ENGINEERING TEST REPORT

Bluetooth Unit
Model: UT-136
FCC ID: AFJ381500

Applicant:

ICOM Incorporated
1-1-32, Kamiminami, Hirano-ku
Osaka, Japan, 547-0003

In Accordance With

Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.247 Frequency Hopping Spread Spectrum (FHSS)

UltraTech's File No.: 16ICOM414_FCC15C247

This Test report is Issued under the Authority of Tri M. Luu Vice President of Engineering UltraTech Group of Labs Date: June 2. 2016	
Report Prepared by: Dan Huynh Issued Date: June 2. 2016	Tested by: Hung Trinh Test Dates: February 10 - April 21, 2016

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- *This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.*

UltraTech

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91038	1309	46390-2049	NVLAP LAB CODE 200093-0	AT-1945	SL2-IN-E-1119R	Korea KCC-RRA CA2049	TL363_B	TPTDP DA1300

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 15, Subpart C, Section 15.247
Title:	Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15
Purpose of Test:	Equipment Certification for Part 15C Spread Spectrum Transmitter
Test Procedures:	▪ ANSI C63.4 ▪ ANSI C63.10 ▪ FCC Public Notice DA 00-705
Environmental Classification:	[x] Commercial, industrial or business environment [ ] Residential environment

1.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

1.3. NORMATIVE REFERENCES

Publication	Year	Title
47 CFR Parts 0-19	2016	Code of Federal Regulations (CFR), Title 47 – Telecommunication
ANSI C63.4	2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 KHz to 40 GHz
ANSI C63.10	2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
CISPR 22 & EN 55022	2008-09, Edition 6.0 2006	Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement
CISPR 16-1-1 +A1 +A2	2006 2006 2007	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
CISPR 16-1-2 +A1 +A2	2003 2004 2006	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-2: Conducted disturbances
FCC Public Notice DA 00-705	2000	Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
FCC ET Docket No. 99-231	2002	Amendment to FCC Part 15 of the Commission's Rules Regarding to Spread Spectrum Devices

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT	
Name:	Icom Incorporated
Address:	1-1-32, Kamiminami, Hirano-ku, Osaka Japan 547-0003
Contact Person:	Mr. Hideji Fujishima Phone #: +81-66-793-8424 Fax #: +81-66-793-3336 Email Address: world_support@icom.co.jp

MANUFACTURER	
Name:	Icom Incorporated
Address:	1-1-32, Kamiminami Hirano-ku, Osaka Japan 547-0003
Contact Person:	Mr. Hideji Fujishima Phone #: +81-66-793-8424 Fax #: +81-66-793-3336 Email Address: world_support@icom.co.jp

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	ICOM
Product Name:	Bluetooth Unit
Model Name or Number:	UT-136
Serial Number:	Test Sample
Type of Equipment:	Spread Spectrum Transmitter
Input Power Supply Type:	External Regulated DC Sources
Primary User Functions of EUT:	Bluetooth Communication

2.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
Equipment Type:	▪ Portable ▪ Mobile ▪ Base Station (fixed use)
Intended Operating Environment:	Commercial, industrial or business environment
Power Supply Requirement:	3.3 VDC nominal
RF Output Power Rating:	3 dBm
Operating Frequency Range:	2402 - 2480 MHz
RF Output Impedance:	50 Ω
Duty Cycle:	Continuous
Modulation Type:	GFSK, π/4-DQPSK and 8-DPSK
Antenna Connector Type:	Integral

2.4. ASSOCIATED ANTENNA DESCRIPTIONS

Manufacturer	Type	Model/Part Number	Frequency Range	Gain
TAIYO YUDEN	Multilayer Monopole Antenna (Chip Antenna)	AH212M245001	2400 MHz to 2500 MHz	2.7 dBi

2.5. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	RF Measurement Port	1	SWG	Shielded
2	DC supply and I/O port	1	SMT	No cable, direct connection

2.6. ANCILLARY EQUIPMENT

The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

Ancillary Equipment # 1	
Description:	Test Jig
Brand name:	Icom
Model Name or Number:	N/A
Serial Number:	N/A
Connected to UUT's Port:	Module pin signals

EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	102 kPa
Power Input Source:	3.3VDC from test jig

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	▪ Each of lowest, middle and highest channel frequencies transmits continuously for emissions measurements. ▪ The EUT operates in normal Frequency Hopping mode for occupancy duration, and frequency separation.
Special Test Software:	Test software provided by the Applicant is installed to allow the EUT to operate in hopping mode or at each channel frequency continuously. For example, the transmitter will be operated at each of lowest, middle and highest frequencies individually continuously during testing.
Special Hardware Used:	Test Jig Board
Transmitter Test Antenna:	The EUT is tested with the antenna fitted in a manner typical of normal intended use as integral antenna equipment as described with the test results.

Transmitter Test Signals	
Frequency Band(s):	2402 - 2480 MHz
Frequency(ies) Tested: (Near lowest, near middle & near highest frequencies in the frequency range of operation.)	2402 MHz, 2441 MHz and 2480 MHz
RF Power Output: (measured maximum output power at antenna terminals)	3.09 dBm, 2.037 mW (conducted)
Normal Test Modulation:	GFSK, π/4-DQPSK and 8-DPSK
Modulating Signal Source:	Internal

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Power Line Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).

- Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with FCC office (FCC File No.: 91038) and Industry Canada office (Industry Canada File No.: 2049A-3). Expiry Date: 2017-04-02.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Compliance (Yes/No)
15.203	Antenna requirements	Yes
15.207(a)	AC Power Line Conducted Emissions	Yes
15.247(a)	Provisions for Frequency Hopping Systems	Yes
15.247(b)(1)	Peak Conducted Output Power	Yes
15.247(d), 15.209 & 15.205	Transmitter Spurious Radiated Emissions	Yes
15.247(i), 1.1307, 1.1310, 2.1091, 2.1093	RF Exposure	Yes

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

EXHIBIT 5. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

5.1. POWER LINE CONDUCTED EMISSIONS [§15.207(a)]

5.1.1. Limit(s)

The equipment shall meet the limits of the following table:

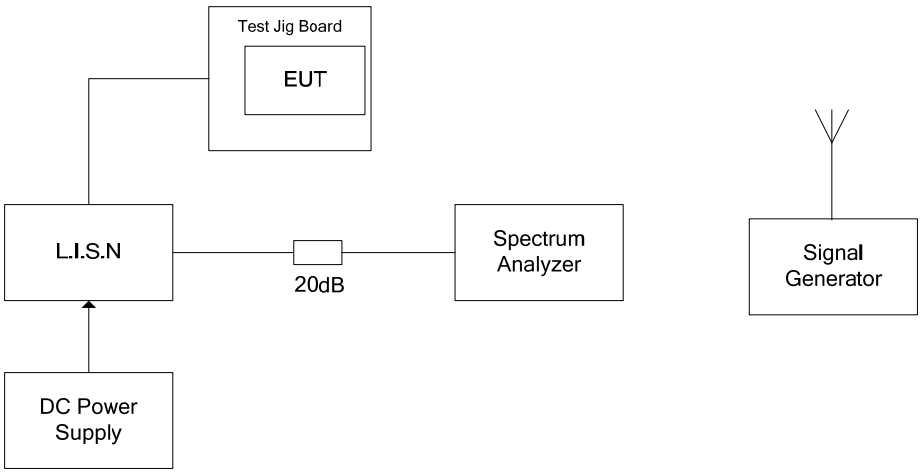
Frequency of emission (MHz)	Conducted Limits (dBμV)	
	Quasi-peak	Average
0.15–0.5 .....……..	66 to 56*	56 to 46*
0.5–5 .....……..	56	46
5-30 ……..	60 ...……..	50

*Decreases linearly with the logarithm of the frequency

5.1.2. Method of Measurements

ANSI C63.4

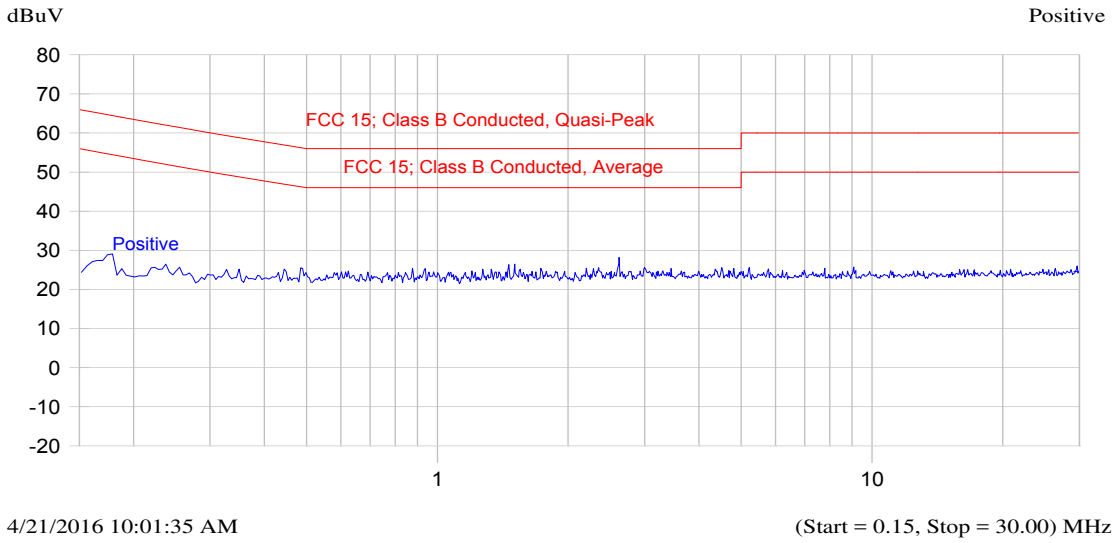
5.1.3. Test Arrangement



5.1.4. Test Data

Plot 5.1.4.1. Power Line Conducted Emissions (Tx Mode)
Line Voltage: 3.3 VDC; Line Tested: Positive

Current Graph

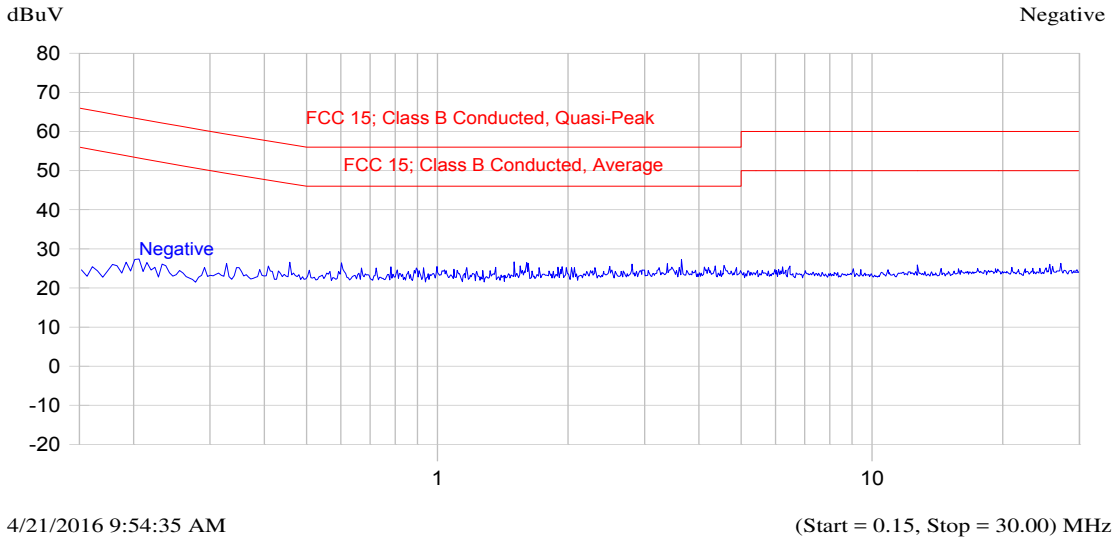


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.174	39.4	34.6	-30.2	29.6	-25.2	Positive
1.496	37.9	32.4	-23.6	27.9	-18.1	Positive
2.623	34.2	29.3	-26.7	23.9	-22.1	Positive

Plot 5.1.4.2. Power Line Conducted Emissions (Tx Mode)
Line Voltage: 3.3 VDC; Line Tested: Negative

Current Graph



Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.192	38.1	33.0	-31.0	27.8	-26.2	Negative
0.457	34.9	29.4	-27.4	23.6	-23.2	Negative
3.641	34.9	29.2	-26.8	23.6	-22.4	Negative

5.2. COMPLIANCE WITH FCC PART 15 – GENERAL TECHNICAL REQUIREMENTS

FCC Section	FCC Rules	Manufacturer's Clarification
15.203	Described how the EUT complies with the requirement that either its antenna is permanently attached, or that it employs a unique antenna connector, for every antenna proposed for use with the EUT. The exception is in those cases where EUT must be professionally installed. In order to demonstrate that professional installation is required, the following 3 points must be addressed: ➢ The application (or intended use) of the EUT ➢ The installation requirements of the EUT ➢ The method by which the EUT will be marketed	The antenna employs an integral antenna.
15.204	Provided the information for every antenna proposed for use with the EUT: ➢ type (e.g. Yagi, patch, grid, dish, etc…), ➢ manufacturer and model number ➢ gain with reference to an isotropic radiator	See proposed antenna listed in user manual.
15.247(a)	Description of how the EUT meets the definition of a frequency hopping spread spectrum, found in Section 2.1. Based on the technical description.	See Operational Description
15.247(a)	Pseudo Frequency Hopping Sequence: Describe how the hopping sequence is generated. Provide an example of the hopping sequence channels, in order to demonstrate that the sequence meets the requirements specified in the definition of a frequency hopping spread spectrum system, found in Section 2.1	See Operational Description
15.247(a)	Equal Hopping Frequency Use: Describe how each individual EUT meets the requirement that each of its hopping channels is used equally on average (e.g. that each new transmission event begins on the next channel in the hopping sequence after final channel used in the previous transmission events).	See Operational Description

FCC Section	FCC Rules	Manufacturer's Clarification
15.247(a)	System Receiver Input Bandwidth: Describe how the associated receiver(s) complies with the requirement that its input bandwidth (either RF or IF) matches the bandwidth of the transmitted signal.	See Operational Description
15.247(a)	System Receiver Hopping Capability: Describe how the associated receiver(s) has the ability to shift frequencies in synchronization with the transmitted signals	See Operational Description
15.247(g)	Describe how the EUT complies with the requirement that it be designed to be capable of operating as a true frequency hopping system	See Operational Description
15.247(h)	Describe how the EUT complies with the requirement that it not have the ability to coordinated with other FHSS is an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitters	See Operational Description

5.3. PROVISIONS FOR FREQUENCY HOPPING SYSTEMS [§ 15.247(a)(1)]

5.3.1. Limits

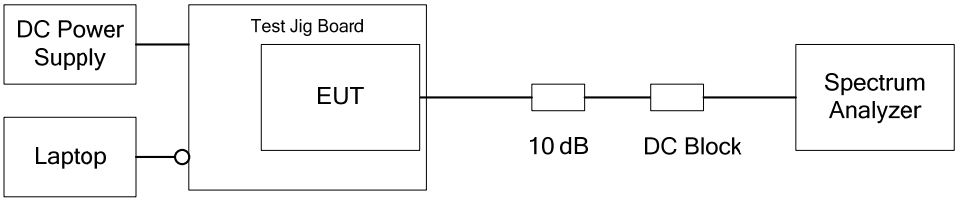
§ 15.247(a)(1): Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier 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. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

§ 15.247(a)(1)(iii): Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. 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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

5.3.2. Method of Measurements

FCC Public Notice DA 00-705 and ANSI C63.10

5.3.3. Test Arrangement



5.3.4. Test Data

Test Description	FCC Specification	Measured Values	Comments
Frequency Hopping Systems Requirements	The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.	--	See operational description exhibit for details.
20 dB BW of the hopping channel	--	GFSK: 0.9379 MHz π/4-DQPSK: 1.2505 MHz 8-DPSK: 1.2745 MHz	Refer to Section 5.3.4.1 for test data plots
Channel Hopping Frequency Separation	Minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, 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.	GFSK: 1.004 MHz π/4-DQPSK: 1.024 MHz 8-DPSK: 1.024 MHz	Refer to Section 5.3.4.2 for test data plots
Number of hopping frequencies	Shall use at least 15 channels	79 hopping frequencies	Refer to Section 5.3.4.3 for test data plots
Average Time of Occupancy	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	Maximum dwell time in a period of 0.4 * 79 = 36.1 s: GFSK: 0.31092 s π/4-DQPSK: 0.31383 s 8-DPSK: 0.30878 s	Refer to Section 5.3.4.4 for test data plots

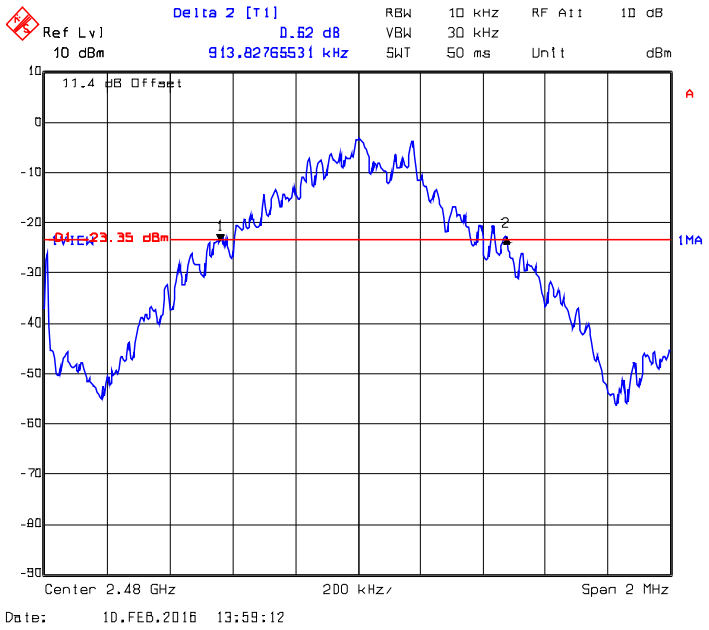
5.3.4.1. 20 dB BW of the Hopping Channel

Mode	Packet	CFG Packet Type	CFG Packet Size	TXDATA1 Power (Ext, Int)	20dB BW (MHz)		
					Channel 0 2402 MHz	Channel 39 2441 MHz	Channel 78 2480 MHz
GFSK	DH1	15	26	255, 53	0.9098	0.9138	0.9138
	DH3	15	183	255, 53	0.9338	0.9339	0.9379
	DH5	15	339	255, 53	0.9339	0.9339	0.9339
π/4-DQPSK	2DH1	30	54	255, 55	1.2024	1.2084	1.2144
	2DH3	30	367	255, 55	1.2505	1.2385	1.2325
	2DH5	30	679	255, 55	1.2144	1.2325	1.2505
8-DPSK	3DH1	31	83	255, 55	1.2024	1.2084	1.2084
	3DH3	31	552	255, 55	1.2625	1.2625	1.2625
	3DH5	31	1021	255, 55	1.2625	1.2625	1.2745

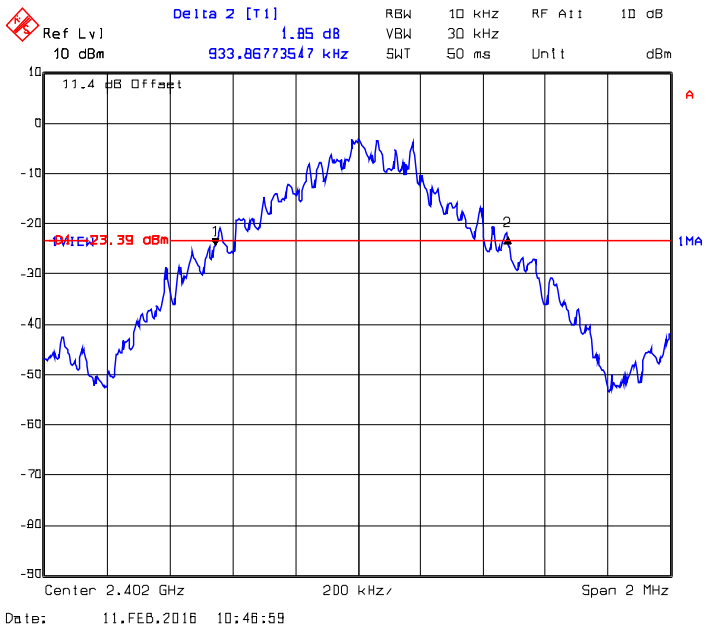
Plot 5.3.4.1.1. 20 dB Bandwidth, GFSK, DH1, CH 0, 2402 MHz

Plot 5.3.4.1.2. 20 dB Bandwidth, GFSK, DH1, CH 39, 2441 MHz

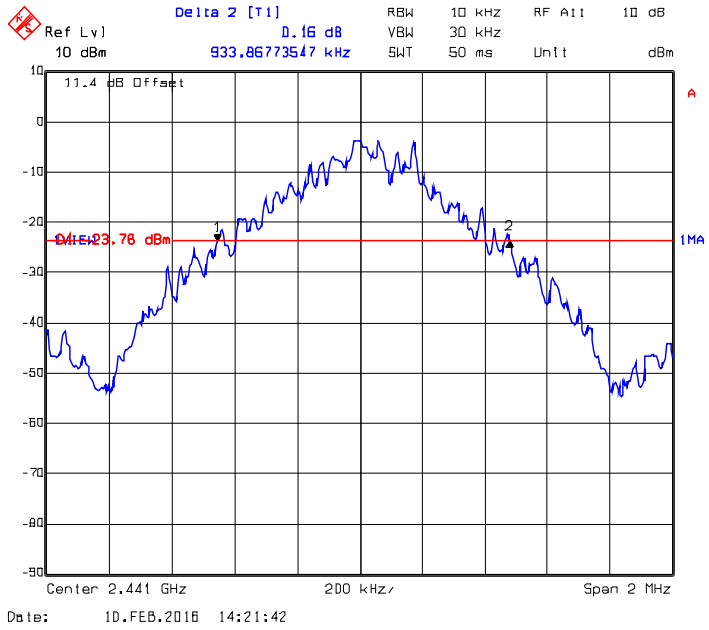
Plot 5.3.4.1.3. 20 dB Bandwidth, GFSK, DH1, CH 78, 2480 MHz



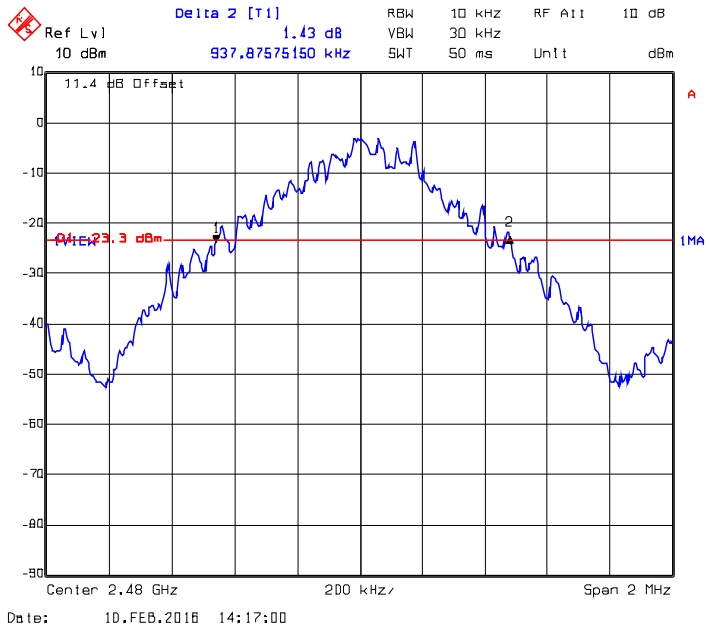
Plot 5.3.4.1.4. 20 dB Bandwidth, GFSK, DH3, CH 0, 2402 MHz



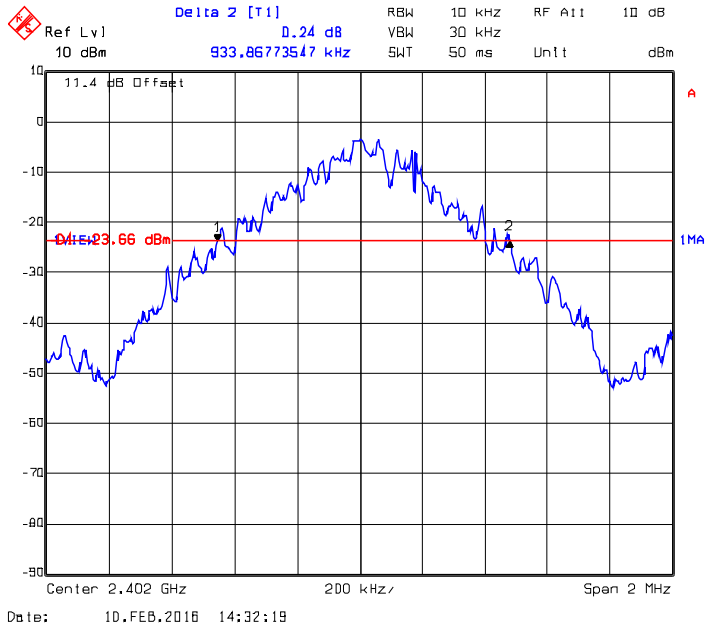
Plot 5.3.4.1.5. 20 dB Bandwidth, GFSK, DH3, CH 39, 2441 MHz



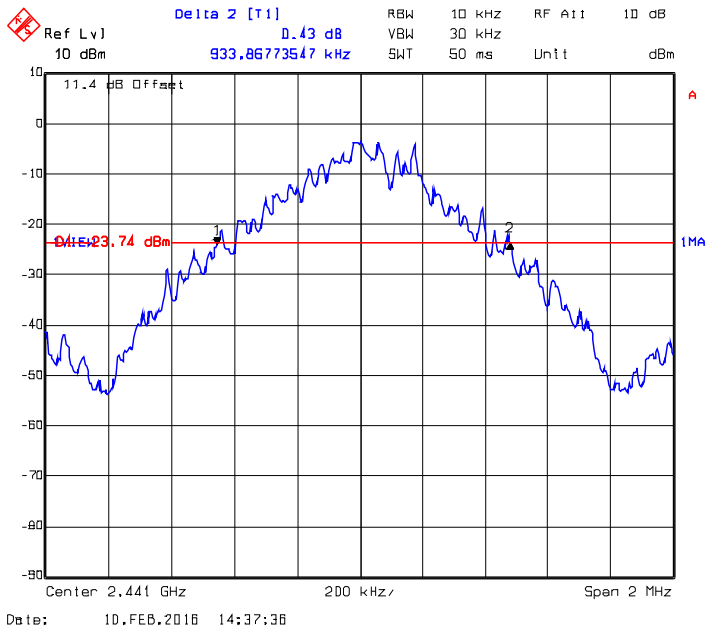
Plot 5.3.4.1.6. 20 dB Bandwidth, GFSK, DH3, CH 78, 2480 MHz



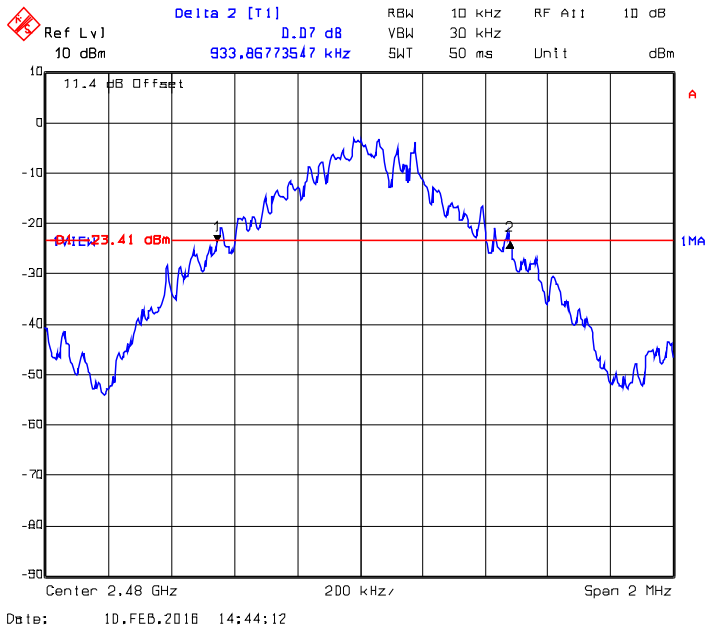
Plot 5.3.4.1.7. 20 dB Bandwidth, GFSK, DH5, CH 0, 2402 MHz



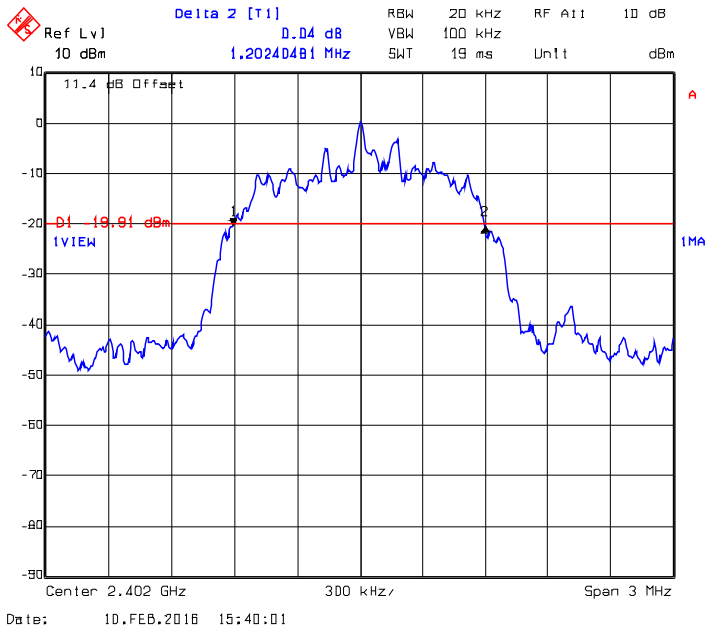
Plot 5.3.4.1.8. 20 dB Bandwidth, GFSK, DH5, CH 39, 2441 MHz



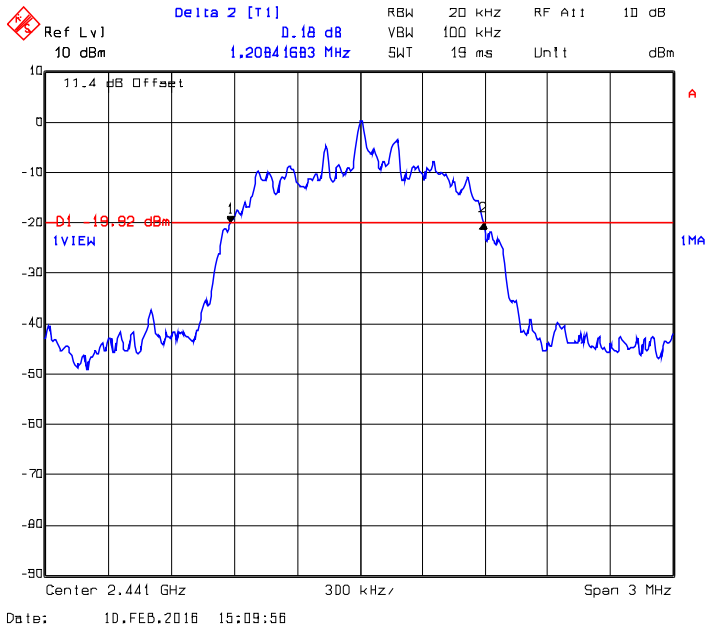
Plot 5.3.4.1.9. 20 dB Bandwidth, GFSK, DH5, CH 78, 2480 MHz



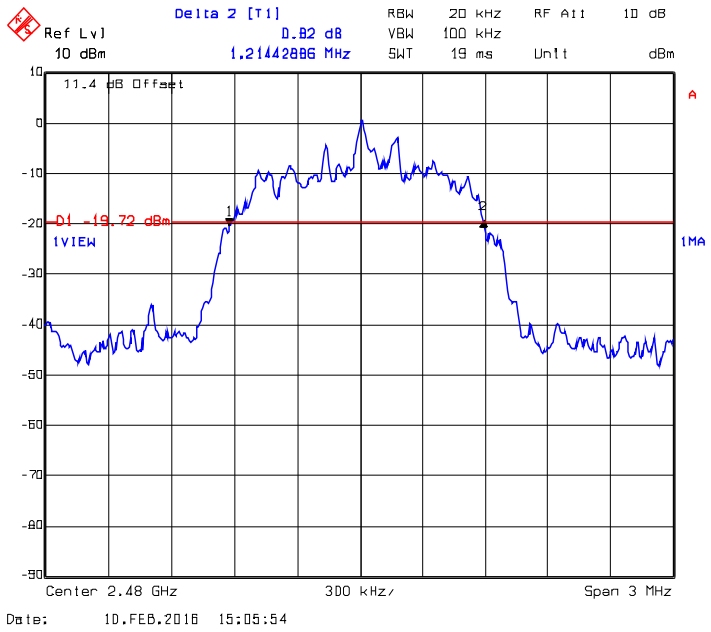
Plot 5.3.4.1.10. 20 dB Bandwidth, π/4-DQPSK, 2DH1, CH 0, 2402 MHz



