EMC TEST REPORT

(FULL COMPLIANCE)

Report Number: 102966681ATL-011
Project Number: G102966681

Report Issue Date: 06/17/2017

Model(s) Tested: MTW100 (BT-EDR)
Model(s) Partially Tested: None
Model(s) Not Tested but declared equivalent by the client: None

Standards: FCC Part 15 Subpart C: 2017
FCC Part 15 Subpart B: 2017
RSS 247 Issue 2: 02/2017
RSS 102 Issue 5: 03/2015
ICES 003 Issue 6: 01/2016

Tested by:
Intertek Testing Services NA, Inc.
1950 Evergreen Blvd, Suite 100
Duluth, GA 30096
USA

Intertek Testing Services NA, Inc.
70 Codman Hill Road
Boxborough, MA 01719
USA

Client:
Owl Labs
33-1/2 Union Square
Somerville, MA 02143
USA

Report prepared by Naga Suryadevara

Naga Suryadevara/EMC Engineer

Report reviewed by Kouma Sinn

Kouma Sinn/EMC Staff Engineer

Table of Contents

1 Introduction and Conclusion 3
2 Test Summary 3
3 Client Information 4
4 Description of Equipment Under Test and Variant Models 4
5 System Setup and Method 5
6 Conducted Peak Output Power 7
7 20dB and Occupied Bandwidth 23
8 Transmitter Antenna Port Conducted Spurious Emissions 52
9 Carrier Frequency Separation 62
10 Number of Hopping Frequencies 64
11 Time of Occupancy (Dwell Time) 66
12 Radiated Emissions (Transmitter Spurious, Digital Device and Receiver) 77
13 AC Mains Conducted Emissions 84
14 Revision History 90

1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

2 Test Summary

Section	Test full name	Result
3	Client Information	--
4	Description of Equipment Under Test and Variant Models	--
5	System Setup and Method	--
6	Transmitter Conducted Output Power and Human RF Exposure (CFR47 FCC Part 15 Subpart C (15.247): 2017 RSS 247: 02/2017 RSS 102: 03/2015)	Compliant
7	20dB and Occupied Bandwidth (CFR47 FCC Part 15 Subpart C (15.247): 2017 RSS 247: 02/2017)	Compliant
8	Transmitter Conducted Spurious Emissions (CFR47 FCC Part 15 Subpart C (15.247): 2017 RSS 247: 02/2017)	Compliant
9	Carrier Frequency Separation (CFR47 FCC Part 15 Subpart C (15.247): 2017 RSS 247: 02/2017)	Compliant
10	Number of Hopping frequencies (CFR47 FCC Part 15 Subpart C (15.247): 2017 RSS 247: 02/2017)	Compliant
11	Dwell time (CFR47 FCC Part 15 Subpart C (15.247): 2017 RSS 247: 02/2017)	Compliant
12	Radiated Emissions (Transmitter Spurious, Band edge, Digital devices and Receiver) (CFR47 FCC Part 15 Subpart C (15.247): 2017 RSS 247: 02/2017 FCC Part 15 Subpart B: 2017 ICES 003: 01/2016)	Compliant
13	Conducted Emissions (CFR47 FCC Part 15 Subpart C (15.247): 2017 RSS 247: 02/2017 FCC Part 15 Subpart B: 2017 ICES 003: 01/2016)	Compliant
14	Revision History	--

3 Client Information

This EUT was tested at the request of:

Client: Owl Labs
33-1/2 Union Square
Somerville, MA 02143
USA

Contact: Amy DeDeo
Telephone: 508-454-1900
Fax: 508-454-1900
Email: amy@owllabs.com

4 Description of Equipment Under Test and Variant Models

Manufacturer: Nanning Fugui Industrial CO. Ltd.
B Factories Area, FOXCONN Nanning Sci-tech Park, No.51,
Tongle Avenue
Nanning, Guangxi 5300000
China

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
Video Conferencing Device	Foxconn	MTW100	ATL1704121031-001 Option A – Conducted Sample
Video Conferencing Device	Foxconn	MTW100	ATL1704121031-002 Option A – Radiated Sample

Receive Date:	04/06/2017
Received Condition:	Good
Type:	Production

Description of Equipment Under Test (provided by client)
Video conferencing device

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
100-240VAC	1.7A	50/60Hz	1

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Transmit mode on low, mid and high channels.
2	Transmit mode hopping
3	Receive mode

Software used by the EUT:

No.	Descriptions of EUT Exercising
1	Qualcomm Radio Tool Kit QRTC3

Radio/Receiver Characteristics	
Frequency Band(s)	2402 ~ 2480 MHz
Modulation Type(s) and Data Rate	GFSK, π/4-DQPSK, 8-DPSK; DH1 and DH5
Maximum Output Power	0.0366 W
Test Channels	Low Channel: 2402 MHz Mid Channel: 2441 MHz High Channel: 2480 MHz
20dB Bandwidth	1.33 MHz
Frequency Hopper: Number of Hopping Channels	79
Frequency Hopper: Max interval between two instances of use of the same channel	DH1 = 990kHz
MIMO Information (# of Transmit and Receive antenna ports)	One
Equipment Type	Standalone
ETSI LBT/Adaptivity	N/A
ETSI Adaptivity Type	N/A
ETSI Temperature Category (I, II, III)	N/A
ETSI Receiver Category (1, 2, 3)	N/A
Antenna Type and Gain	2400-2500MHz; Dipole, i-pex (MHF) connector, Gain = 2.6 dBi (Antenna 1)

Variant Models:

The following variant models were not tested as part of this evaluation, but have been identified by the manufacturer as being electrically identical models, depopulated models, or with reasonable similarity to the model(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

None

5 System Setup and Method

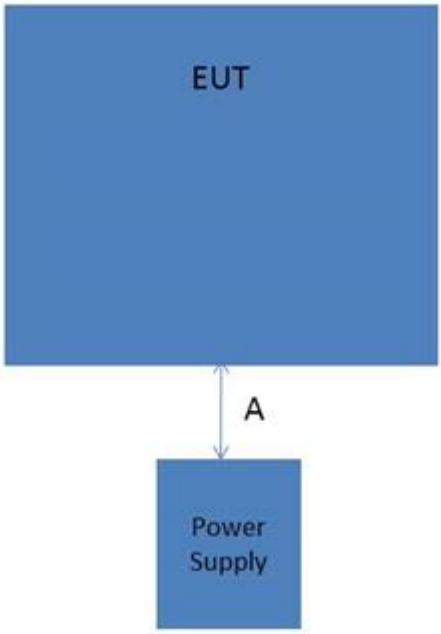
Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
--	Power Cable	2.5	No	No	AC Mains
--	USB Cable	2	Yes	None	None

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
None			

5.1 Method:

Configuration as required by FCC Part 15 Subpart C: 2017, FCC Part 15 Subpart B: 2017, RSS 247 Issue 2: 02/2017, RSS 102 Issue 5: 03/2015, ICES 003 Issue 6: 01/2016, FCC KDB 558074 D01 DTS Measurement Guidance v03r02, ANSI C63.10: 2013 and ANSI C 63.4: 2014.
.

5.2 EUT Block Diagram:



6 Conducted Peak Output Power

6.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C, RSS 247 and RSS 102.
TEST SITE: EMC Lab (Boxborough, MA)

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

6.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV004'	Weather Station	Davis Instruments	7400	PE80529A61A	05/10/2017	05/10/2018
ROS005'	ETSI Test System	Rhode & Schwartz	TS8997	N/A	09/15/2016	09/15/2017
MIN23'	Attenuator 2 watt 20dB DC-26GHz	Mini Circuits	BW-S20-2W263+	MIN23	05/20/2017	05/20/2018
CBLHF2012-2M-1'	2m 9kHz-40GHz Coaxial Cable - SET1	Huber & Suhner	SF102	252675001	02/08/2017	02/08/2018

Software Utilized:

Name	Manufacturer	Version
None (Spectrum Analyzer Firmware)		

6.3 Results:

The sample tested was found to Comply.

FCC 15.247(b)(1)

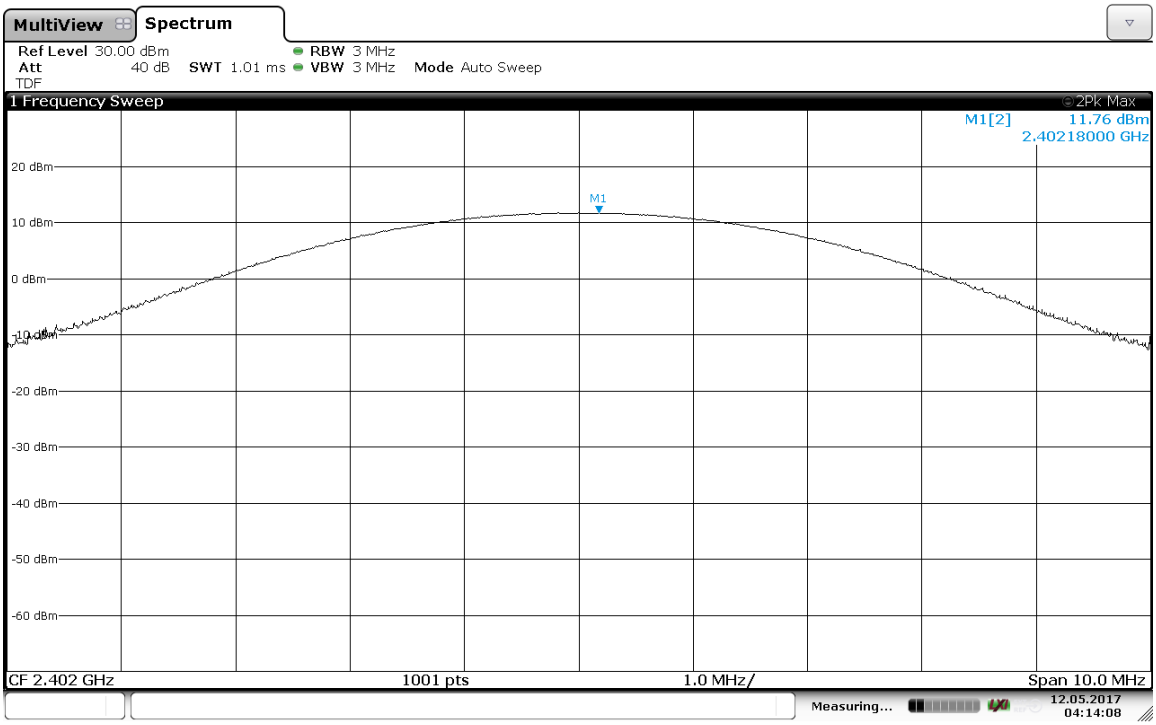
(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(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.

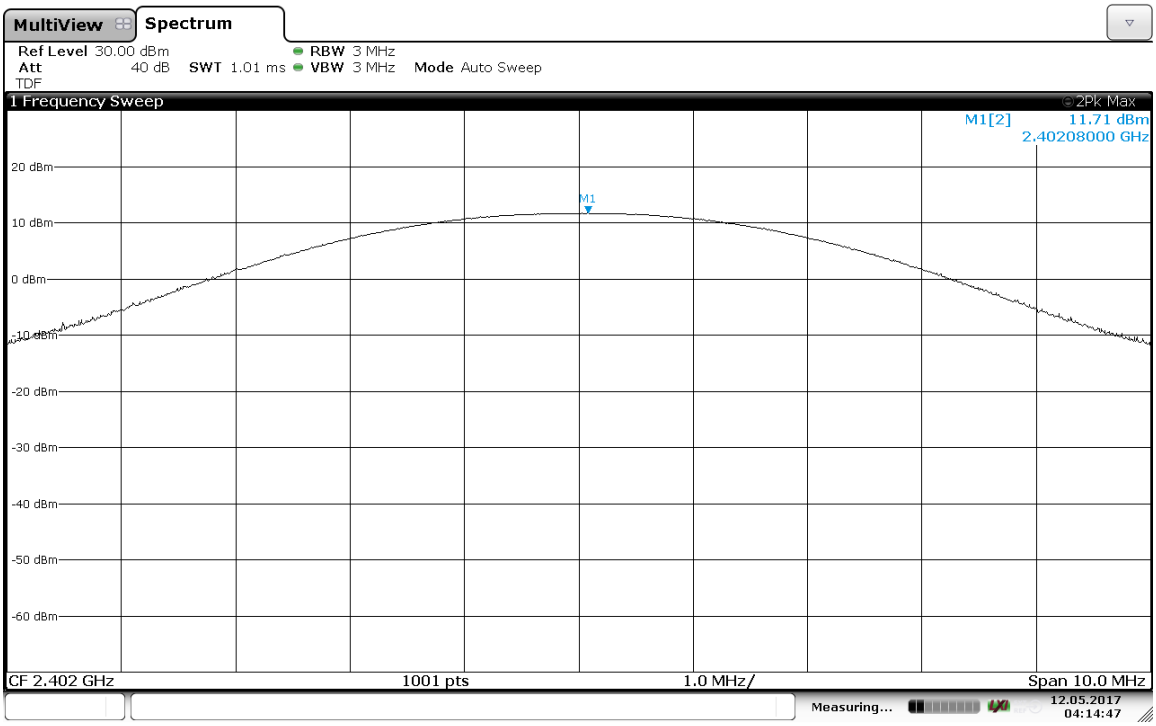
RSS-247 Section 5.4
b) For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

6.4 Plots/Data:

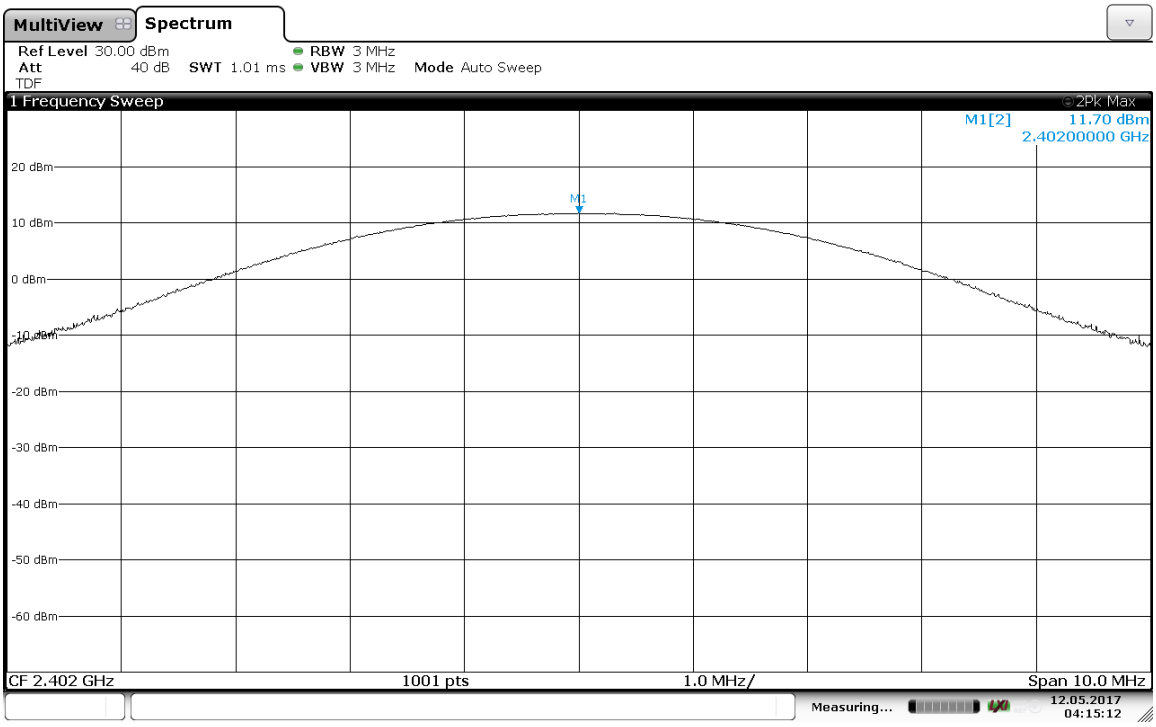
GFSK Modulation, Low Channel (2402 MHz), Output Power @ DH1 Data rate = 11.76 dBm



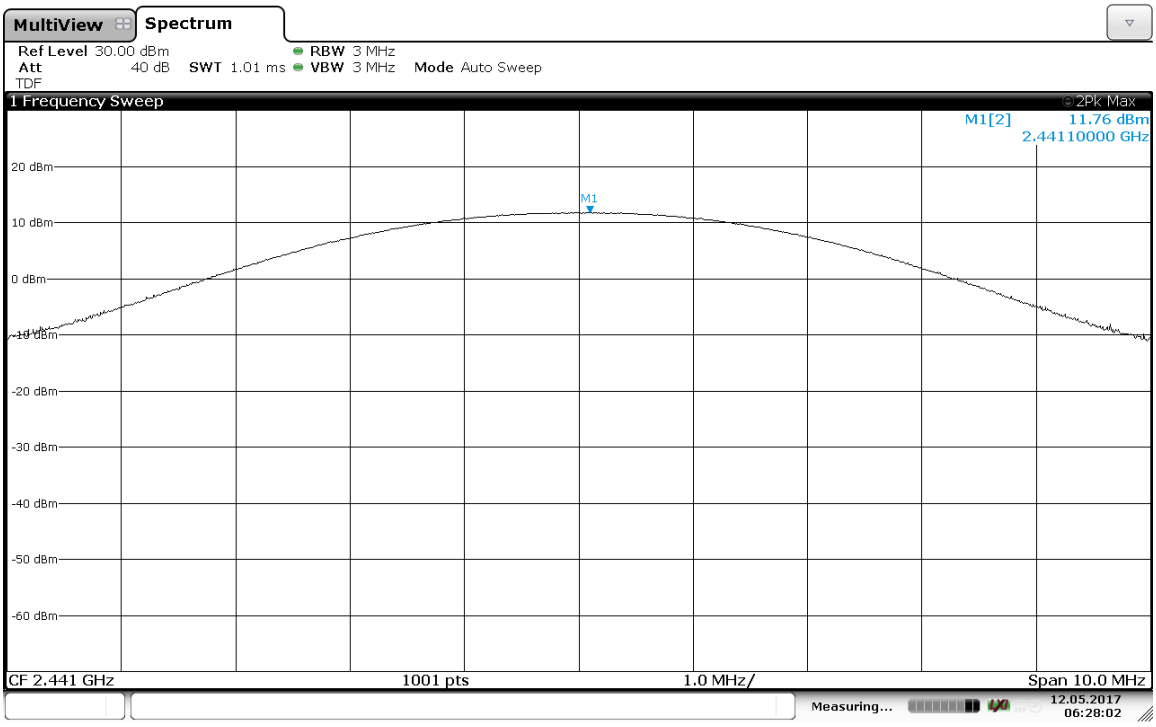
GFSK Modulation, Low Channel (2402 MHz), Output Power @ DH3 Data rate = 11.71 dBm



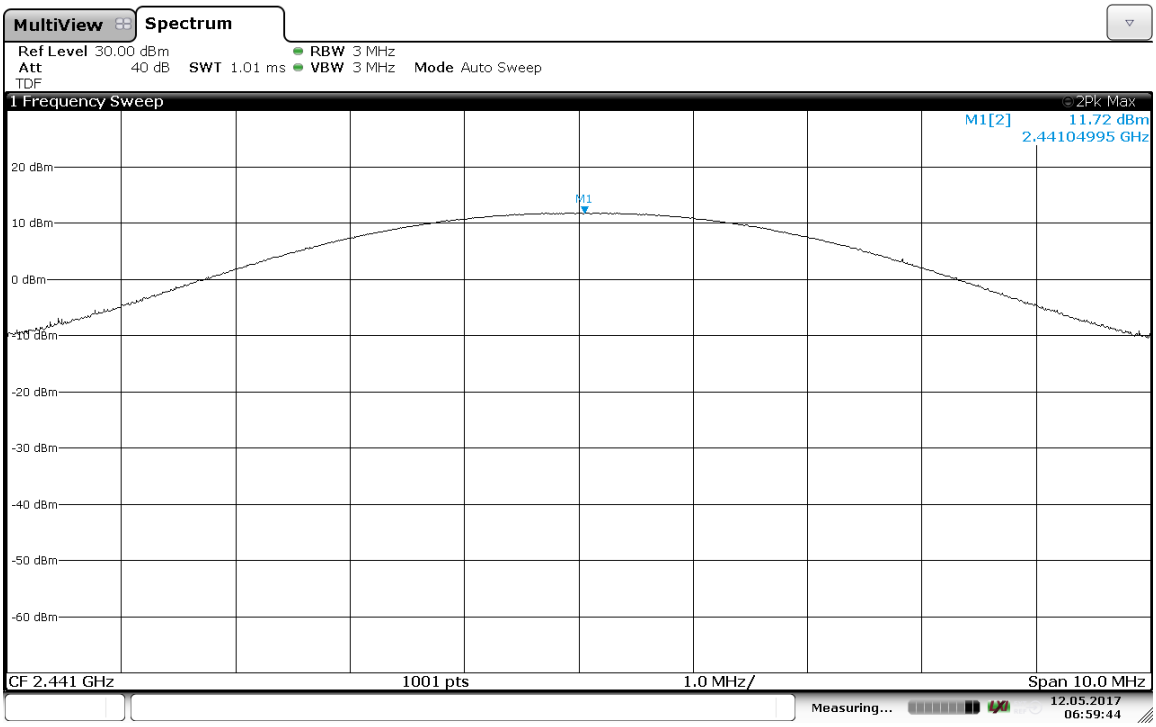
GFSK Modulation, Low Channel (2402 MHz), Output Power @ DH5 Data rate = 11.70 dBm



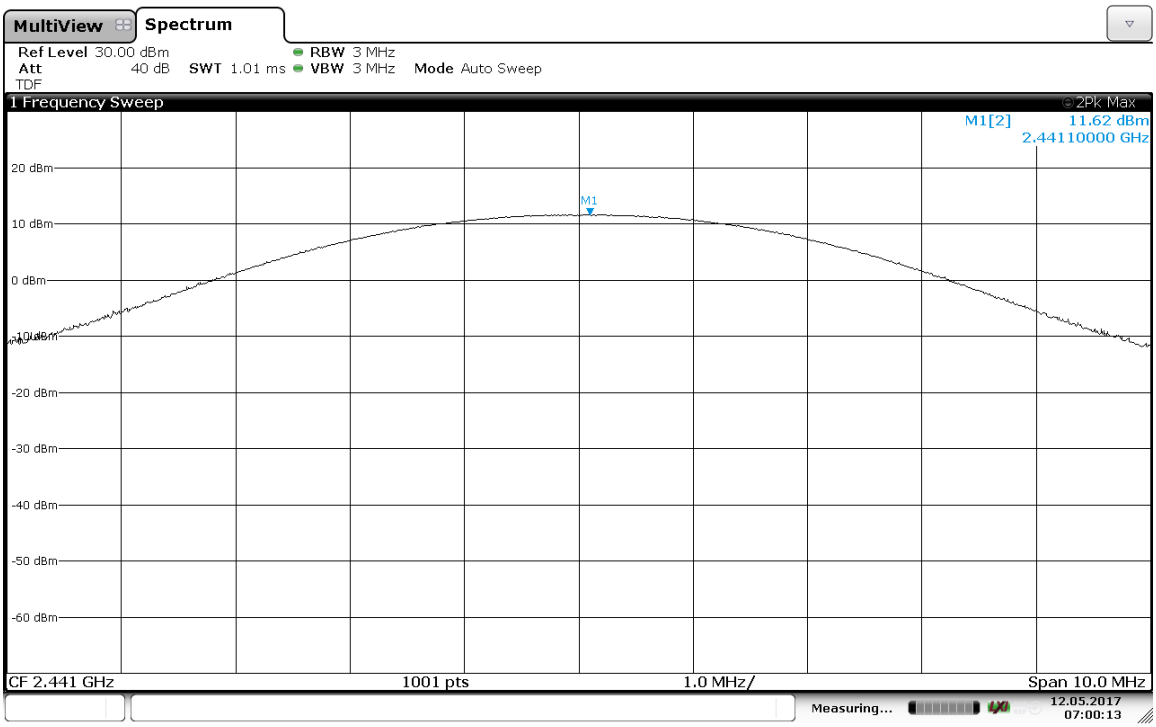
GFSK Modulation, Mid Channel (2441 MHz), Output Power @ DH1 Data rate = 11.76 dBm



