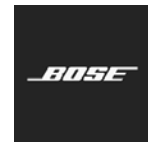




PRODUCT ASSURANCE ENGINEERING
Wireless Transceiver DSS Test Report



FCC ID: A94429358 IC: 3232A-429358

Test Type: Emissions Immunity

Product Type: Wireless Headphones

Product Name/Number: *Model Number(s): 429358*
FCC ID: A94429358
IC: 3232A-429358

Prepared For: *Product Assurance Engineering Department,*
Bose Corporation

Name of manufacturing agency applying for equipment type approval: *Bose Corporation*

Postal Address of manufacturing Agency: *The Mountain*
Framingham, MA 01701
USA

Test Results: Pass Fail

Applicable Standards: FCC CFR 47 Part 15 Subpart C
Industry Canada RSS-247 Issue 2
Industry Canada RSS-GEN Issue 5

Report Number: *EMC.429358.22.056.1*

General Comments/Special Test Conditions:

This report relates only to the items tested. This report covers EMC marking requirements for model 429358

	Print Name	Signature	Date
Prepared By:	Karl Klemm		26-Apr-2022
Electrical Engineer Review* By:	Bryan Cerqua		26-Apr-2022

* Since every test result is separately reviewed after its completion, the electrical engineer review indicated above represents a higher level review to ensure this report lists and contains all applicable and appropriate requirements.

If the report carries the "accredited" logo, the reviewer must verify all the tests in this report are covered under the current ISO17025 accreditation. The A2LA-accredited logo must be removed if any of the tests in the report are not performed under the current scope of accreditation. It is the responsibility of the reviewer to ensure the A2LA advertising policy is followed.



PRODUCT ASSURANCE ENGINEERING
Wireless Transceiver DSS Test Report

FCC ID: A94429358 IC: 3232A-429358



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Test Report Summary

Product Information:

Description

The EUT is a wireless headphone that contains DSS/DTS transceivers, manufactured by Qualcomm Technologies, QCC5127. The EUT uses Adaptive Frequency Hopping (AFH) mode, using a reduced hop set if interference is detected in band, however a minimum of 20 channels is always maintained.

Setup (Cables and Accessories)

For radio tests the radio was configured with Qualcomm Blue Suite software (details provided in SOFTWARE AND FIRMWARE section).

EUT Antenna Description

The antenna is an SMD chip antenna with antenna gain of 2.2 dBi, Johanson Technology model 2450AT45A100.

SOFTWARE AND FIRMWARE

*The firmware installed in the EUT during testing was version 00.00.09
The test utility software used during testing was Blue Suite version 3.3.10.*

Scope:

This report covers EMC requirements. FCC CFR 47 PART 15 SUBPART C, Industry Canada RSS-247 Issue 2, and Industry Canada RSS-GEN Issue 5.

All measurements in this report were made with a direct connection to the antenna terminal, with the antenna disconnected.

Test Objective:

Verify product meets all applicable EMC requirements.

Measurement Method:

ANSI C63.10 (2013).

Results:

Product complies with all applicable EMC requirements. All final results represent worst-case emissions and/or immunity.

Conclusions:

The device under test (D.U.T.):

meets all test standards selected in section 2 of this report.

does not meet all test standards selected in section 2 of this report.



PRODUCT ASSURANCE ENGINEERING
Wireless Transceiver DSS Test Report



FCC ID: A94429358 IC: 3232A-429358

Test Standards

Emissions:

- Standard
- FCC Part 15C
- Canada RSS-247
- Canada RSS-GEN

Environmental Conditions

Ambient:

- Temperature: 22±4 °C
- Humidity: 30-60 %RH
- Mains Voltage: 5 Vdc

FCC Test Site Accreditation.

Firm Name	Location	Accreditation	MRA Designation Number	Expiration Date	Contact	Contact Title
Bose Corporation	1 New York Avenue, Framingham, MA	American Association for Laboratory Accreditation	N/A US1088	07/31/2022	Mr. Cable Best	Quality Manager

Canadian Test Site Registration.

Organization	CAR identifier	Scope/Recognition Date (yyyy-mm-dd)	Expiration (yyyy-mm-dd)
BOSE CORPORATION 1 New York Avenue Framingham, MA 01701 UNITED STATES Company Number: 3232A Contact: Mario Espinal mario_espinal@bose.com	US0210	RSS-GEN (2019-02-11) RSS-210 (2019-02-11) RSS-247 (2019-02-11) RSS-248 (2021-11-19)	RECOGNIZED UNTIL: 2022-07-31 A2LA ISO/IEC 17025:2017 Expires: 2022-07-31



20dB and 99% Bandwidth

Requirement:

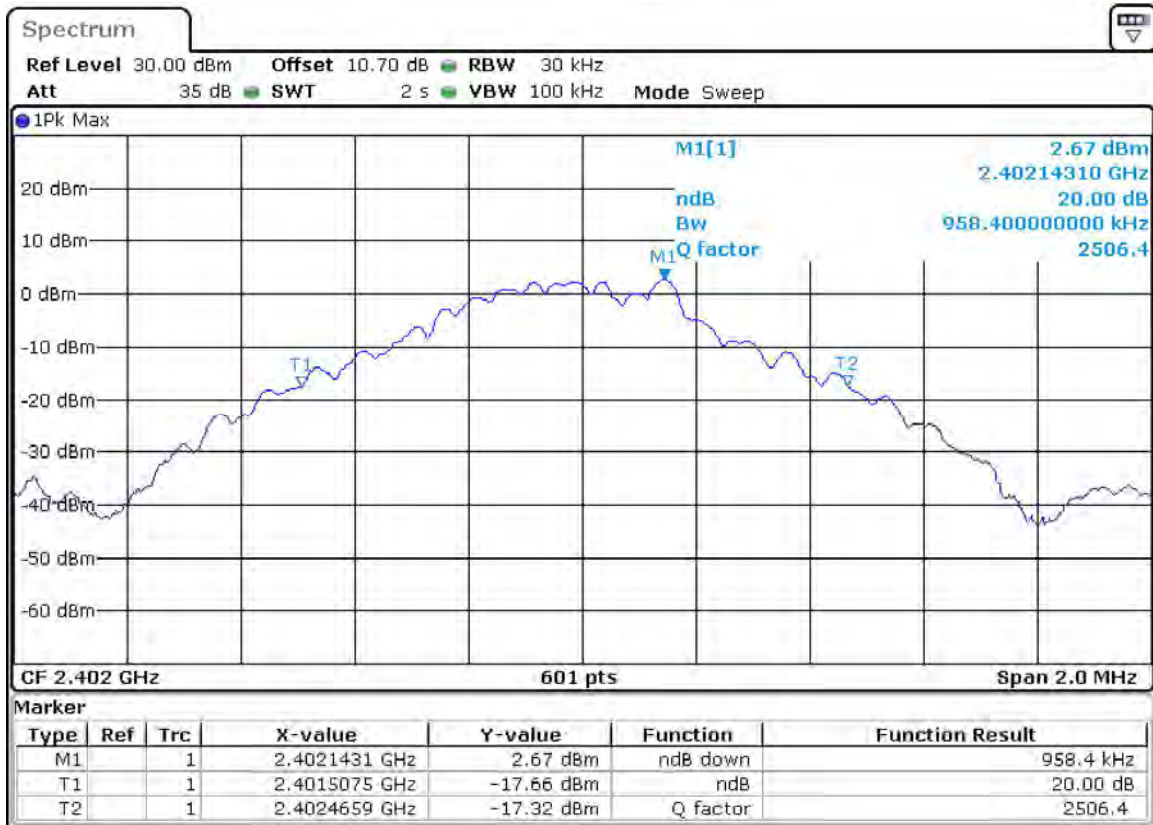
None; for reporting purposes only. Test per FCC 15.247(a)(1); IC RSS-247 5.1 (1), RSS-Gen 6.6.

Test Procedure:

The transmitter output is connected to a spectrum analyzer. The RBW is set to 1-5% of the 20 dB bandwidth and 99% Occupied Bandwidth. The VBW is set to \geq RBW. The sweep time is set to 2 seconds.

20dB Occupied Bandwidth

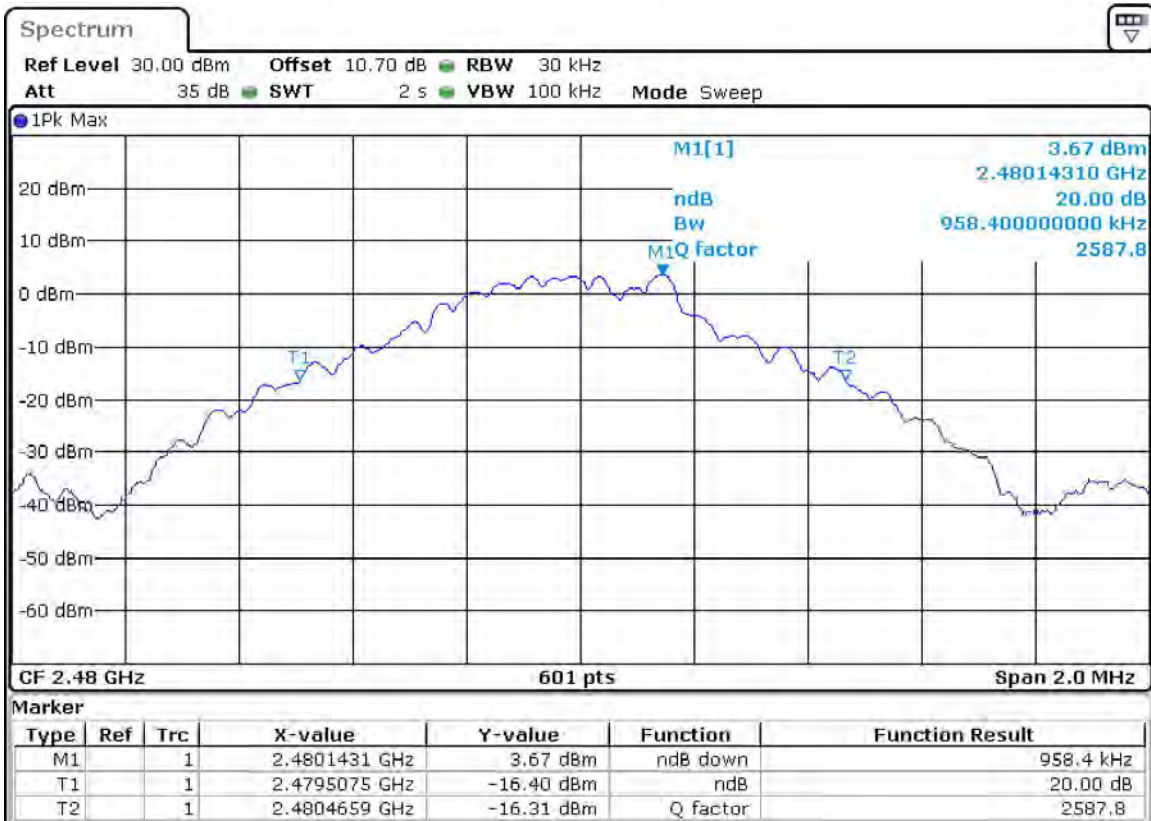
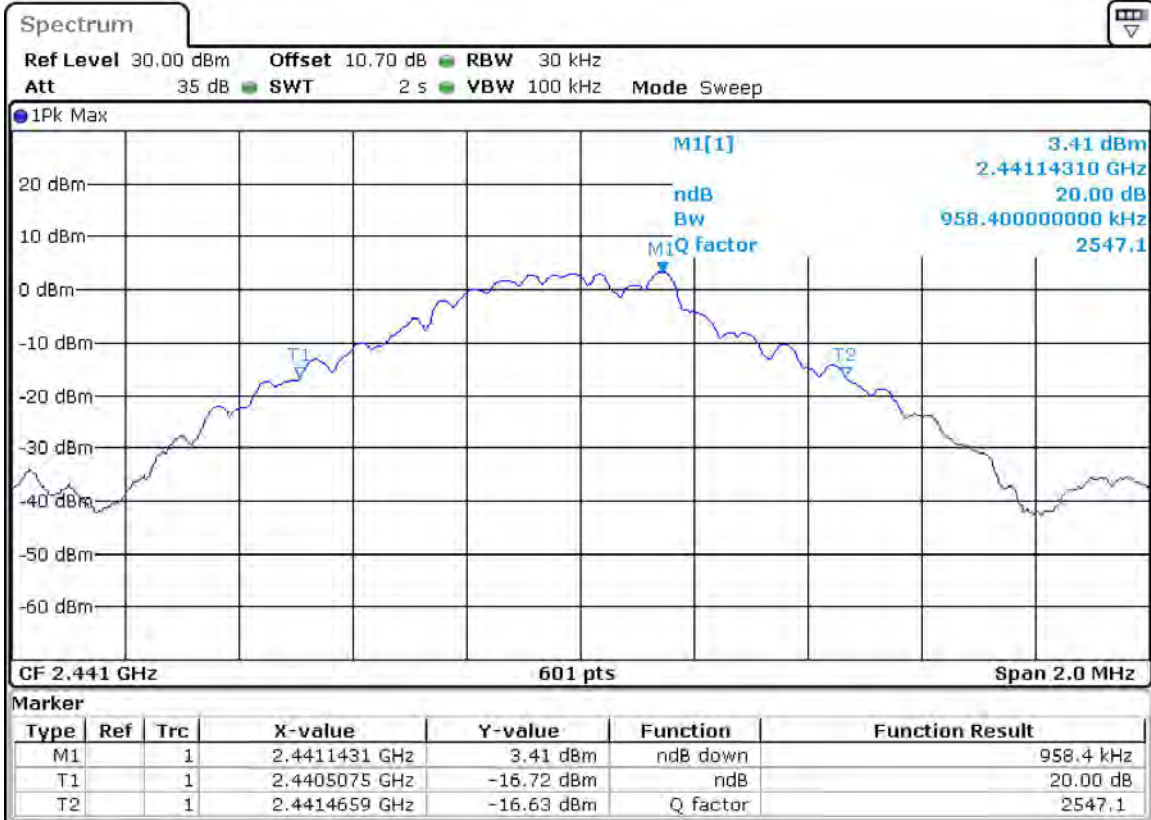
20 dB OBW Summary Table (Basic Rate: 1 Mbps)				
Channel	Frequency (MHz)	Mode	20 dB OBW (MHz)	Limit NA
Low	2402	DH5	0.958	-
Middle	2441	DH5	0.958	-
High	2480	DH5	0.958	-





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Wireless Transceiver DSS Test Report

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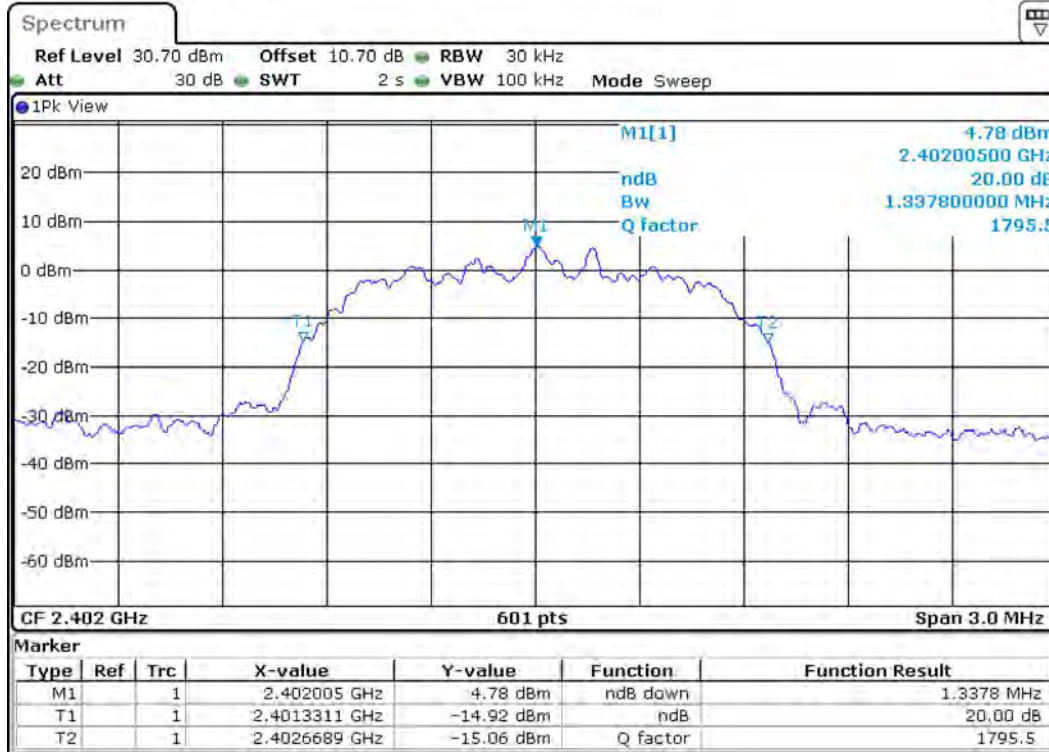


PRODUCT ASSURANCE ENGINEERING
Wireless Transceiver DSS Test Report

FCC ID: A94429358 IC: 3232A-429358



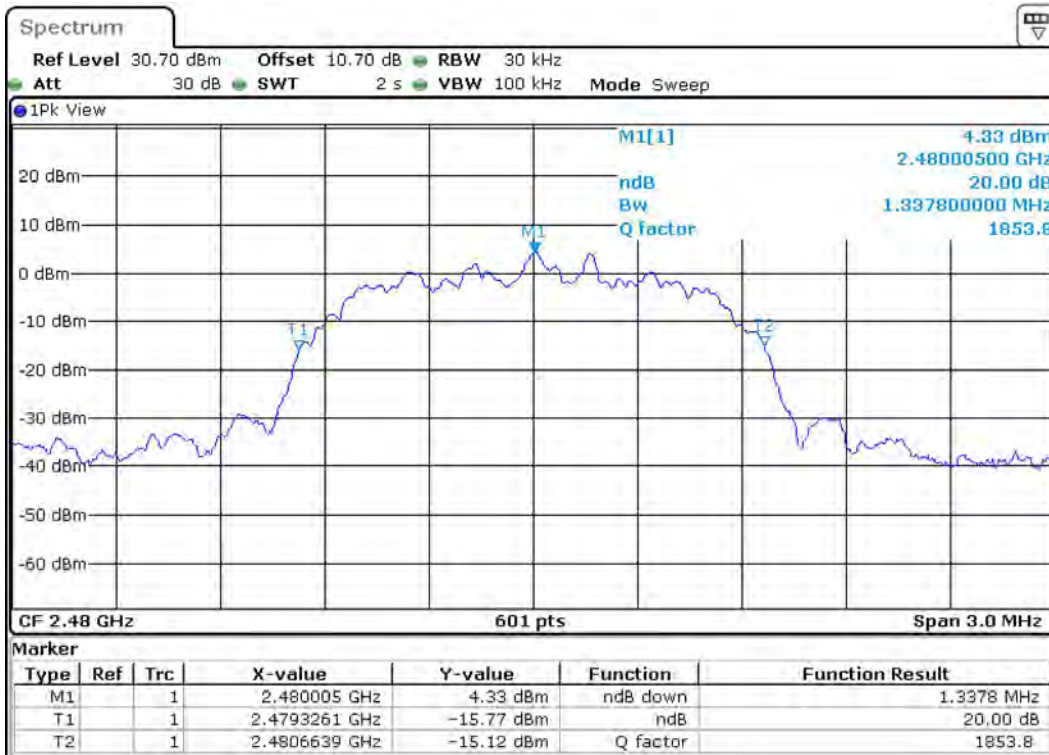
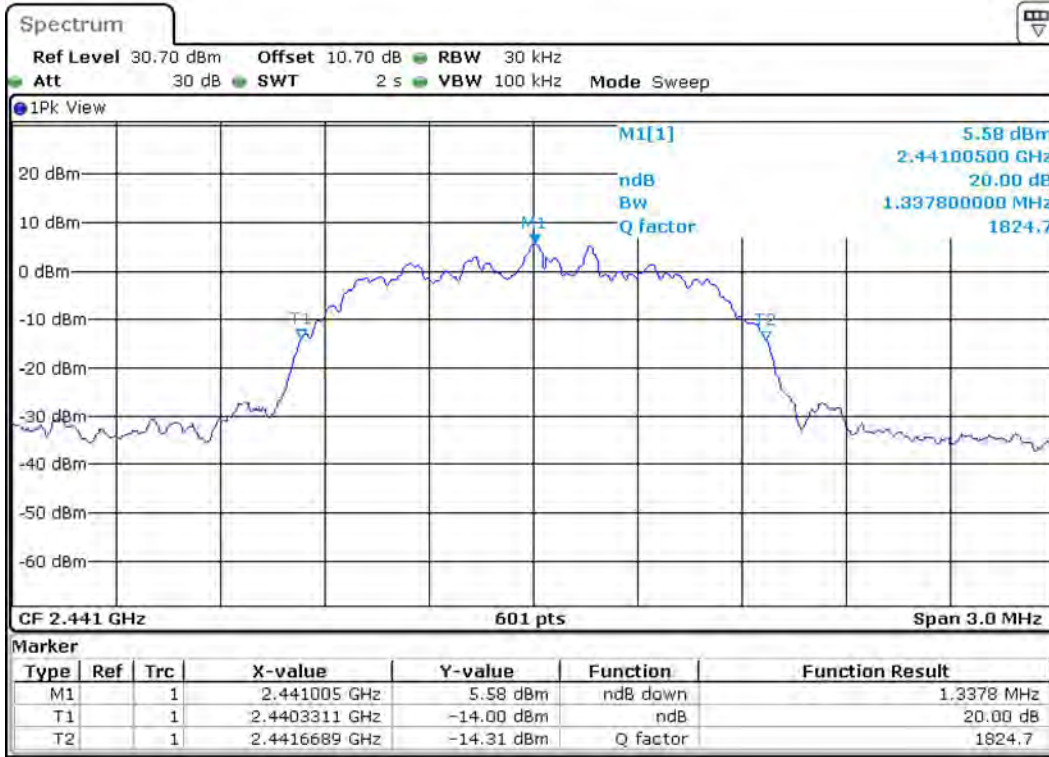
20 dB OBW Summary Table (Enhanced Rate: 3 Mbps)				
Channel	Frequency (MHz)	Mode	20 dB OBW (MHz)	Limit NA
Low	2402	3-DH5	1.308	-
Middle	2441	3-DH5	1.308	-
High	2480	3-DH5	1.308	-