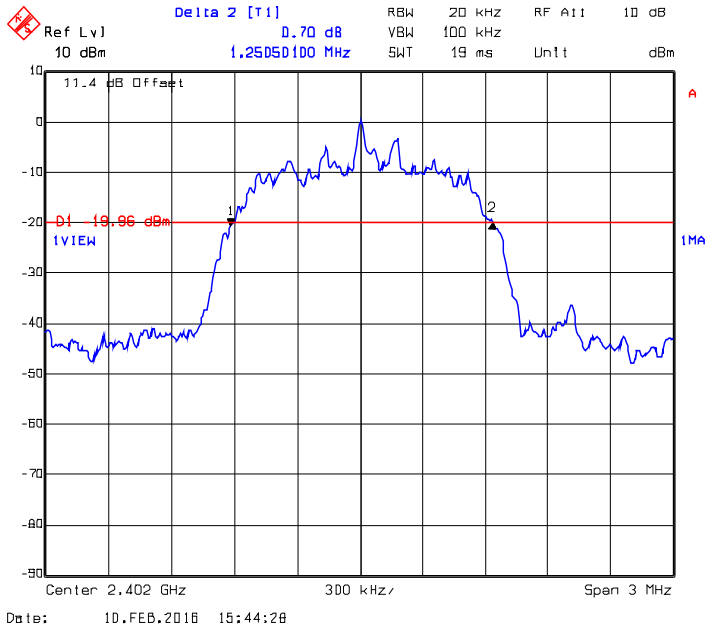
Plot 5.3.4.1.11. 20 dB Bandwidth, π/4-DQPSK, 2DH1, CH 39, 2441 MHz



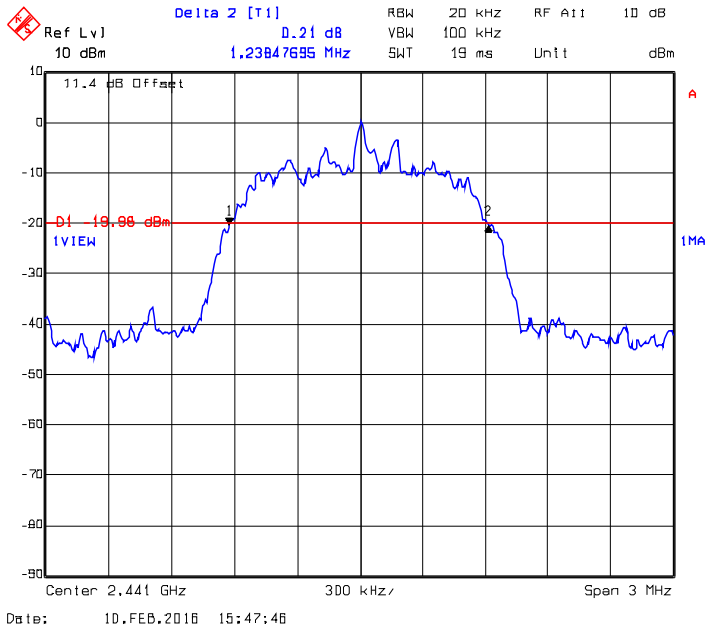
Plot 5.3.4.1.12. 20 dB Bandwidth, π/4-DQPSK, 2DH1, CH 78, 2480 MHz



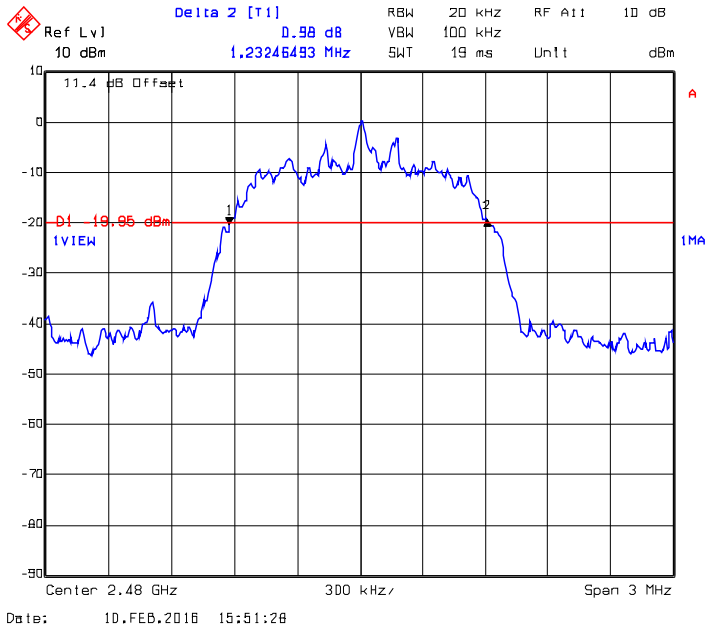
Plot 5.3.4.1.13. 20 dB Bandwidth, π/4-DQPSK, 2DH3, CH 0, 2402 MHz



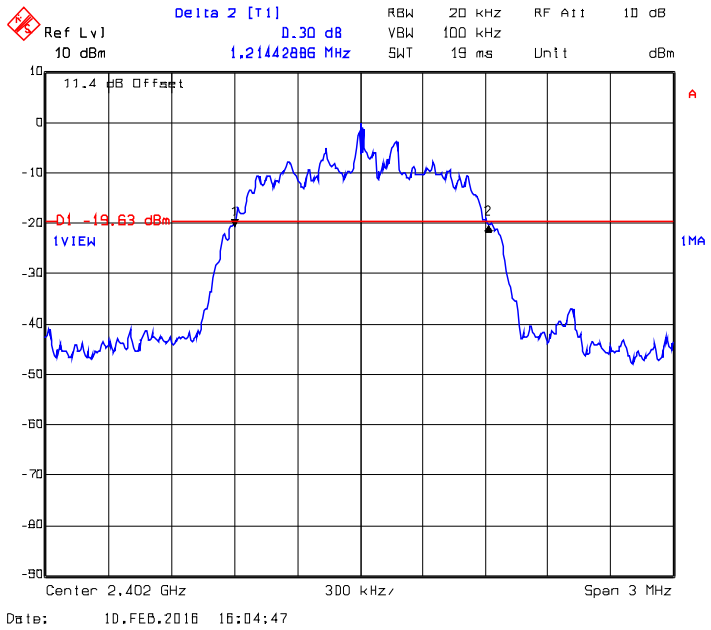
Plot 5.3.4.1.14. 20 dB Bandwidth, π/4-DQPSK, 2DH3, CH 39, 2441 MHz



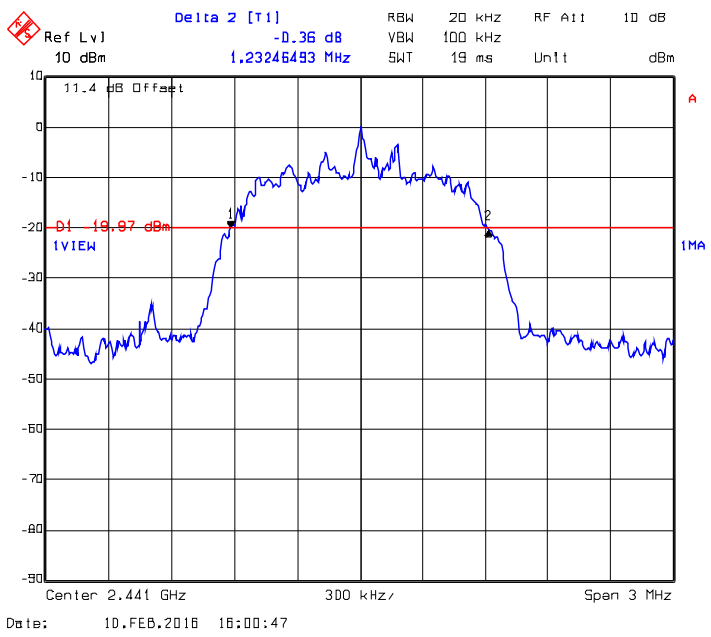
Plot 5.3.4.1.15. 20 dB Bandwidth, π/4-DQPSK, 2DH3, CH 78, 2480 MHz



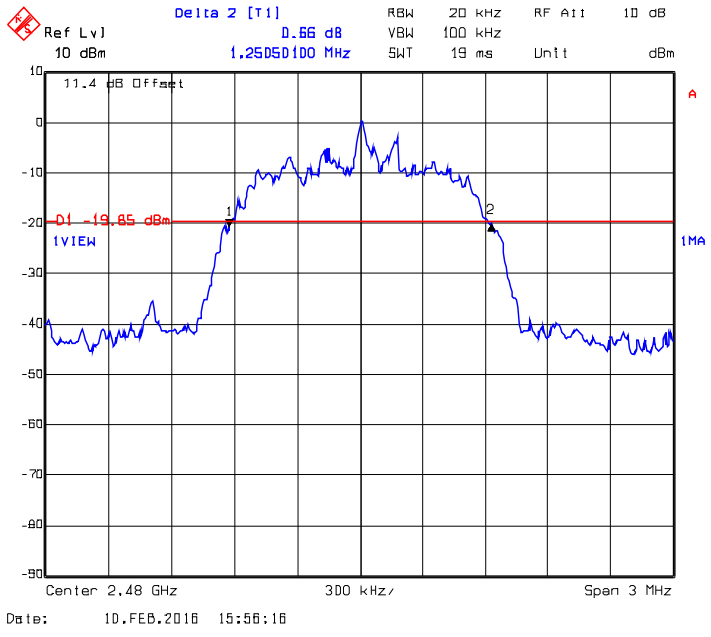
Plot 5.3.4.1.16. 20 dB Bandwidth, π/4-DQPSK, 2DH5, CH 0, 2402 MHz



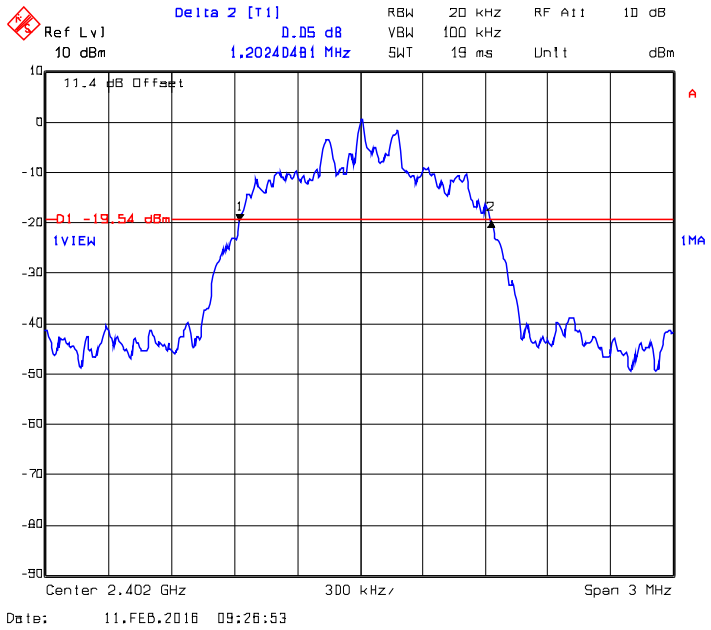
Plot 5.3.4.1.17. 20 dB Bandwidth, π/4-DQPSK, 2DH5, CH 39, 2441 MHz



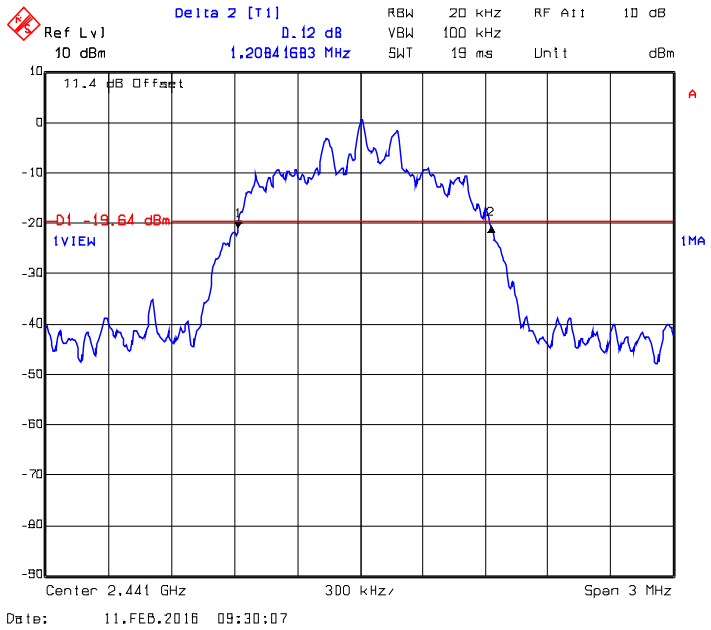
Plot 5.3.4.1.18. 20 dB Bandwidth, π/4-DQPSK, 2DH5, CH 78, 2480 MHz



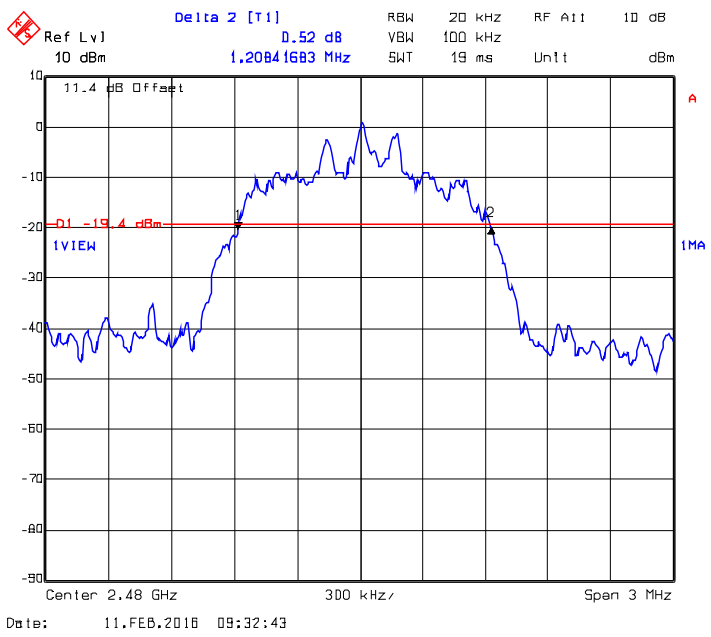
Plot 5.3.4.1.19. 20 dB Bandwidth, 8-DPSK, 3DH1, CH 0, 2402 MHz



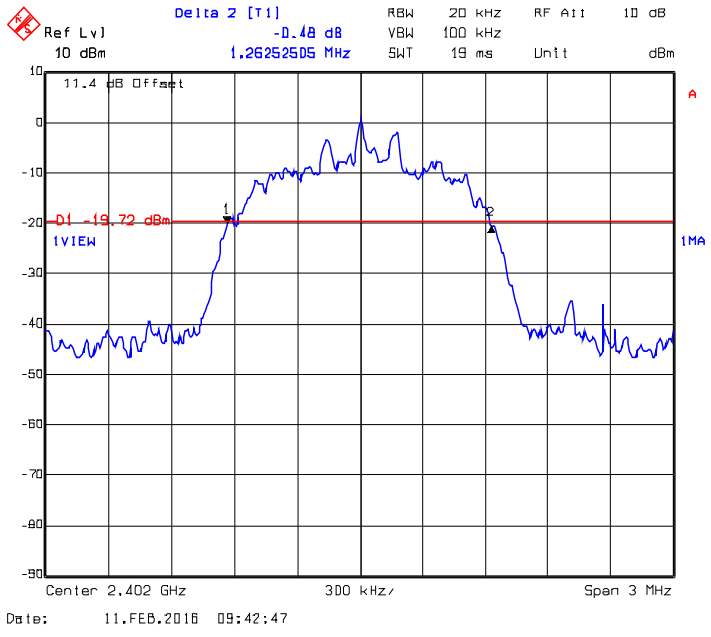
Plot 5.3.4.1.20. 20 dB Bandwidth, 8-DPSK, 3DH1, CH 39, 2441 MHz



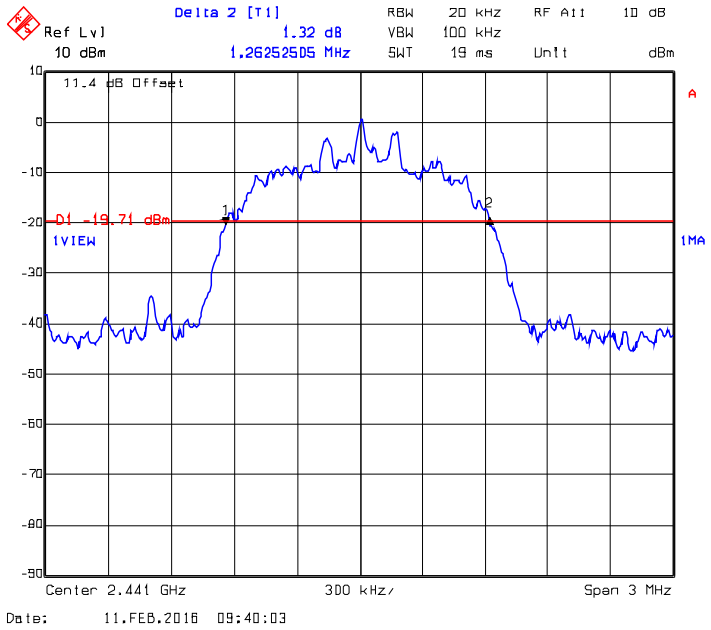
Plot 5.3.4.1.21. 20 dB Bandwidth, 8-DPSK, 3DH1, CH 78, 2480 MHz



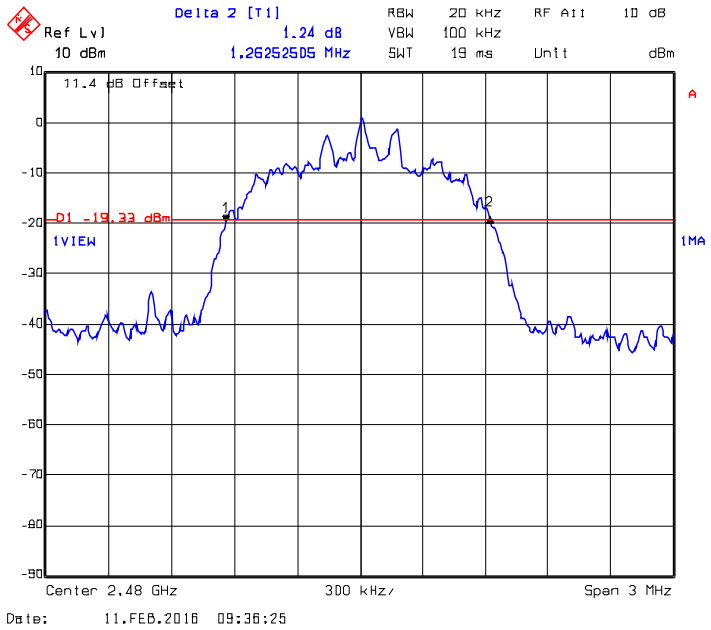
Plot 5.3.4.1.22. 20 dB Bandwidth, 8-DPSK, 3DH3, CH 0, 2402 MHz



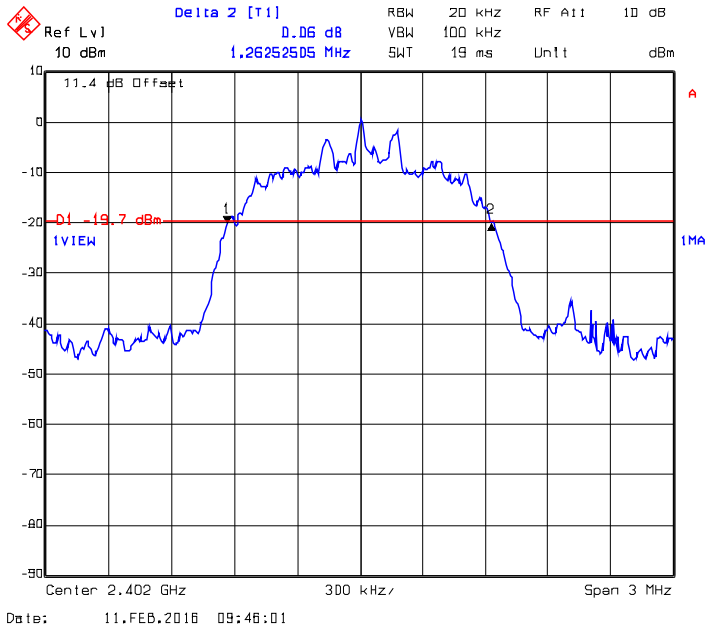
Plot 5.3.4.1.23. 20 dB Bandwidth, 8-DPSK, 3DH3, CH 39, 2441 MHz



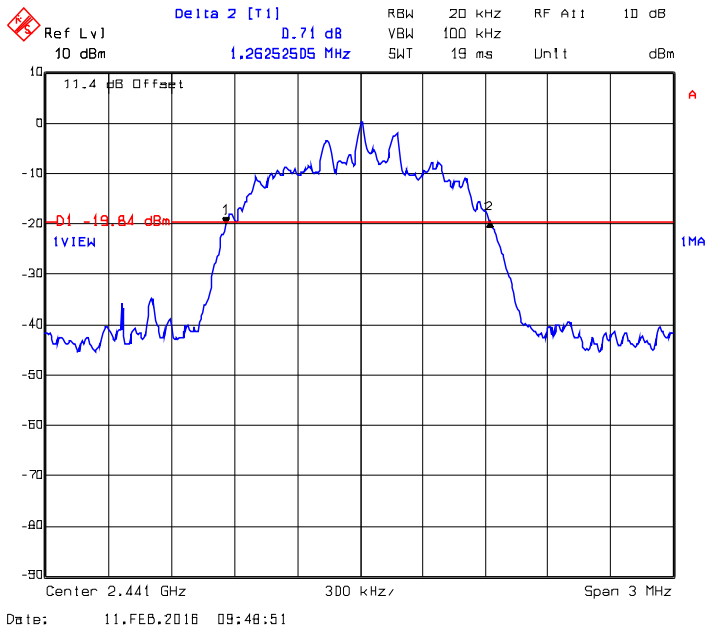
Plot 5.3.4.1.24. 20 dB Bandwidth, 8-DPSK, 3DH3, CH 78, 2480 MHz



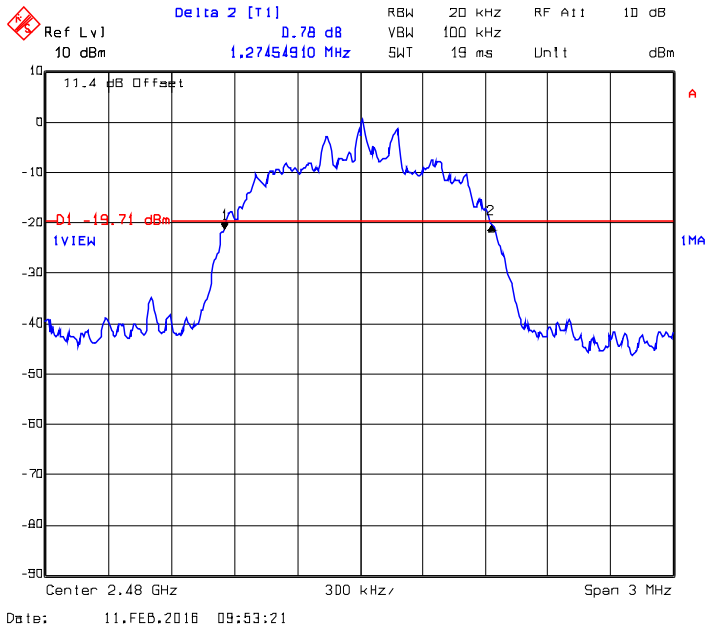
Plot 5.3.4.1.25. 20 dB Bandwidth, 8-DPSK, 3DH5, CH 0, 2402 MHz



Plot 5.3.4.1.26. 20 dB Bandwidth, 8-DPSK, 3DH5, CH 39, 2441 MHz



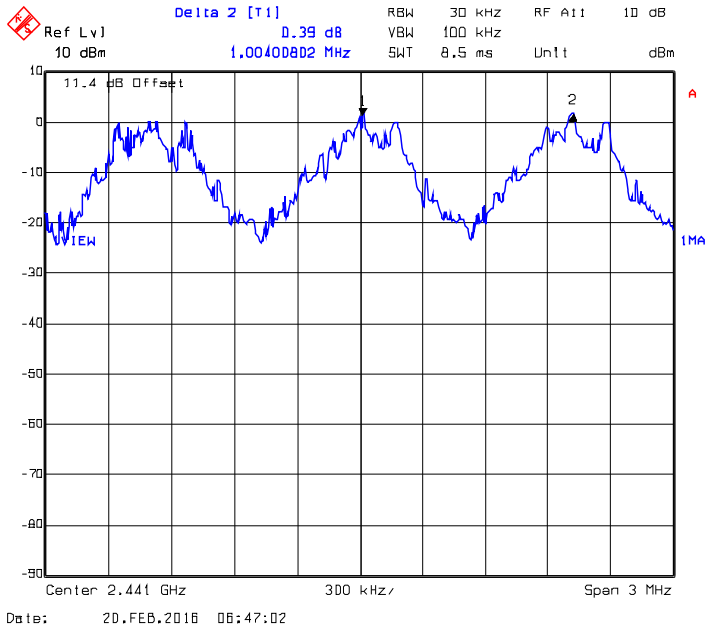
Plot 5.3.4.1.27. 20 dB Bandwidth, 8-DPSK, 3DH5, CH 78, 2480 MHz



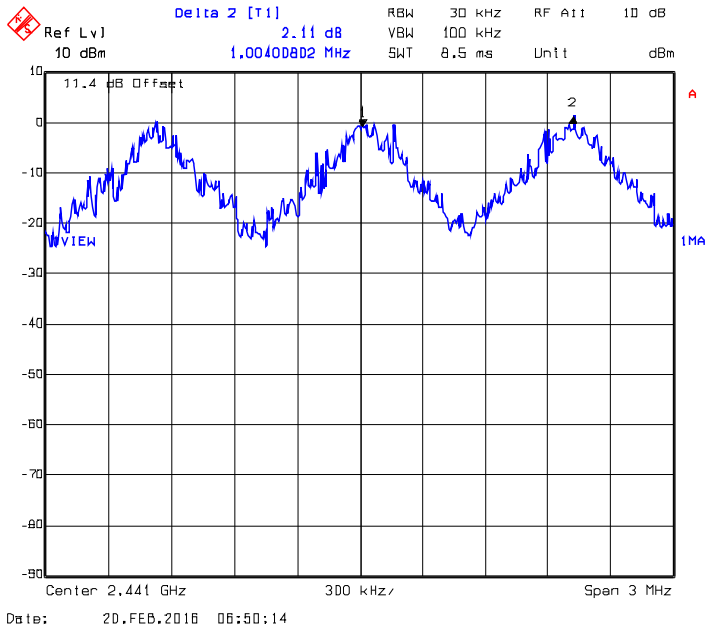
5.3.4.2. Channel Hopping Frequency Separation

Mode	Packet	CFG Packet Type	CFG Packet Size	TXDATA1 Power (Ext, Int)	Carrier Frequency Separation Channel 39 2441 MHz (MHz)	20dB BW Channel 39 2441 MHz (MHz)	2/3 of 20dB BW (MHz)
GFSK	DH1	15	26	255, 53	1.004	0.9138	0.6092
	DH3	15	183	255, 53	1.004	0.9339	0.6226
	DH5	15	339	255, 53	1.004	0.9339	0.6226
π/4-DQPSK	2DH1	30	54	255, 55	1.024	1.2084	0.8056
	2DH3	30	367	255, 55	1.024	1.2385	0.8257
	2DH5	30	679	255, 55	1.024	1.2325	0.8217
8-DPSK	3DH1	31	83	255, 55	1.024	1.2084	0.8056
	3DH3	31	552	255, 55	1.024	1.2625	0.8417
	3DH5	31	1021	255, 55	1.024	1.2625	0.8417

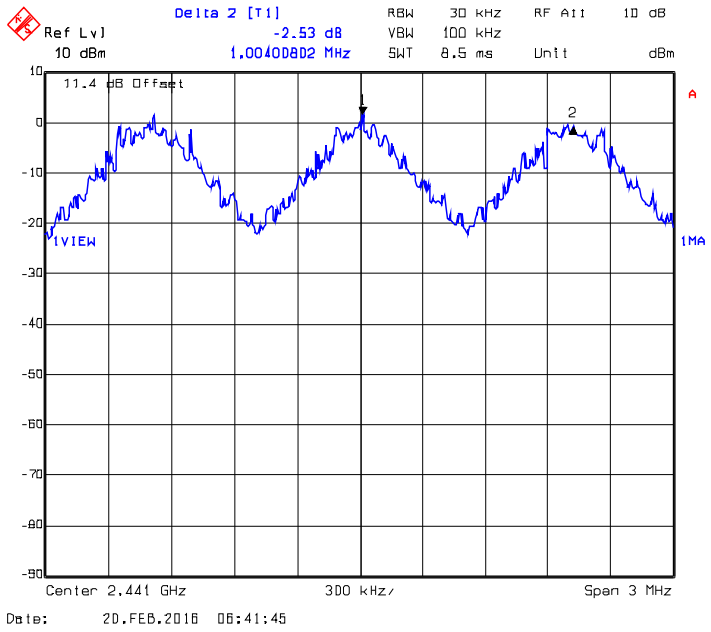
Plot 5.3.4.2.1. Carrier Frequency Separation, GFSK, DH1, CH 39, 2441 MHz



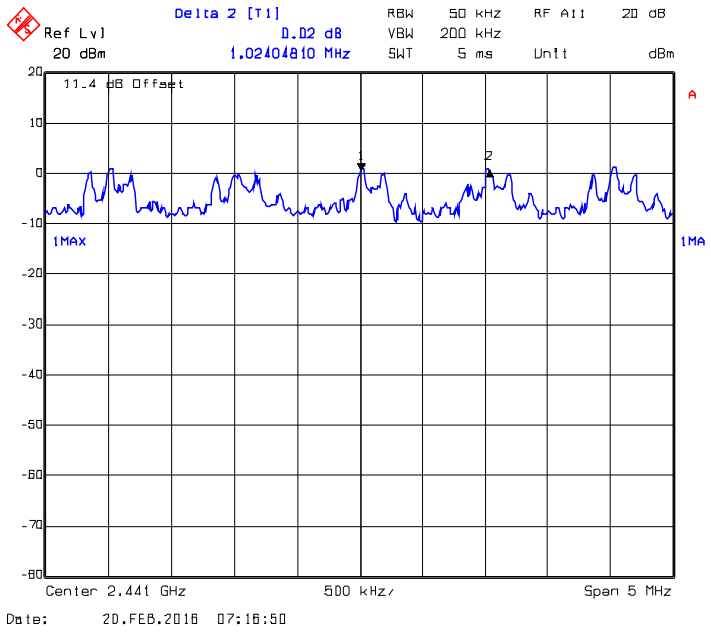
Plot 5.3.4.2.2. Carrier Frequency Separation, GFSK, DH3, CH 39, 2441 MHz



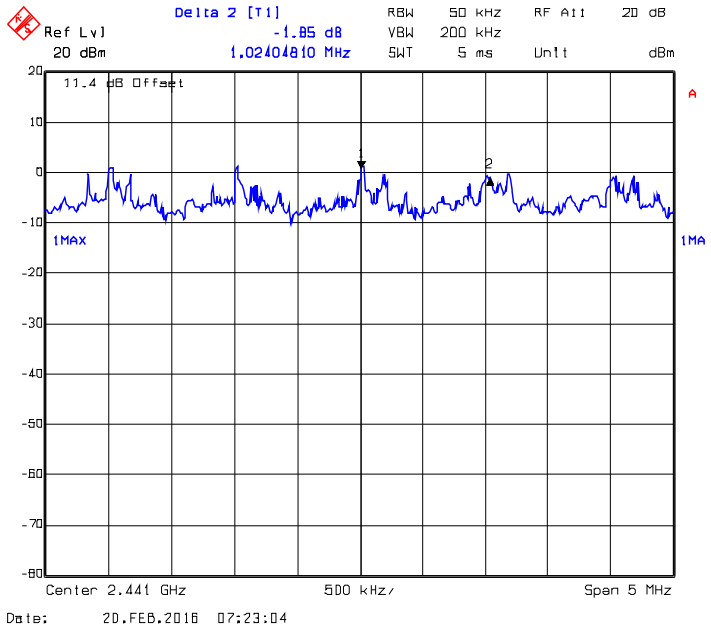
Plot 5.3.4.2.3. Carrier Frequency Separation, GFSK, DH5, CH 39, 2441 MHz



