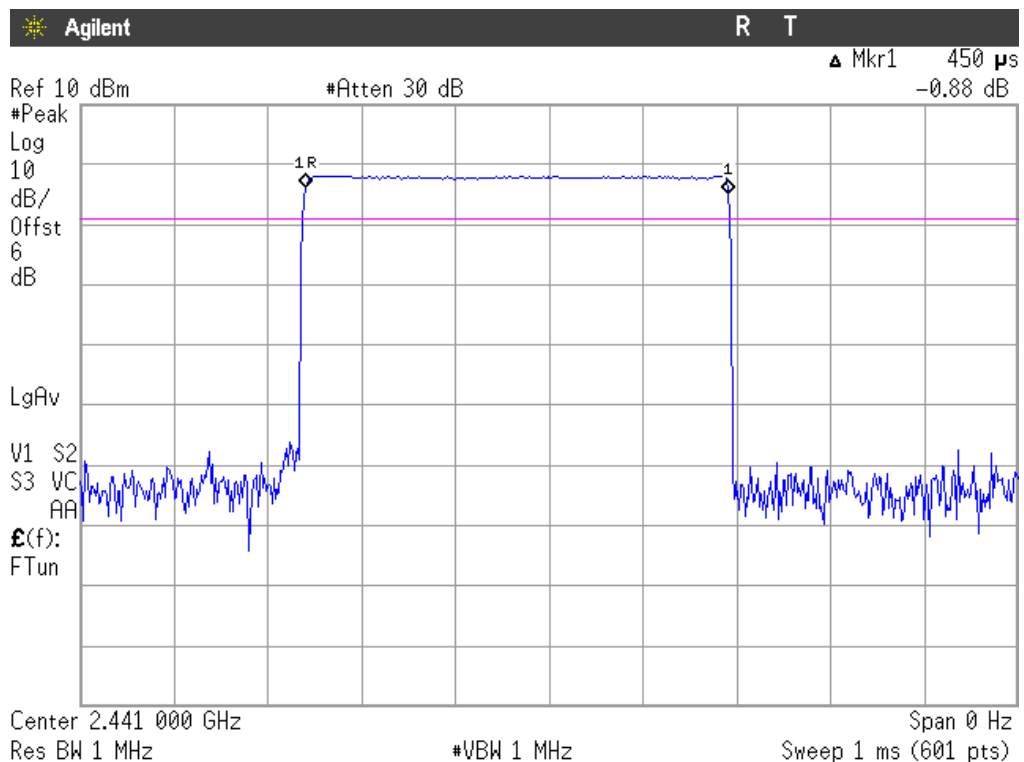
RESULTS

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 $625\mu\text{s}$ 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 $0.4 \times 79 = 31.6$ seconds you have $10.13 \times 31.6 = 320.11$ times of appearance.

Each Tx-time per appearance is $450\ \mu\text{s}$ (see next plot).
So we have $320.11 \times 450\ \mu\text{s} = 144.05\ \text{ms}$ per 31.6 seconds.



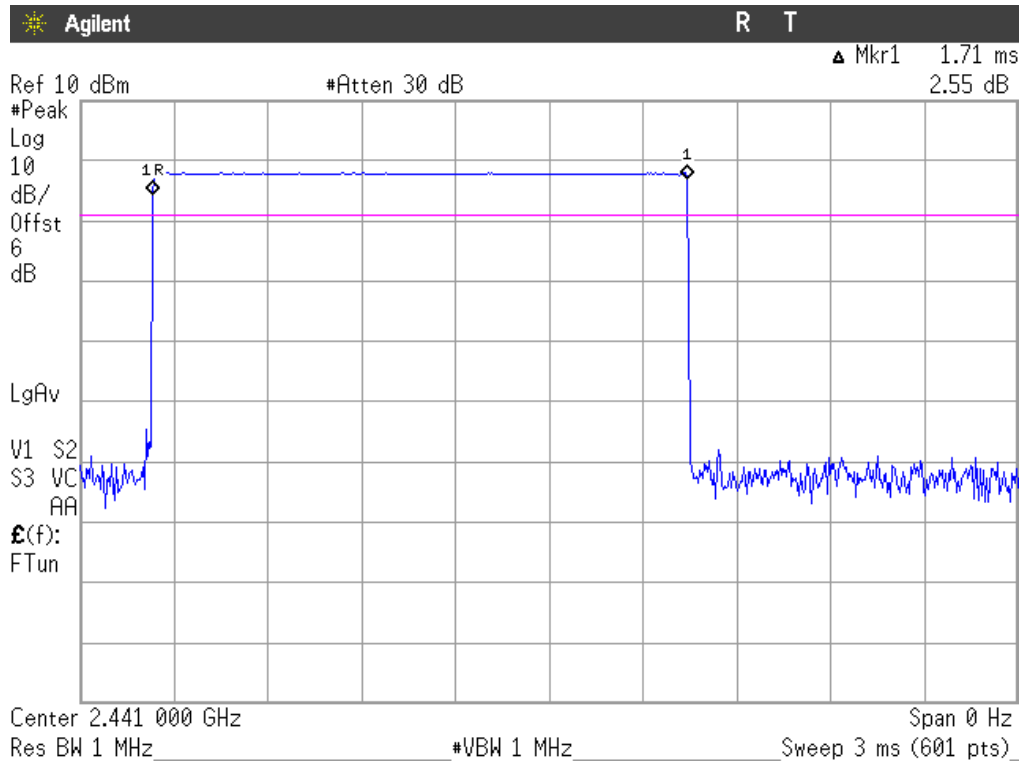
Verdict: PASS

2. TIME OF OCCUPANCY (DWEELL 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 $0.4 \times 79 = 31.6$ seconds you have $5.1 \times 31.6 = 161.16$ times of appearance.

Each Tx-time per appearance is 1.71 ms (see next plot).

So we have $161.16 \times 1.71 \text{ ms} = 275.58 \text{ ms}$ per 31.6 seconds.



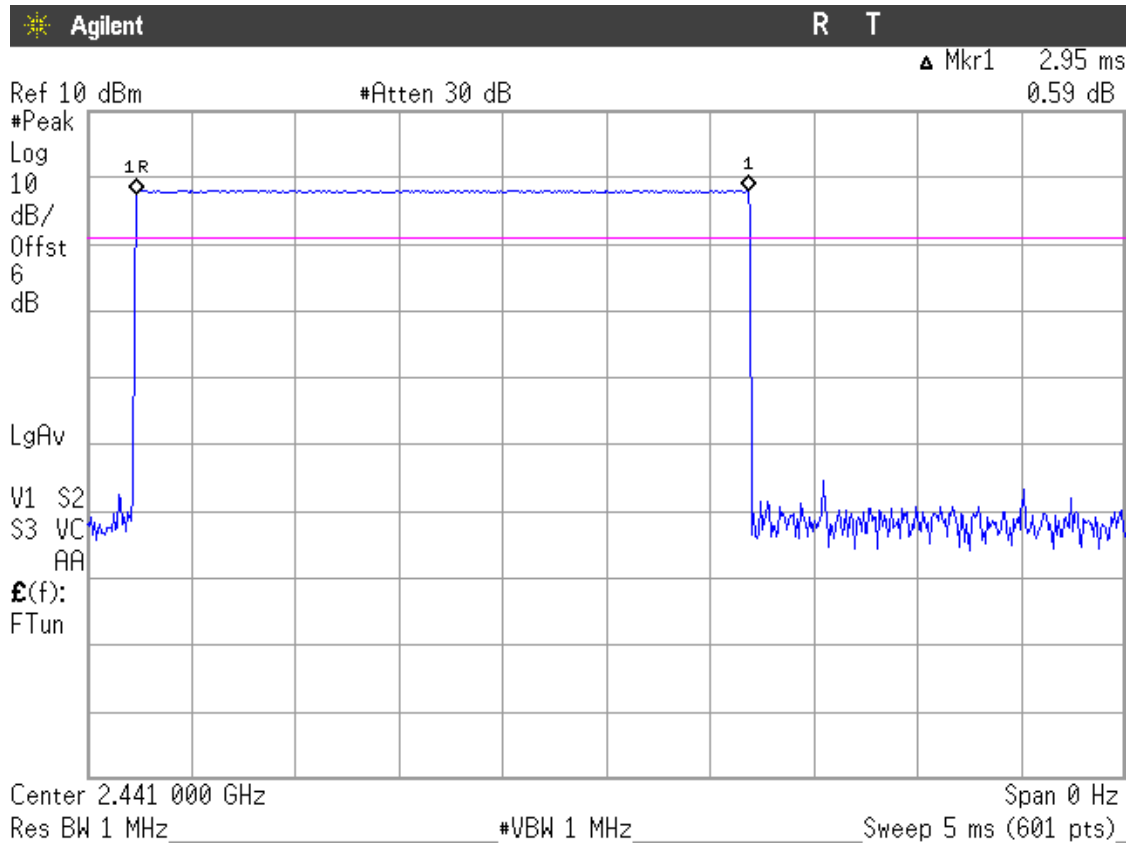
Verdict: PASS

3. TIME OF OCCUPANCY (DWEELL 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 $0.4 \times 79 = 31.6$ seconds you have $3.37 \times 31.6 = 106.49$ times of appearance.

Each Tx-time per appearance is 2.95 ms (see next plot).

So we have $106.49 \times 2.95 \text{ ms} = 314.15 \text{ ms}$ per 31.6 seconds.



Verdict: PASS

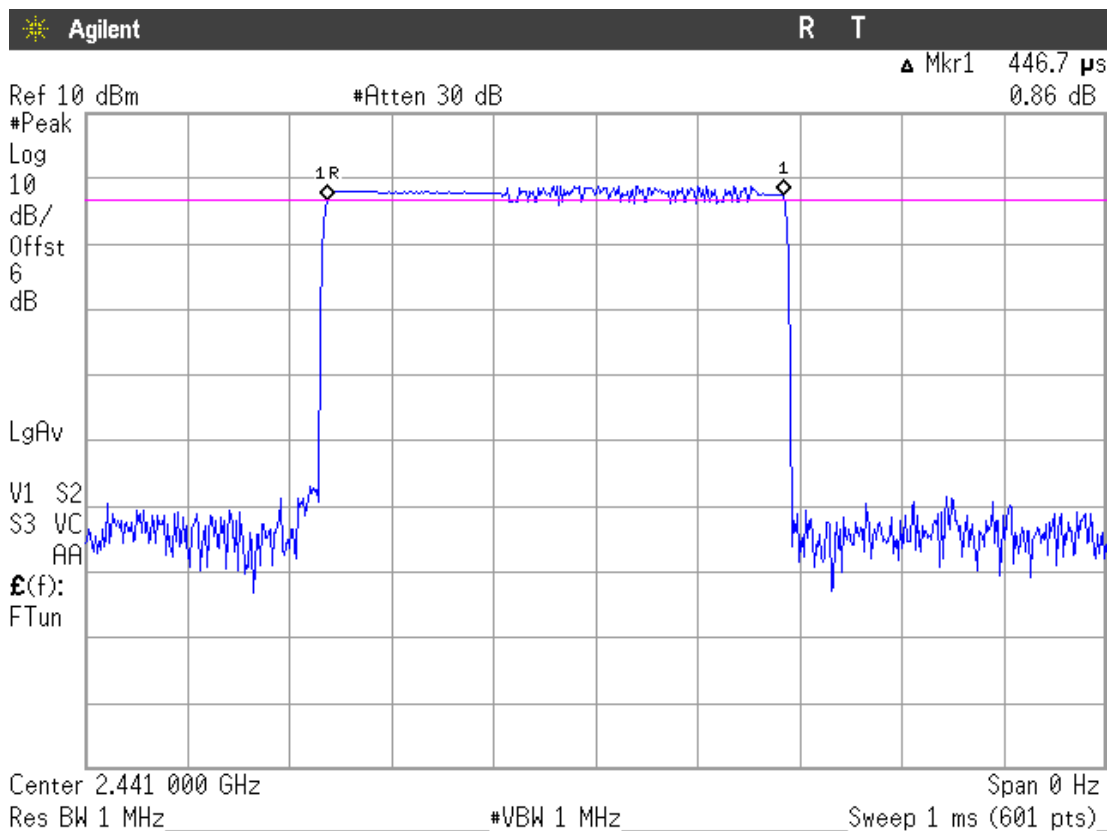
Modulation: $\Pi/4$ -DQPSK

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 $625\mu\text{s}$ 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 $0.4 \times 79 = 31.6$ seconds you have $10.13 \times 31.6 = 320.11$ times of appearance.

Each Tx-time per appearance is $446.7 \mu\text{s}$ (see next plot).

So we have $320.11 \times 446.7 \mu\text{s} = 142.99 \text{ ms}$ per 31.6 seconds.



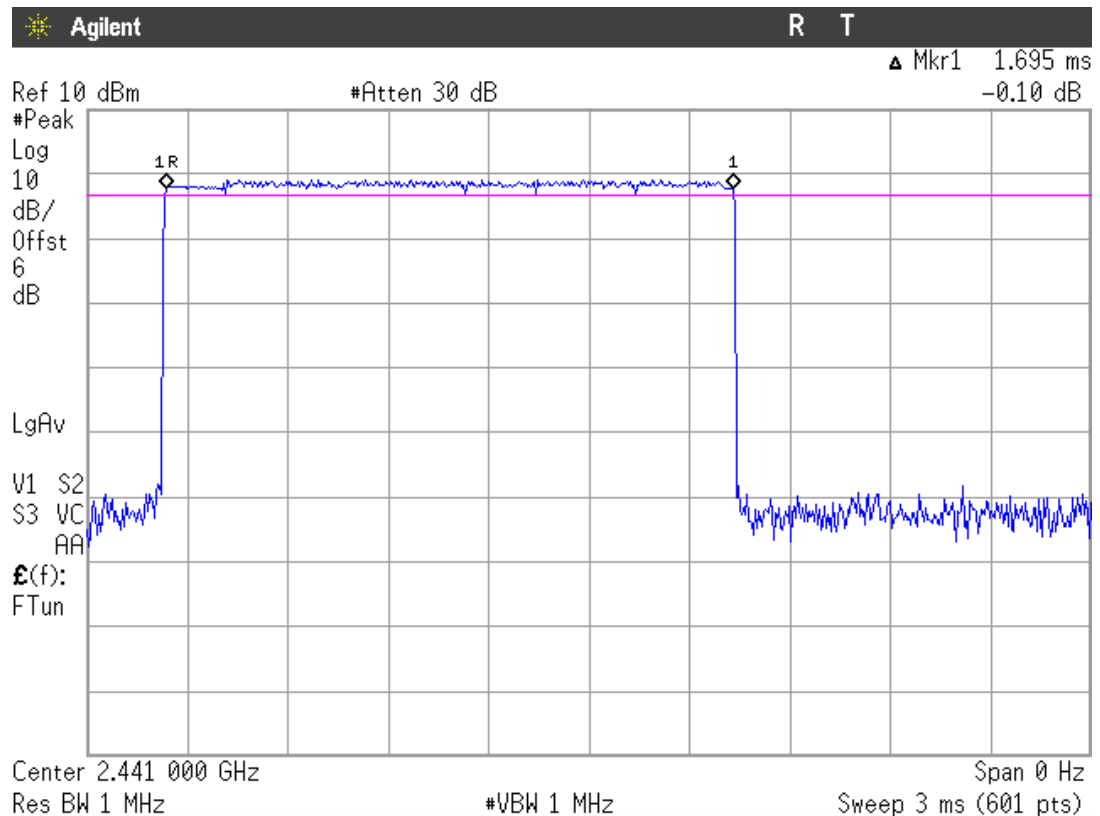
Verdict: PASS

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 $0.4 \times 79 = 31.6$ seconds you have $5.1 \times 31.6 = 161.16$ times of appearance.

Each Tx-time per appearance is 1.695 ms (see next plot).

So we have $161.16 \times 1.695 \text{ ms} = 273.17 \text{ ms}$ per 31.6 seconds.



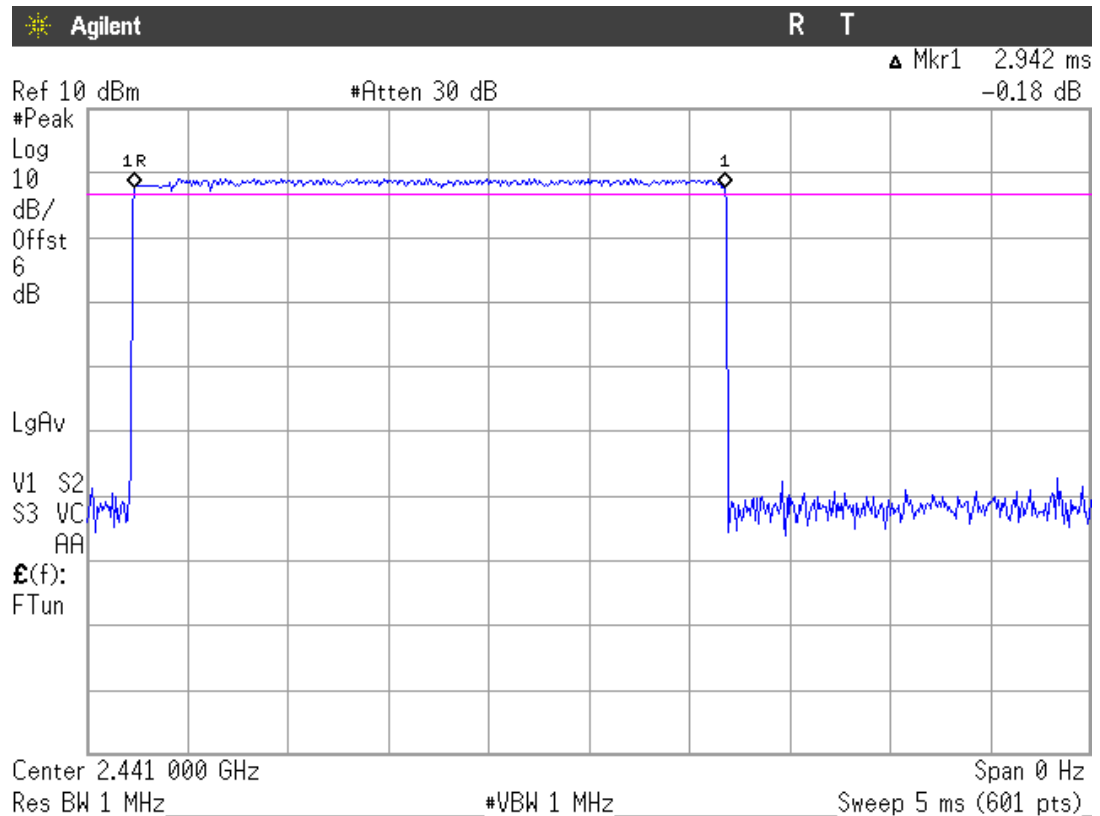
Verdict: PASS

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 $0.4 \times 79 = 31.6$ seconds you have $3.37 \times 31.6 = 106.49$ times of appearance.

Each Tx-time per appearance is 2.942 ms (see next plot).

So we have $106.49 \times 2.942 \text{ ms} = 313.29 \text{ ms}$ per 31.6 seconds.



Verdict: PASS

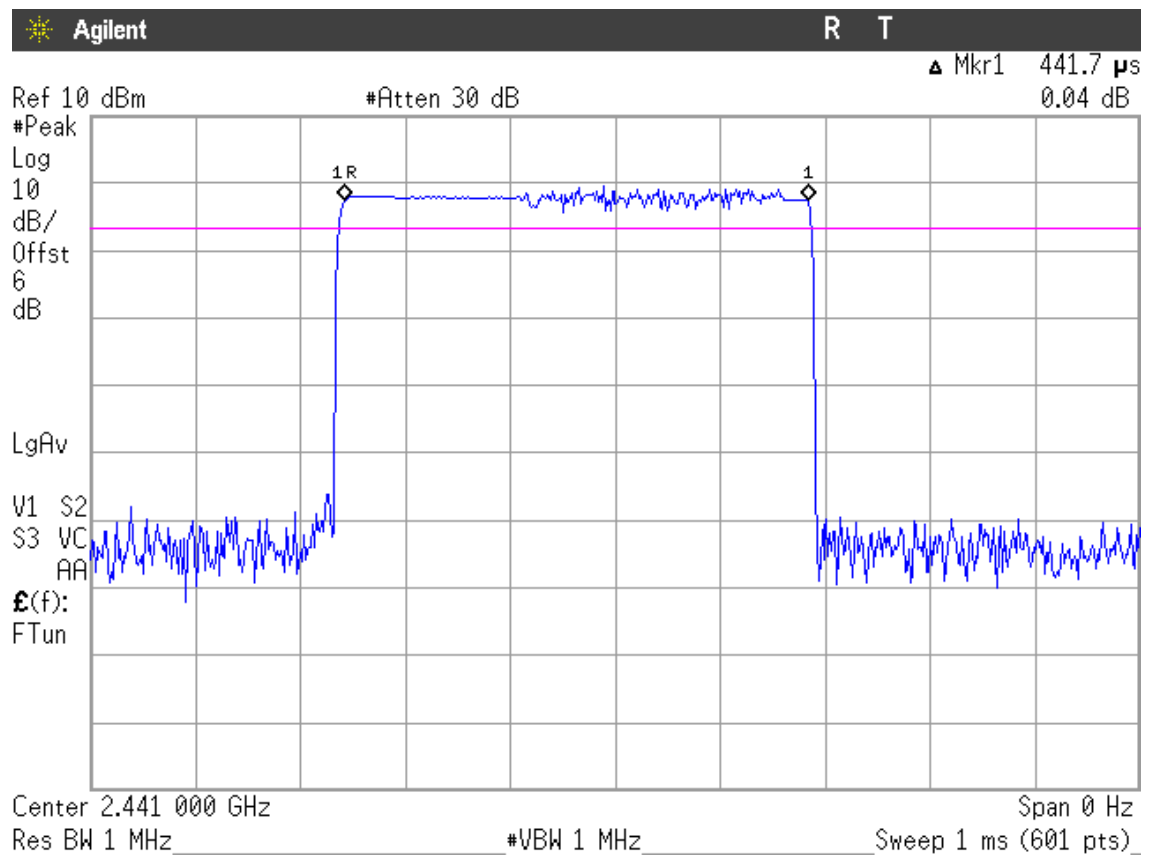
Modulation: 8-DPSK

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 $625\mu\text{s}$ 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 $0.4 \times 79 = 31.6$ seconds you have $10.13 \times 31.6 = 320.11$ times of appearance.

Each Tx-time per appearance is $441.7 \mu\text{s}$ (see next plot).

So we have $320.11 \times 441.7 \mu\text{s} = 141.39 \text{ ms}$ per 31.6 seconds.



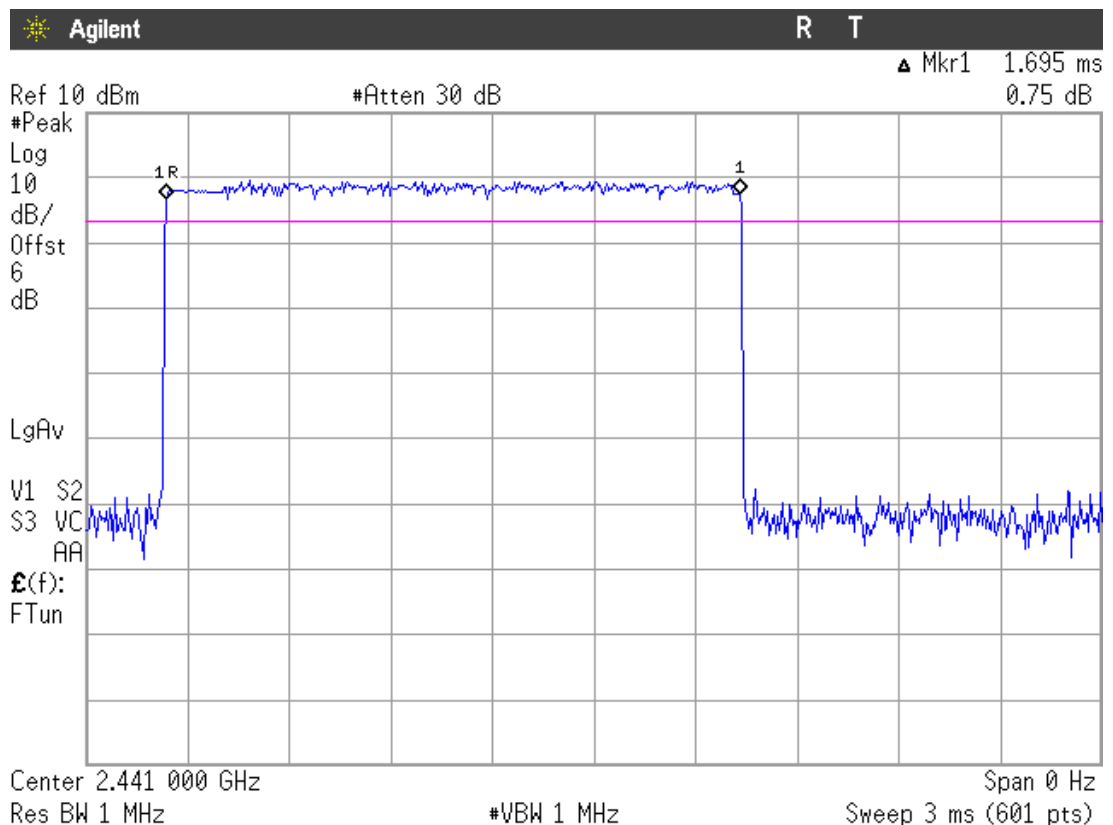
Verdict: PASS

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 $0.4 \times 79 = 31.6$ seconds you have $5.1 \times 31.6 = 161.16$ times of appearance.

Each Tx-time per appearance is 1.695 ms (see next plot).

So we have $161.16 \times 1.695 \text{ ms} = 273.17 \text{ ms}$ per 31.6 seconds.



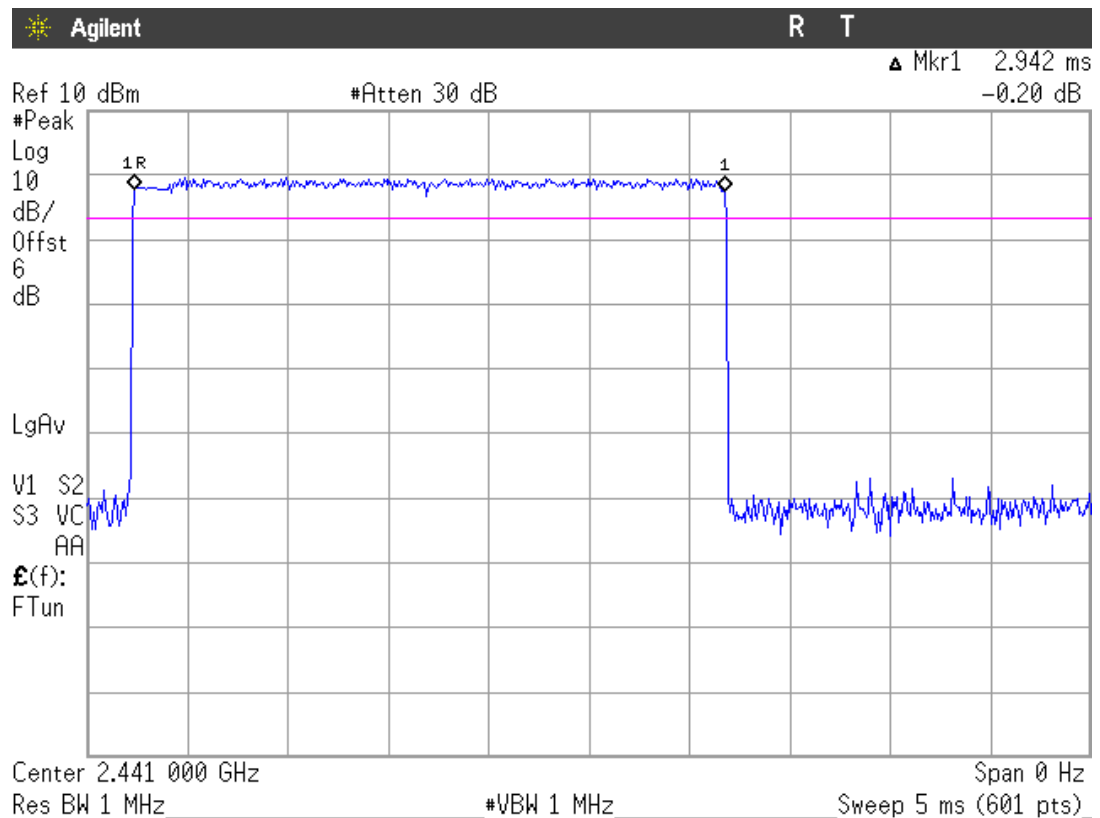
Verdict: PASS

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 $0.4 \times 79 = 31.6$ seconds you have $3.37 \times 31.6 = 106.49$ times of appearance.

Each Tx-time per appearance is 2.942 ms (see next plot).

So we have $106.49 \times 2.942 \text{ ms} = 313.29 \text{ ms}$ per 31.6 seconds.



Verdict: PASS

FCC Section 15.247 Subclause (b) / RSS-210 Is. 7, 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)	-1.38	-1.99	-3.96
Measurement uncertainty (dB)	±1.5		

The maximum declared antenna gain for this device is 2.4 dBi, therefore the maximum theoretical peak radiated power (EIRP) in the three measurement channels for this device is 1.02 dBm or 1.26 mW.

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

Modulation: $\Pi/4$ -DQPSK (2Mbps)

	Lowest frequency 2402 MHz	Middle frequency 2441 MHz	Highest frequency 2480 MHz
Maximum peak power (dBm)	0.26	-0.32	-2.30
Measurement uncertainty (dB)	±1.5		

The maximum declared antenna gain for this device is 2.4 dBi, therefore the maximum theoretical peak radiated power (EIRP) in the three measurement channels for this device is 1.84 dBm or 1.53 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)	0.71	0.16	-1.80
Measurement uncertainty (dB)	±1.5		

The maximum declared antenna gain for this device is 2.4 dBi, therefore the maximum theoretical peak radiated power (EIRP) in the three measurement channels for this device is 3.11 dBm or 2.05 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
Correction Factor (dB)	35.0	35.1	35.2
Maximum EIRP peak power (dBm)	-3.29	-3.07	-2.05
Measurement uncertainty (dB)	±4.0		

Modulation: Π/4-DQPSK (2 Mbps)

	Lowest frequency 2402 MHz	Middle frequency 2441 MHz	Highest frequency 2480 MHz
Correction Factor (dB)	35.0	35.1	35.2
Maximum EIRP peak power (dBm)	-3.29	-3.77	-3.10
Measurement uncertainty (dB)	±4.0		

Modulation: 8-DPSK (3Mbps)

	Lowest frequency 2402 MHz	Middle frequency 2441 MHz	Highest frequency 2480 MHz
Correction Factor (dB)	35.0	35.1	35.2
Maximum EIRP peak power (dBm)	-3.02	-3.34	-2.69
Measurement uncertainty (dB)	±4.0		

Declared peak gain: 2.4 dBi

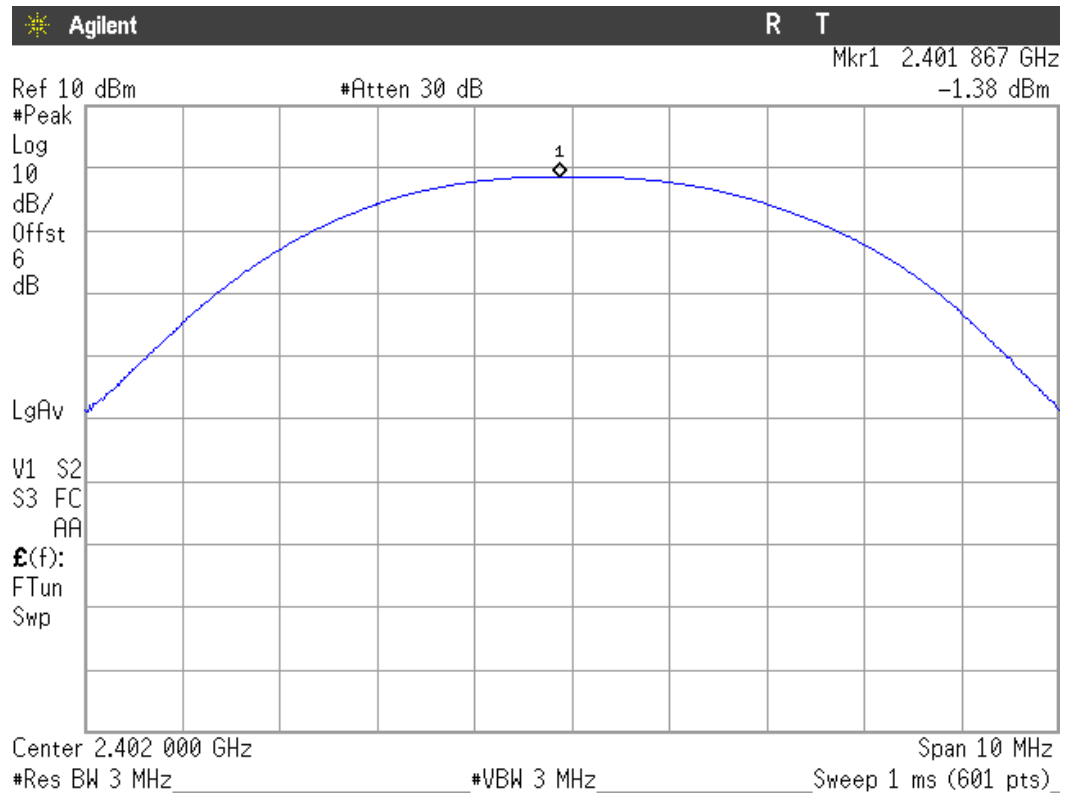
The maximum directional gain of the antenna is less than 6 dBi and therefore the maximum output power is not required to be reduced from the stated values.