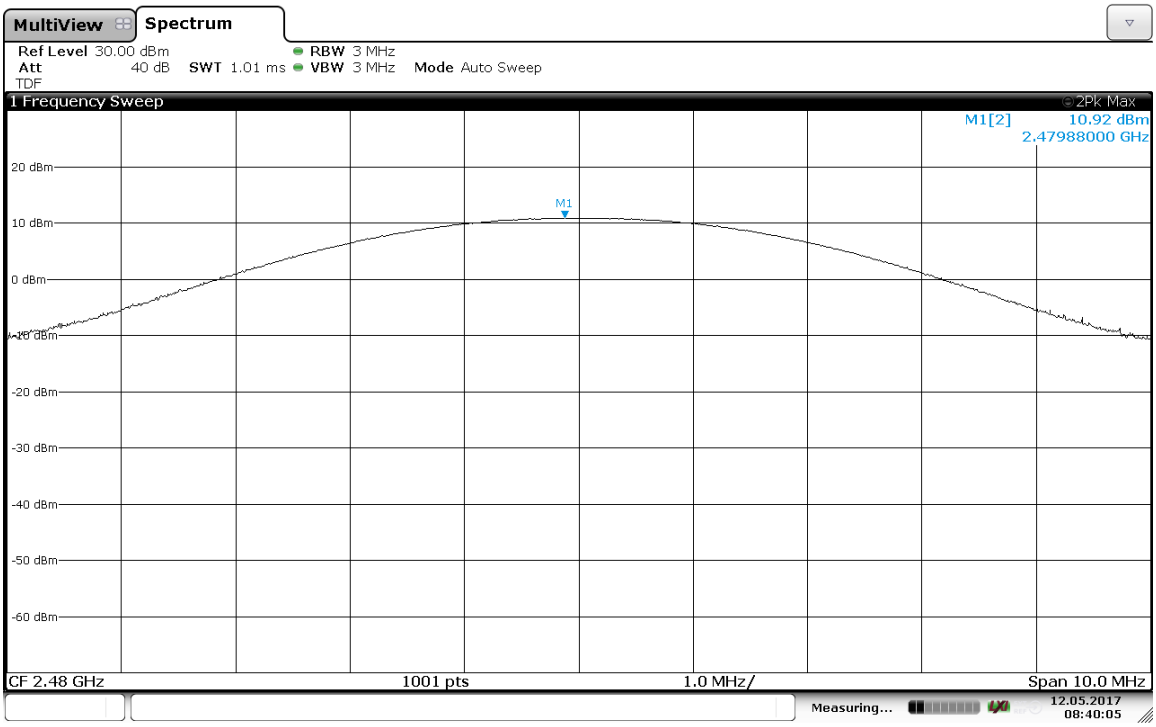
GFSK Modulation, Mid Channel (2441 MHz), Output Power @ DH3 Data rate = 11.72 dBm



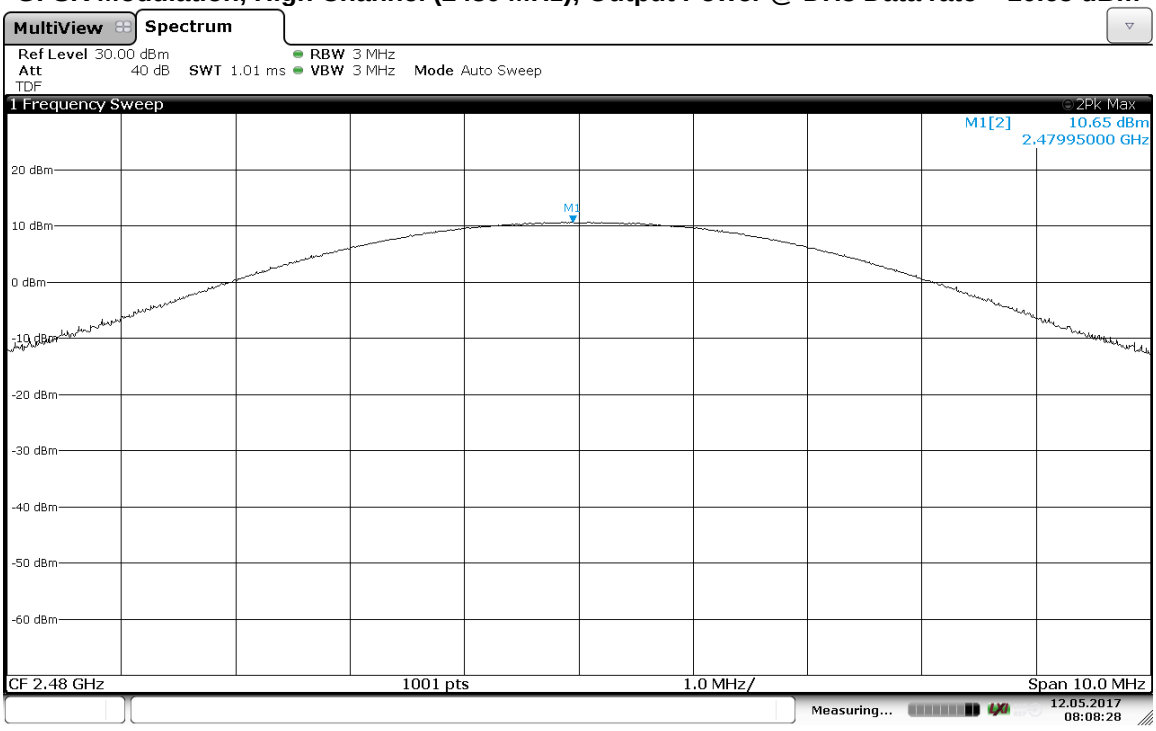
GFSK Modulation, Mid Channel (2441 MHz), Output Power @ DH5 Data rate = 11.62 dBm



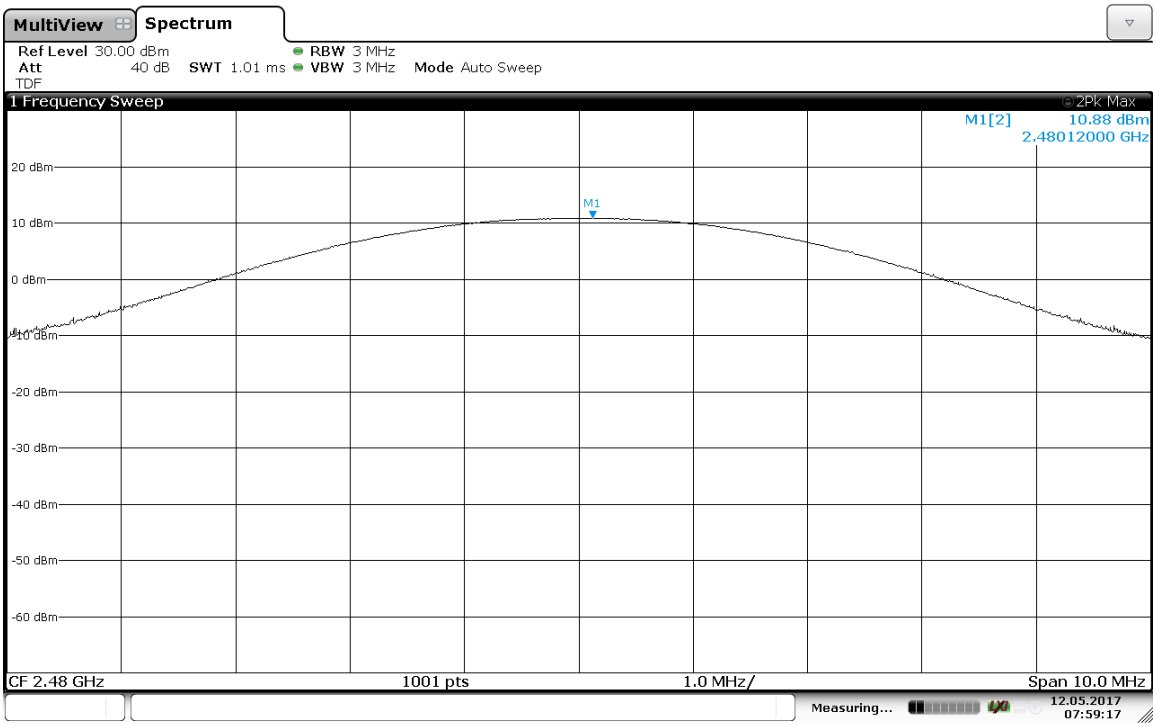
GFSK Modulation, High Channel (2480 MHz), Output Power @ DH1 Data rate = 10.92 dBm



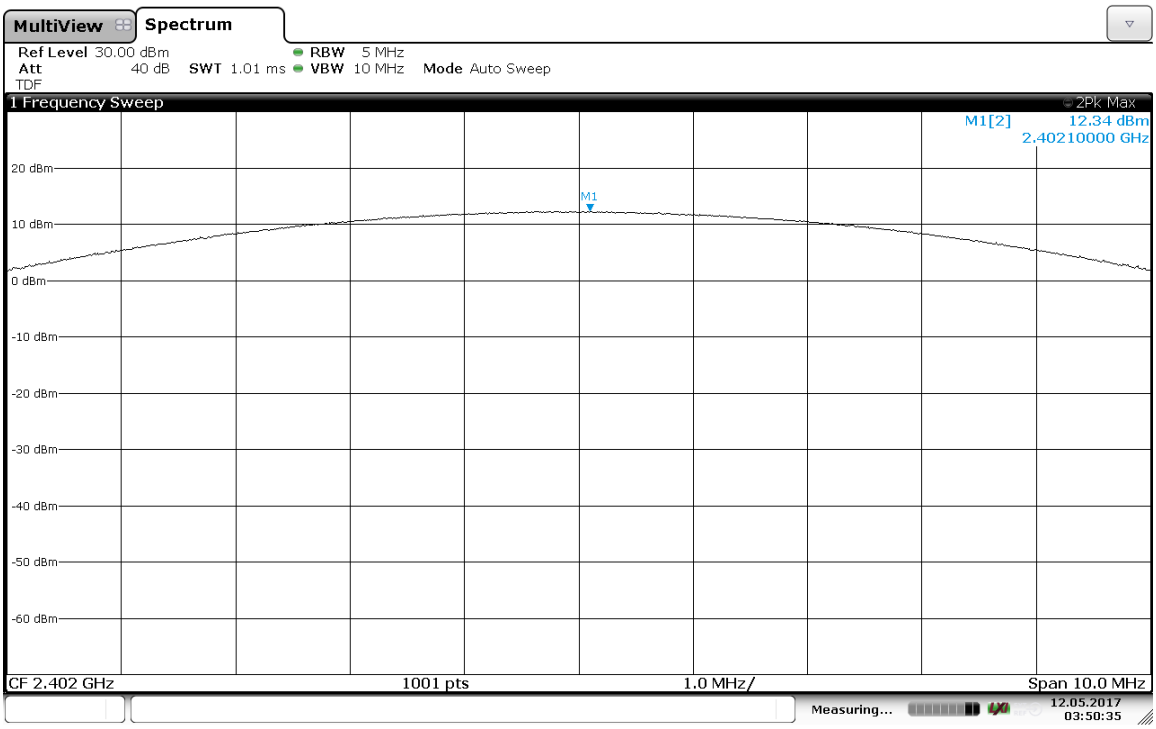
GFSK Modulation, High Channel (2480 MHz), Output Power @ DH3 Data rate = 10.65 dBm



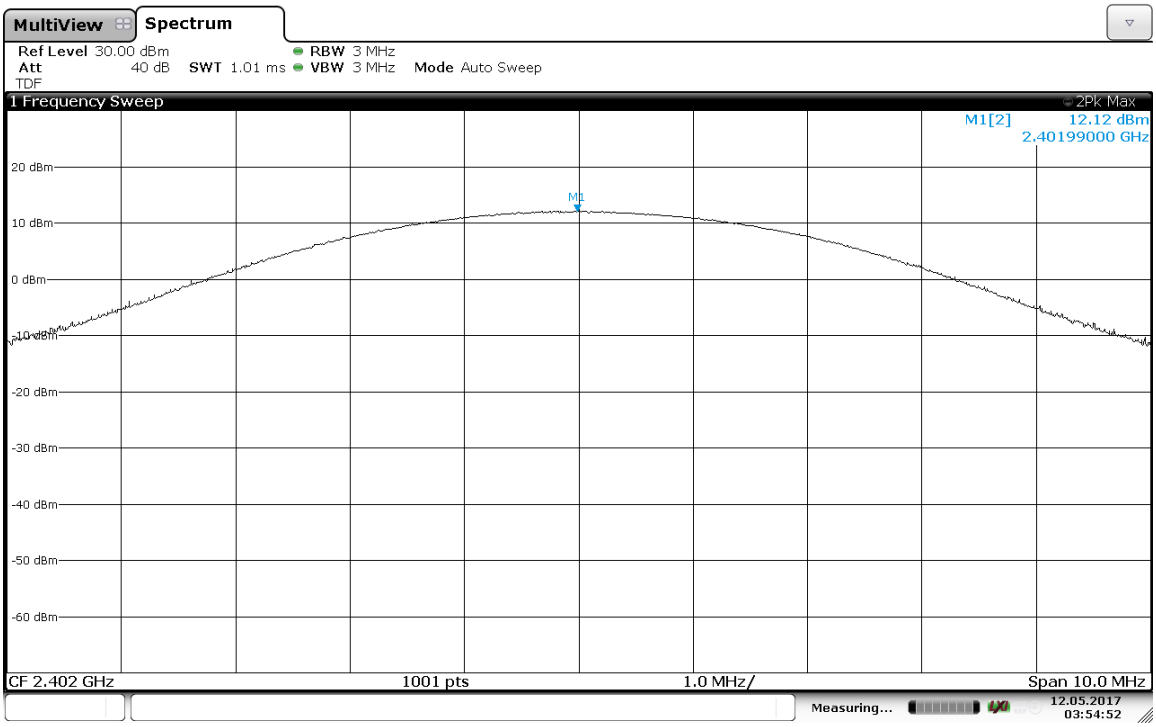
GFSK Modulation, High Channel (2480 MHz), Output Power @ DH5 Data rate = 10.88 dBm



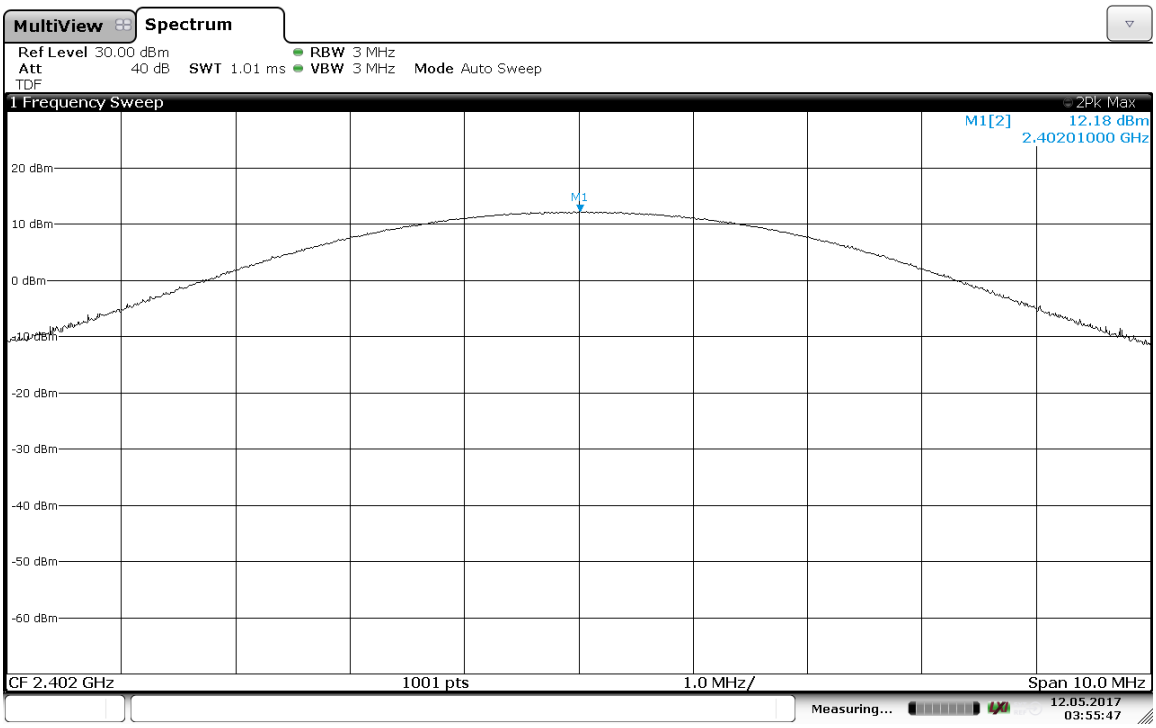
Pi/4DPSK Modulation, Low Channel (2402 MHz), Output Power @ DH1 Data rate = 12.34 dBm



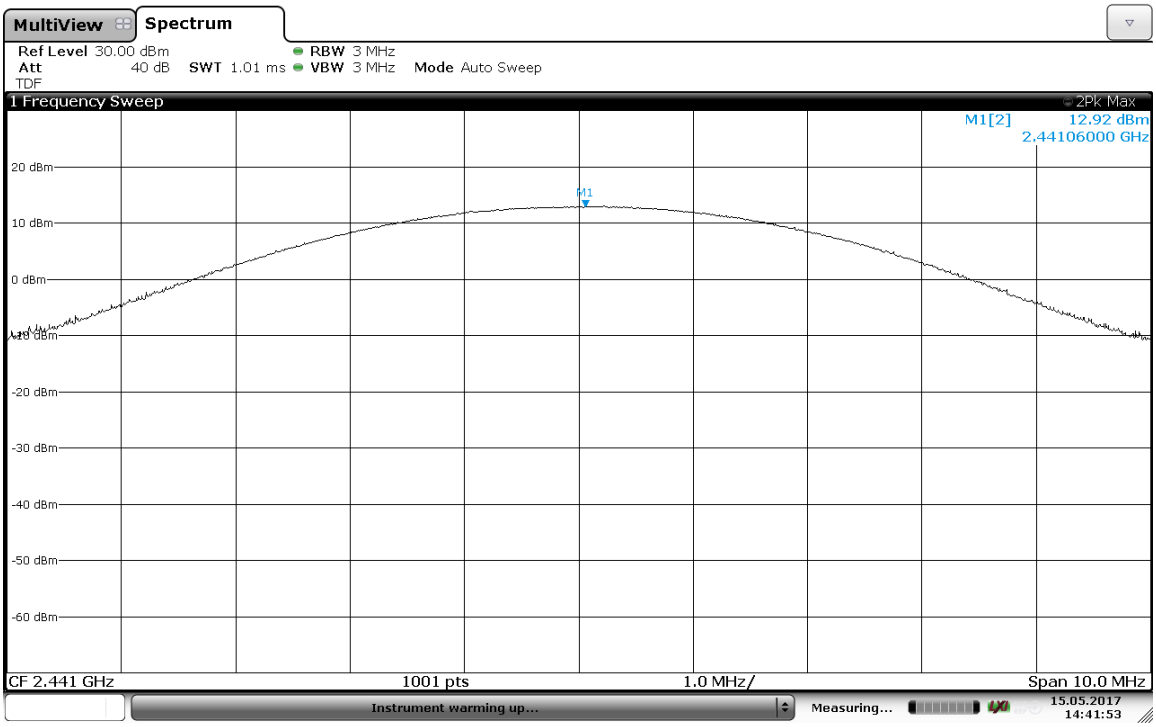
Pi/4DPSK Modulation, Low Channel (2402 MHz), Output Power @ DH3 Data rate = 12.12 dBm



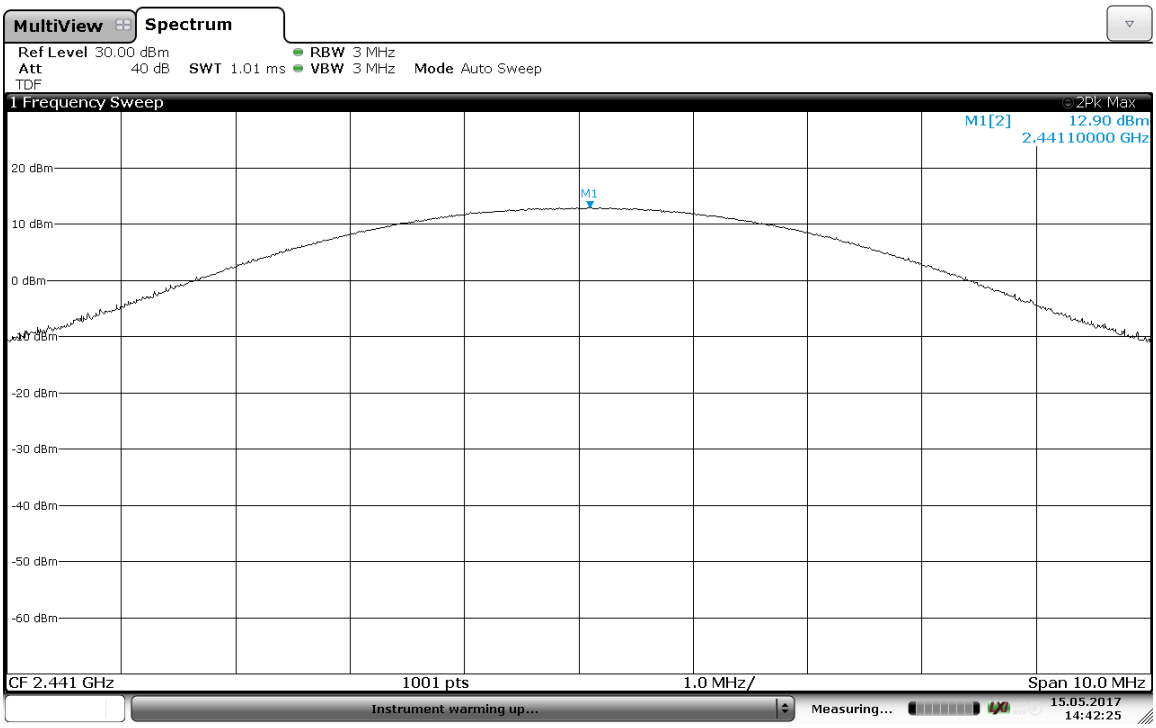
Pi/4DPSK Modulation, Low Channel (2402 MHz), Output Power @ DH5 Data rate = 12.18 dBm