PRODUCT ASSURANCE ENGINEERING
Wireless Transceiver DSS Test Report

FCC ID: A94429358 IC: 3232A-429358





99% Occupied Bandwidth

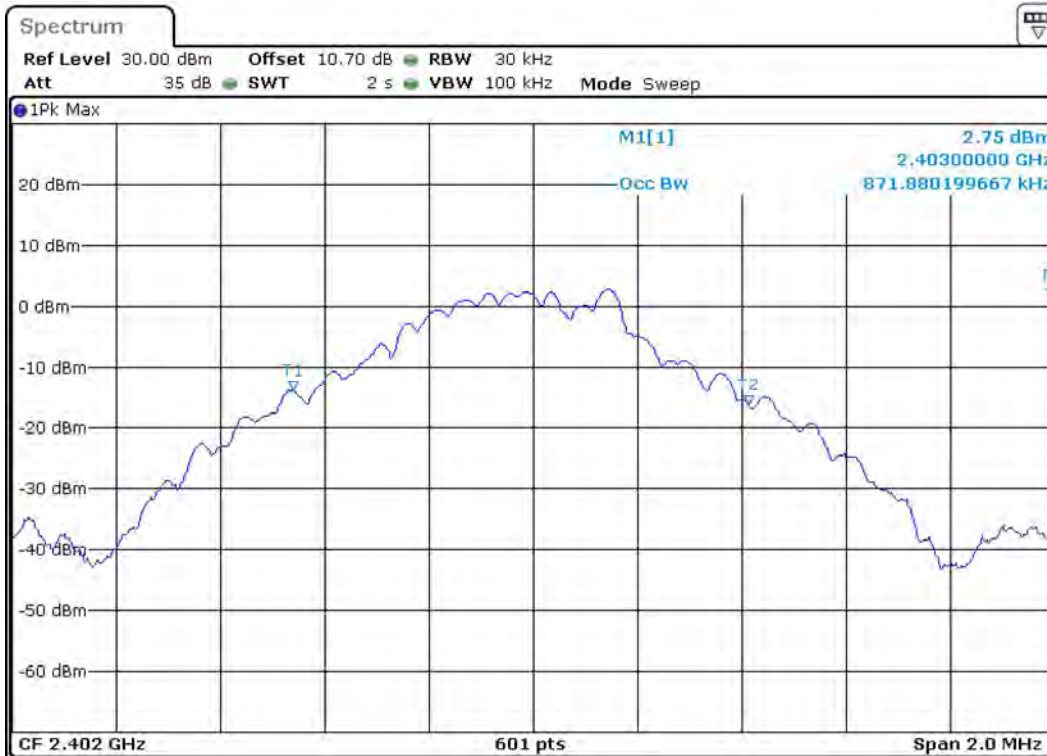
99% OBW Summary Table (xDH5)						
Channel	Frequency (MHz)	Mode	99% OBW (MHz)	Limit (MHz)	Margin (MHz)	Result
Low	2402	DH5	0.872	2400	1.56	Pass
High	2480	DH5	0.872	2483.5	3.06	Pass
Low	2402	3-DH5	1.181	2400	1.41	Pass
High	2480	3-DH5	1.188	2483.5	2.91	Pass

99% OBW Summary Table (xDH5)						
Channel	Frequency (MHz)	Mode	99% OBW (MHz)	Limit (MHz)	Margin (MHz)	Result
Low	2402	DH5	0.872	5	4.128	Pass
Middle	2441	DH5	0.879	5	4.121	Pass
High	2480	DH5	0.872	5	4.128	Pass
Low	2402	3-DH5	1.181	5	3.819	Pass
Middle	2441	3-DH5	1.188	5	3.812	Pass
High	2480	3-DH5	1.188	5	3.812	Pass

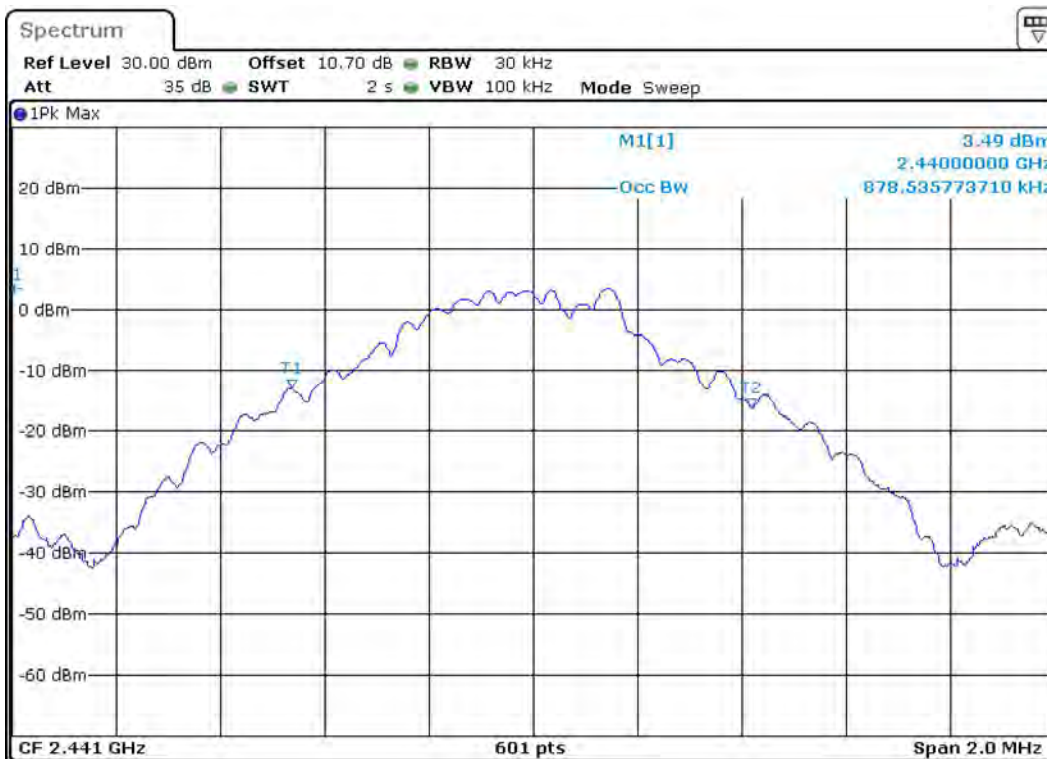


PRODUCT ASSURANCE ENGINEERING Wireless Transceiver DSS Test Report

FCC ID: A94429358 IC: 3232A-429358



DH5, Tx on 2402 MHz



DH5, Tx on 2441 MHz

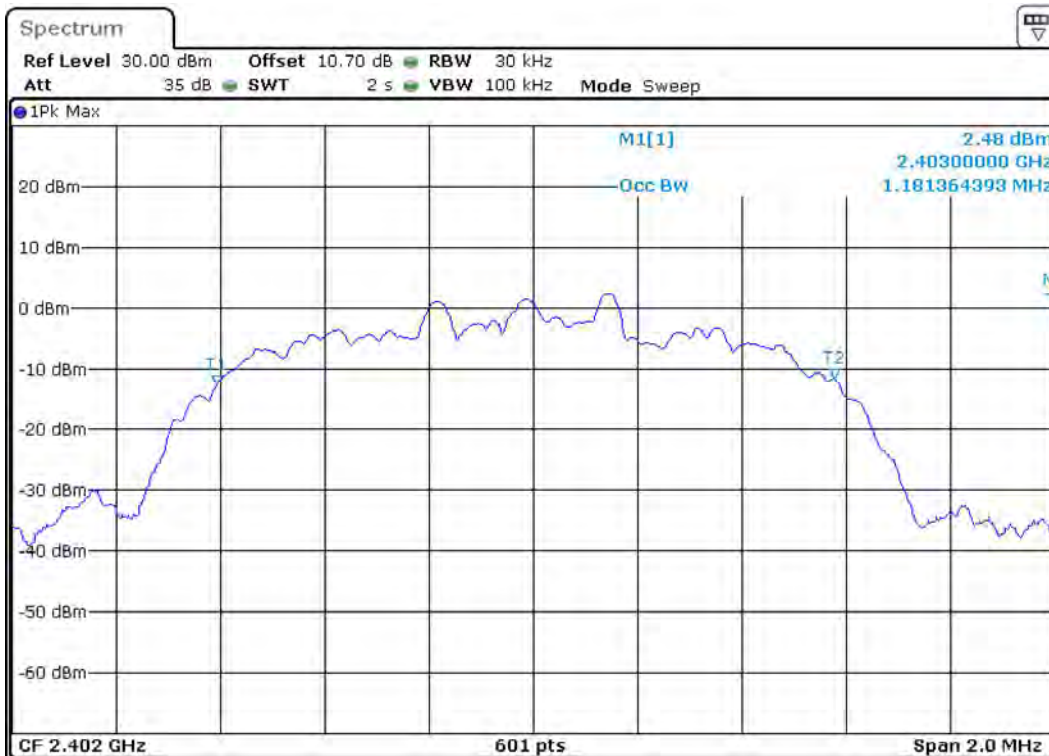


PRODUCT ASSURANCE ENGINEERING Wireless Transceiver DSS Test Report

FCC ID: A94429358 IC: 3232A-429358



DH5, Tx on 2480 MHz

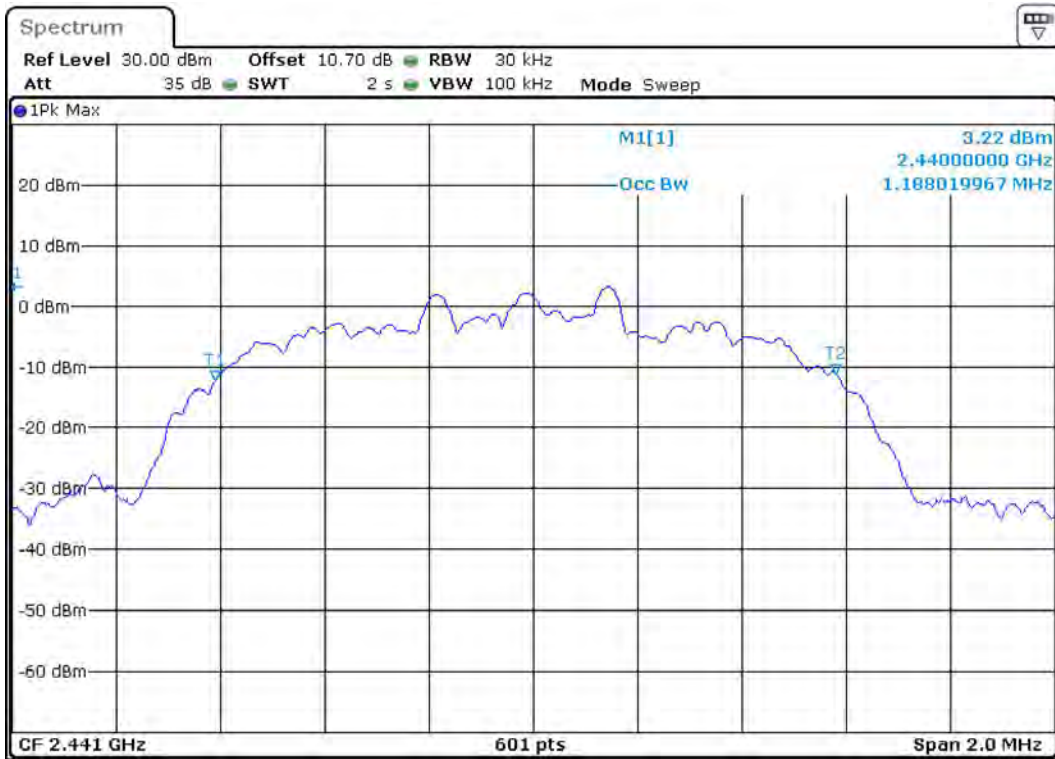


3-DH5, Tx on 2402 MHz



PRODUCT ASSURANCE ENGINEERING Wireless Transceiver DSS Test Report

FCC ID: A94429358 IC: 3232A-429358



3-DH5, Tx on 2441 MHz



3-DH5, Tx on 2480 MHz



Conducted Output Power Requirements:

FCC 15.247 (b) (1)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

RSS-247 5.4 (2)

For frequency hopping systems operating in the band 2400-2483.5 MHz and employing at least 75 hopping channels, the maximum peak conducted output power shall not exceed 1 W; for all other frequency hopping systems in the band, the maximum peak conducted output power shall not exceed 0.125 W.

Test setup details:

The EUT is controlled via the USB port with Blue Suite software which is used to set the test modes of the Bluetooth device. The EUT antenna is disconnected. A temporary test connector is mounted to the PCB. A 6 inch SMA adapter cable with 0.7 dB loss was used for all conducted measurements. To compensate for the cable loss, the reference level offset feature of the spectrum analyzer was used. The EUT is programmed to operate on fixed frequencies at the low, middle, and high end of the authorized frequency band. The spectrum analyzer resolution bandwidth is set to 3 MHz (higher than the occupied bandwidth), peak detector and max hold. The maximum output power is recorded for each of the three frequencies in both basic and enhanced data rates.



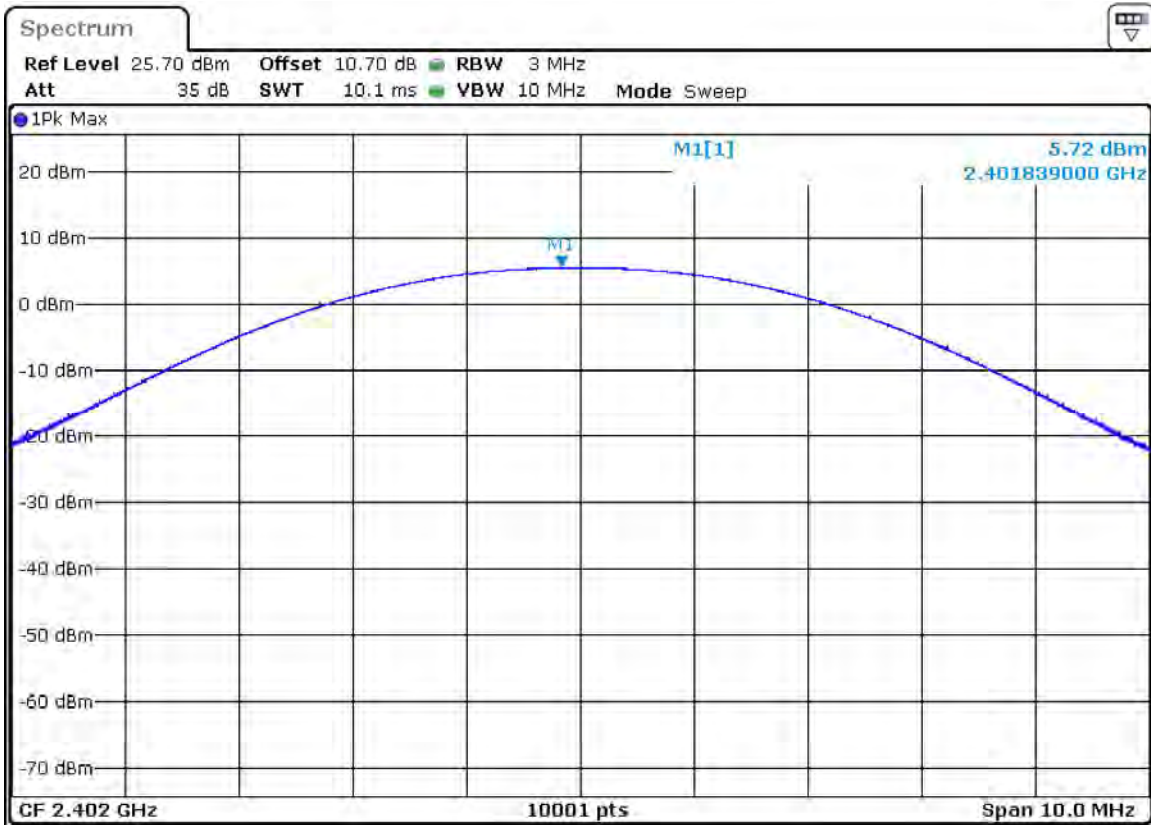
PRODUCT ASSURANCE ENGINEERING
Wireless Transceiver DSS Test Report

FCC ID: A94429358 IC: 3232A-429358



Test Results:

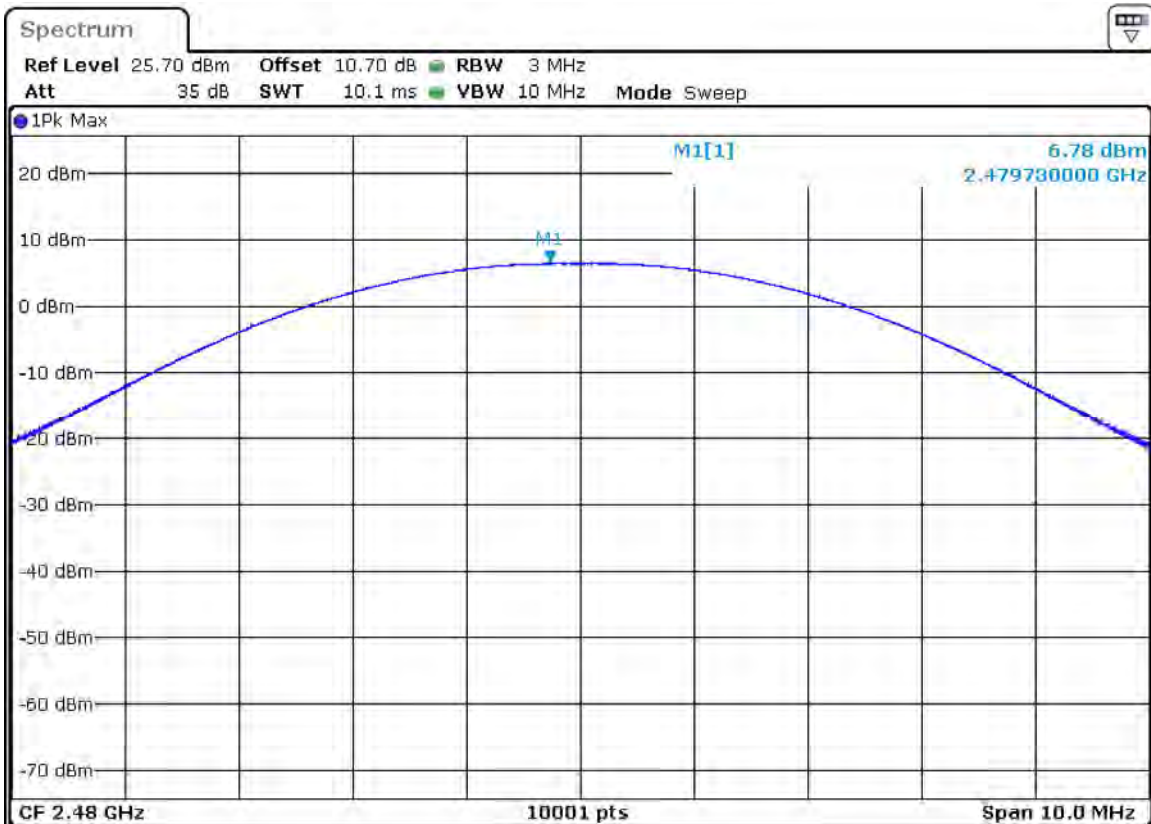
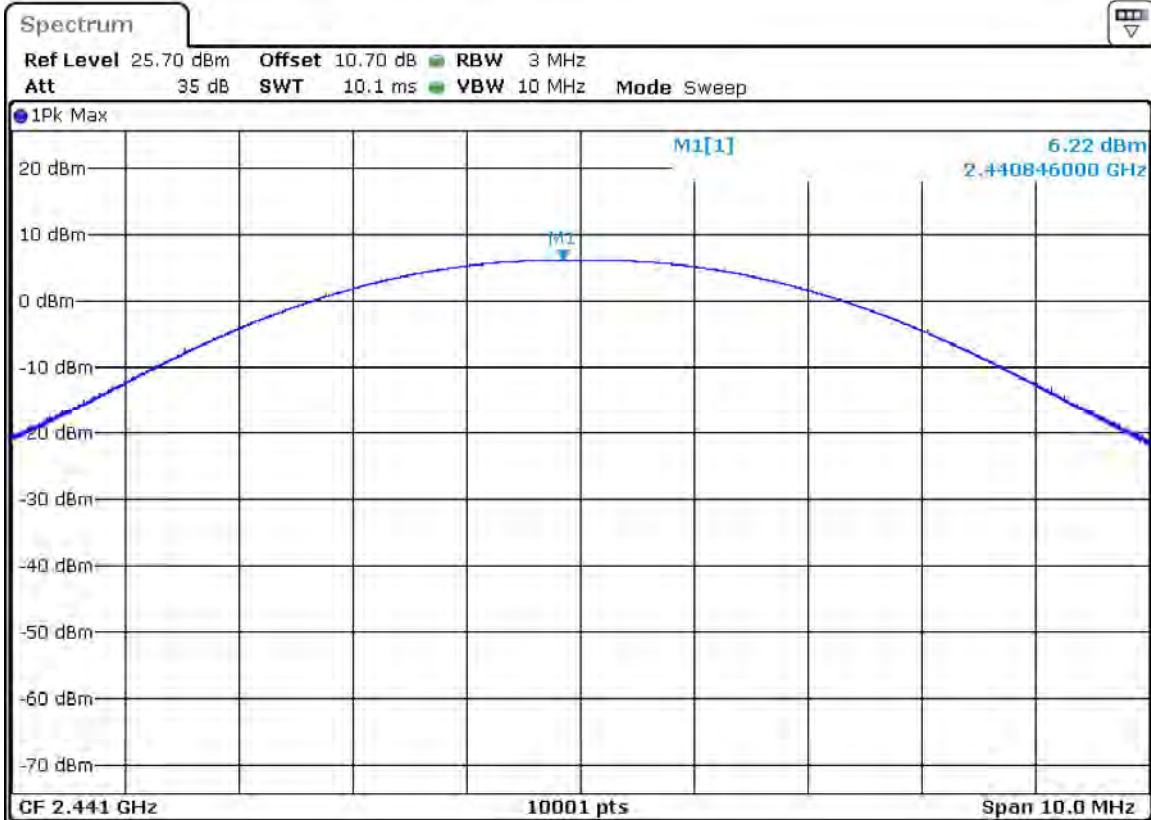
Output Power Summary Table (Basic Rate: 1 Mbps)							
Channel	Frequency (MHz)	Mode	Output Power (dBm)	Directional Gain (dBi)	Limit (dB)	Margin (dB)	Result
Low	2402	DH5	5.7	0	30	24.3	Pass
Middle	2441	DH5	6.2	0	30	23.8	Pass
High	2480	DH5	6.5	0	30	23.5	Pass





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Wireless Transceiver DSS Test Report

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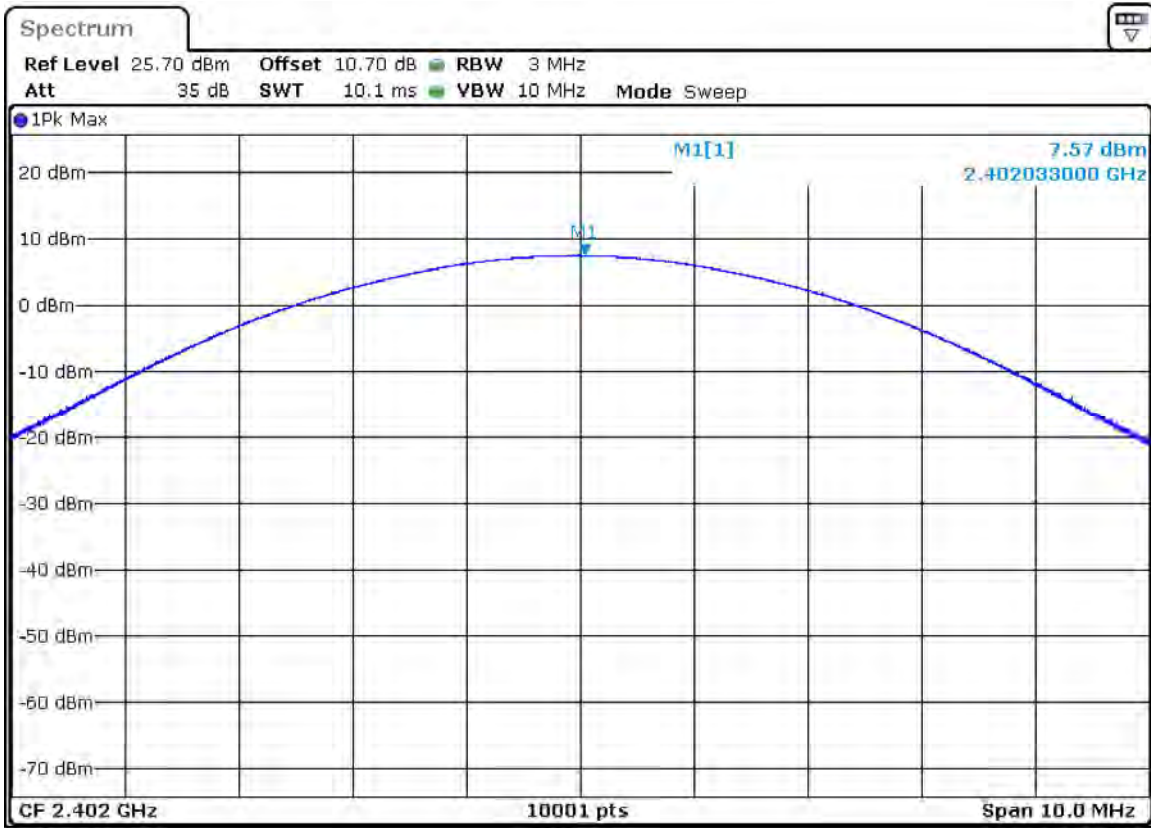


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Wireless Transceiver DSS Test Report

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Output Power Summary Table (Enhanced Rate: 3 Mbps)							
Channel	Frequency (MHz)	Mode	Output Power (dBm)	Directional Gain (dBi)	Limit (dB)	Margin (dB)	Result
Low	2402	3-DH5	7.6	0	30	22.4	Pass
Middle	2441	3-DH5	8.3	0	30	21.7	Pass
High	2480	3-DH5	8.7	0	30	21.3	Pass

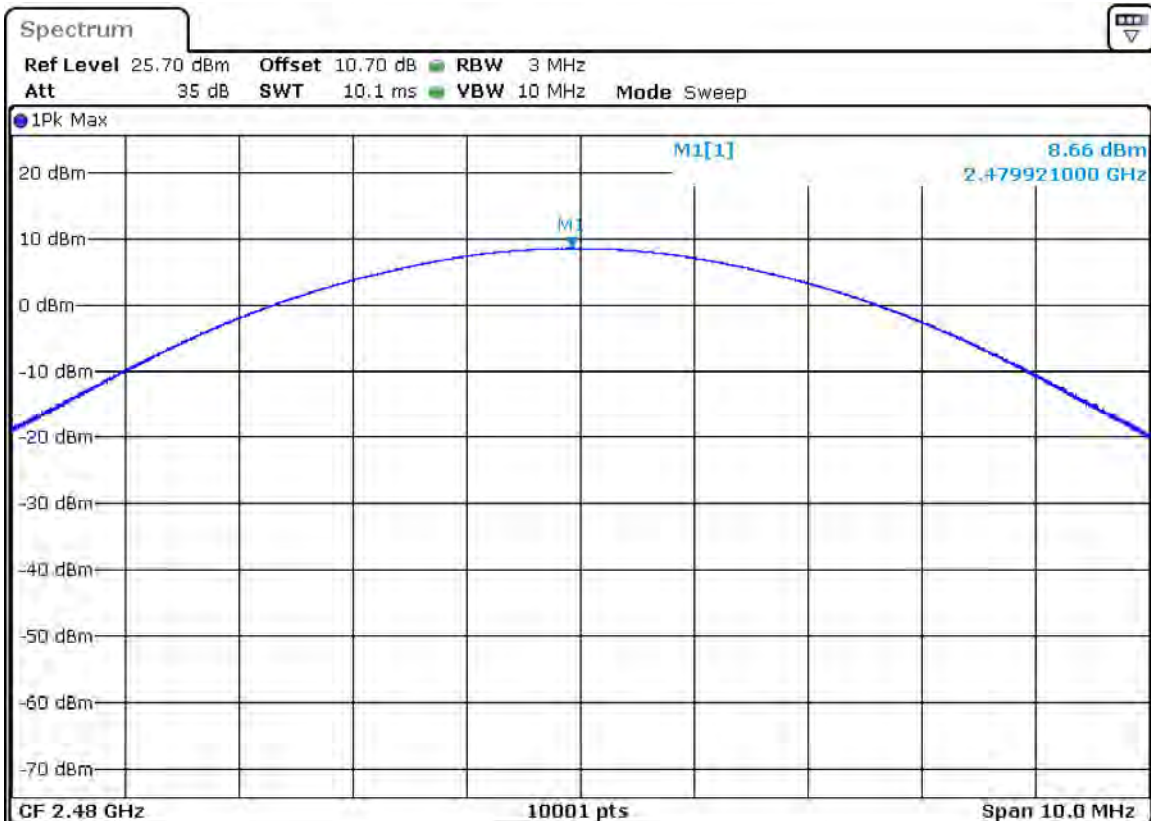
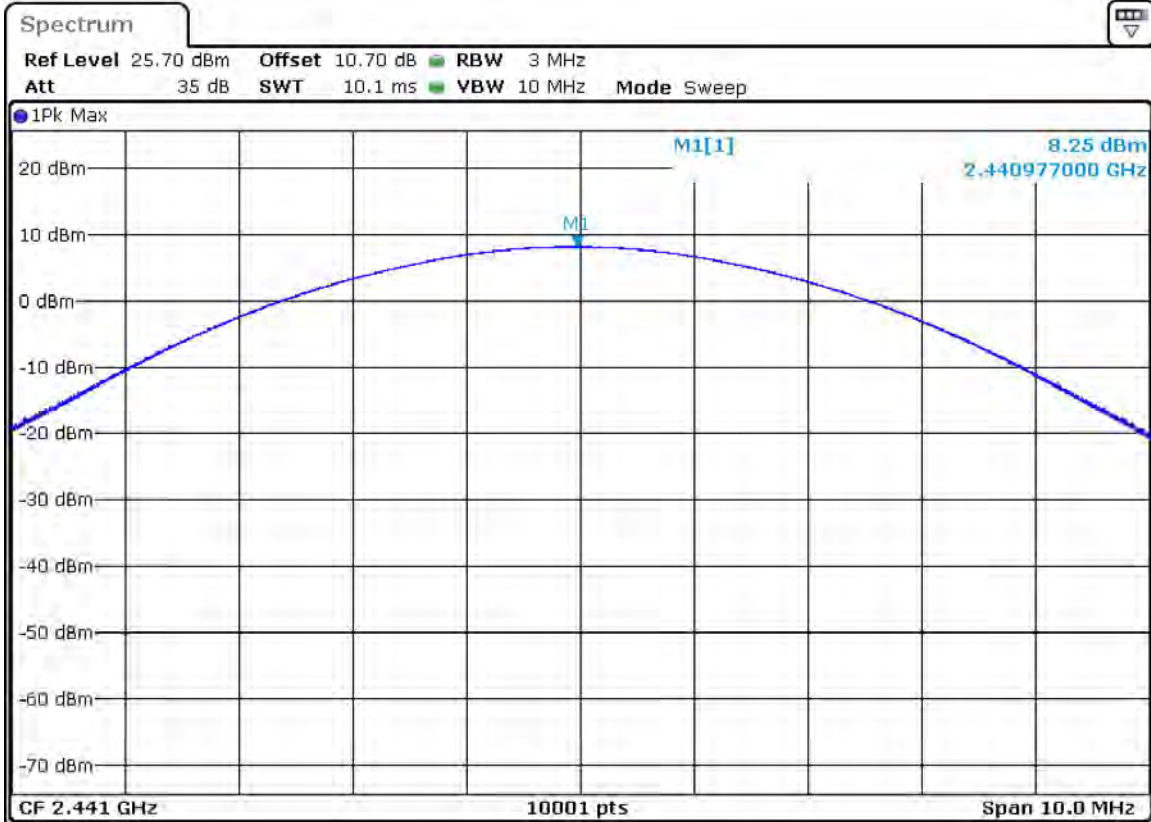


Tx 3DH5 at power level 10 on 2402 MHz



PRODUCT ASSURANCE ENGINEERING Wireless Transceiver DSS Test Report

FCC ID: A94429358 IC: 3232A-429358





Hopping Frequency Separation Requirements:

FCC 15.247 (a) (1), IC RSS-247 5.1 (2)

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.

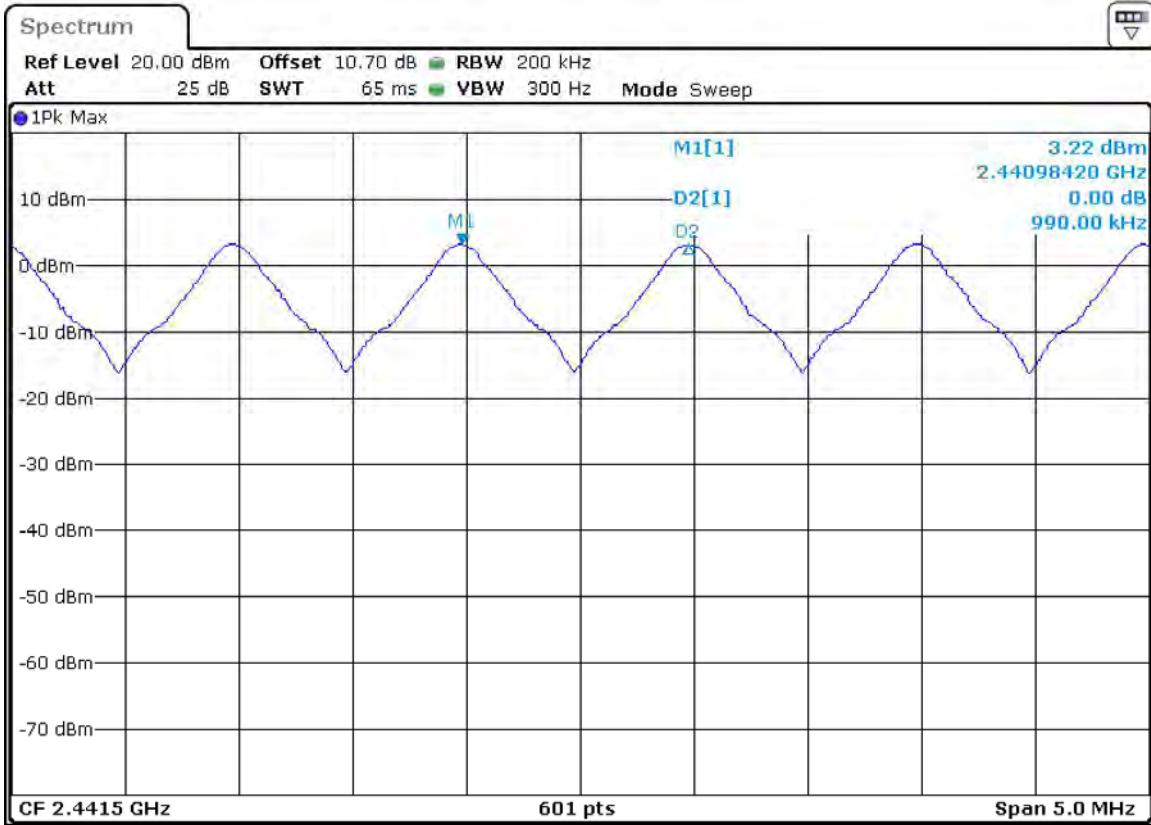


PRODUCT ASSURANCE ENGINEERING
Wireless Transceiver DSS Test Report

FCC ID: A94429358 IC: 3232A-429358



Test Results:

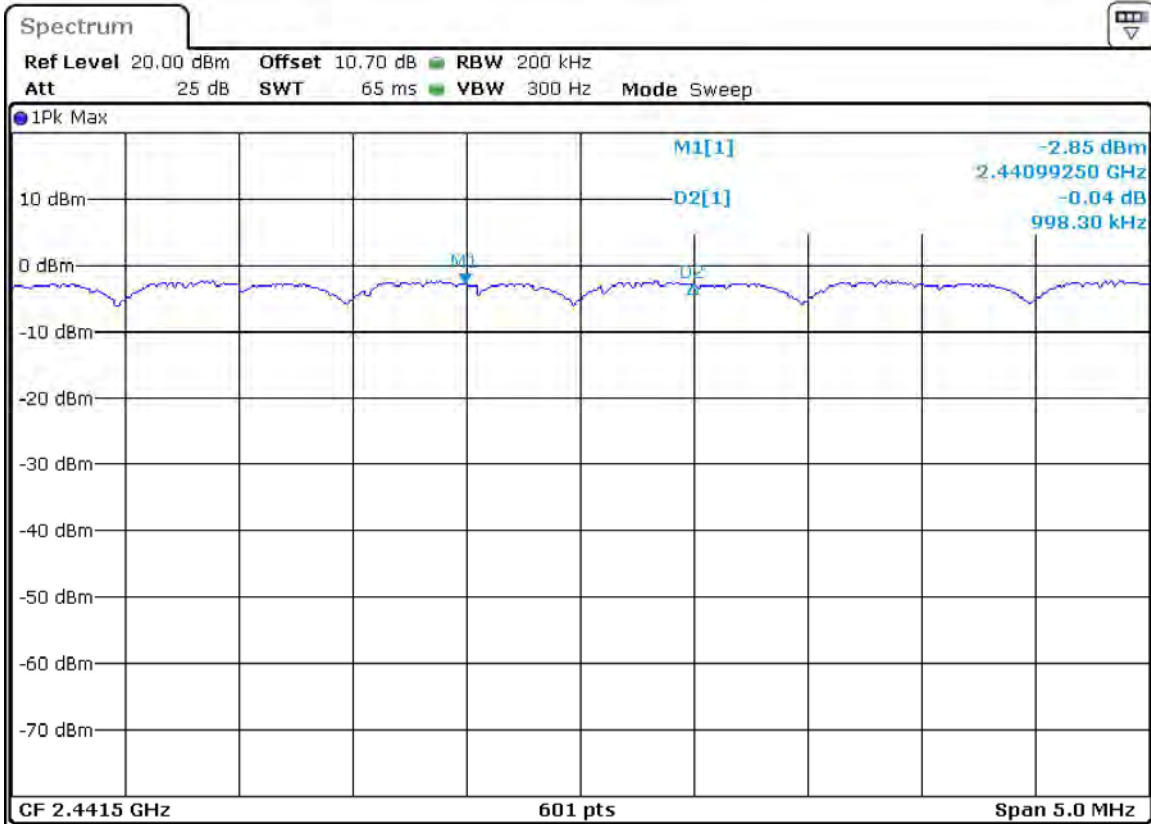


Hopping frequencies are separated by 1 MHz, which is greater than the required minimum of the 20 dB bandwidth; 958 kHz for DH5.