Verdict: PASS

PEAK OUTPUT POWER (CONDUCTED).

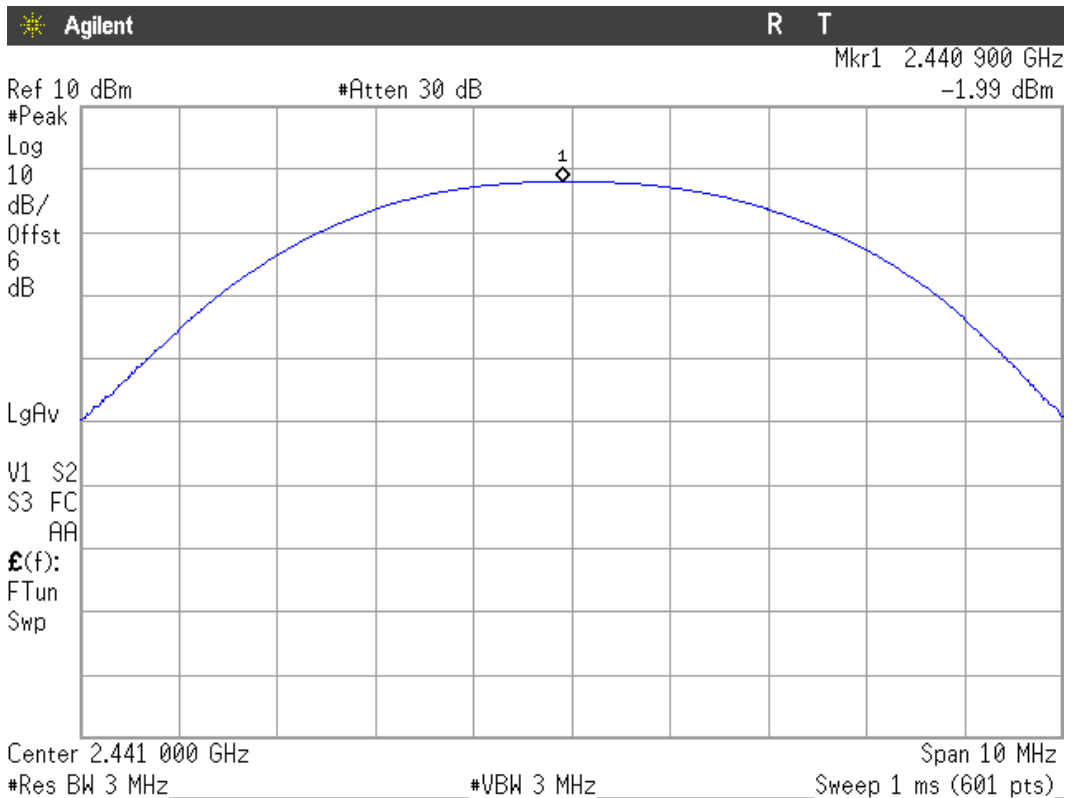
Modulation: GFSK

Lowest Channel: 2402 MHz.



Modulation: GFSK

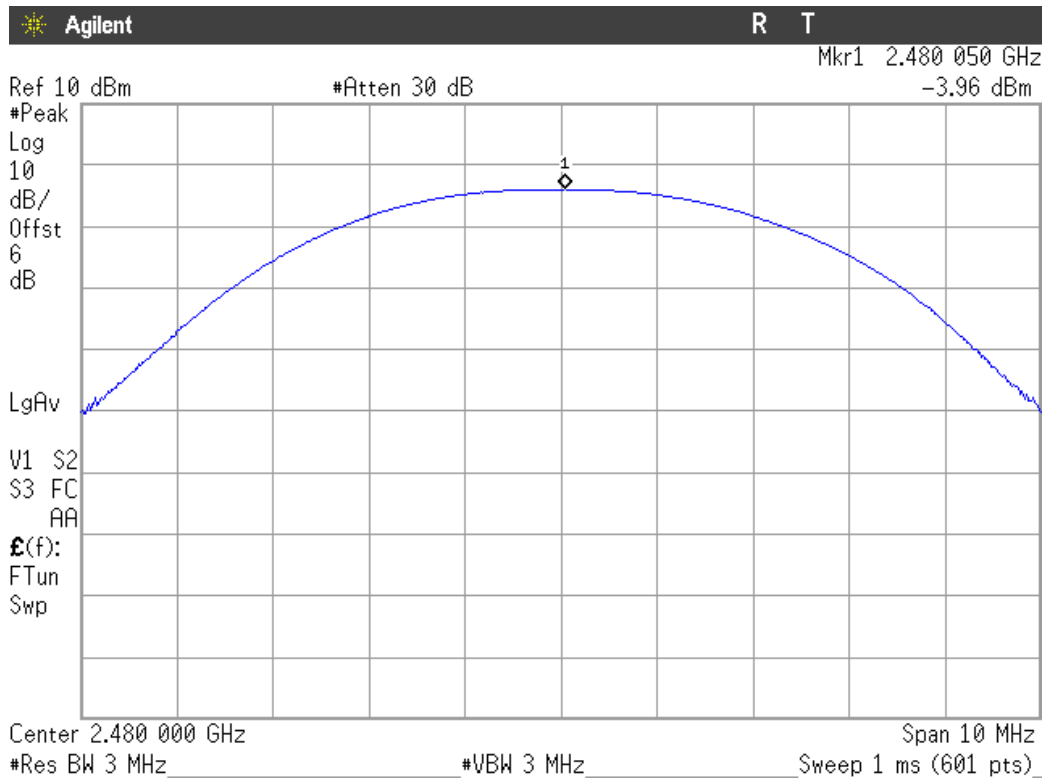
Middle Channel: 2441 MHz.



PEAK OUTPUT POWER (CONDUCTED).

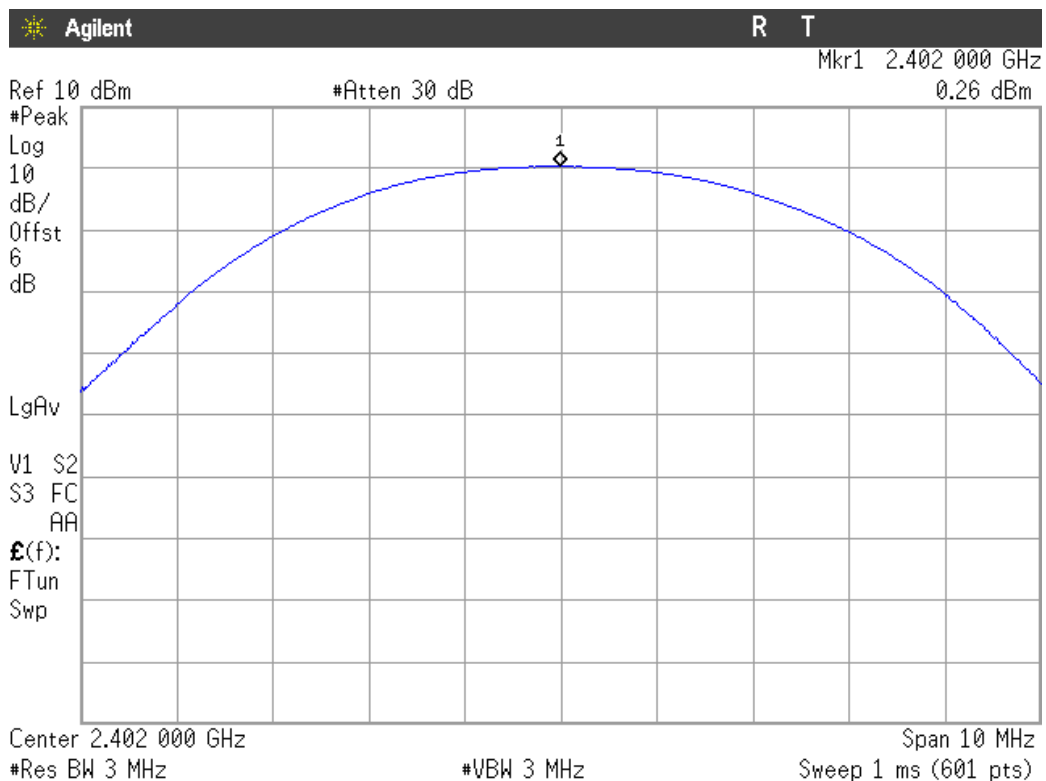
Modulation: GFSK

Highest Channel: 2480 MHz.



Modulation: $\Pi/4$ -DQPSK

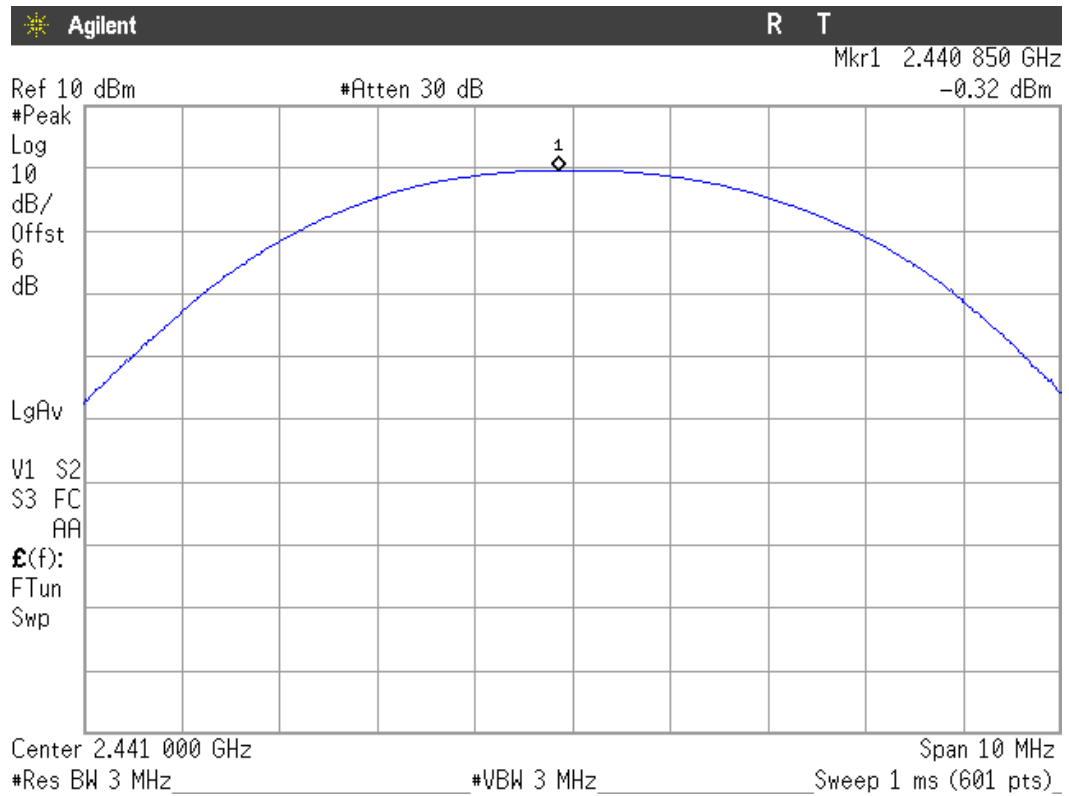
Lowest Channel: 2402 MHz



PEAK OUTPUT POWER (CONDUCTED)

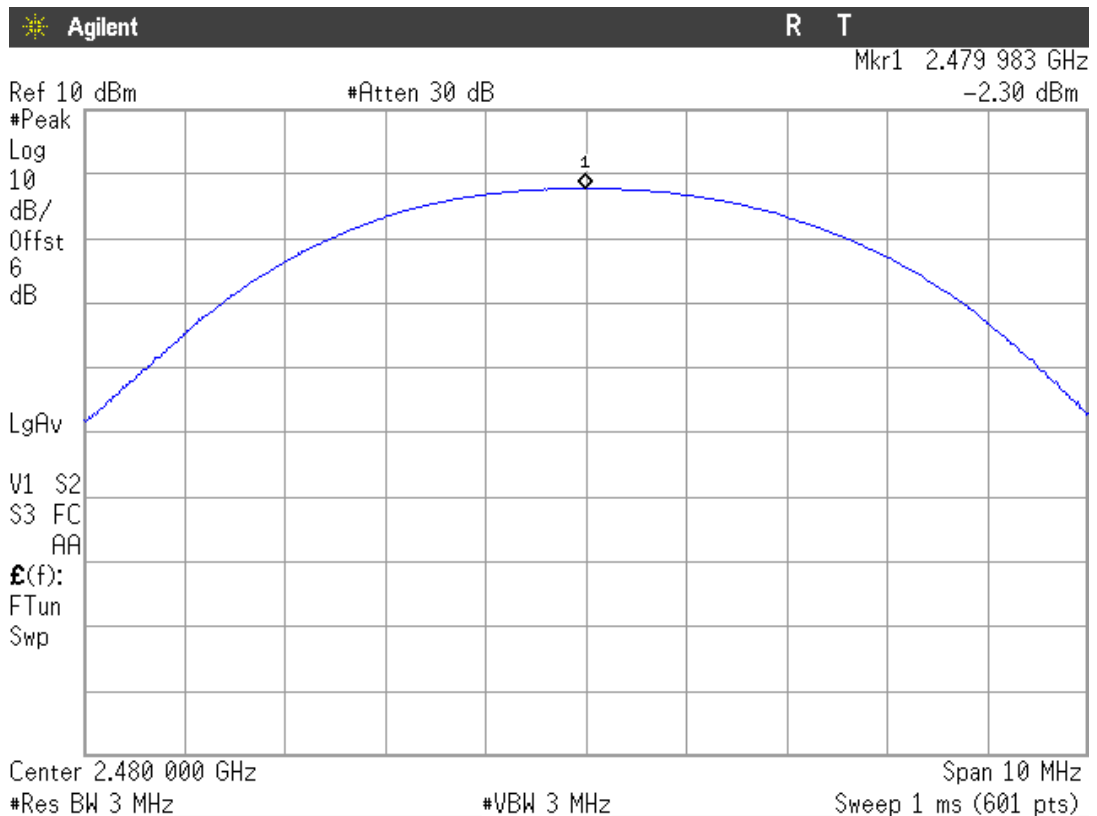
Modulation: $\Pi/4$ -DQPSK

Middle Channel: 2441 MHz.



Modulation: $\Pi/4$ -DQPSK

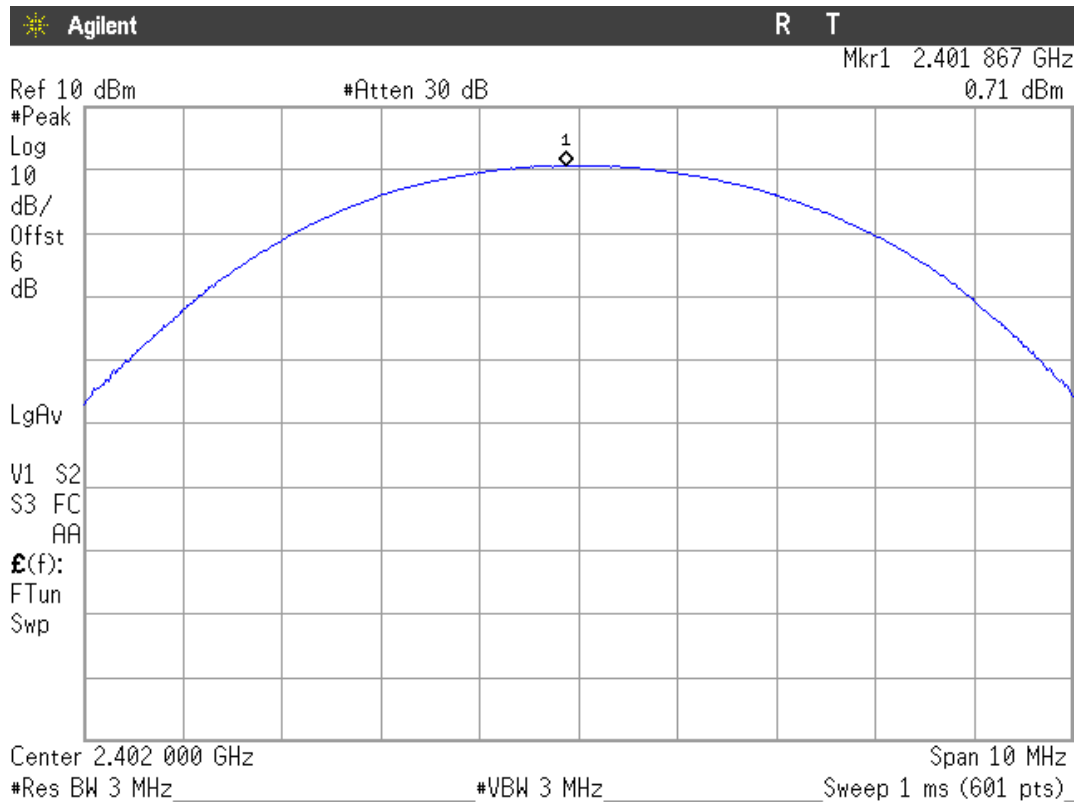
Highest Channel: 2480 MHz.



PEAK OUTPUT POWER (CONDUCTED).

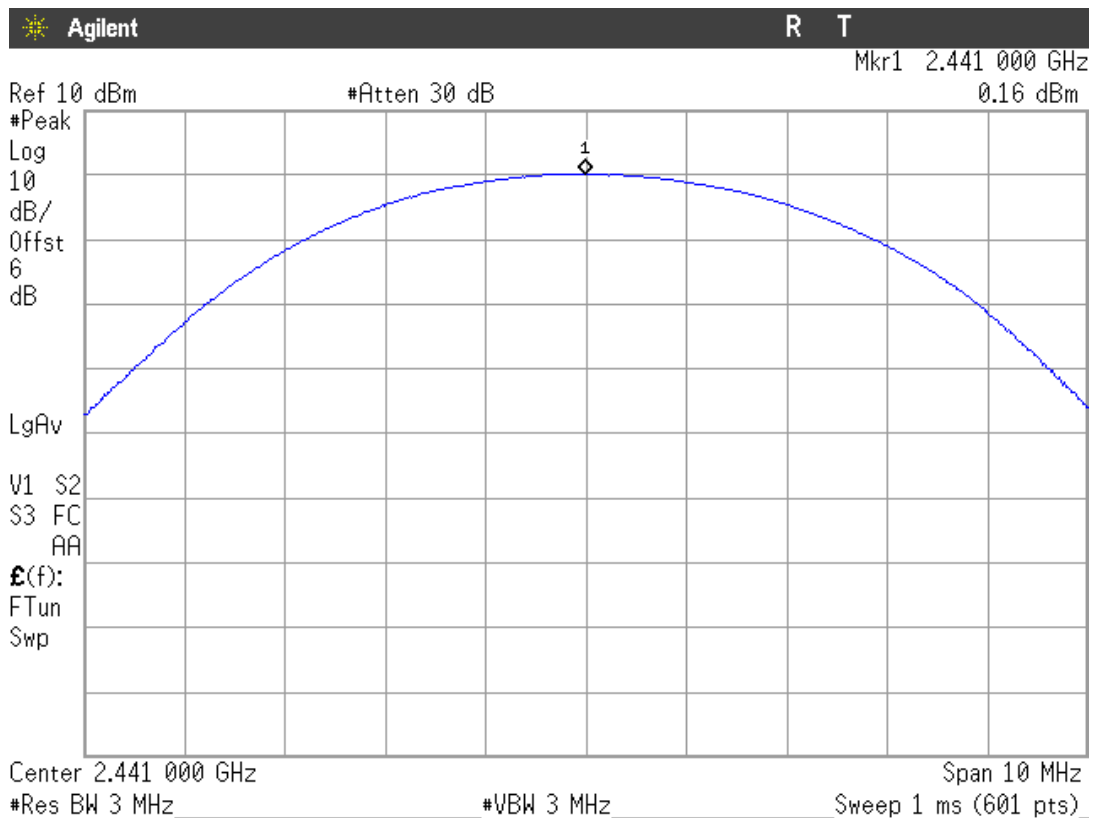
Modulation: 8-DPSK

Lowest Channel: 2402 MHz



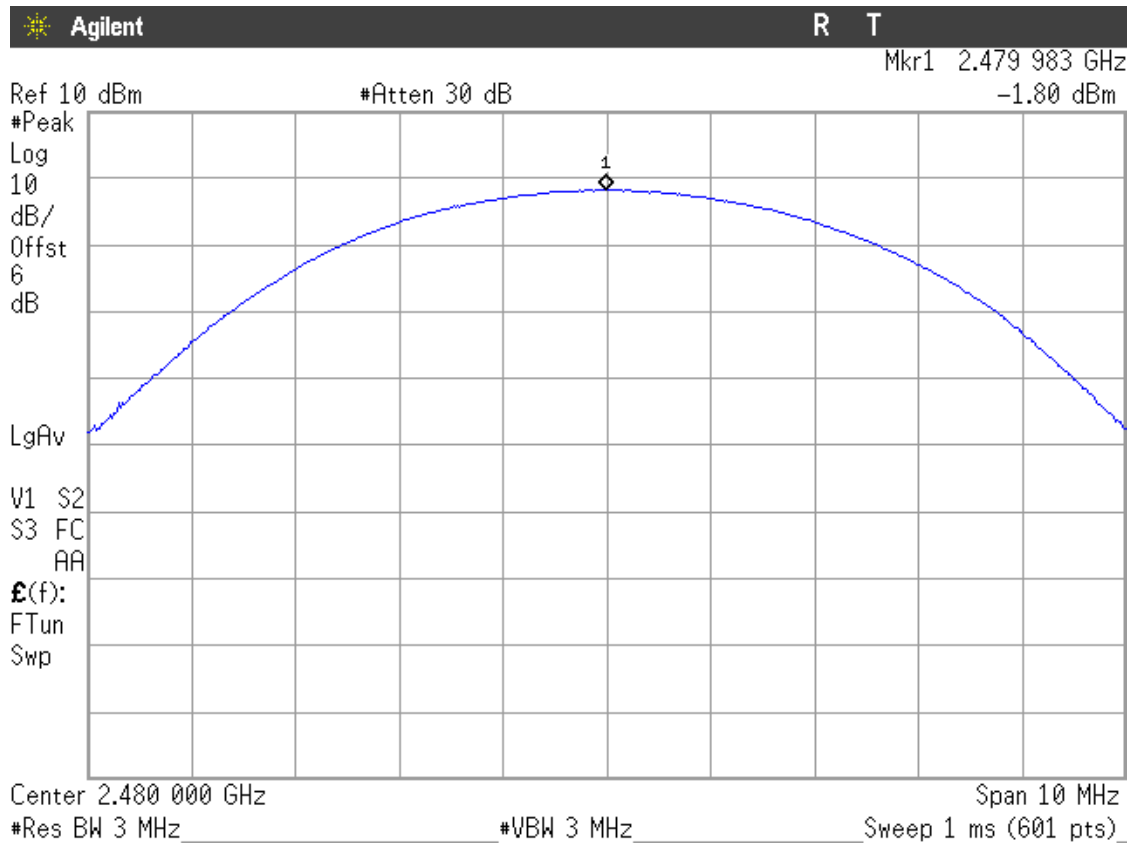
Modulation: 8-DPSK

Middle Channel: 2441 MHz.



PEAK OUTPUT POWER (CONDUCTED).

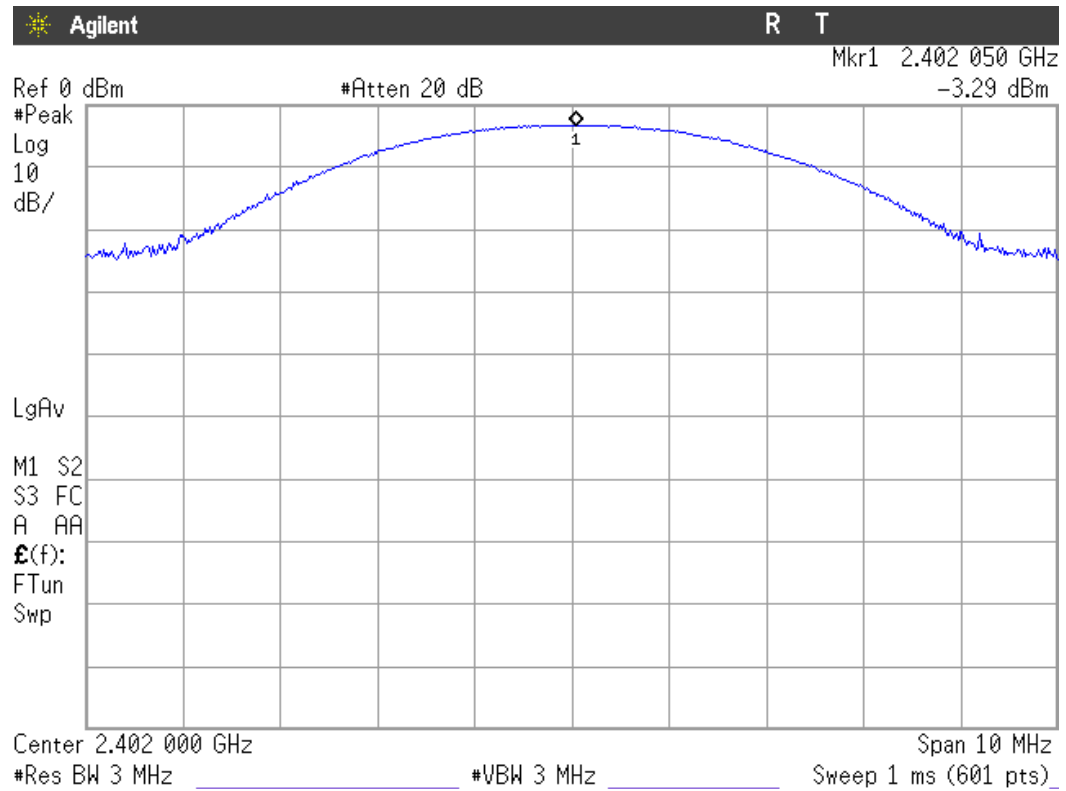
Modulation: 8-DPSK Highest Channel: 2480 MHz.



PEAK OUTPUT POWER (RADIATED).

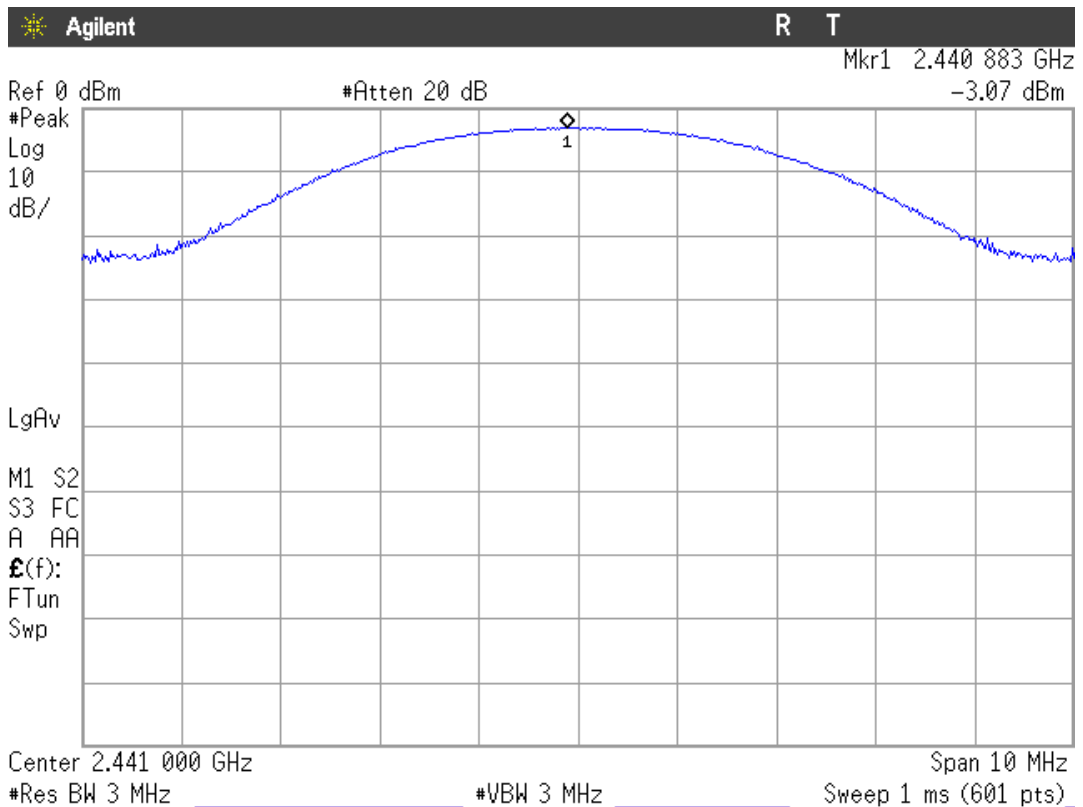
Modulation: GFSK

Lowest Channel: 2402 MHz.



Modulation: GFSK

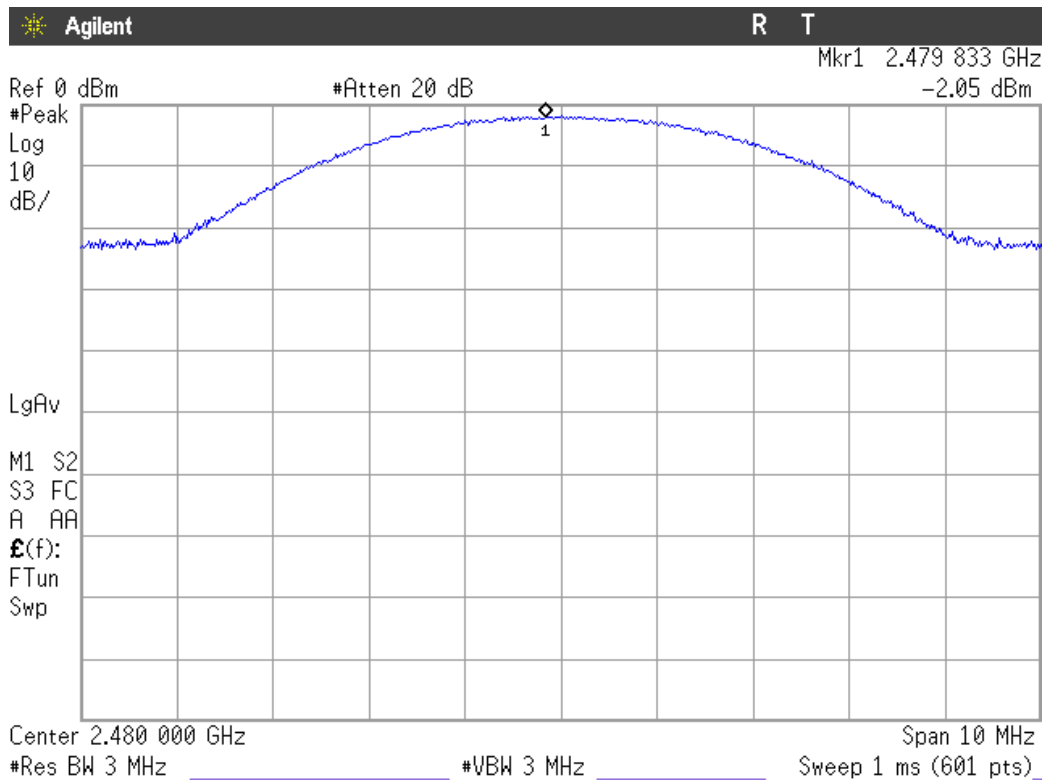
Middle Channel: 2441 MHz.



PEAK OUTPUT POWER (RADIATED).