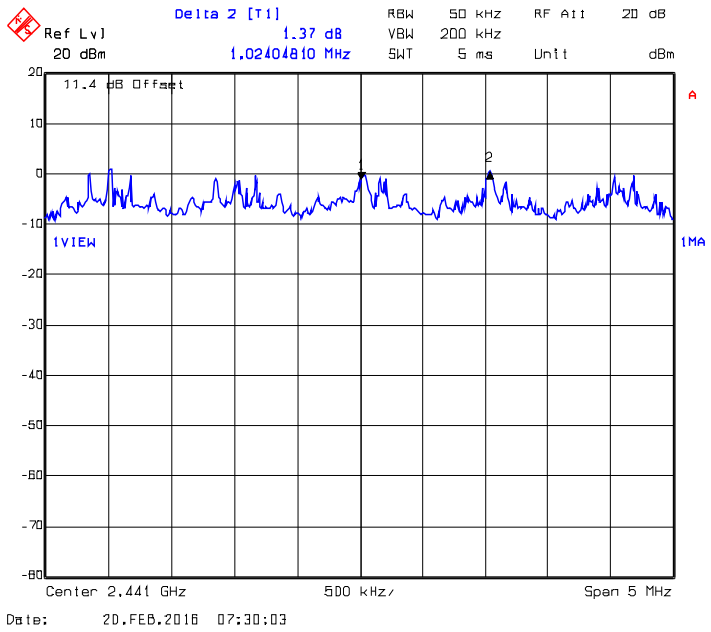
Plot 5.3.4.2.4. Carrier Frequency Separation, π/4-DQPSK, 2DH1, CH 39, 2441 MHz



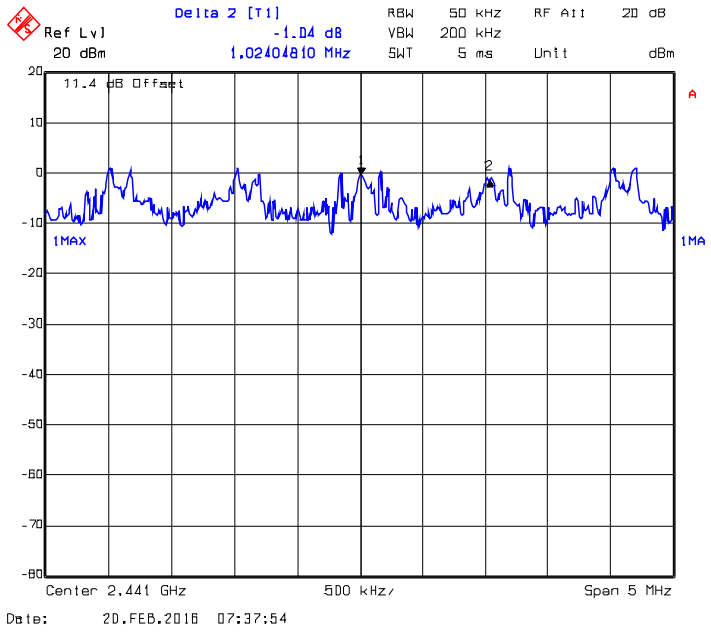
Plot 5.3.4.2.5. Carrier Frequency Separation, π/4-DQPSK, 2DH3, CH 39, 2441 MHz



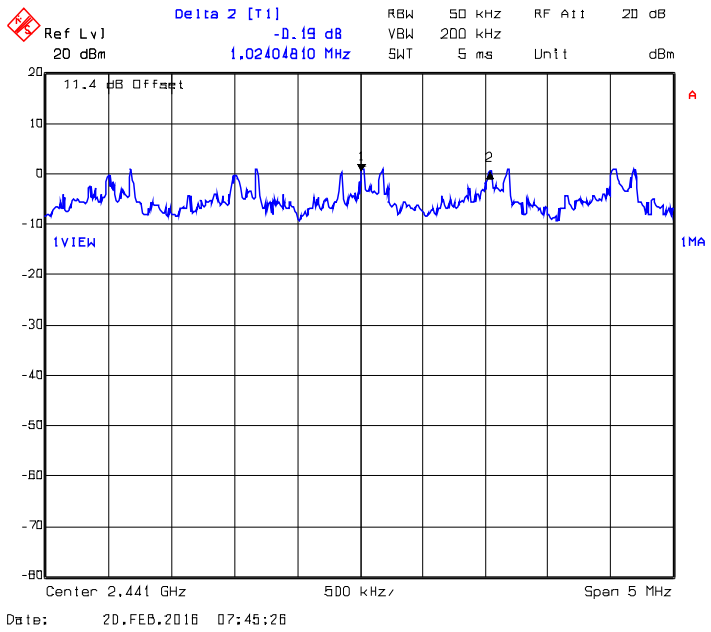
Plot 5.3.4.2.6. Carrier Frequency Separation, π/4-DQPSK, 2DH5, CH 39, 2441 MHz



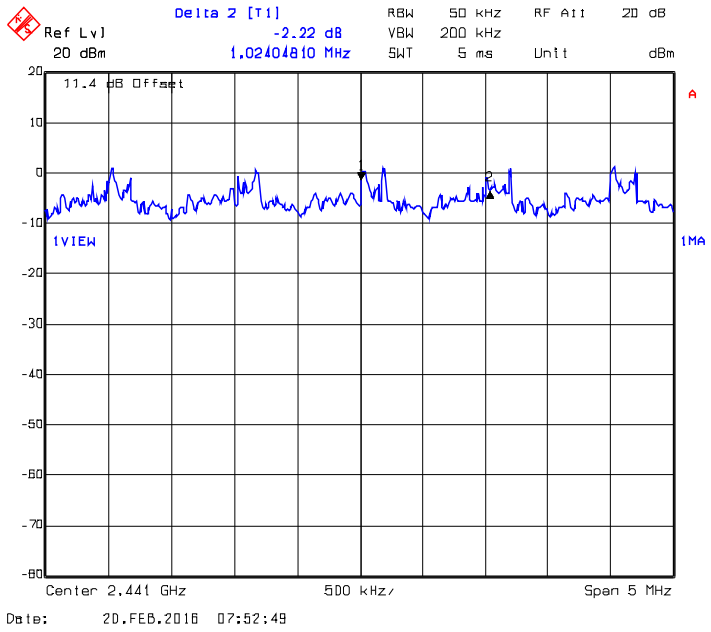
Plot 5.3.4.2.7. Carrier Frequency Separation, 8-DPSK, 3DH1, CH 39, 2441 MHz



Plot 5.3.4.2.8. Carrier Frequency Separation, 8-DPSK, 3DH3, CH 39, 2441 MHz

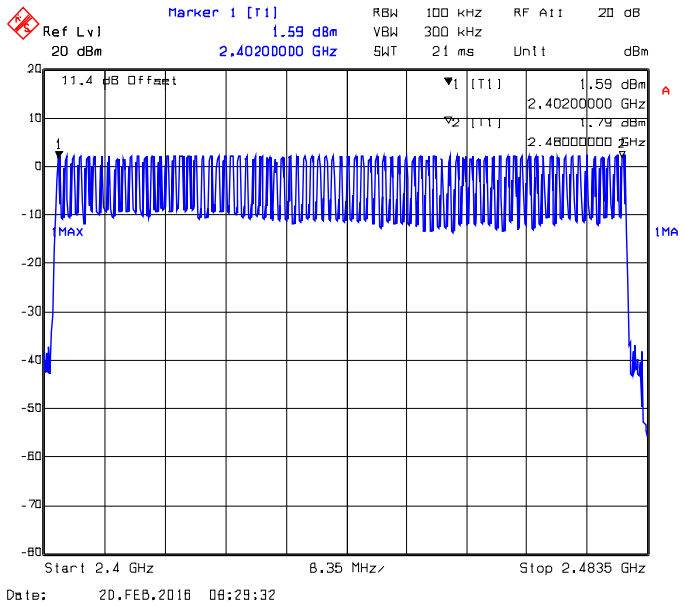


Plot 5.3.4.2.9. Carrier Frequency Separation, 8-DPSK 3DH5, CH 39, 2441 MHz

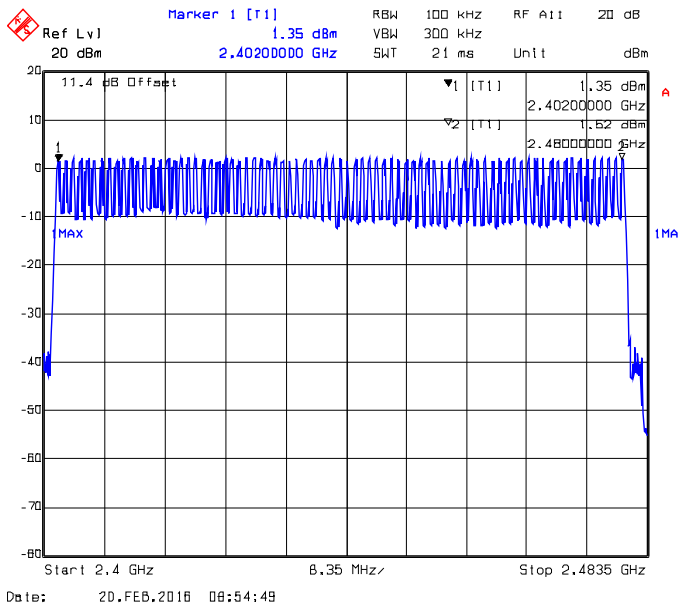


5.3.4.3. Number of Hopping Frequencies

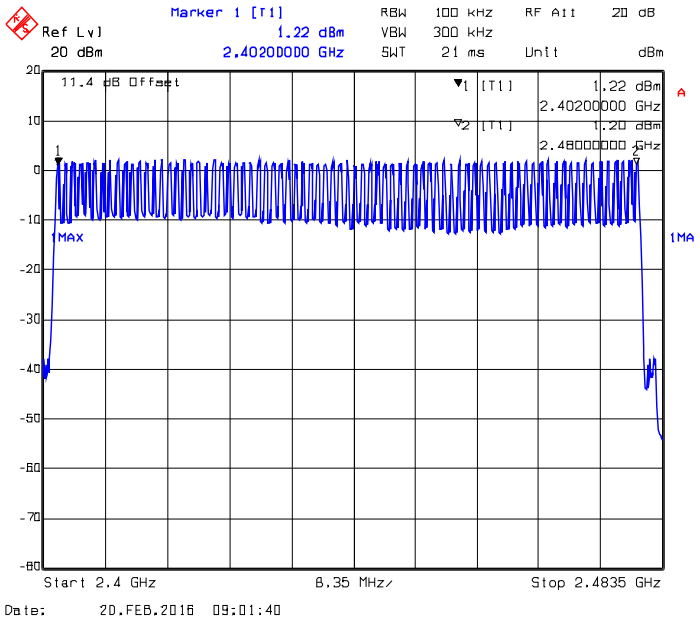
Plot 5.3.4.3.1. Number of Hopping Frequencies
GFSK, DH1, 79 Hopping Channels



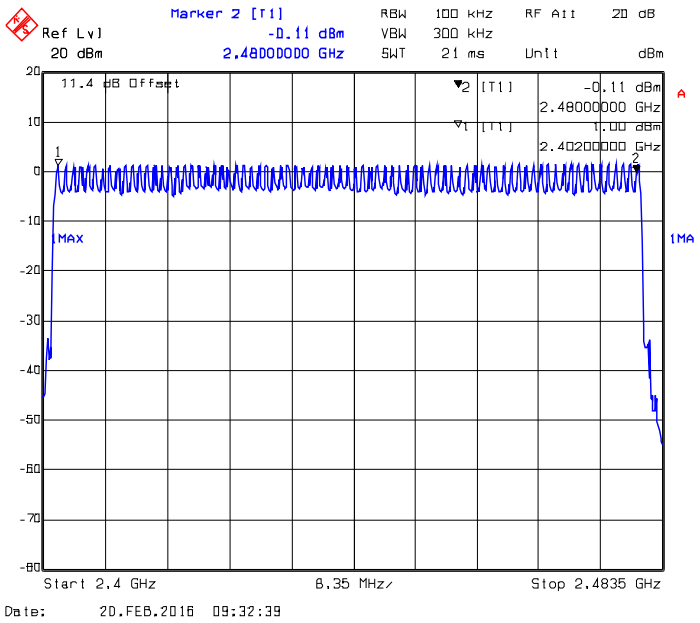
Plot 5.3.4.3.2. Number of Hopping Frequencies
GFSK, DH3, 79 Hopping Channels



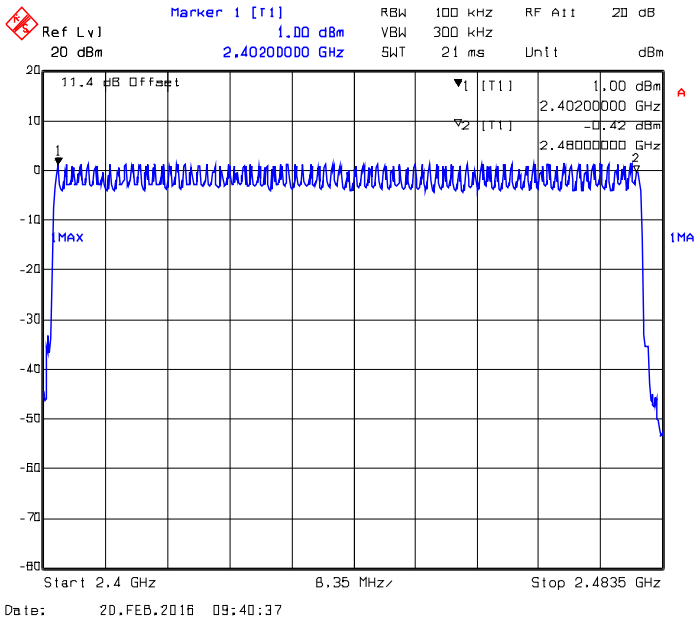
Plot 5.3.4.3.3. Number of Hopping Frequencies
GFSK, DH5, 79 Hopping Channels



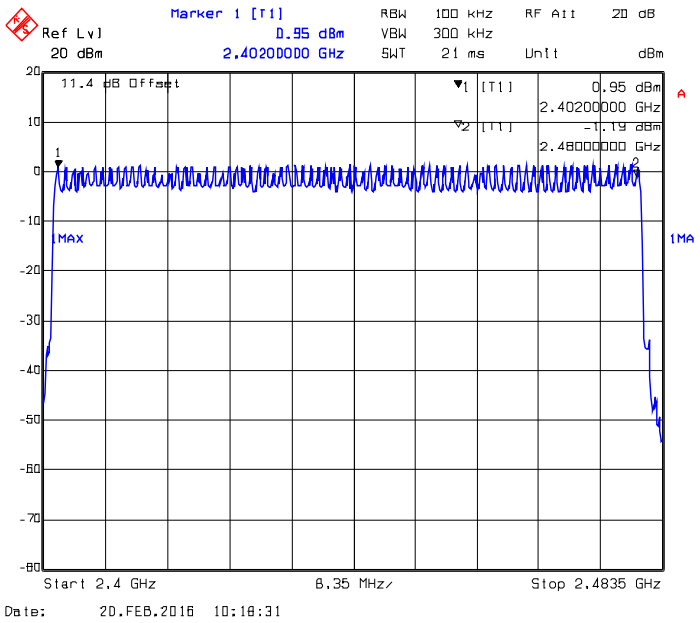
Plot 5.3.4.3.4. Number of Hopping Frequencies
π/4-DQPSK, 2DH1, 79 Hopping Channels



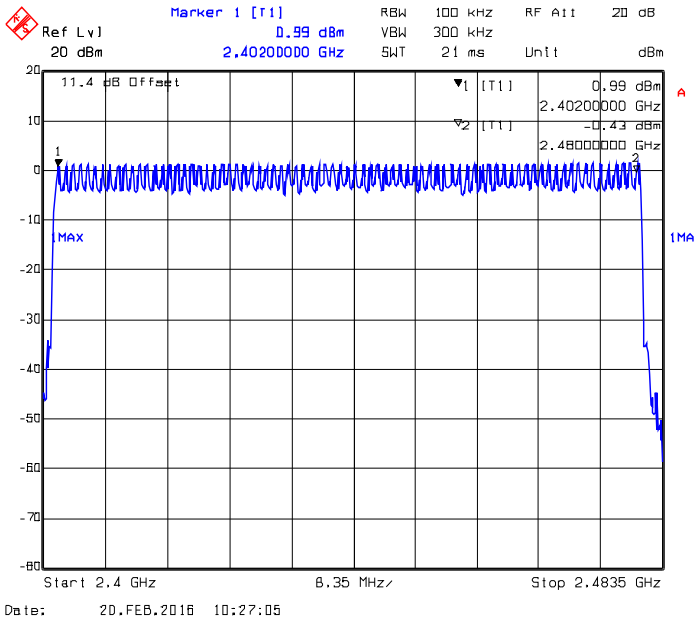
Plot 5.3.4.3.5. Number of Hopping Frequencies
π/4-DQPSK, 2DH3, 79 Hopping Channels



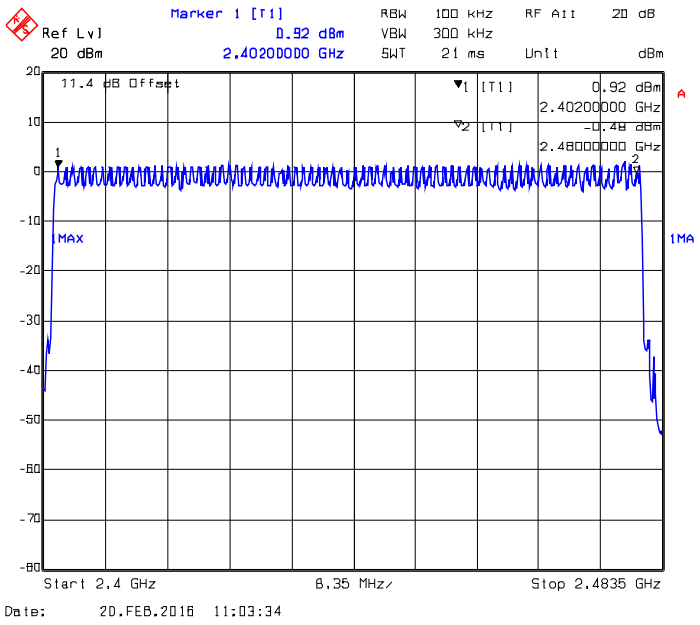
Plot 5.3.4.3.6. Number of Hopping Frequencies
π/4-DQPSK, 2DH5, 79 Hopping Channels



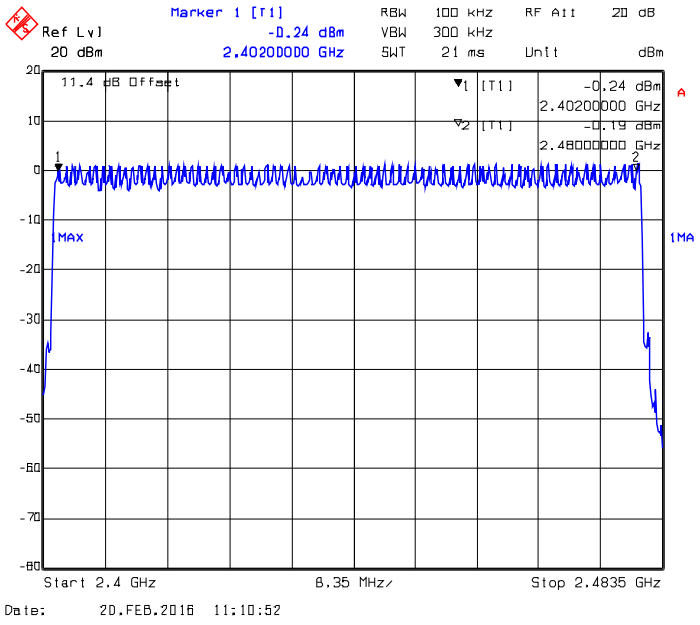
Plot 5.3.4.3.7. Number of Hopping Frequencies
8-DPSK, 3DH1, 79 Hopping Channels



Plot 5.3.4.3.8. Number of Hopping Frequencies
8-DPSK, 3DH3, 79 Hopping Channels



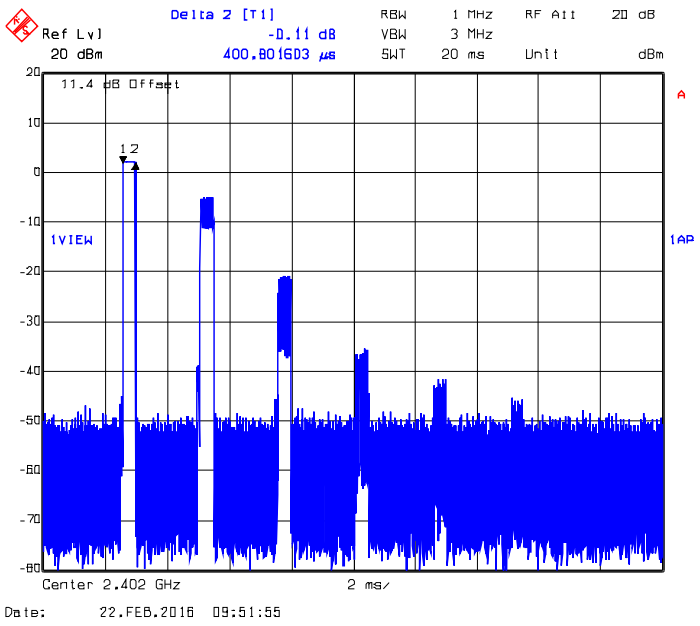
Plot 5.3.4.3.9. Number of Hopping Frequencies
8-DPSK, 3DH5, 79 Hopping Channels



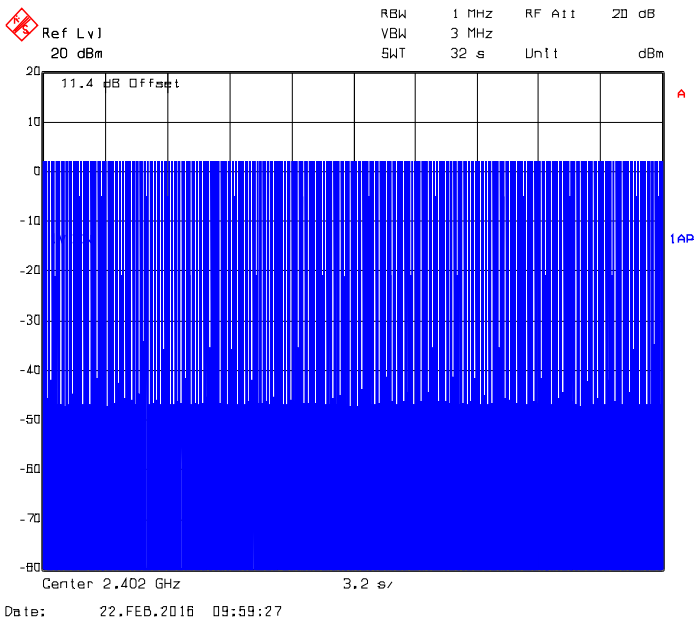
5.3.4.4. Time of Occupancy (Dwell Time)

Mode	Packet	CFG Packet Type	CFG Packet Size	TXDATA1 Power (Ext, Int)	Time of Occupancy (ms)		
					Channel 0 2402 MHz	Channel 39 2441 MHz	Channel 78 2480 MHz
GFSK	DH1	15	26	255, 53	70.54	70.54	70.54
	DH3	15	183	255, 53	266.21	266.21	266.21
	DH5	15	339	255, 53	310.92	310.92	310.92
π/4-DQPSK	2DH1	30	54	255, 55	71.43	71.43	71.43
	2DH3	30	367	255, 55	271.03	271.03	271.03
	2DH5	30	679	255, 55	313.83	313.83	313.83
8-DPSK	3DH1	31	83	255, 55	70.67	70.67	70.67
	3DH3	31	552	255, 55	271.03	271.03	271.03
	3DH5	31	1021	255, 55	308.78	308.78	308.78

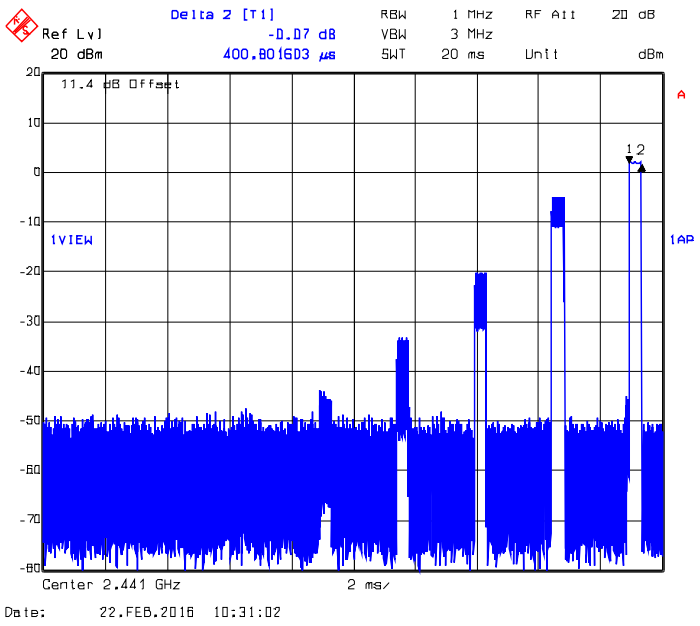
Plot 5.3.4.4.1. Time of Occupancy, GFSK, DH1, 2402 MHz
Dwell Time @ 2402 MHz = 0.4008 ms



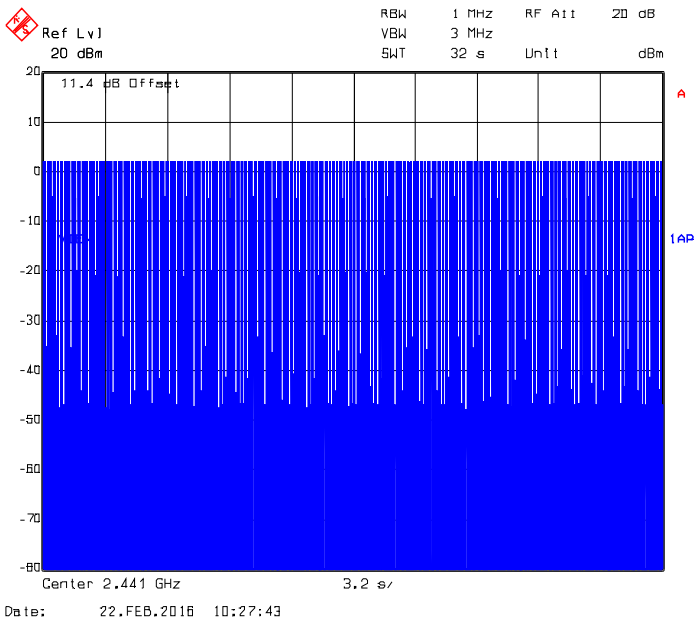
Plot 5.3.4.4.2. Time of Occupancy, GFSK, DH1, 2402 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 0.4008 ms x 176 = 70.54 ms



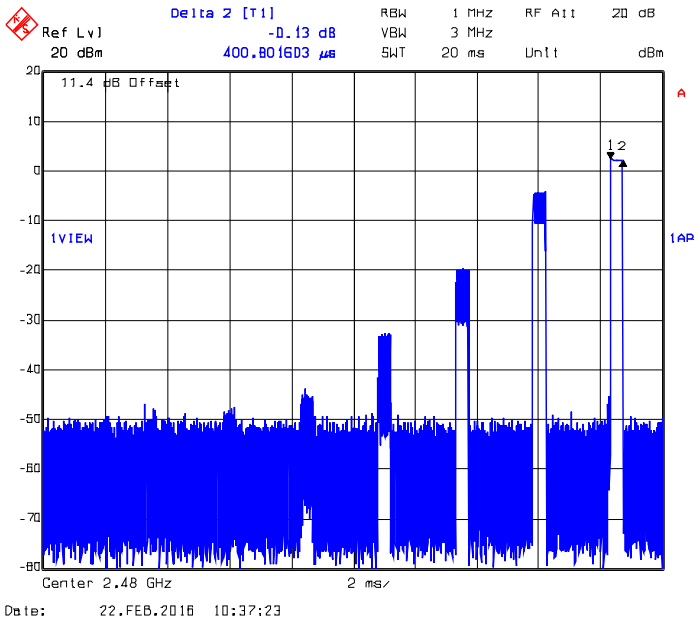
Plot 5.3.4.4.3. Time of Occupancy, GFSK, DH1, 2441 MHz
Dwell Time @ 2441 MHz = 0.4008 ms



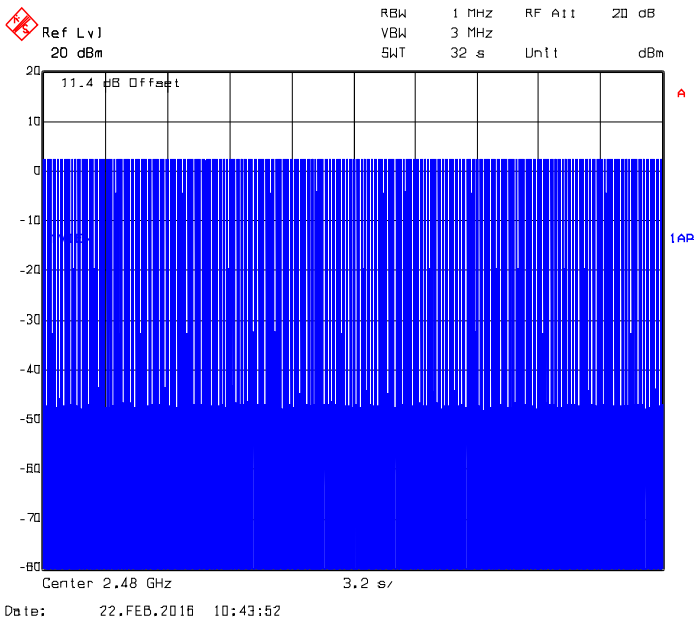
Plot 5.3.4.4.4. Time of Occupancy, GFSK, DH1, 2441 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 0.4008 ms x 176 = 70.54 ms



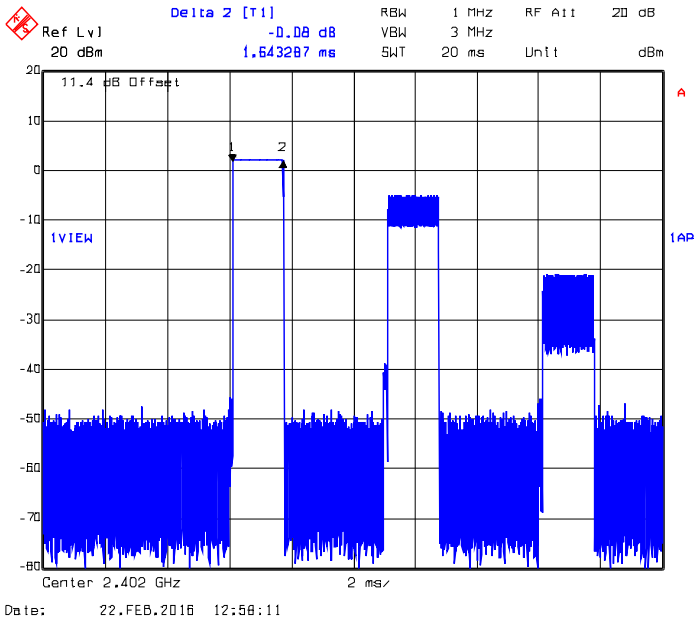
Plot 5.3.4.4.5. Time of Occupancy, GFSK, DH1, 2480 MHz
Dwell Time @ 2480 MHz = 0.4008 ms



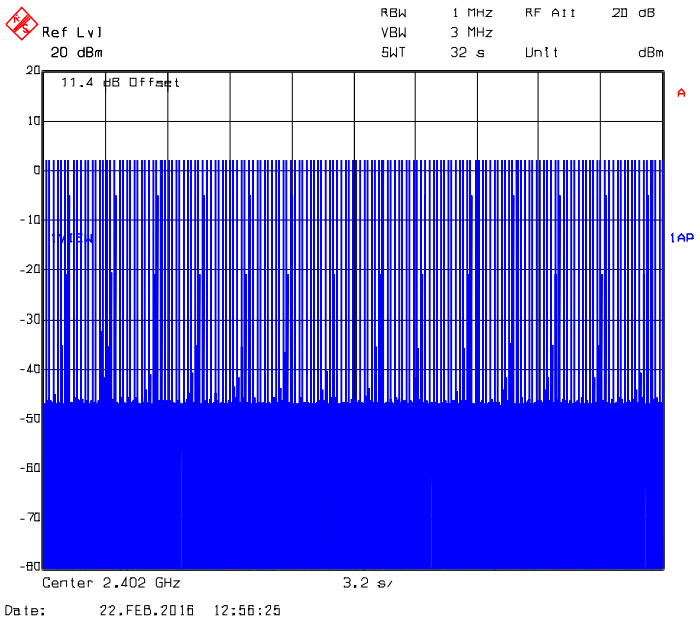
Plot 5.3.4.4.6. Time of Occupancy, GFSK, DH1, 2480 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 0.4008 ms x 176 = 70.54 ms