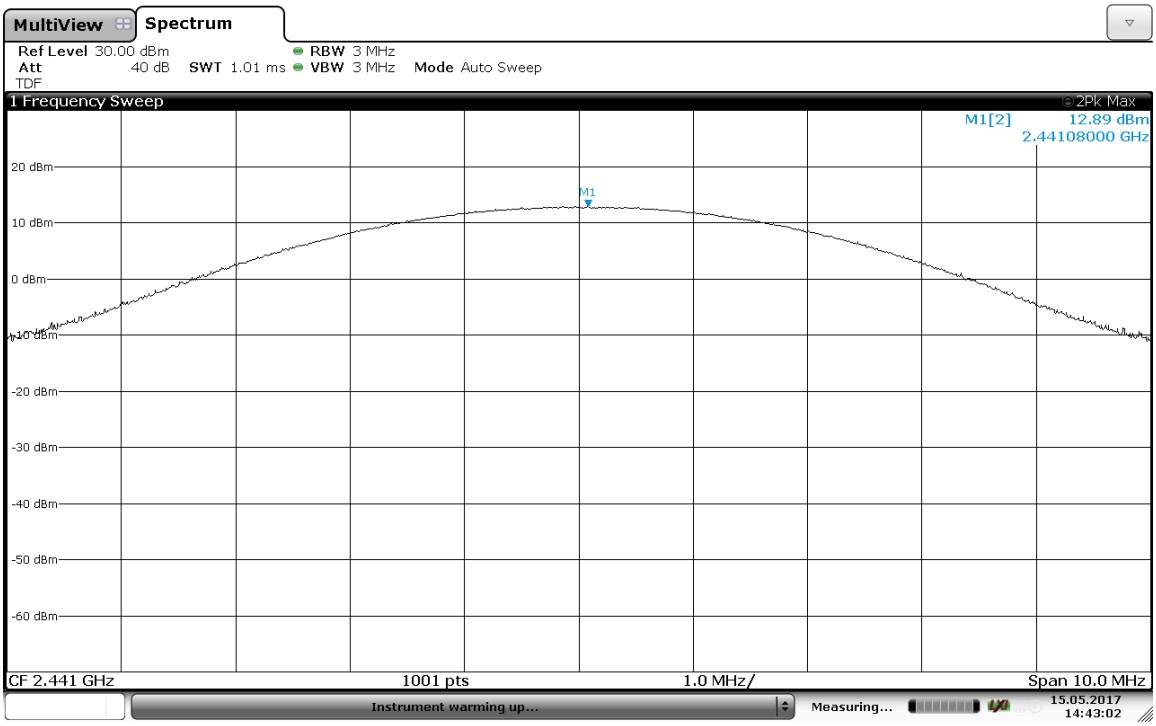
Pi/4DPSK Modulation, Mid Channel (2441 MHz), Output Power @ DH1 Data rate = 12.92 dBm



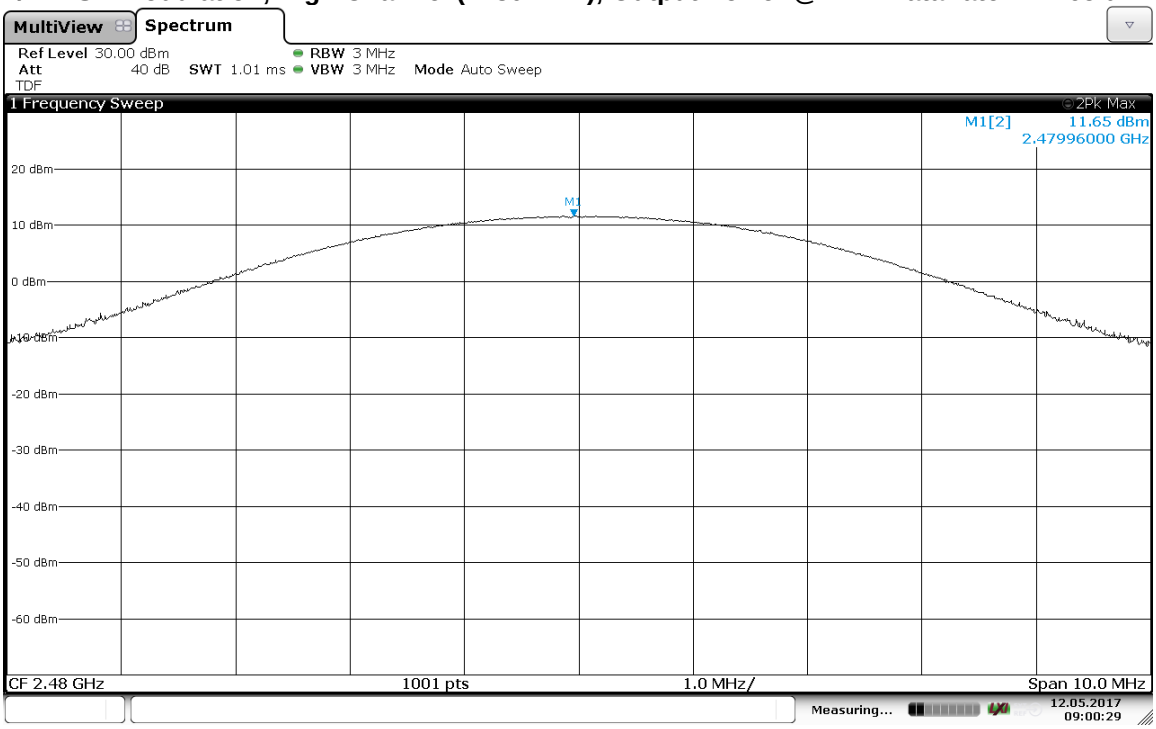
Pi/4DPSK Modulation, Mid Channel (2441 MHz), Output Power @ DH3 Data rate = 12.90 dBm



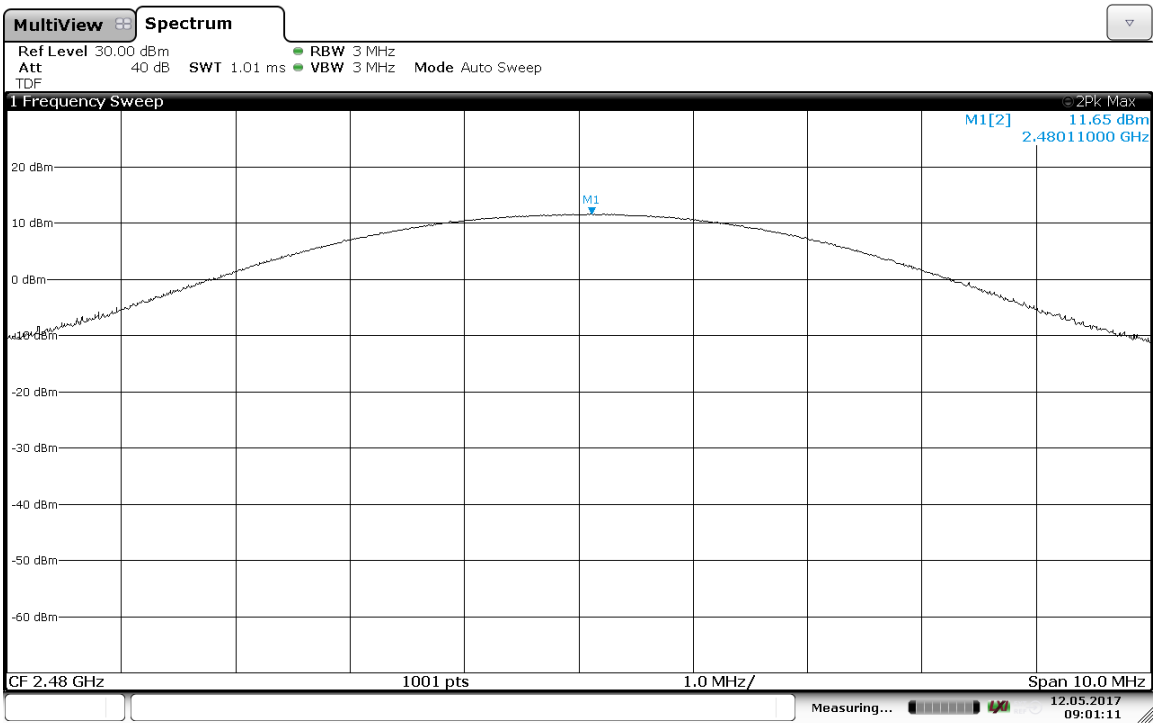
Pi/4DPSK Modulation, Mid Channel (2441 MHz), Output Power @ DH5 Data rate = 12.89 dBm



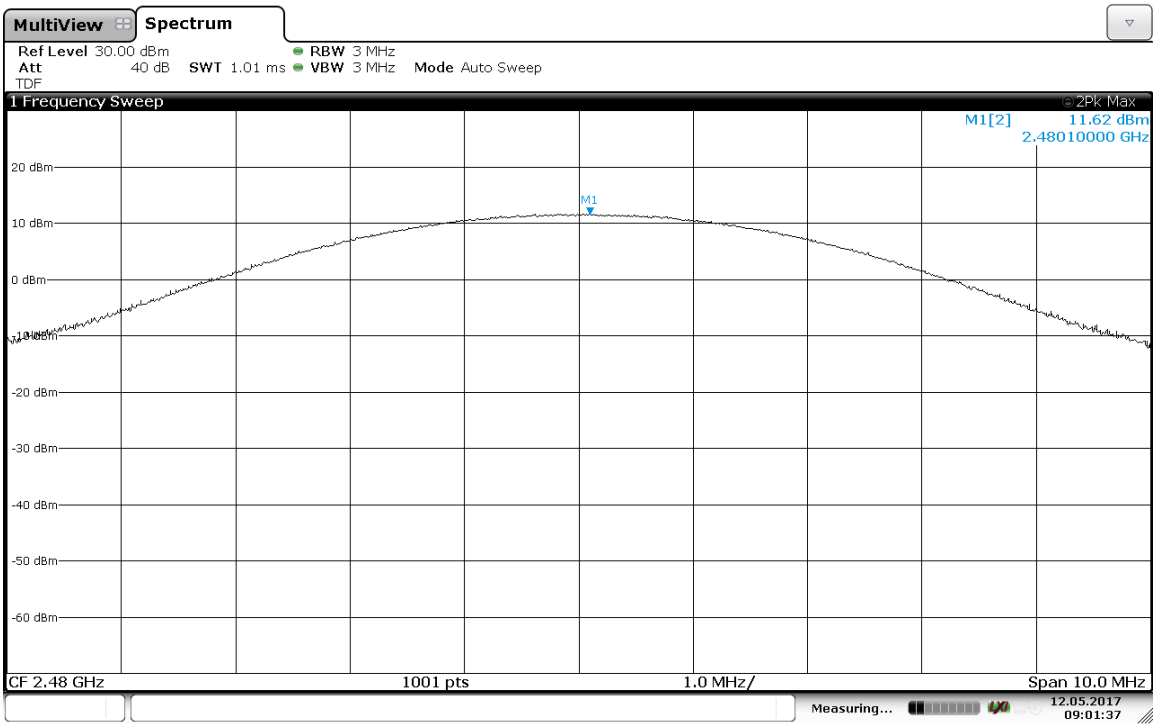
Pi/4DPSK Modulation, High Channel (2480 MHz), Output Power @ DH1 Data rate = 11.65 dBm



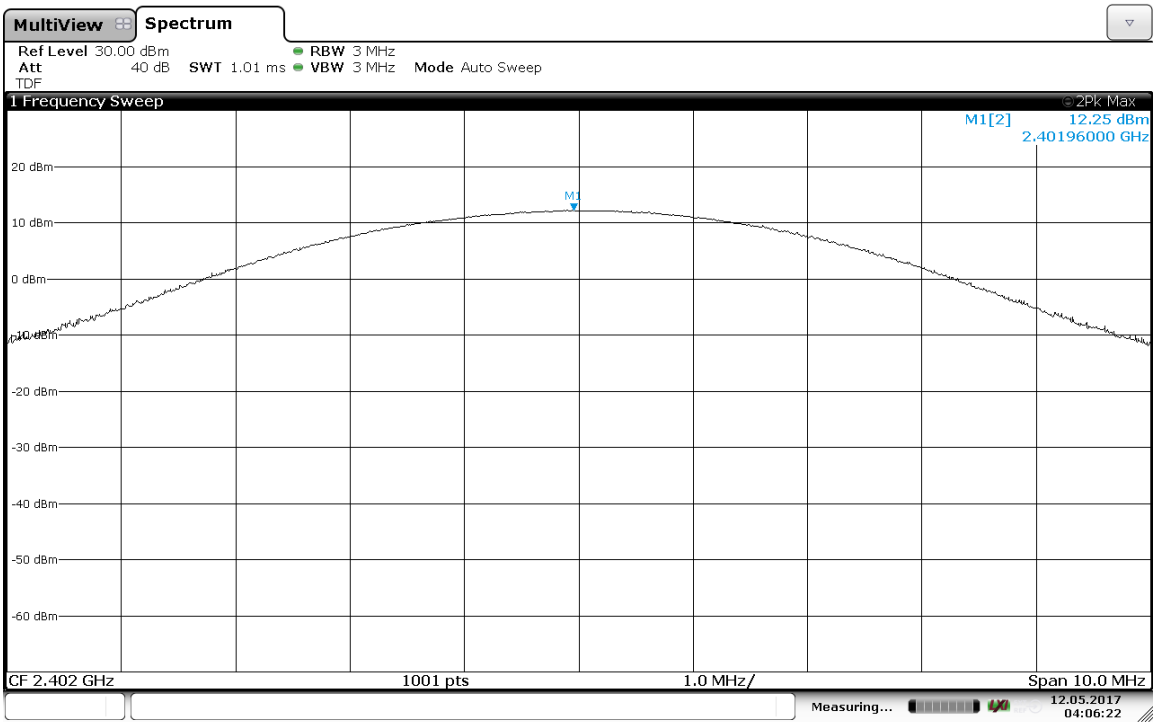
Pi/4DPSK Modulation, High Channel (2480 MHz), Output Power @ DH3 Data rate = 11.65 dBm



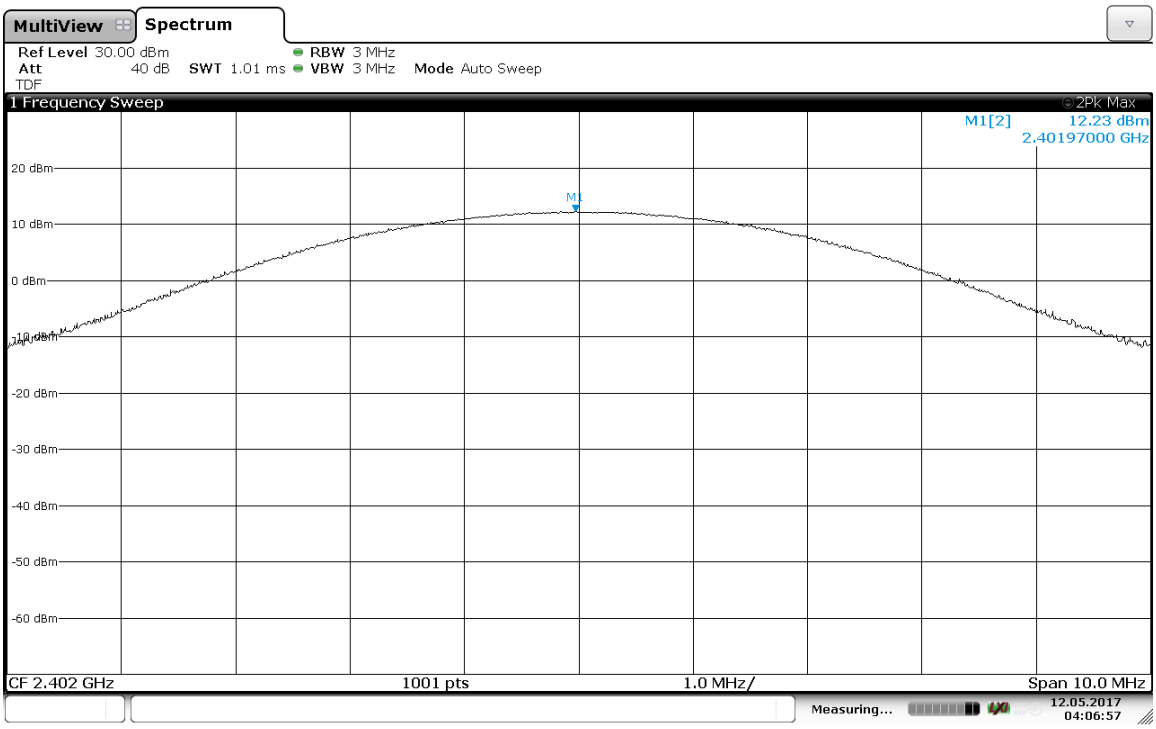
Pi/4DPSK Modulation, High Channel (2480 MHz), Output Power @ DH5 Data rate = 11.65 dBm



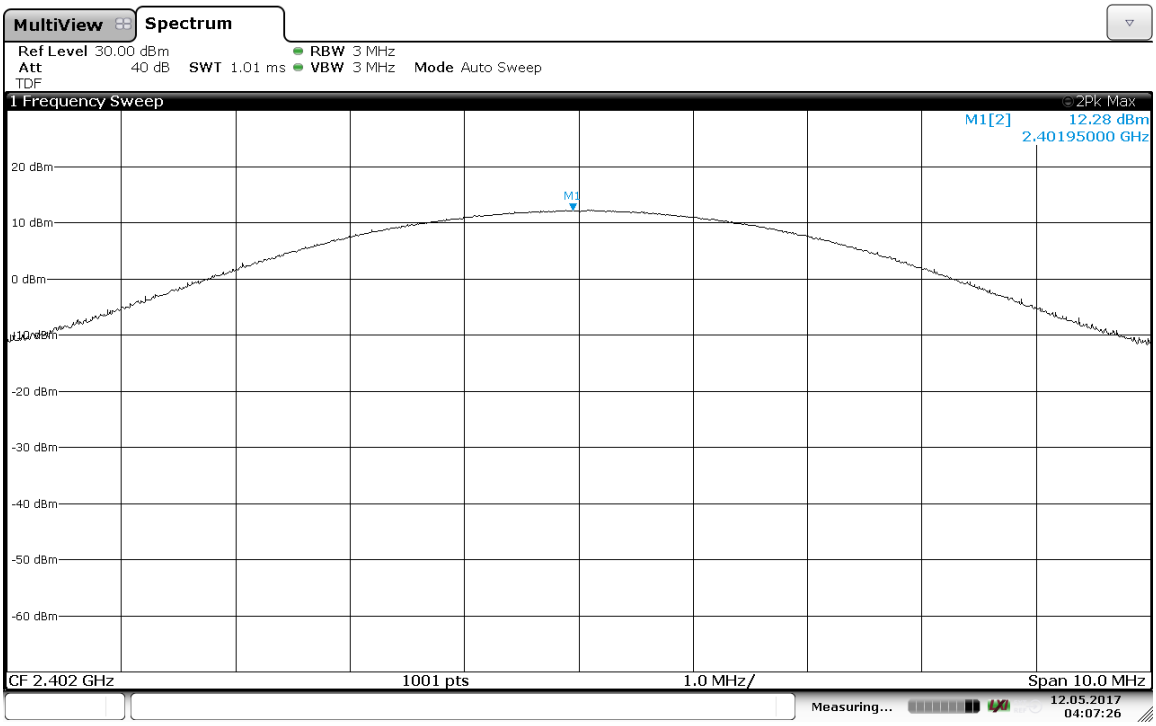
8DPSK Modulation, Low Channel (2402 MHz), Output Power @ DH1 Data rate = 12.25 dBm



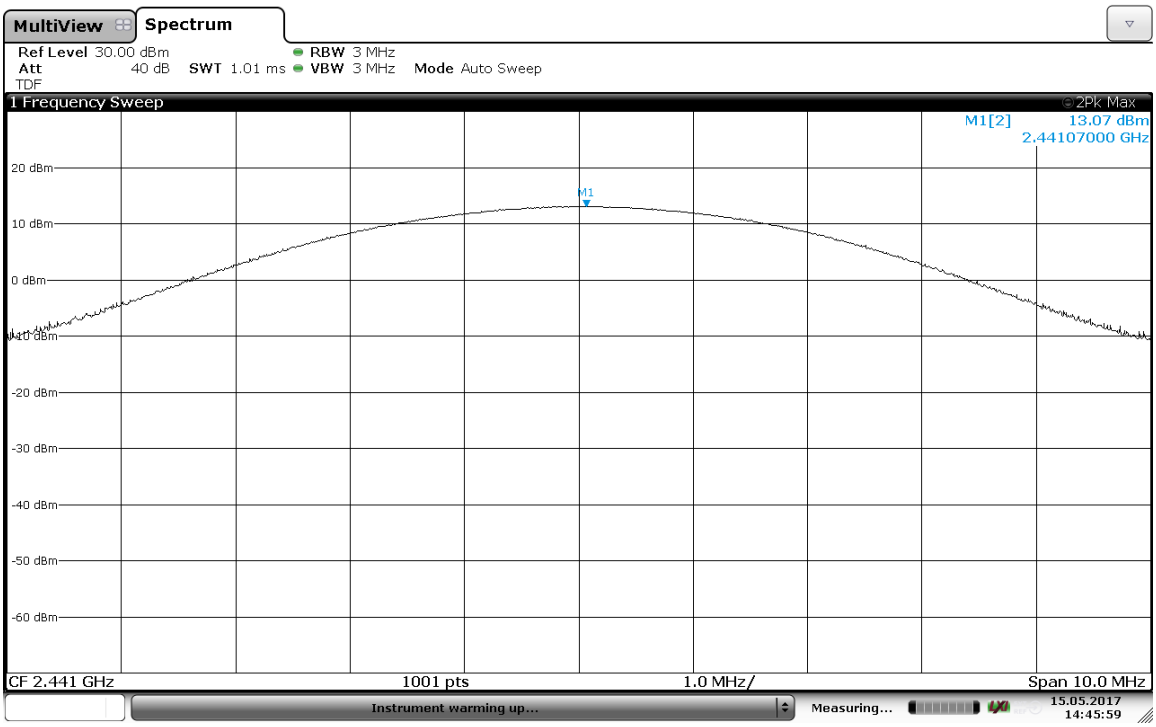
8DPSK Modulation, Low Channel (2402 MHz), Output Power @ DH3 Data rate = 12.23 dBm