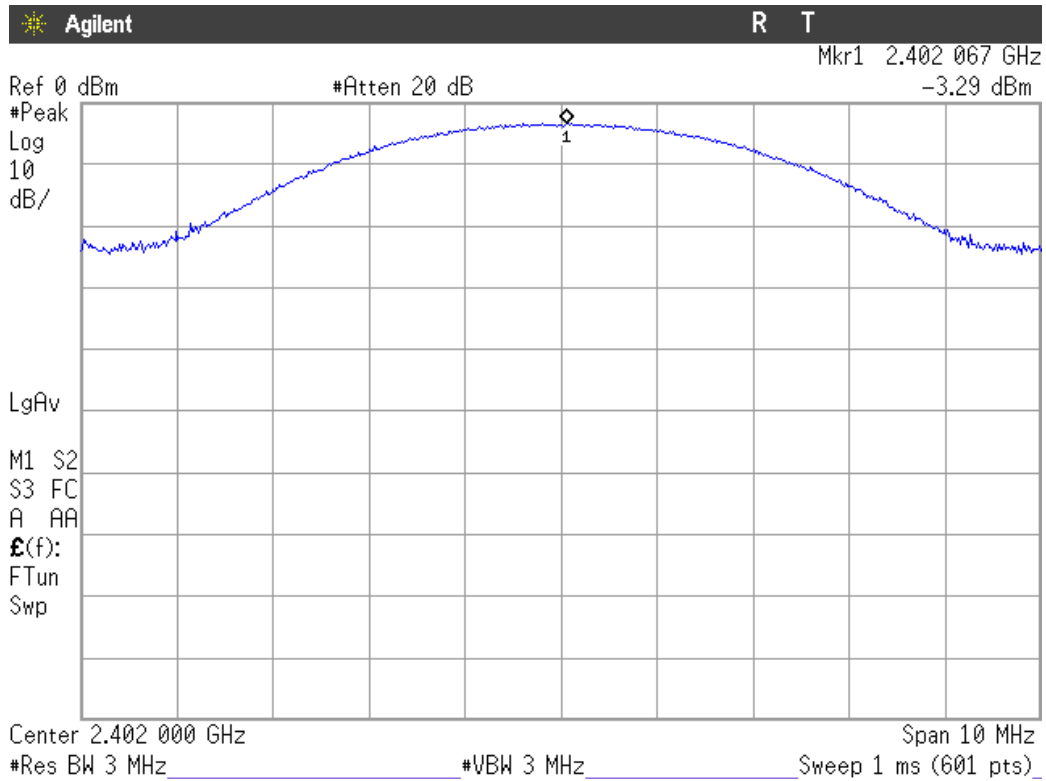
Modulation: GFSK

Highest Channel: 2480 MHz.



Modulation: $\pi/4$ -DQPSK

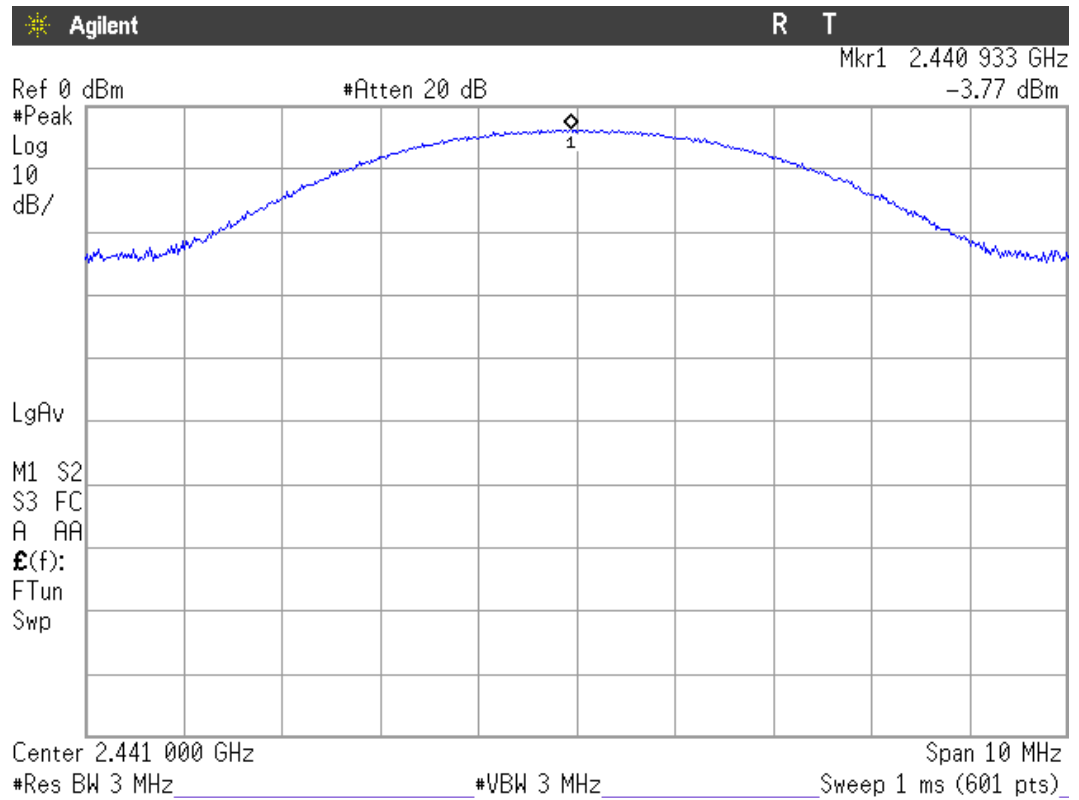
Lowest Channel: 2402 MHz.



PEAK OUTPUT POWER (RADIATED).

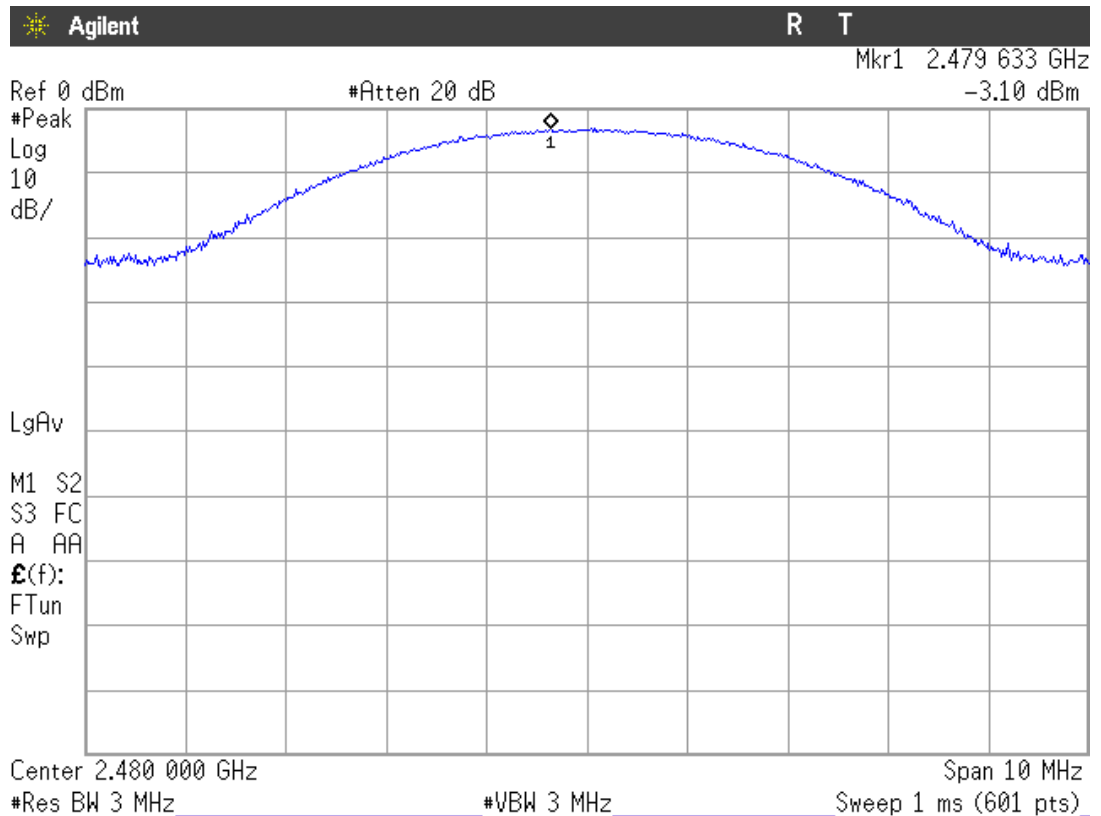
Modulation: $\Pi/4$ -DQPSK

Middle Channel: 2441 MHz.



Modulation: $\Pi/4$ -DQPSK

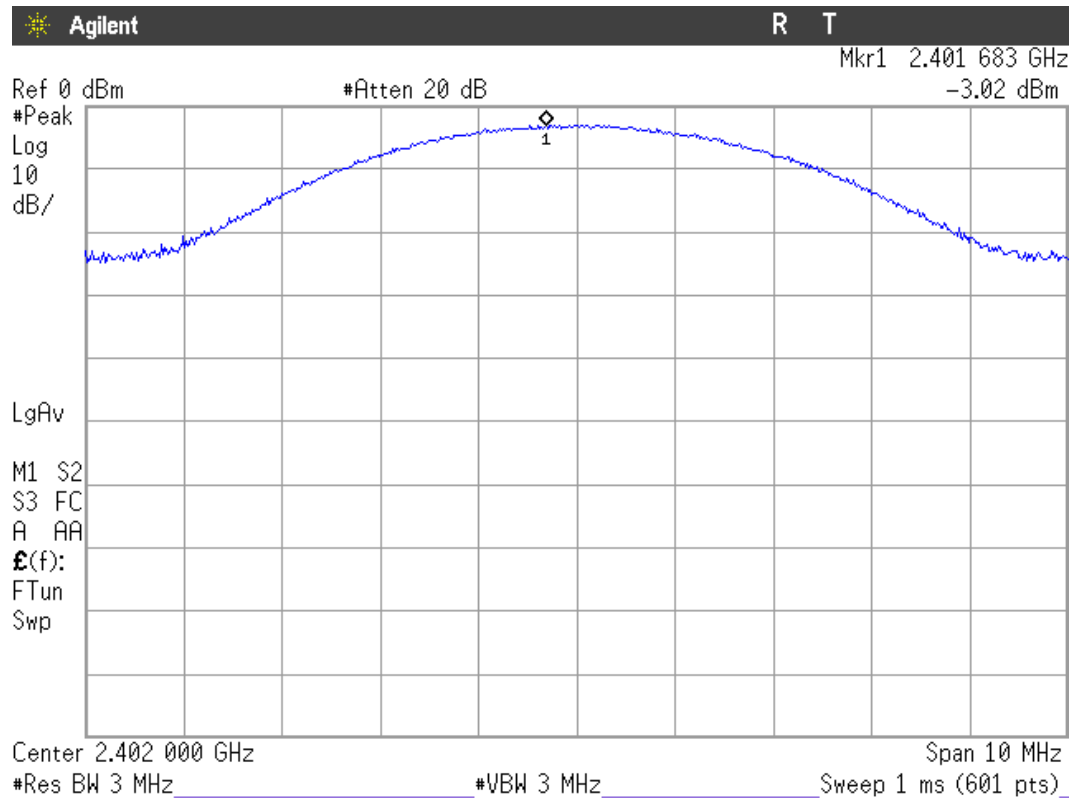
Highest Channel: 2480 MHz.



PEAK OUTPUT POWER (RADIATED).

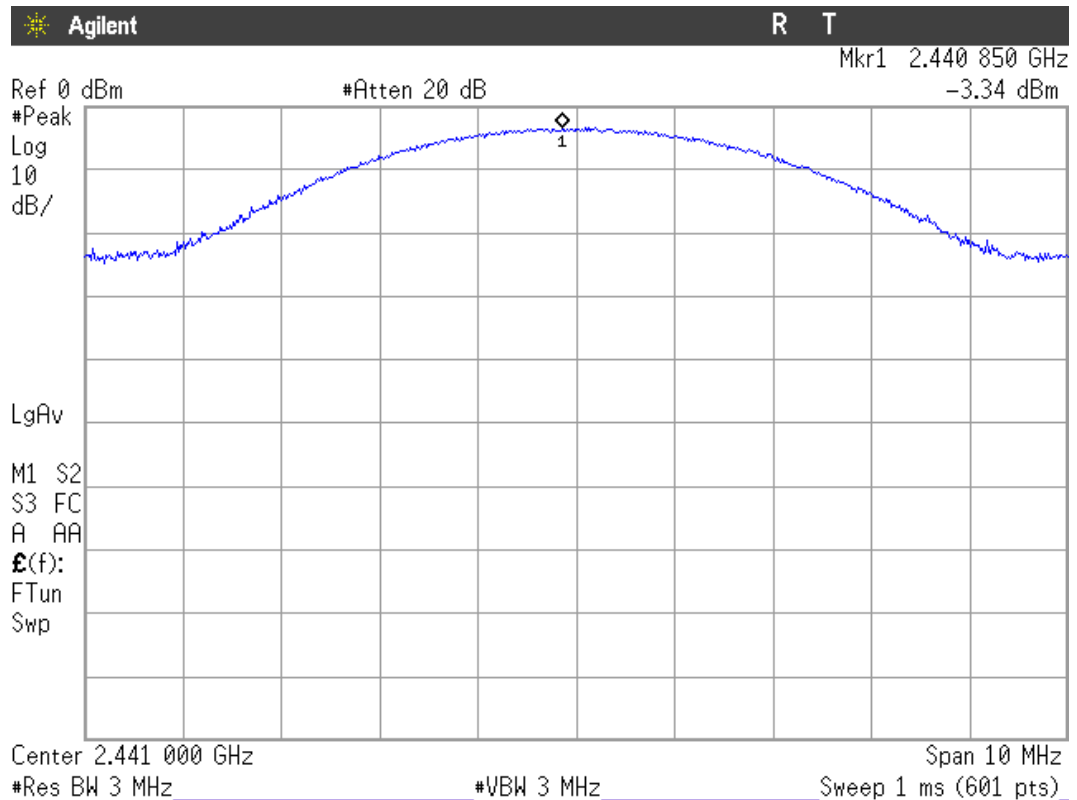
Modulation: 8-DPSK

Lowest Channel: 2402 MHz.



Modulation: 8-DPSK

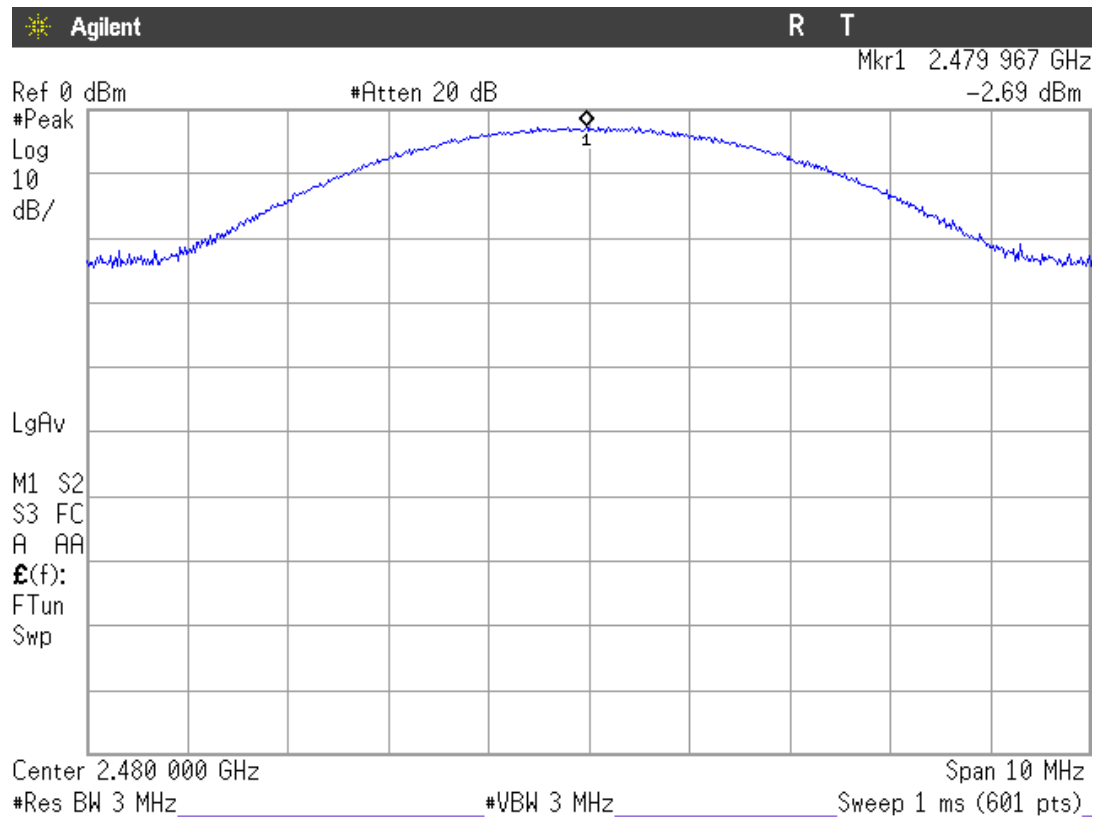
Middle Channel: 2441 MHz.



PEAK OUTPUT POWER (RADIATED).

Modulation: 8-DPSK

Highest Channel: 2480 MHz.



FCC Section 15.247 Subclause (d) / RSS-210 Is. 7, Clauses 2.2(b) & A8.5. Band-edge compliance of conducted emissions (Transmitter)

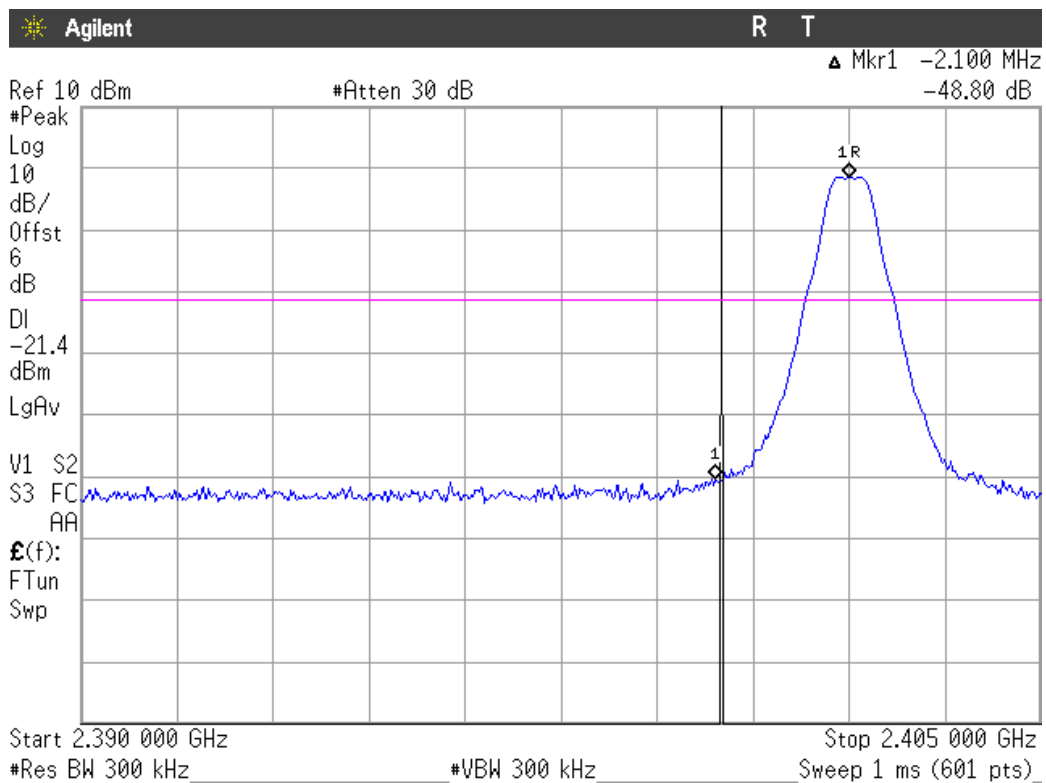
SPECIFICATION

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:

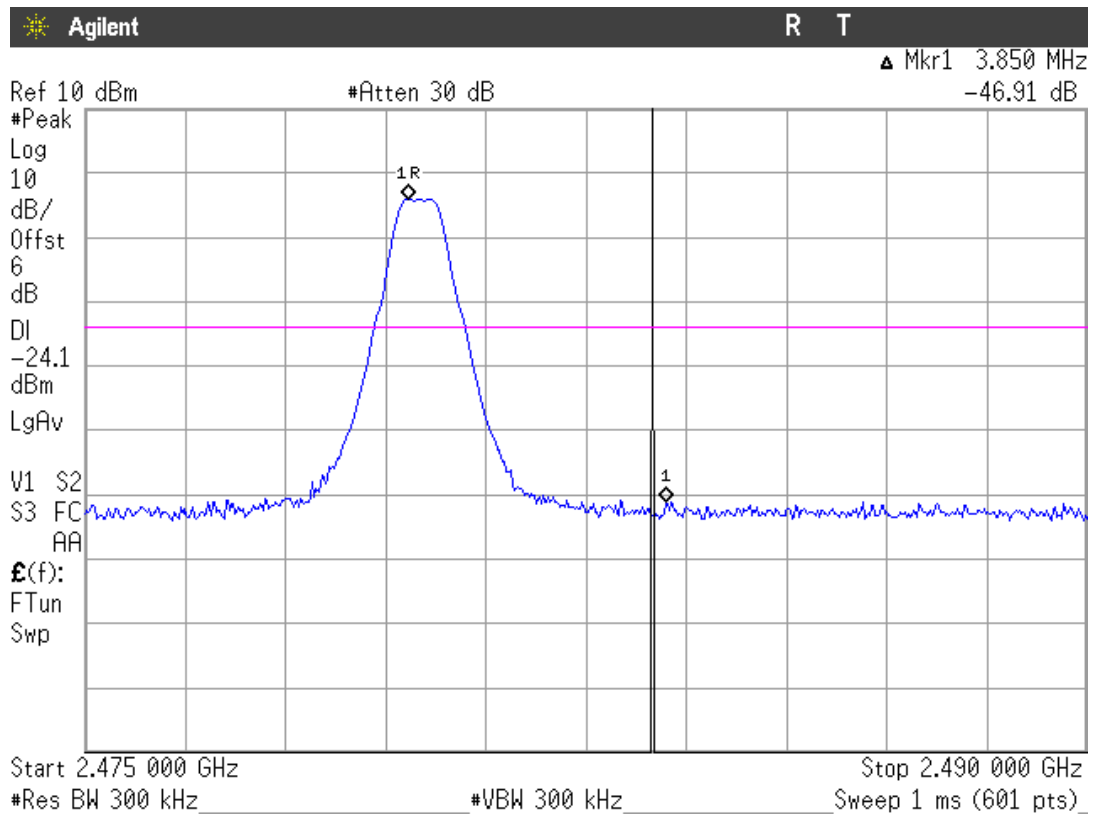
Modulation: GFSK

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



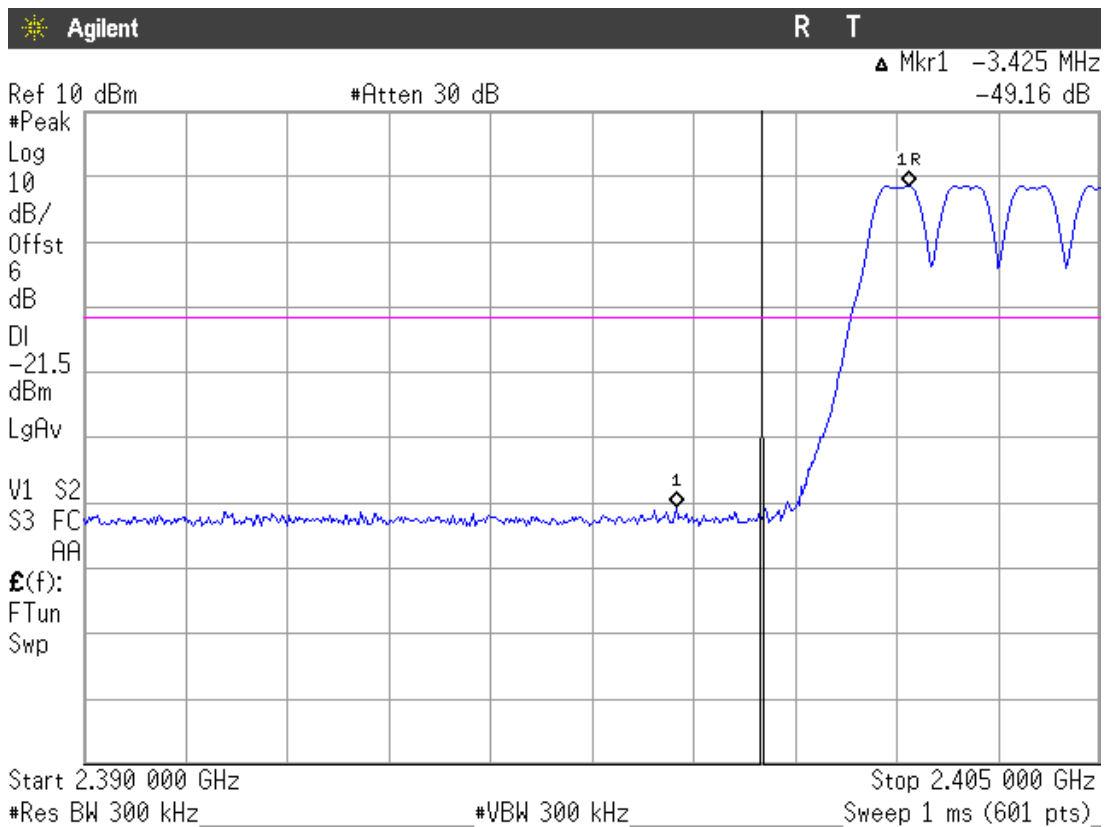
Verdict: PASS

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



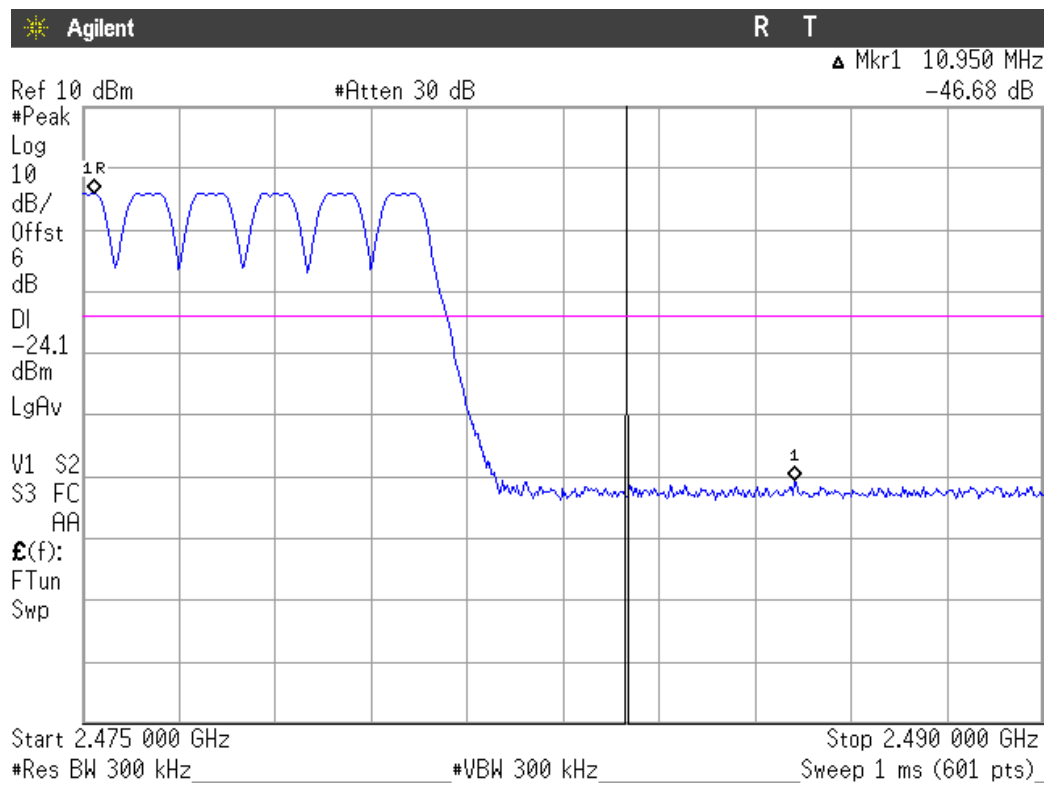
Verdict: PASS

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



Verdict: PASS

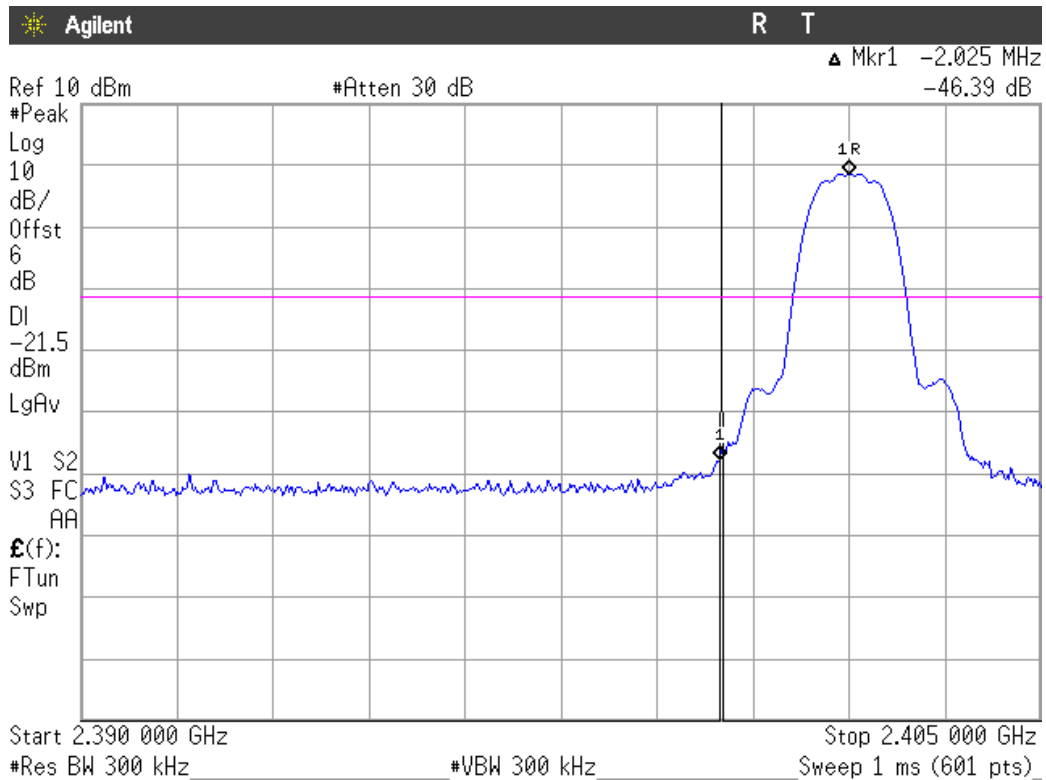
4. HIGH FREQUENCY SECTION (HOPPING ON). See next plot.