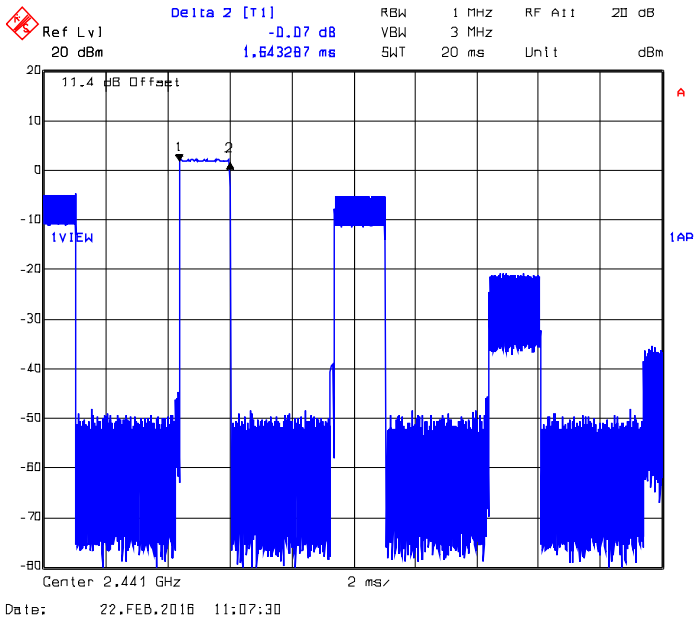
Plot 5.3.4.4.7. Time of Occupancy, GFSK, DH3, 2402 MHz
Dwell Time @ 2402 MHz = 1.6433 ms



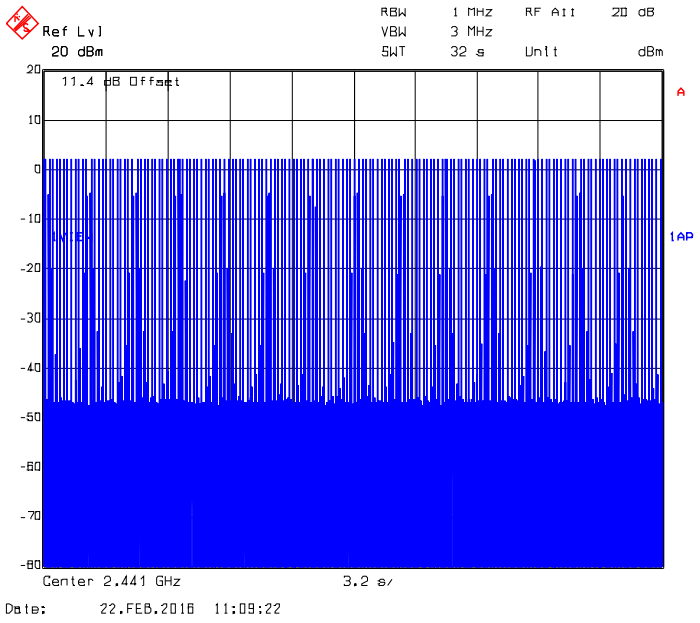
Plot 5.3.4.4.8. Time of Occupancy, GFSK, DH3, 2402 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 1.6433 ms x 162 = 266.21 ms



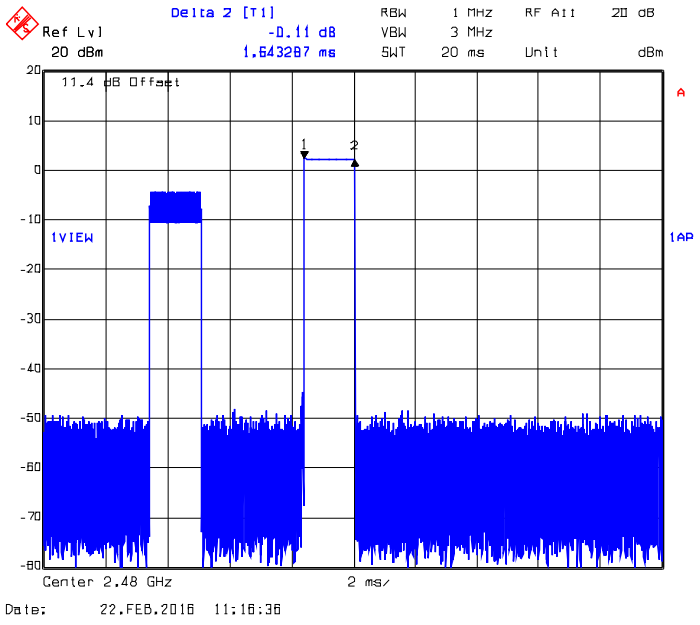
Plot 5.3.4.4.9. Time of Occupancy, GFSK, DH3, 2441 MHz
Dwell Time @ 2441 MHz = 1.6433 ms



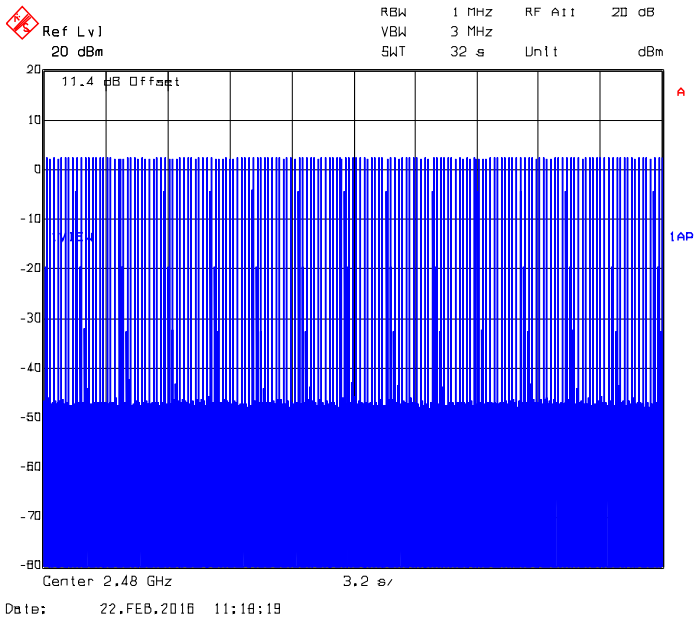
Plot 5.3.4.4.10. Time of Occupancy, GFSK, DH3, 2441 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 1.6433 ms x 162 = 266.21 ms



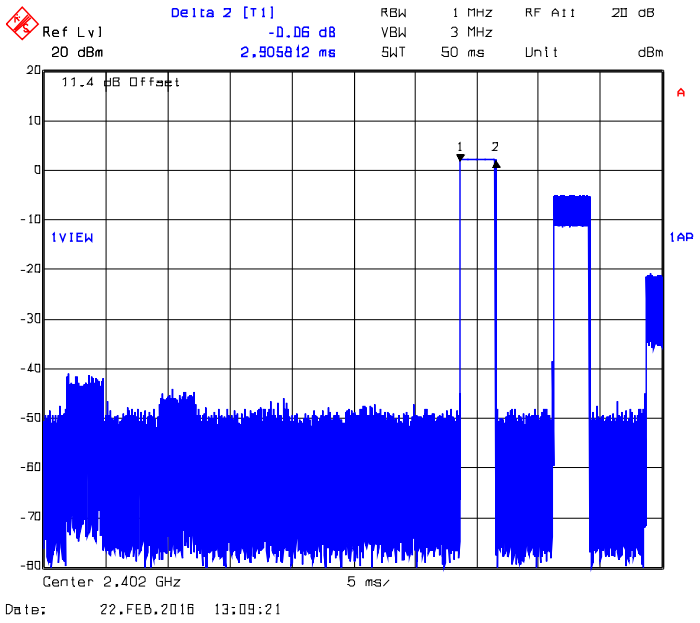
Plot 5.3.4.4.11. Time of Occupancy, GFSK, DH3, 2480 MHz
Dwell Time @ 2480 MHz = 1.6433 ms



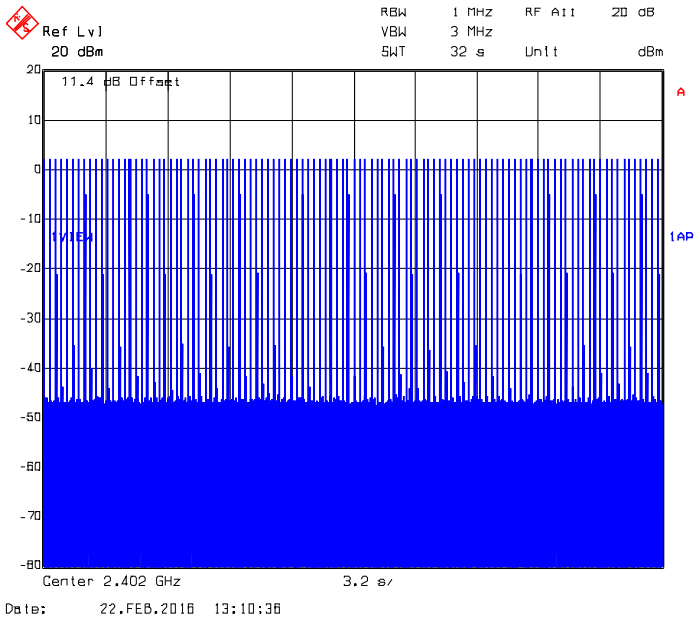
Plot 5.3.4.4.12. Time of Occupancy, GFSK, DH3, 2480 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 1.6433 ms x 162 = 266.21 ms



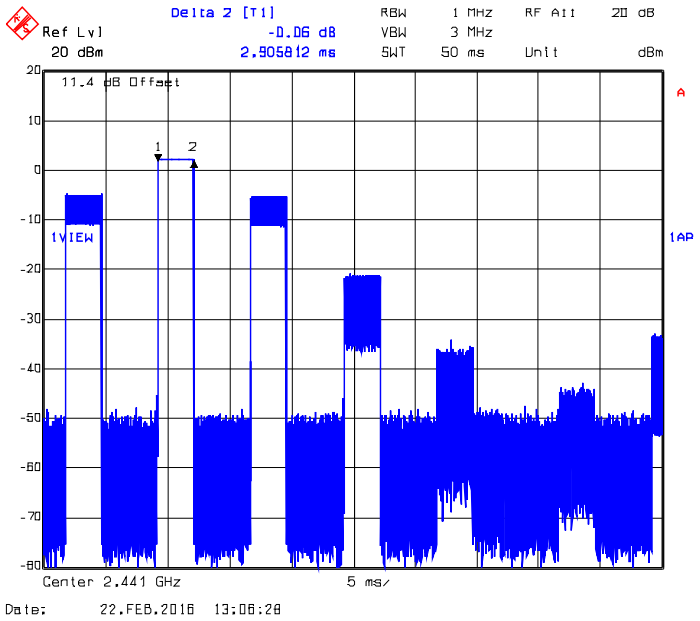
Plot 5.3.4.4.13. Time of Occupancy, GFSK, DH5, 2402 MHz
Dwell Time @ 2402 MHz = 2.9058 ms



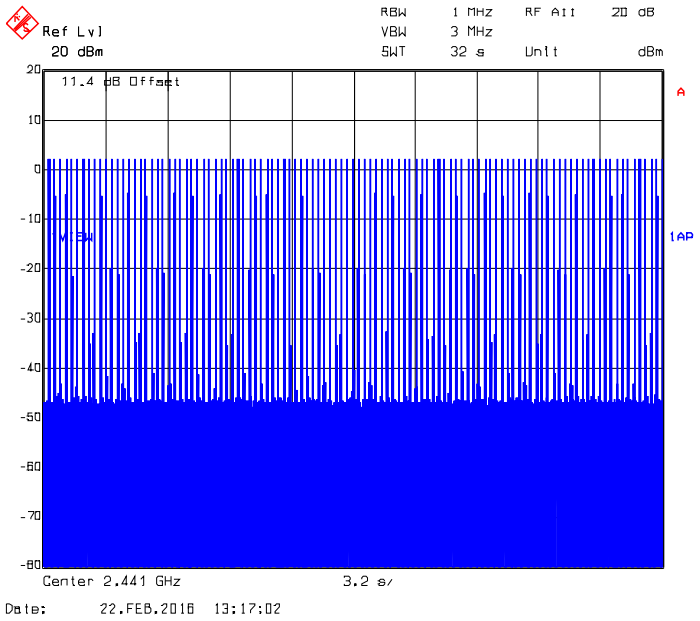
Plot 5.3.4.4.14. Time of Occupancy, GFSK, DH5, 2402 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 2.9058 ms x 107 = 310.92 ms



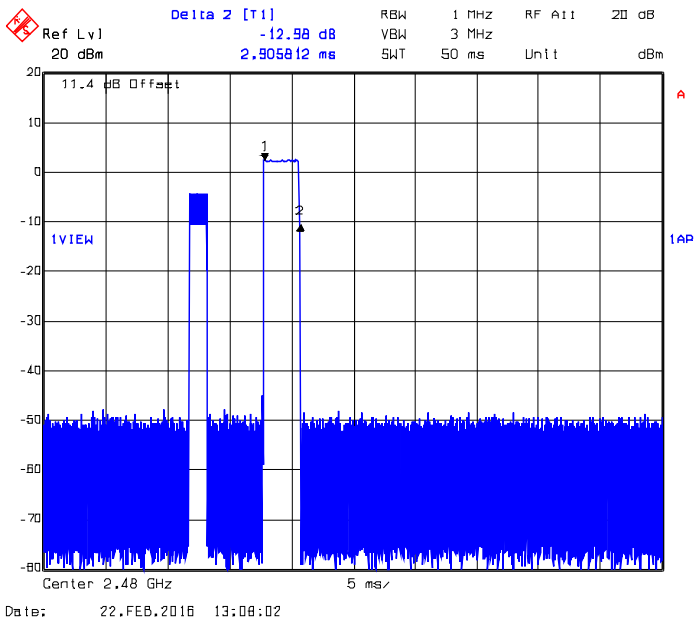
Plot 5.3.4.4.15. Time of Occupancy, GFSK, DH5, 2441 MHz
Dwell Time @ 2441 MHz = 2.9058 ms



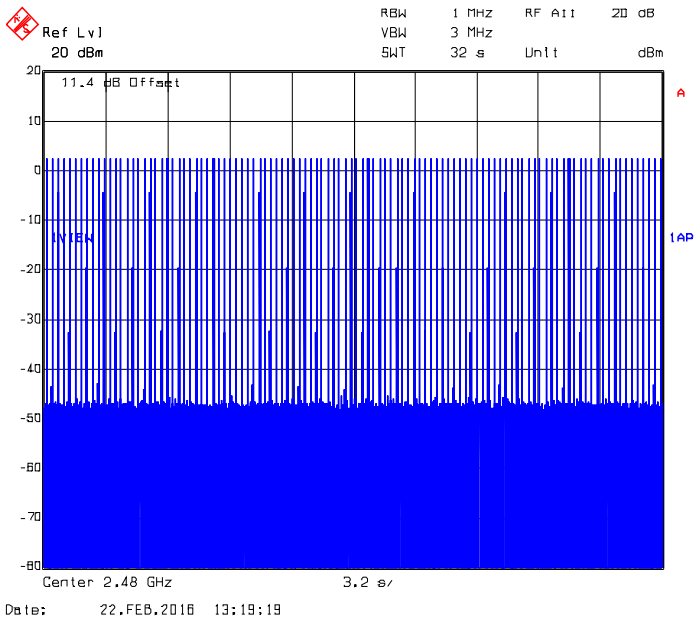
Plot 5.3.4.4.16. Time of Occupancy, GFSK, DH5, 2441 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 2.9058 ms x 107 = 310.92 ms



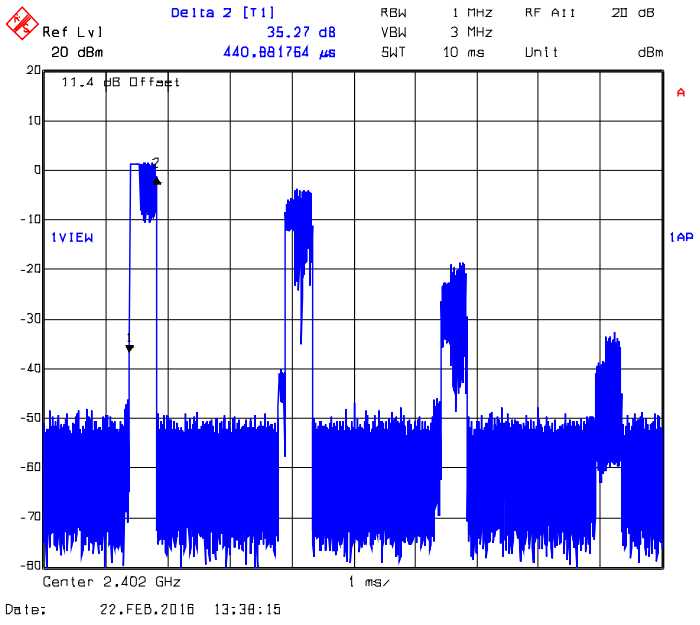
Plot 5.3.4.4.17. Time of Occupancy, GFSK, DH5, 2480 MHz
Dwell Time @ 2480 MHz = 2.9058 ms



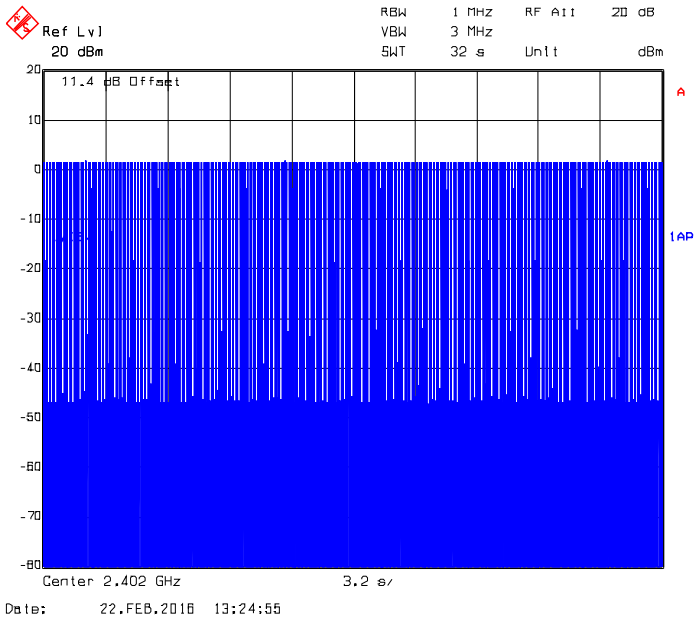
Plot 5.3.4.4.18. Time of Occupancy, GFSK, DH5, 2480 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 2.9058 ms x 107 = 310.92 ms



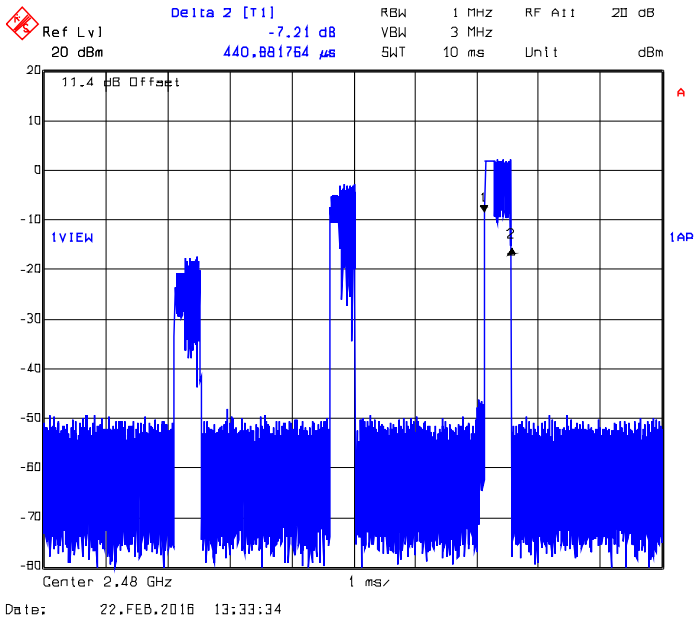
Plot 5.3.4.4.19. Time of Occupancy, π/4-DQPSK, 2DH1, 2402 MHz
Dwell Time @ 2402 MHz = 0.4409 ms



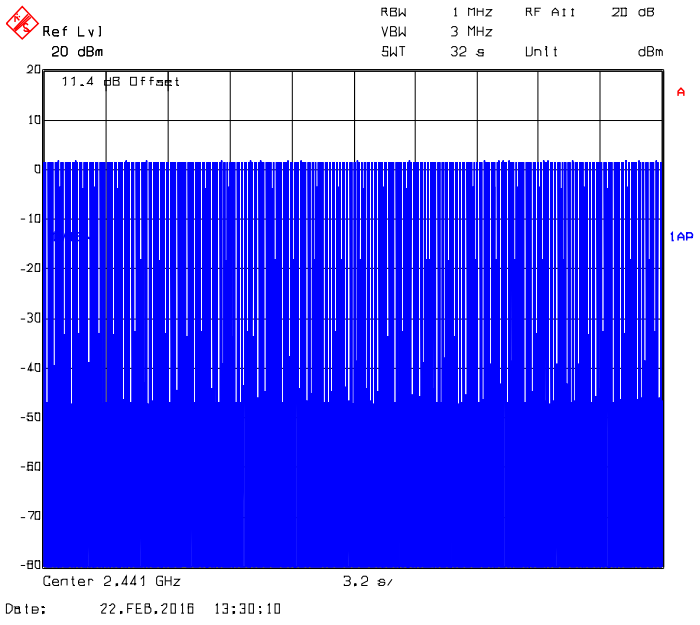
Plot 5.3.4.4.20. Time of Occupancy, π/4-DQPSK, 2DH1, 2402 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 0.4409 ms x 162 = 71.43 ms



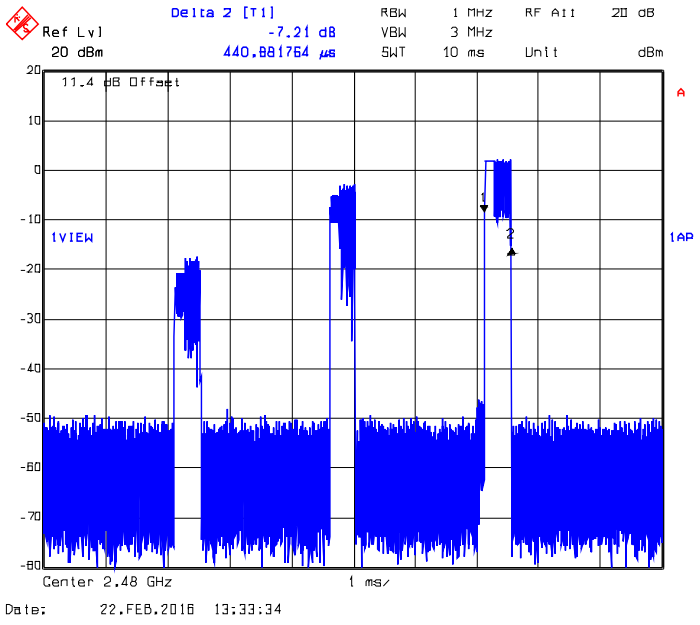
Plot 5.3.4.4.21. Time of Occupancy, π/4-DQPSK, 2DH1, 2441 MHz
Dwell Time @ 2441 MHz = 0.4409 ms



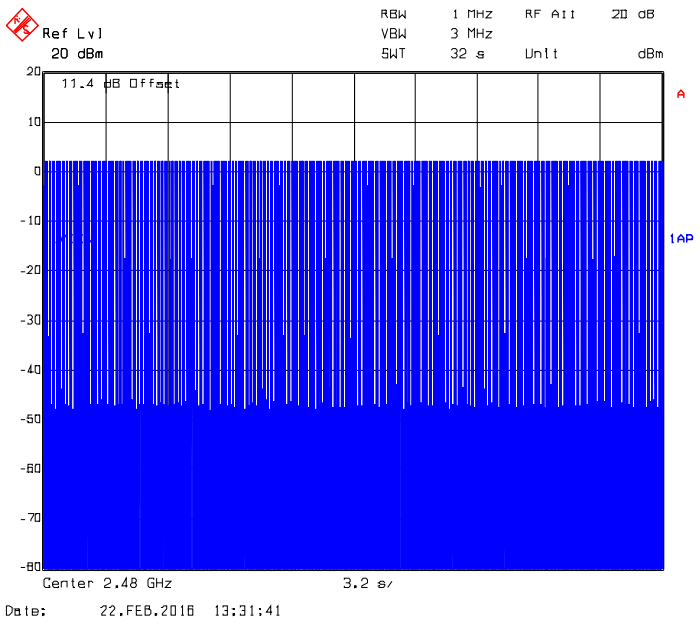
Plot 5.3.4.4.22. Time of Occupancy, π/4-DQPSK, 2DH1, 2441 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 0.4409 ms x 162 = 71.43 ms



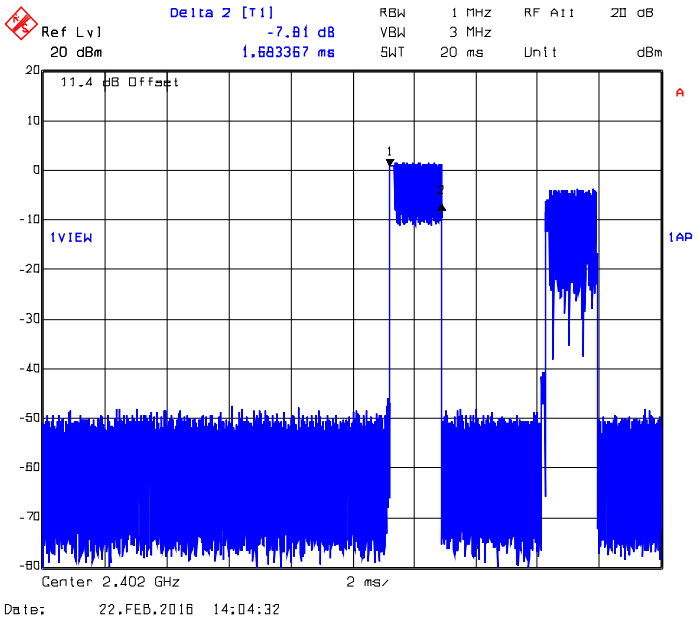
Plot 5.3.4.4.23. Time of Occupancy, π/4-DQPSK, 2DH1, 2480 MHz
Dwell Time @ 2480 MHz = 0.4409 ms



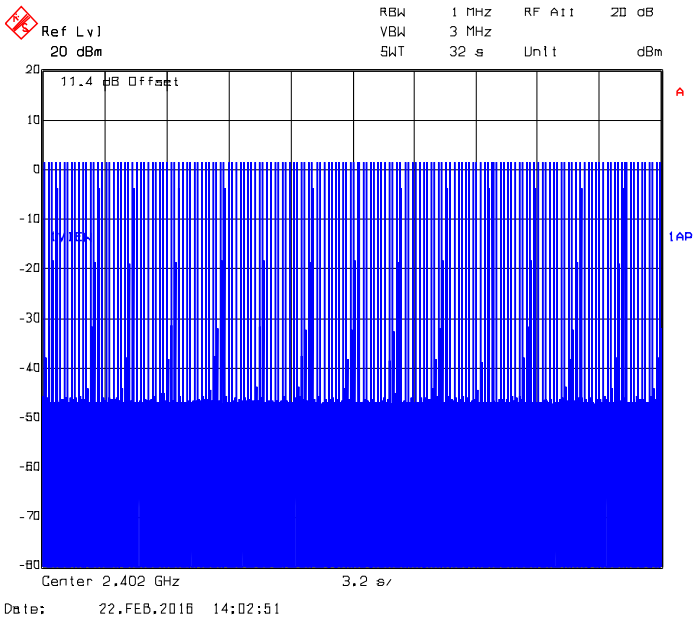
Plot 5.3.4.4.24. Time of Occupancy, π/4-DQPSK, 2DH1, 2480 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 0.4409 ms x 162 = 71.43 ms



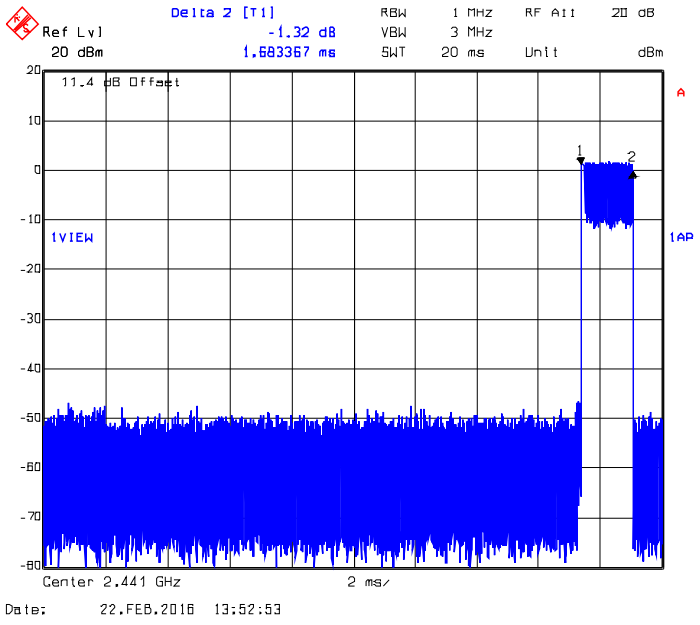
Plot 5.3.4.4.25. Time of Occupancy, π/4-DQPSK, 2DH3, 2402 MHz
Dwell Time @ 2402 MHz = 1.6834 ms



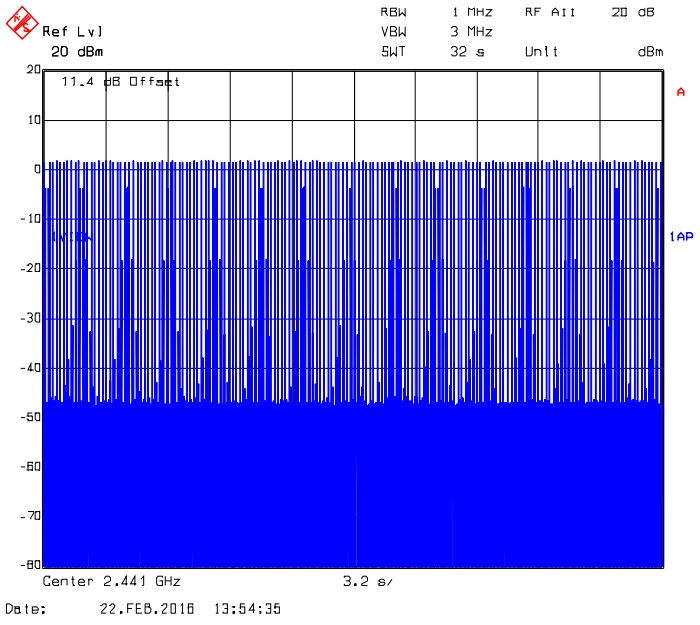
Plot 5.3.4.4.26. Time of Occupancy, π/4-DQPSK, 2DH3, 2402 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 1.6834 ms x 161 = 271.03 ms



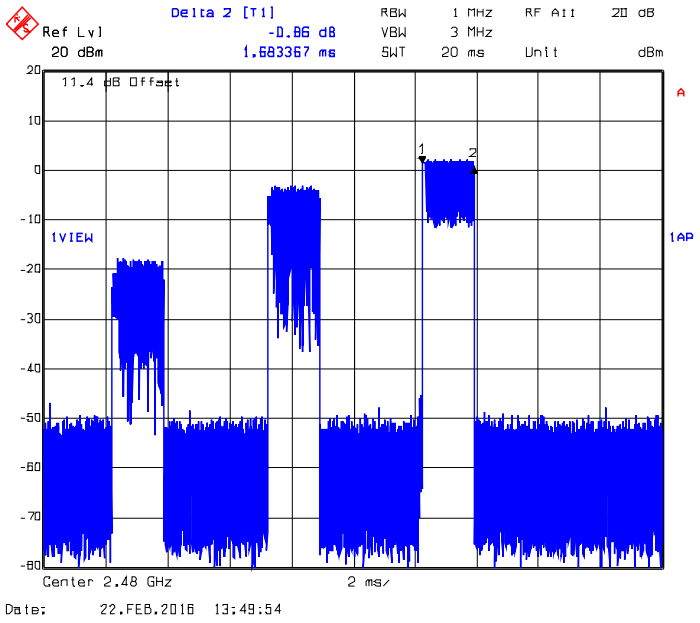
Plot 5.3.4.4.27. Time of Occupancy, π/4-DQPSK, 2DH3, 2441 MHz
Dwell Time @ 2441 MHz = 1.6834 ms