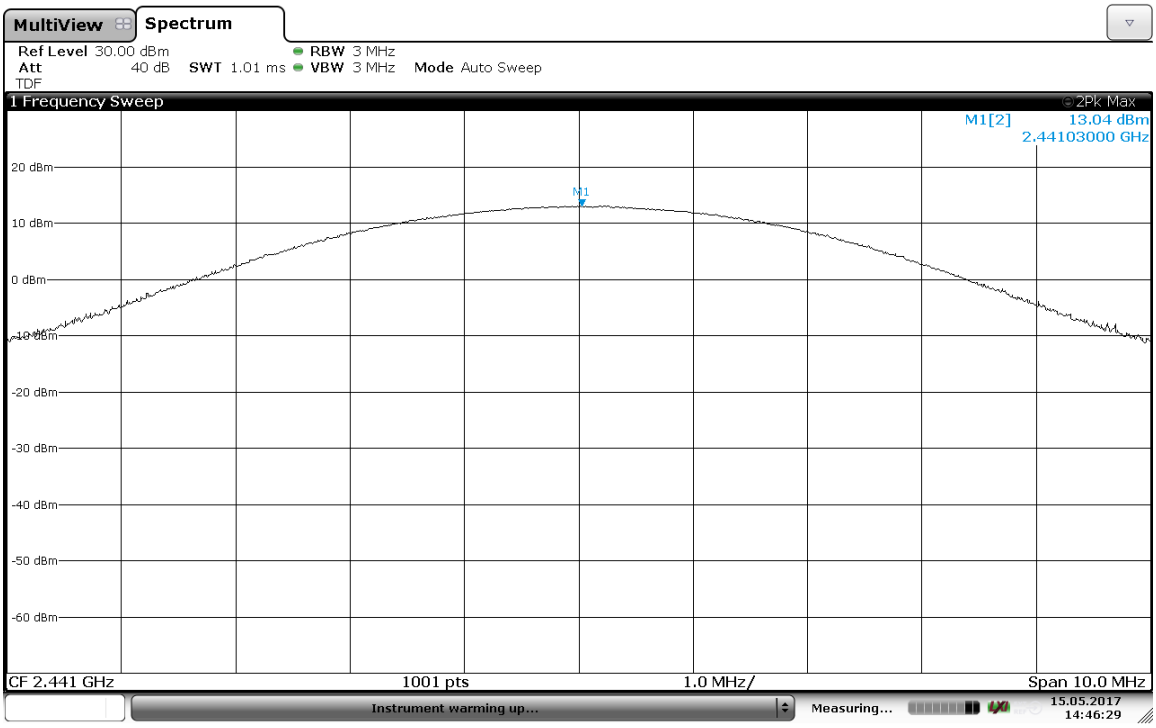
8DPSK Modulation, Low Channel (2402 MHz), Output Power @ DH5 Data rate = 12.28 dBm



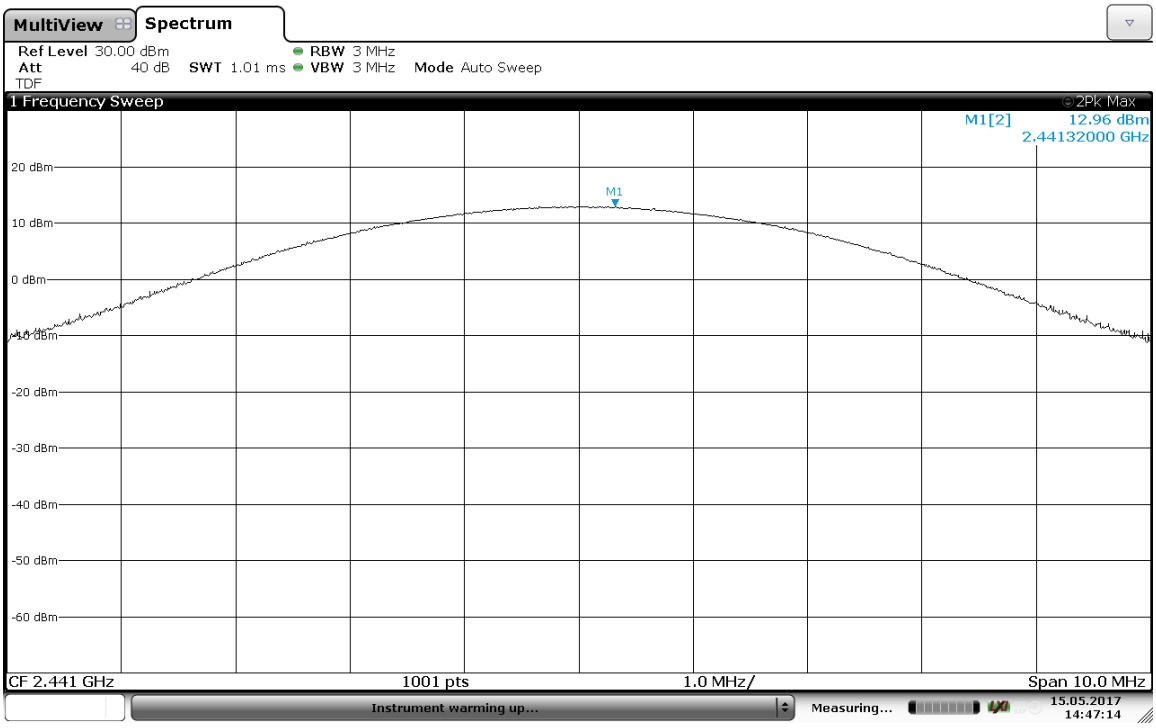
8DPSK Modulation, Mid Channel (2441 MHz), Output Power @ DH1 Data rate = 13.07 dBm



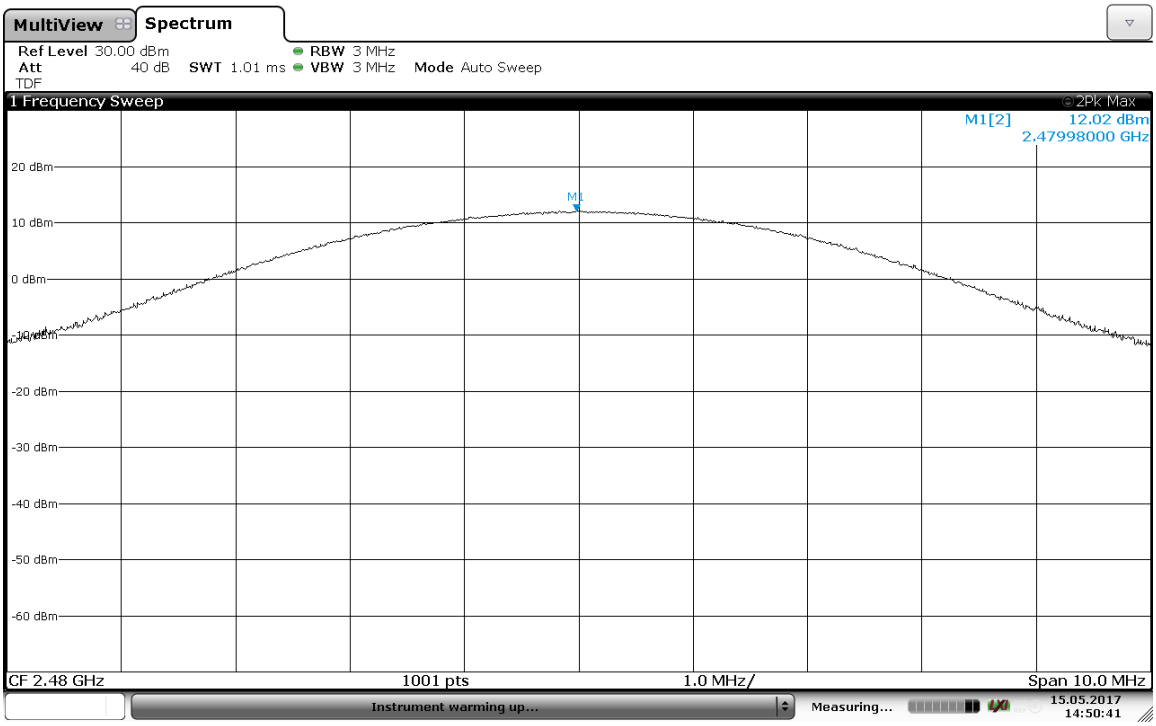
8DPSK Modulation, Mid Channel (2441 MHz), Output Power @ DH3 Data rate = 13.04 dBm



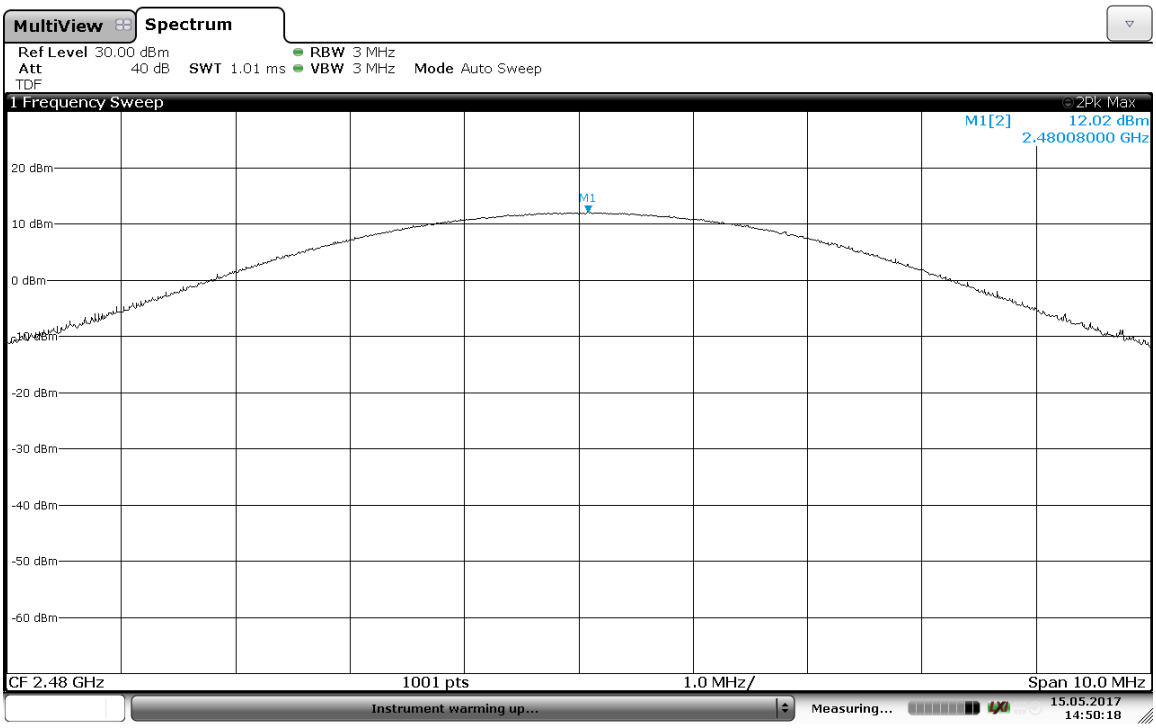
8DPSK Modulation, Mid Channel (2441 MHz), Output Power @ DH5 Data rate = 12.96 dBm



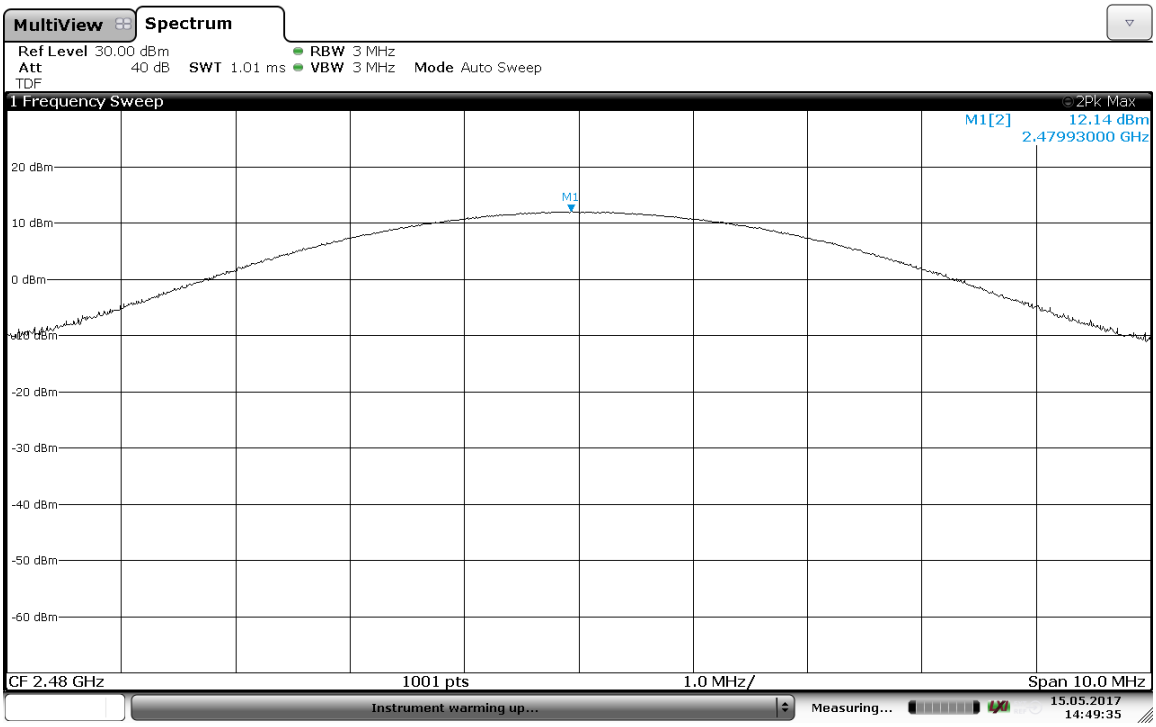
8DPSK Modulation, High Channel (2480 MHz), Output Power @ DH1 Data rate = 12.02 dBm



8DPSK Modulation, High Channel (2480 MHz), Output Power @ DH3 Data rate = 12.02 dBm



8DPSK Modulation, High Channel (2480 MHz), Output Power @ DH5 Data rate = 12.02 dBm



6.5 RF Exposure

6.6 Method

Calculation in in accordance with CFR47 FCC Part 15 Subpart C: 2017 Paragraphs 15.215, 15.247(i), Innovation, Science and Economic Development Canada's (ISED) RSS-GEN: 2014 Section 3.2.

The maximum measured conducted power, P is 13.07 dBm.
The antenna gain, G is 2.6 dBi.
The maximum EIRP power = P+G
EIRP = 13.07 + 2.6 = 15.67 dBm or 0.0366 W
The limits for Maximum Permissible Exposure (MPE) for transmitter operating at 2.4 GHz,
MPE is 1.0 W/m^2.
The Power Density, S is related to EIRP with the equation:
$S = EIRP / 4\pi D^2$, where D is the safe separation distance and = 0.2 m, or 20 cm
$S = 0.0366 W / 4\pi 0.2^2$,
$S = 0.072 W/m^2$,
which is below the Maximum Permissible Exposure (MPE) of 10 W/m^2 and RSS 102 Issue 5 RF Exposure limit 5.35 W/ m^2

Test Personnel:	Naga Suryadevara N.S	Test Date:	06/07/2017
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC 15.247 RSS 247	Limit Applied:	See section 6.3
Input Voltage:	120VAC 60Hz		
		Ambient Temperature:	22 ºC
Pretest Verification:	N/A	Relative Humidity:	33 %
		Atmospheric Pressure:	1008mbars

Deviations, Additions, or Exclusions: None

7 20dB and Occupied Bandwidth

7.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C and RSS 247.

TEST SITE: EMC Lab (Boxborough, MA)

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

7.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV004'	Weather Station	Davis Instruments	7400	PE80529A61A	05/10/2017	05/10/2018
ROS005'	ETSI Test System	Rhode & Schwartz	TS8997	N/A	09/15/2016	09/15/2017
MIN23'	Attenuator 2 watt 20dB DC-26GHz	Mini Circuits	BW-S20-2W263+	MIN23	05/20/2017	05/20/2018
CBLHF2012-2M-1'	2m 9kHz-40GHz Coaxial Cable - SET1	Huber & Suhner	SF102	252675001	02/08/2017	02/08/2018

Software Utilized:

Name	Manufacturer	Version
None (Spectrum Analyzer Firmware)		

7.3 Results:

The sample tested was found to Comply.

FCC 15.247(a)(1)(i)

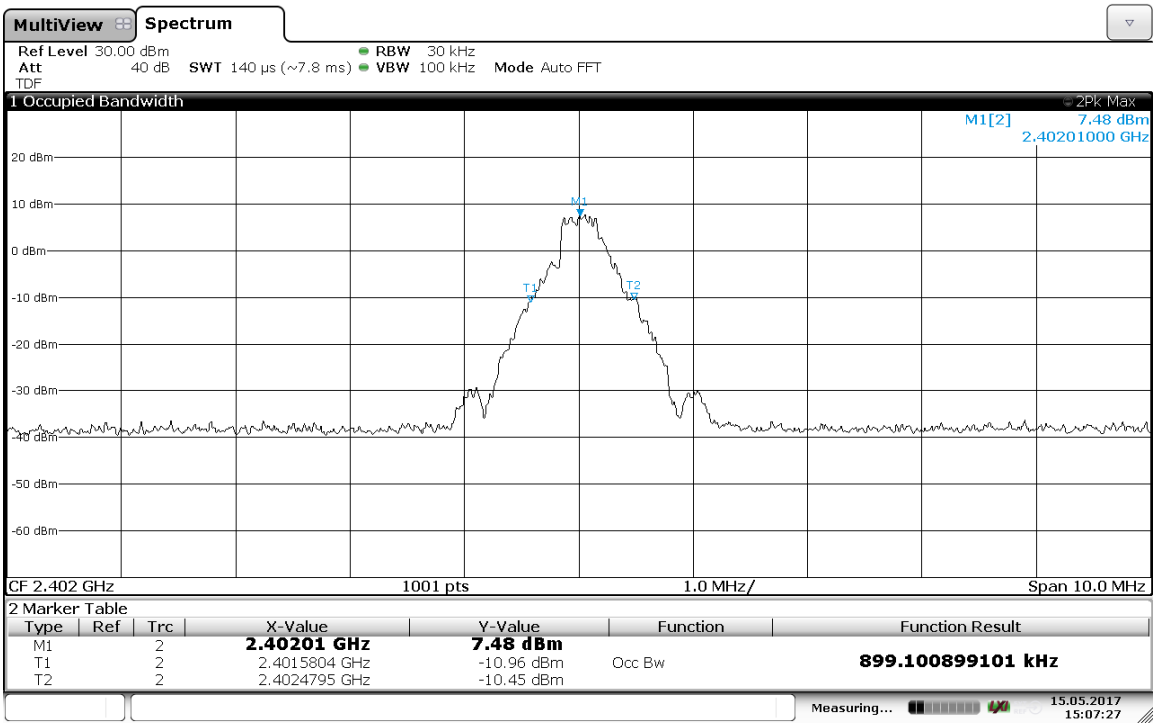
(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(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.

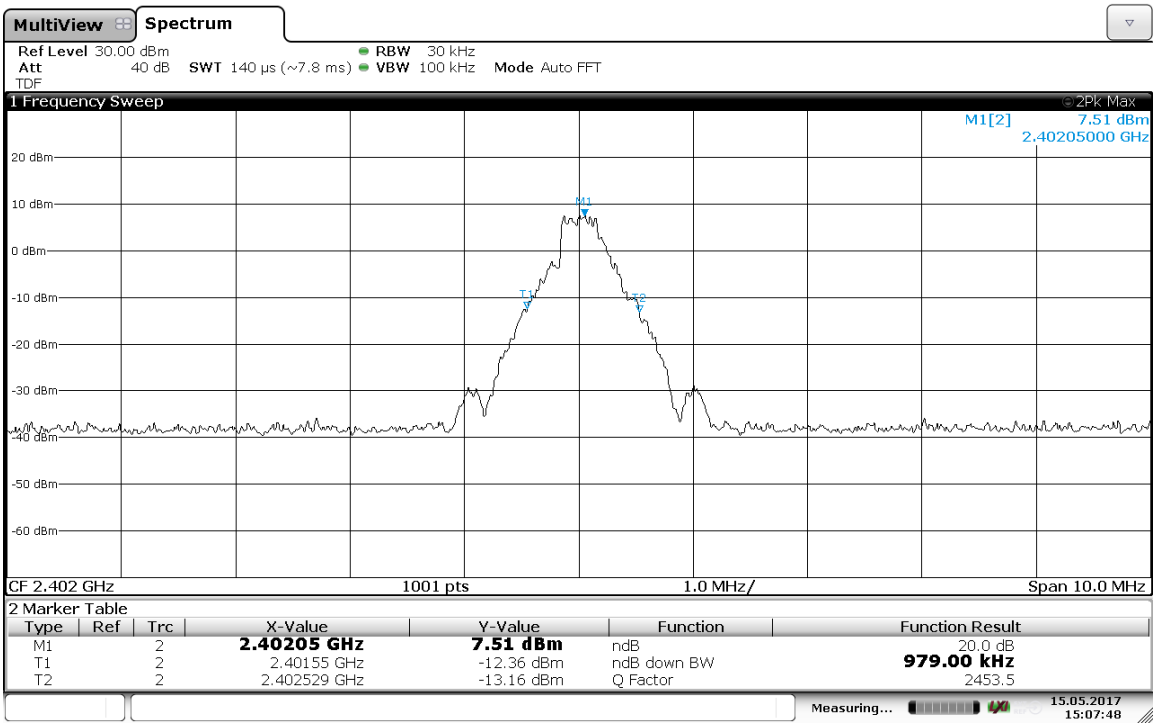
RSS-247 Section 5.1(a)
a) The bandwidth of a frequency hopping channel is the 20 dB emission bandwidth, measured with the hopping stopped. The system's radio frequency (RF) bandwidth is equal to the channel bandwidth multiplied by the number of channels in the hopset. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. 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.