Verdict: PASS

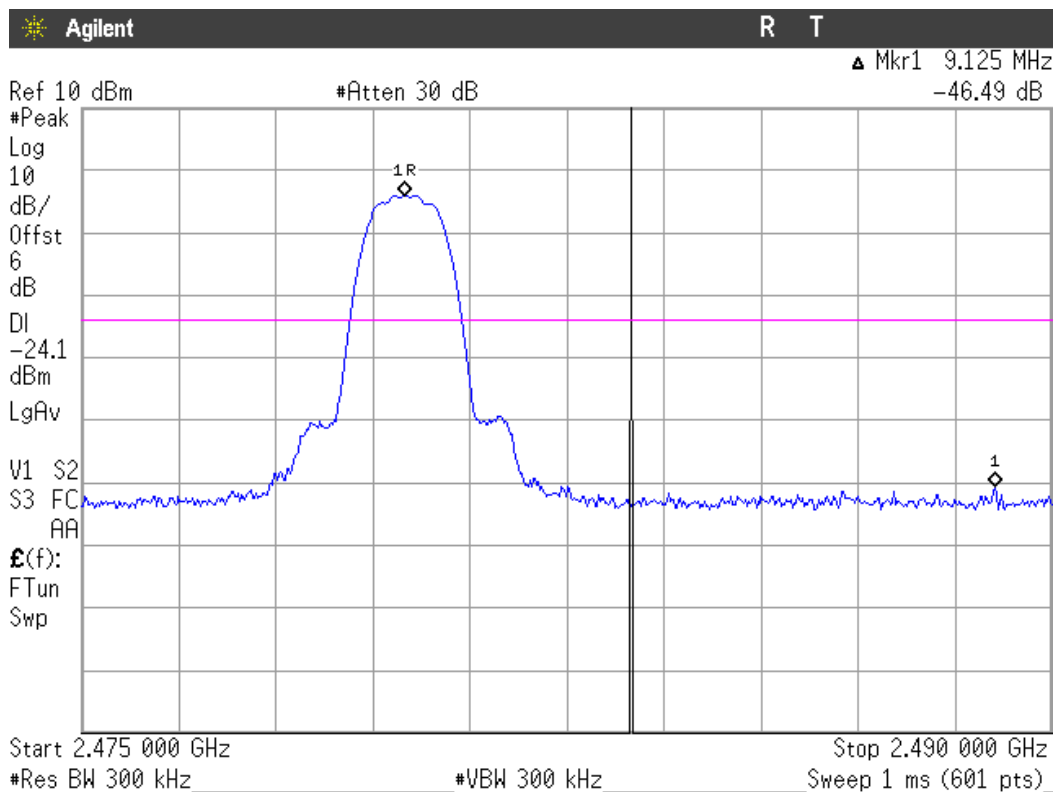
Modulation: $\Pi/4$ -DQPSK

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



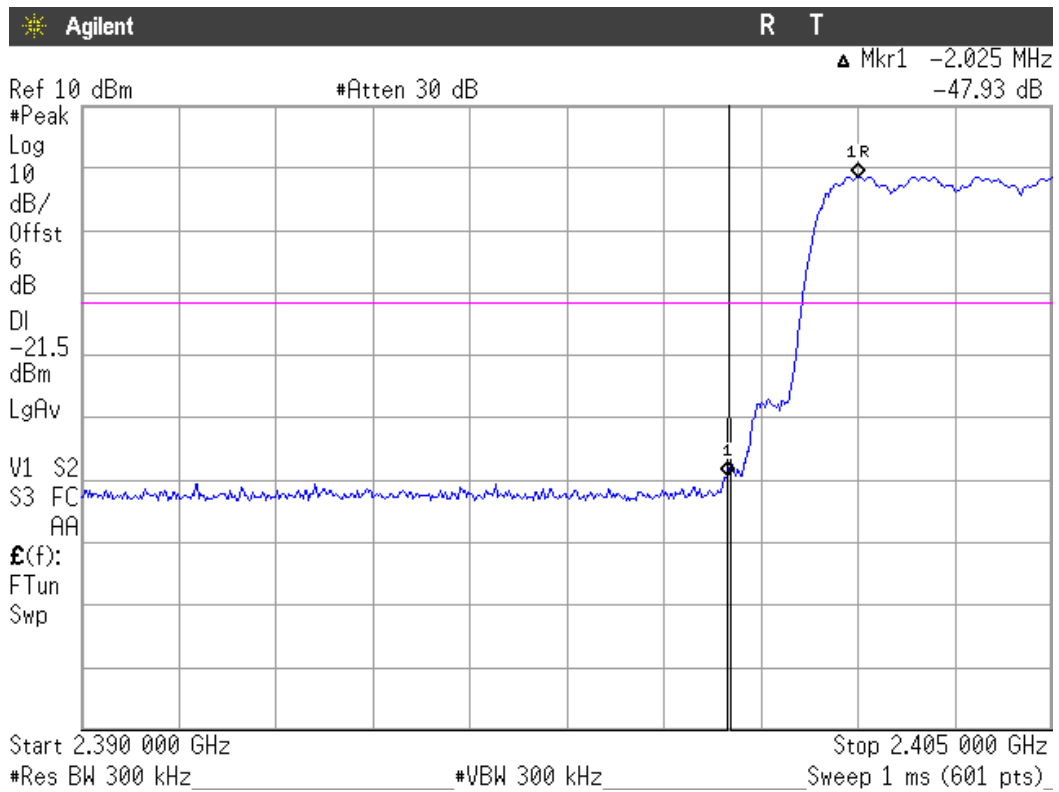
Verdict: PASS

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



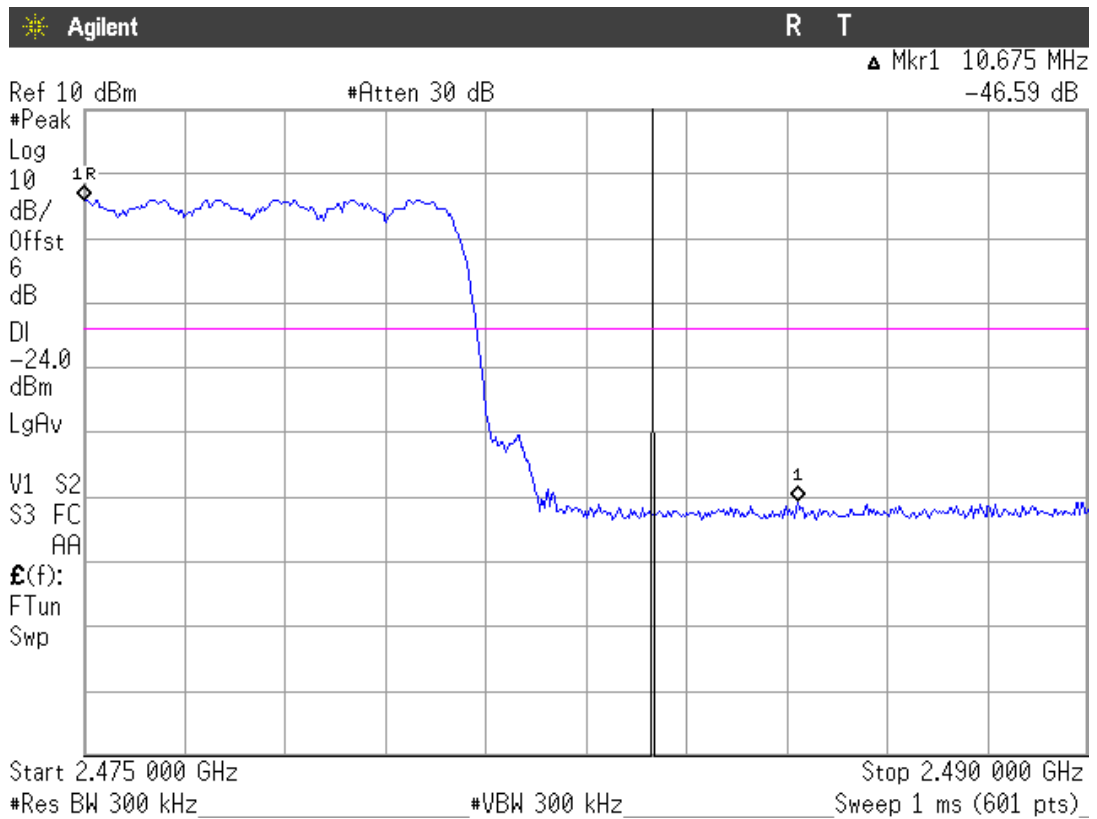
Verdict: PASS

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



Verdict: PASS

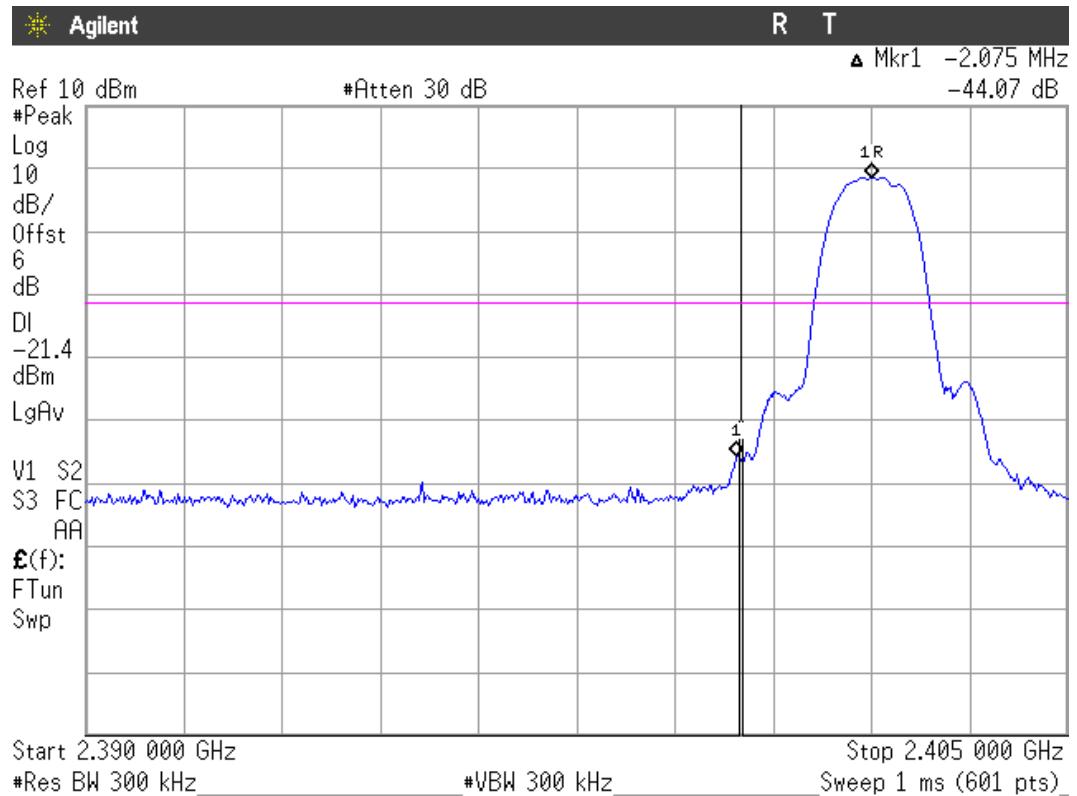
4. HIGH FREQUENCY SECTION (HOPPING ON). See next plot.



Verdict: PASS

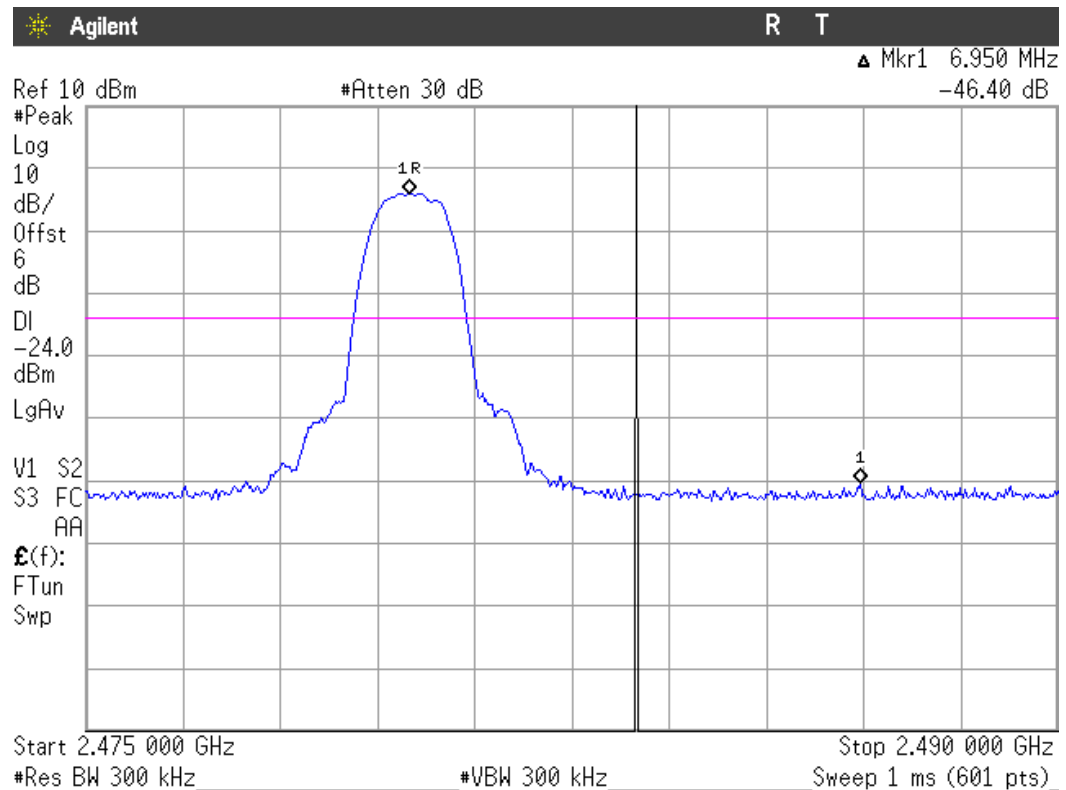
Modulation: 8-DPSK

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



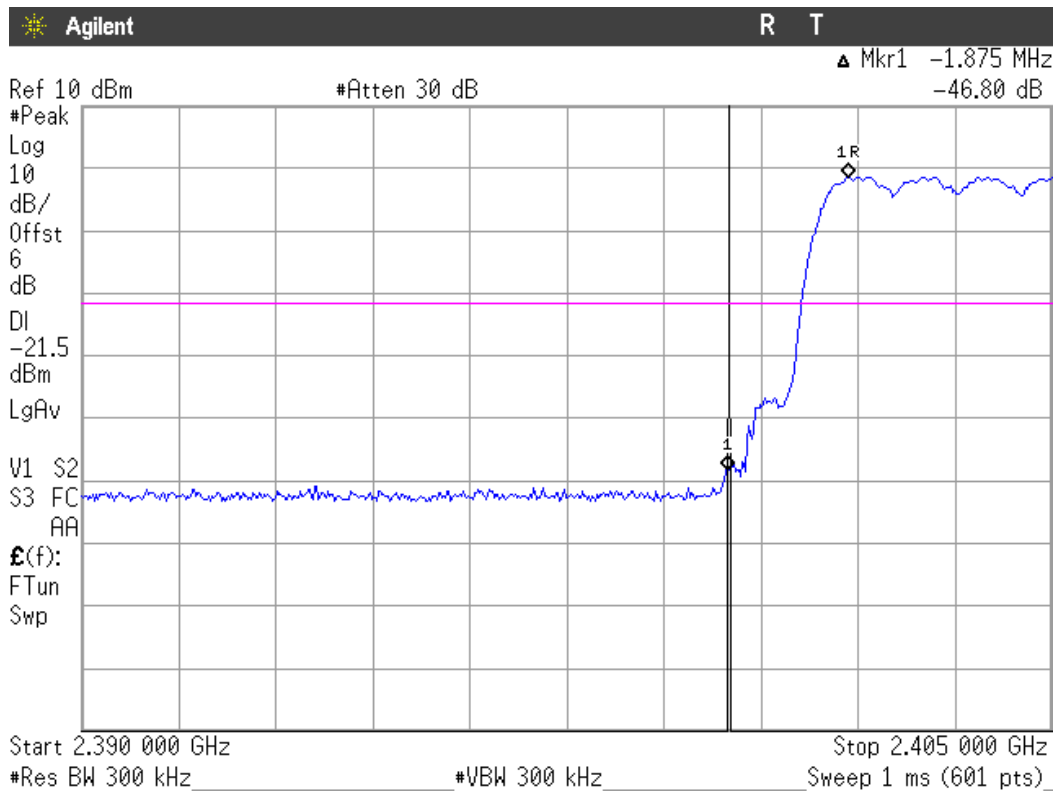
Verdict: PASS

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



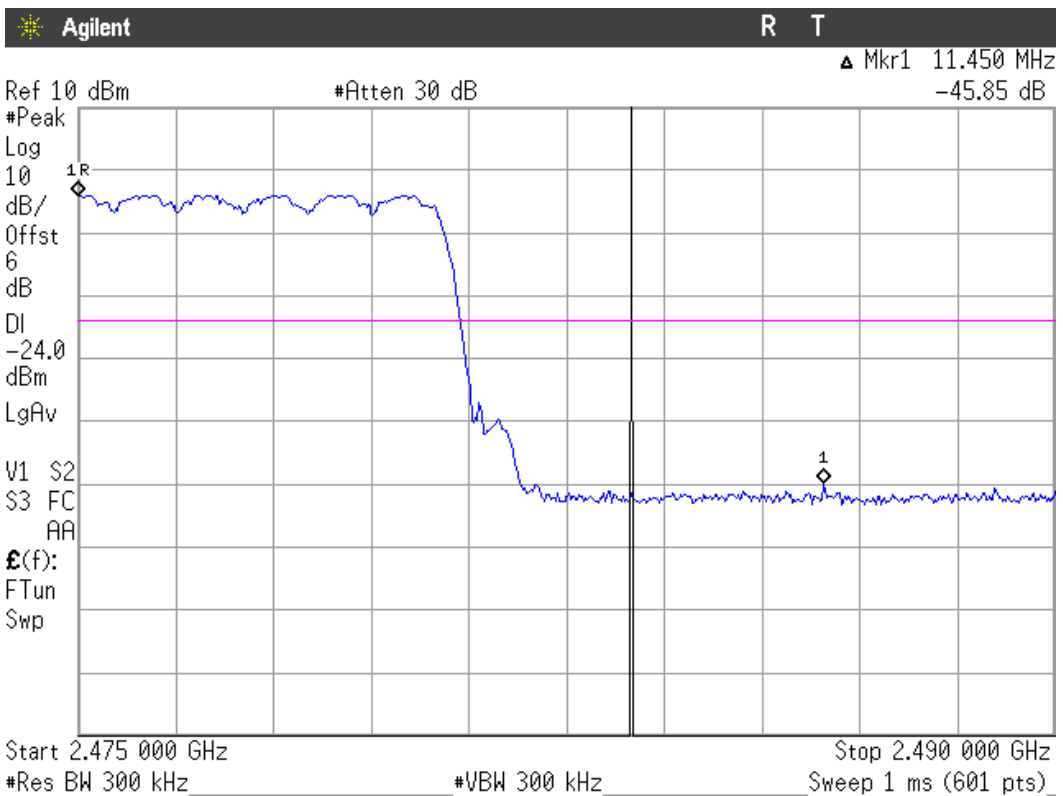
Verdict: PASS

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 Is. 7, Clauses 2.2(b) & 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.

RESULTS:

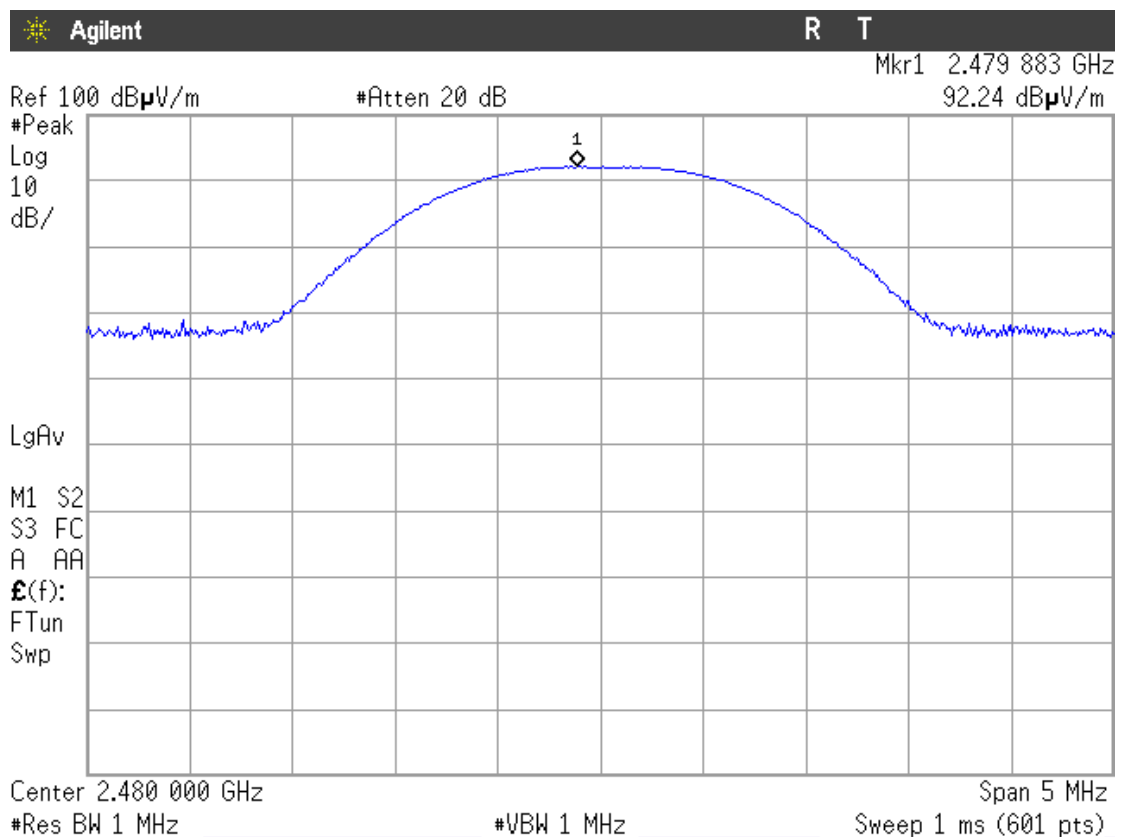
Band-edge compliance of radiated emissions

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

HIGHEST CHANNEL (2480 MHz):

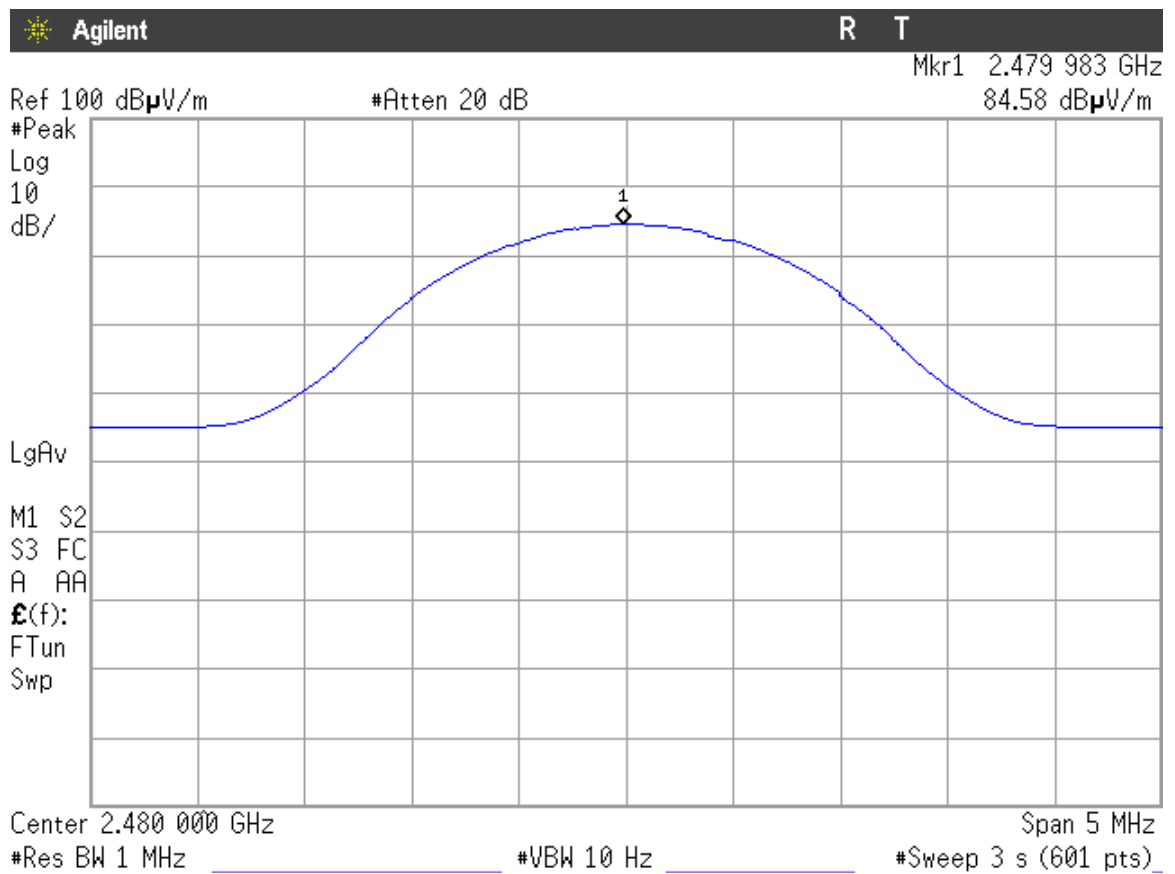
Modulation: GFSK

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.

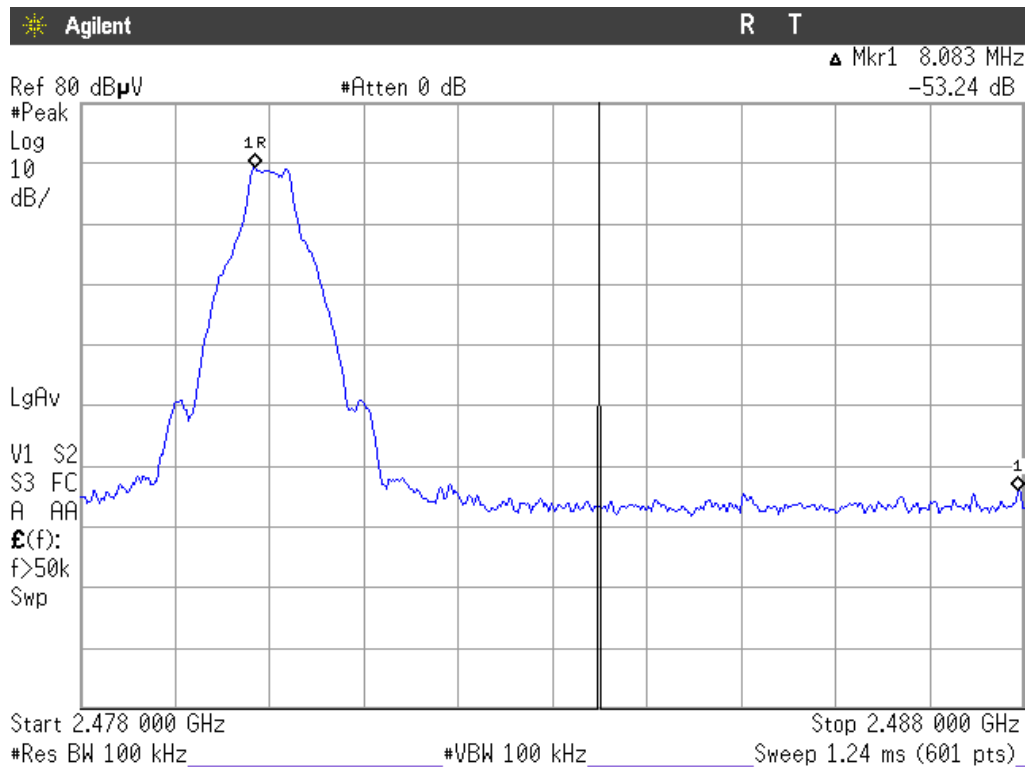
Maximum field strength at 3 m. Average value.



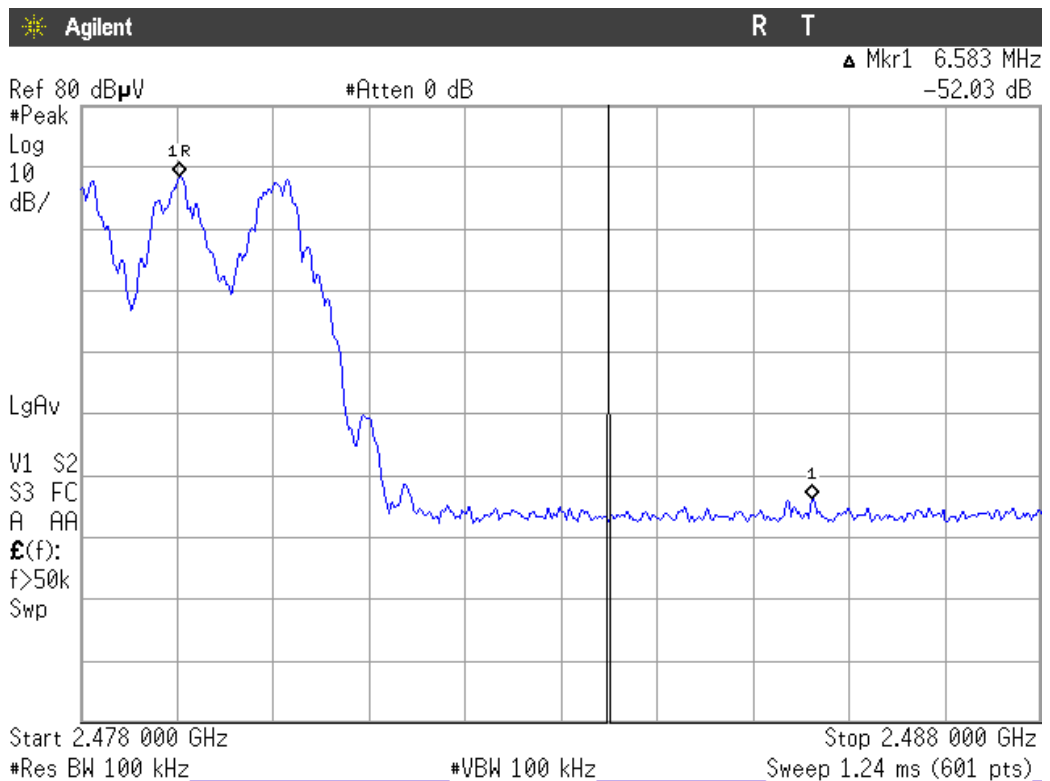
Note: The correction factor is already included in the spectrum analyzer as a transducer factor so that the marker shows directly the field strength level.

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

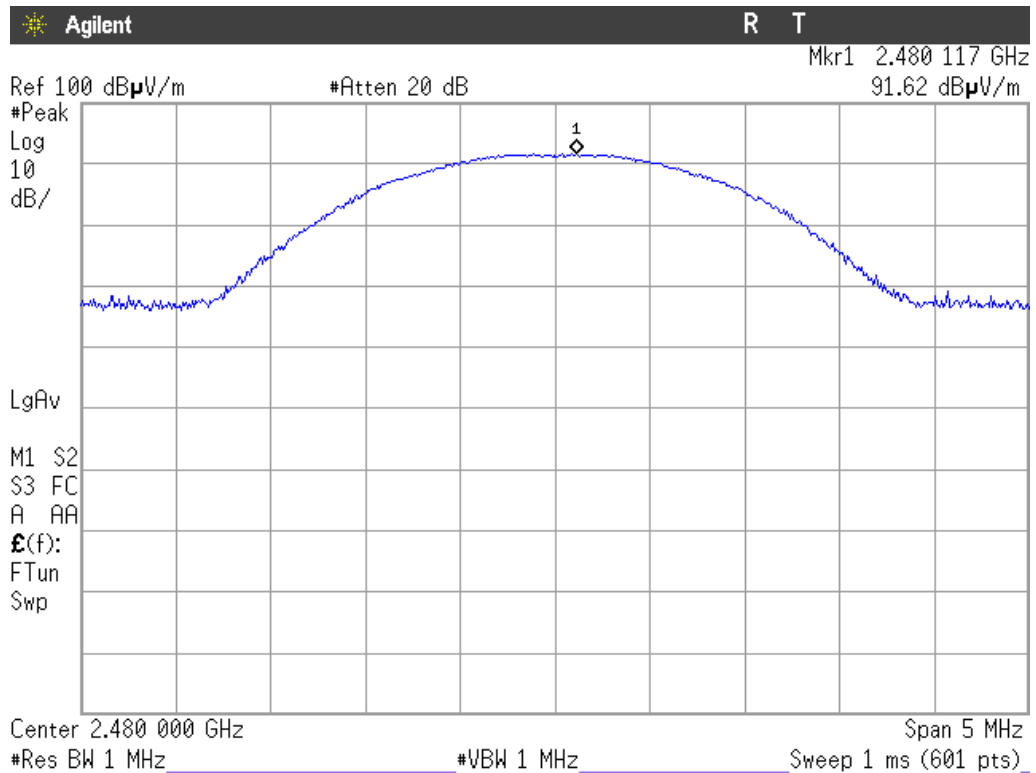
Fundamental max. average value 3 m	Delta value	Calculated value 3 m	Limit
84.58 dB μ V/m	53.24 dB (single carrier) 52.03 dB (hopping mode)	31.34 dB μ V/m (single carrier) 32.55 dB μ V/m (hopping mode)	54 dB μ V/m

Fundamental max. Peak value 3 m	Delta value	Calculated value 3 m	Limit
92.24 dB μ V/m	53.24 dB (single carrier) 52.03 dB (hopping mode)	39.00 dB μ V/m (single carrier) 40.21 dB μ V/m (hopping mode)	74 dB μ V/m

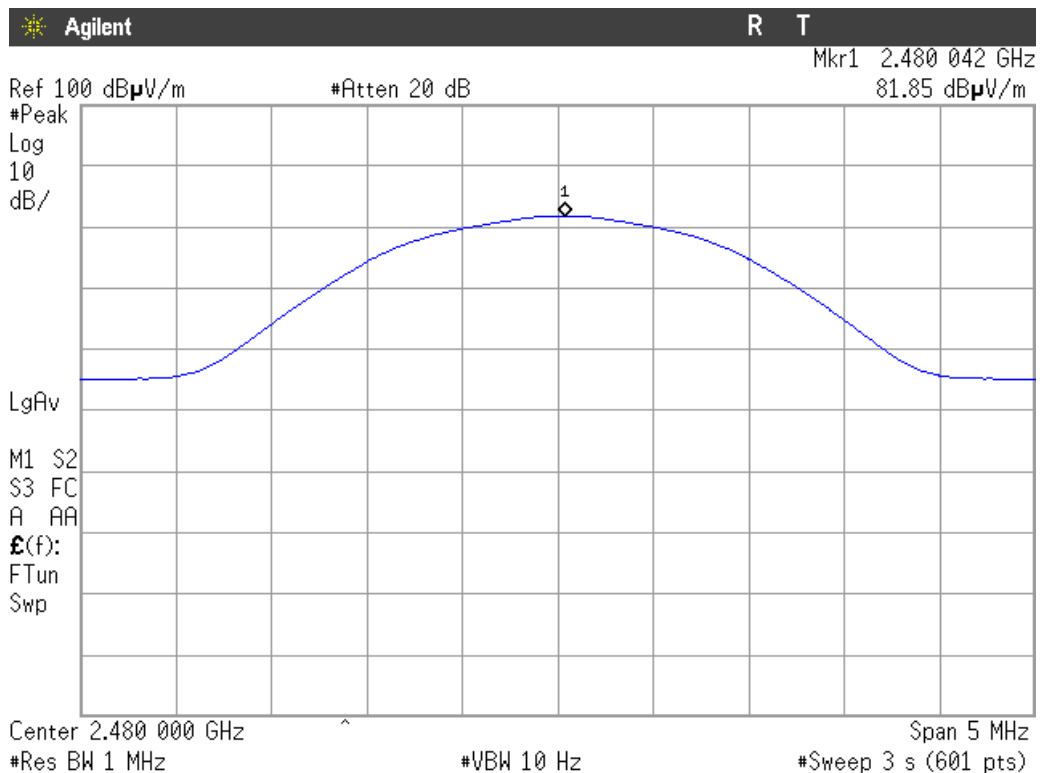
Verdict: PASS

Modulation: $\Pi/4$ -DQPSK

Maximum field strength at 3 m. Peak value.