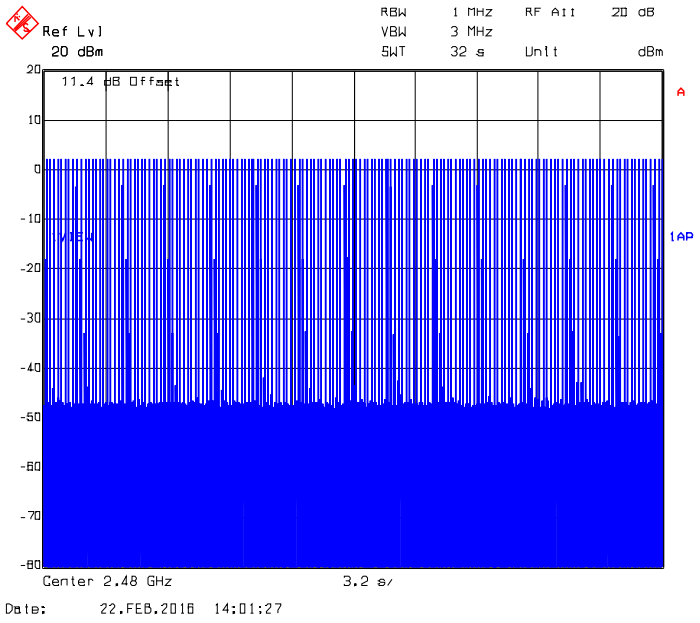
Plot 5.3.4.4.28. Time of Occupancy, π/4-DQPSK, 2DH3, 2441 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 1.6834 ms x 161 = 271.03 ms



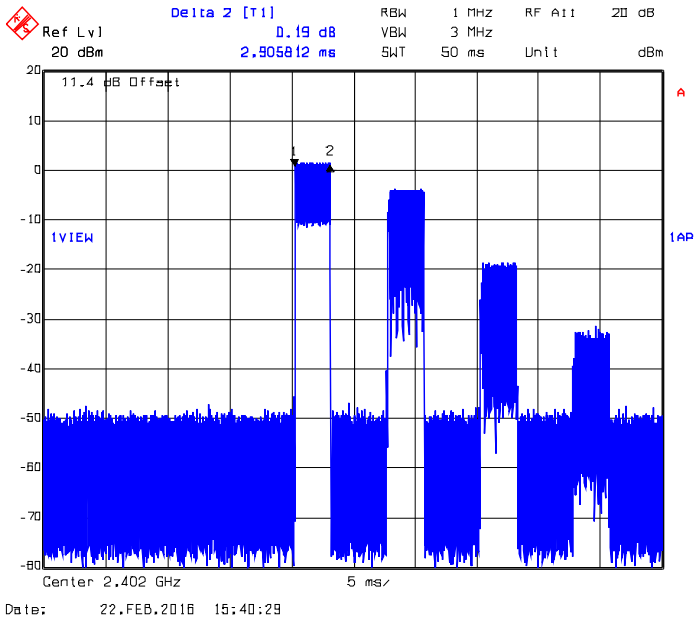
Plot 5.3.4.4.29. Time of Occupancy, π/4-DQPSK, 2DH3, 2480 MHz
Dwell Time @ 2480 MHz = 1.6834 ms



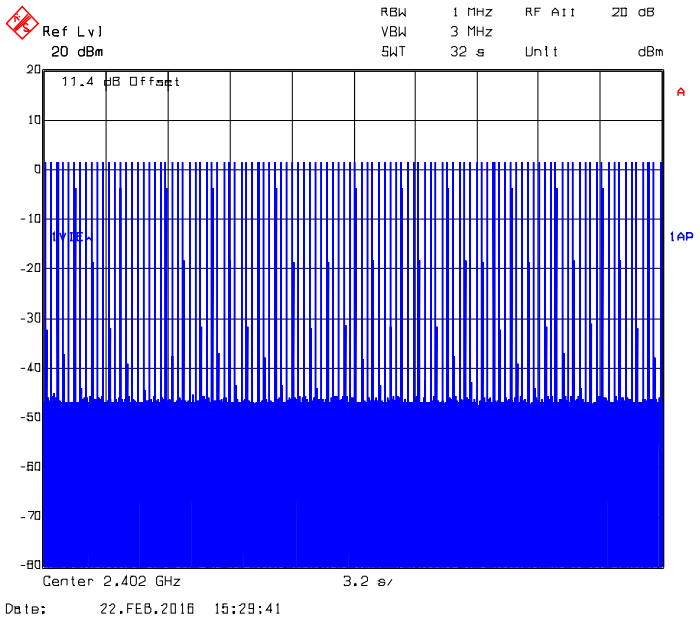
Plot 5.3.4.4.30. Time of Occupancy, π/4-DQPSK, 2DH3, 2480 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 1.6834 ms x 161 = 271.03 ms



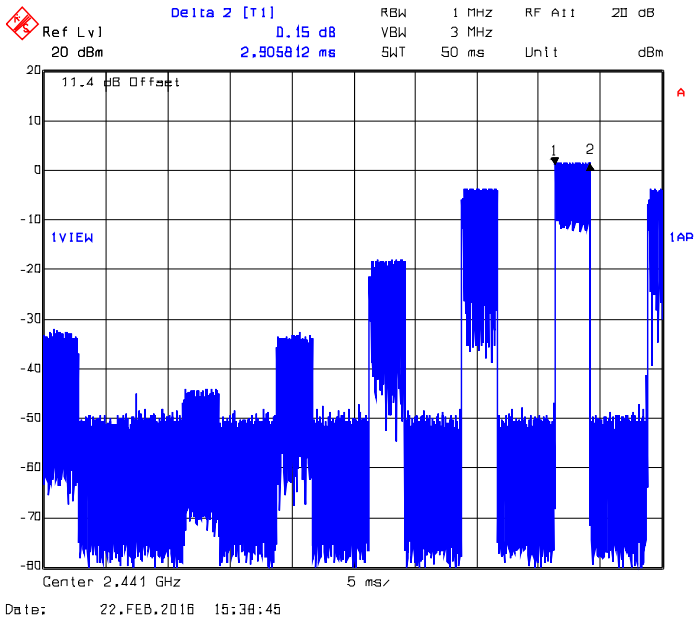
Plot 5.3.4.4.31. Time of Occupancy, π/4-DQPSK, 2DH5, 2402 MHz
Dwell Time @ 2402 MHz = 2.9058 ms



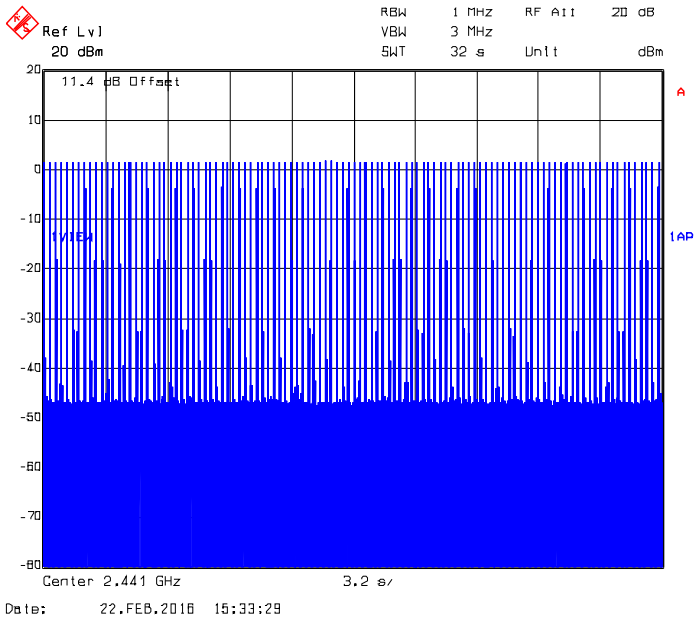
Plot 5.3.4.4.32. Time of Occupancy, π/4-DQPSK, 2DH5, 2402 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 2.9058 ms x 108 = 313.83 ms



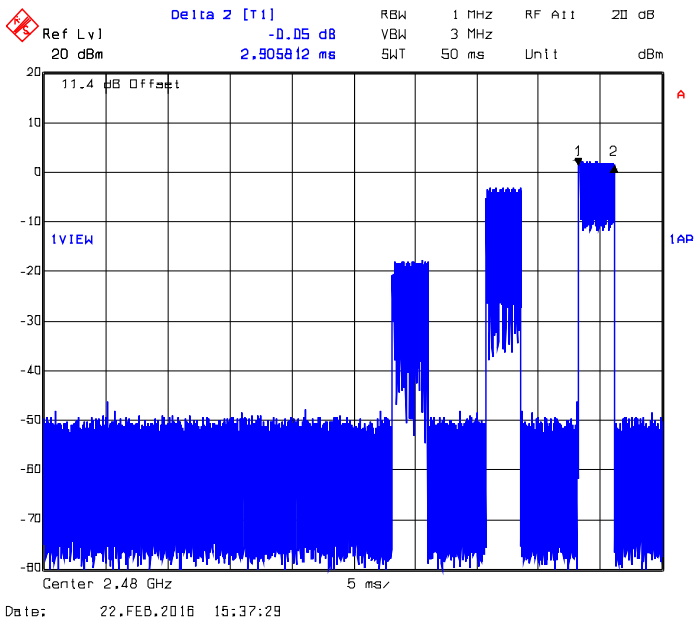
Plot 5.3.4.4.33. Time of Occupancy, π/4-DQPSK, 2DH5, 2441 MHz
Dwell Time @ 2441 MHz = 2.9058 ms



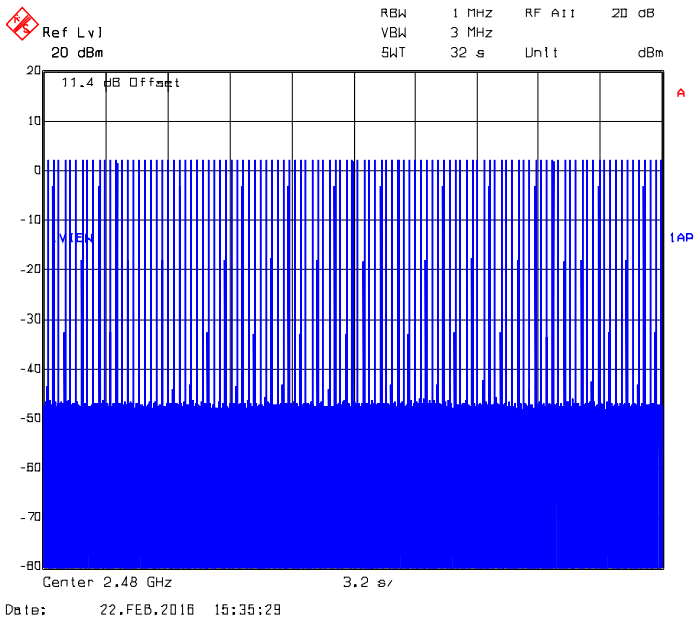
Plot 5.3.4.4.34. Time of Occupancy, π/4-DQPSK, 2DH5, 2441 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 2.9058 ms x 108 = 313.83 ms



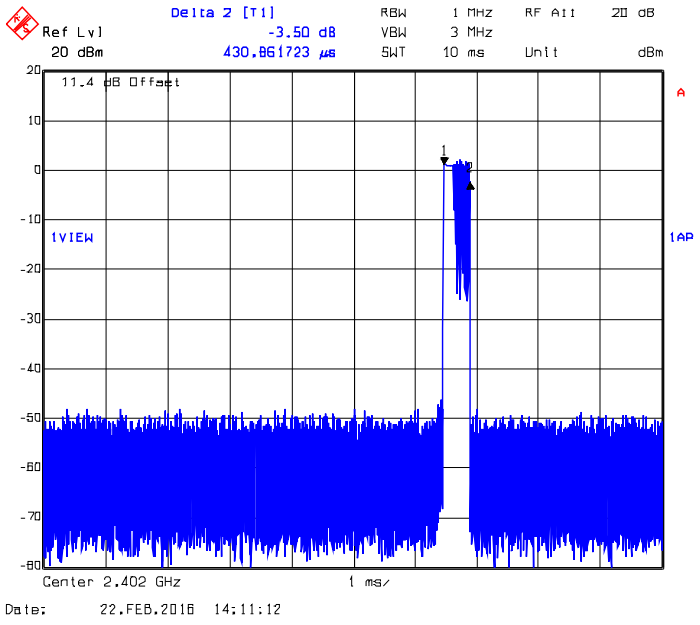
Plot 5.3.4.4.35. Time of Occupancy, π/4-DQPSK, 2DH5, 2480 MHz
Dwell Time @ 2480 MHz = 2.9058 ms



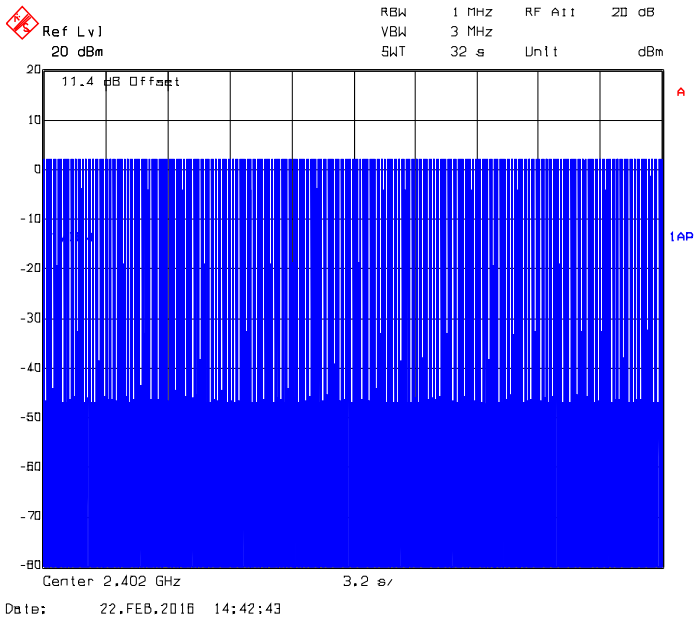
Plot 5.3.4.4.36. Time of Occupancy, π/4-DQPSK, 2DH5, 2480 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 2.9058 ms x 108 = 313.83 ms



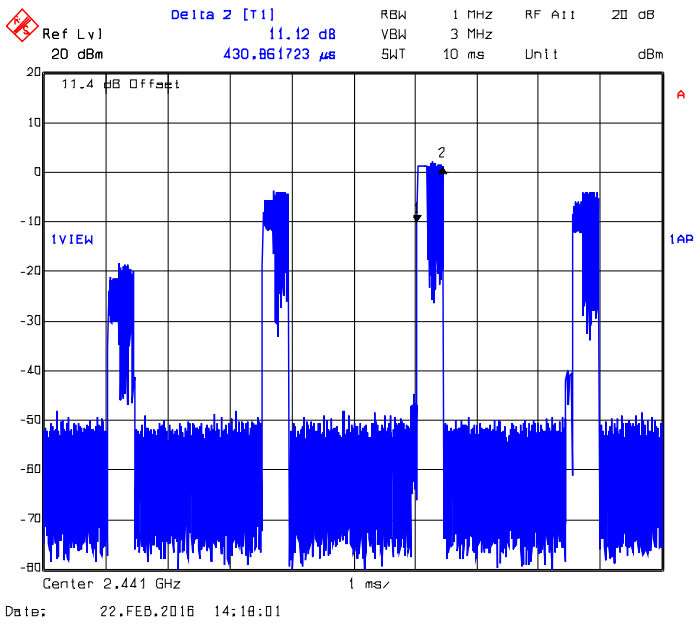
Plot 5.3.4.4.37. Time of Occupancy, 8-DPSK, 3DH1, 2402 MHz
Dwell Time @ 2402 MHz = 0.4309 ms



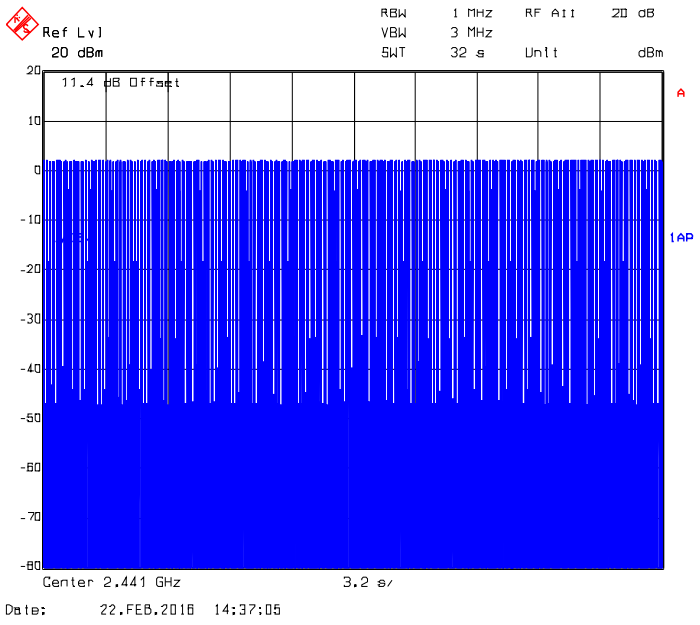
Plot 5.3.4.4.38. Time of Occupancy, 8-DPSK, 3DH1, 2402 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 0.4309 ms x 164 = 70.67 ms



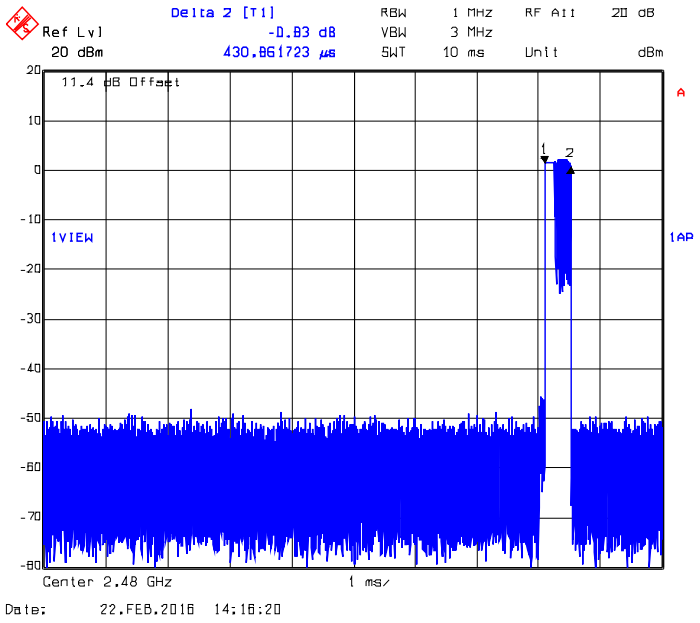
Plot 5.3.4.4.39. Time of Occupancy, 8-DPSK, 3DH1, 2441 MHz
Dwell Time @ 2441 MHz = 0.4309 ms



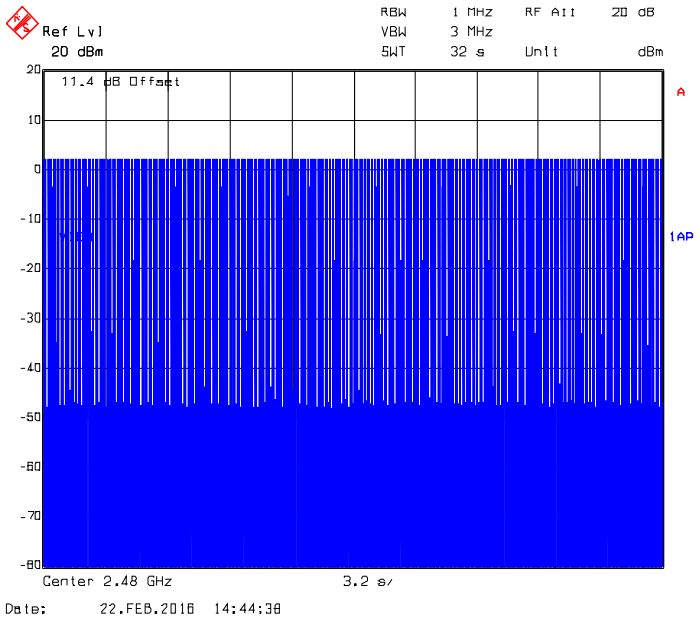
Plot 5.3.4.4.40. Time of Occupancy, 8-DPSK, 3DH1, 2441 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 0.4309 ms x 164 = 70.67 ms



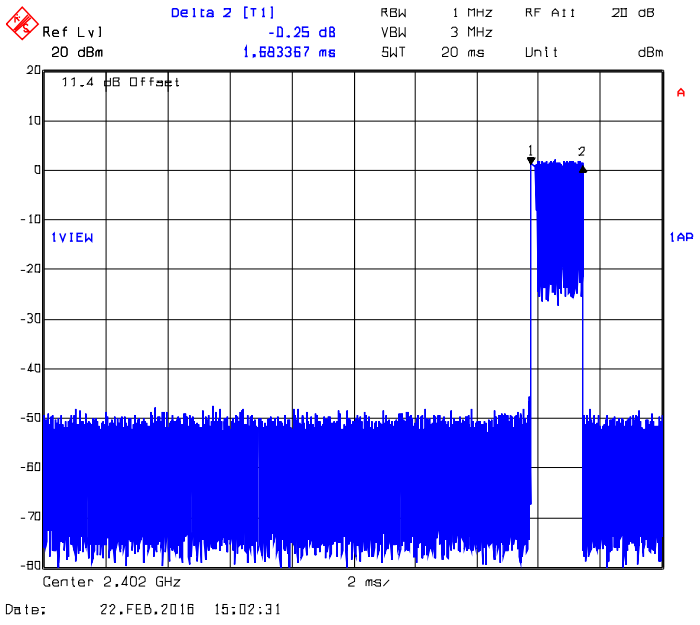
Plot 5.3.4.4.41. Time of Occupancy, 8-DPSK, 3DH1, 2480 MHz
Dwell Time @ 2480 MHz = 0.4309 ms



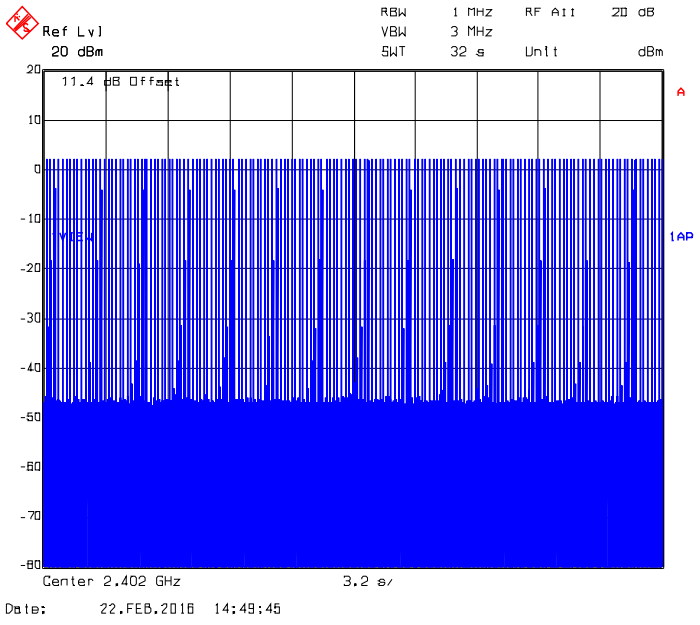
Plot 5.3.4.4.42. Time of Occupancy, 8-DPSK, 3DH1, 2480 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 0.4309 ms x 164 = 70.67 ms



Plot 5.3.4.4.43. Time of Occupancy, 8-DPSK, 3DH3, 2402 MHz
Dwell Time @ 2402 MHz = 1.6834 ms

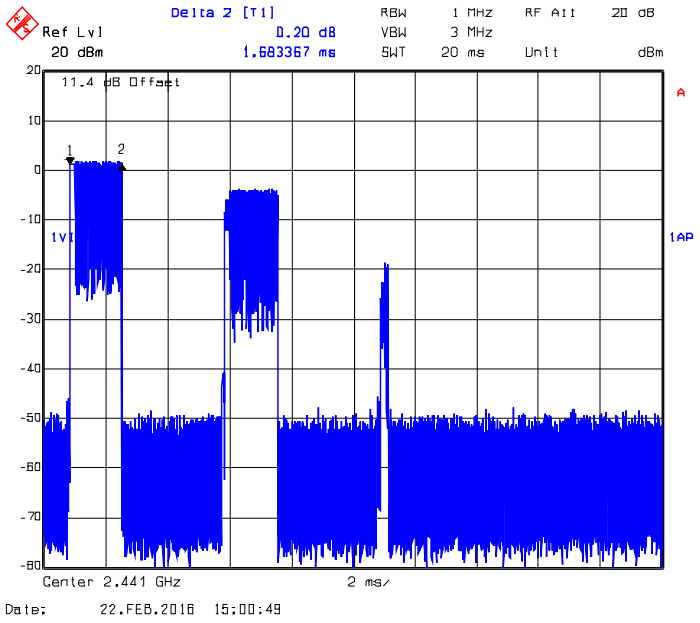


Plot 5.3.4.4.44. Time of Occupancy, 8-DPSK, 3DH3, 2402 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 1.6834 ms x 161 = 271.03 ms

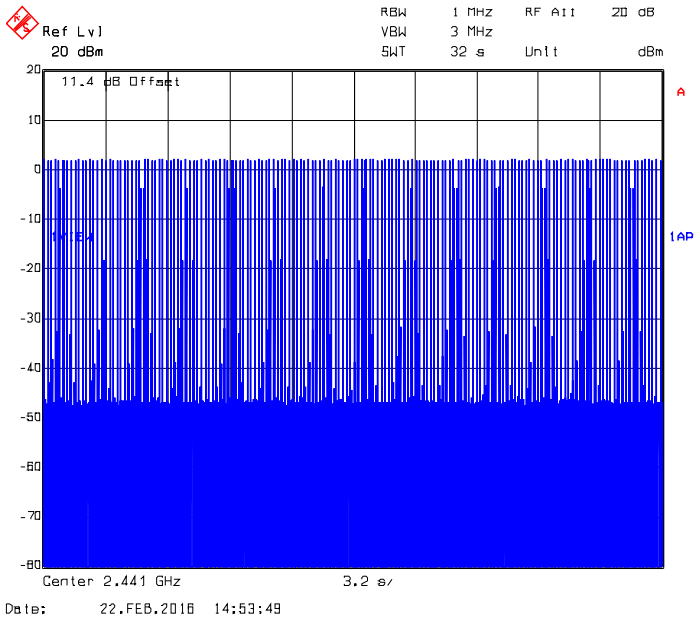


All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

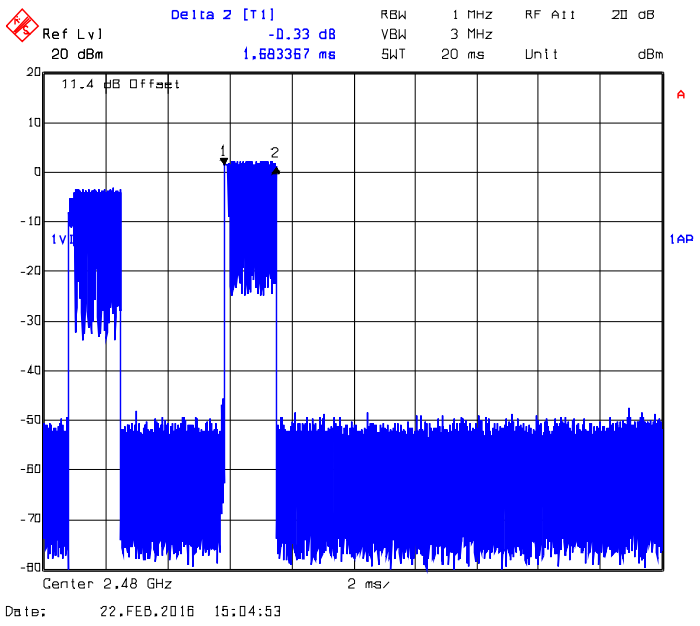
Plot 5.3.4.4.45. Time of Occupancy, 8-DPSK, 3DH3, 2441 MHz
Dwell Time @ 2441 MHz = 1.6834 ms



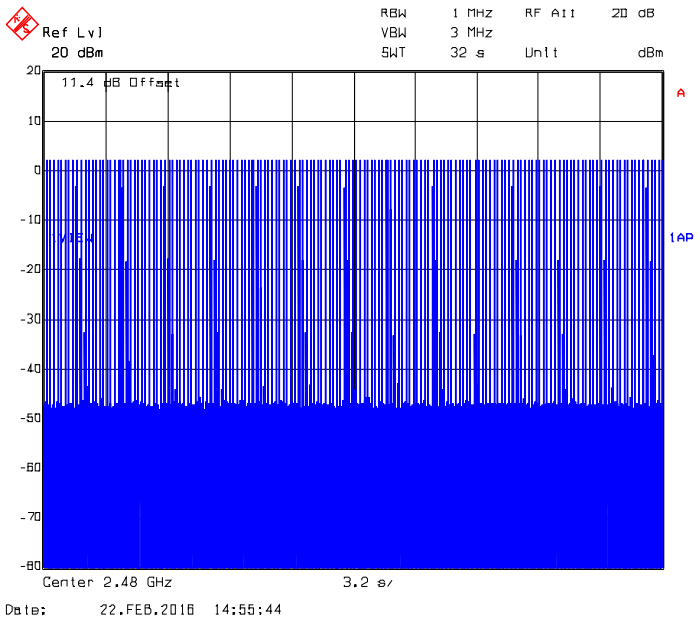
Plot 5.3.4.4.46. Time of Occupancy, 8-DPSK, 3DH3, 2441 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 1.6834 ms x 161 = 271.03 ms



Plot 5.3.4.4.47. Time of Occupancy, 8-DPSK, 3DH3, 2480 MHz
Dwell Time @ 2480 MHz = 1.6834 ms

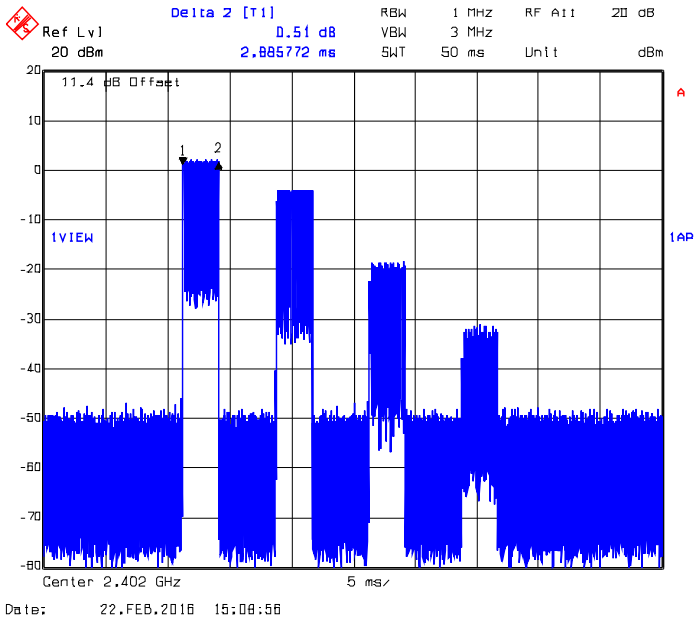


Plot 5.3.4.4.48. Time of Occupancy, 8-DPSK, 3DH3, 2480 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 1.6834 ms x 161 = 271.03 ms