7.4 Plots/Data:

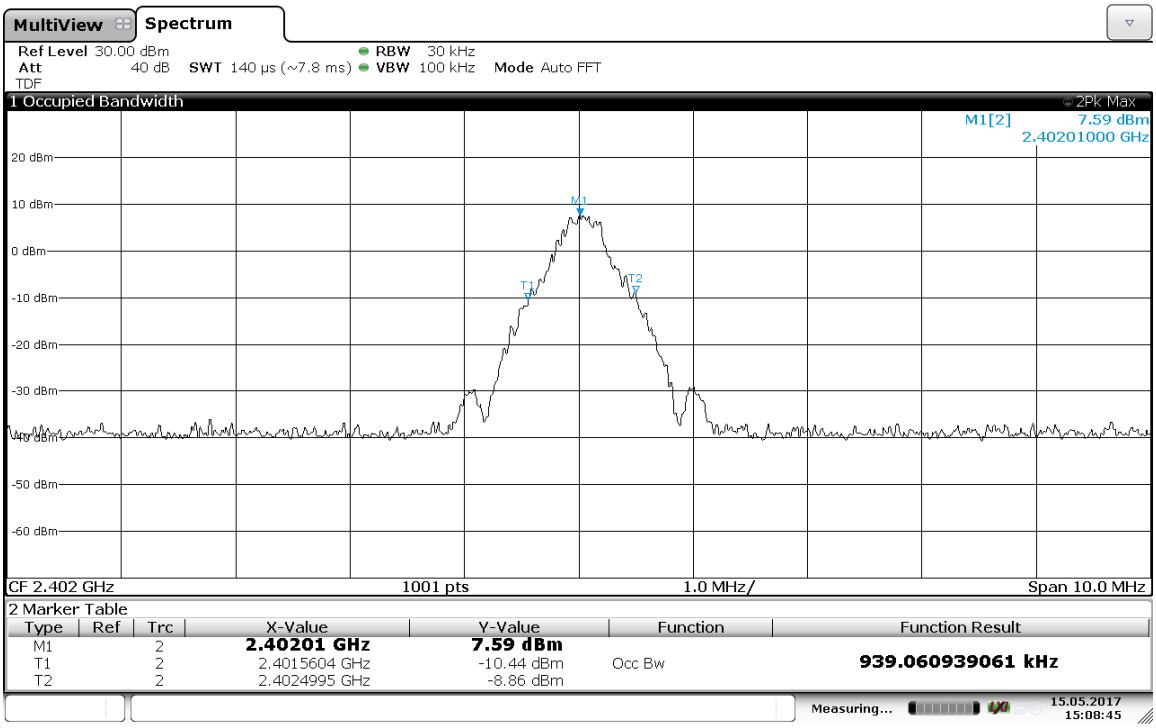
GFSK modulation, Low Channel (2402 MHz), OBW @ DH1 data rate = 899.10 kHz



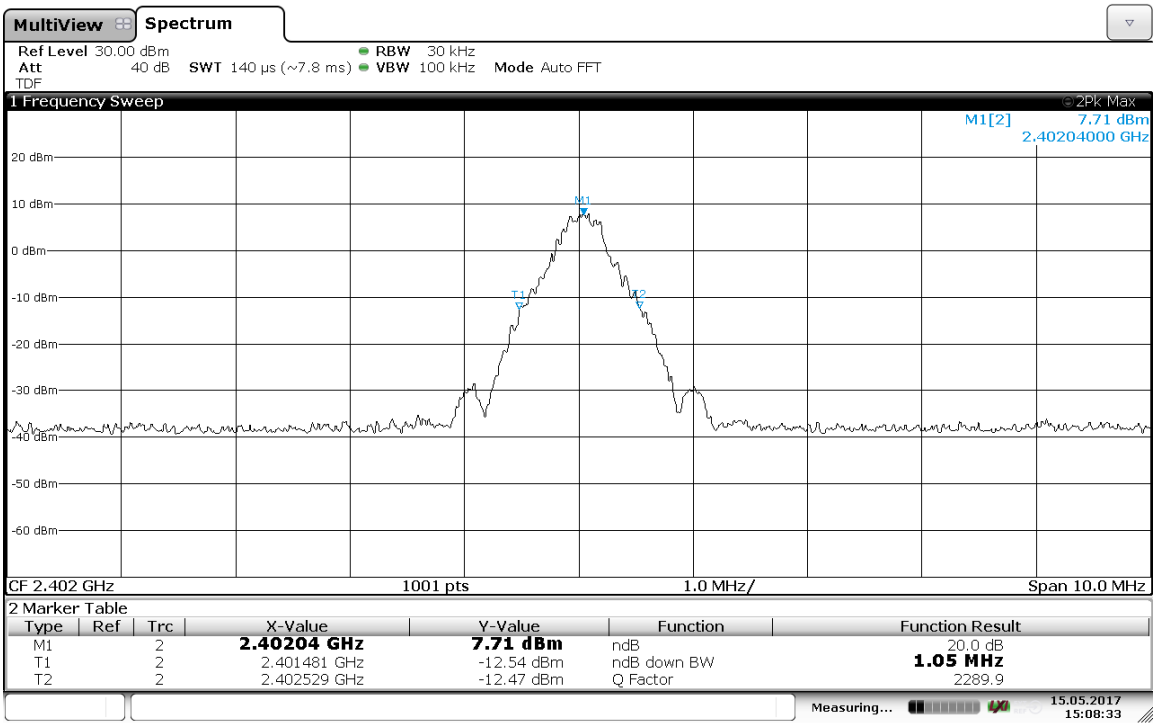
GFSK modulation, Low Channel (2402 MHz), 20 dB BW @ DH1 data rate = 979.00 kHz



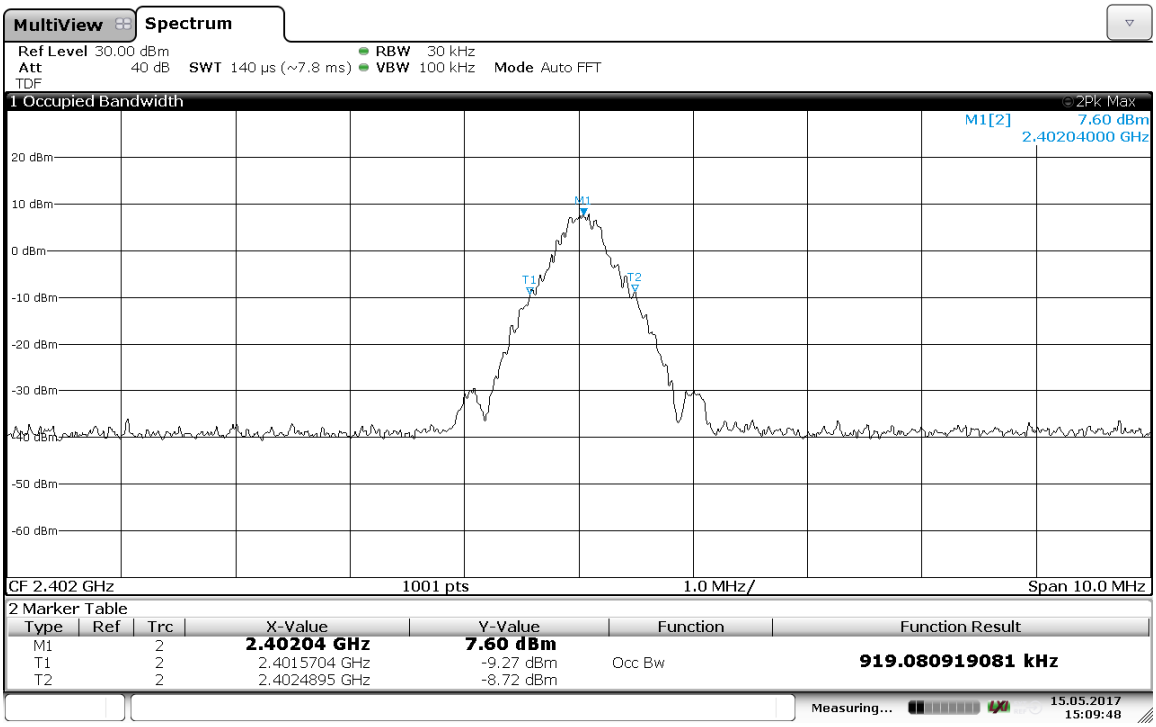
GFSK modulation, Low Channel (2402 MHz), OBW @ DH3 data rate = 939.06 kHz



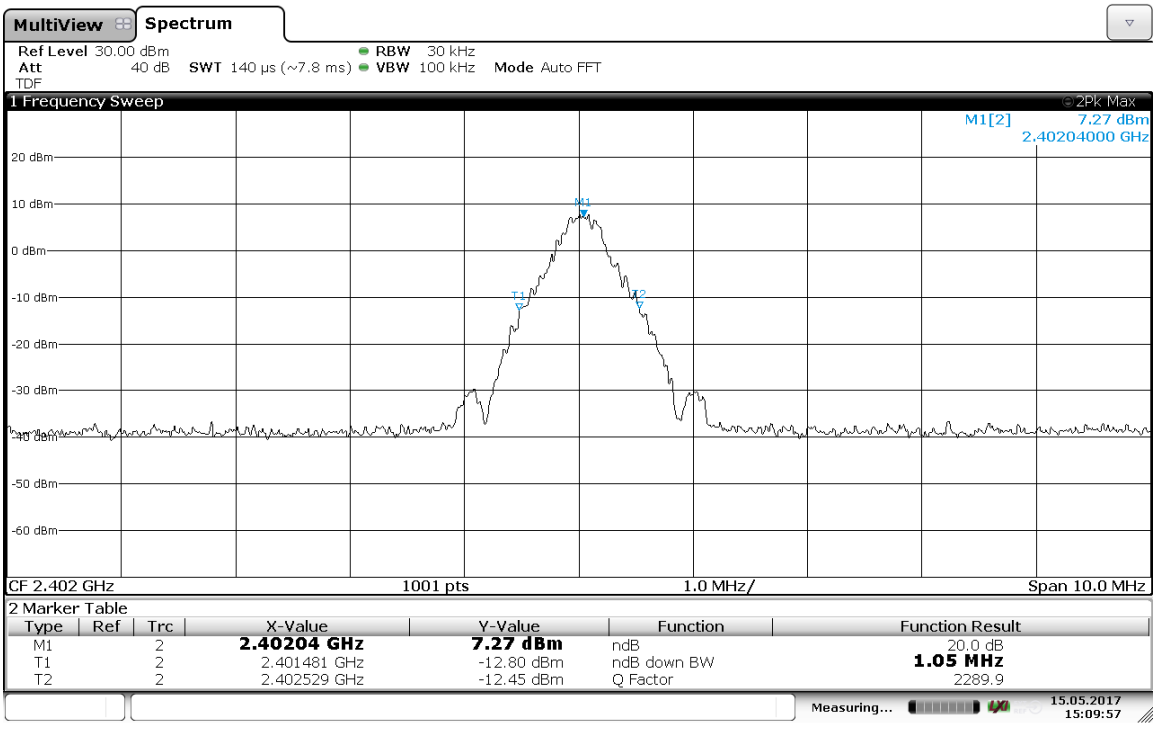
GFSK modulation, Low Channel (2402 MHz), 20 dB BW @ DH3 data rate = 1.05 MHz



GFSK modulation, Low Channel (2402 MHz), OBW @ DH5 data rate = 919.08 kHz

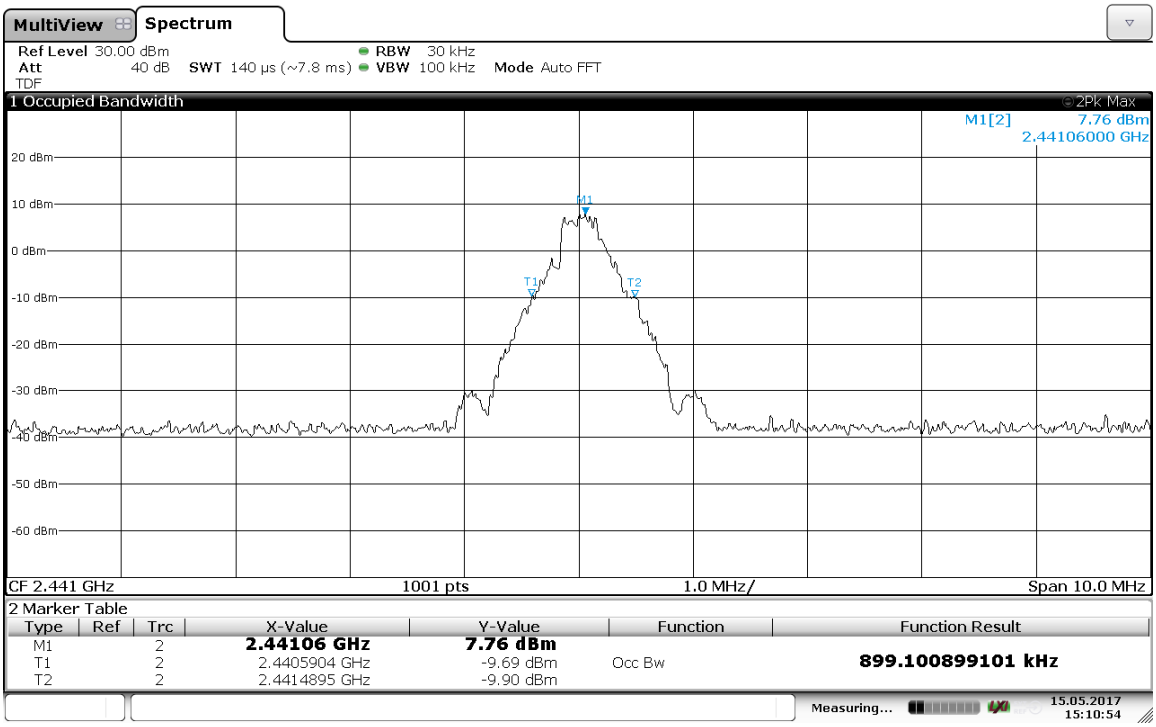


GFSK modulation, Low Channel (2402 MHz), 20 dB BW @ DH5 data rate = 1.05 MHz

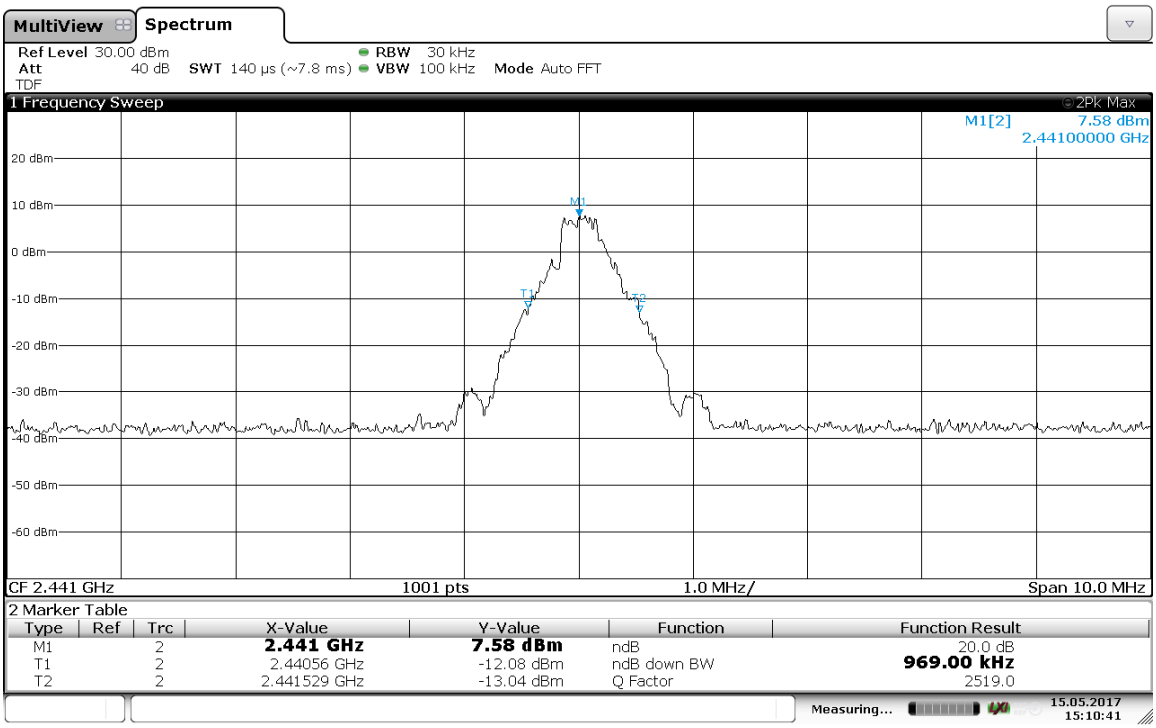


Date: 15.MAY.2017 15:09:57

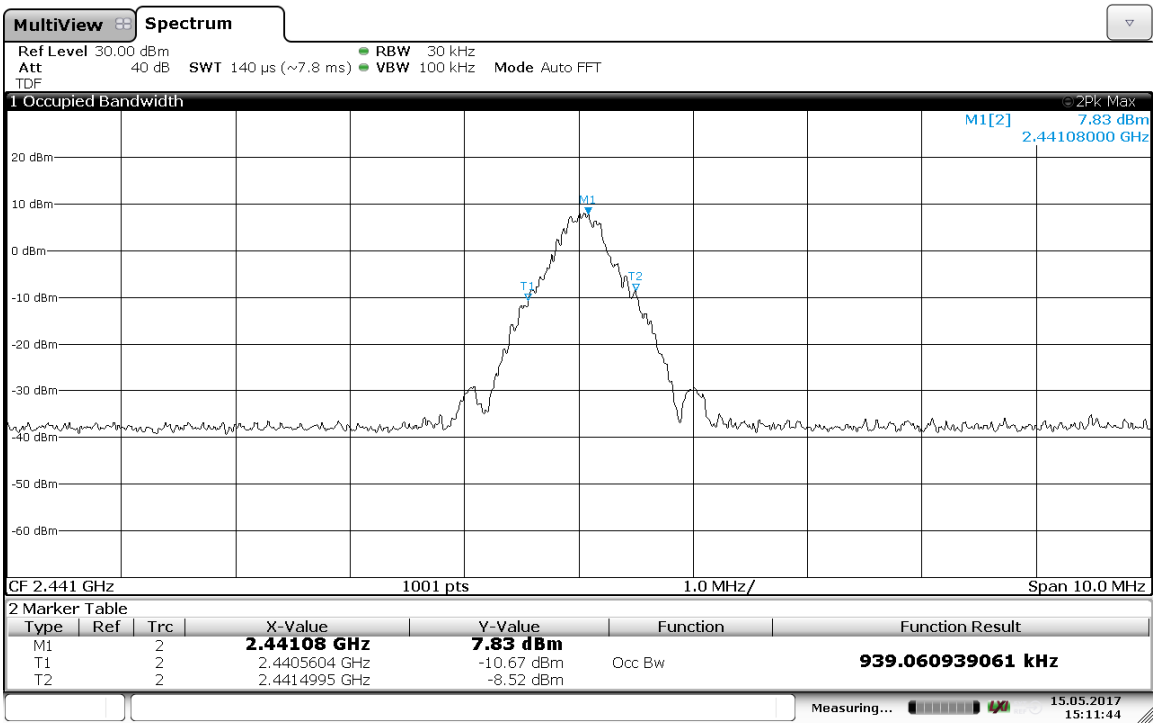
GFSK modulation, Mid Channel (2441 MHz), OBW @ DH1 data rate = 899.10 kHz



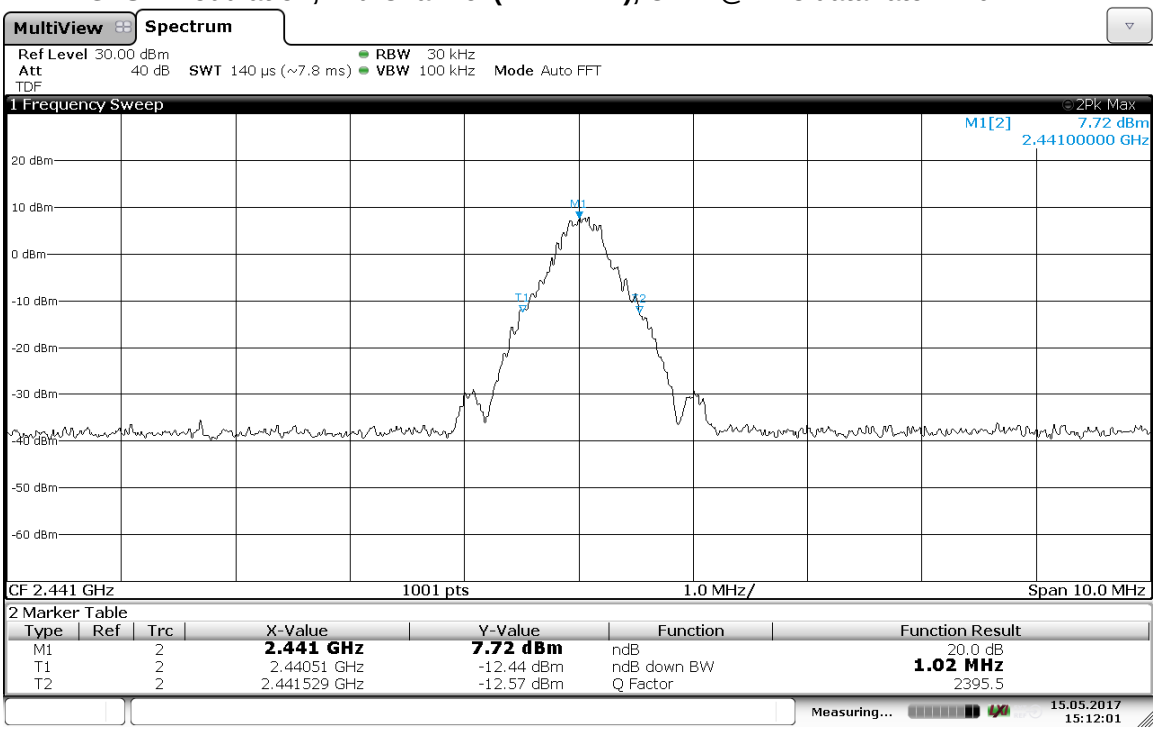
GFSK modulation, Mid Channel (2441 MHz), 20 dB BW @ DH1 data rate = 969.00 kHz



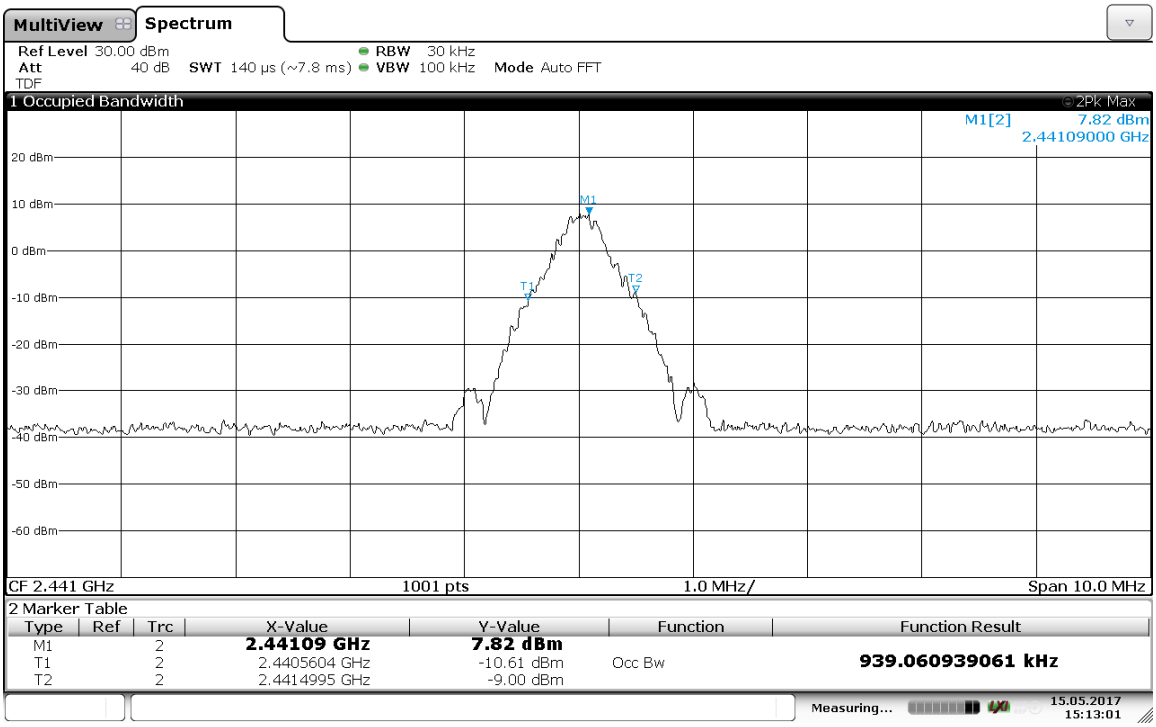
GFSK modulation, Mid Channel (2441 MHz), OBW @ DH3 data rate = 939.06 kHz