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Hopping frequencies are separated by 1 MHz which is greater than the required minimum of 2/3 of the 20 dB bandwidth of the hopping channel, which would be 872 kHz for 3-DH5; the output power in 3-DH5 mode is less than 125 mW



Conducted Spurious Emissions Requirements:

FCC 15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, 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)).

IC RSS-247 5.5

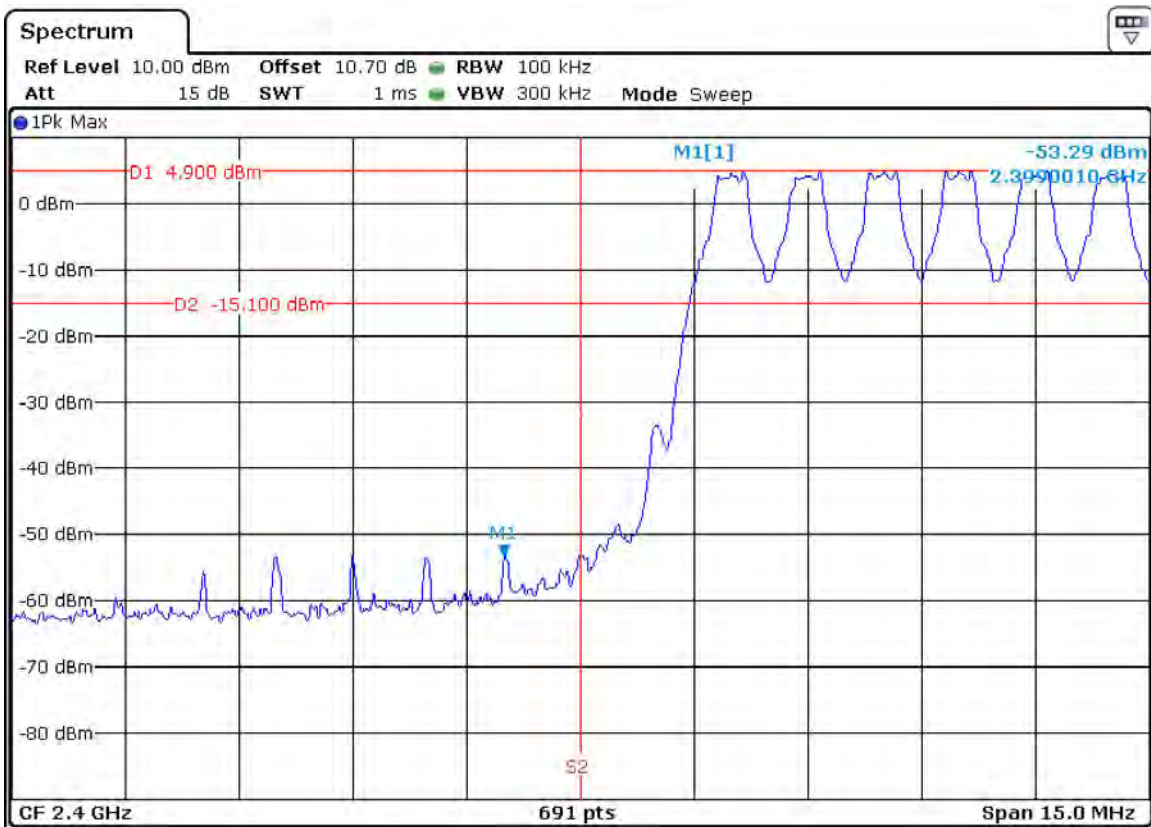
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section A8.4 (4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Note: Antenna gain outside of the wanted band was assumed to be zero. The conducted spurious readings are for additional information as the radiated readings take precedence.



Spurious Band-edge Emissions

Lower Band Edge (Hopping Mode)						
Mode	Frequency (MHz)	Mode	Worst Case (dBc)	Limit (dBc)	Margin (dB)	Result
Hopping	All	DH5	58.2	20	38.2	Pass
Hopping	All	3-DH5	52.2	20	32.2	Pass

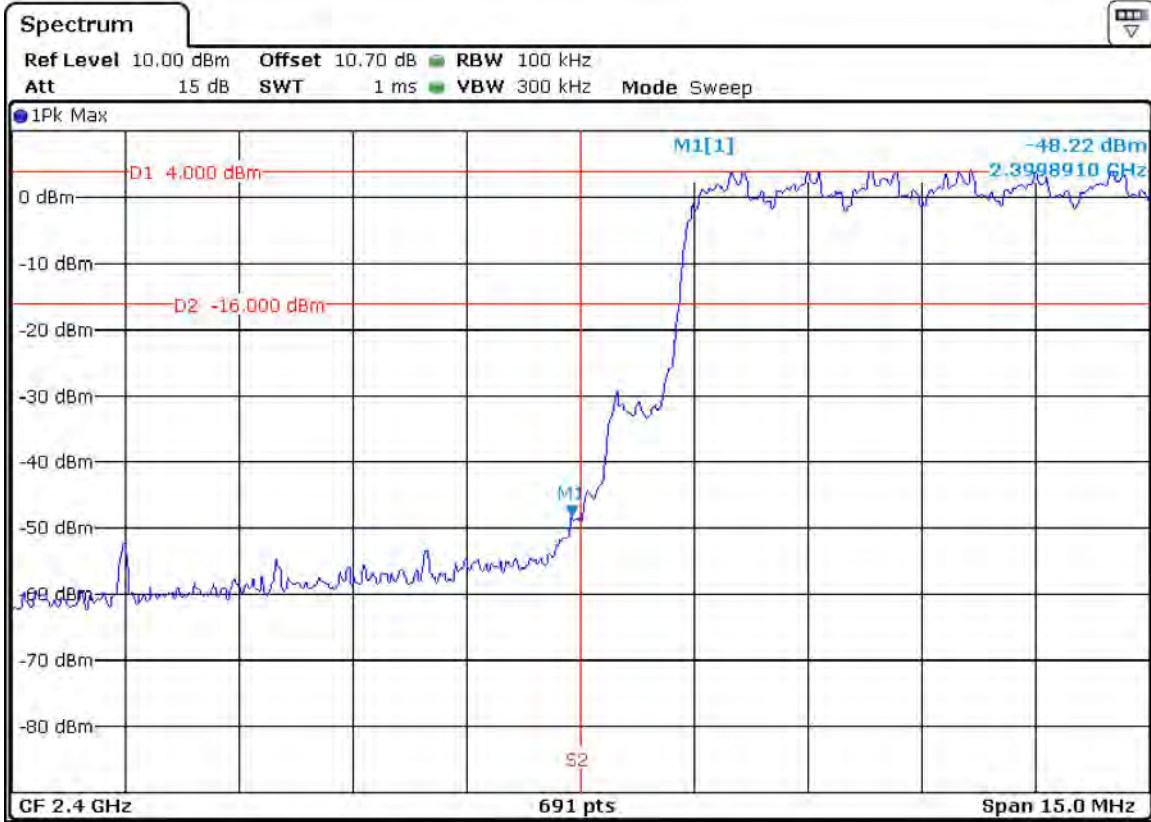


DH5, hopping on all channels



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FCC ID: A94429358 IC: 3232A-429358



3DH5, hopping on all channels

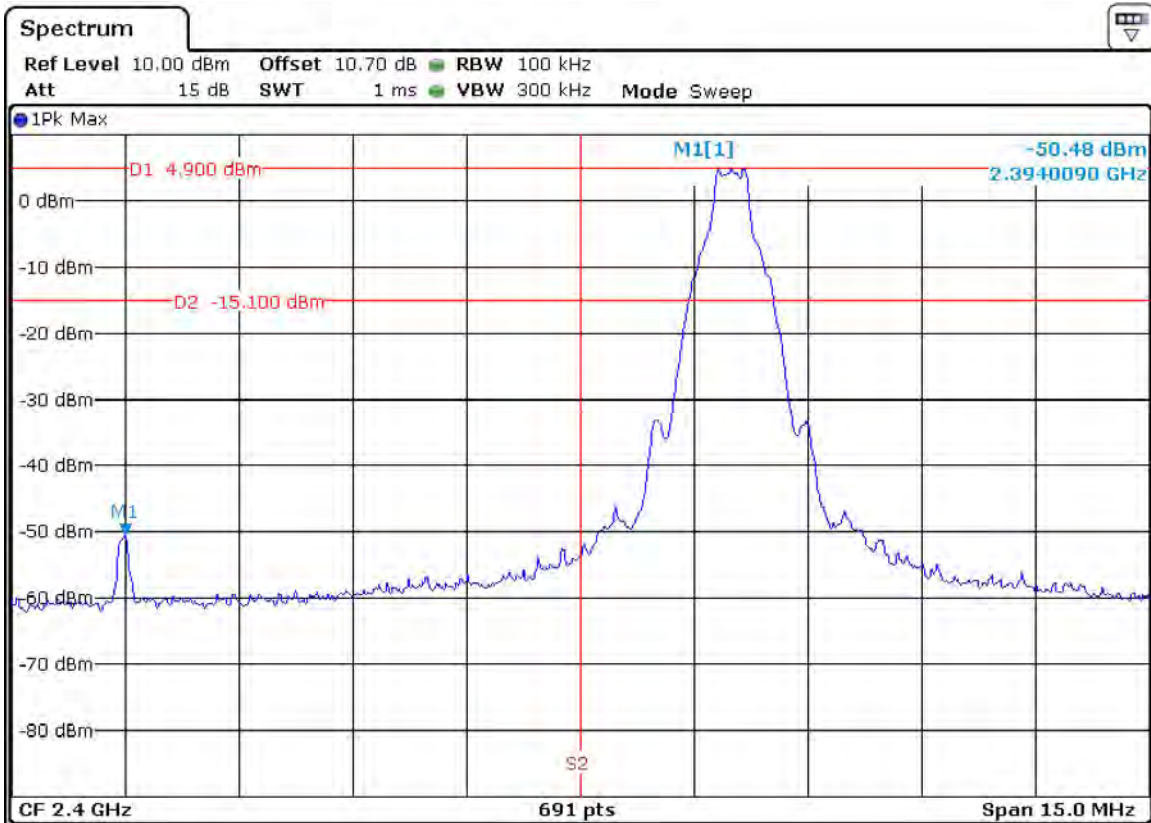


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Wireless Transceiver DSS Test Report

FCC ID: A94429358 IC: 3232A-429358



Lower Band Edge (Non-Hopping Mode)						
Channel	Frequency (MHz)	Mode	Worst Case (dBc)	Limit (dBc)	Margin (dB)	Result
Low	2402	DH5	55.4	20	35.4	Pass
Low	2402	3-DH5	50.3	20	30.3	Pass

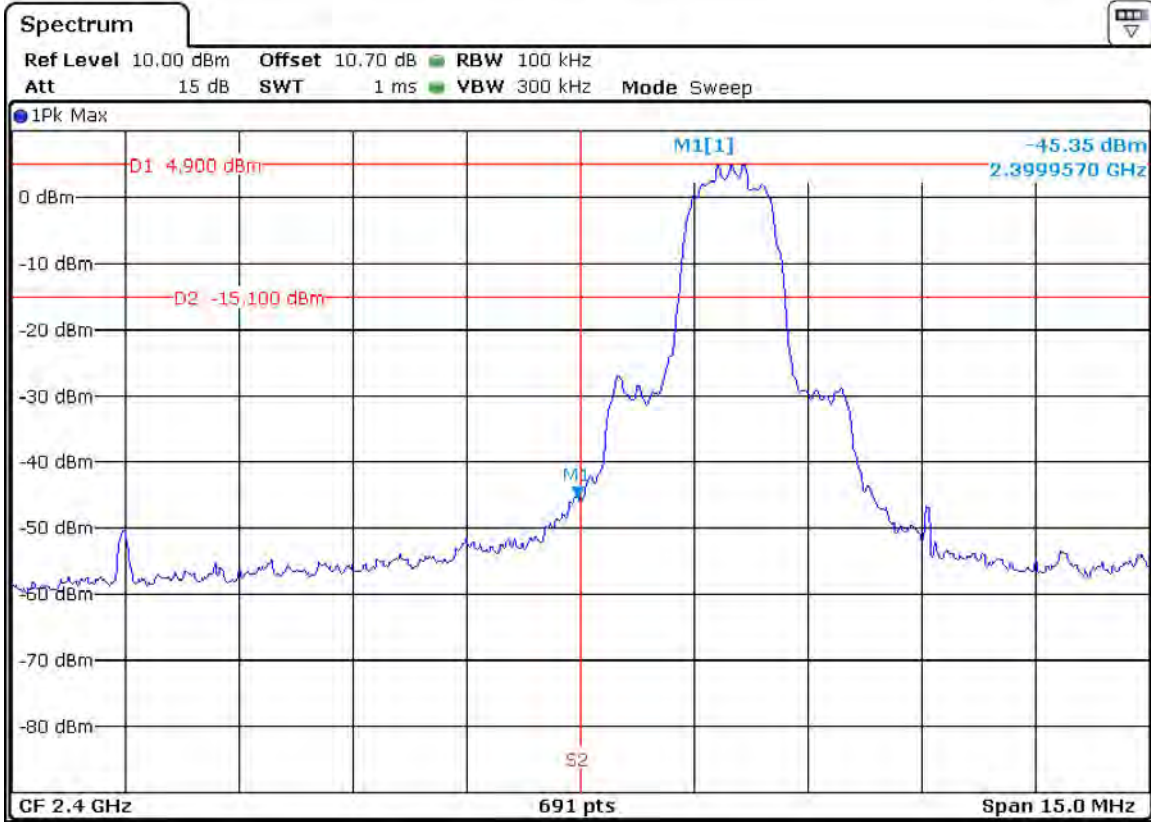


DH5, non-hopping



PRODUCT ASSURANCE ENGINEERING Wireless Transceiver DSS Test Report

FCC ID: A94429358 IC: 3232A-429358



3DH5, non-hopping

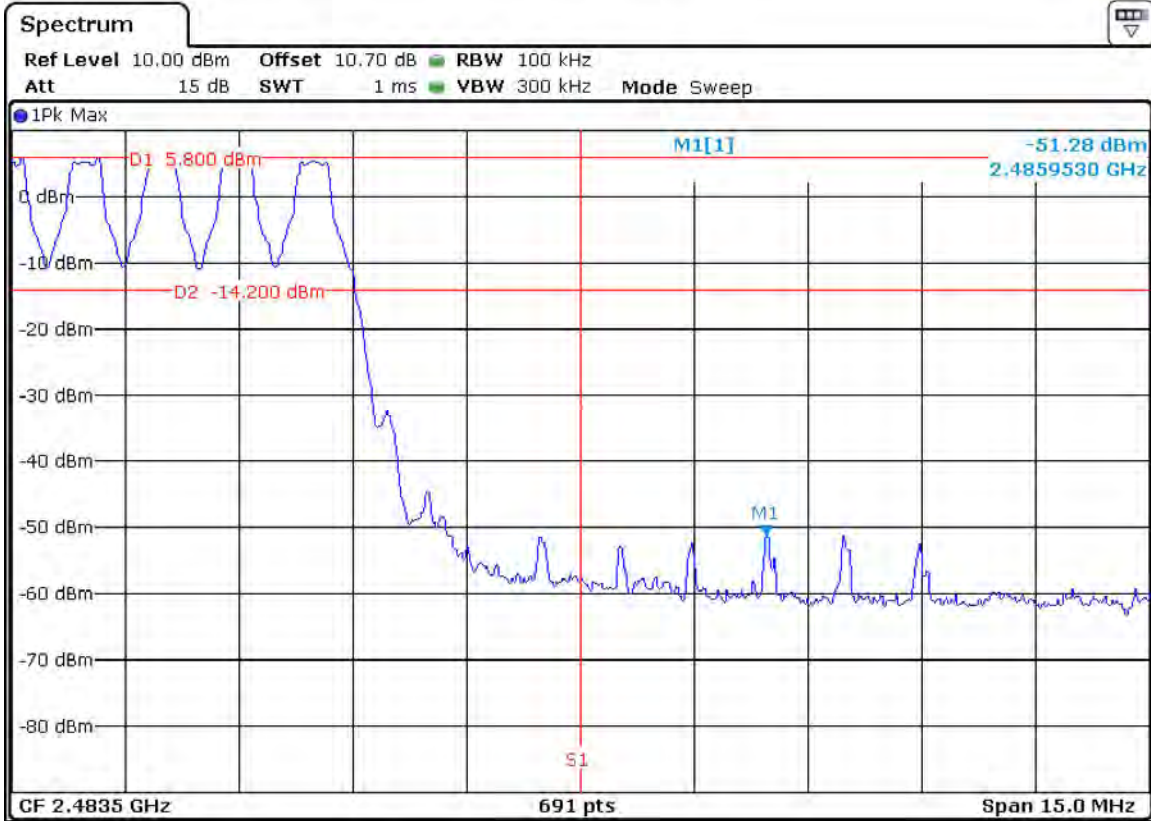


PRODUCT ASSURANCE ENGINEERING
Wireless Transceiver DSS Test Report

FCC ID: A94429358 IC: 3232A-429358



Upper Band Edge (Hopping Mode)						
Mode	Frequency (MHz)	Mode	Worst Case (dBc)	Limit (dBc)	Margin (dB)	Result
Hopping	All	DH5	57.1	20	37.1	Pass
Hopping	All	3-DH5	55.3	20	35.3	Pass

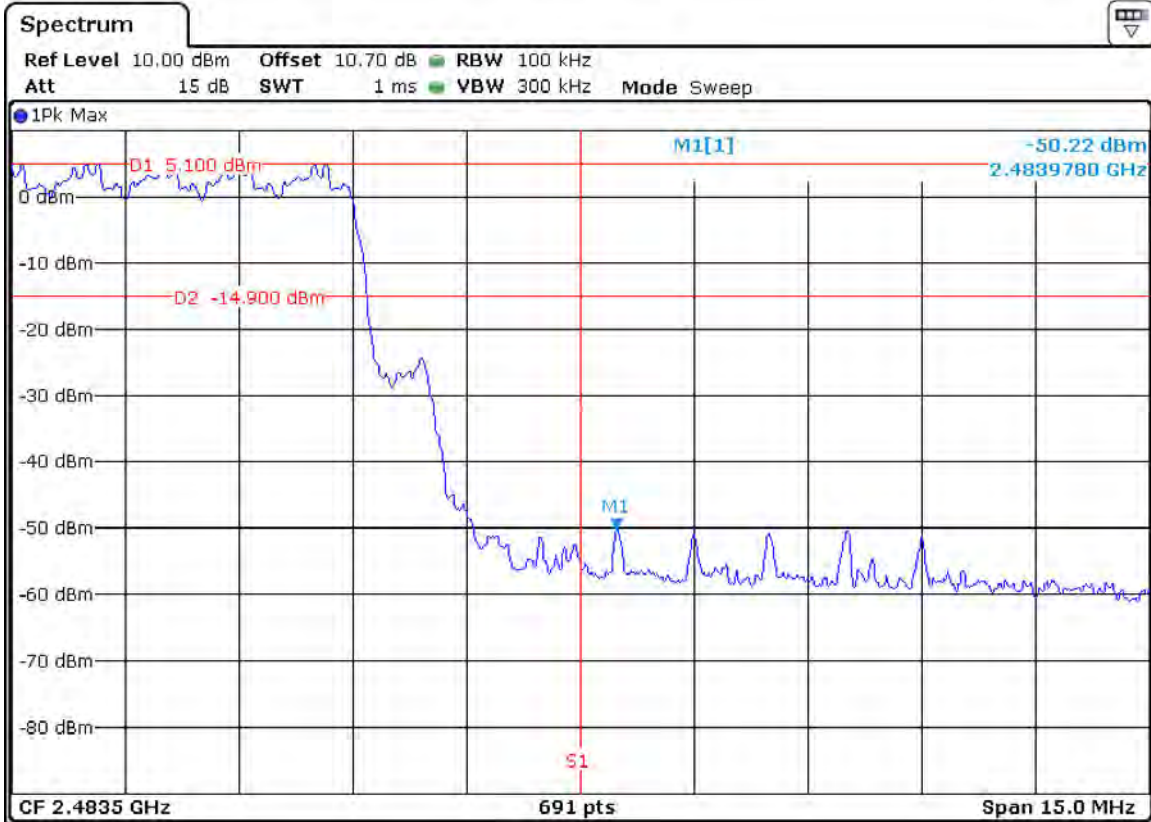


DH5, hopping on all channels



PRODUCT ASSURANCE ENGINEERING Wireless Transceiver DSS Test Report

FCC ID: A94429358 IC: 3232A-429358



3DH5, hopping on all channels

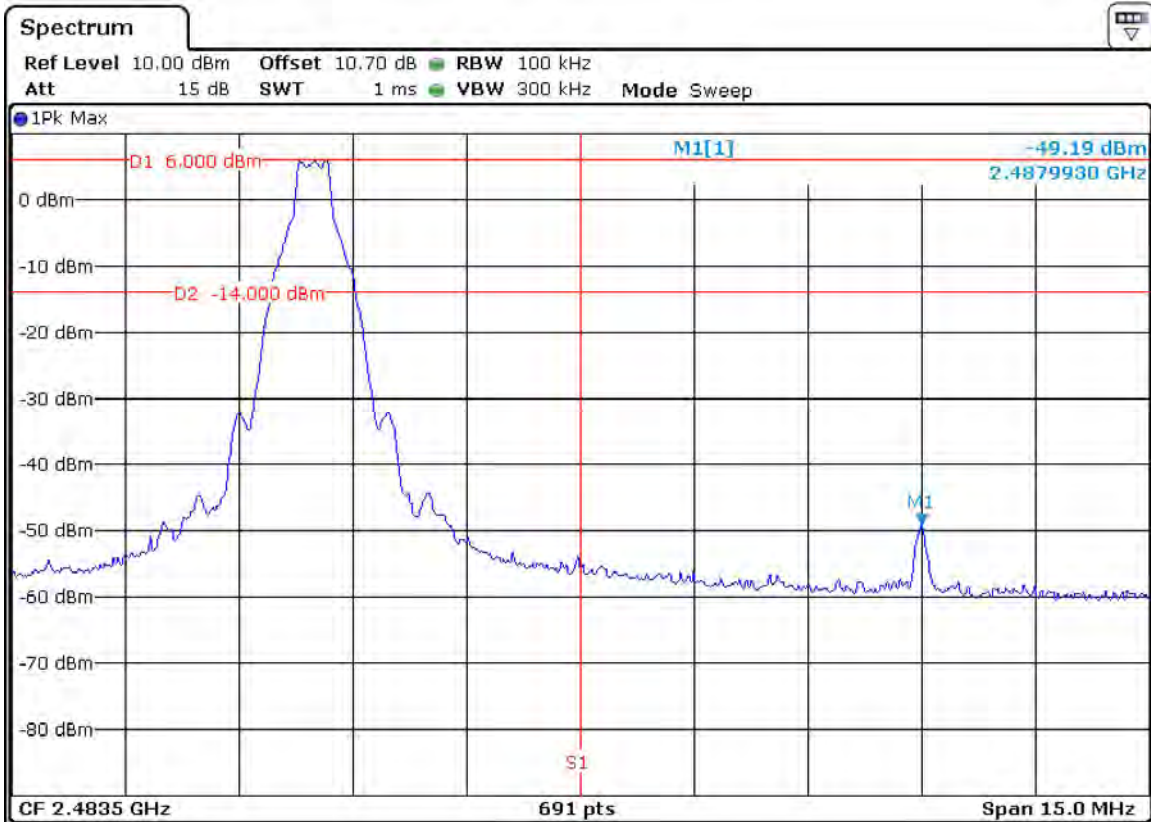


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Wireless Transceiver DSS Test Report