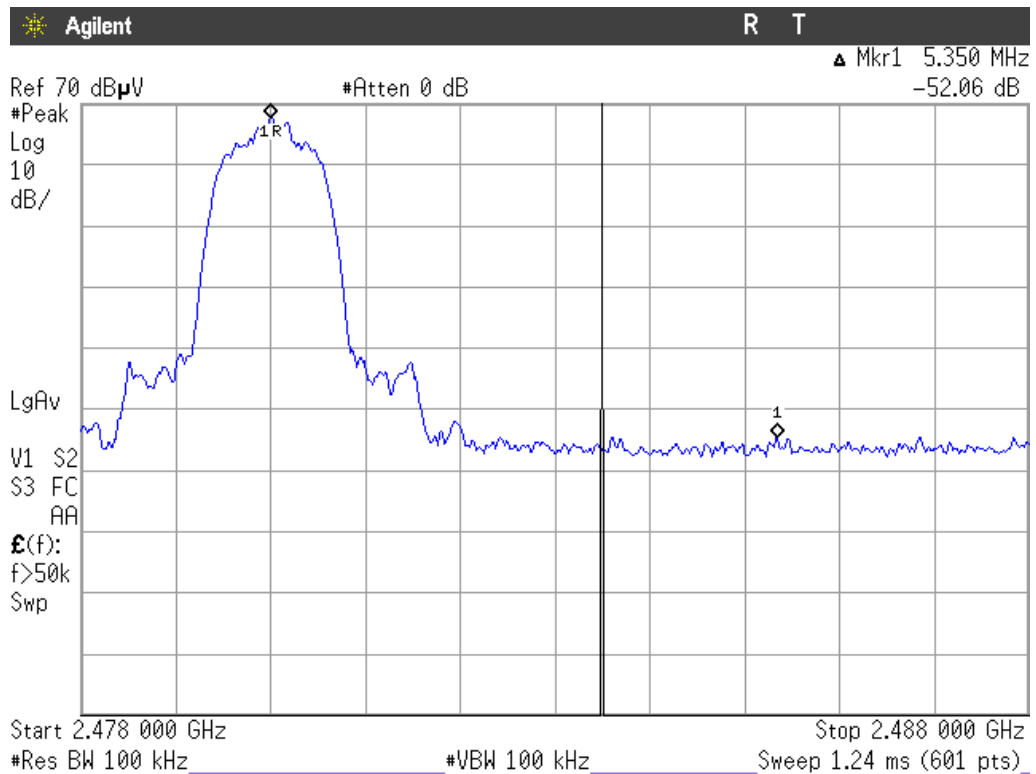
Maximum field strength at 3 m. Average value.



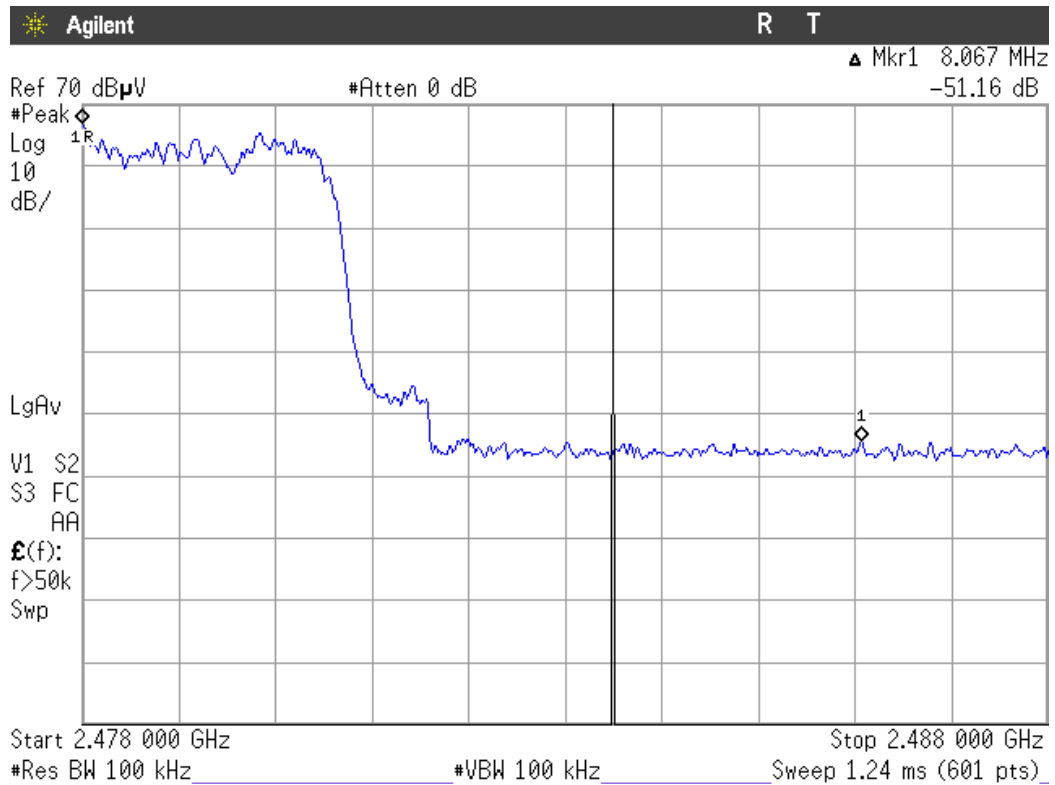
Note: The correction factor is already included in the spectrum analyzer as a transducer factor so that the marker shows directly the field strength level.

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

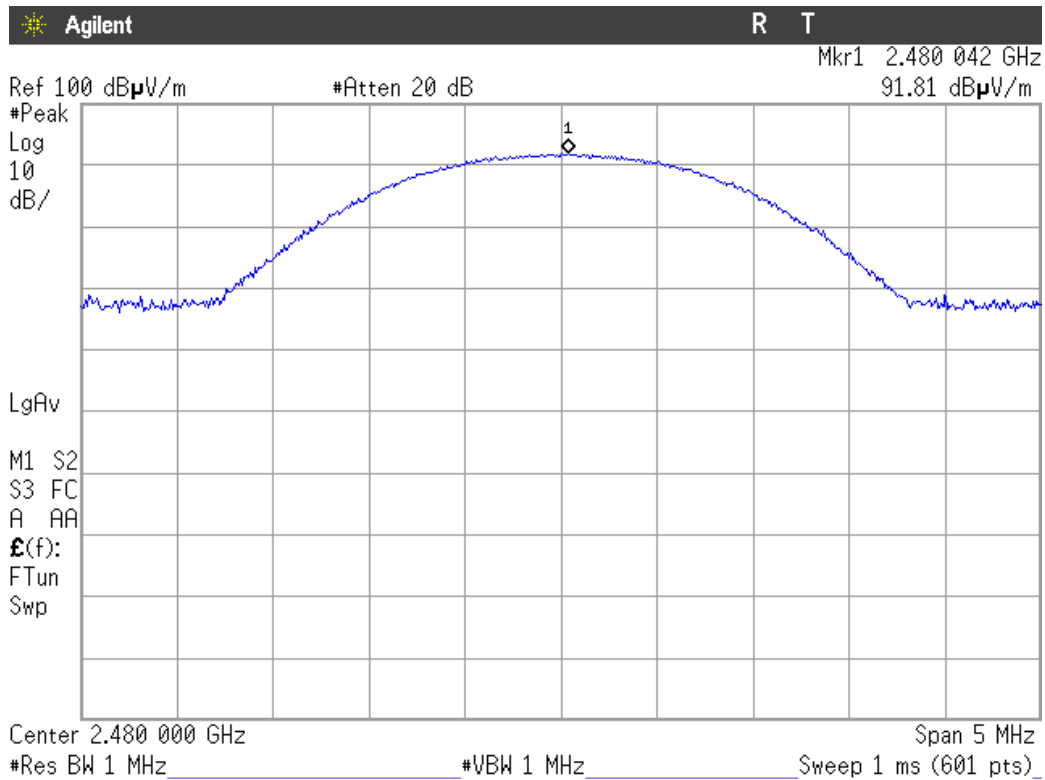
Fundamental max. average value 3 m	Delta value	Calculated value 3 m	Limit
81.85 dB μ V/m	52.06 dB (single carrier) 51.16 dB (hopping mode)	29.79 dB μ V/m (single carrier) 30.69 dB μ V/m (hopping mode)	54 dB μ V/m

Fundamental max. Peak value 3 m	Delta value	Calculated value 3 m	Limit
91.62 dB μ V/m	52.06 dB (single carrier) 51.16 dB (hopping mode)	39.56 dB μ V/m (single carrier) 40.46 dB μ V/m (hopping mode)	74 dB μ V/m

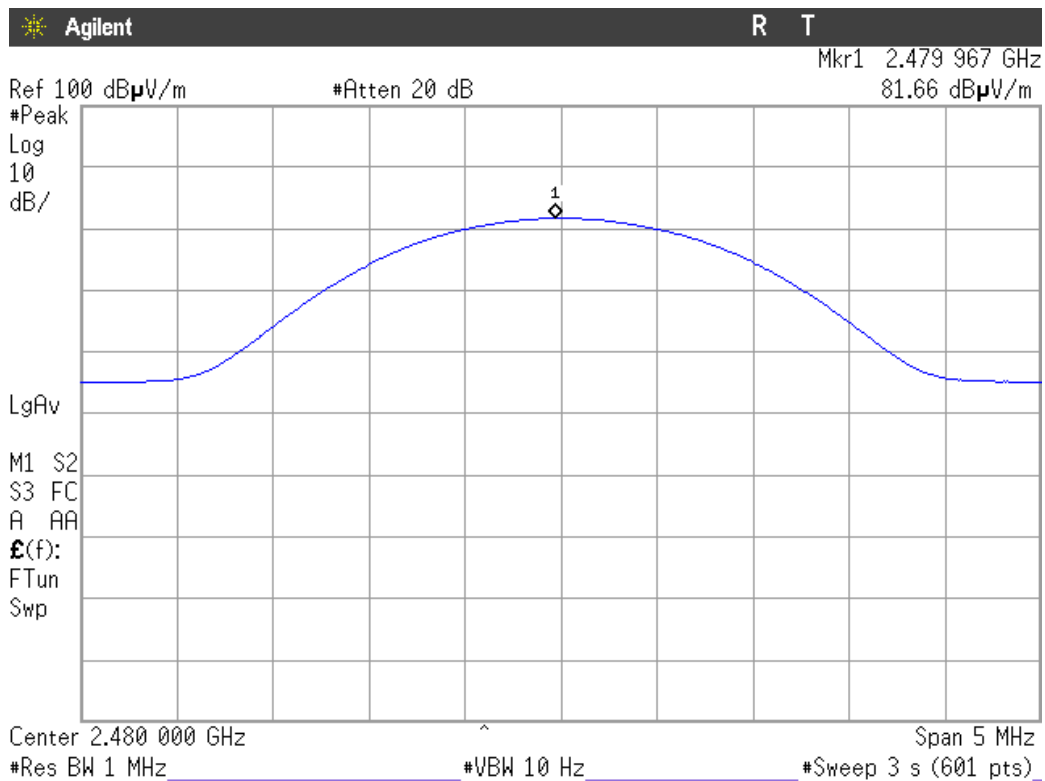
Verdict: PASS

Modulation: 8-DPSK

Maximum field strength at 3 m. Peak value.



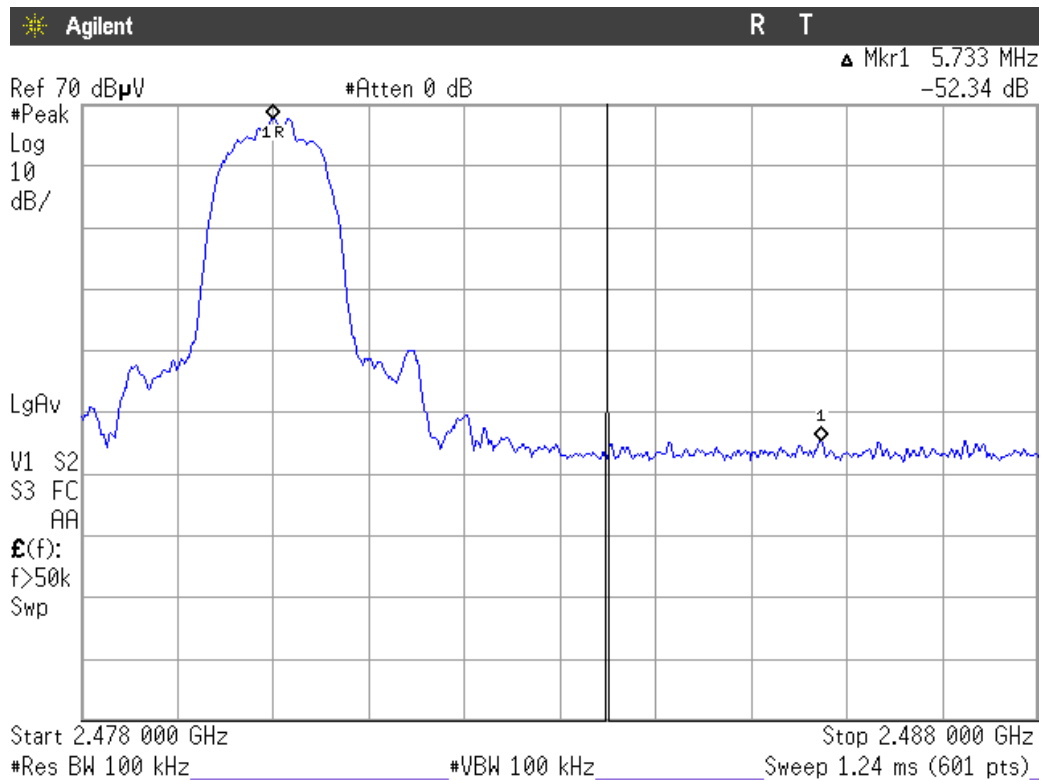
Maximum field strength at 3 m. Average value.



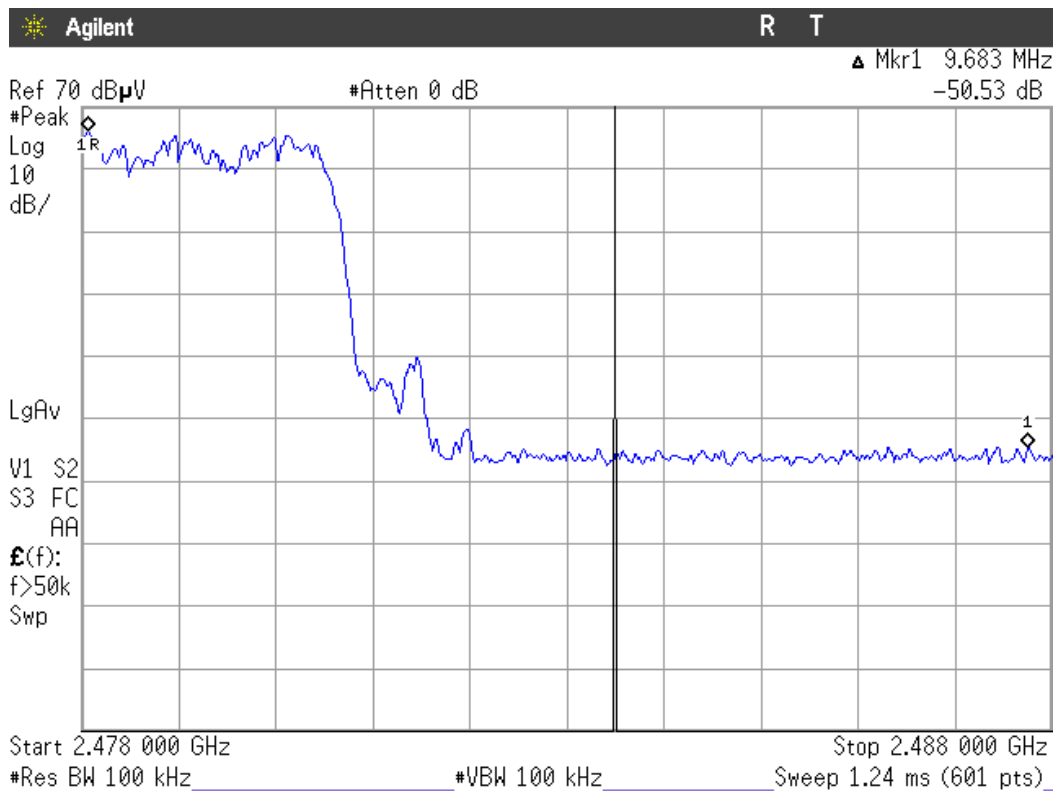
Note: The correction factor is already included in the spectrum analyzer as a transducer factor so that the marker shows directly the field strength level.

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
81.66 dB μ V/m	52.34 dB (single carrier) 50.53 dB (hopping mode)	29.32 dB μ V/m (single carrier) 31.13 dB μ V/m (hopping mode)	54 dB μ V/m

Fundamental max. Peak value 3 m	Delta value	Calculated value 3 m	Limit
91.81 dB μ V/m	52.34 dB (single carrier) 50.53 dB (hopping mode)	39.47 dB μ V/m (single carrier) 41.28 dB μ V/m (hopping mode)	74 dB μ V/m

Verdict: PASS

FCC Section 15.247 Subclause (d) / RSS-210 Is. 7, Clauses 2.2(b) & A8.5. Emission limitations conducted (Transmitter)

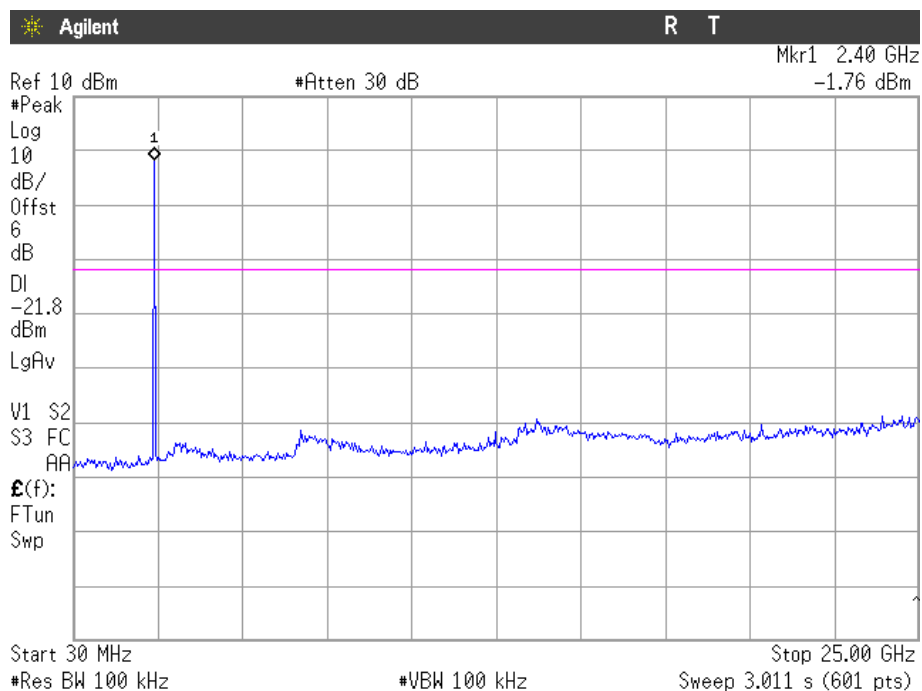
SPECIFICATION

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

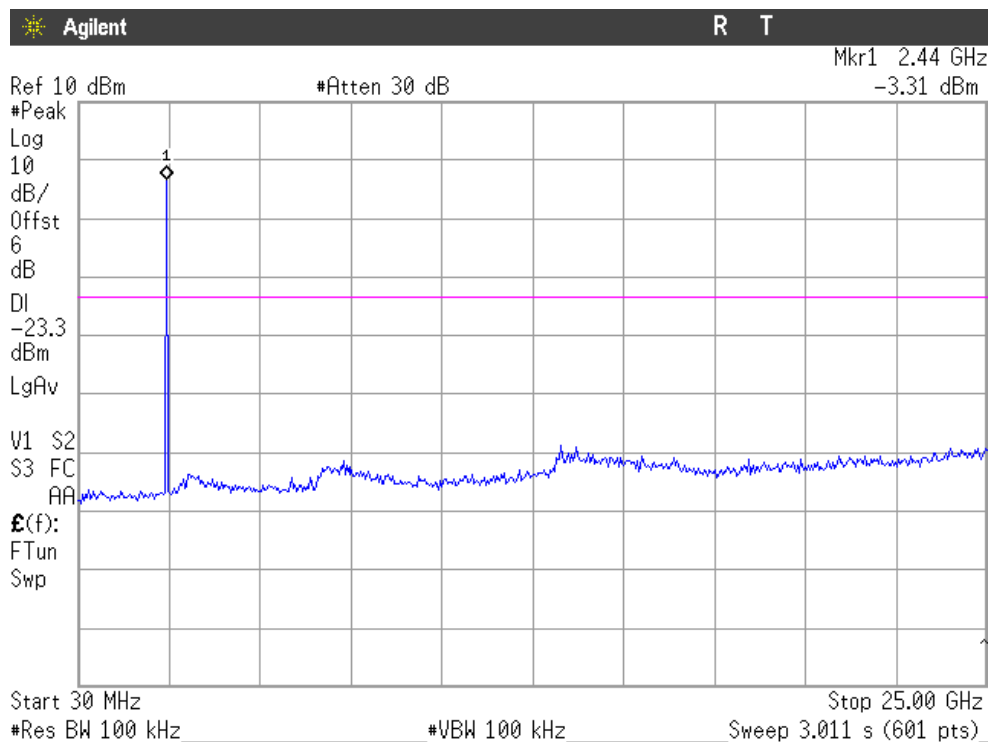
1. LOWEST CHANNEL (2402 MHz): 30 MHz-25 GHz (see next plot).



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

Verdict: PASS

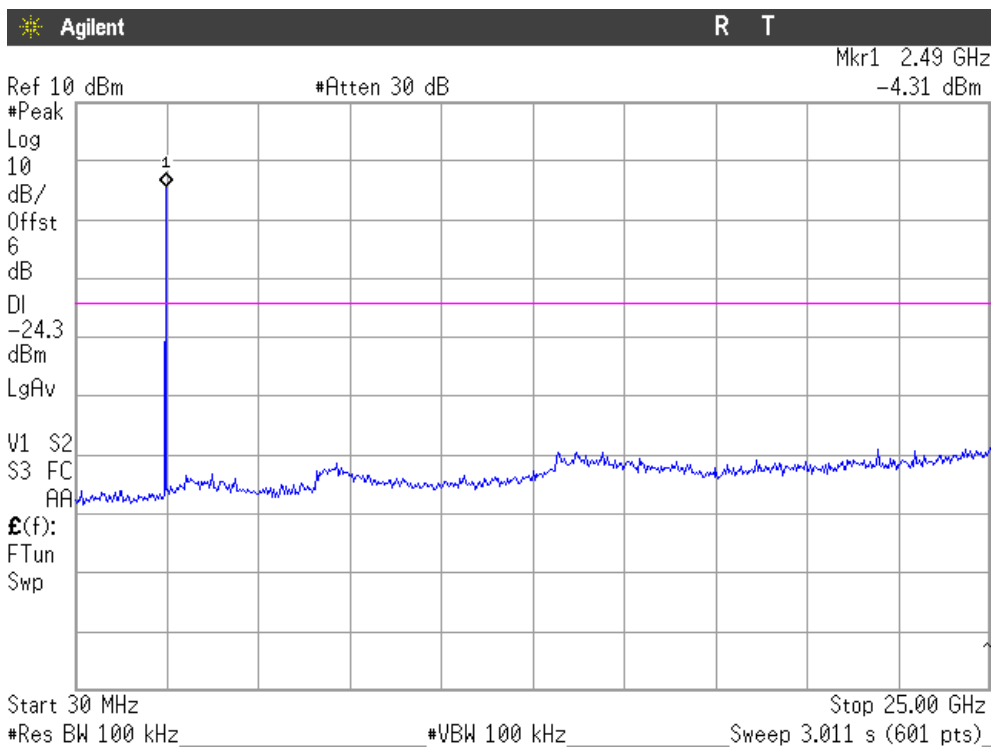
2. MIDDLE CHANNEL (2441 MHz): 30 MHz-25 GHz (see next plot).



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

Verdict: PASS

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

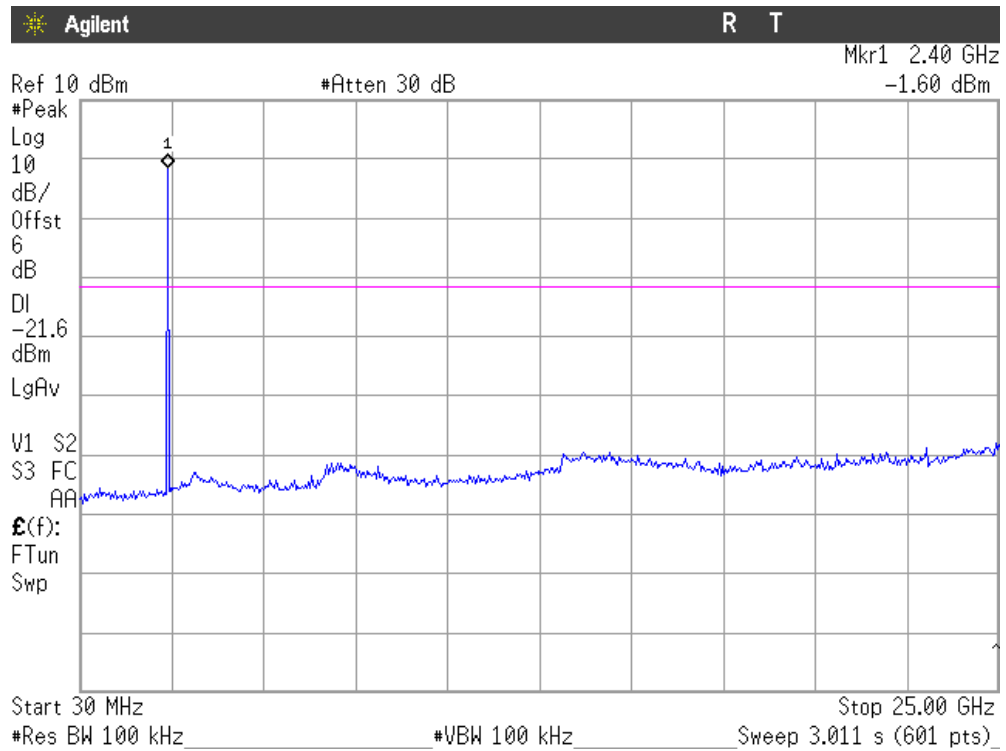


Note: The peak above the limits is the carrier frequency.

Verdict: PASS

Modulation: $\Pi/4$ -DQPSK

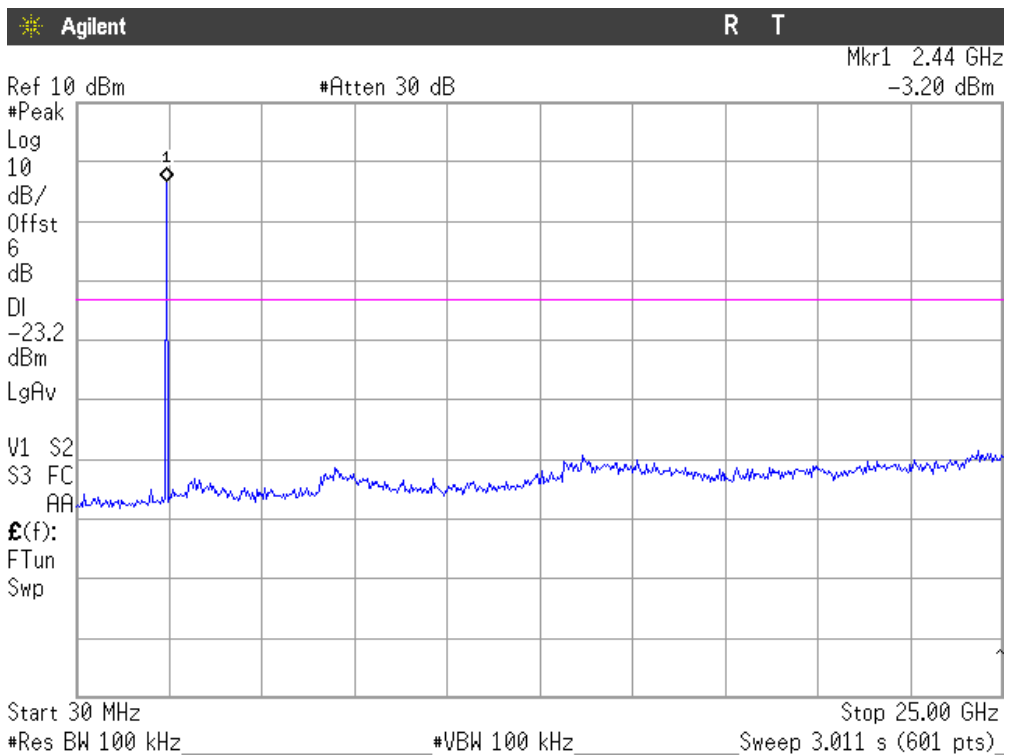
1. LOWEST CHANNEL (2402 MHz): 30 MHz-25 GHz (see next plot).