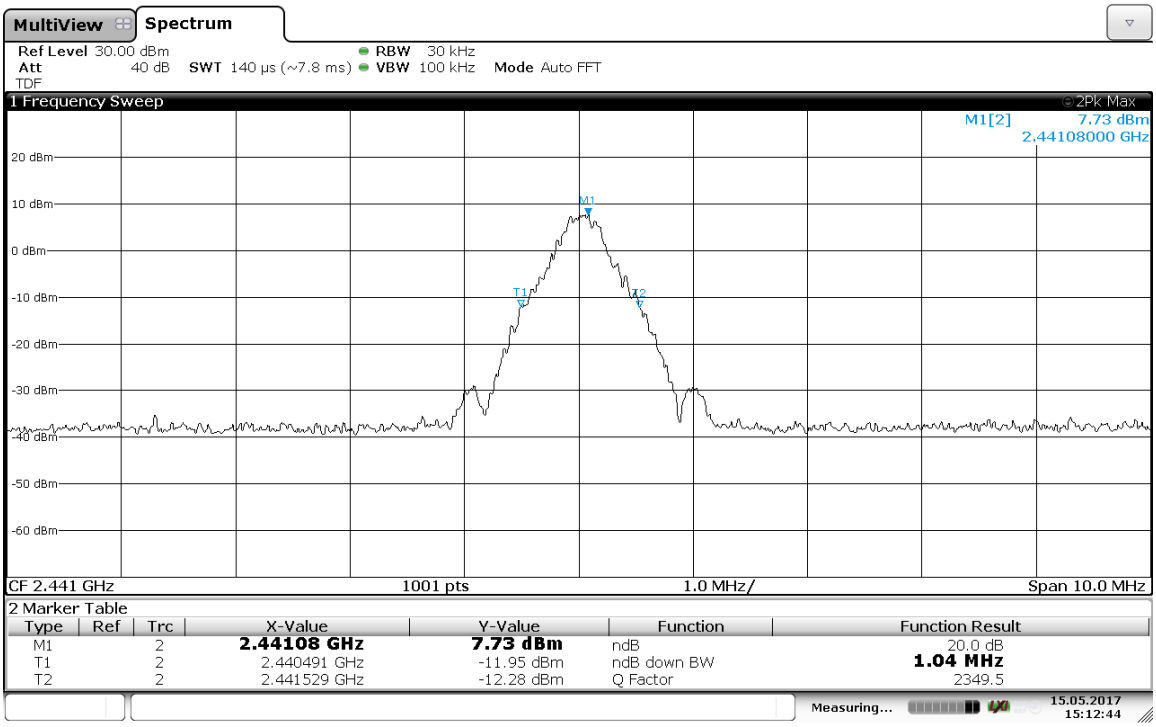
GFSK modulation, Mid Channel (2441 MHz), OBW @ DH3 data rate = 1.02 MHz



GFSK modulation, Mid Channel (2441 MHz), OBW @ DH5 data rate = 939.06 KHz

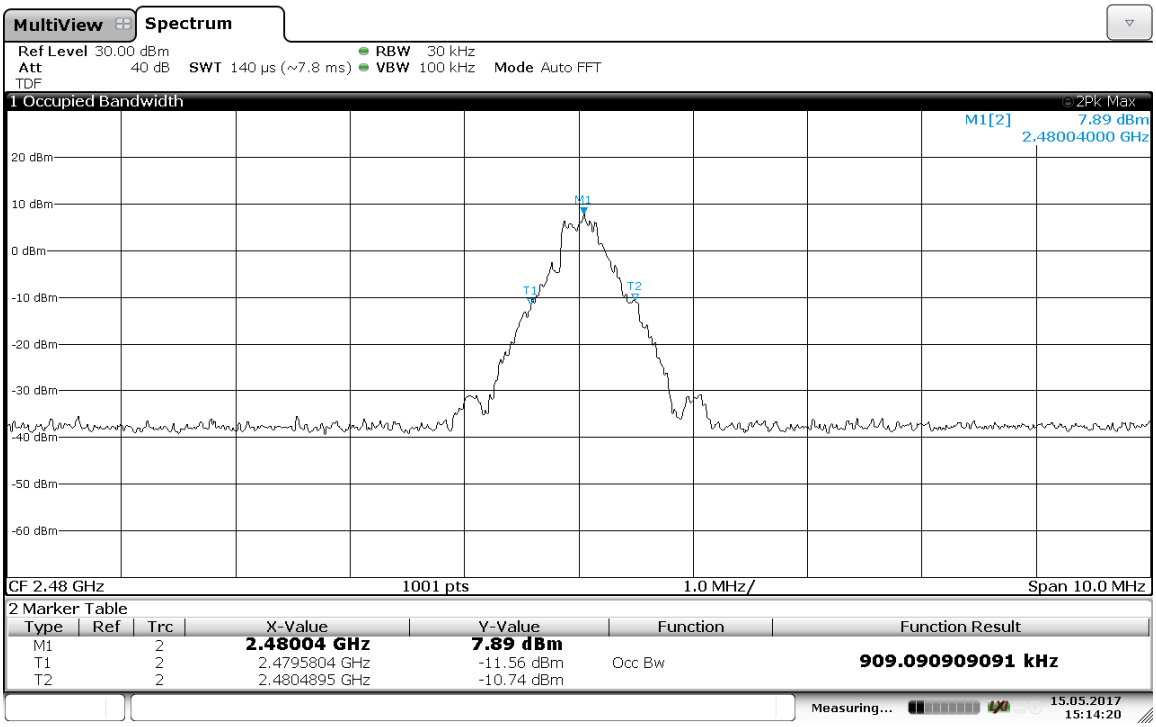


GFSK modulation, Mid Channel (2441 MHz), 20 dB BW @ DH5 data rate = 1.04 MHz

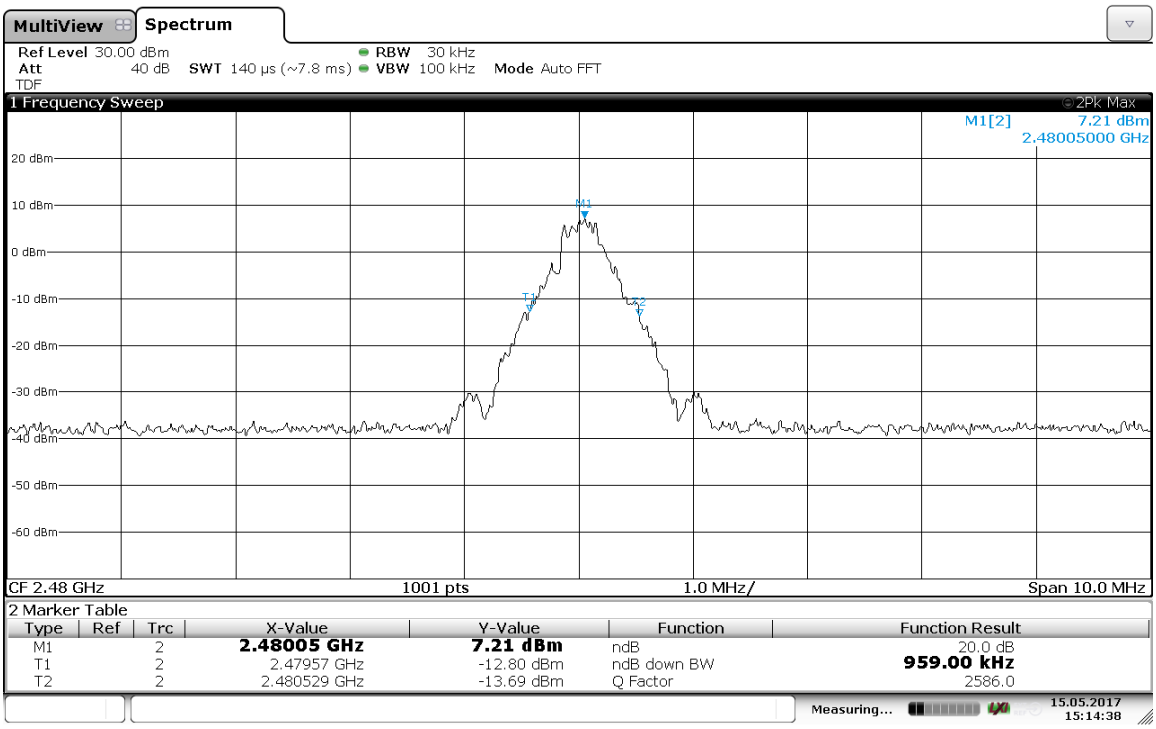


Date: 15.MAY.2017 15:12:44

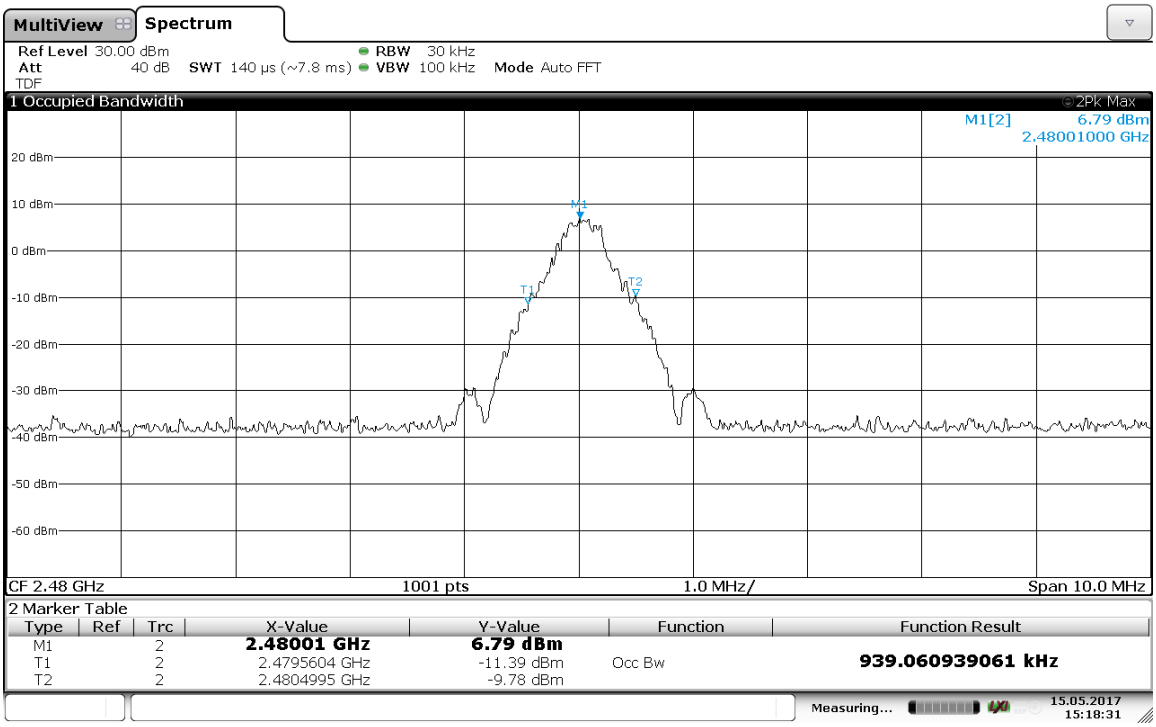
GFSK modulation, High Channel (2480 MHz), OBW @ DH1 data rate = 909.09 KHz



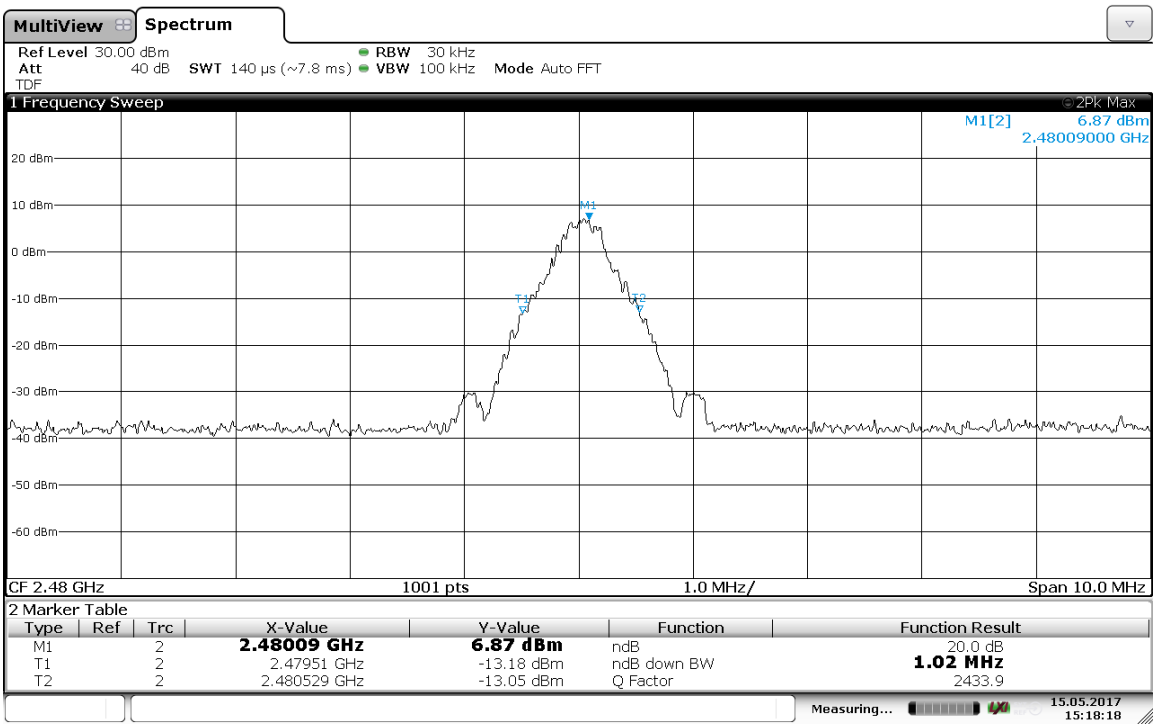
GFSK modulation, High Channel (2480 MHz), 20 dB BW @ DH1 data rate = 959.00 KHz



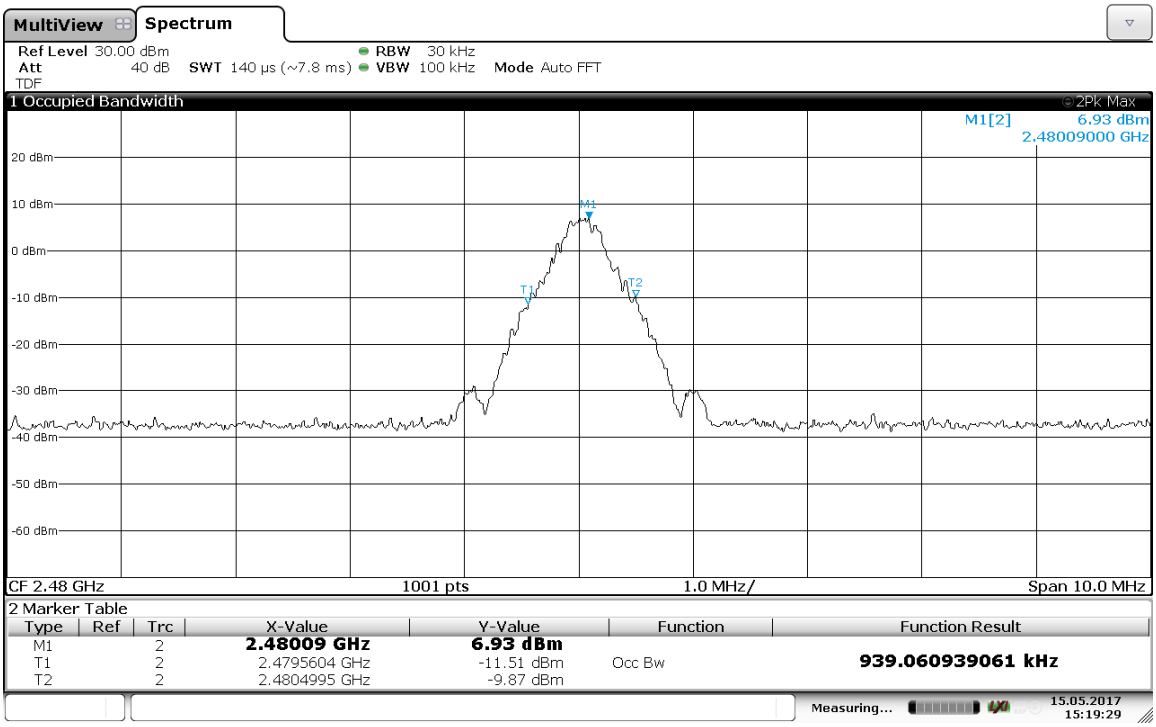
GFSK modulation, High Channel (2480 MHz), OBW @ DH3 data rate = 939.06 KHz



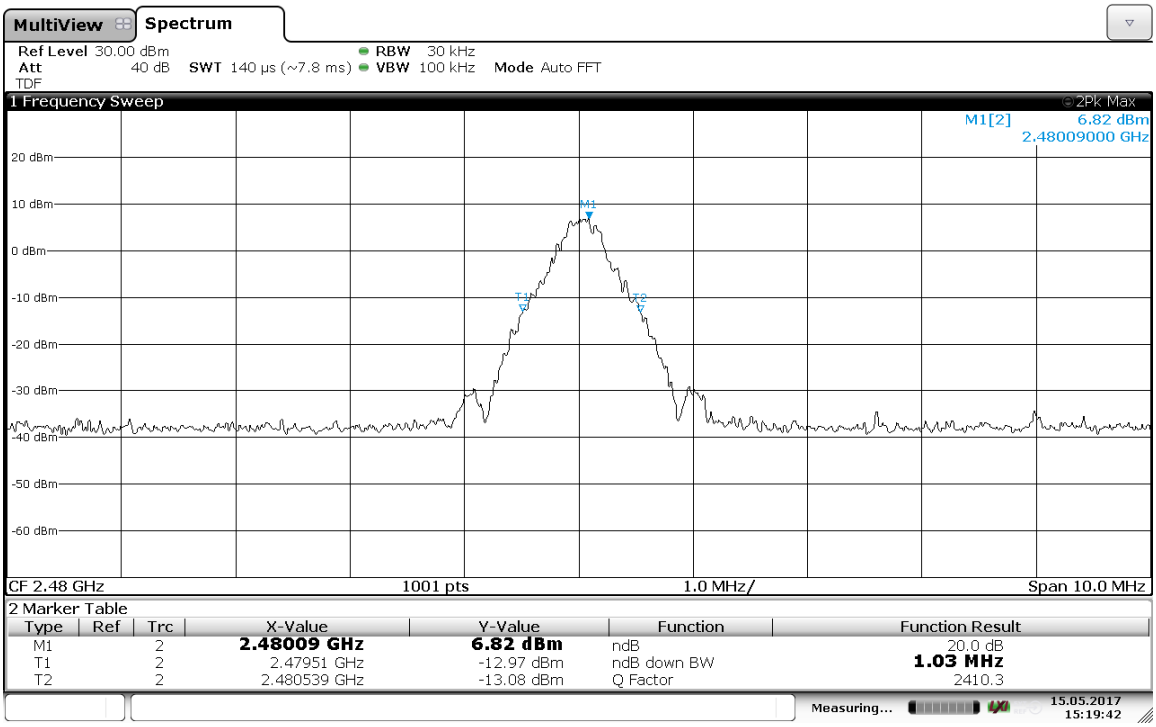
GFSK modulation, High Channel (2480 MHz), 20 dB BW @ DH3 data rate = 1.02 MHz



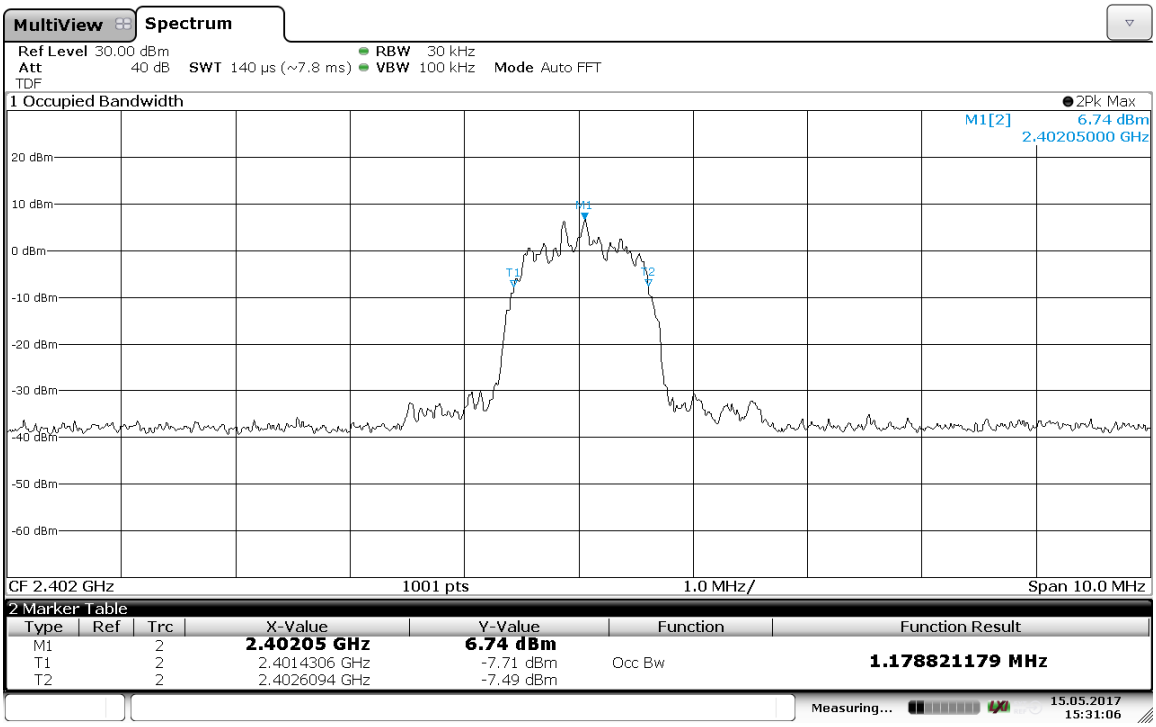
GFSK modulation, High Channel (2480 MHz), OBW @ DH5 data rate = 939.06 KHz



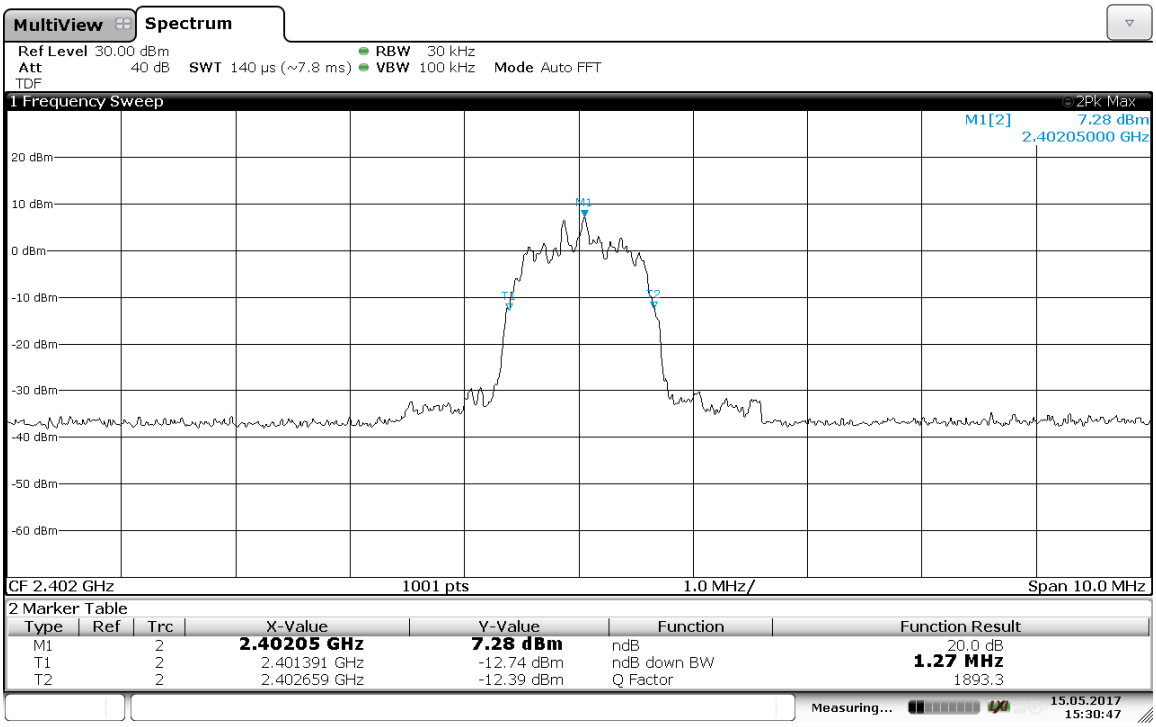
GFSK modulation, High Channel (2480 MHz), OBW @ DH5 data rate = 1.03 MHz