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Upper Band Edge (Non-Hopping Mode)						
Channel	Frequency (MHz)	Mode	Worst Case (dBc)	Limit (dBc)	Margin (dB)	Result
High	2480	DH5	55.2	20	35.2	Pass
High	2480	3-DH5	55.9	20	35.9	Pass

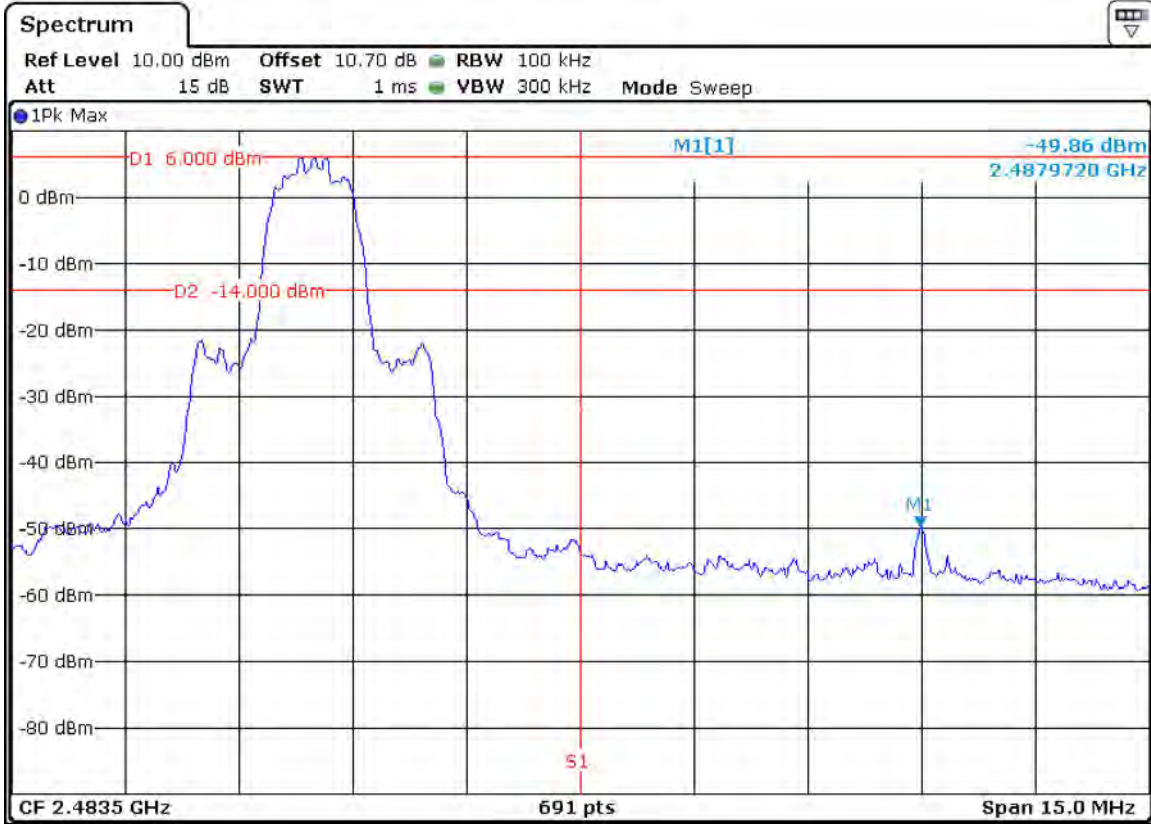


DH5, non-hopping



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3DH5, non-hopping



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Spurious Emissions

Spurious Summary Table (Basic Rate: 1 Mbps)											
Channel	Band Range (MHz)	Mode	Peak Raw Measurement (dBm)	Test Cable Loss (dB)	Pad ATTN (dB)	EUT Antenna Gain At Harmonic Frequency (dBi)	Corrected Reading (dBm)	Convert to E-Field at 3 meters (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Result
Low/Mid/High	30 To 1000	DH5	-62.5	0.7	10.0	0.0	-51.8	43.43	54	10.57	Pass
Low/Mid/High	2483.5 To 25000	DH5	-67.6	0.7	10.0	0.0	-56.9	38.33	54	15.67	Pass
Hopping	30 To 1000	DH5	-67.2	0.7	10.0	0.0	-56.5	38.73	54	15.27	Pass
Hopping	2483.5 To 25000	DH5	-68.1	0.7	10.0	0.0	-57.4	37.83	54	16.17	Pass

Note: Peak reading applied to Average Limit

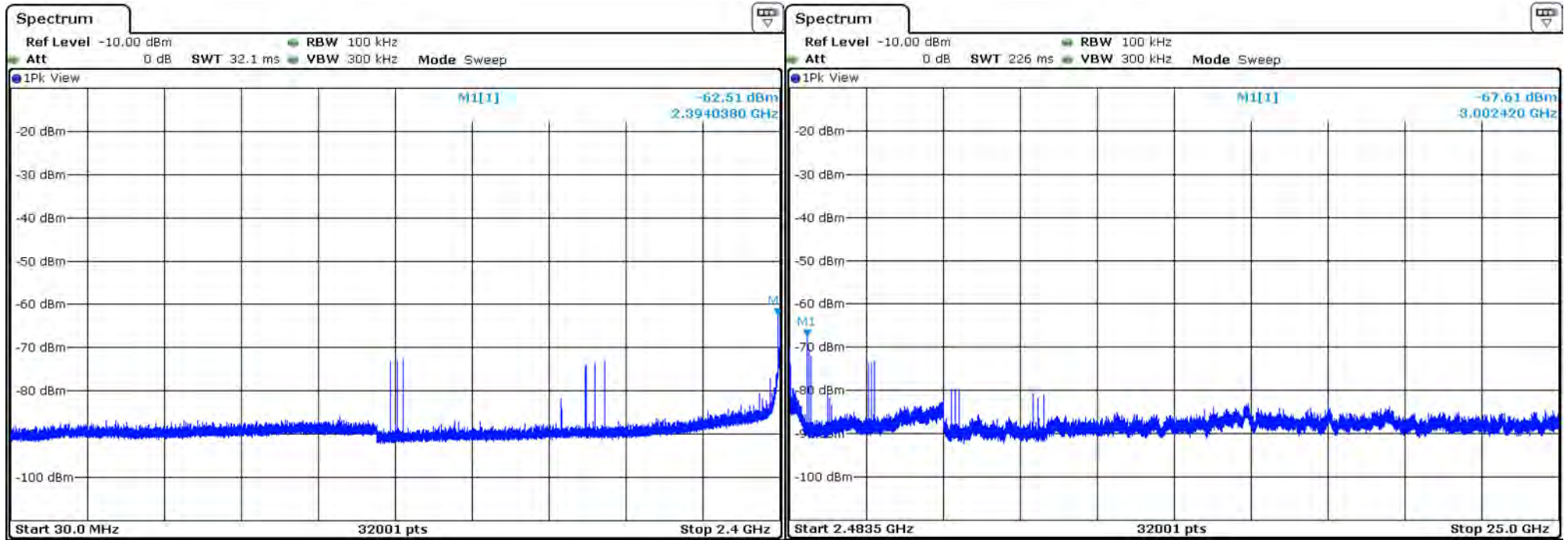
Spurious Summary Table (Enhanced Rate: 3 Mbps)											
Channel	Band Range (MHz)	Mode	Peak Raw Measurement (dBm)	Test Cable Loss (dB)	Pad ATTN (dB)	EUT Antenna Gain At Harmonic Frequency (dBi)	Corrected Reading (dBm)	Convert to E-Field at 3 meters (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Result
Low/Mid/High	30 To 1000	3DH5	-57.4	0.7	10.0	0.0	-46.7	48.53	54	5.47	Pass
Low/Mid/High	2483.5 To 25000	3DH5	-68.7	0.7	10.0	0.0	-58.0	37.23	54	16.77	Pass
Hopping	30 To 1000	3DH5	-59.5	0.7	10.0	0.0	-48.8	46.43	54	7.57	Pass
Hopping	2483.5 To 25000	3DH5	-69.8	0.7	10.0	0.0	-59.1	36.13	54	17.87	Pass

Note: Peak reading applied to Average Limit



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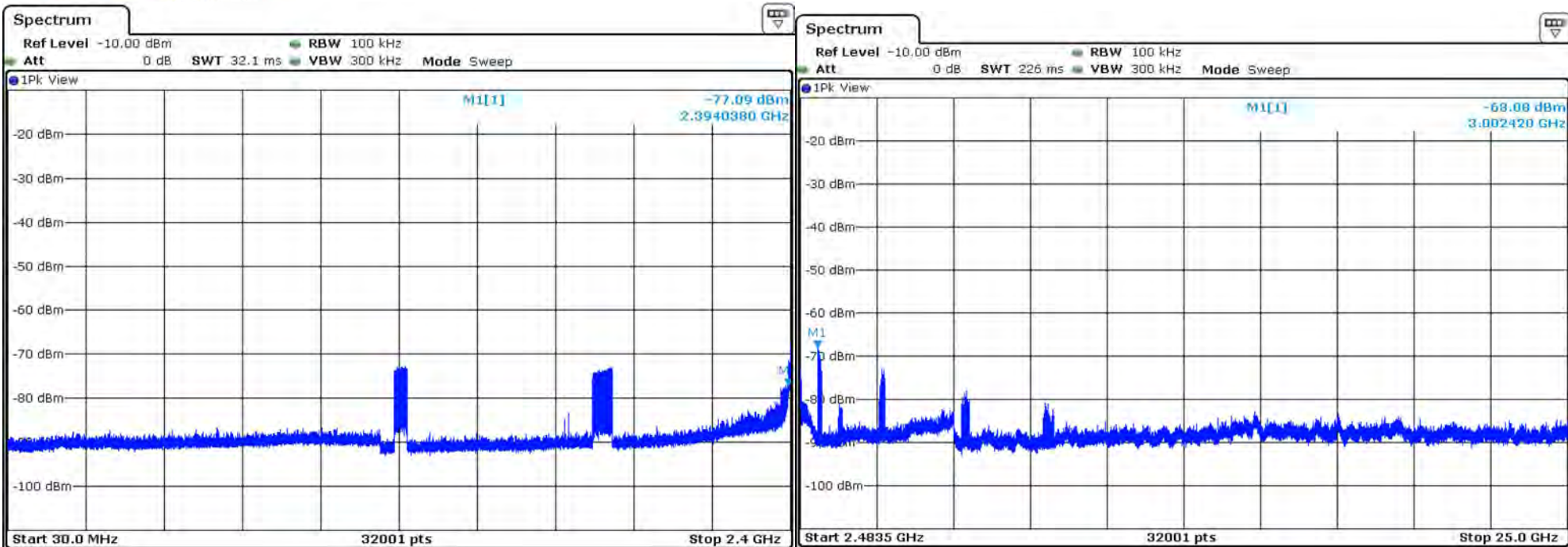


Transmitting DH5 packets on 2402 MHz, 2441 MHz, or 2480 MHz



PRODUCT ASSURANCE ENGINEERING
Wireless Transceiver DSS Test Report

FCC ID: A94429358 IC: 3232A-429358

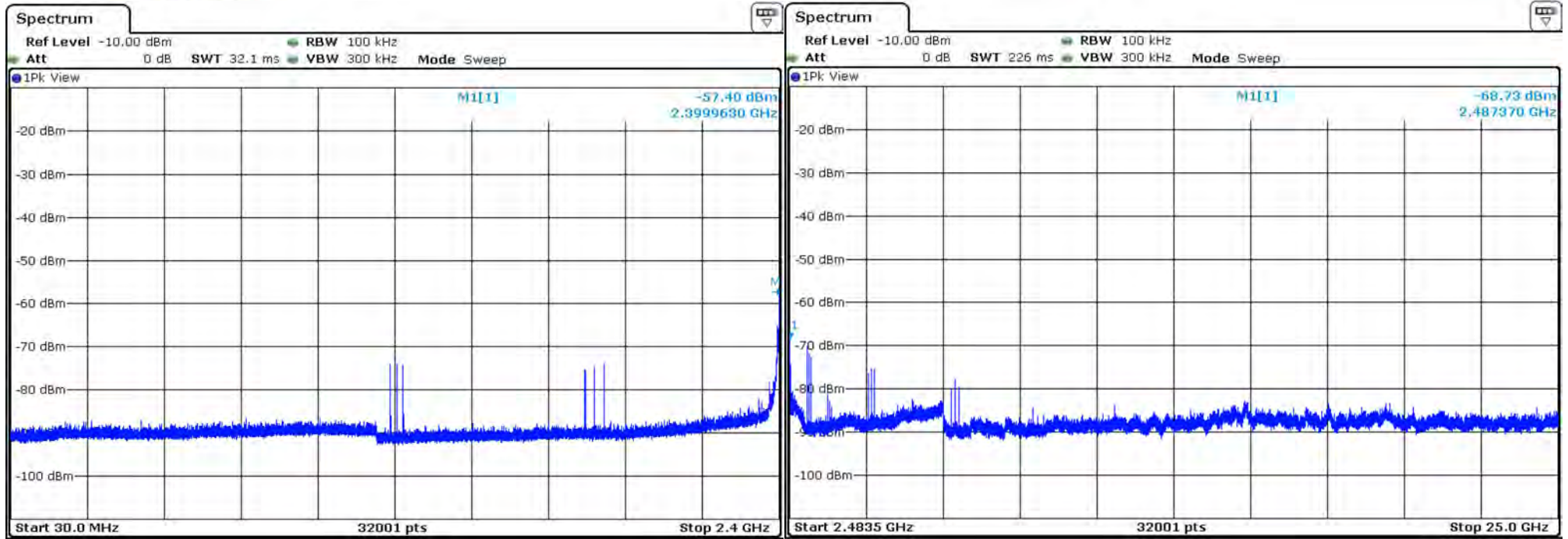


Transmitting DH5 packets while hopping on all channels



PRODUCT ASSURANCE ENGINEERING
Wireless Transceiver DSS Test Report

FCC ID: A94429358 IC: 3232A-429358

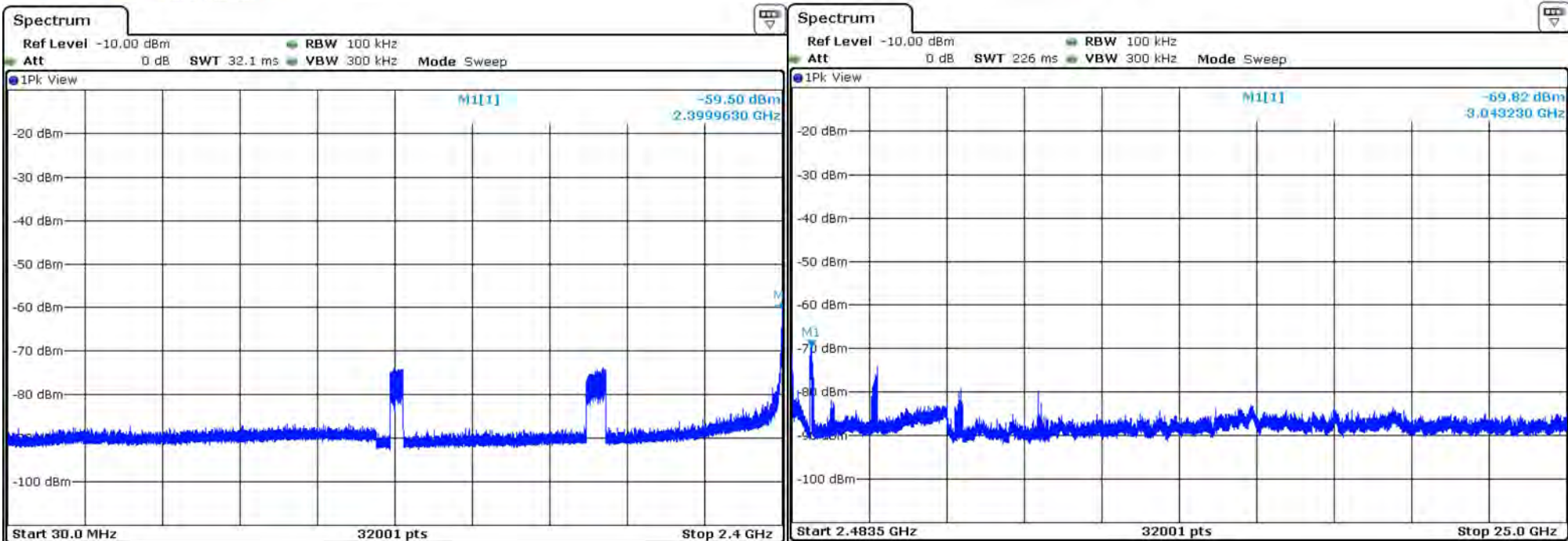


Transmitting 3DH5 packets on 2402 MHz, 2441 MHz, or 2480 MHz



PRODUCT ASSURANCE ENGINEERING
Wireless Transceiver DSS Test Report

FCC ID: A94429358 IC: 3232A-429358



Transmitting 3DH5 packets while hopping on all channels



Average Time of Occupancy Requirements:

FCC 15.247 (a) (1) (iii), IC RSS-247 5.1 (4)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

Test setup details

The EUT is controlled via the USB cable with Blue Suite software which is used to set the test modes of EUT. The EUT is programmed to operate at fixed frequencies at the low, middle, and high end of the authorized frequency band.