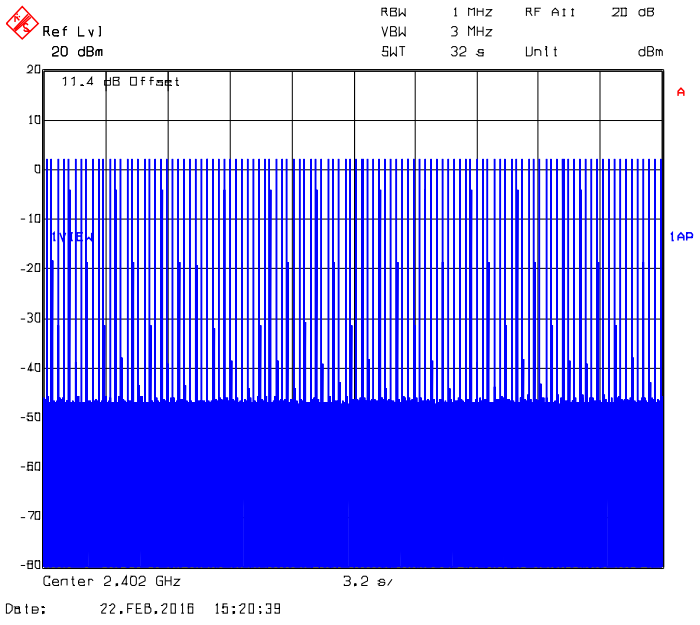


All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

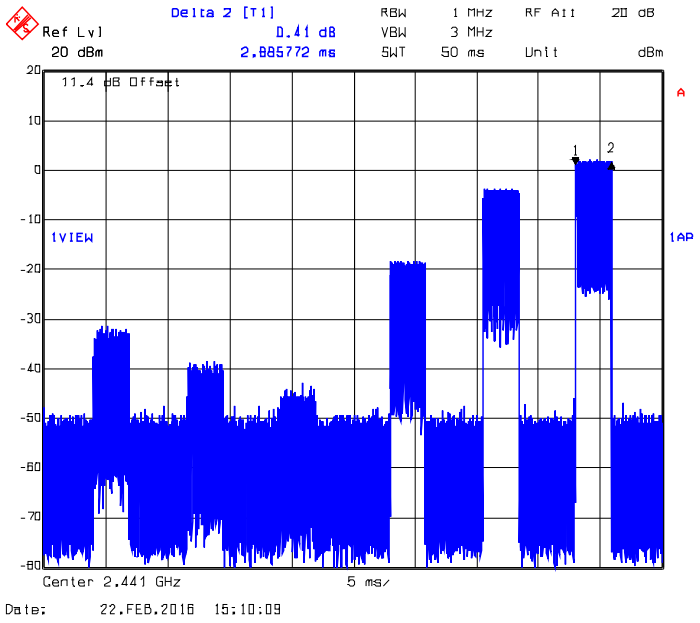
Plot 5.3.4.4.49. Time of Occupancy, 8-DPSK, 3DH5, 2402 MHz
Dwell Time @ 2402 MHz = 2.8858 ms



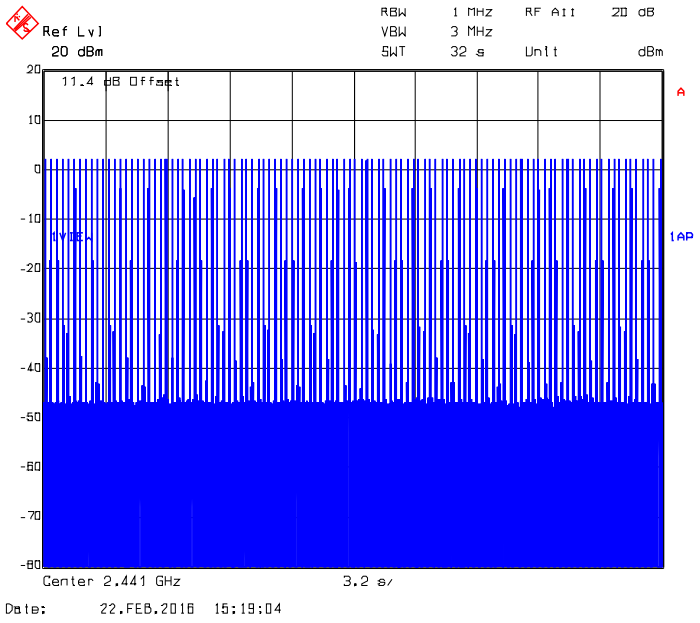
Plot 5.3.4.4.50. Time of Occupancy, 8-DPSK, 3DH5, 2402 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 2.8858 ms x 107 = 308.78 ms



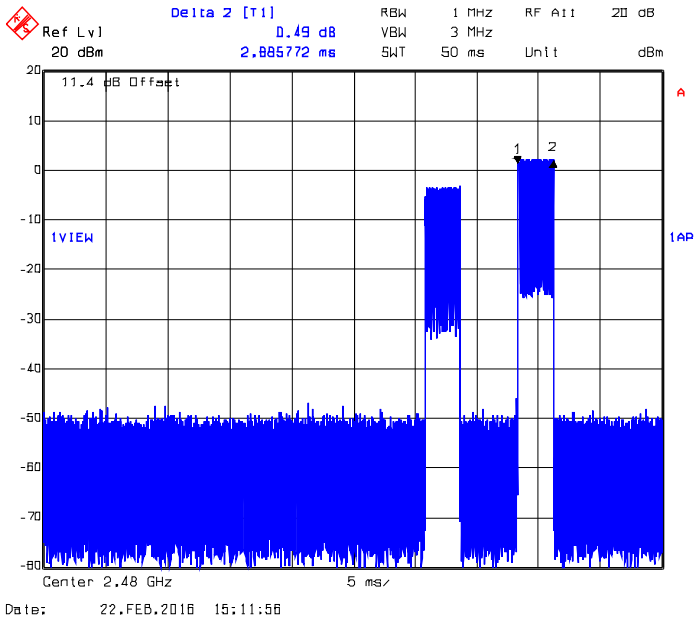
Plot 5.3.4.4.51. Time of Occupancy, 8-DPSK, 3DH5, 2441 MHz
Dwell Time @ 2441 MHz = 2.8858 ms



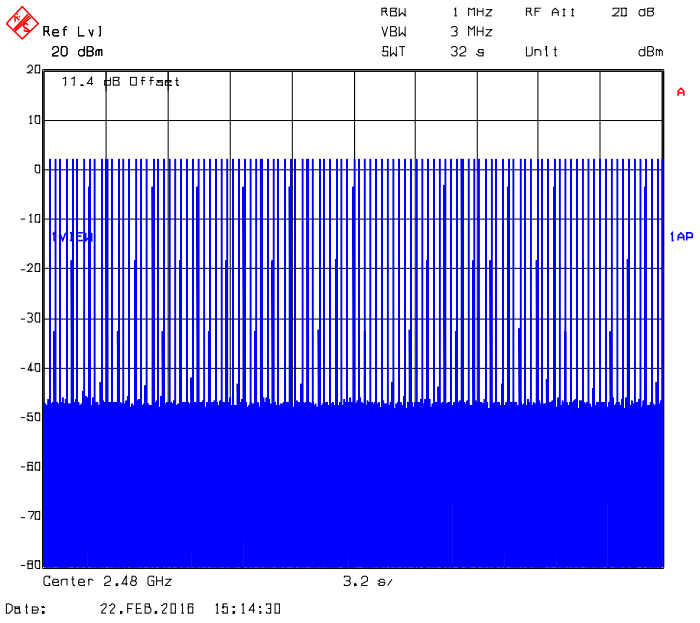
Plot 5.3.4.4.52. Time of Occupancy, 8-DPSK, 3DH5, 2441 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 2.8858 ms x 107 = 308.78 ms



Plot 5.3.4.4.53. Time of Occupancy, 8-DPSK, 3DH5, 2480 MHz
Dwell Time @ 2480 MHz = 2.8858 ms



Plot 5.3.4.4.54. Time of Occupancy, 8-DPSK, 3DH5, 2480 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a period) = 2.8858 ms x 107 = 308.78 ms



5.4. PEAK CONDUCTED OUTPUT POWER [§ 15.247(b)]

5.4.1. Limits

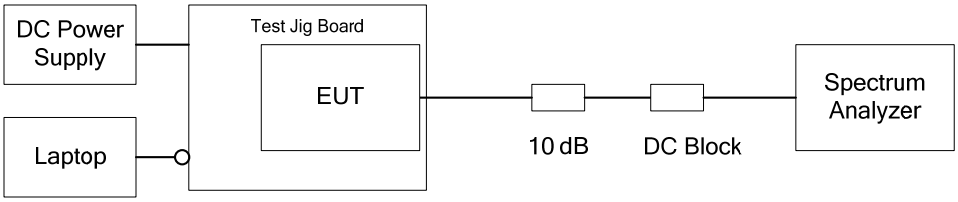
§15.247(b)(1): For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

§15.247(b)(4): The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.4.2. Method of Measurements

FCC Public Notice DA 00-705 and ANSI C63.10.

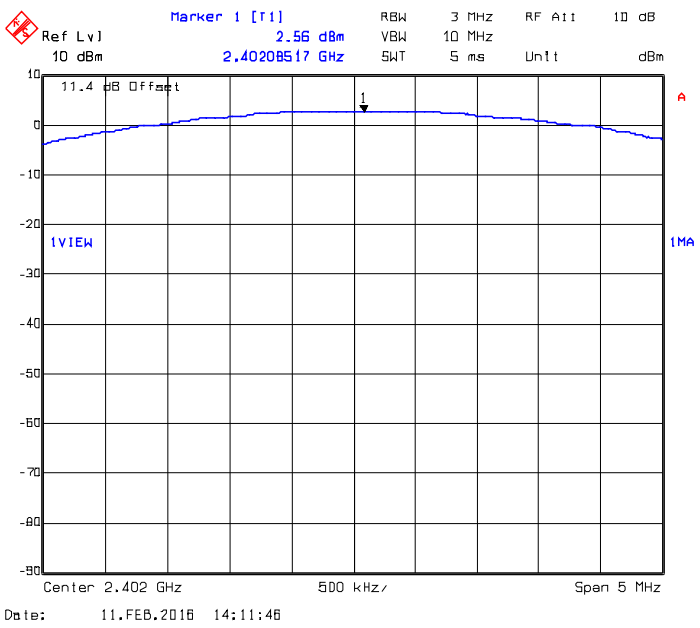
5.4.3. Test Arrangement



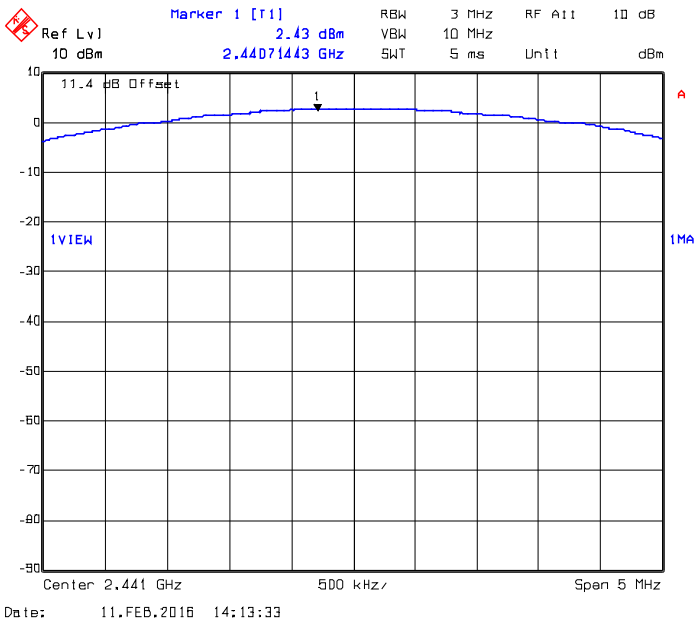
5.4.4. Test Data

Mode	Packet	CFG Packet Type	CFG Packet Size	TXDATA1 Power (Ext, Int)	Peak Conducted Output Power (dBm)		
					Ch 0 2402 MHz	Ch 39 2441 MHz	Ch 78 2480 MHz
GFSK	DH1	15	26	255, 53	2.56	2.43	2.83
	DH3	15	183	255, 53	2.56	2.43	2.96
	DH5	15	339	255, 53	2.43	2.29	2.83
π/4-DQPSK	2DH1	30	54	255, 55	2.29	2.29	2.69
	2DH3	30	367	255, 55	2.43	2.43	2.69
	2DH5	30	679	255, 55	2.29	2.43	2.69
8-DPSK	3DH1	31	83	255, 55	2.69	2.69	3.09
	3DH3	31	552	255, 55	2.69	2.69	3.09
	3DH5	31	1021	255, 55	2.69	2.69	3.09

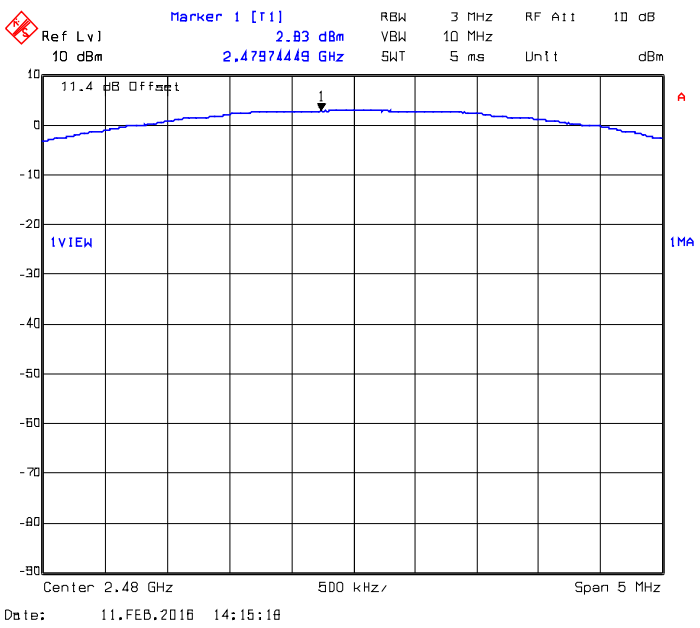
Plot 5.4.4.1. Peak Conducted Output Power, GFSK, DH1, CH 0, 2402 MHz



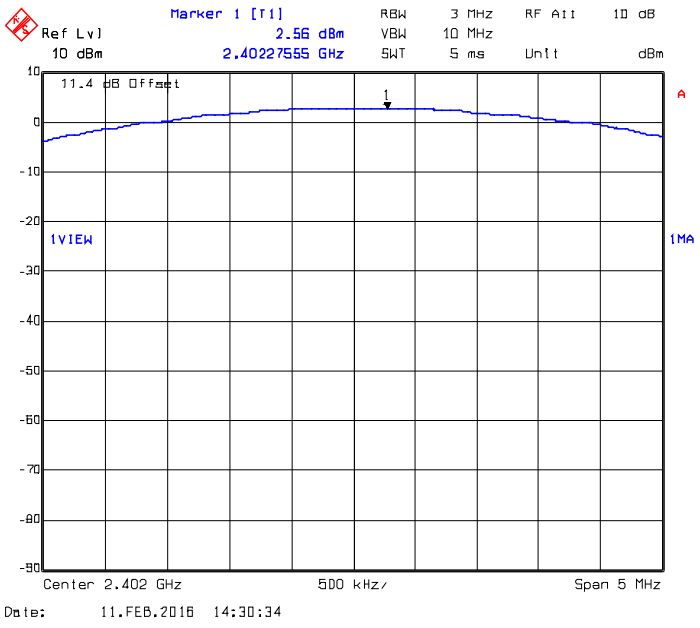
Plot 5.4.4.2. Peak Conducted Output Power, GFSK, DH1, CH 39, 2441 MHz



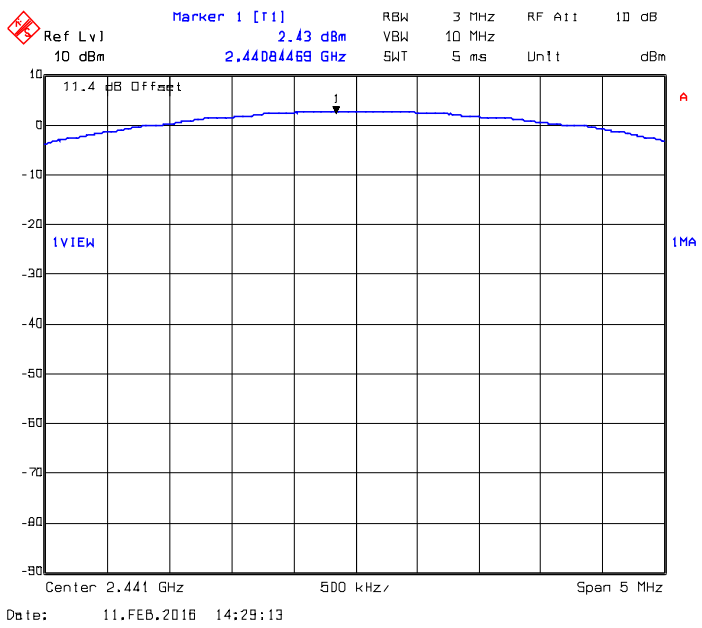
Plot 5.4.4.3. Peak Conducted Output Power, GFSK, DH1, CH 78, 2480 MHz



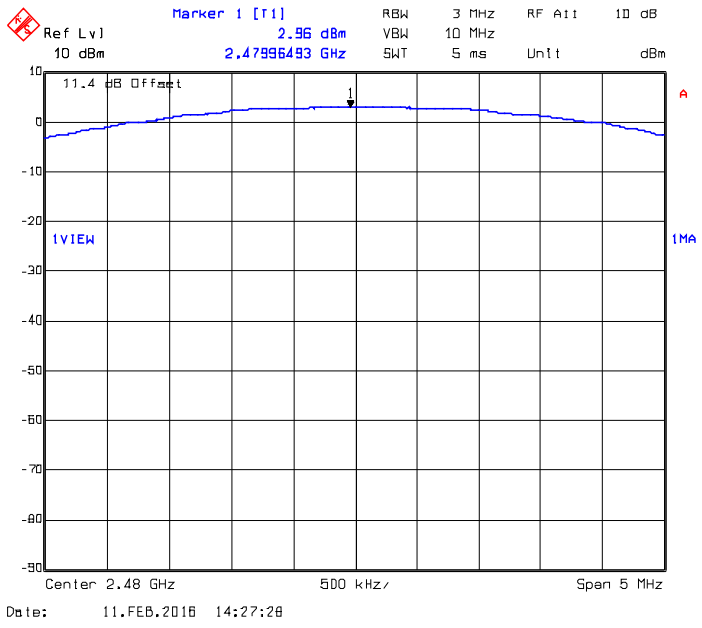
Plot 5.4.4.4. Peak Conducted Output Power, GFSK, DH3, CH 0, 2402 MHz



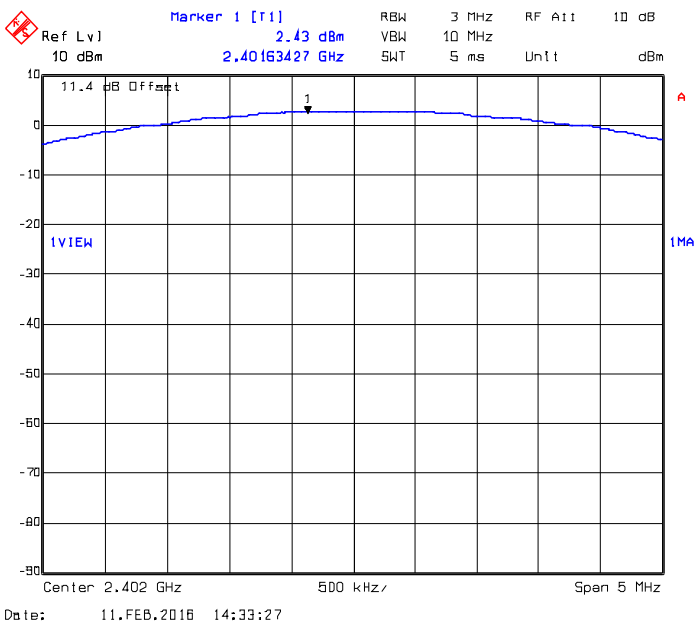
Plot 5.4.4.5. Peak Conducted Output Power, GFSK, DH3, CH 39, 2441 MHz



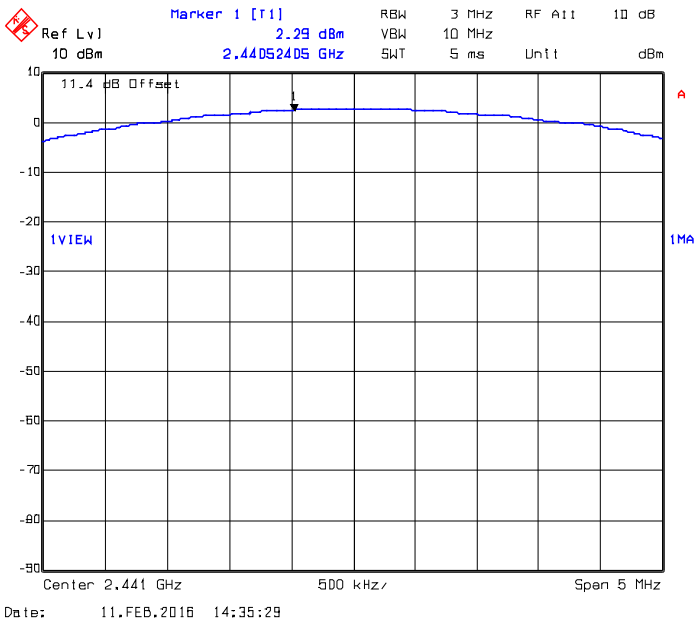
Plot 5.4.4.6. Peak Conducted Output Power, GFSK, DH3, CH 78, 2480 MHz



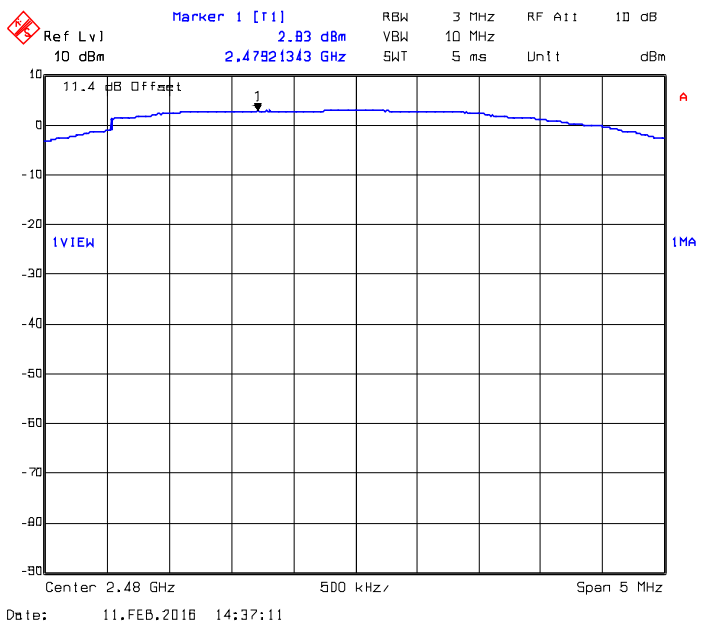
Plot 5.4.4.7. Peak Conducted Output Power, GFSK, DH5, CH 0, 2402 MHz



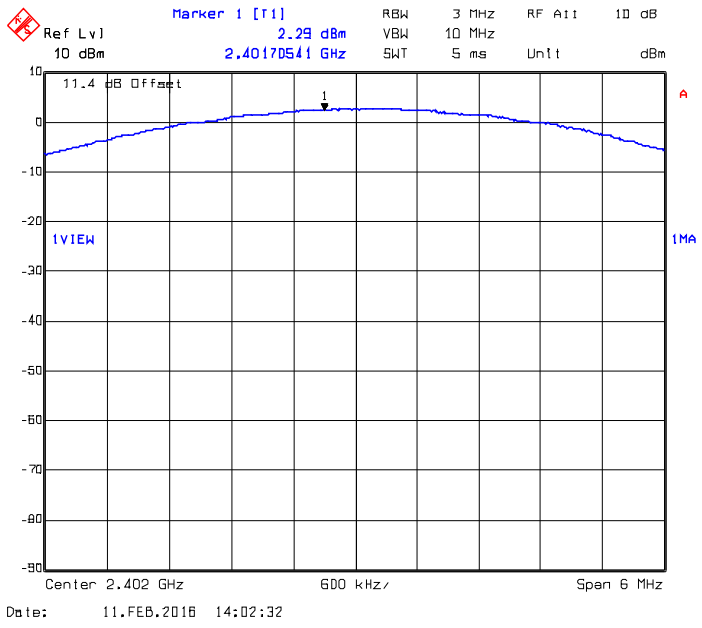
Plot 5.4.4.8. Peak Conducted Output Power, GFSK, DH5, CH 39, 2441 MHz



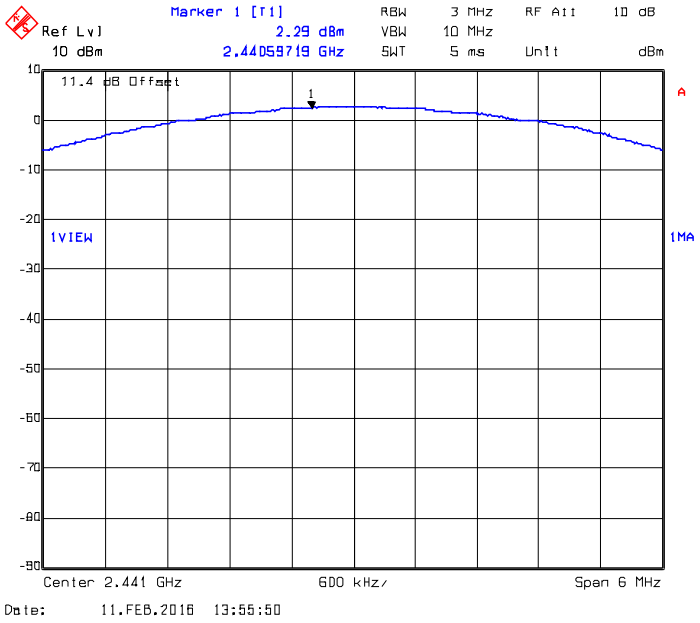
Plot 5.4.4.9. Peak Conducted Output Power, GFSK, DH5, CH 78, 2480 MHz



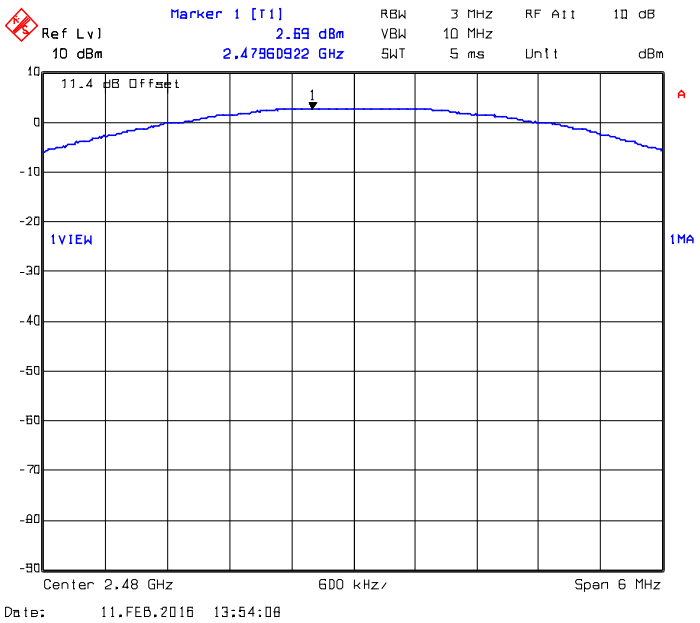
Plot 5.4.4.10. Peak Conducted Output Power, π/4-DQPSK, 2DH1, CH 0, 2402 MHz



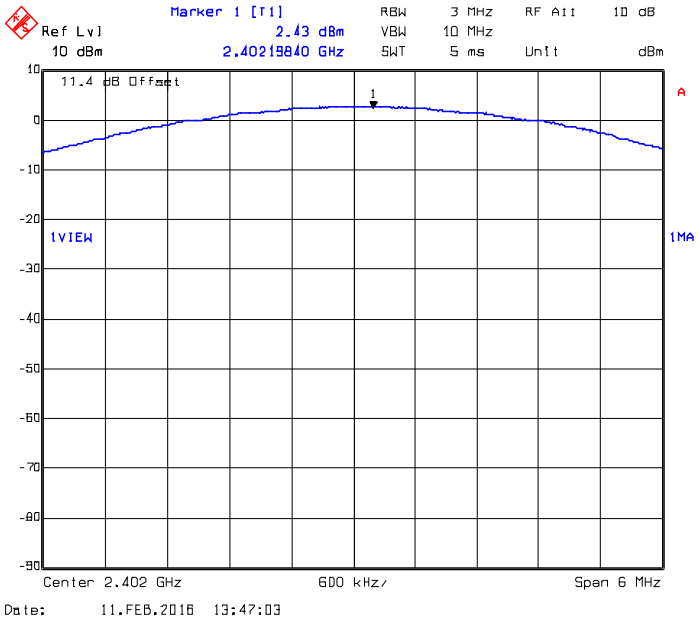
Plot 5.4.4.11. Peak Conducted Output Power, π/4-DQPSK, 2DH1, CH 39, 2441 MHz



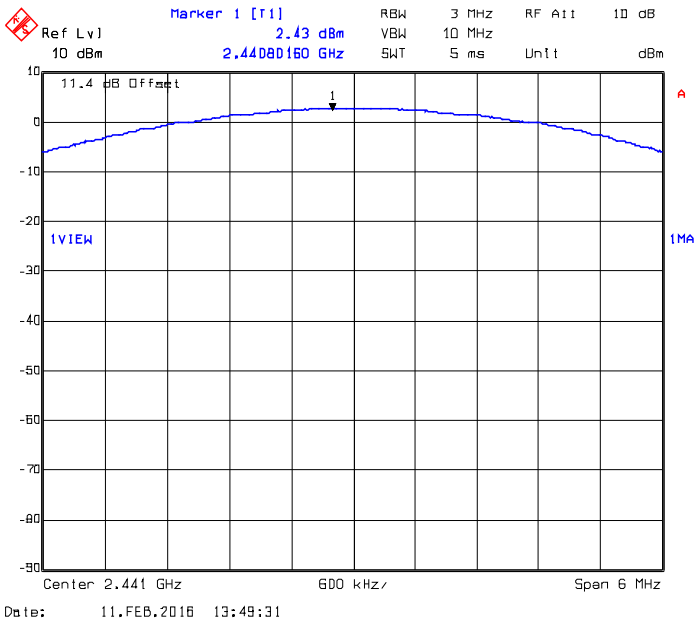
Plot 5.4.4.12. Peak Conducted Output Power, π/4-DQPSK, 2DH1, CH 78, 2480 MHz



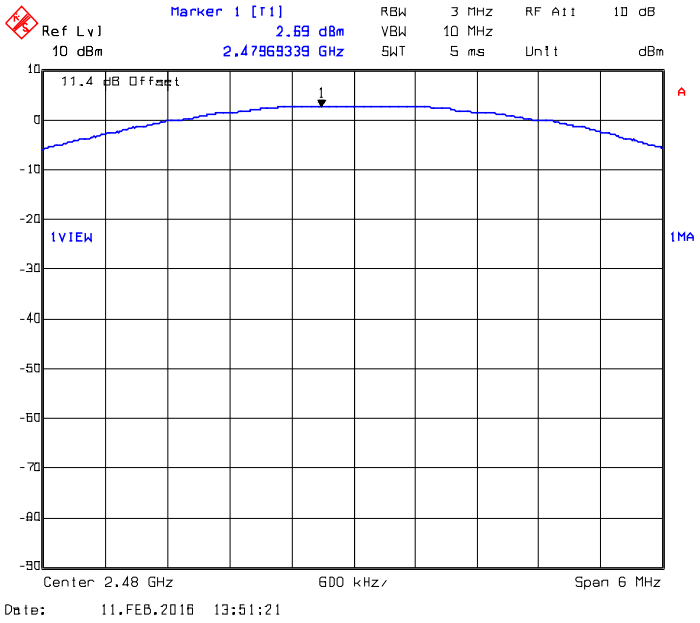
Plot 5.4.4.13. Peak Conducted Output Power, π/4-DQPSK, 2DH3, CH 0, 2402 MHz



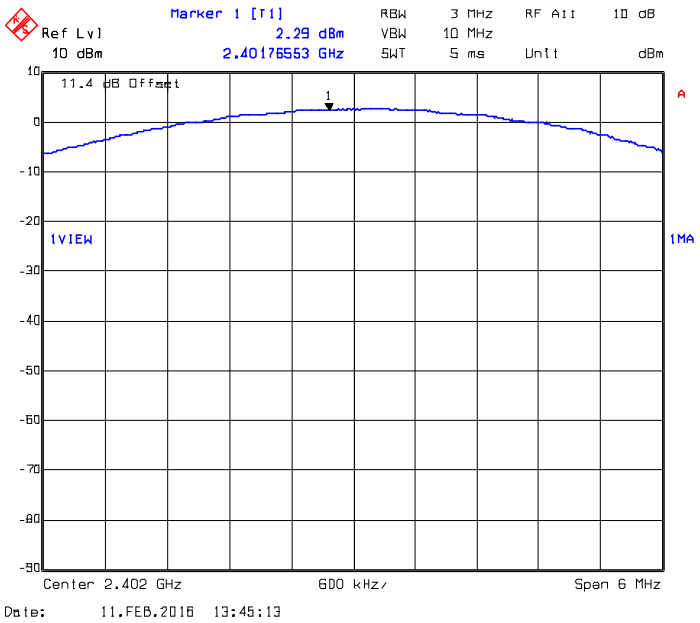
Plot 5.4.4.14. Peak Conducted Output Power, π/4-DQPSK, 2DH3, CH 39, 2441 MHz