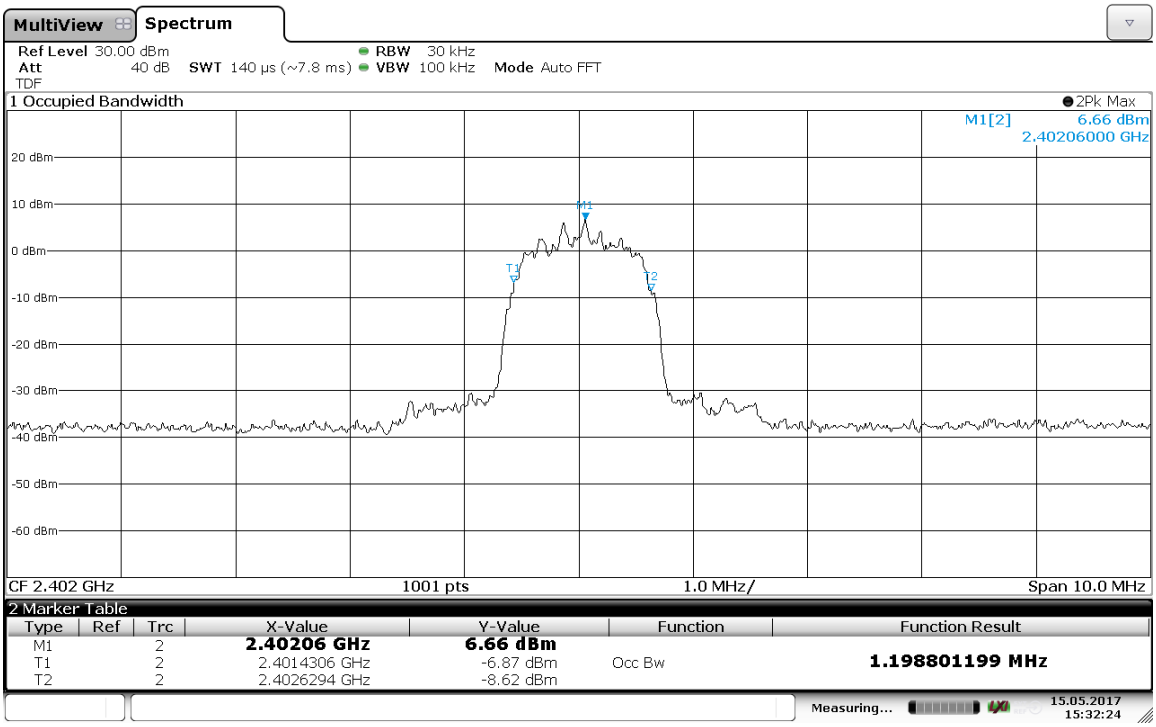
Pi/4DPSK modulation, Low Channel (2402 MHz), OBW @ DH1 data rate = 1.17 MHz



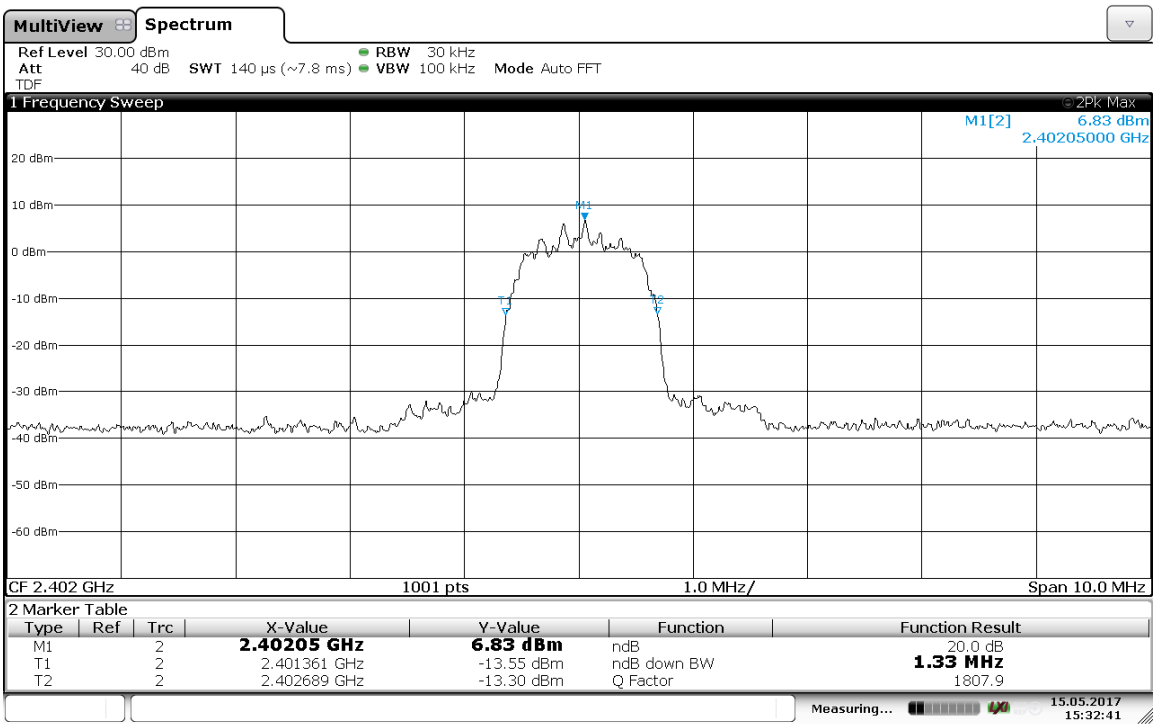
Pi/4DPSK modulation, Low Channel (2402 MHz), 20 dB BW @ DH1 data rate = 1.27 MHz



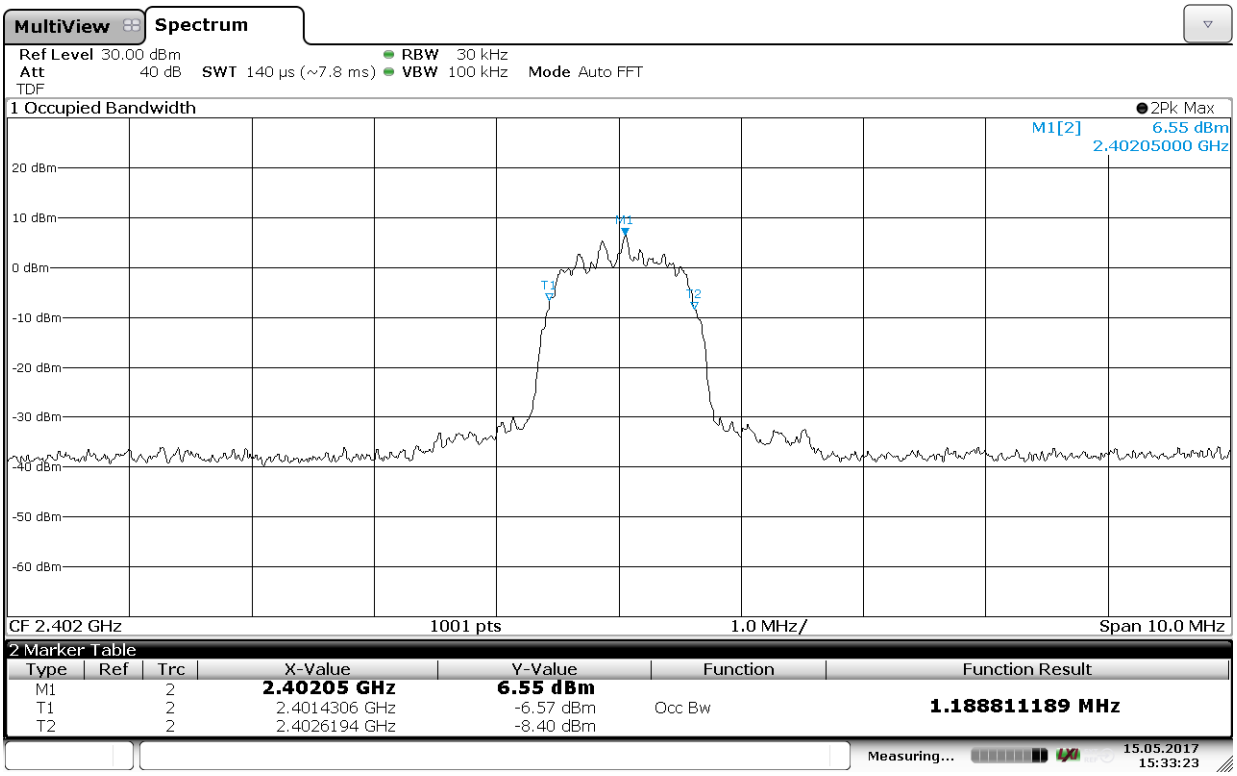
Pi/4DPSK modulation, Low Channel (2402 MHz), OBW @ DH3 data rate = 1.19 MHz



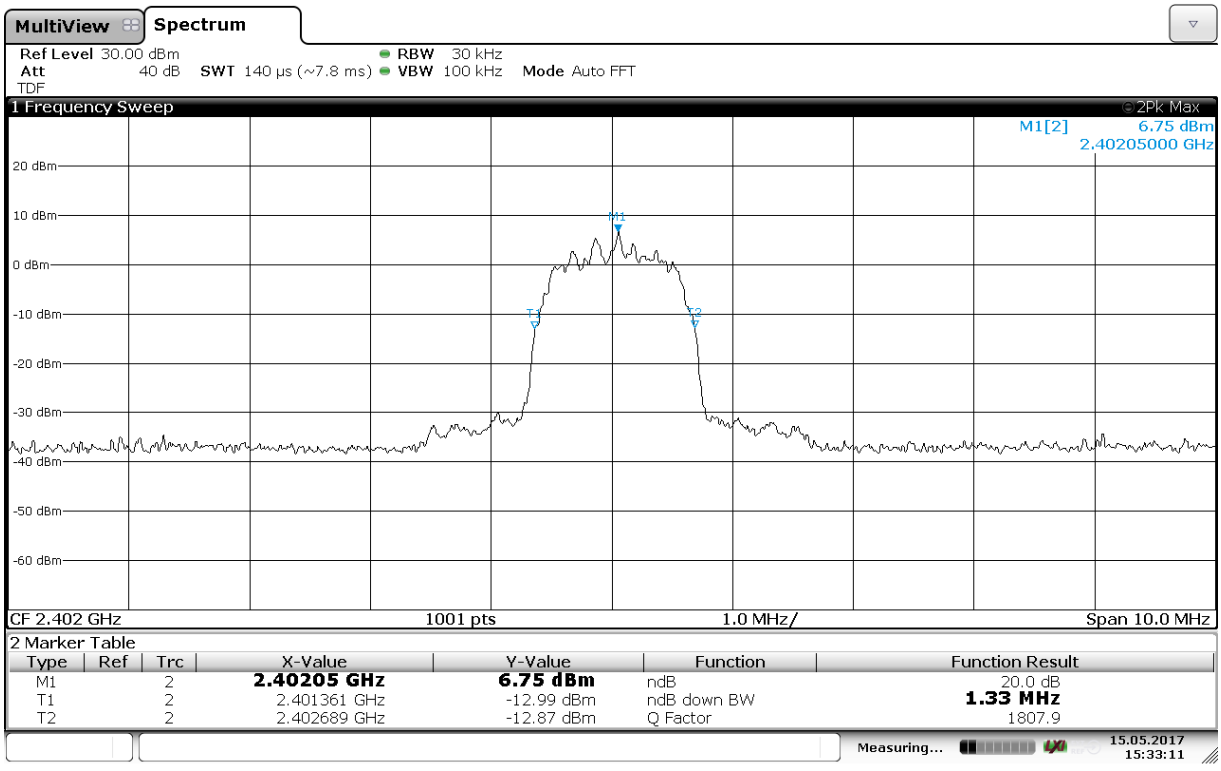
Pi/4DPSK modulation, Low Channel (2402 MHz), 20 dB BW @ DH3 data rate = 1.33 MHz



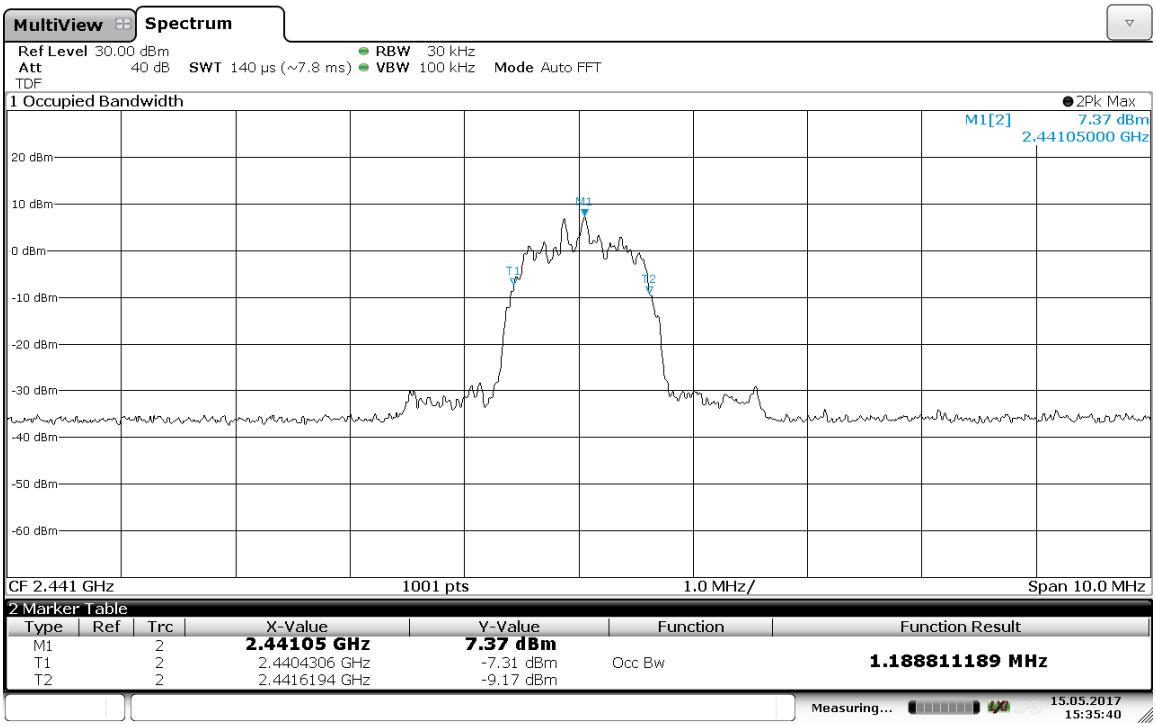
Pi/4DPSK modulation, Low Channel (2402 MHz), OBW @ DH5 data rate = 1.18 MHz



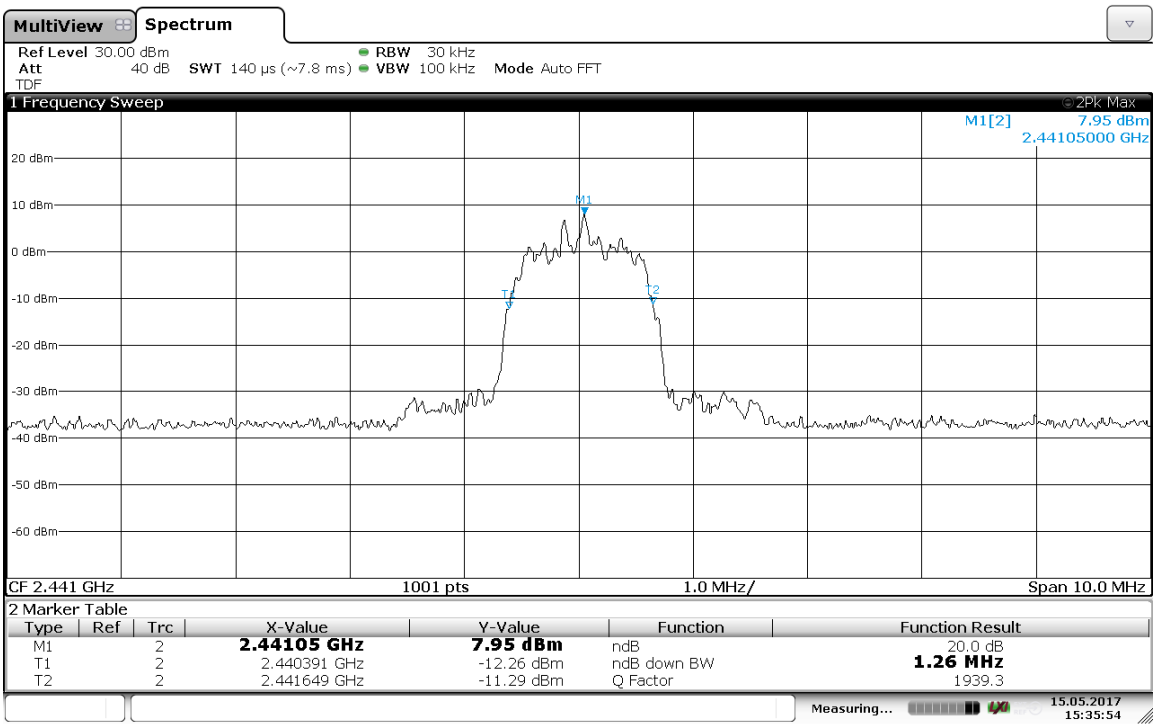
Pi/4DPSK modulation, Low Channel (2402 MHz), 20 dB BW @ DH5 data rate = 1.33 MHz



Pi/4DPSK modulation, Mid Channel (2441 MHz), OBW @ DH1 data rate = 1.18 MHz

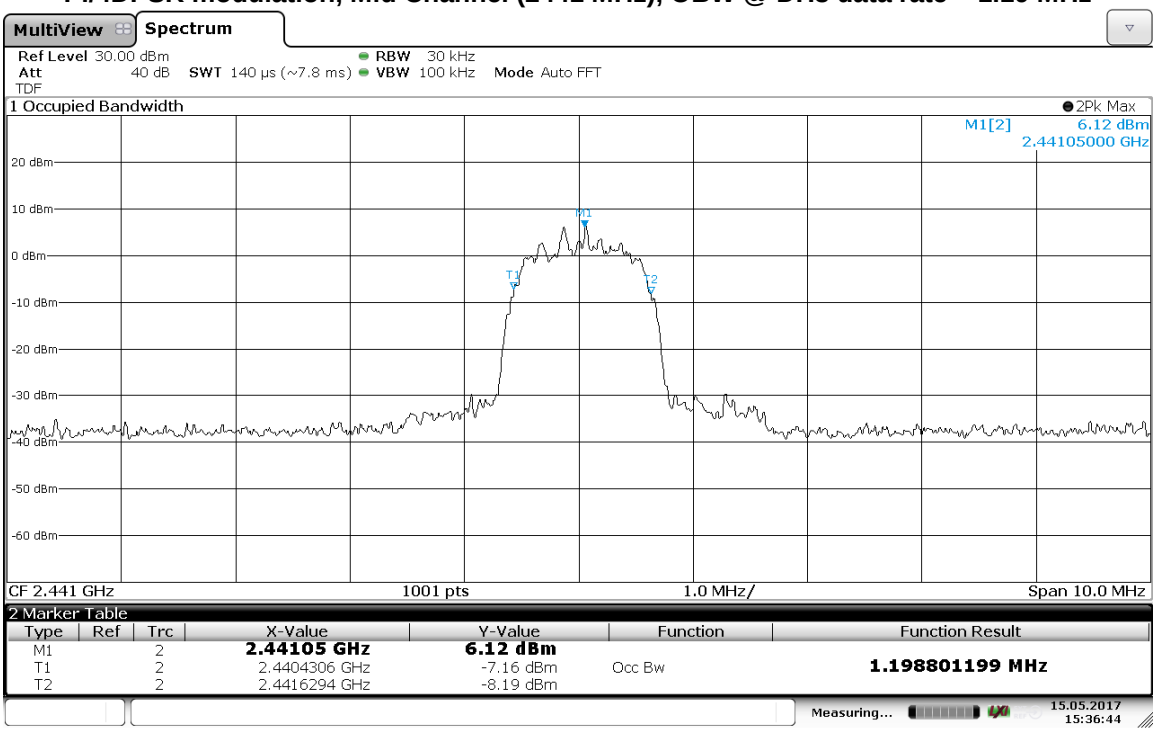


Pi/4DPSK modulation, Mid Channel (2441 MHz), 20 dB BW @ DH1 data rate = 1.26 MHz

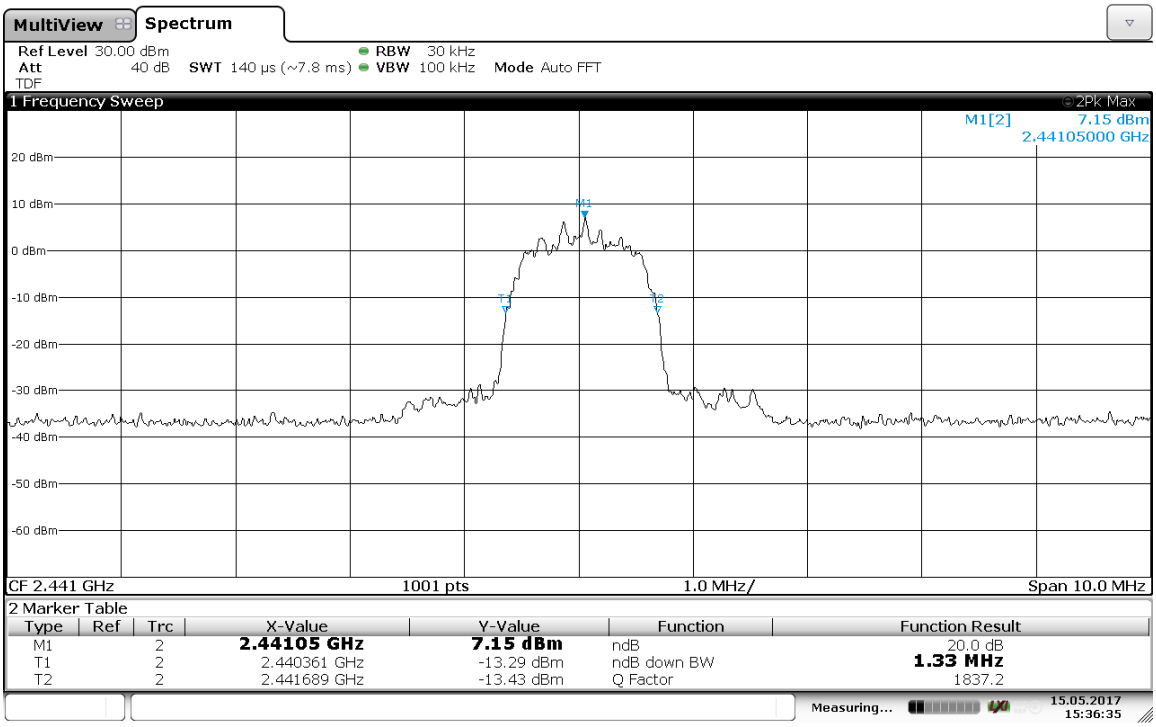


Date: 15.MAY.2017 15:35:53

Pi/4DPSK modulation, Mid Channel (2441 MHz), OBW @ DH3 data rate = 1.19 MHz



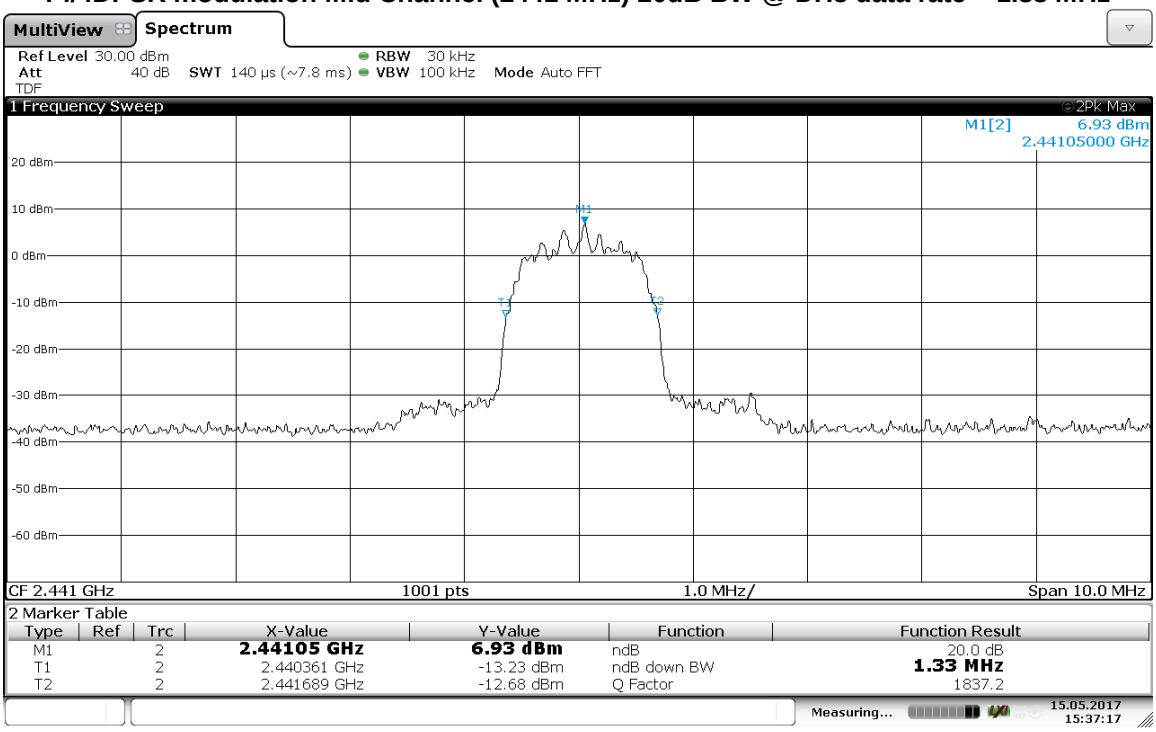
Pi/4DPSK modulation, Mid Channel (2441 MHz), 20 dB BW @ DH3 data rate = 1.33 MHz