Using zero span mode on the channel center frequency the transmit pulse width was measured for each of the following modes, DH1, DH3 & DH5 with the maximum payload size for basic and enhanced data rates.

$$\begin{aligned} \text{Dwell Time} &= (\text{TX Pulse Width}) * (\text{Hop Rate}) / (\# \text{ of Channels}) / (\# \text{ of slots}) * 31.6 \\ &= (\text{TX Pulse Width}) * 1600 / 79 / (\# \text{ of Slots}) * 31.6 \\ &= (\text{TX Pulse Width}) * 640 / (\# \text{ Slots}) \end{aligned}$$

Hop Rate = 1600 hops / S

of channels = 79

of slots = number of slots used per packet in a given mode: DH1 = 2, DH3 = 4, DH5 = 6

$$31.6 \text{ Seconds} = (79 \text{ channels}) * 0.4 \text{ Seconds}$$

$$8 \text{ Seconds} = (20 \text{ channels}) * 0.4 \text{ Seconds}$$



Test Results:

TX Pulse Width (xDH1)									
Channel	Frequency (MHz)	Mode	Pulse Width (mS)	Number of pulses in 3.16 S	Number of pulses in 31.6 S	Time of occupancy (mS)	Limit (mS)	Margin (mS)	Result
Middle	2441	DH1	0.388	32	320	124.3	400	275.74	Pass
Middle	2441	2-DH1	0.398	32	320	127.4	400	272.64	Pass
Middle	2441	3-DH1	0.398	32	320	127.4	400	272.64	Pass

Number of pulses in 31.6 s = Number of pulses in 3.16 x * 10

Time of occupancy = Pulse Width * Number of pulses

TX Pulse Width (xDH3)									
Channel	Frequency (MHz)	Mode	Pulse Width (mS)	Number of pulses in 3.16 S	Number of pulses in 31.6 S	Time of occupancy (mS)	Limit (mS)	Margin (mS)	Result
Middle	2441	DH3	1.652	16	160	264.3	400	135.73	Pass
Middle	2441	2-DH3	1.658	16	160	265.3	400	134.72	Pass
Middle	2441	3-DH3	1.655	16	160	264.8	400	135.20	Pass

Number of pulses in 31.6 s = Number of pulses in 3.16 x * 10

Time of occupancy = Pulse Width * Number of pulses

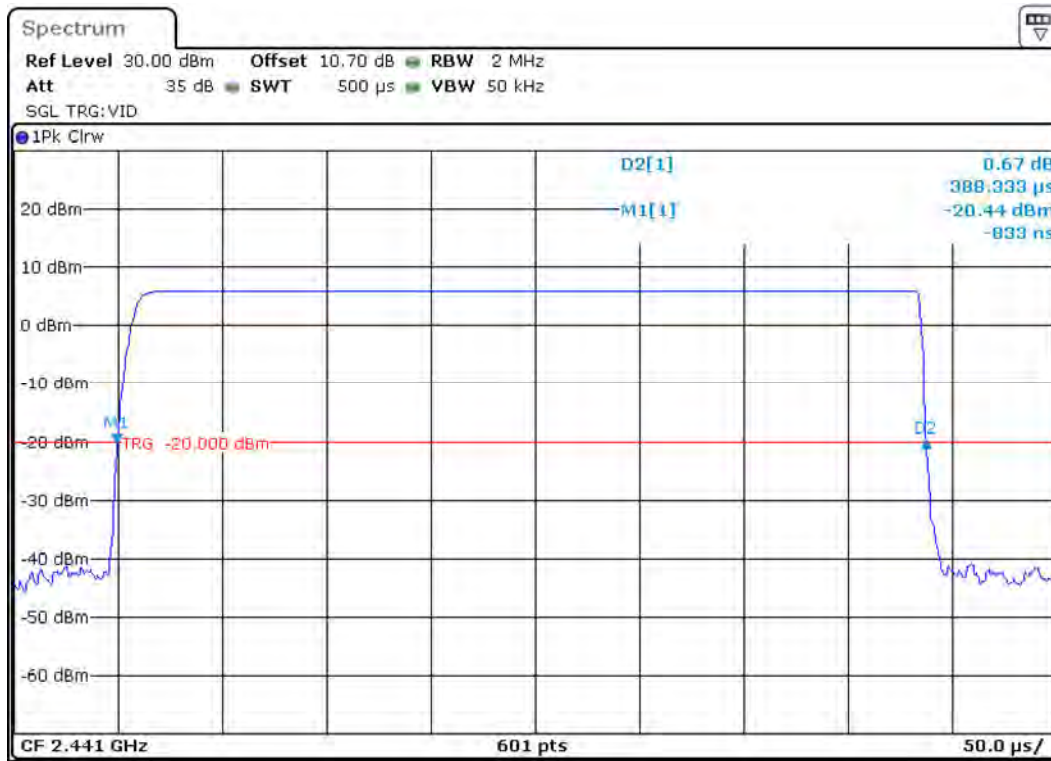
TX Pulse Width (xDH5)									
Channel	Frequency (MHz)	Mode	Pulse Width (mS)	Number of pulses in 3.16 S	Number of pulses in 31.6 S	Time of occupancy (mS)	Limit (mS)	Margin (mS)	Result
Middle	2441	DH5	2.898	11	110	318.7	400	81.28	Pass
Middle	2441	2-DH5	2.903	11	110	319.3	400	80.67	Pass
Middle	2441	3-DH5	2.903	11	110	319.3	400	80.67	Pass

Number of pulses in 31.6 s = Number of pulses in 3.16 x * 10

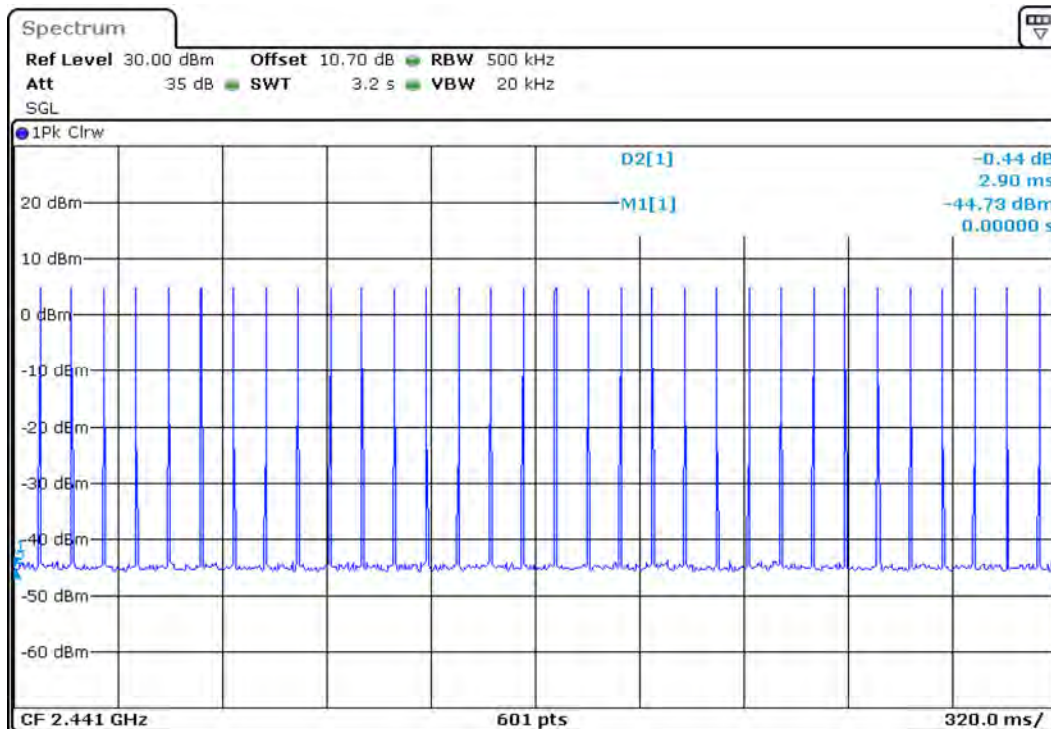
Time of occupancy = Pulse Width * Number of pulses



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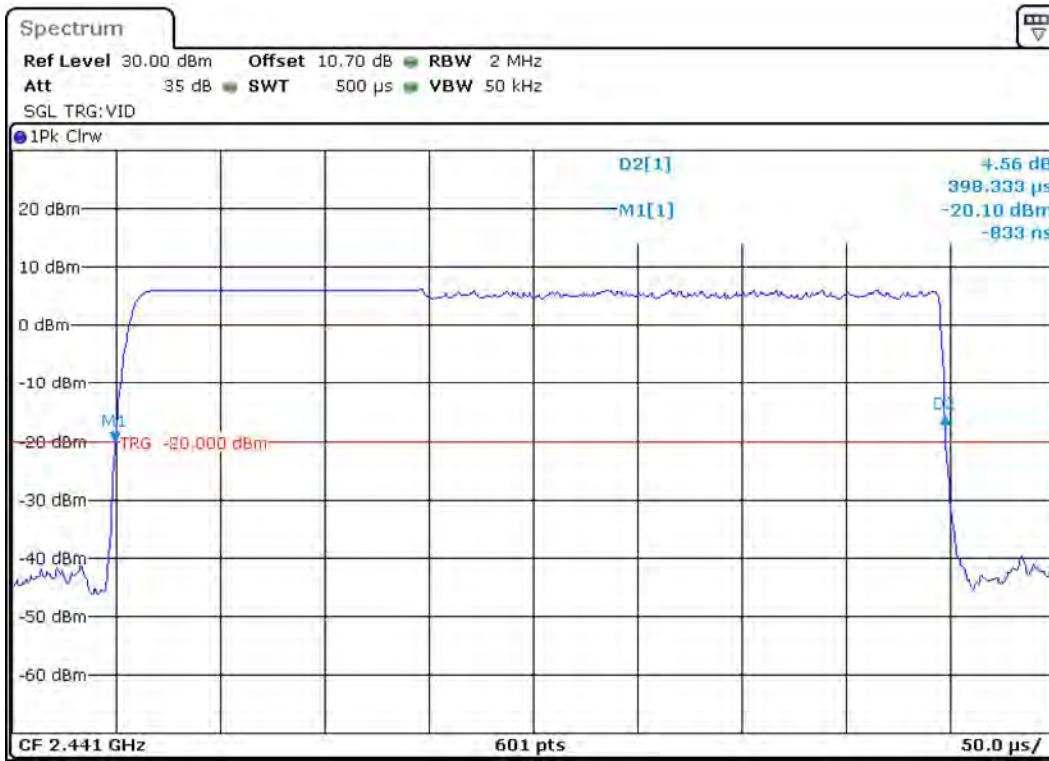
DH1 Pulse Width



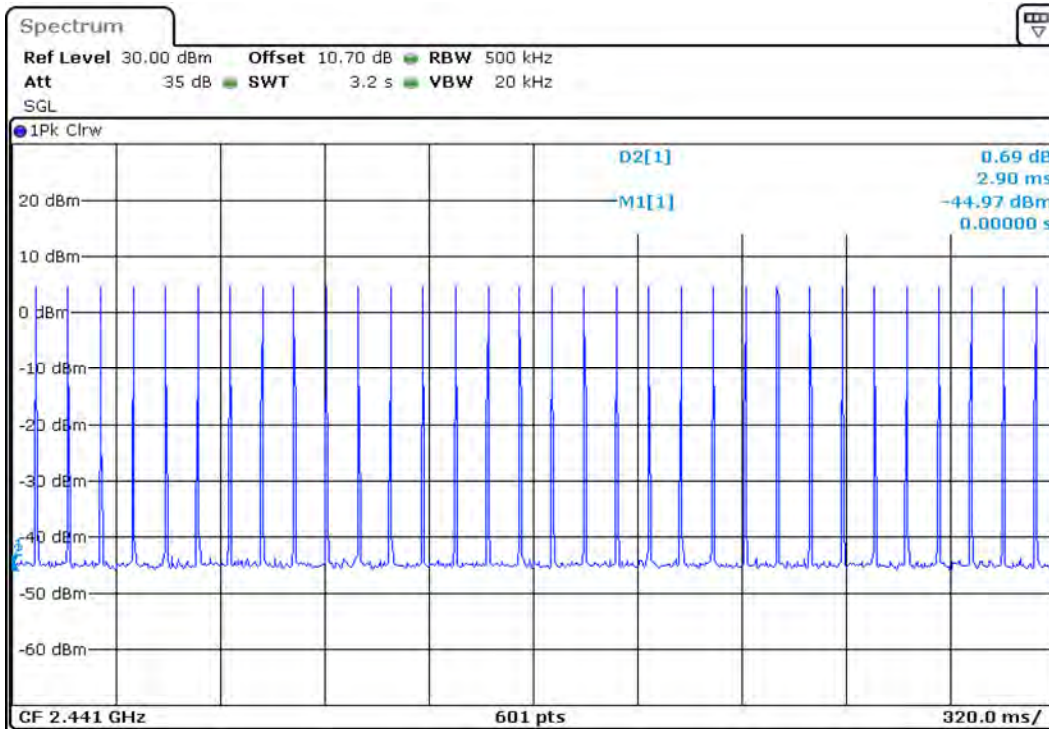
DH1 pulse count



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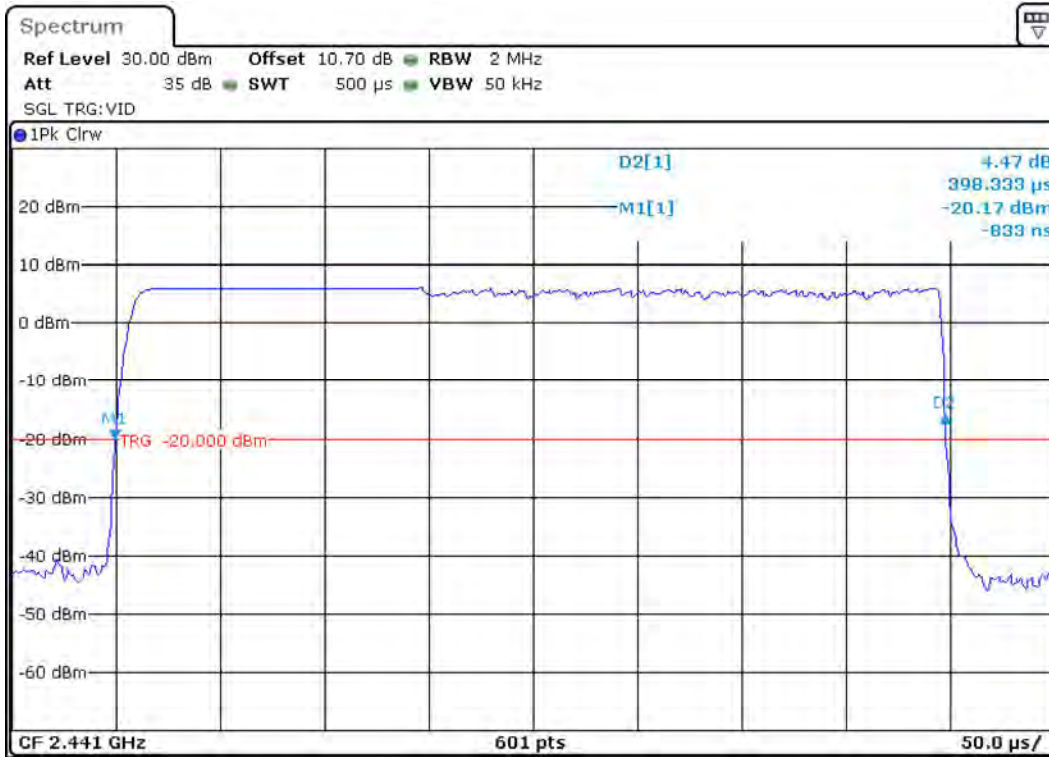
2-DH1 pulse width



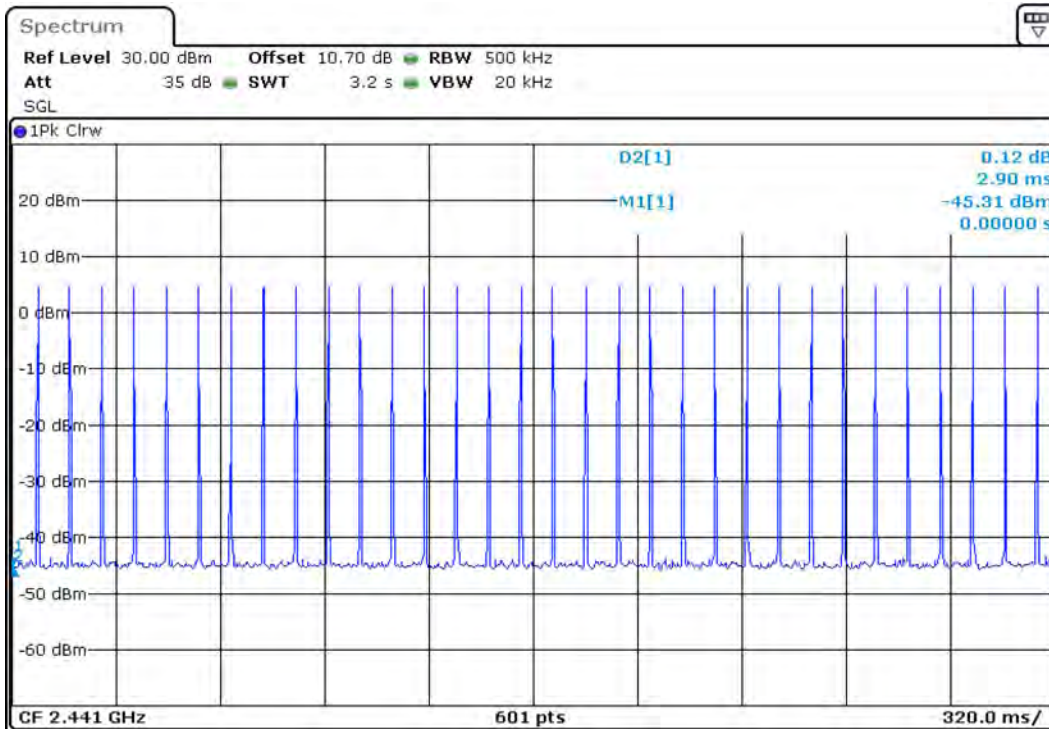
2-DH1 pulse count



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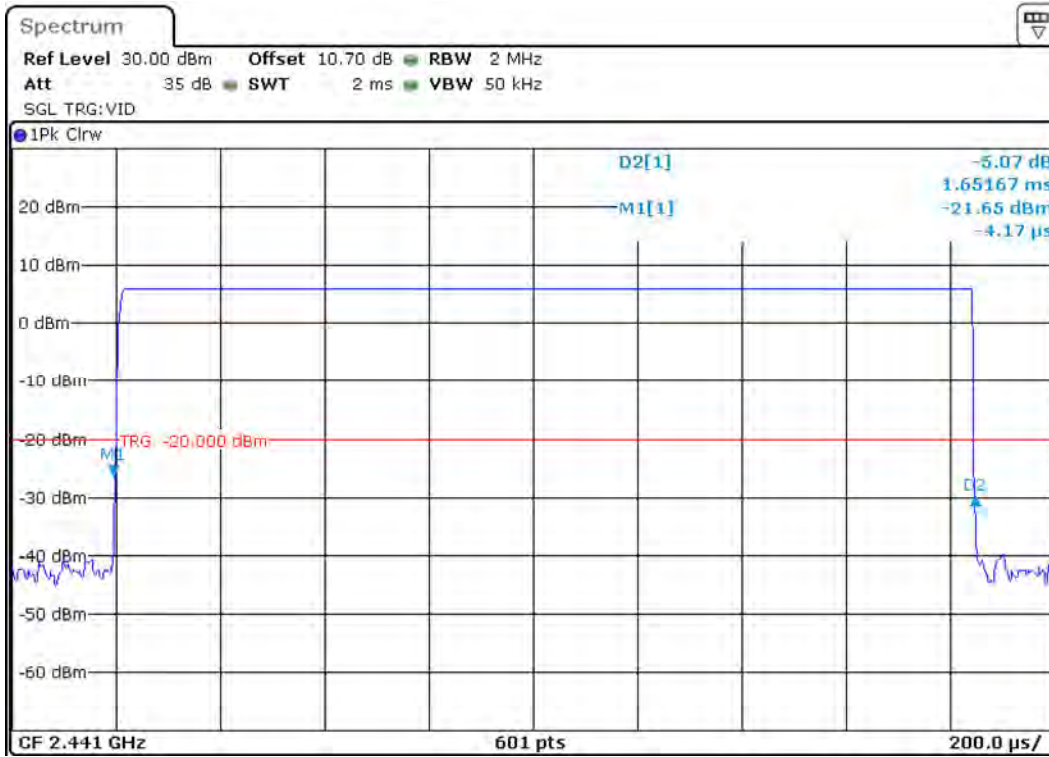
3-DH1 pulse width