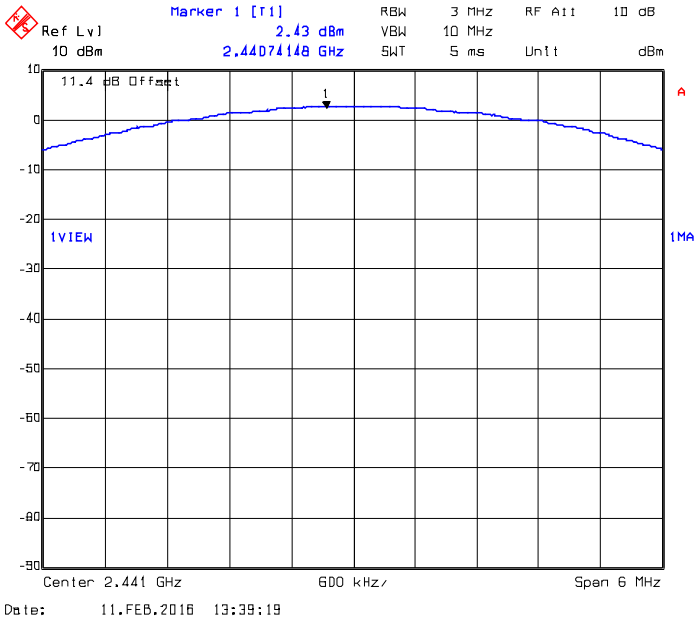
Plot 5.4.4.15. Peak Conducted Output Power, π/4-DQPSK, 2DH3, CH 78, 2480 MHz



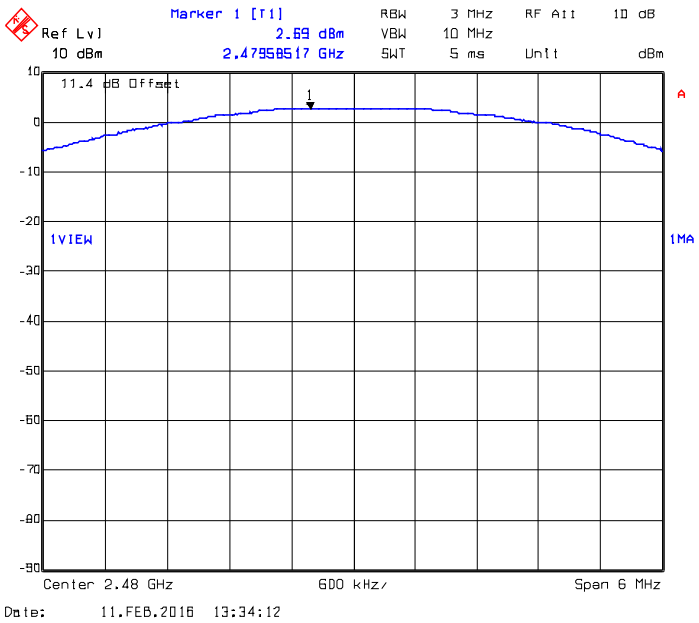
Plot 5.4.4.16. Peak Conducted Output Power, π/4-DQPSK, 2DH5, CH 0, 2402 MHz



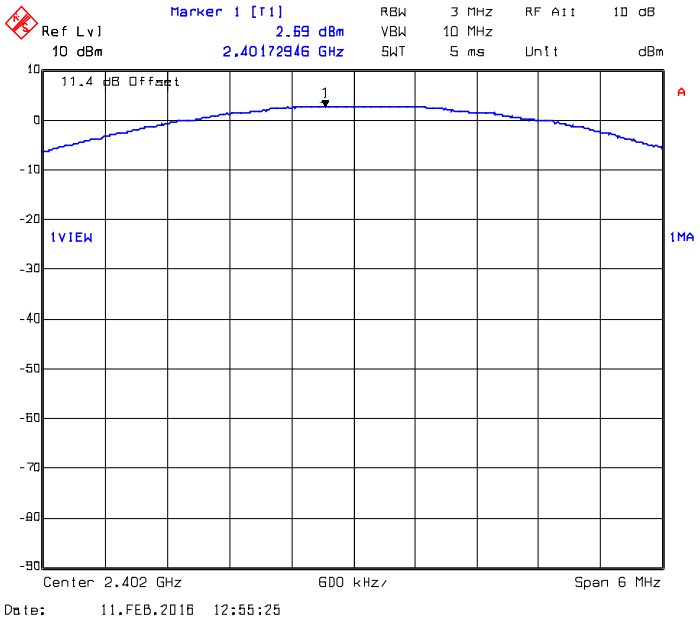
Plot 5.4.4.17. Peak Conducted Output Power, π/4-DQPSK, 2DH5, CH 39, 2441 MHz



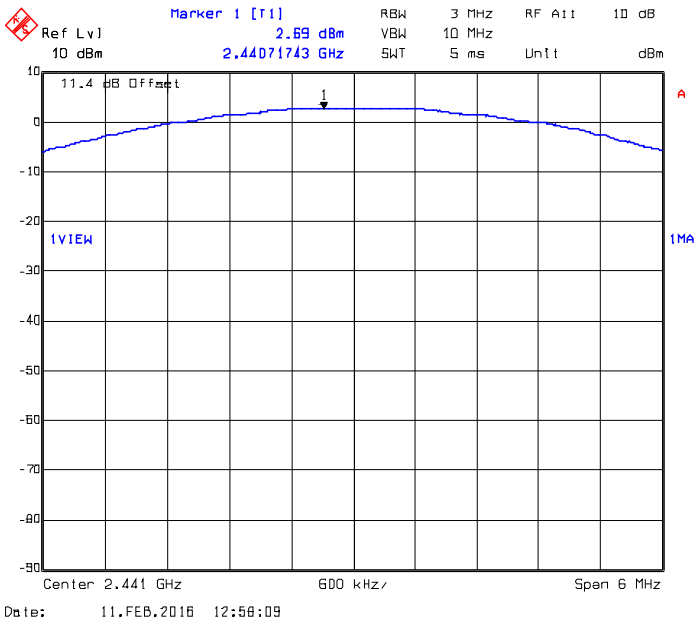
Plot 5.4.4.18. Peak Conducted Output Power, π/4-DQPSK, 2DH5, CH 78, 2480 MHz



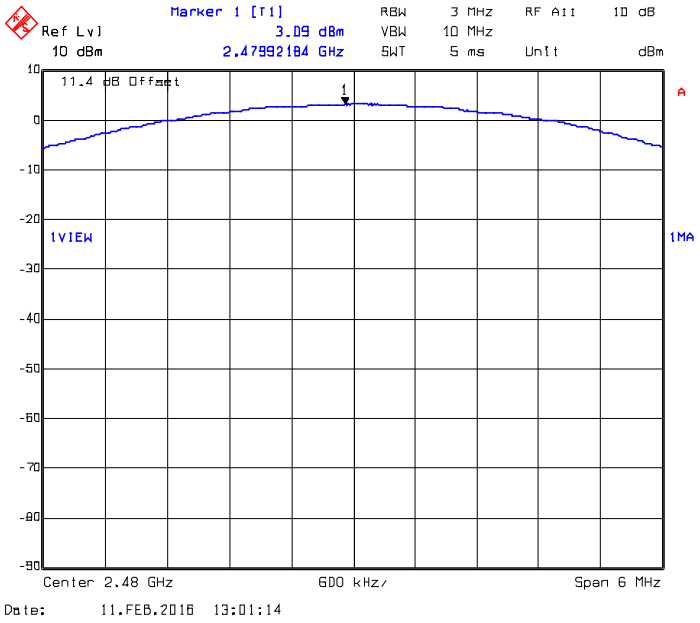
Plot 5.4.4.19. Peak Conducted Output Power, 8-DPSK, 3DH1, CH 0, 2402 MHz



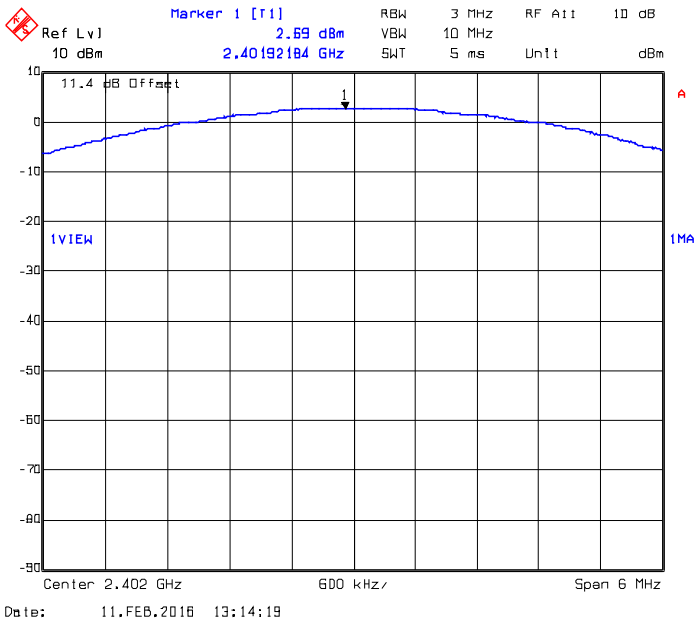
Plot 5.4.4.20. Peak Conducted Output Power, 8-DPSK, 3DH1, CH 39, 2441 MHz



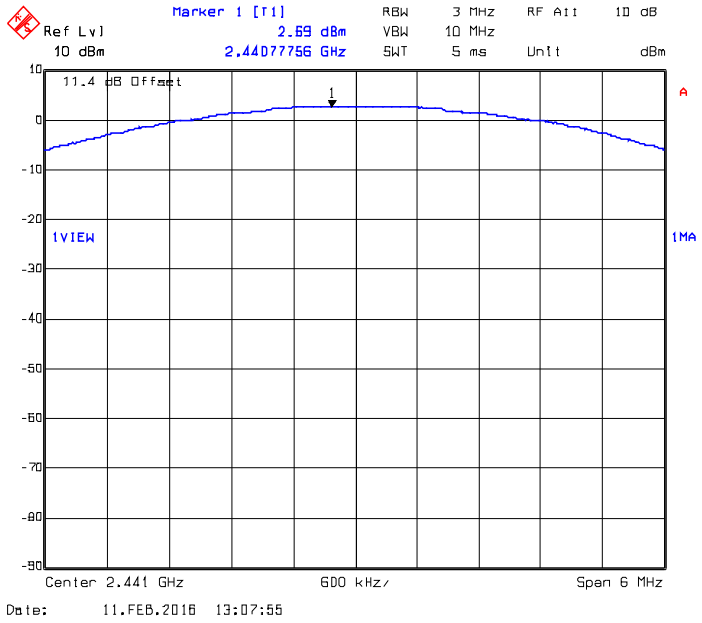
Plot 5.4.4.21. Peak Conducted Output Power, 8-DPSK, 3DH1, CH 78, 2480 MHz



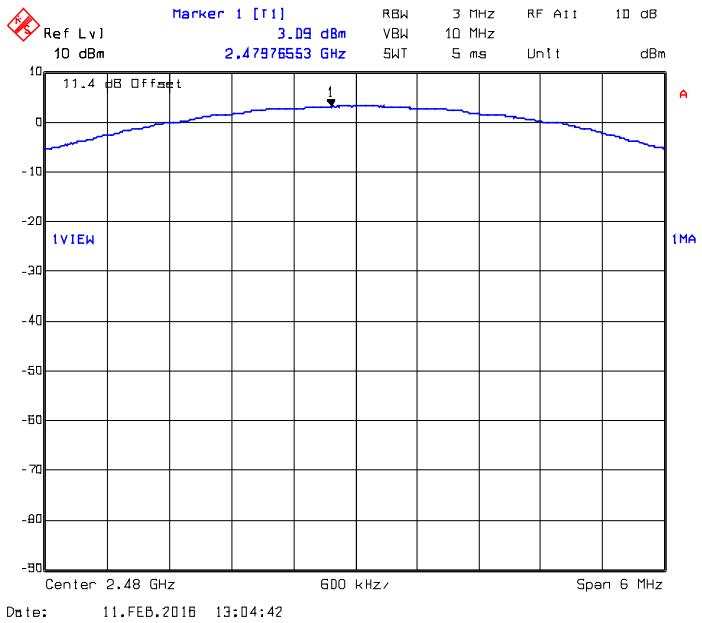
Plot 5.4.4.22. Peak Conducted Output Power, 8-DPSK, 3DH3, CH 0, 2402 MHz



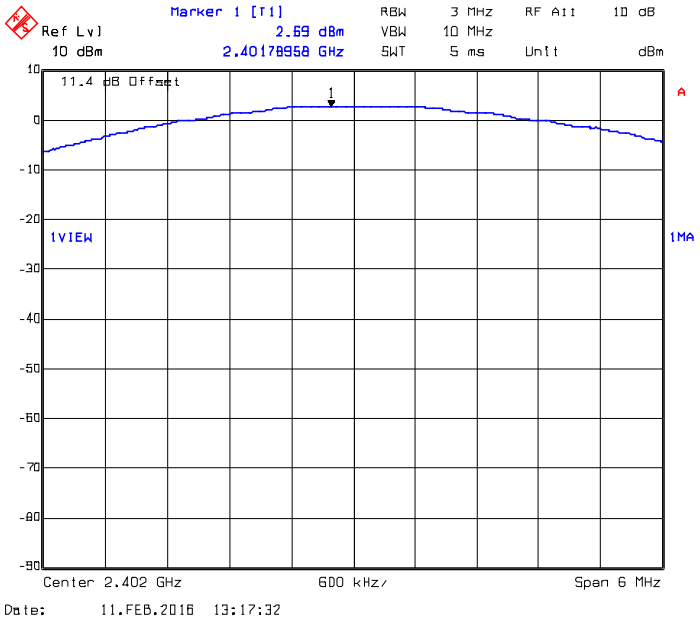
Plot 5.4.4.23. Peak Conducted Output Power, 8-DPSK, 3DH3, CH 39, 2441 MHz



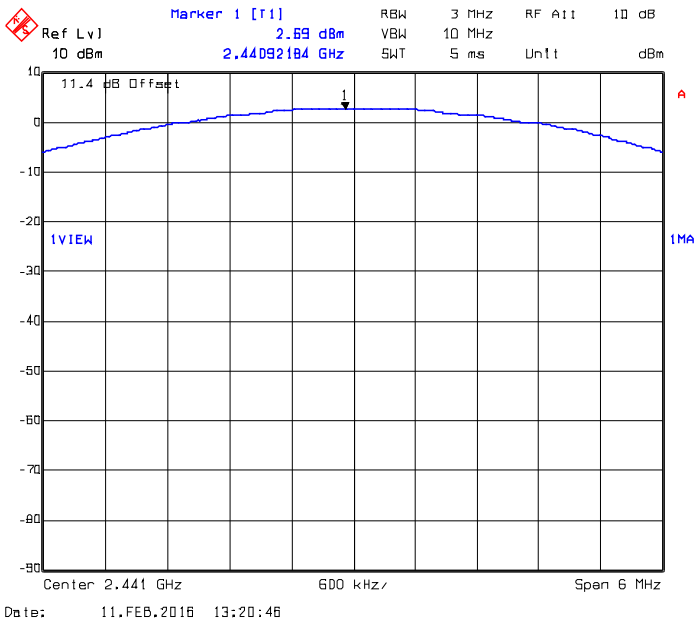
Plot 5.4.4.24. Peak Conducted Output Power, 8-DPSK, 3DH3, CH 78, 2480 MHz



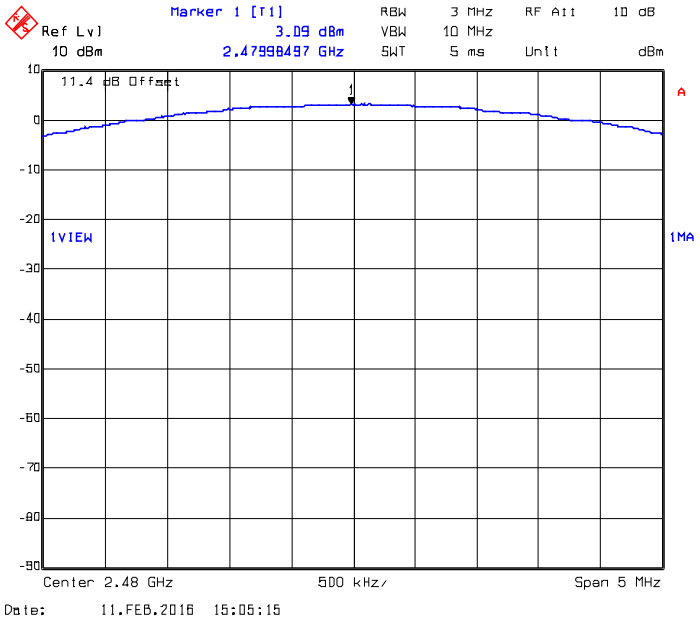
Plot 5.4.4.25. Peak Conducted Output Power, 8-DPSK, 3DH5, CH 0, 2402 MHz



Plot 5.4.4.26. Peak Conducted Output Power, 8-DPSK, 3DH5, CH 39, 2441 MHz



Plot 5.4.4.27. Peak Conducted Output Power, 8-DPSK, 3DH5, CH 78, 2480 MHz



5.5. TRANSMITTER SPURIOUS RADIATED EMISSIONS AT 3 METERS [§§ 15.247(d), 15.209 & 15.205]

5.5.1. Limit

§ 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)).

Section 15.205(a) - Restricted Bands of Operation

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
[1] 0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	([2])
13.36–13.41.			

[1] Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.
[2] Above 38.6

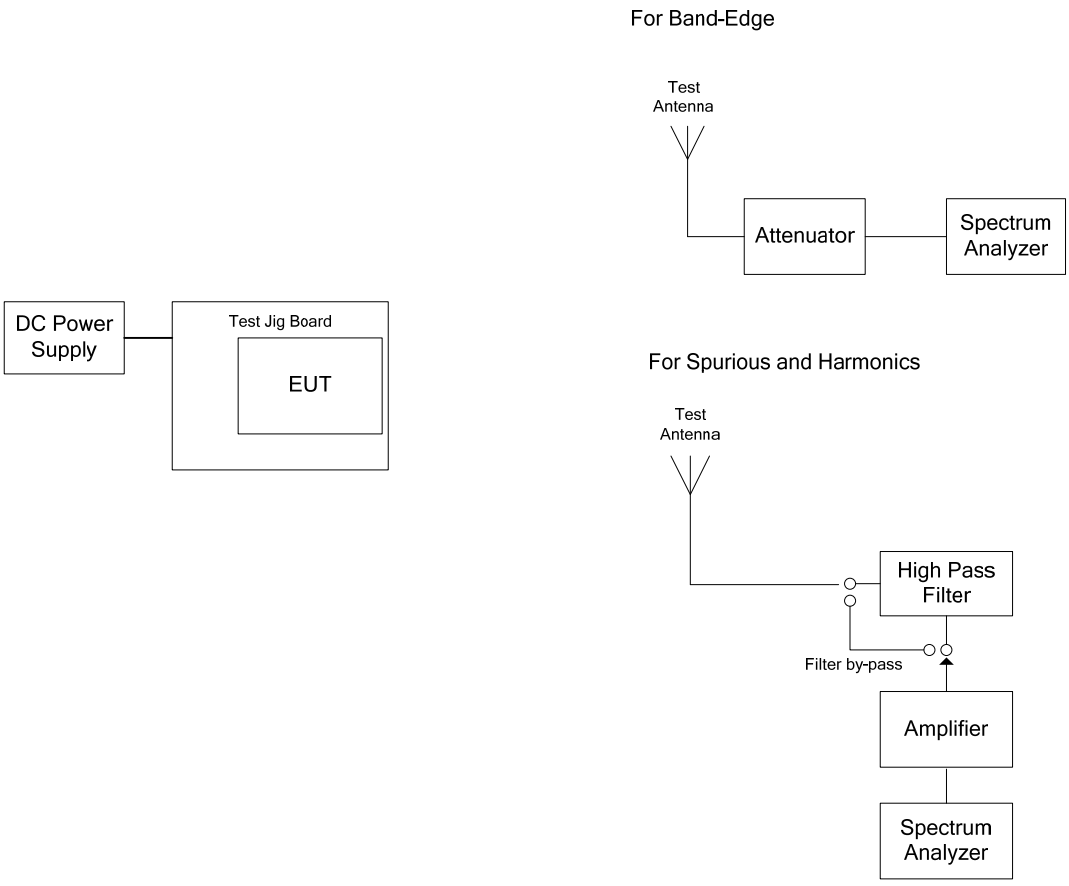
Section 15.209(a) - Field Strength Limits within Restricted Frequency Bands

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2,400 / F (kHz)	300
0.490 - 1.705	24,000 / F (kHz)	30
1.705 - 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

5.5.2. Method of Measurements

FCC Public Notice DA 00-705, ANSI C63.10 and ANSI 63.4 procedures.

5.5.3. Test Arrangement



5.5.4. Test Data

Remark(s):

- All spurious emissions that are in excess of 20 dB below the specified limit shall be recorded.
- EUT shall be tested in three orthogonal positions.
- The following test results represent the worst-case derived from exploratory tests.

5.5.4.1. EUT Operating in GFSK DH5

5.5.4.1.1. Spurious Radiated Emissions

Fundamental Frequency:	2402 MHz						
Frequency Test Range:	30 MHz – 10 GHz						
Frequency (MHz)	**RF Peak Level (dBµV/m)**	**RF Avg Level (dBµV/m)**	**Antenna Plane (H/V)**	**Limit 15.209 (dBµV/m)**	**Limit 15.247 (dBµV/m)**	**Margin (dB)**	**Pass/ Fail**
2402	96.36	--	V	--	--	--	--
2402	94.89	--	H	--	--	--	--
4804	56.41	45.08	V	54.0	76.4	-8.9	Pass*
4804	58.80	47.14	H	54.0	76.4	-6.9	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency:	2441 MHz						
Frequency Test Range:	30 MHz – 10 GHz						
Frequency (MHz)	**RF Peak Level (dBµV/m)**	**RF Avg Level (dBµV/m)**	**Antenna Plane (H/V)**	**Limit 15.209 (dBµV/m)**	**Limit 15.247 (dBµV/m)**	**Margin (dB)**	**Pass/ Fail**
2441	95.77	--	V	--	--	--	--
2441	96.58	--	H	--	--	--	--
4882	59.10	47.28	V	54.0	76.6	-6.7	Pass*
4882	60.40	49.34	H	54.0	76.6	-4.7	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

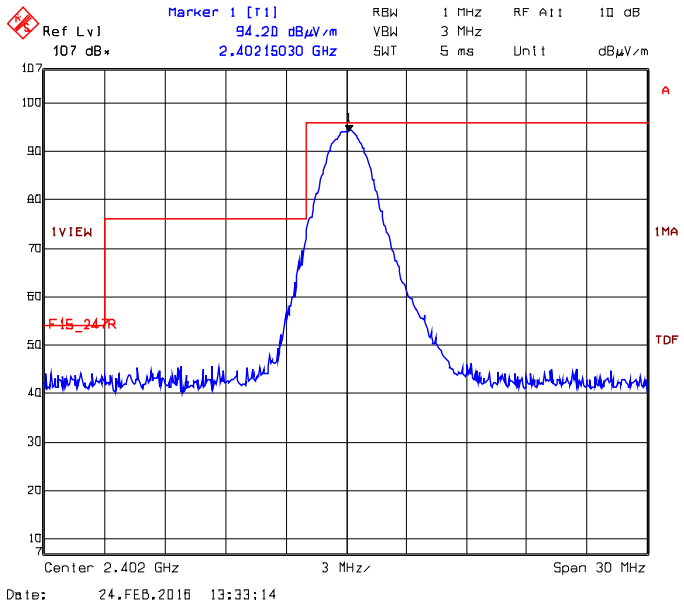
*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency:	2480 MHz						
Frequency Test Range:	30 MHz – 10 GHz						
Frequency (MHz)	**RF Peak Level (dBµV/m)**	**RF Avg Level (dBµV/m)**	**Antenna Plane (H/V)**	**Limit 15.209 (dBµV/m)**	**Limit 15.247 (dBµV/m)**	**Margin (dB)**	**Pass/ Fail**
2480	95.34	--	V	--	--	--	--
2480	97.99	--	H	--	--	--	--
4960	58.77	47.85	V	54.0	78.0	-6.2	Pass*
4960	62.08	50.81	H	54.0	78.0	-3.2	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

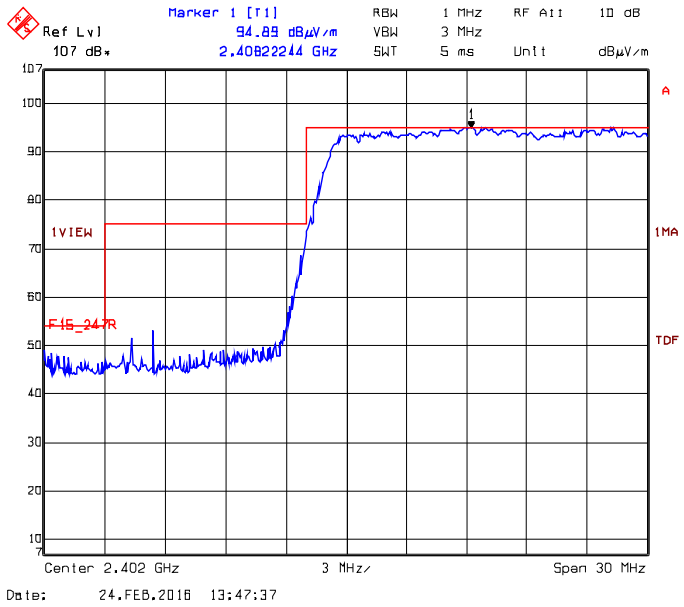
*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

5.5.4.1.2. Band –Edge RF Radiated Emissions

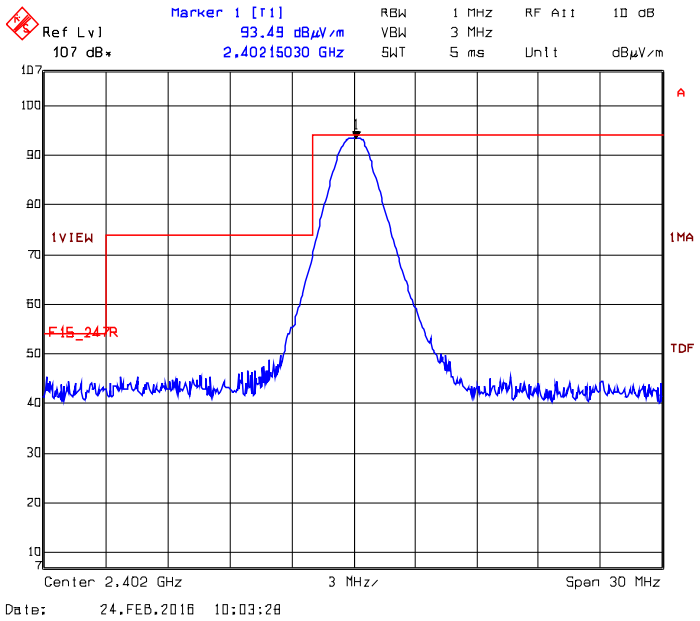
Plot 5.5.4.1.2.1. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Single Frequency Mode, Low End of Frequency Band



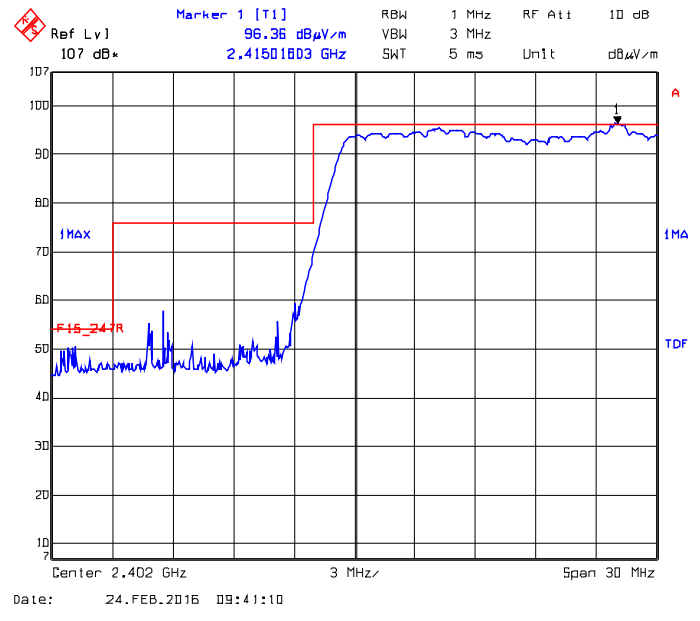
Plot 5.5.4.1.2.2. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Pseudorandom Channel Hopping Mode, Low End of Frequency Band



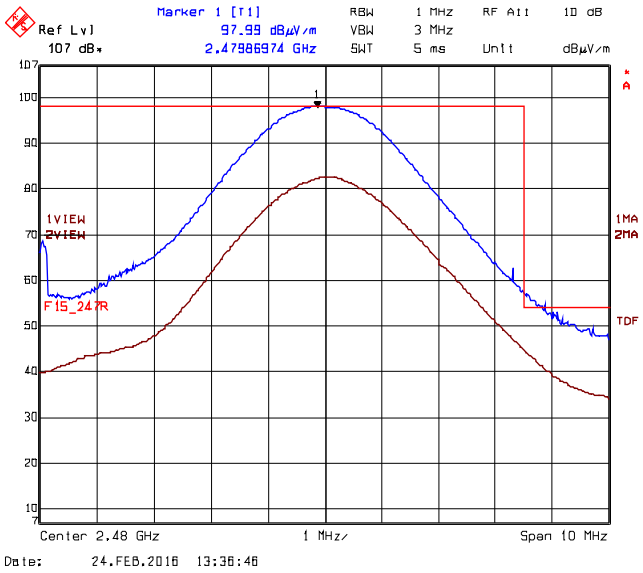
Plot 5.5.4.1.2.3. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Single Frequency Mode, Low End of Frequency Band



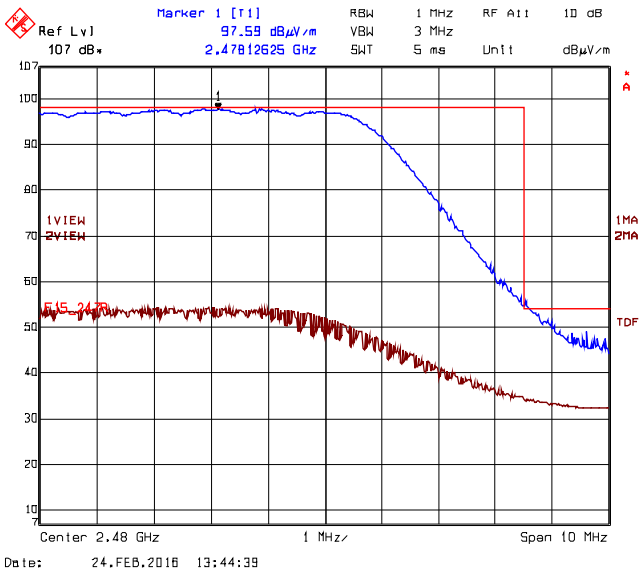
Plot 5.5.4.1.2.4. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Pseudorandom Channel Hopping Mode, Low End of Frequency Band



Plot 5.5.4.1.2.5. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Single Frequency Mode, High End of Frequency Band

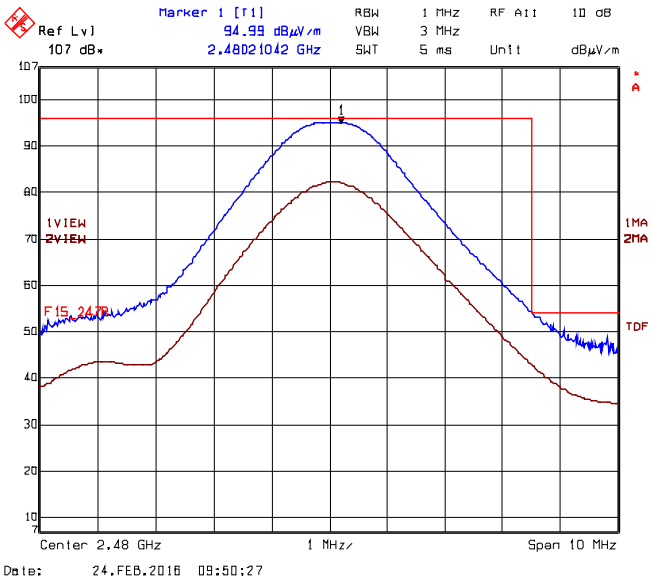


Plot 5.5.4.1.2.6. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Pseudorandom Channel Hopping Mode, High End of Frequency Band

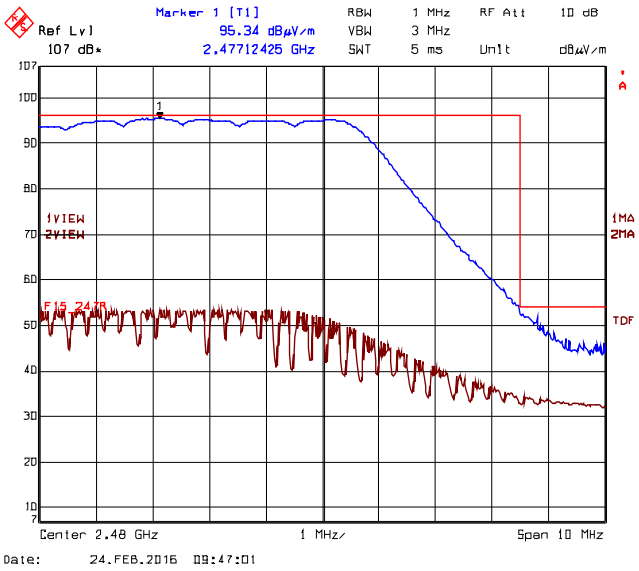


Trace 1: VBW = 1 MHz, VBW = 3 MHz.
Trace 2: VBW = 1 MHz, VBW = 10 Hz.