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

Verdict: PASS

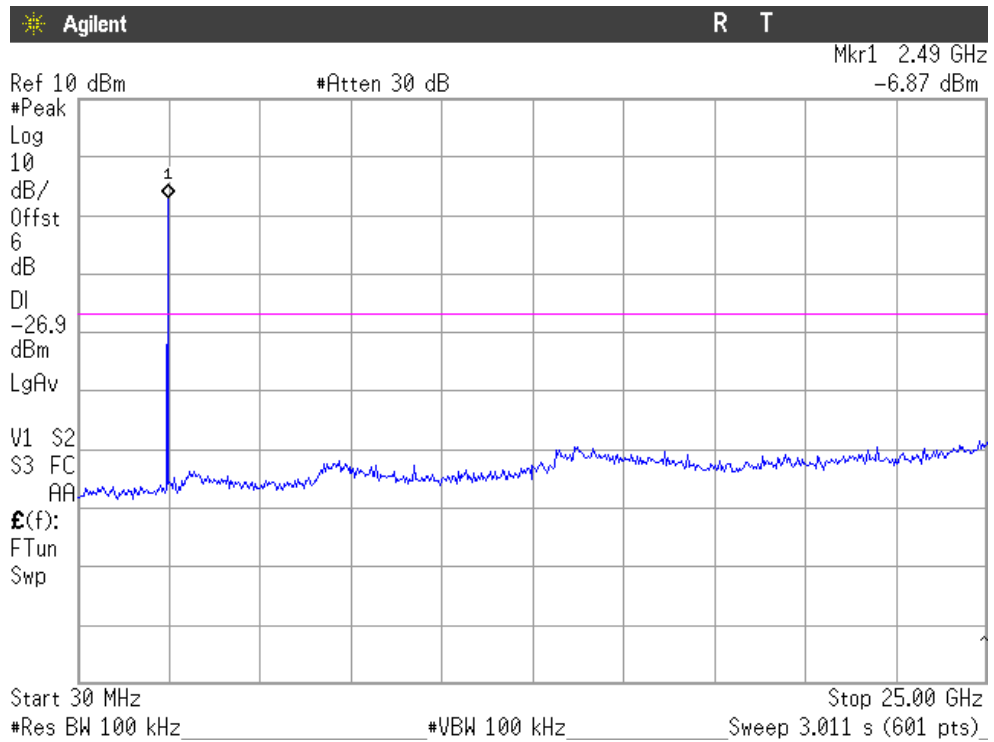
2. MIDDLE CHANNEL (2441 MHz): 30 MHz-25 GHz (see next plot).



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

Verdict: PASS

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

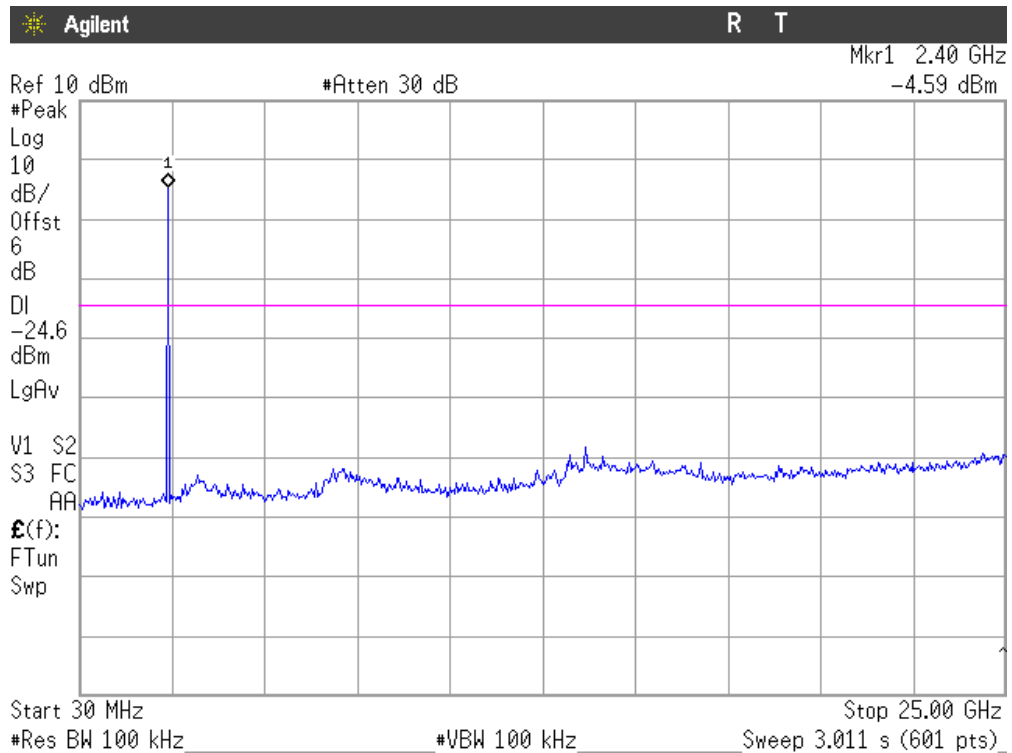


Note: The peak above the limit is the carrier frequency.

Verdict: PASS

Modulation: 8-DPSK

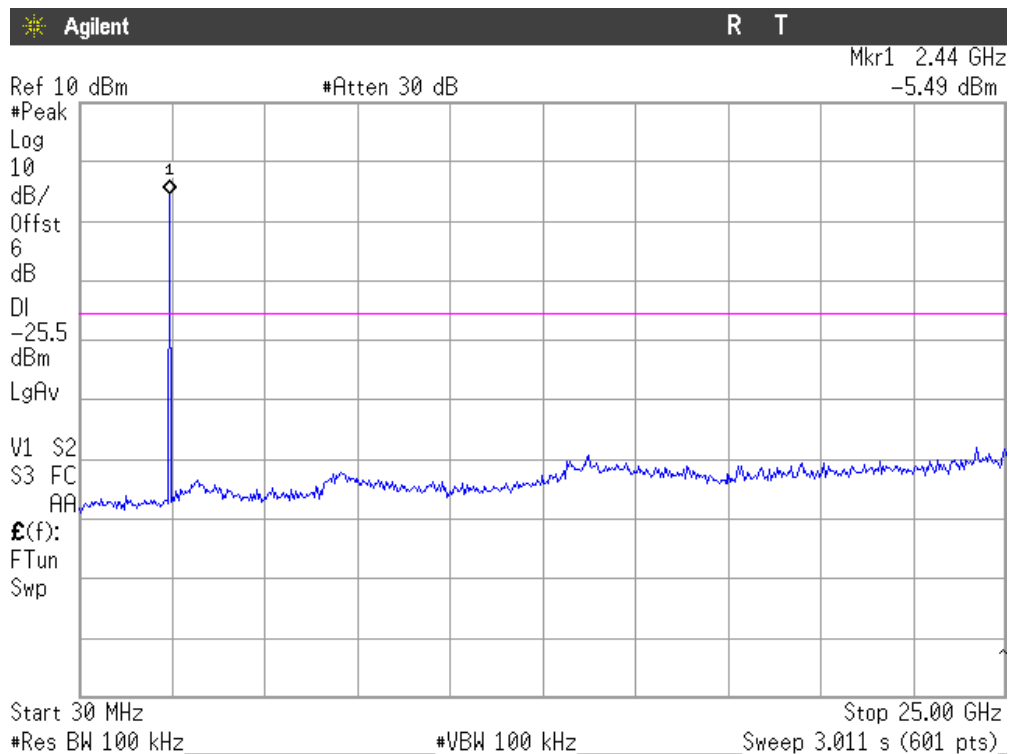
1. LOWEST CHANNEL (2402 MHz): 30 MHz-25 GHz (see next plot).



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

Verdict: PASS

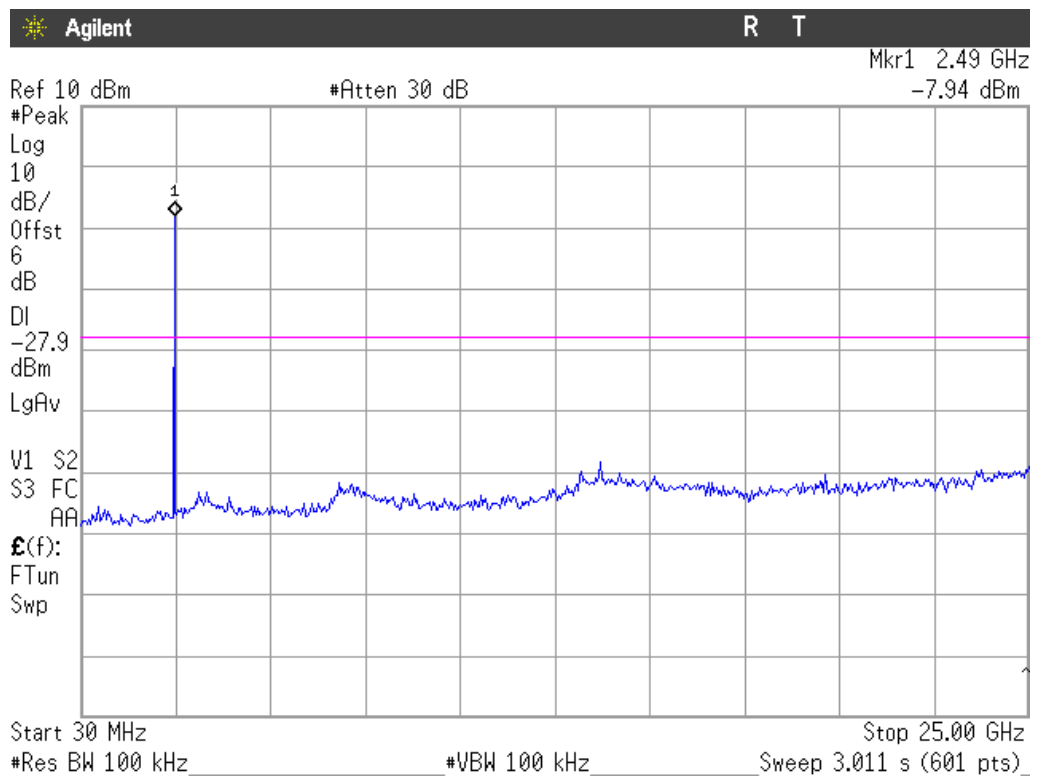
2. MIDDLE CHANNEL (2441 MHz): 30 MHz-25 GHz (see next plot).



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 Is. 7, Clauses 2.2(b) & 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 ($\mu\text{V/m}$)	Field strength ($\text{dB}\mu\text{V/m}$)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	300
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 25000	500	54	3

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

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

RESULTS:

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

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

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

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

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

Frequency range 30 MHz-1000 MHz.

No spurious signals found in all the range for all modulation modes.

Frequency range 1 GHz-25 GHz

Modulation: GFSK

1. CHANNEL: LOWEST (2402 MHz).

Spurious frequency (MHz)	Polarization	Detector	Emission Level (dB μ V/m)	Measurement Uncertainty (dB)
4803.9502	H	Peak	44.79	± 4.0
4803.9502	H	Average	41.18	± 4.0

2. CHANNEL: MIDDLE (2441 MHz).

Spurious frequency (MHz)	Polarization	Detector	Emission Level (dB μ V/m)	Measurement Uncertainty (dB)
4881.8893	H	Peak	45.19	± 4.0
4881.8893	H	Average	42.32	± 4.0

3. CHANNEL: HIGHEST (2480 MHz).

Spurious frequency (MHz)	Polarization	Detector	Emission Level (dB μ V/m)	Measurement Uncertainty (dB)
4960.0311	H	Peak	45.13	± 4.0
4960.0311	H	Average	42.18	± 4.0

Verdict: PASS

Modulation: $\Pi/4$ -DQPSK

1. CHANNEL: LOWEST (2402 MHz).

Spurious frequency (MHz)	Polarization	Detector	Emission Level (dB μ V/m)	Measurement Uncertainty (dB)
4803.8838	H	Peak	44.38	± 4.0
4803.8838	H	Average	41.11	± 4.0

2. CHANNEL: MIDDLE (2441 MHz).

Spurious frequency (MHz)	Polarization	Detector	Emission Level (dB μ V/m)	Measurement Uncertainty (dB)
4881.9174	H	Peak	44.28	± 4.0
4881.9174	H	Average	41.36	± 4.0

3. CHANNEL: HIGHEST (2480 MHz).

Spurious frequency (MHz)	Polarization	Detector	Emission Level (dB μ V/m)	Measurement Uncertainty (dB)
4960.0312	H	Peak	44.73	± 4.0
4960.0312	H	Average	41.80	± 4.0

Verdict: PASS

Modulation: 8-DPSK

1. CHANNEL: LOWEST (2402 MHz).

Spurious frequency (MHz)	Polarization	Detector	Emission Level (dB μ V/m)	Measurement Uncertainty (dB)
4803.9839	H	Peak	44.23	± 4.0
4803.9839	H	Average	41.03	± 4.0

2. CHANNEL: MIDDLE (2441 MHz).

Spurious frequency (MHz)	Polarization	Detector	Emission Level (dB μ V/m)	Measurement Uncertainty (dB)
4881.9835	H	Peak	44.14	± 4.0
4881.9835	H	Average	41.08	± 4.0

3. CHANNEL: HIGHEST (2480 MHz).

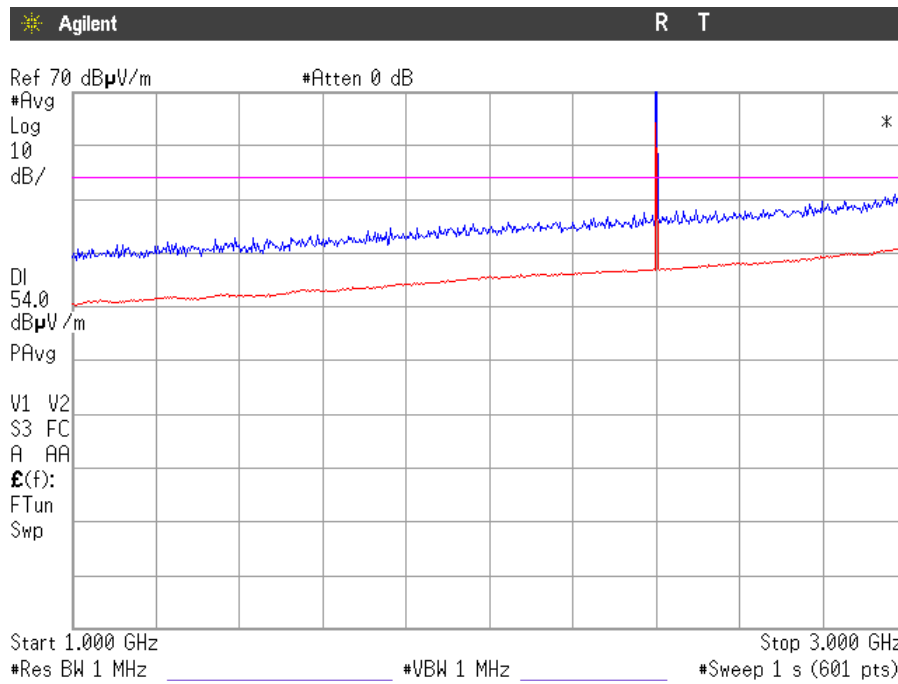
Spurious frequency (MHz)	Polarization	Detector	Emission Level (dB μ V/m)	Measurement Uncertainty (dB)
4959.8678	H	Peak	44.45	± 4.0
4959.8678	H	Average	41.73	± 4.0

Verdict: PASS

FREQUENCY RANGE 1 GHz to 3 GHz.

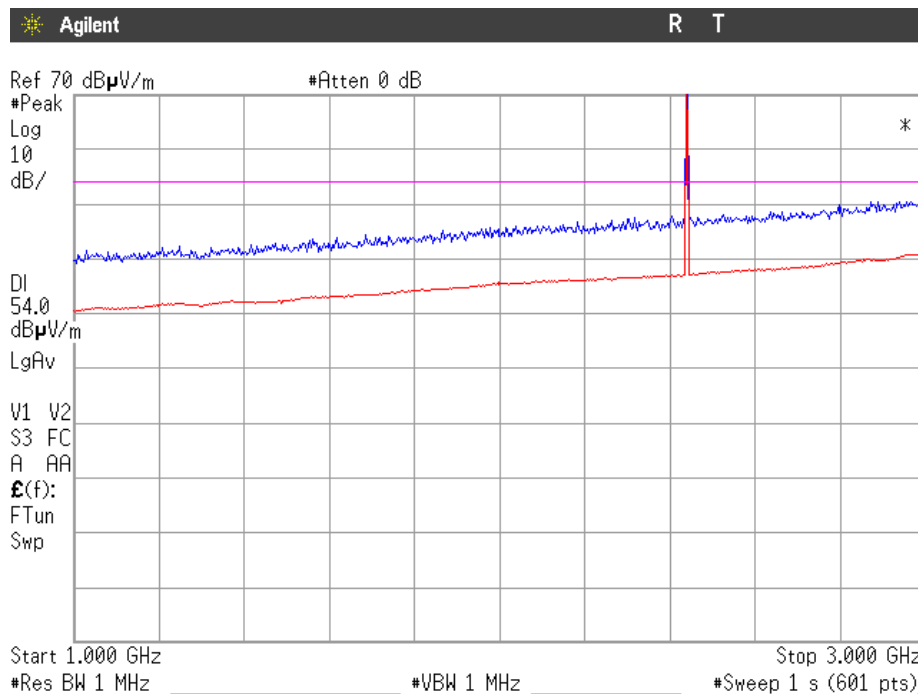
Modulation: GFSK

CHANNEL: Lowest (2402 MHz).



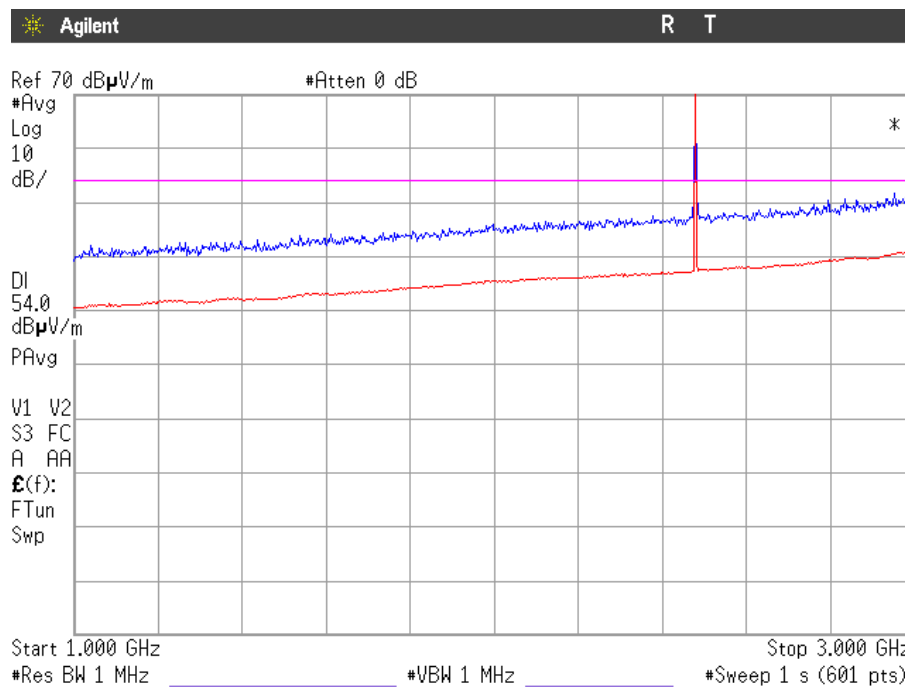
Note: The peak shown in the plot is the carrier frequency.

CHANNEL: Middle (2441 MHz).



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

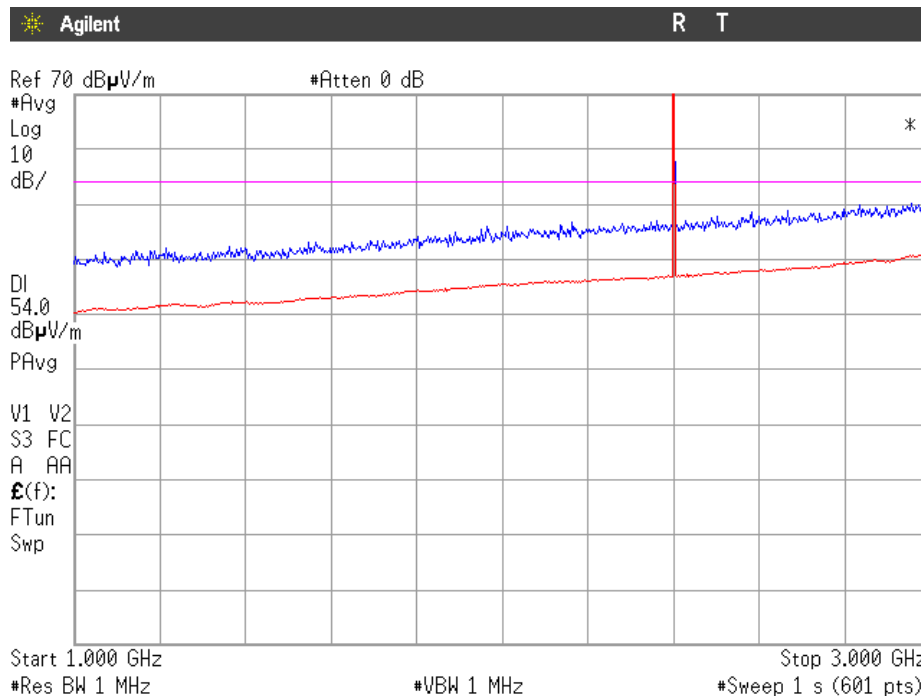
CHANNEL: Highest (2480 MHz).



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

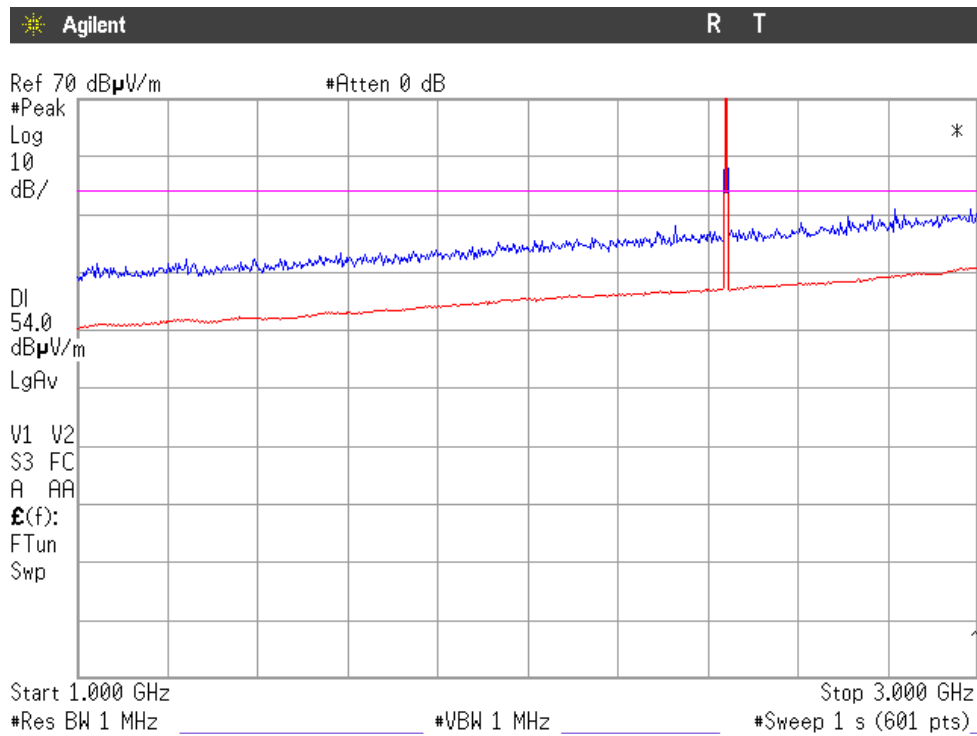
Modulation: $\Pi/4$ -DQPSK

CHANNEL: Lowest (2402 MHz).



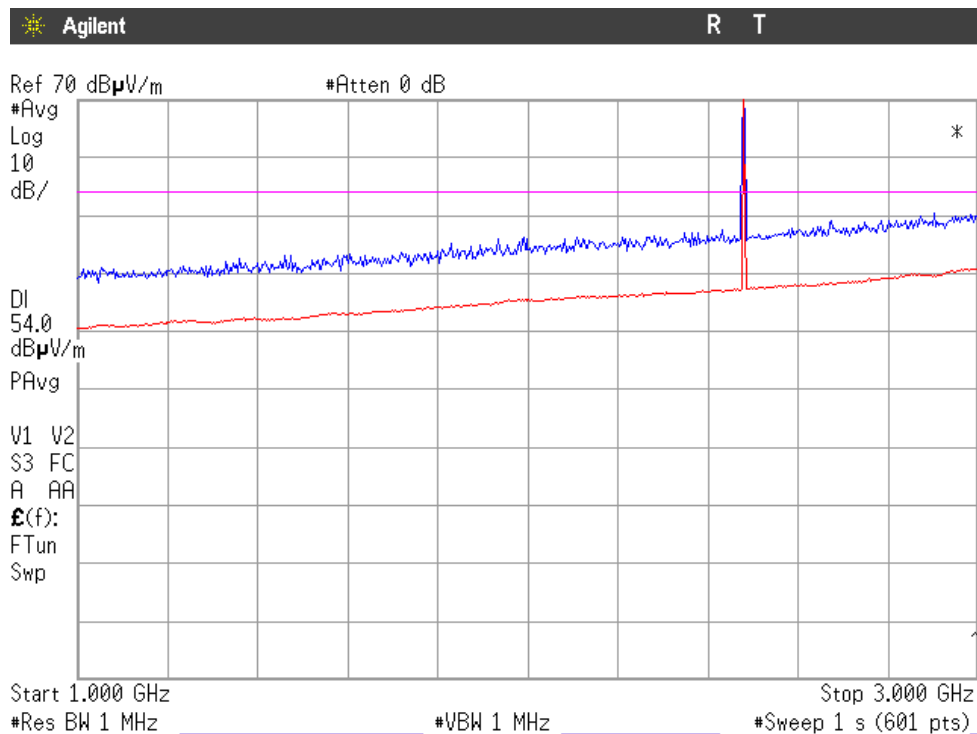
Note: The peak shown in the plot is the carrier frequency.

CHANNEL: Middle (2441 MHz).



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

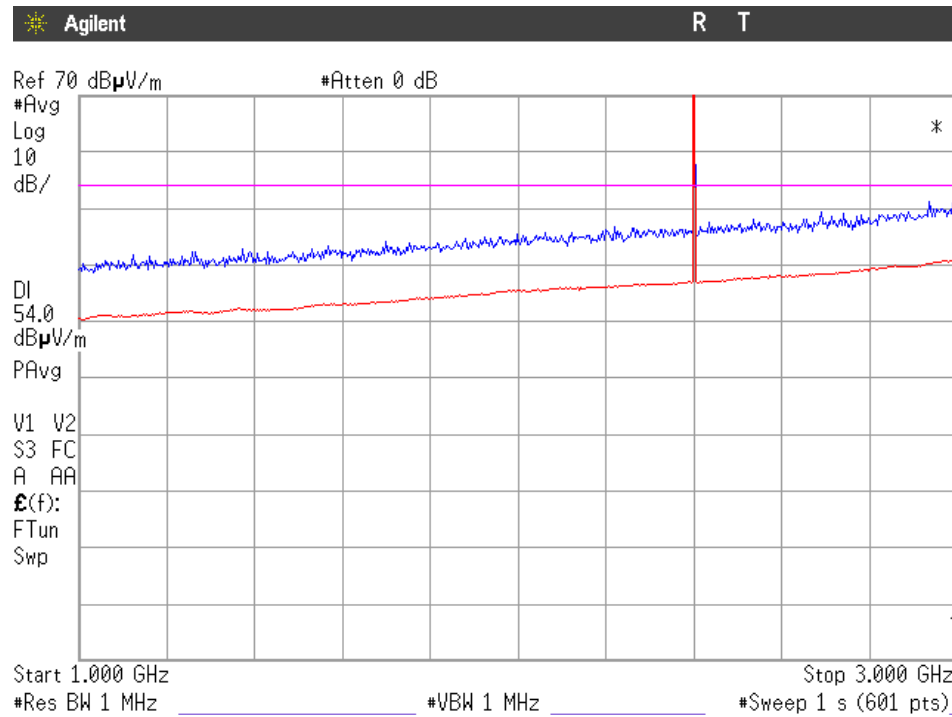
CHANNEL: Highest (2480 MHz).



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

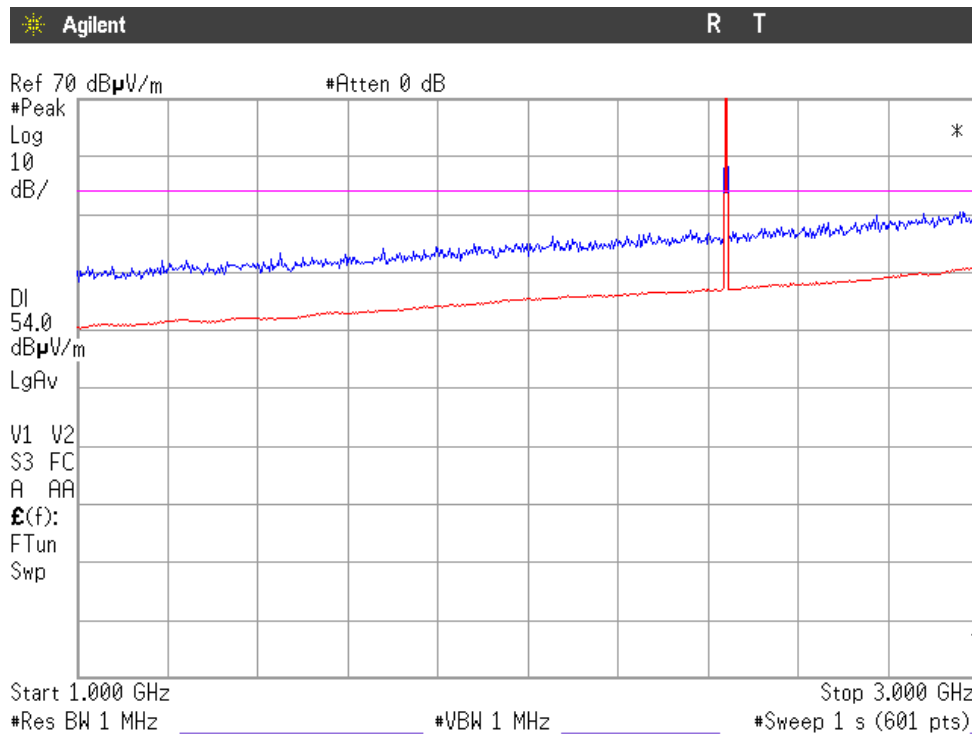
Modulation: 8-DPSK

CHANNEL: Lowest (2402 MHz).



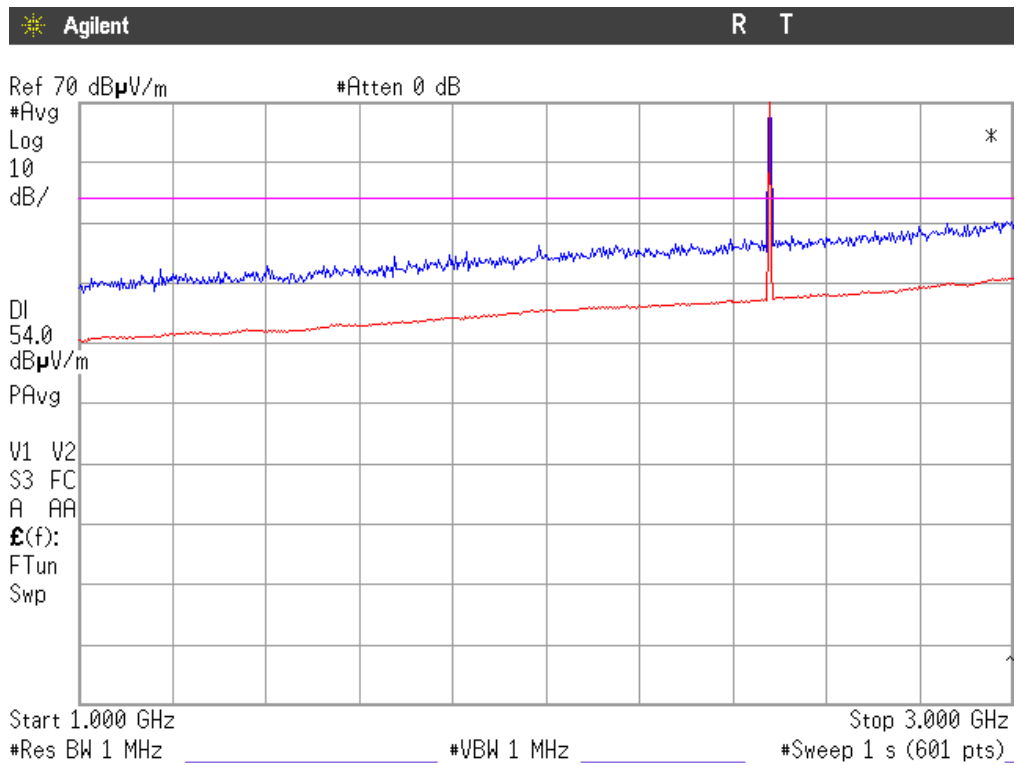
Note: The peak shown in the plot is the carrier frequency.