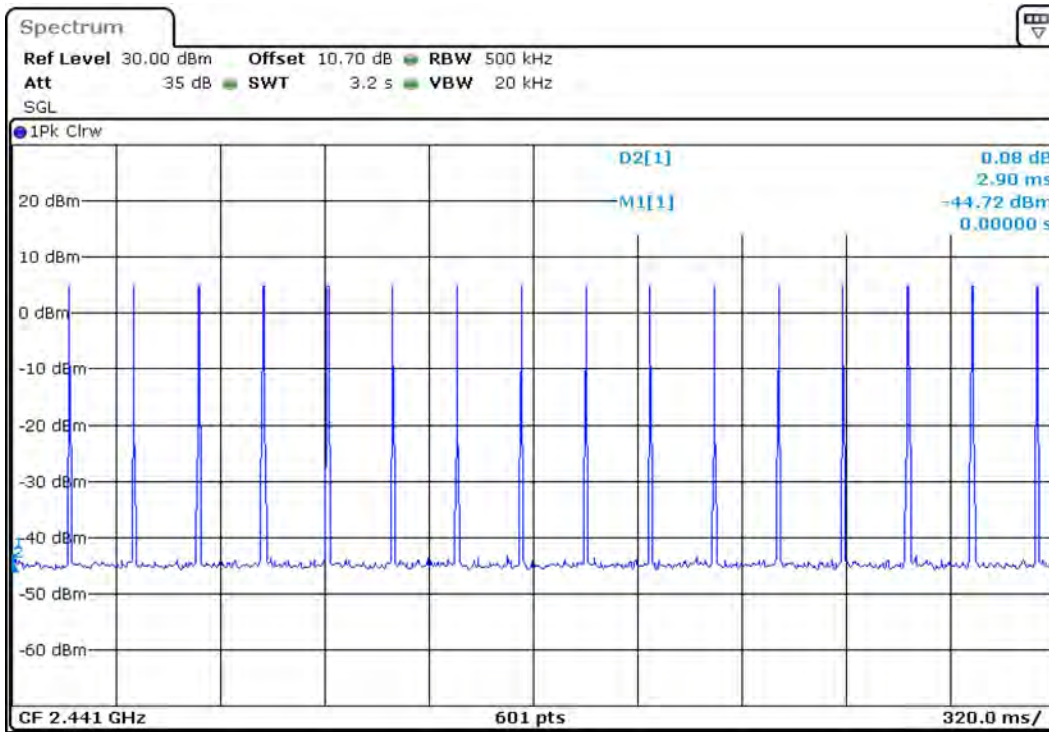
3-DH1 pulse count



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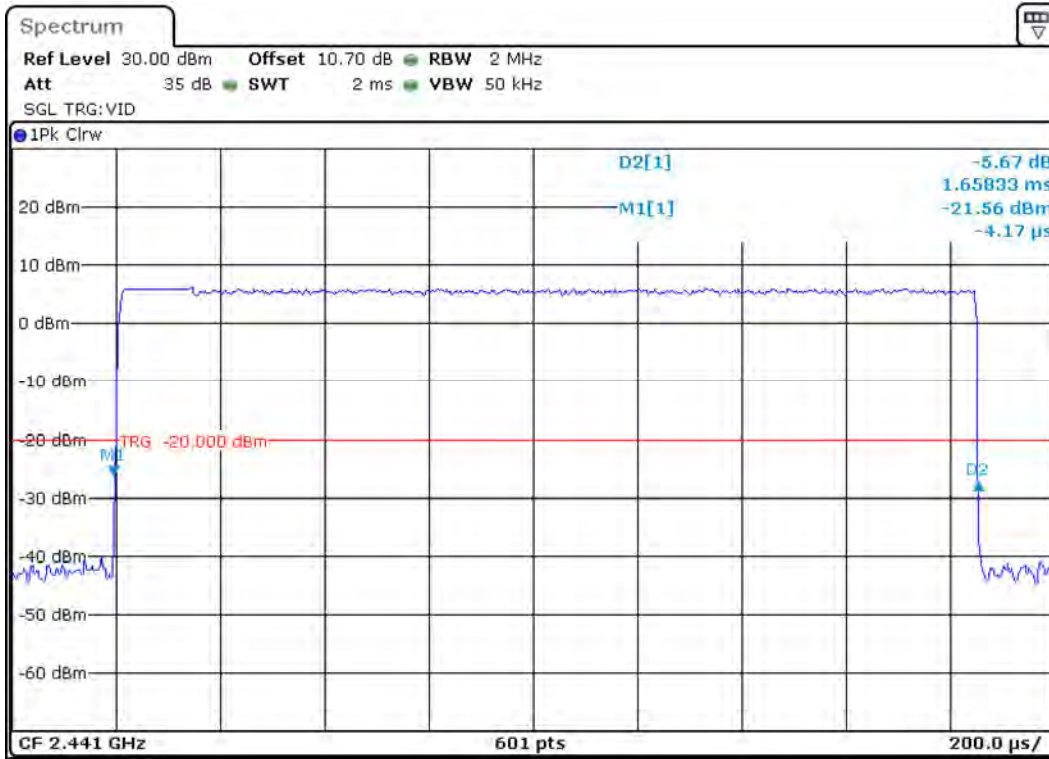
DH3 pulse width



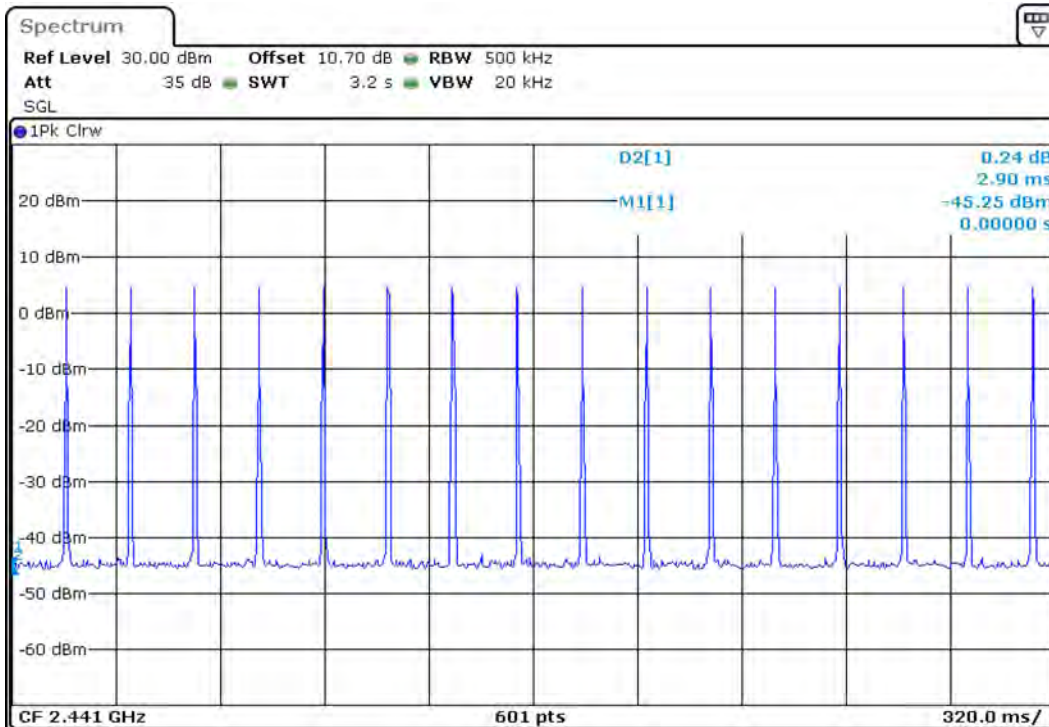
DH3 pulse count



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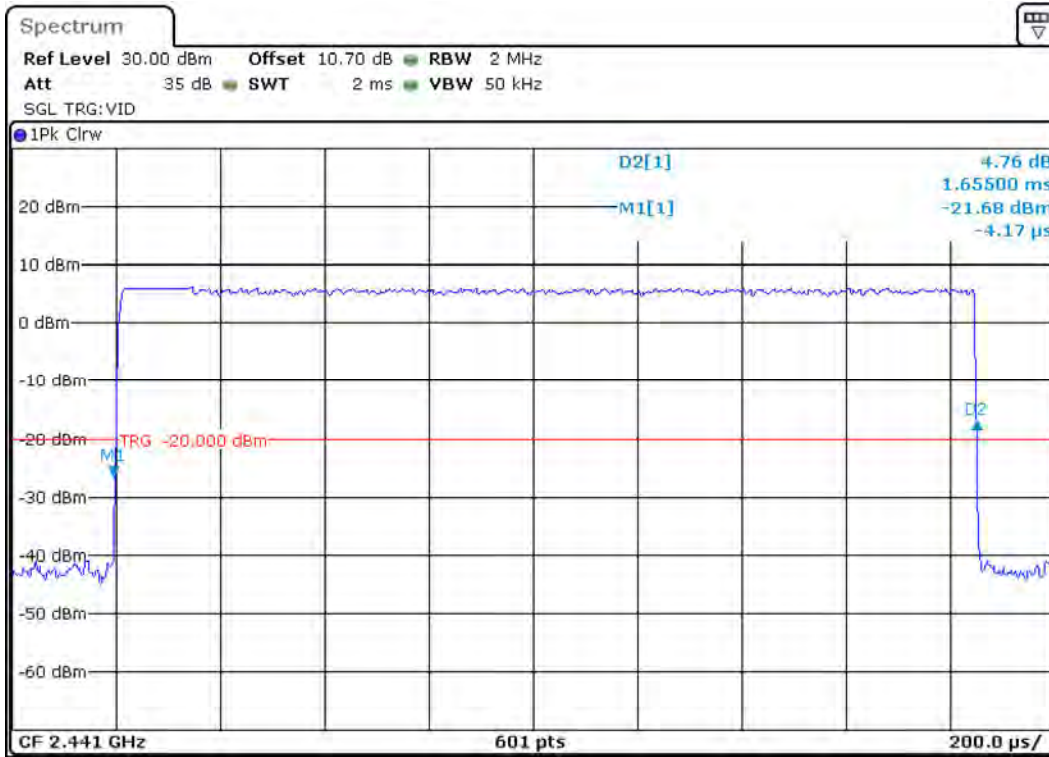
2-DH3 pulse width



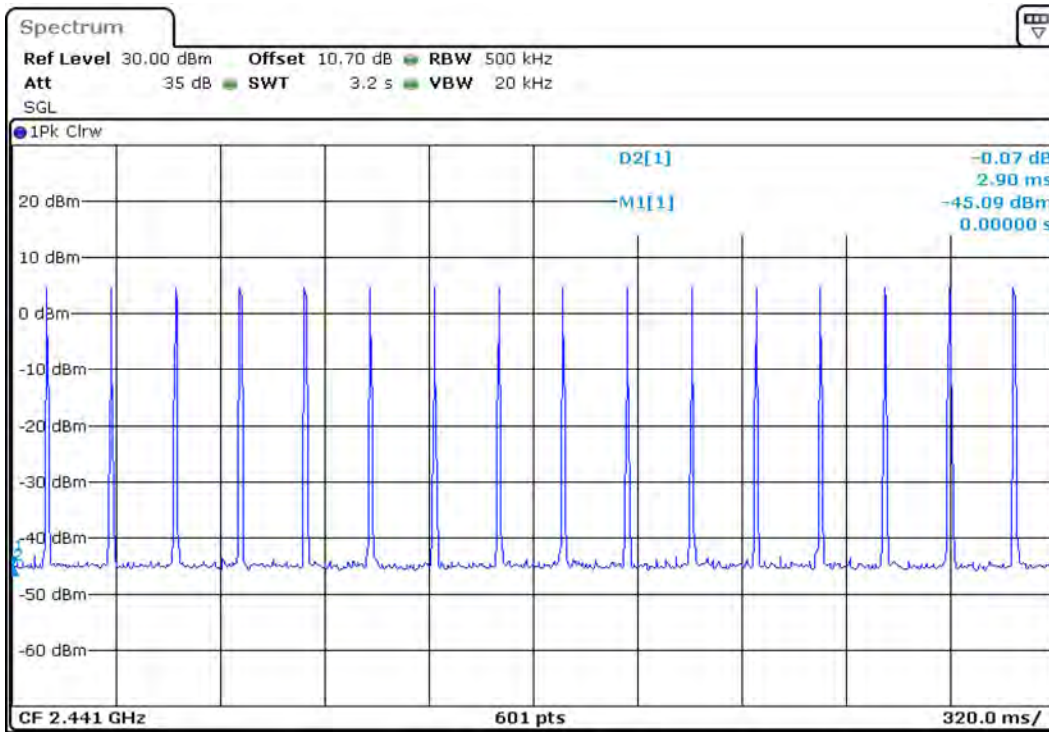
2-DH3 pulse count



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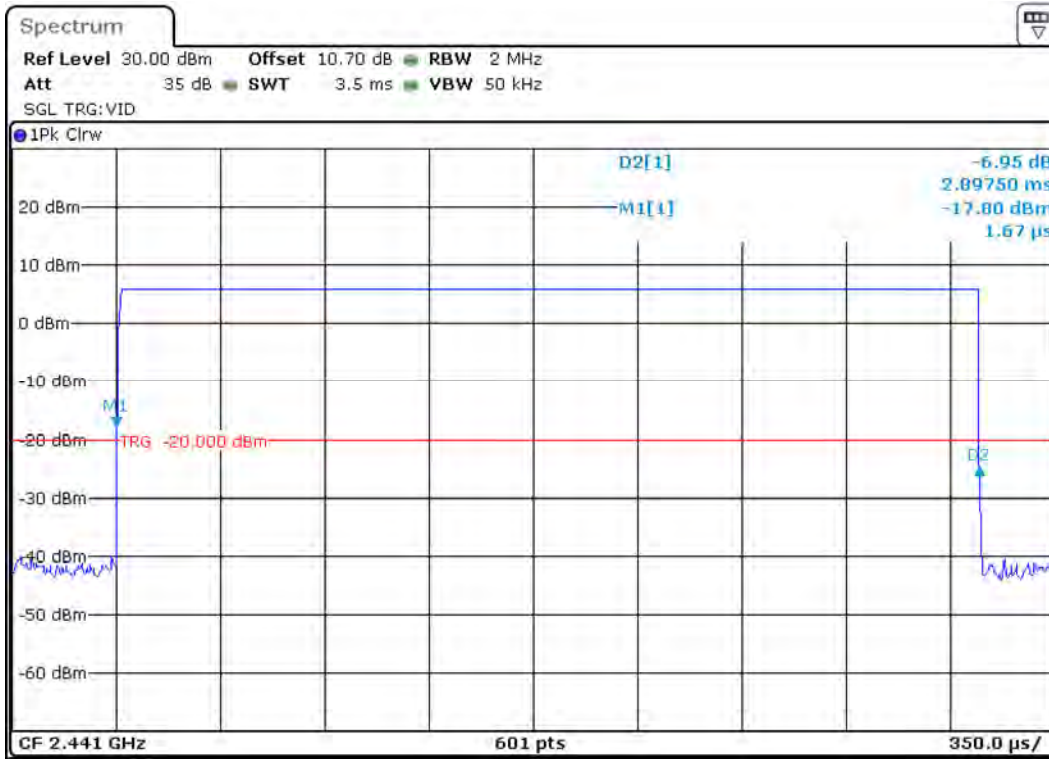
3-DH3 pulse width



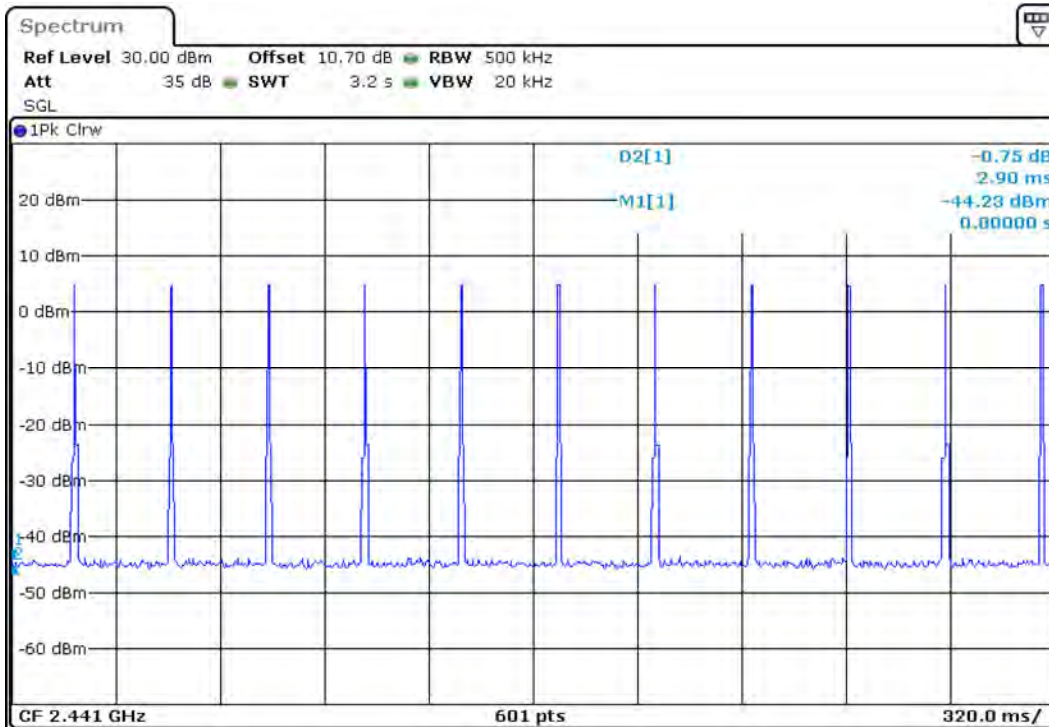
3-DH3 pulse count



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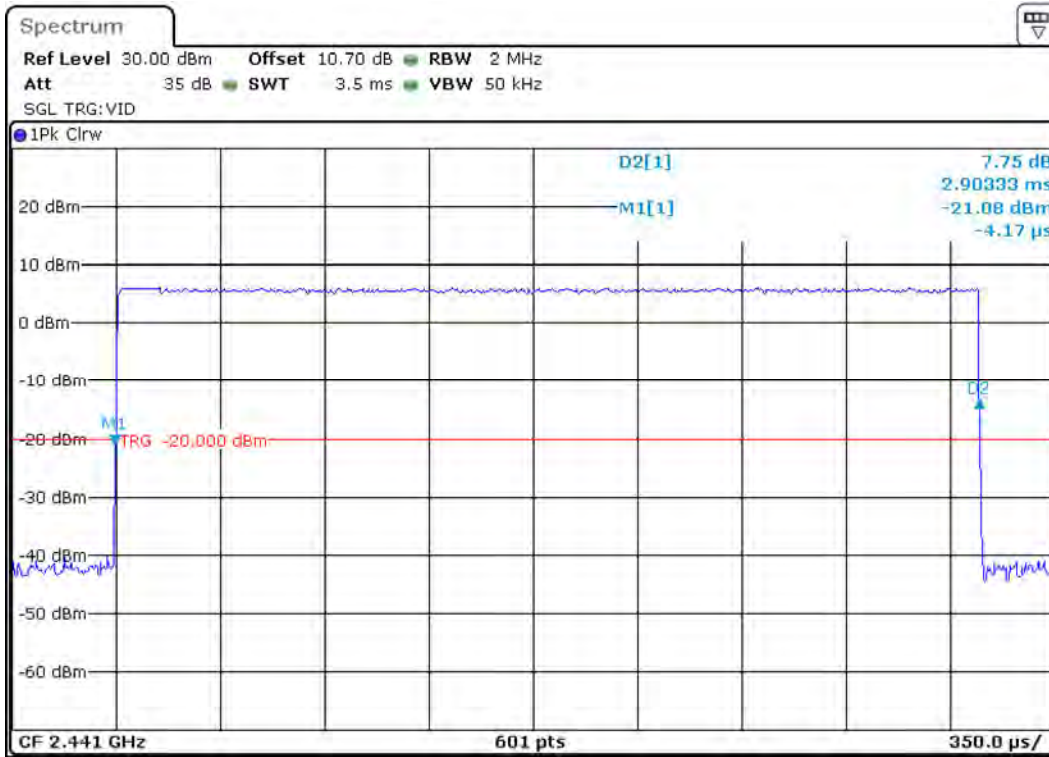
DH5 pulse width