Plot 5.5.4.1.2.7. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Single Frequency Mode, High of Frequency Band



Plot 5.5.4.1.2.8. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Pseudorandom Channel Hopping Mode, High End of Frequency Band



Trace 1: VBW = 1 MHz, VBW = 3 MHz.
Trace 2: VBW = 1 MHz, VBW = 10 Hz.

5.5.4.2. EUT Operating in π4-DQPSK 2DH5

5.5.4.2.1. Spurious Radiated Emissions

Fundamental Frequency: 2402 MHz
Frequency Test Range: 30 MHz – 10 GHz

Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
2402	94.11	--	V	--	--	--	--
2402	95.81	--	H	--	--	--	--
4804	57.25	44.16	V	54.0	75.8	-9.8	Pass*
4804	55.91	43.57	H	54.0	75.8	-10.4	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency: 2441 MHz
Frequency Test Range: 30 MHz – 10 GHz

Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
2441	94.55	--	V	--	--	--	--
2441	97.38	--	H	--	--	--	--
4882	57.99	46.76	V	54.0	77.4	-7.2	Pass*
4882	59.30	48.73	H	54.0	77.4	-5.3	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

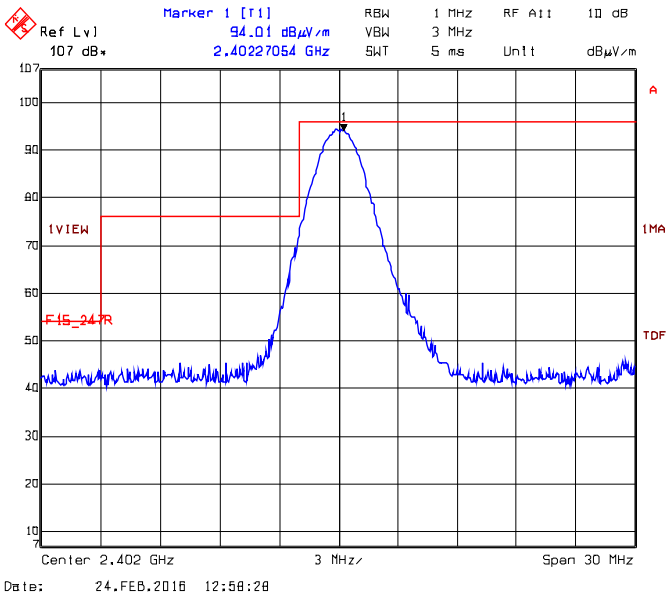
Fundamental Frequency: 2480 MHz
Frequency Test Range: 30 MHz – 10 GHz

Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
2480	94.60	--	V	--	--	--	--
2480	98.52	--	H	--	--	--	--
4960	58.09	47.23	V	54.0	78.5	-6.8	Pass*
4960	62.20	49.94	H	54.0	78.5	-4.1	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

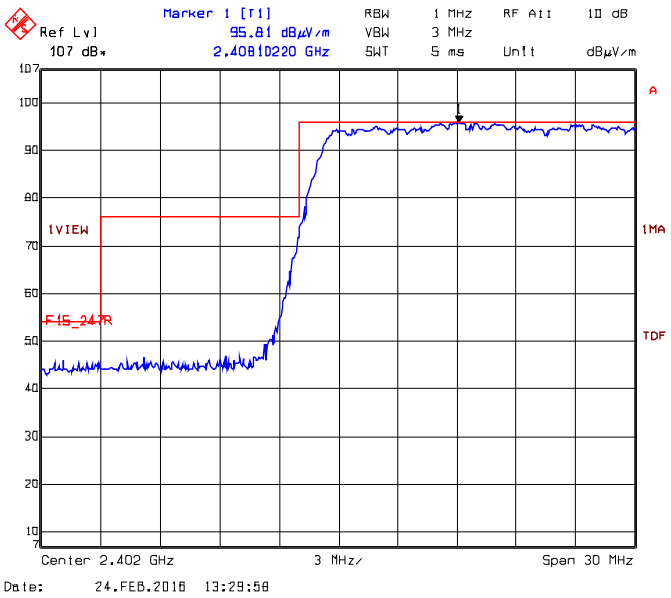
*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

5.5.4.2.2. Band-Edge RF Radiated Emissions

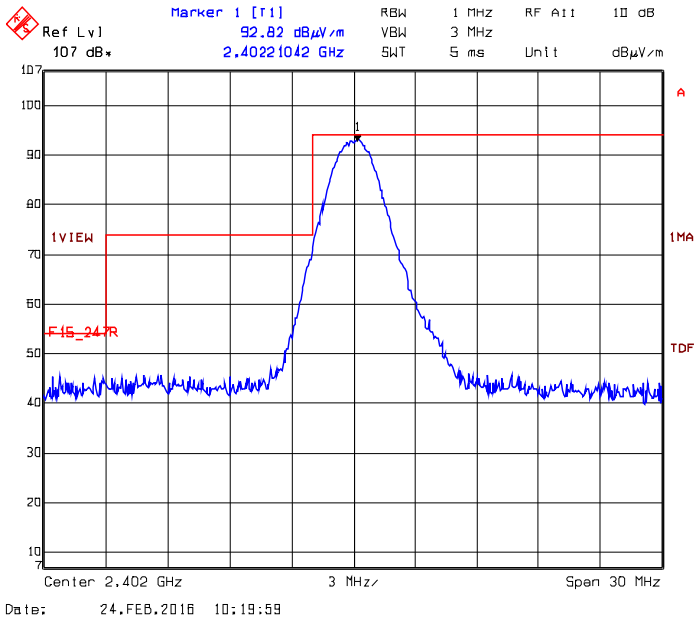
Plot 5.5.4.2.2.1. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Single Frequency Mode, Low End of Frequency Band



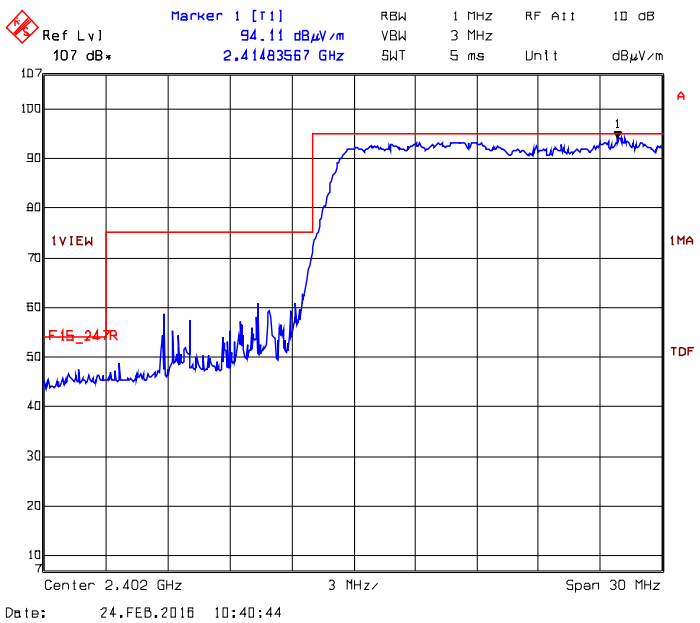
Plot 5.5.4.2.2.2. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Pseudorandom Channel Hopping Mode, Low End of Frequency Band



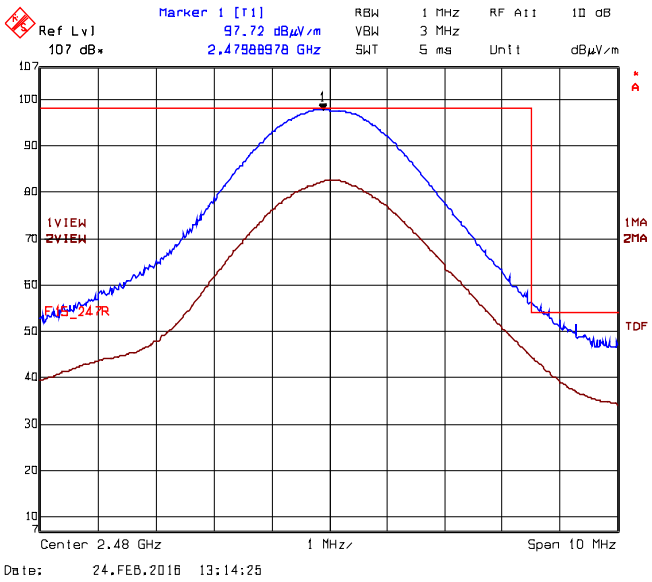
Plot 5.5.4.2.2.3. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Single Frequency Mode, Low End of Frequency Band



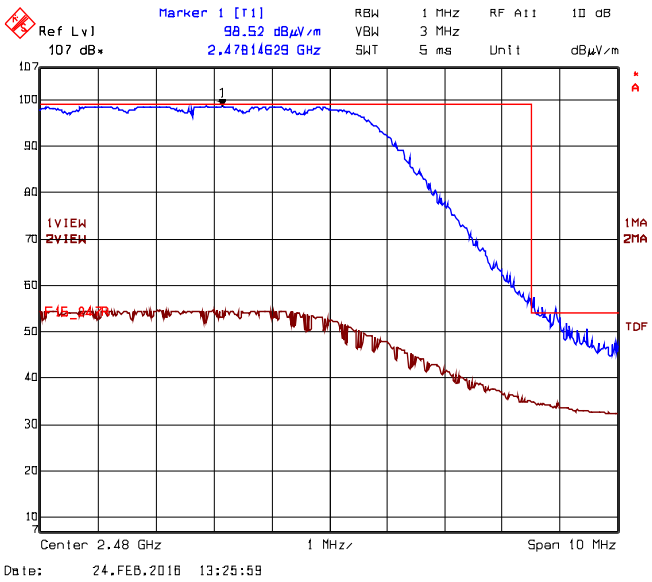
Plot 5.5.4.2.2.4. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Pseudorandom Channel Hopping Mode, Low End of Frequency Band



Plot 5.5.4.2.2.5. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Single Frequency Mode, High End of Frequency Band

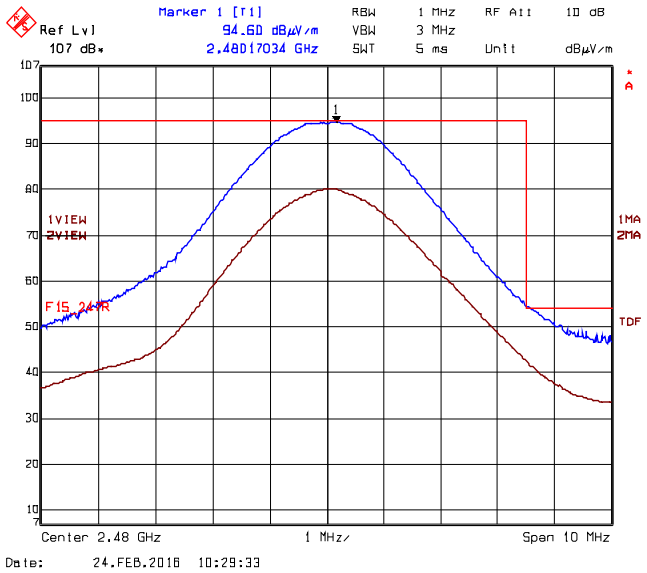


Plot 5.5.4.2.2.6. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Pseudorandom Channel Hopping Mode, High End of Frequency Band

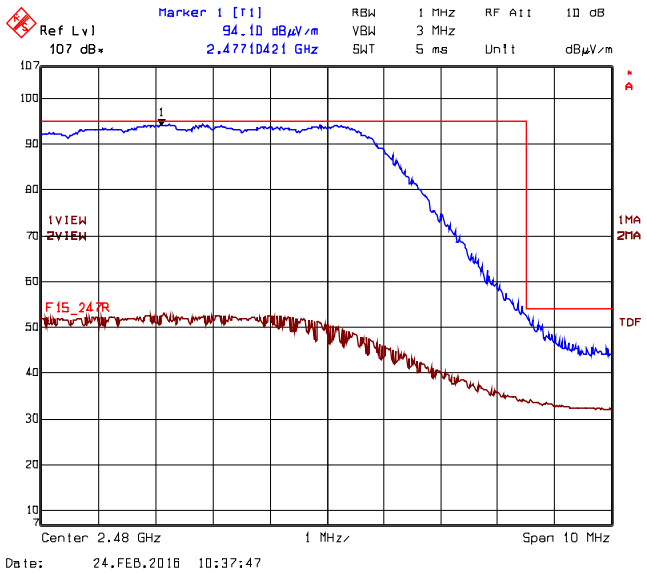


Trace 1: VBW = 1 MHz, VBW = 3 MHz.
Trace 2: VBW = 1 MHz, VBW = 10 Hz.

Plot 5.5.4.2.2.7. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Single Frequency Mode, High of Frequency Band



Plot 5.5.4.2.2.8. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Pseudorandom Channel Hopping Mode, High End of Frequency Band



Trace 1: VBW = 1 MHz, VBW = 3 MHz.
Trace 2: VBW = 1 MHz, VBW = 10 Hz.

5.5.4.3. EUT Operating in 8-DPSK 3DH5

5.5.4.3.1. Spurious Radiated Emissions

Fundamental Frequency: 2402 MHz
Frequency Test Range: 30 MHz – 10 GHz

Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
2402	94.29	--	V	--	--	--	--
2402	95.90	--	H	--	--	--	--
4804	56.69	43.58	V	54.0	75.9	-10.4	Pass*
4804	54.32	41.84	H	54.0	75.9	-12.2	Pass*

All other spurious emissions and harmonics are more than 20 dB below the applicable limit.

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency: 2441 MHz
Frequency Test Range: 30 MHz – 10 GHz

Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
2441	94.11	--	V	--	--	--	--
2441	97.22	--	H	--	--	--	--
4882	58.11	46.24	V	54.0	77.2	-7.8	Pass*
4882	59.67	47.61	H	54.0	77.2	-6.4	Pass*

All other spurious emissions and harmonics are more than 20 dB below the applicable limit.

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency: 2480 MHz
Frequency Test Range: 30 MHz – 10 GHz

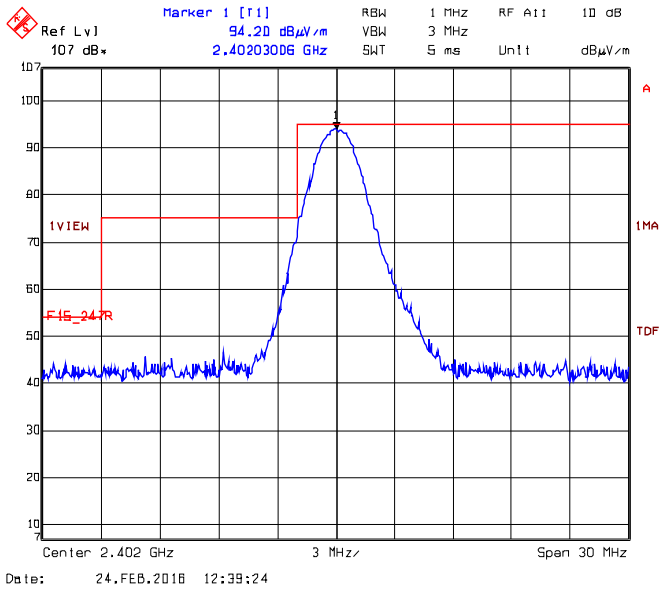
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
2480	94.75	--	V	--	--	--	--
2480	98.52	--	H	--	--	--	--
4960	58.51	47.27	V	54.0	78.5	-6.7	Pass*
4960	60.94	49.64	H	54.0	78.5	-4.4	Pass*

All other spurious emissions and harmonics are more than 20 dB below the applicable limit.

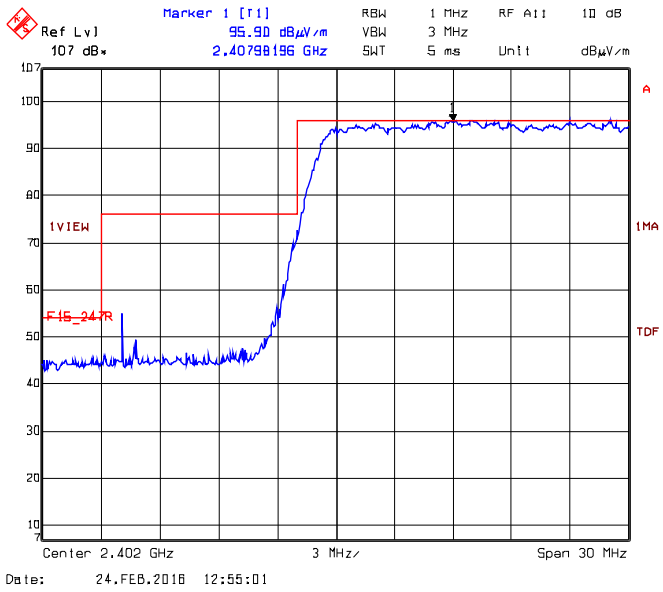
*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

5.5.4.3.2. Band-Edge RF Radiated Emissions

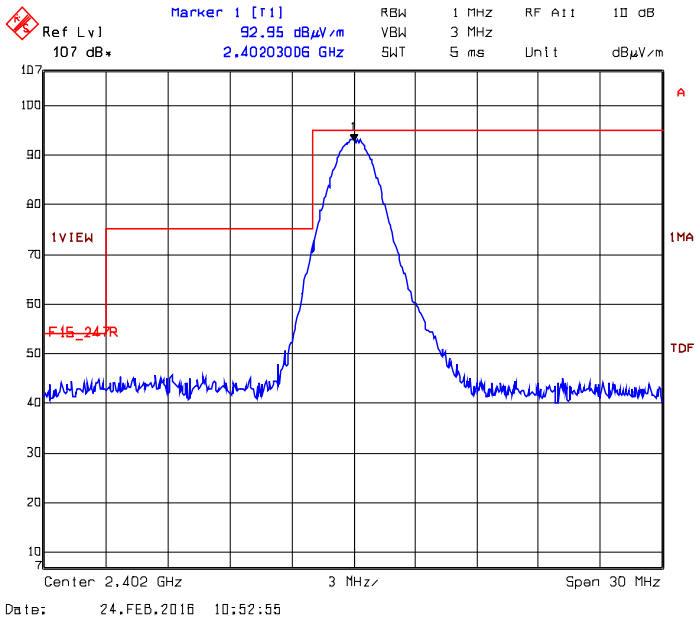
Plot 5.5.4.3.2.1. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Single Frequency Mode, Low End of Frequency Band



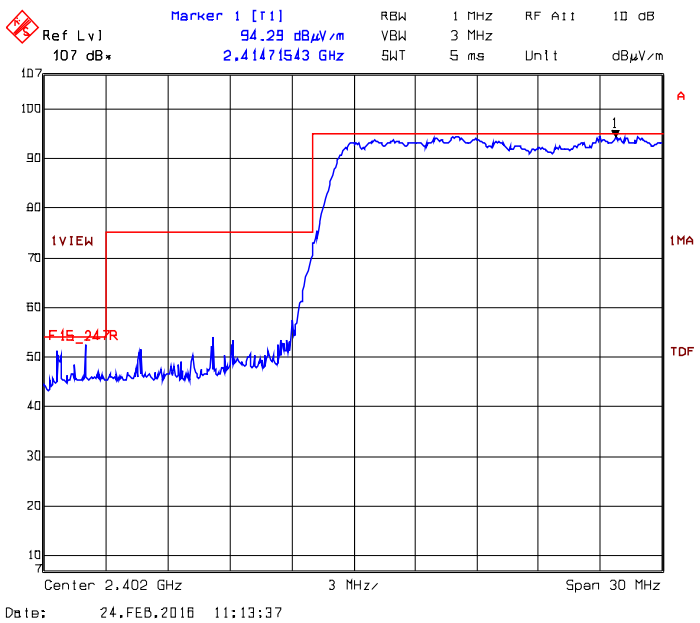
Plot 5.5.4.3.2.2. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Pseudorandom Channel Hopping Mode, Low End of Frequency Band



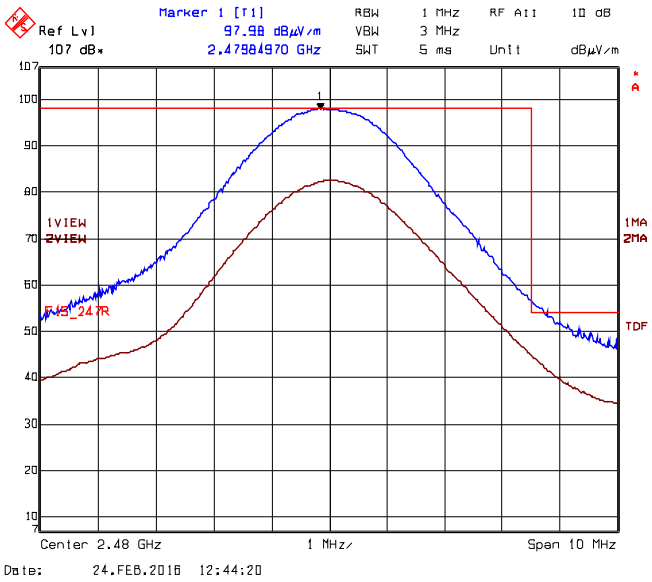
Plot 5.5.4.3.2.3. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Single Frequency Mode, Low End of Frequency Band



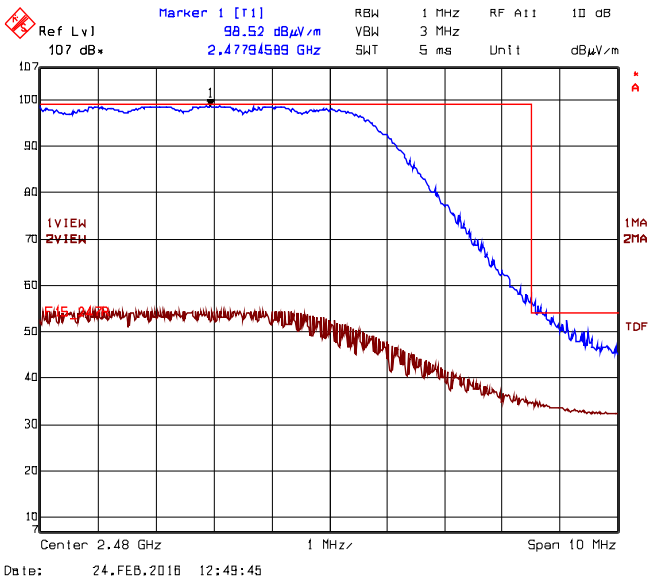
Plot 5.5.4.3.2.4. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Pseudorandom Channel Hopping Mode, Low End of Frequency Band



Plot 5.5.4.3.2.5. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Single Frequency Mode, High End of Frequency Band

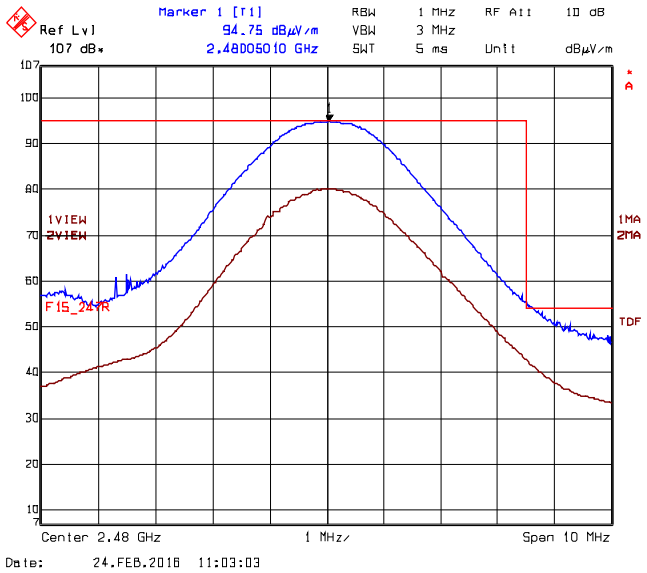


Plot 5.5.4.3.2.6. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Pseudorandom Channel Hopping Mode, High End of Frequency Band

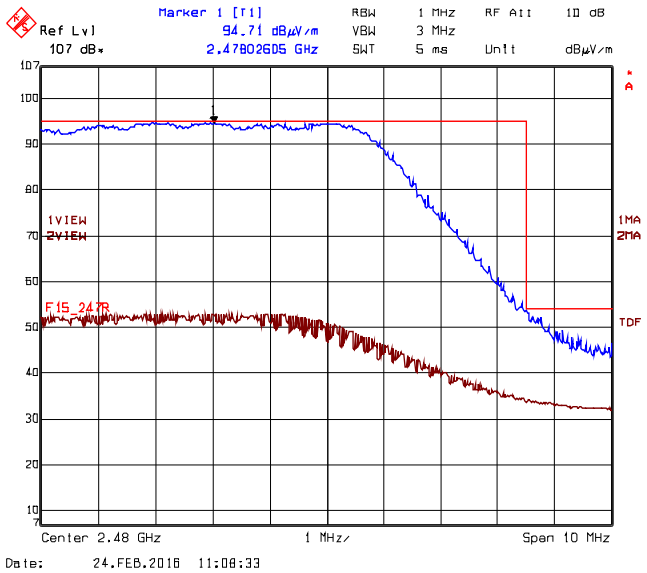


Trace 1: VBW = 1 MHz, VBW = 3 MHz.
Trace 2: VBW = 1 MHz, VBW = 10 Hz.

Plot 5.5.4.3.2.7. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Single Frequency Mode, High of Frequency Band



Plot 5.5.4.3.2.8. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Pseudorandom Channel Hopping Mode, High End of Frequency Band



Trace 1: VBW = 1 MHz, VBW = 3 MHz.
Trace 2: VBW = 1 MHz, VBW = 10 Hz.

5.6. RF EXPOSURE REQUIRMENTS [§§ 15.247(i), 1.1310 & 2.1091]

§ **1.1310:** The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*($900/f^2$)	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500			f/1500	30
1500-100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

Note 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

Note 2: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

5.6.1. Method of Measurements

Calculation Method of Power Density/RF Safety Distance:

$$S = \frac{PG}{4\pi \cdot r^2} = \frac{EIRP}{4\pi \cdot r^2}$$

Where, P: power input to the antenna in mW
EIRP: Equivalent (effective) isotropic radiated power.
S: power density mW/cm^2
G: numeric gain of antenna relative to isotropic radiator
r: distance to centre of radiation in cm

5.6.2. RF Evaluation

5.6.2.1. Standalone

For Mobile Application						
Frequency (MHz)	**EIRP (dBm)**	**EIRP (mW)**	**Evaluation Distance, r (cm)**	**Power Density, S (mW/cm^2)**	**MPE Limit (mW/cm^2)**	**Margin (mW/cm^2)**
2402	5.79	3.793	20	0.00075	1.0	-0.999

For Portable Application				
Pursuant to FCC KDB 447498 D01 General RF Exposure Guidance v06, Section 4.3.1. Standalone SAR test exclusion considerations a) For 100 MHz to 6 GHz and *test separation distances* ≤ 50 mm, the 1-g and 10-g *SAR test exclusion thresholds* are determined by the following: [(*max. power of channel, including tune-up tolerance, mW*) / (*min. test separation distance, mm*)] · [√f(GHz)] ≤ 3.0 for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR,30 where f(GHz) is the RF channel transmit frequency in GHz				
Max. power of channel, including tune-up tolerance, mW	**Min. test separation distance, mm**	**f(GHz)**	**Calculated 1-g (head or boby) SAR test exclusion threshold**	**1-g (head or boby) SAR test exclusion threshold limit**
2.037	2	2.402	1.6	3.0
Conclusion: The EUT qualify for SAR test exclusion at an evaluated separation distance of 2mm, the calculated 1-g SAR test exclusion threshold is 1.6 < 3.0.				

5.6.2.2. Co-location for Mobile Device

Pursuant to KDB 447498 D01 General RF Exposure Guidance v06, Section 7.2:

Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneously transmitting antennas incorporated in a host device is ≤ 1.0, according to calculated/estimated, numerically modeled, or measured field strengths or power density.

The maximum calculated MPE ratio of the EUT with 2.7 dBi Multilayer Monopole Antenna

Frequency (MHz)	EUT EIRP (dBm)	EUT EIRP (mW)	Evaluation Distance (cm)	Power Density (mW/cm^2)	FCC MPE Limit (mW/cm^2)	MPE Ratio
2402	5.79	3.793	20	0.00075	1.0	0.00075

The maximum calculated MPE ratio for the EUT with 2.7 dBi Multilayer Monopole Antenna is 0.00075, this configuration can be co-located with other antennas provided the sum of the MPE ratios for all the other simultaneous transmitting antennas incorporated in a host device is $\leq$ 1.0 - 0.00075 $\leq$ 0. 0.99925.

EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Operating Range	Cal. Due Date
Spectrum Analyzer	Hewlett Packard	HP8593EM	3412A00103	9 kHz–26.5 GHz	09 Apr 2017
Attenuator	Pasternack	PE7010-20	7	DC–2 GHz	26 Mar 2017
L.I.S.N	Schwarzbeck	NSLK8127	8127276	0.10 -30 MHz	28 Aug 2016
Signal Generator	Hewlett Packard	8648C	3443U00391	100 kHz – 3200 MHz	02 Feb 2017
Spectrum Analyzer	Rohde & Schwarz	FSEK30	100077	20Hz–40 GHz	21 Nov 2016
Attenuator	Pasternack	7024-10	4	DC–26.5 GHz	Cal on use
DC Block	Hewlett Packard	11742A	12460	0.045 – 26.5 GHz	Cal on use
EMI Receiver	Rohde & Schwarz	ESU40	100037	20Hz–40 GHz	08 May 2017
RF Amplifier	Com-Power	PAM-0118A	551052	0.5 – 18 GHz	13 Jul 2016
RF Amplifier	Hewlett Packard	84498	3008A00769	1 – 26.5 GHz	20 Aug 2016
Biconilog	EMCO	3142C	26873	26-3000 MHz	14 Apr 2016*
Horn Antenna	EMCO	3155	6570	1 – 18 GHz	11 Sep 2016
Horn Antenna	EMCO	3160-09	118385	18 – 26.5 GHz	04 Aug 2016
High Pass Filter	K & L	11SH10-4000/T12000	4	Cut off 2400 MHz	Cal on use
Band Reject Filter	Micro-Tronics	BRM50701	105	Cut off 2.4-2.483 GHz	Cal on use

* Equipment used before calibration due date.

EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement.

7.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

	Line Conducted Emission Measurement Uncertainty (9 kHz – 30 MHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 1.44**	**± 1.8**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 2.89**	**± 3.6**

7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

	Radiated Emission Measurement Uncertainty @ 3m, Horizontal (30-1000 MHz):	**Measured (dB)**	**Limit (dB)**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 2.39**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 4.79**	**± 5.2**

	Radiated Emission Measurement Uncertainty @ 3m, Vertical (30-1000 MHz):	**Measured (dB)**	**Limit (dB)**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 2.39**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 4.78**	**± 5.2**

	Radiated Emission Measurement Uncertainty @ 3 m, Horizontal & Vertical (1 – 18 GHz):	**Measured (dB)**	**Limit (dB)**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 1.87**	**Under consideration**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 3.75**	**Under consideration**