CHANNEL: Middle (2441 MHz).



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

CHANNEL: Highest (2480 MHz).

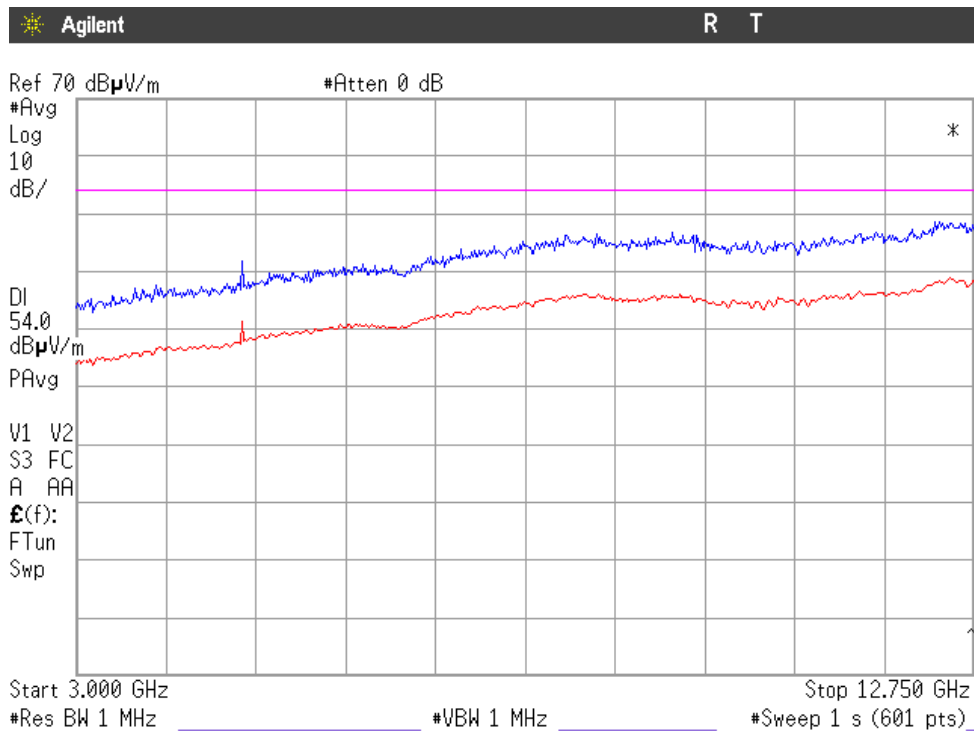


Note: The peak shown in the plot is the carrier frequency.

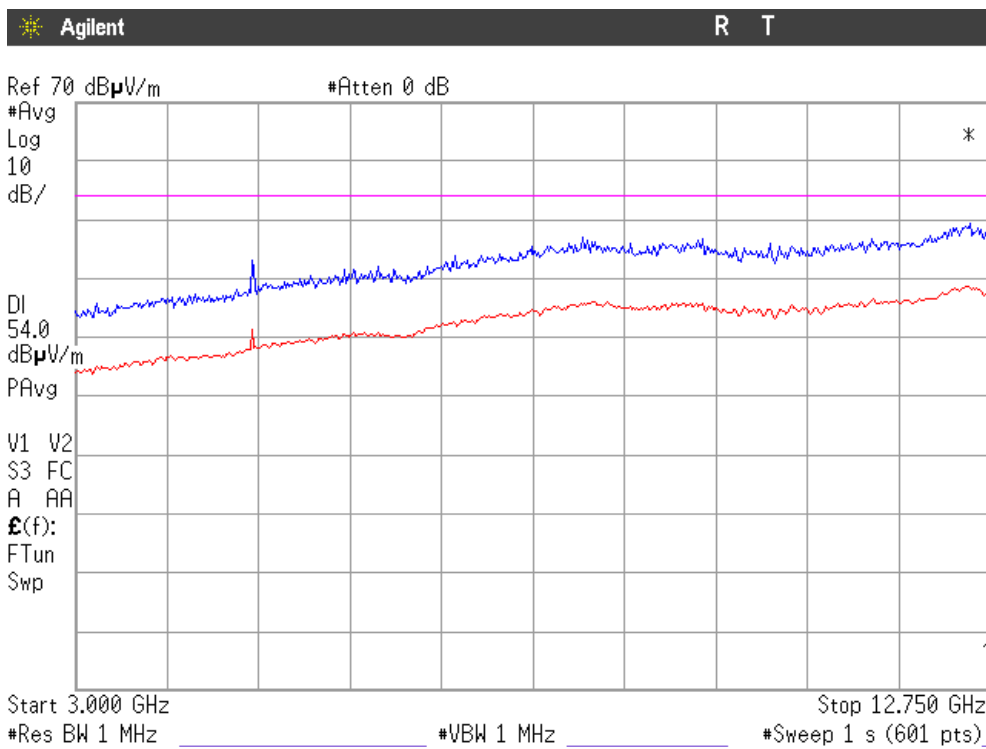
FREQUENCY RANGE 3 GHz to 12.75 GHz.

Modulation: GFSK

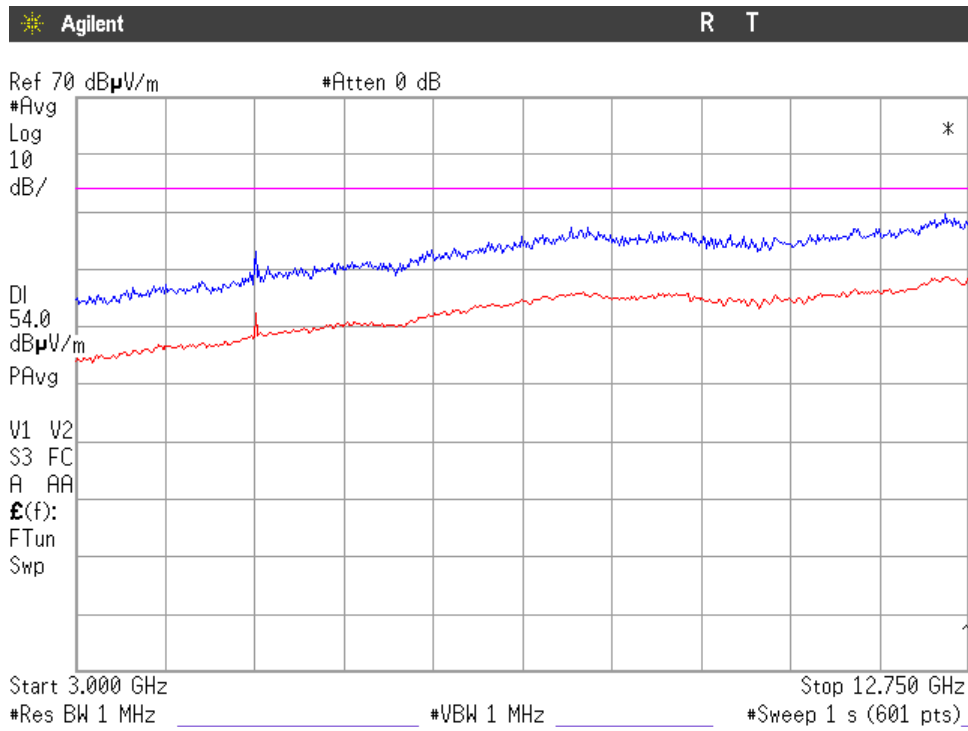
CHANNEL: Lowest (2402 MHz).



CHANNEL: Middle (2441 MHz).

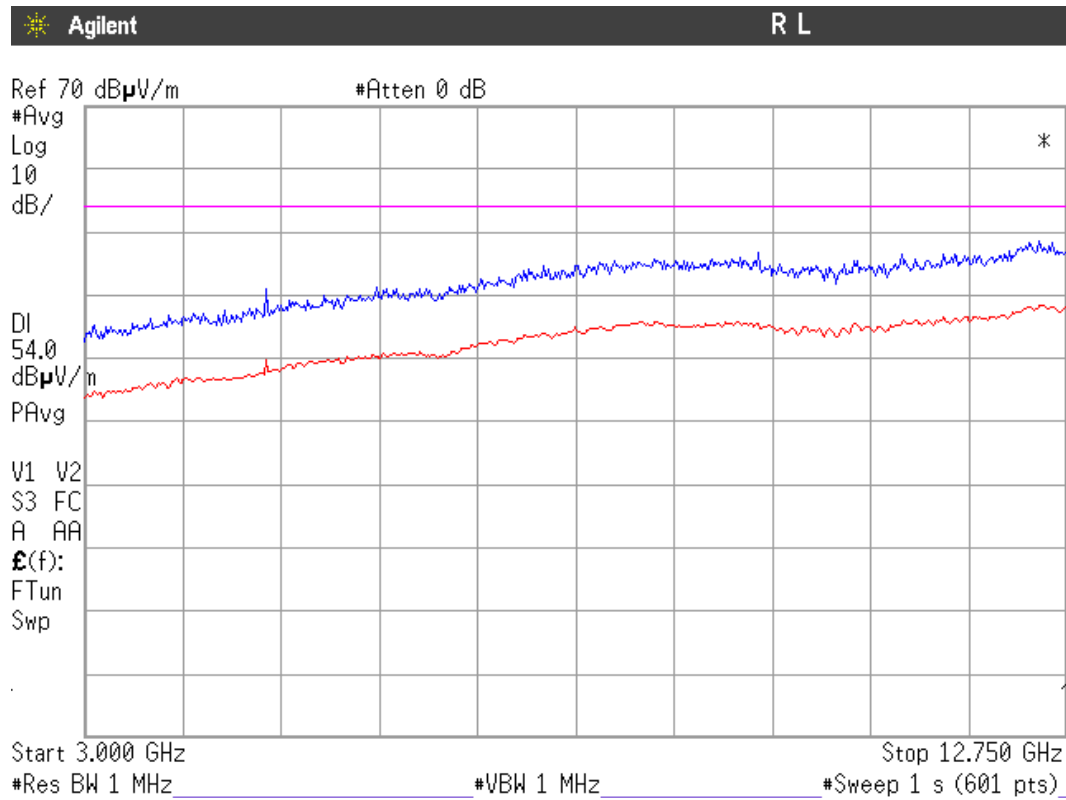


CHANNEL: Highest (2480 MHz).

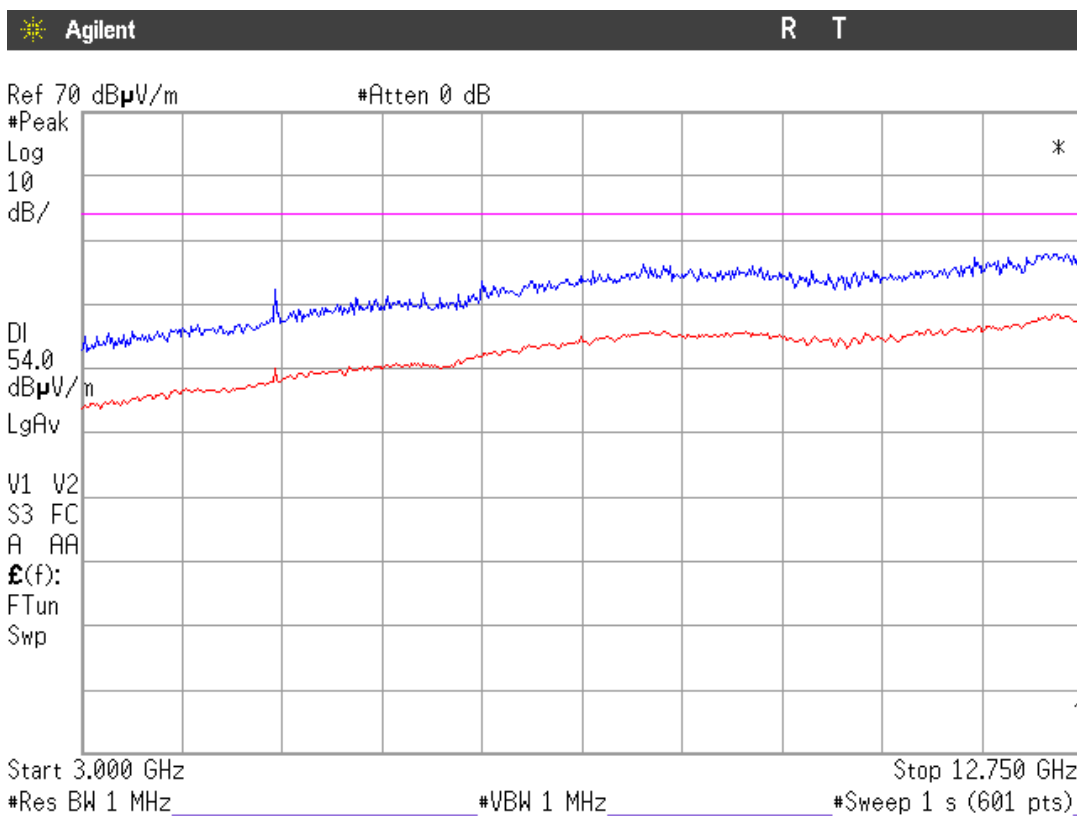


Modulation: $\Pi/4$ -DQPSK

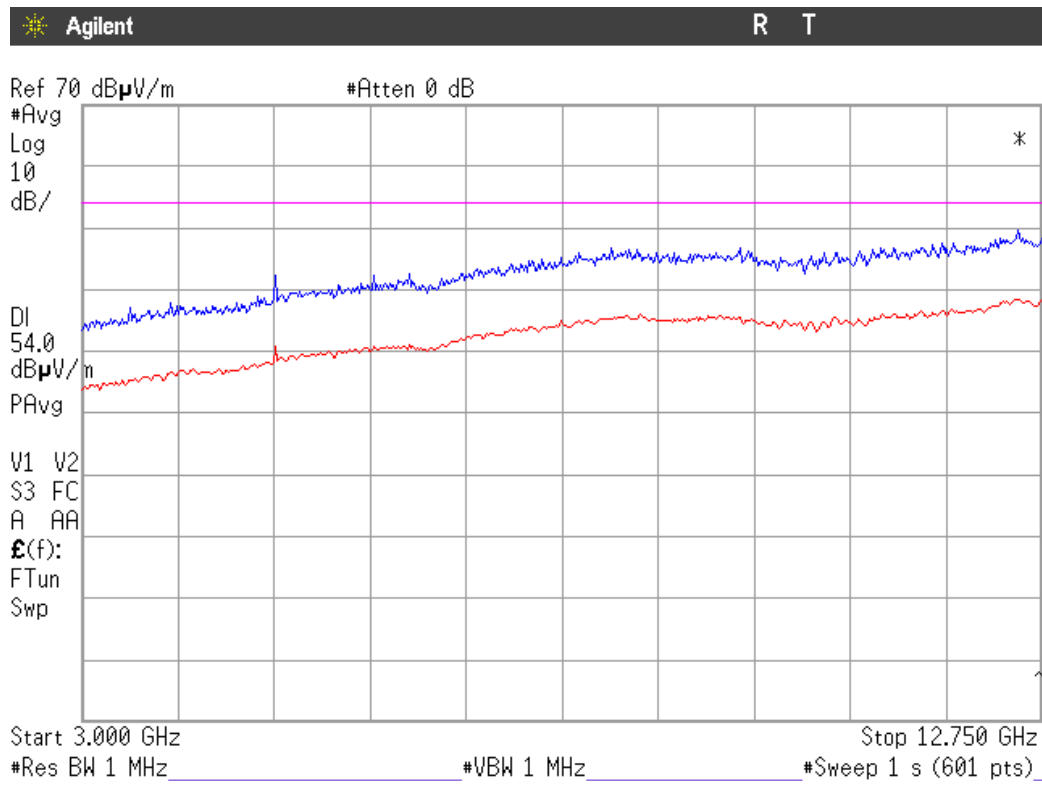
CHANNEL: Lowest (2402 MHz).



CHANNEL: Middle (2441 MHz).

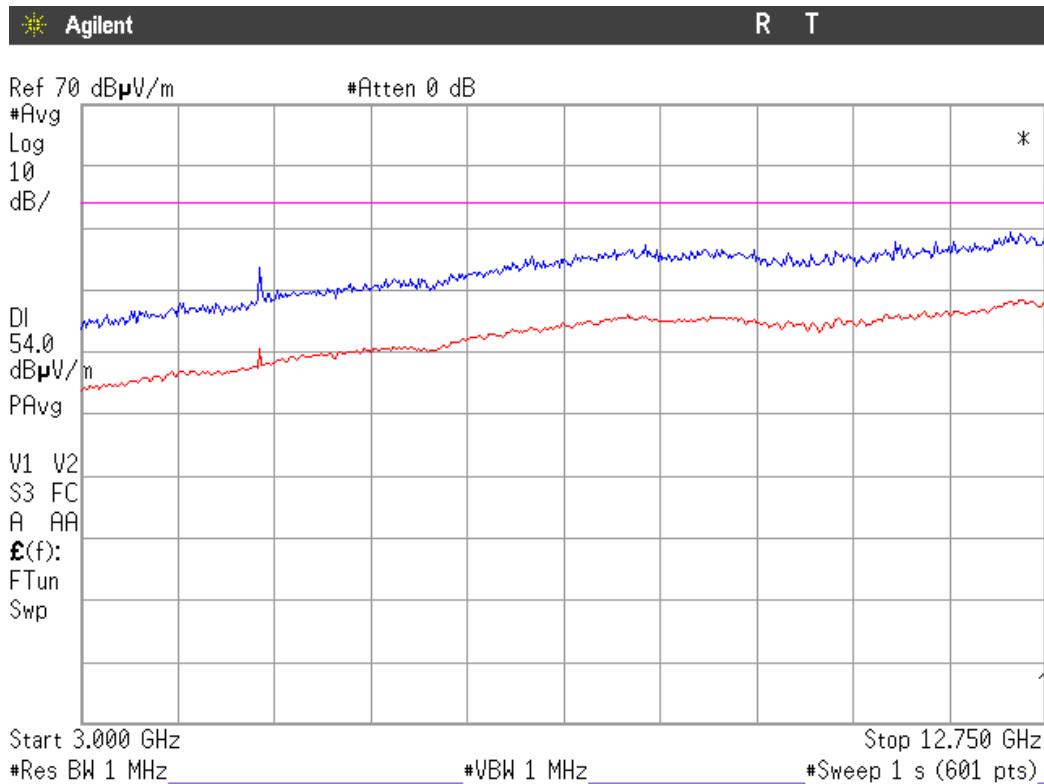


CHANNEL: Highest (2480 MHz).

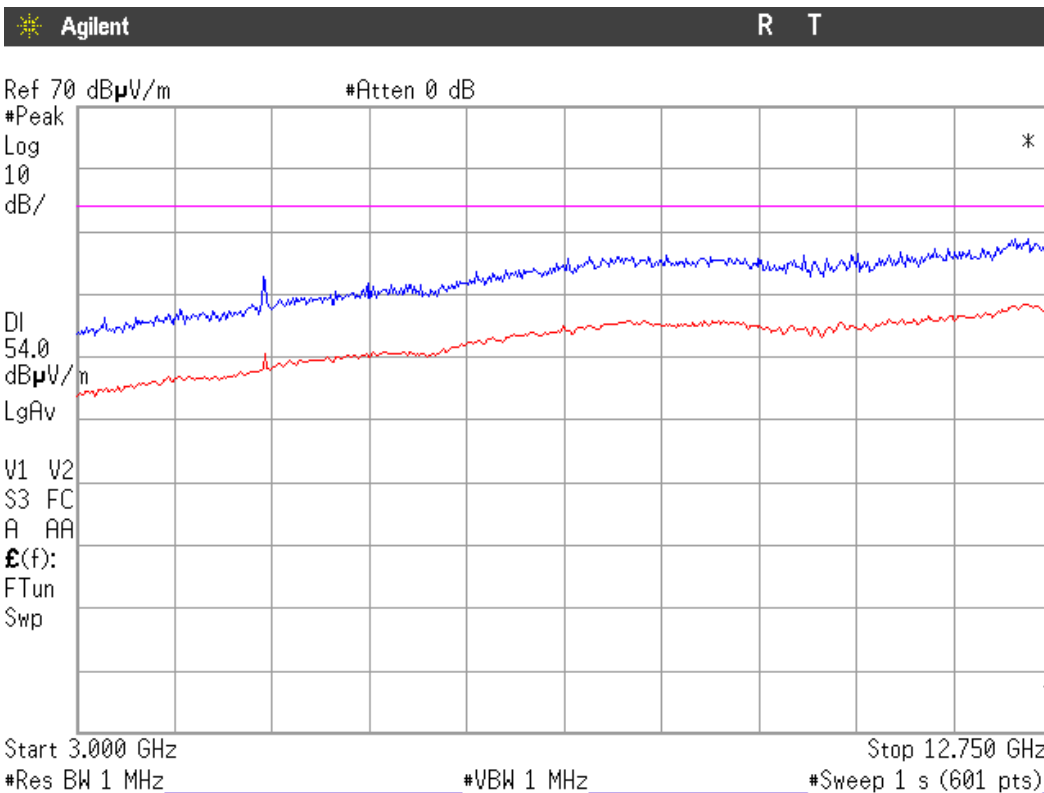


Modulation: 8-DPSK

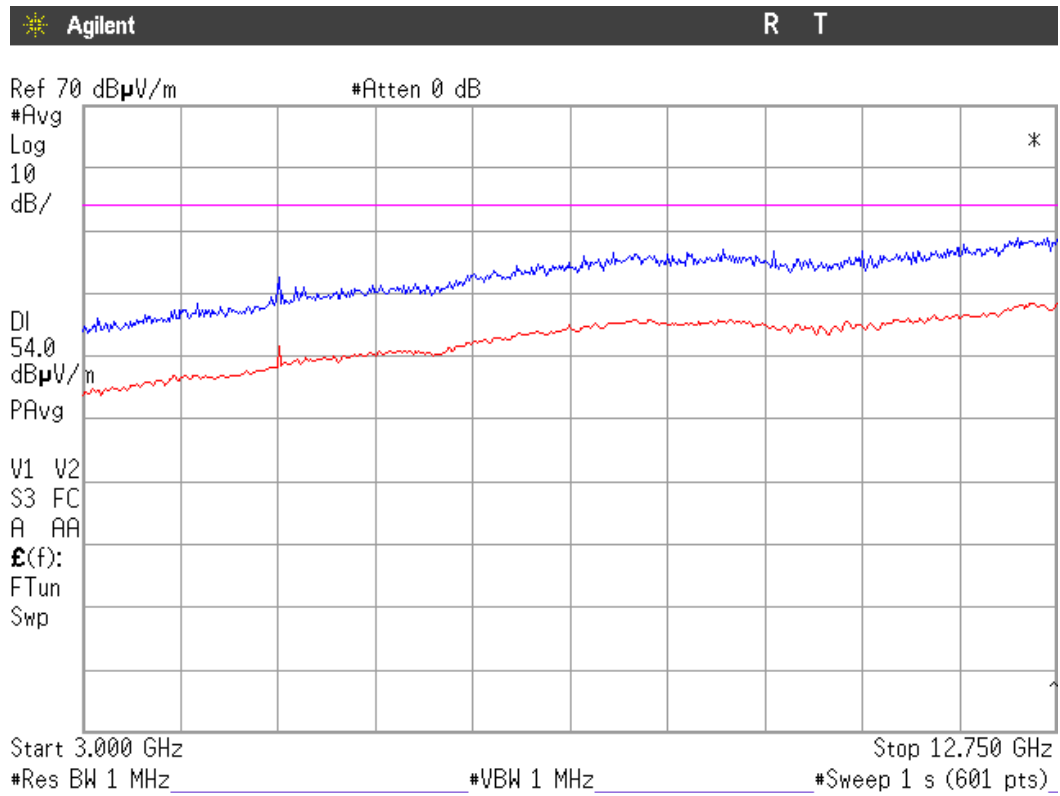
CHANNEL: Lowest (2402 MHz).



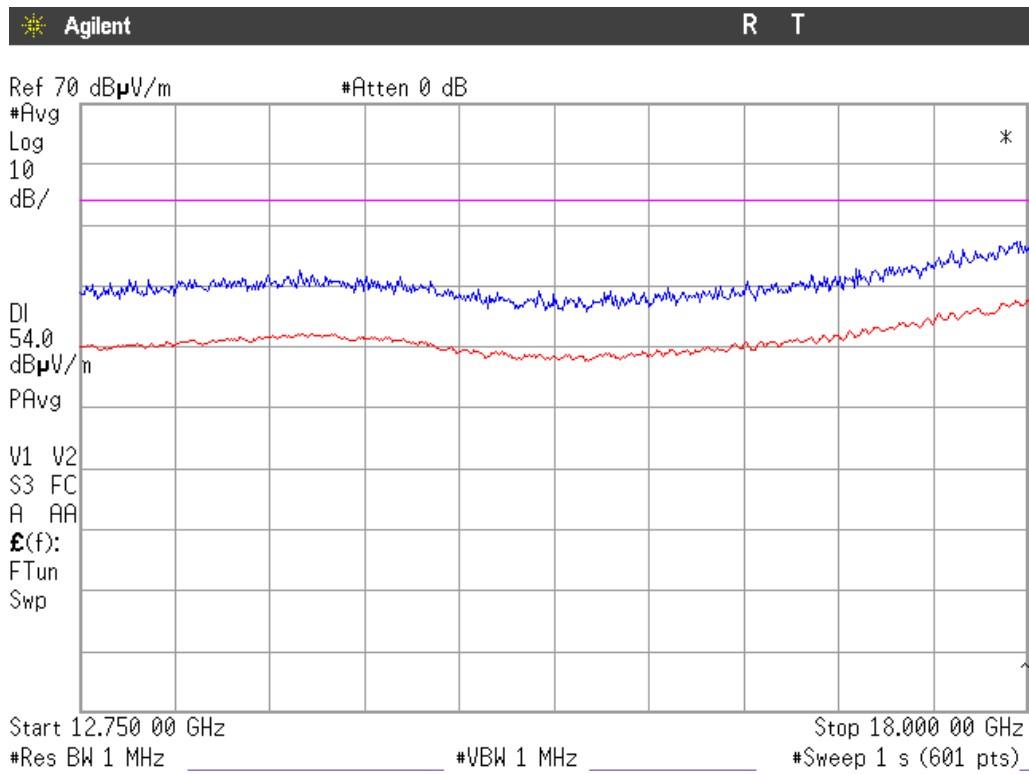
CHANNEL: Middle (2441 MHz).



CHANNEL: Highest (2480 MHz).

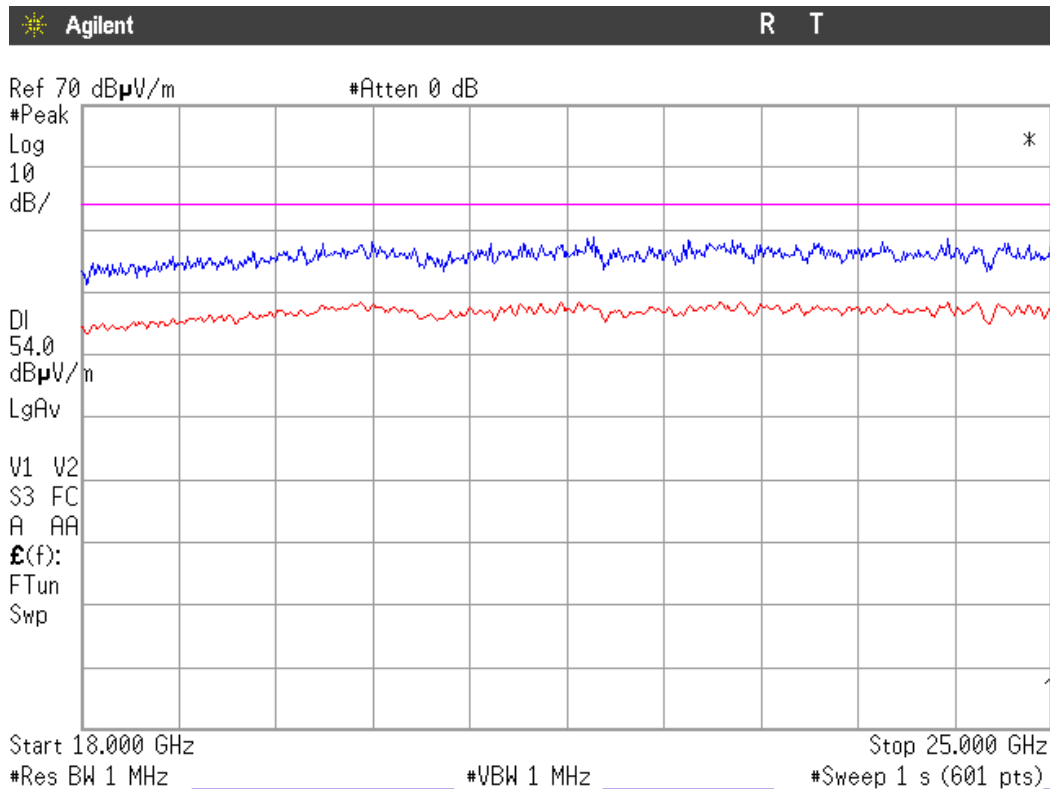


FREQUENCY RANGE 12.75 GHz to 18 GHz.



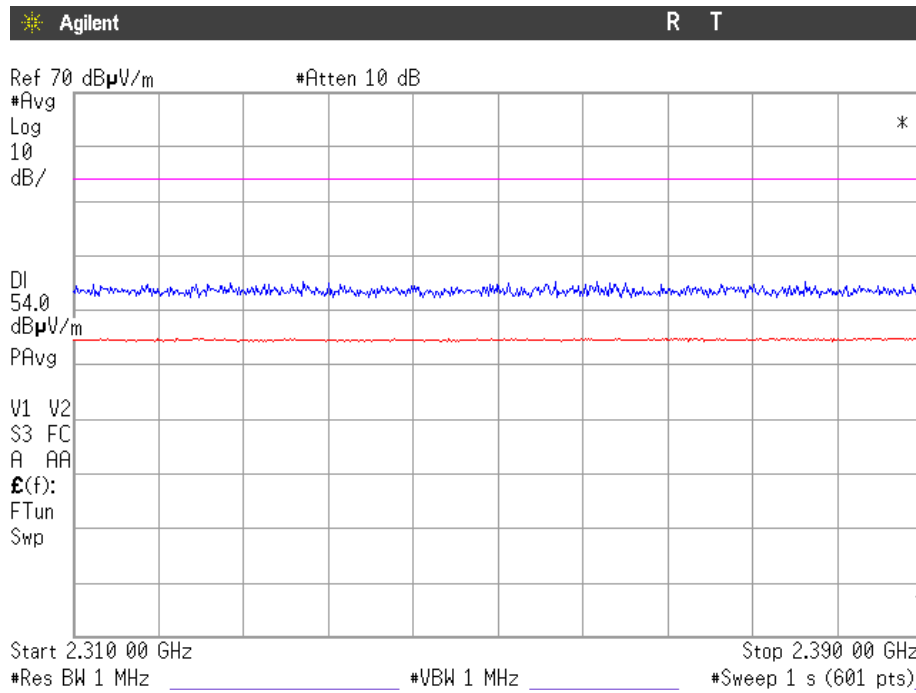
(This plot is valid for all three channels and all modulation modes).

FREQUENCY RANGE 18 GHz to 25 GHz.



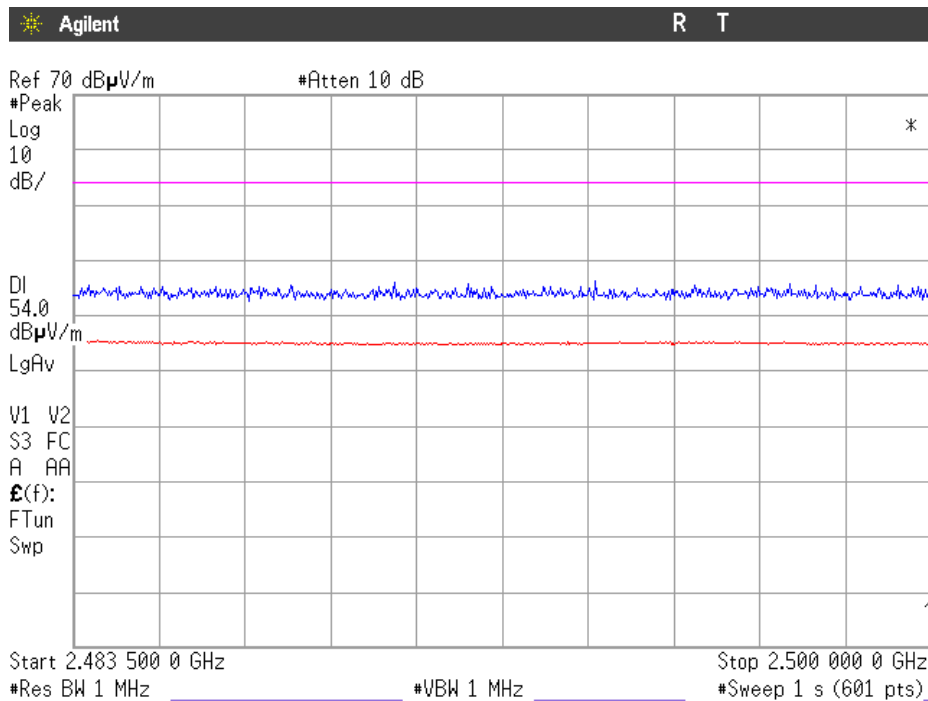
(This plot is valid for all three channels and all modulation modes).