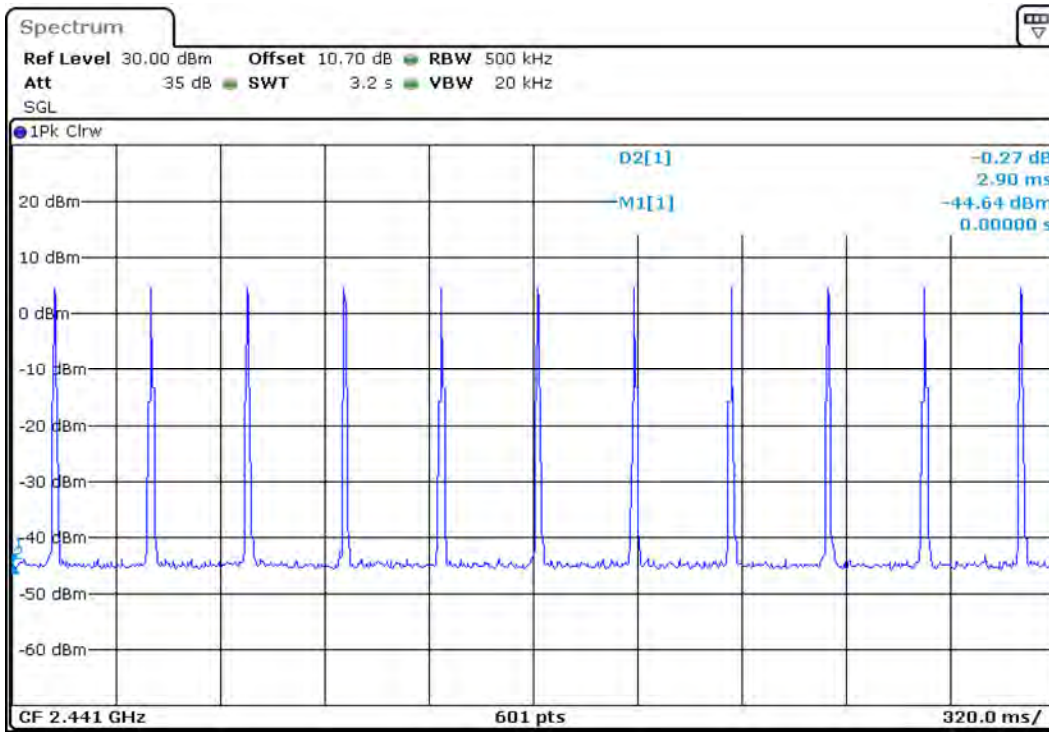
DH5 pulse count



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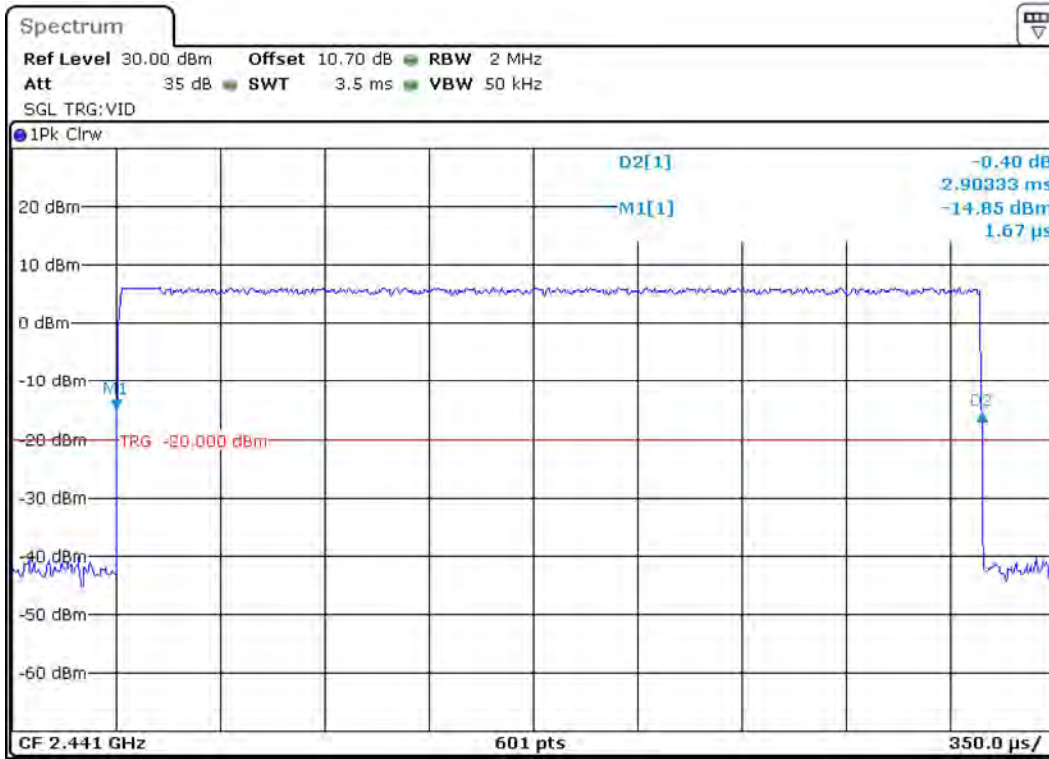
2-DH5 pulse width



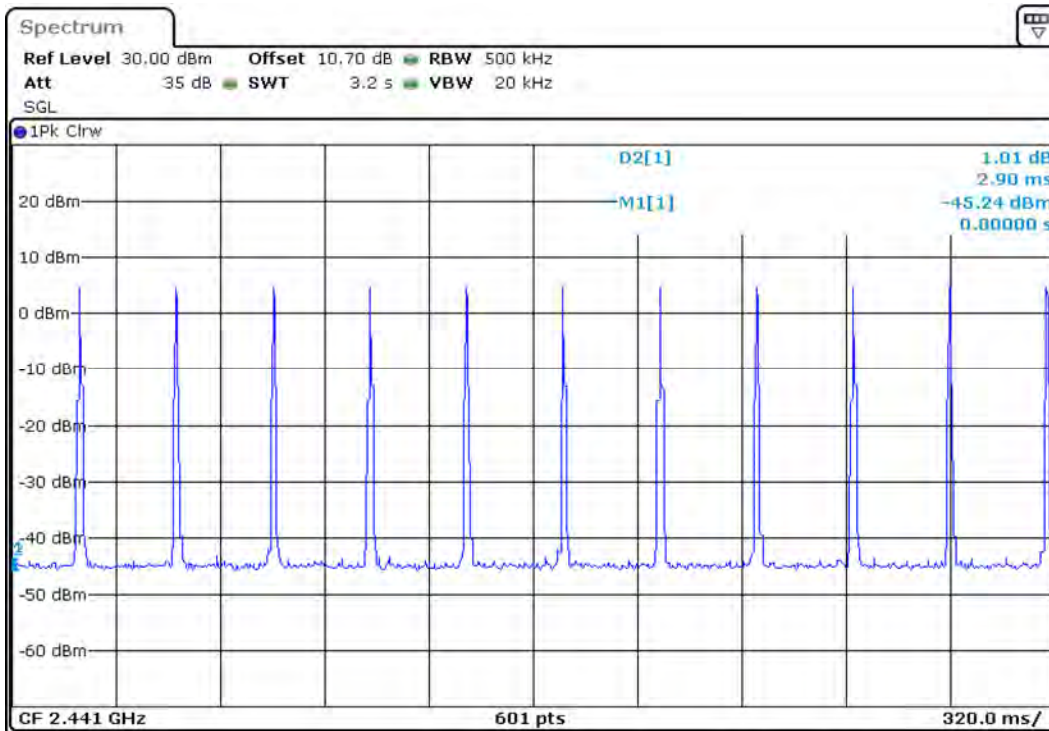
2-DH5 pulse count



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3-DH5 pulse width



3-DH5 pulse count



Number of Hopping Channels

Requirements:

FCC 15.247 (a) (1) (iii), IC RSS-247 5.1 (4)

Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels.

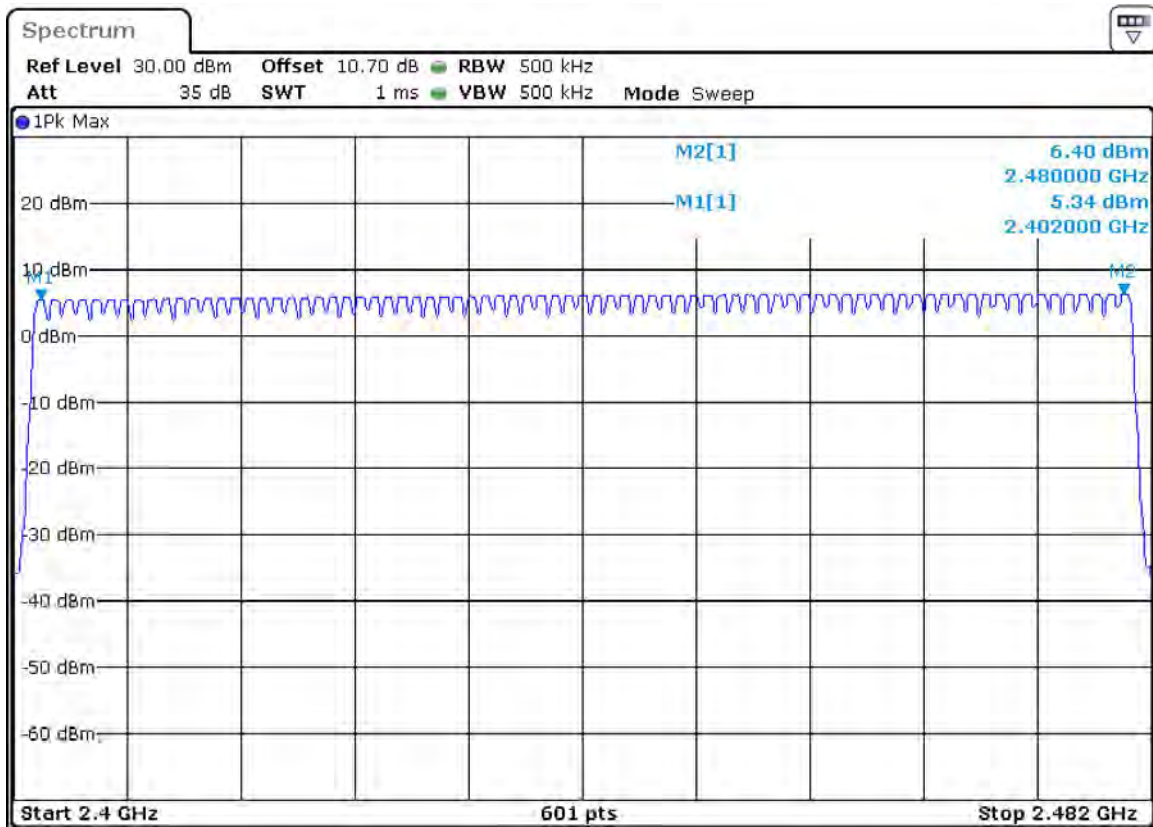
Test Setup:

EUT is controlled by Blue Suite software to enable testing of the spurious output in specific operational modes.

Measurements are made with the EUT in normal operation (hopping through all available channels) in basic and enhanced data rate modes.



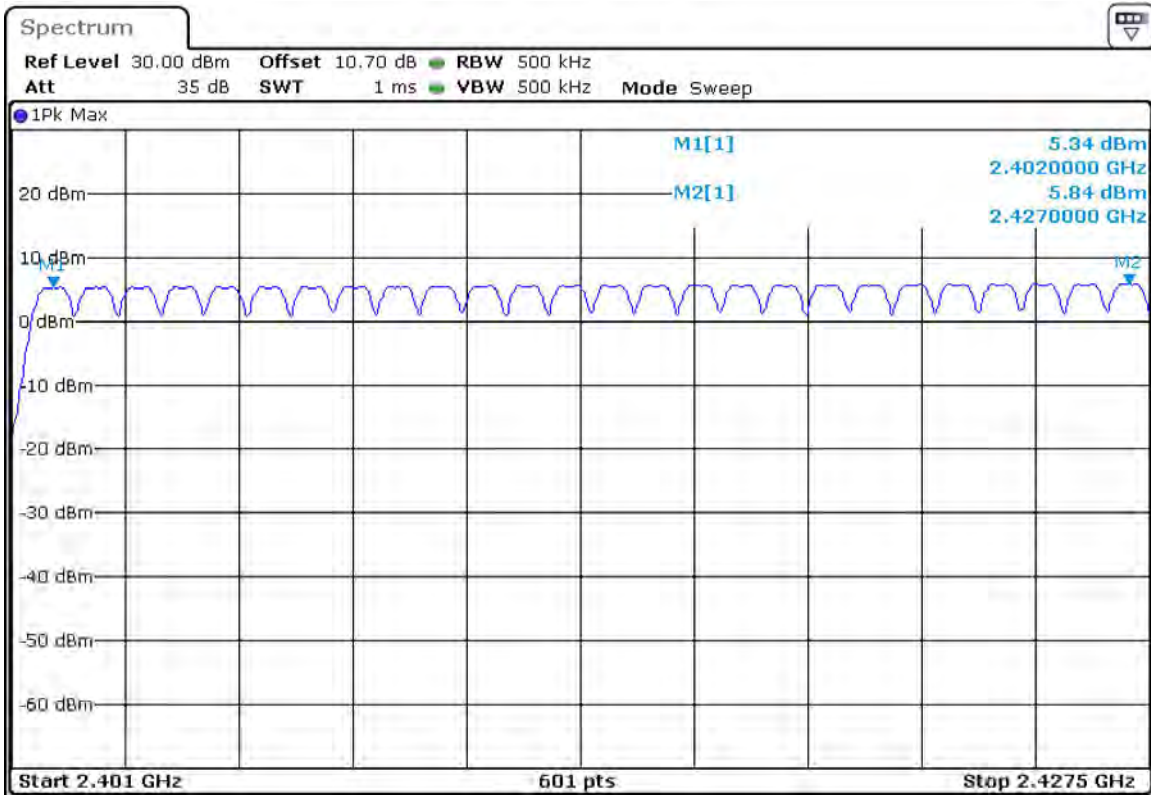
Test Results:



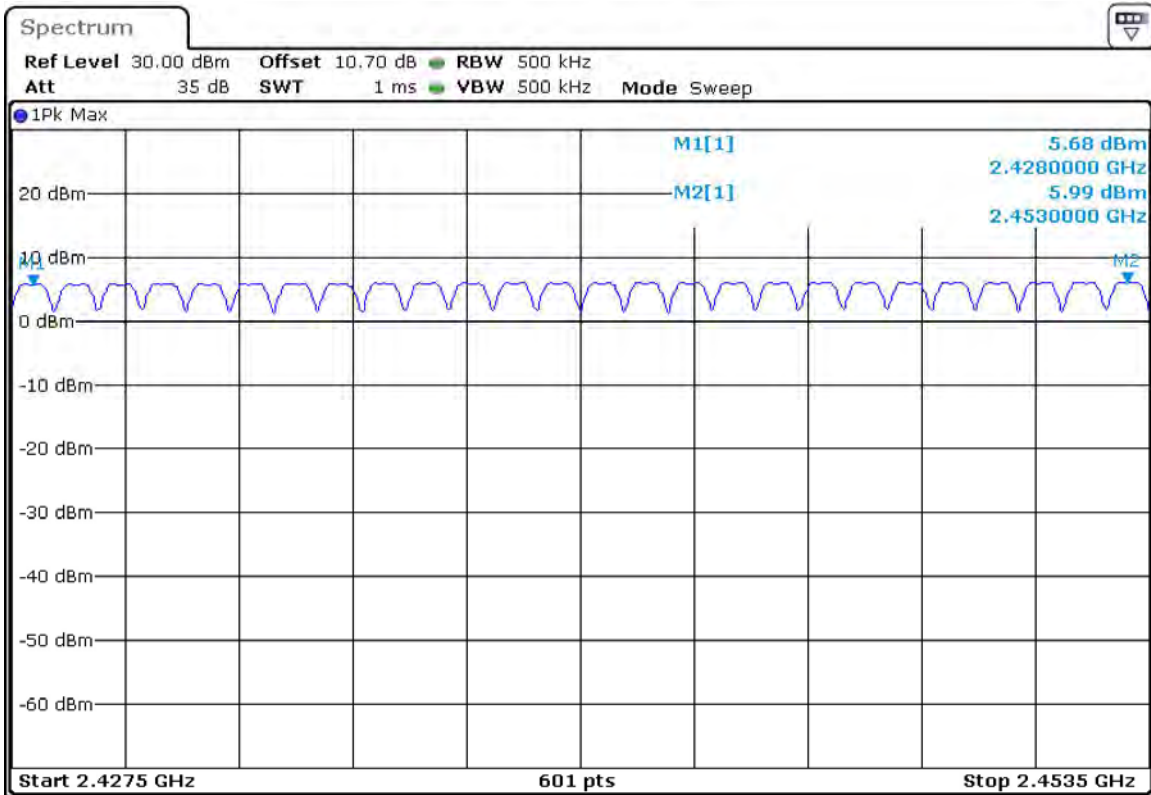
79 hopping channels, DH5



PRODUCT ASSURANCE ENGINEERING Wireless Transceiver DSS Test Report



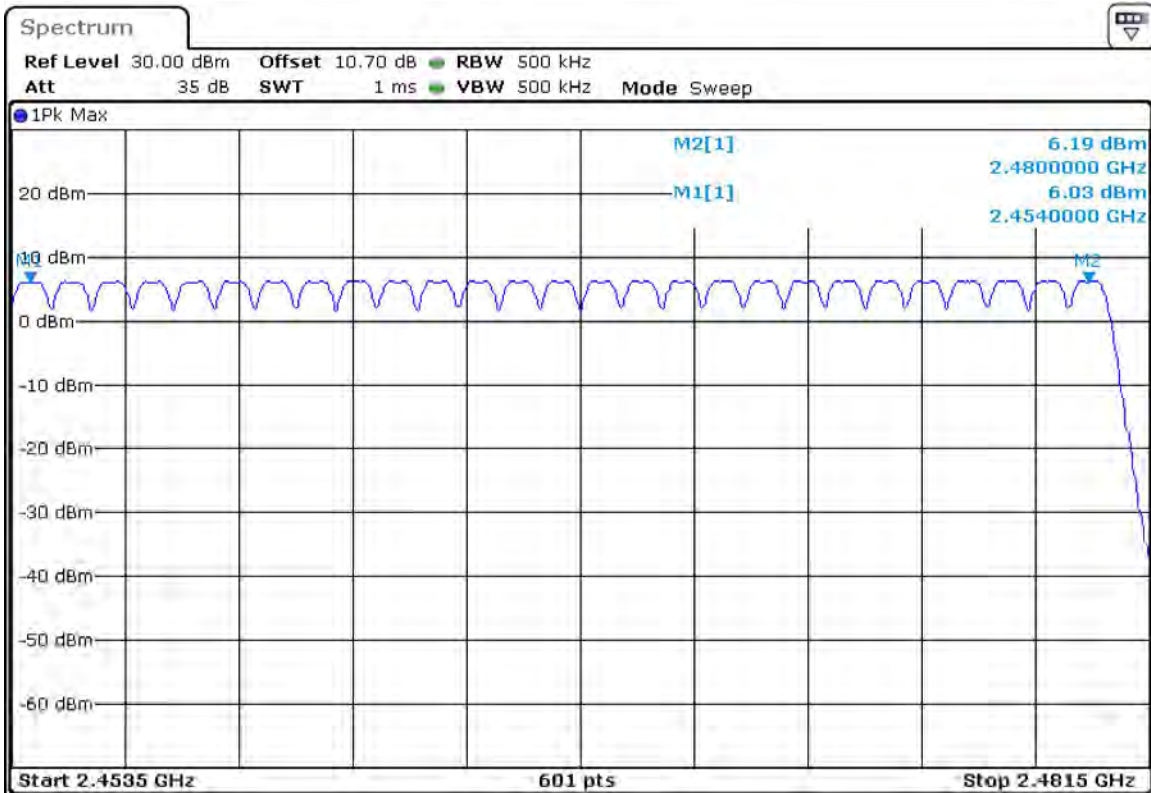
First segment, 26 frequencies, DH5



Second segment, 26 frequencies, DH5



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Wireless Transceiver DSS Test Report



Third segment, 27 frequencies, DH5



Conducted Measurements Resources Used

TN	Description	Model	S/N	Manufacturer	Most Recent Service	Service Due Date
2408	Signal and Spectrum Analyzer	FSV40	101414	Rohde & Schwarz	25-Mar-2020	25-Mar-2022
n/a	10 dB attenuator	VAT-10+	n/a	Mini-Circuits	Verify Before Use	

Date(s) of test: 10-Dec-2021 to 21-Dec-2021



Revision History

Date	Author	Changes
10-Mar-2022	KK	Initial release
26-Apr-2022	KK	Updated 20 dB BW test procedure. Updated Spurious Bandedge plots Added attenuator to equipment list



End of Report