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



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

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



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

FCC Section 15.109 / RSS-210 Is. 7, Clause 2.3 & RSS-Gen Is. 2, Clause 7.2.3. Receiver spurious radiation

SPECIFICATION

The field strength shall not exceed the following values:

Frequency Range (MHz)	Field strength ($\mu\text{V/m}$)	Field strength ($\text{dB}\mu\text{V/m}$)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	300
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 25000	500	54	3

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

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

RESULTS:

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

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

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

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

Note: It is not possible to select individual receiving channels in the equipment under test. The equipment under test is set in inquiry scan mode with the receiver open and scanning through receiving channels.

Frequency range 30 MHz-1000 MHz.

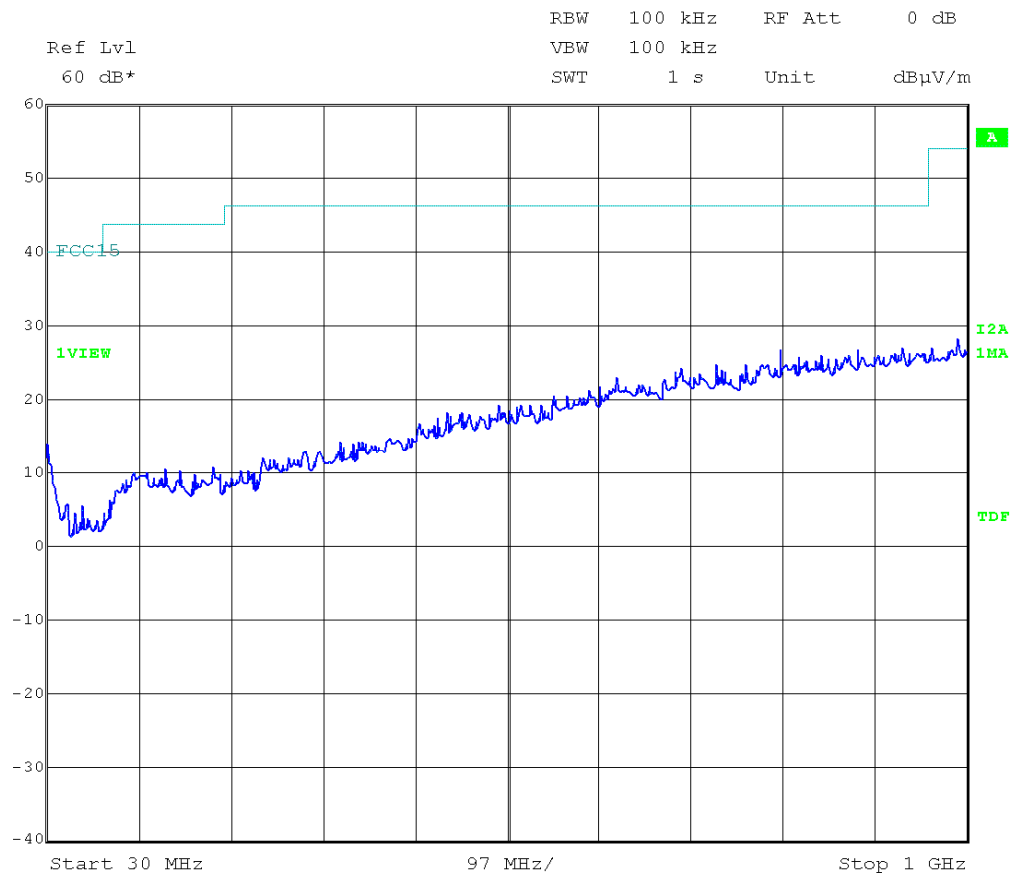
No spurious signals were detected in all the range.

Frequency range 1 GHz-25 GHz.

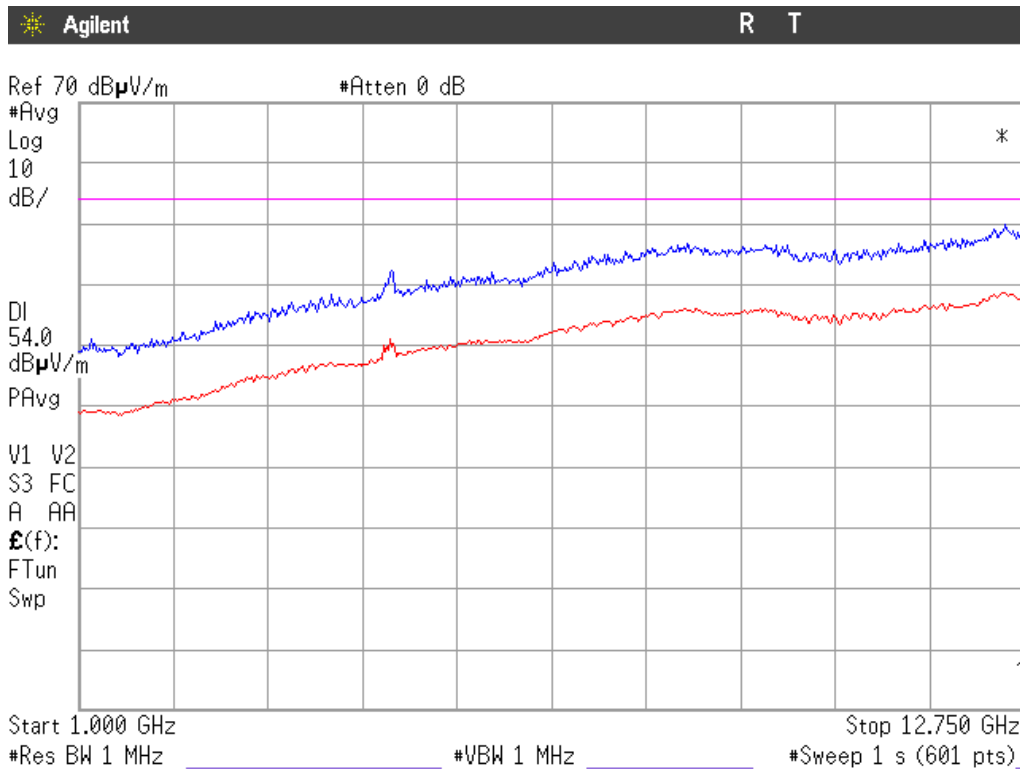
Spurious frequency (MHz)	Polarization	Detector	Emission Level (dB μ V/m)	Measurement Uncertainty (dB)
4871.2103	H	Peak	42.28	± 4.0
4871.2103	H	Average	39.18	± 4.0

Verdict: PASS.

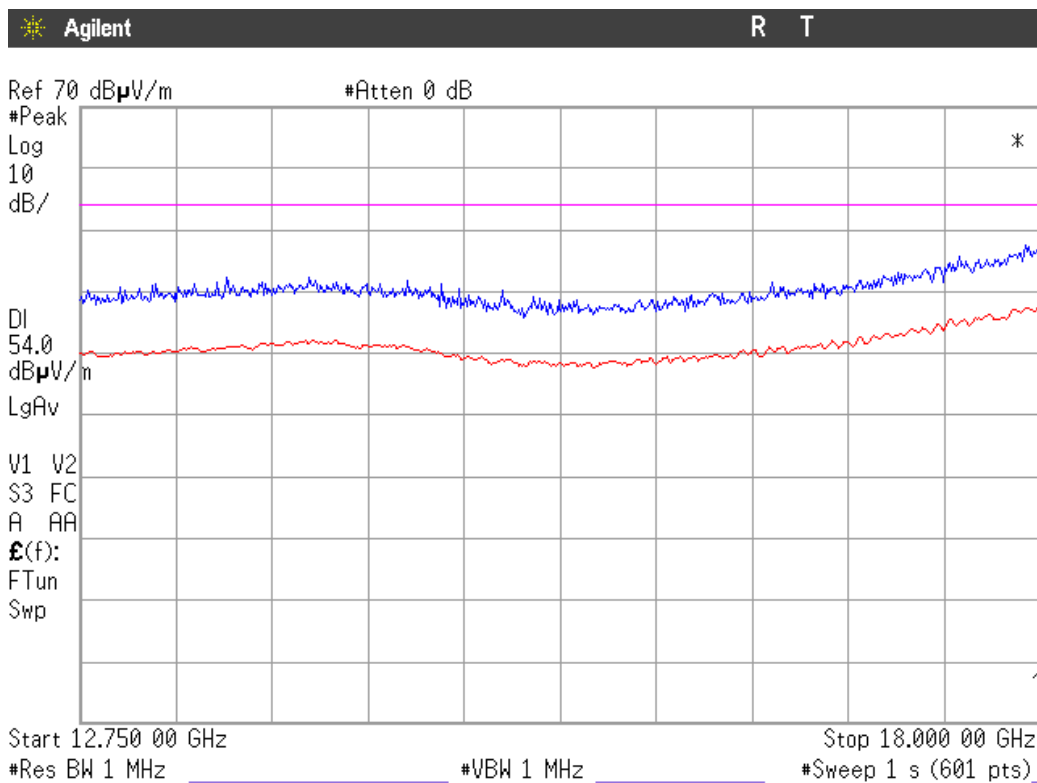
FREQUENCY RANGE 30 MHz-1000 MHz.



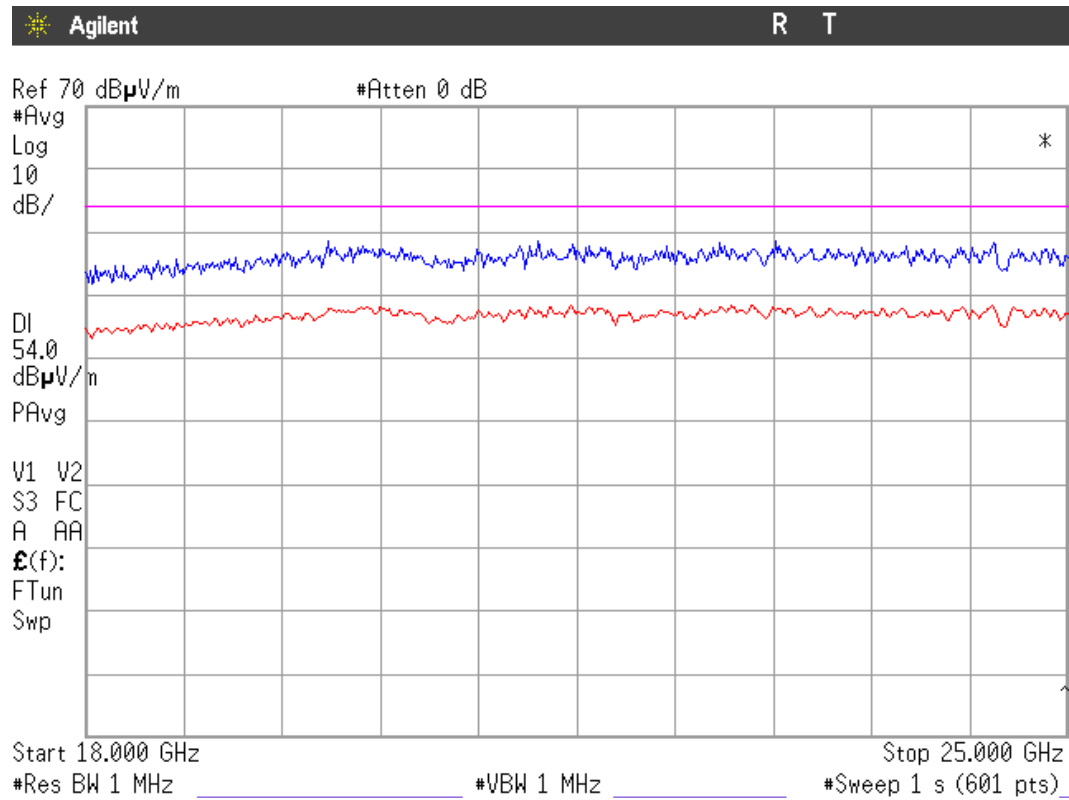
FREQUENCY RANGE 1 GHz-12.75 GHz.



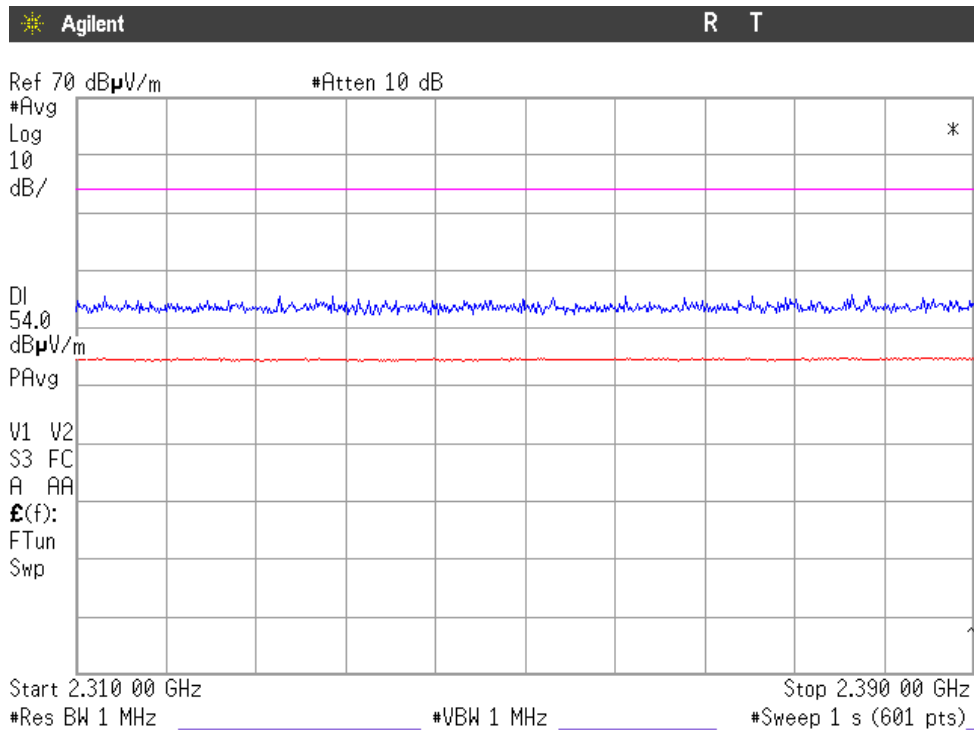
FREQUENCY RANGE 12.75 GHz-18 GHz.



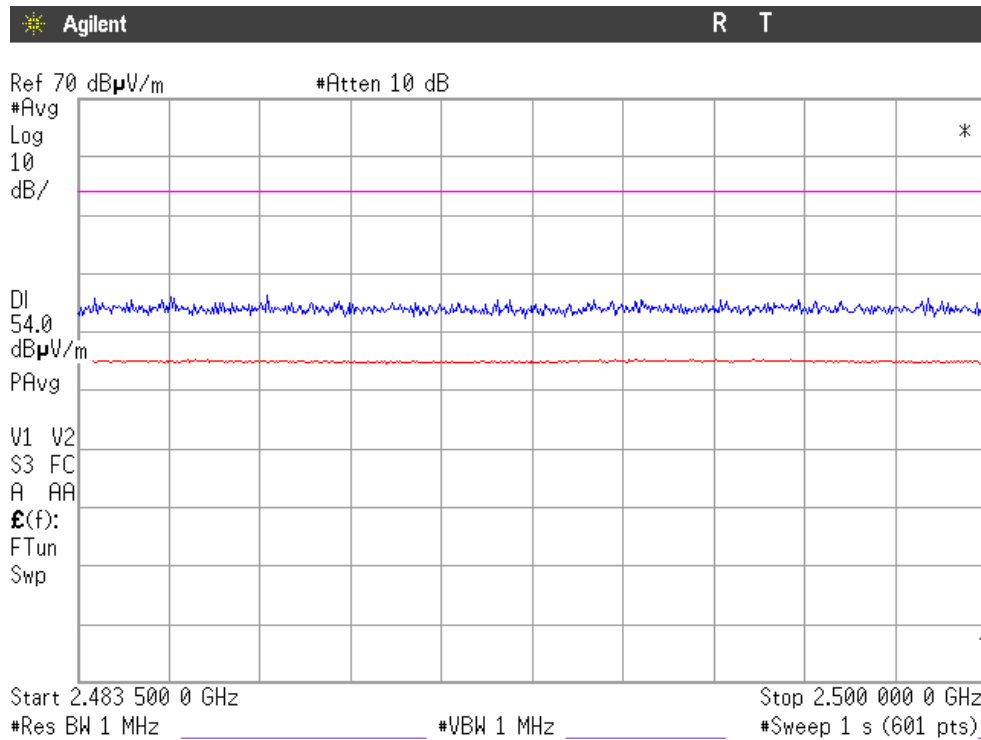
FREQUENCY RANGE 18 GHz-25 GHz.



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



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

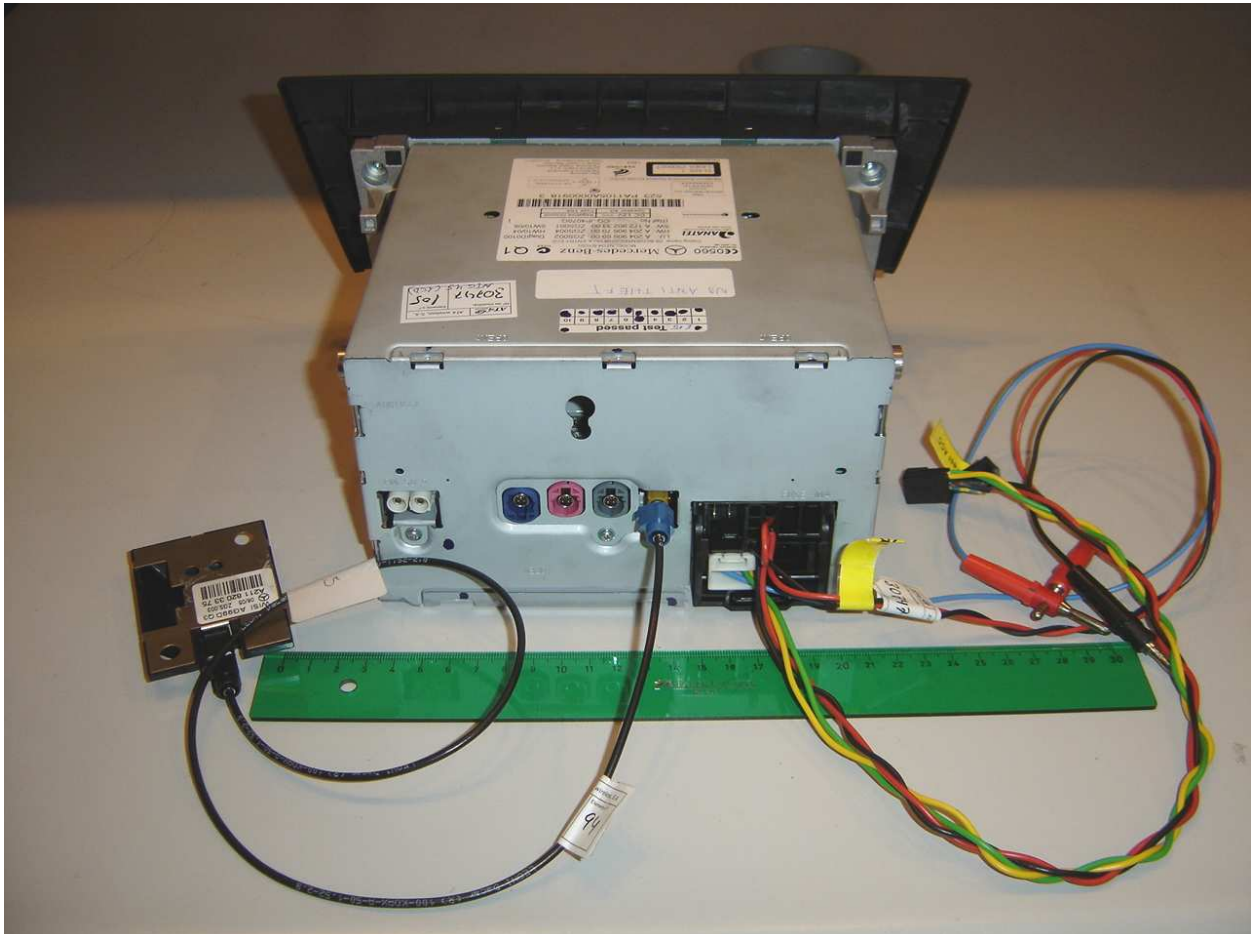


APPENDIX B: Photographs

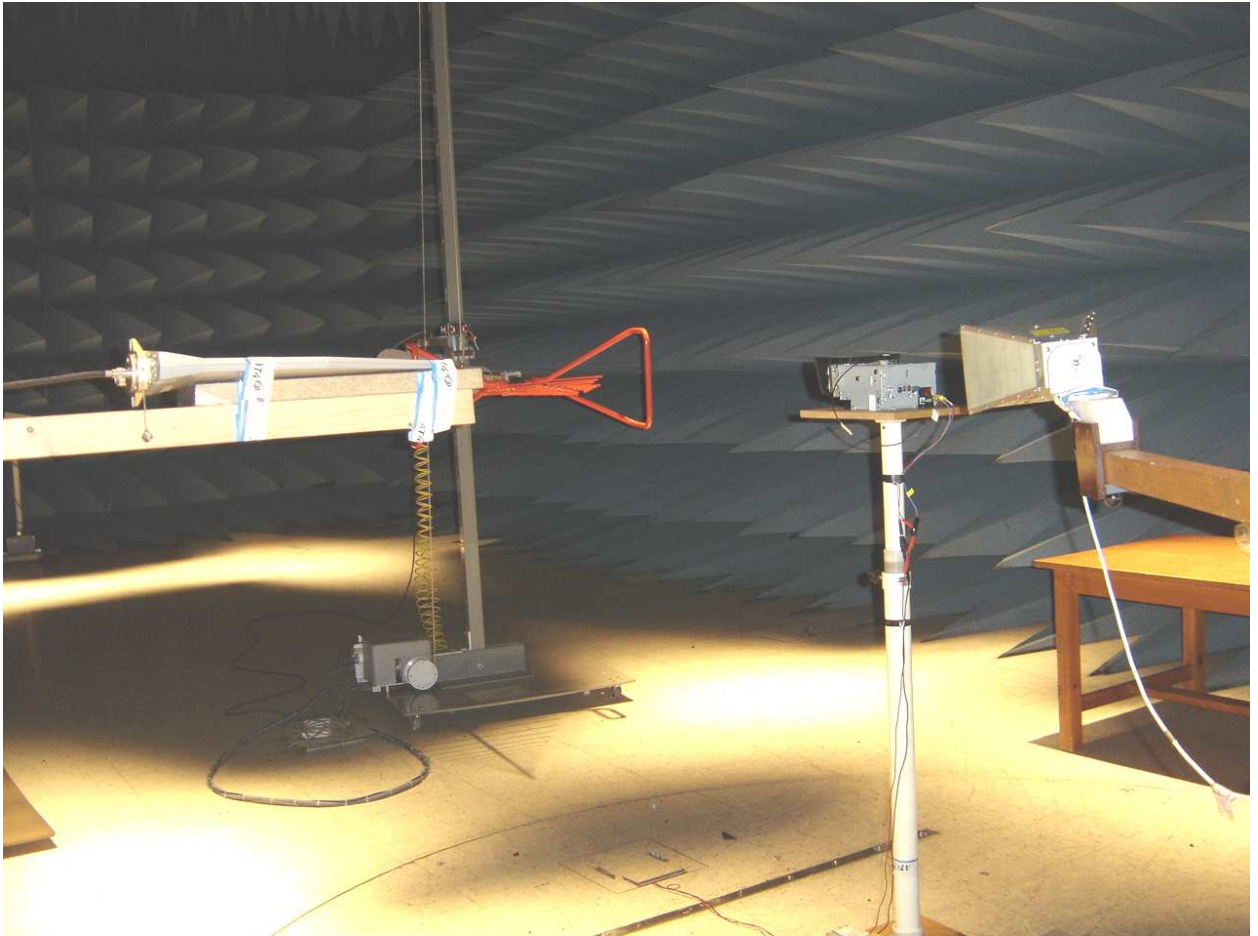
EQUIPMENT (FRONT VIEW)



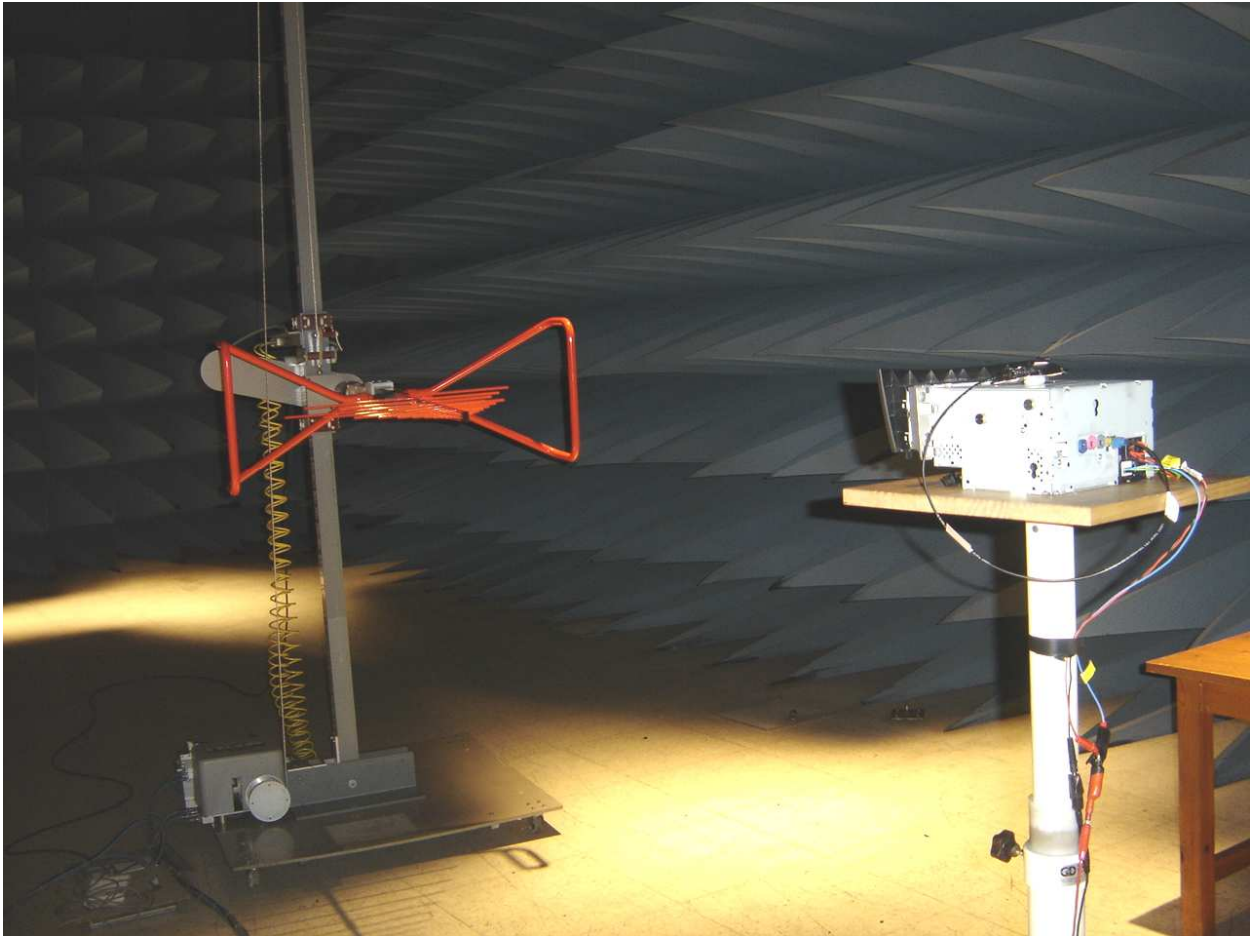
EQUIPMENT (BACK VIEW)



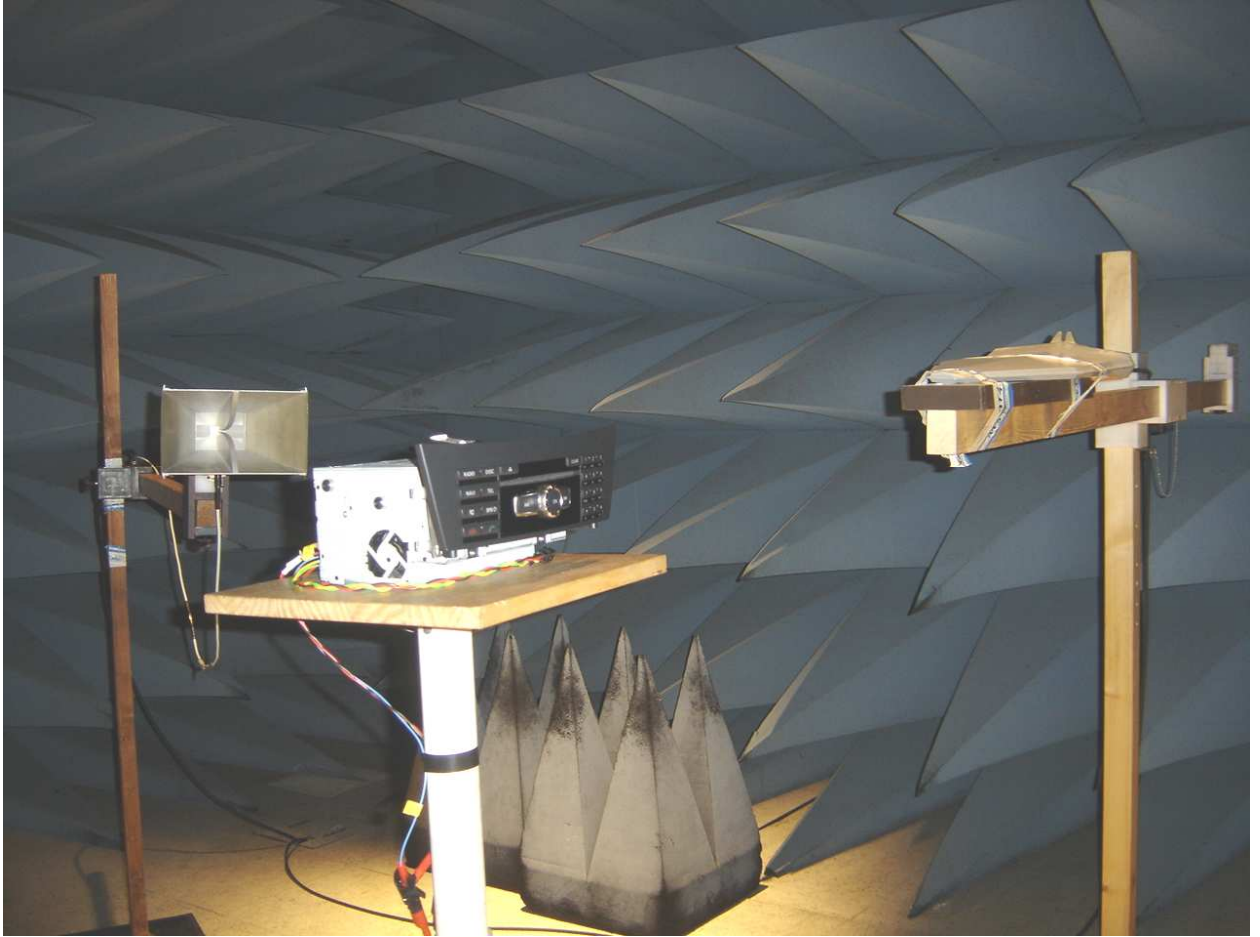
GENERAL SET-UP FOR RADIATED MEASUREMENTS



TEST SET-UP FOR RADIATED MEASUREMENTS BELOW 1 GHz



TEST SET-UP FOR RADIATED MEASUREMENTS ABOVE 1GHz



TEST SET-UP FOR CONDUCTED MEASUREMENTS