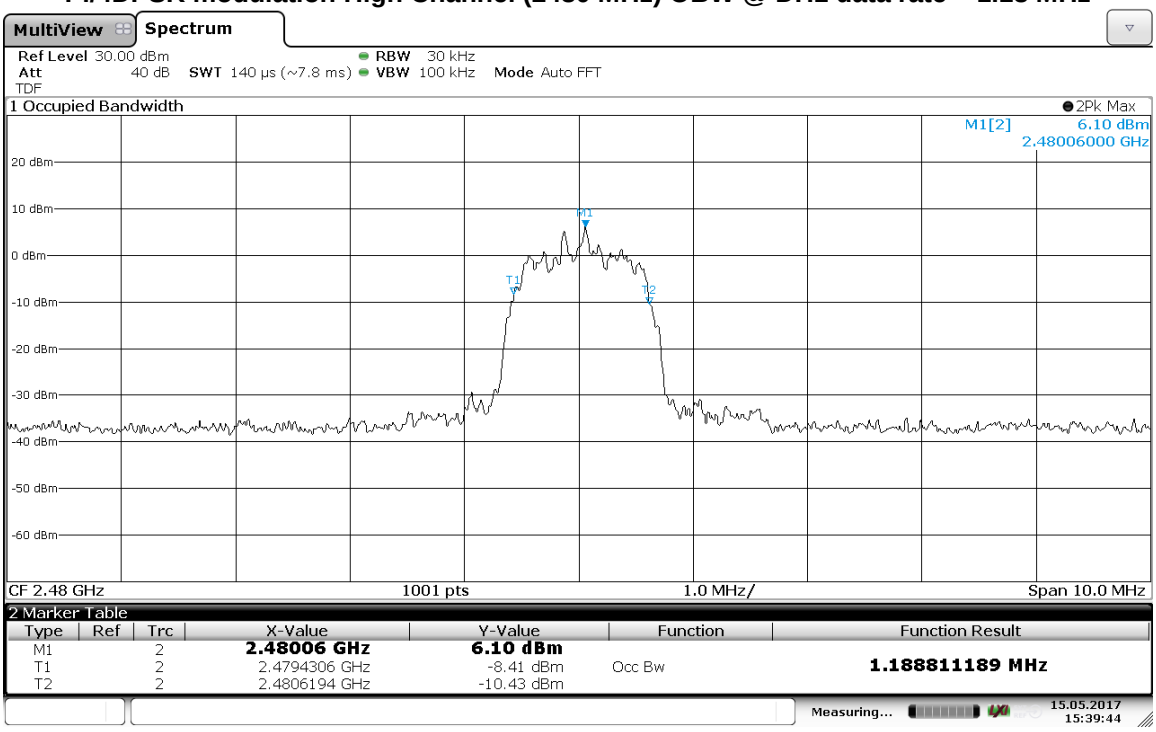
Date: 15.MAY.2017 15:36:35

Pi/4DPSK modulation Mid Channel (2441 MHz) OBW @ DH5 data rate = 1.19 MHz

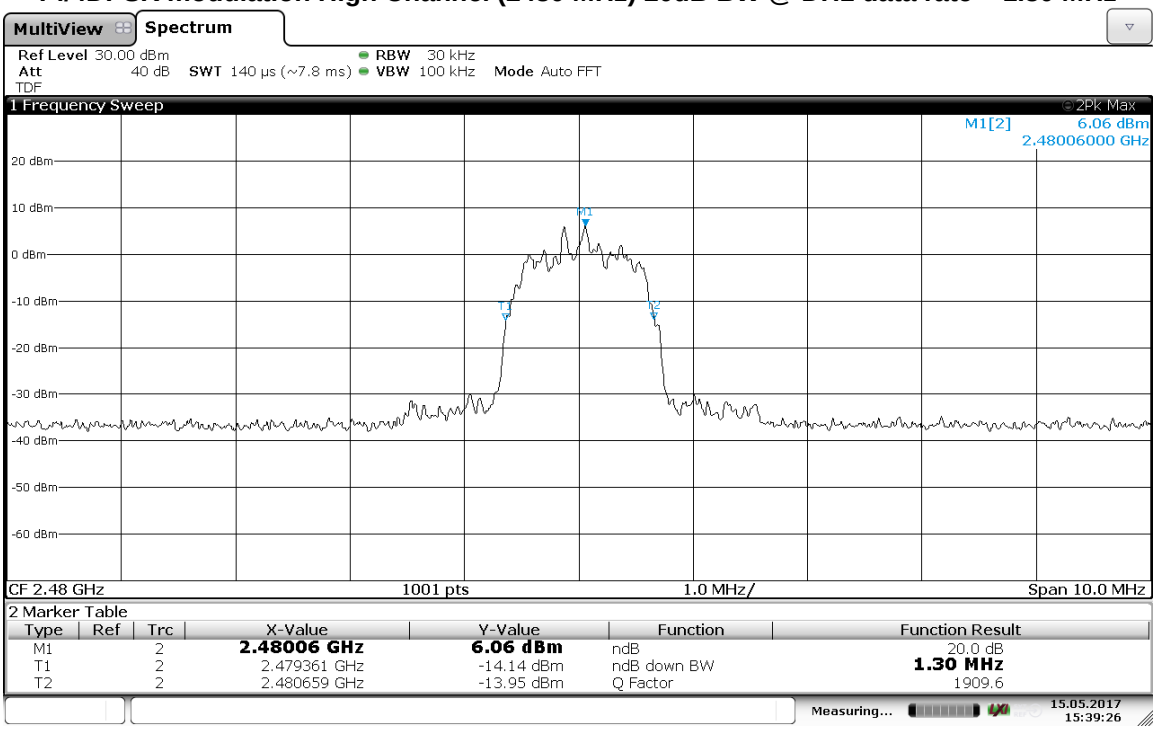
Pi/4DPSK modulation Mid Channel (2441 MHz) 20dB BW @ DH5 data rate = 1.33 MHz



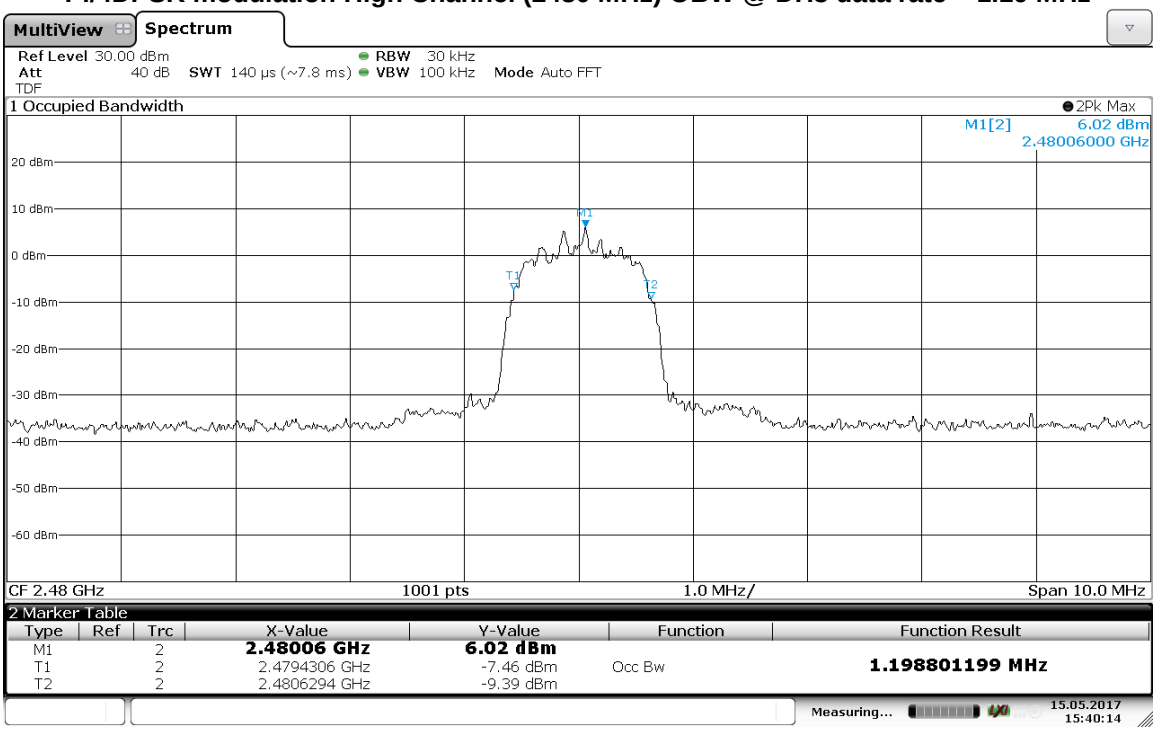
Pi/4DPSK modulation High Channel (2480 MHz) OBW @ DH1 data rate = 1.18 MHz



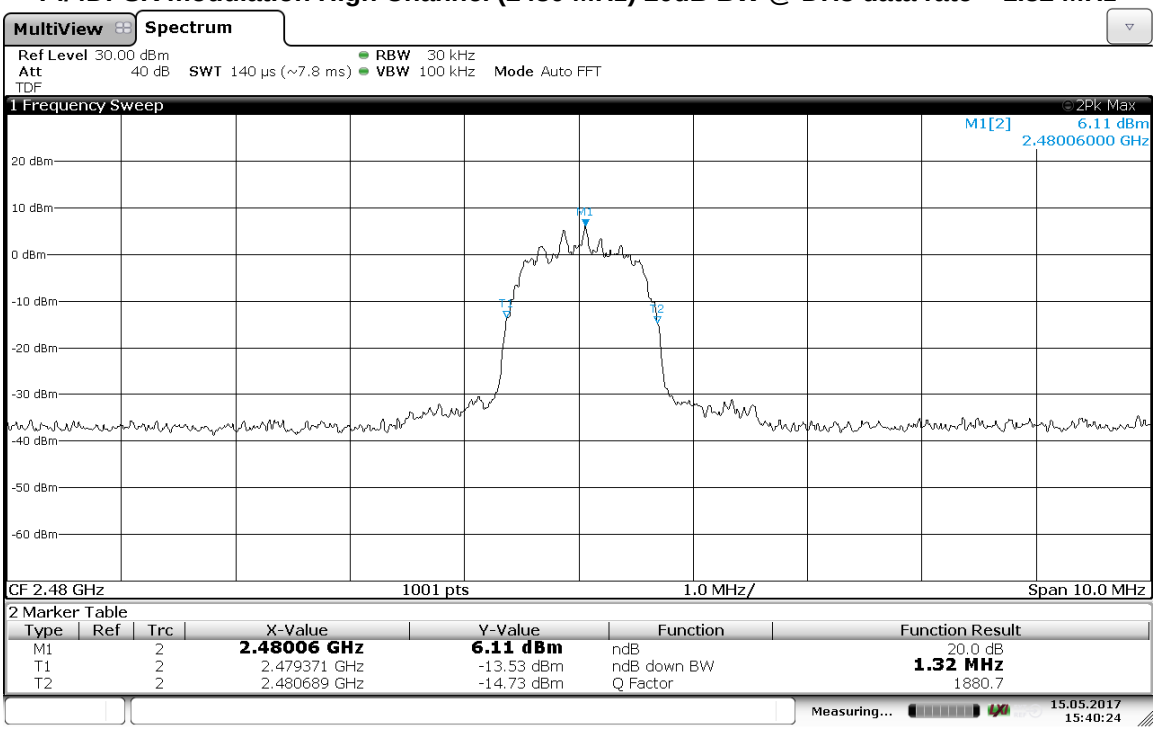
Pi/4DPSK modulation High Channel (2480 MHz) 20dB BW @ DH1 data rate = 1.30 MHz



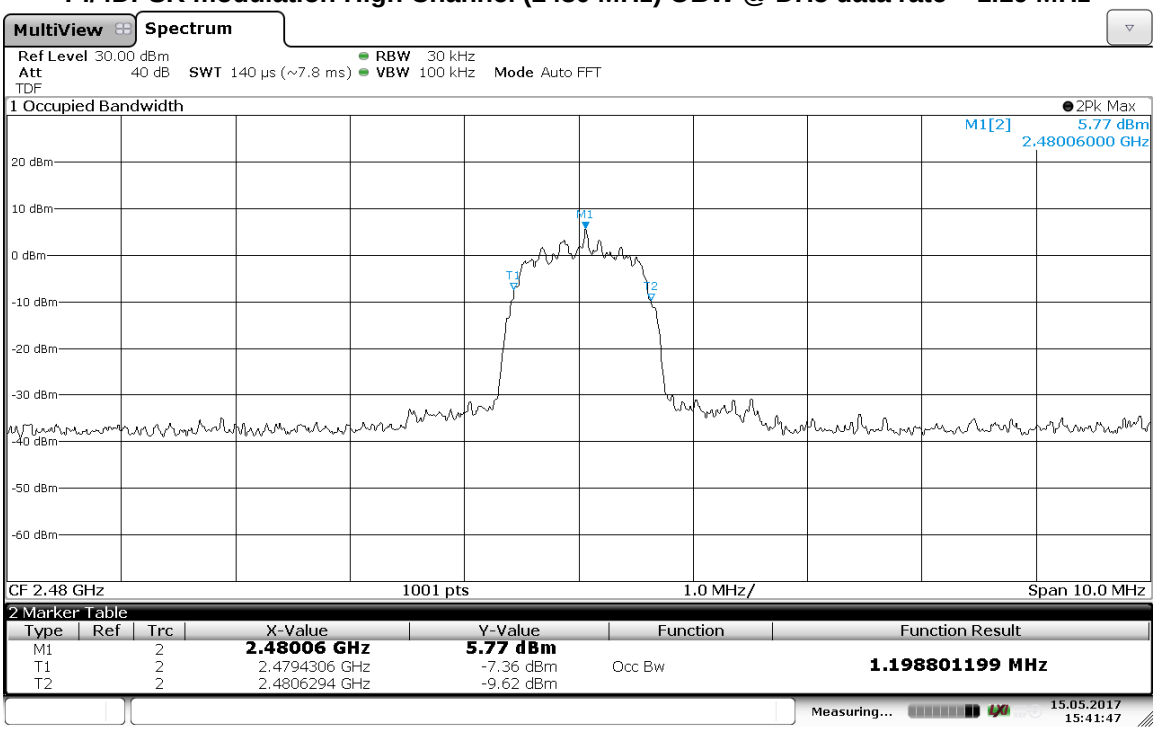
Pi/4DPSK modulation High Channel (2480 MHz) OBW @ DH3 data rate = 1.19 MHz



Pi/4DPSK modulation High Channel (2480 MHz) 20dB BW @ DH3 data rate = 1.32 MHz

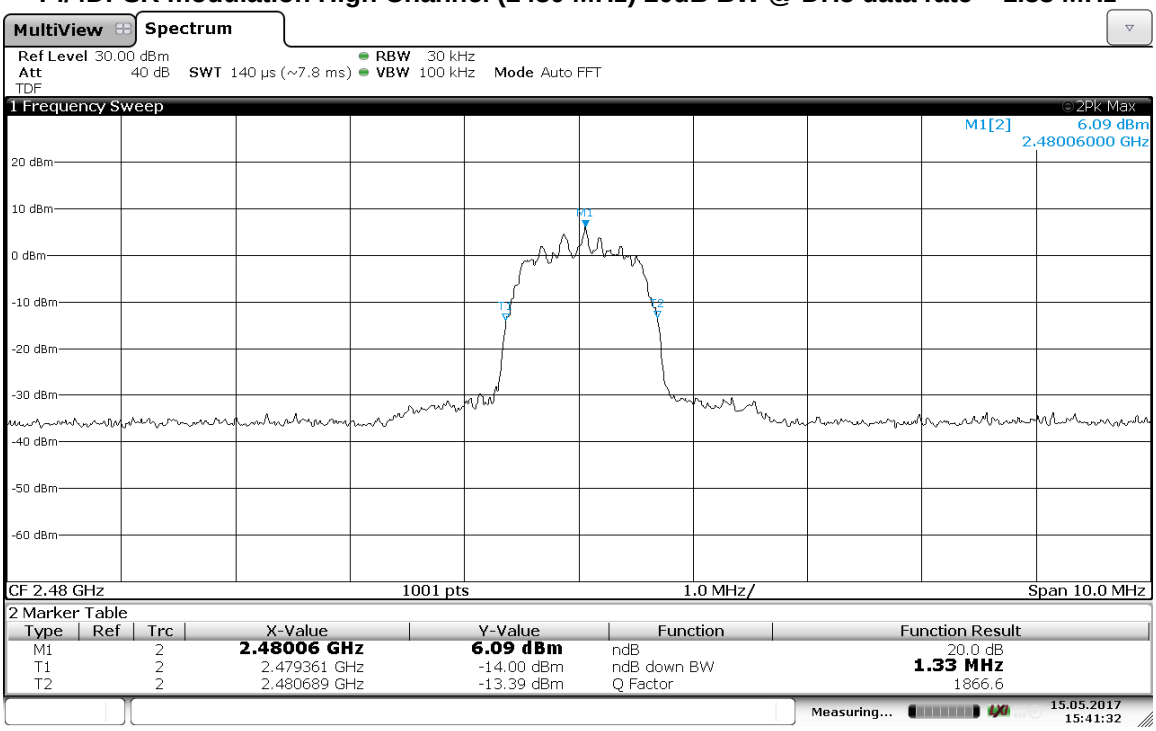


Pi/4DPSK modulation High Channel (2480 MHz) OBW @ DH5 data rate = 1.19 MHz



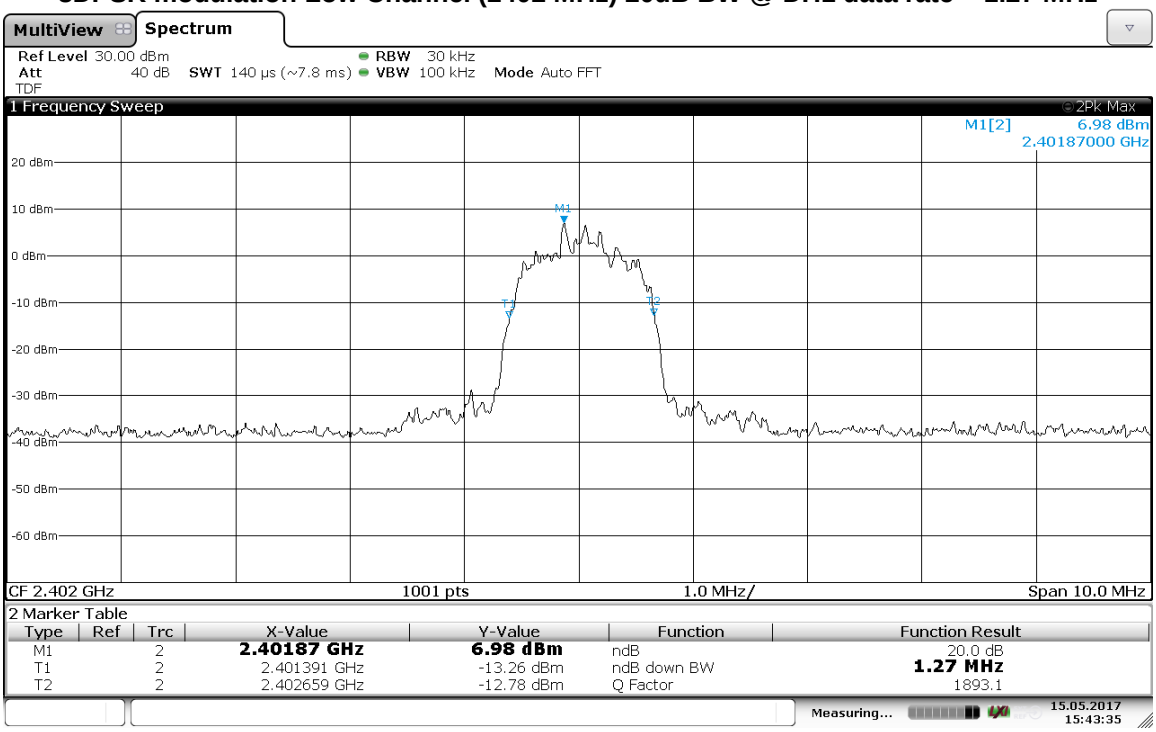
Date: 15.MAY.2017 15:41:47

Pi/4DPSK modulation High Channel (2480 MHz) 20dB BW @ DH5 data rate = 1.33 MHz

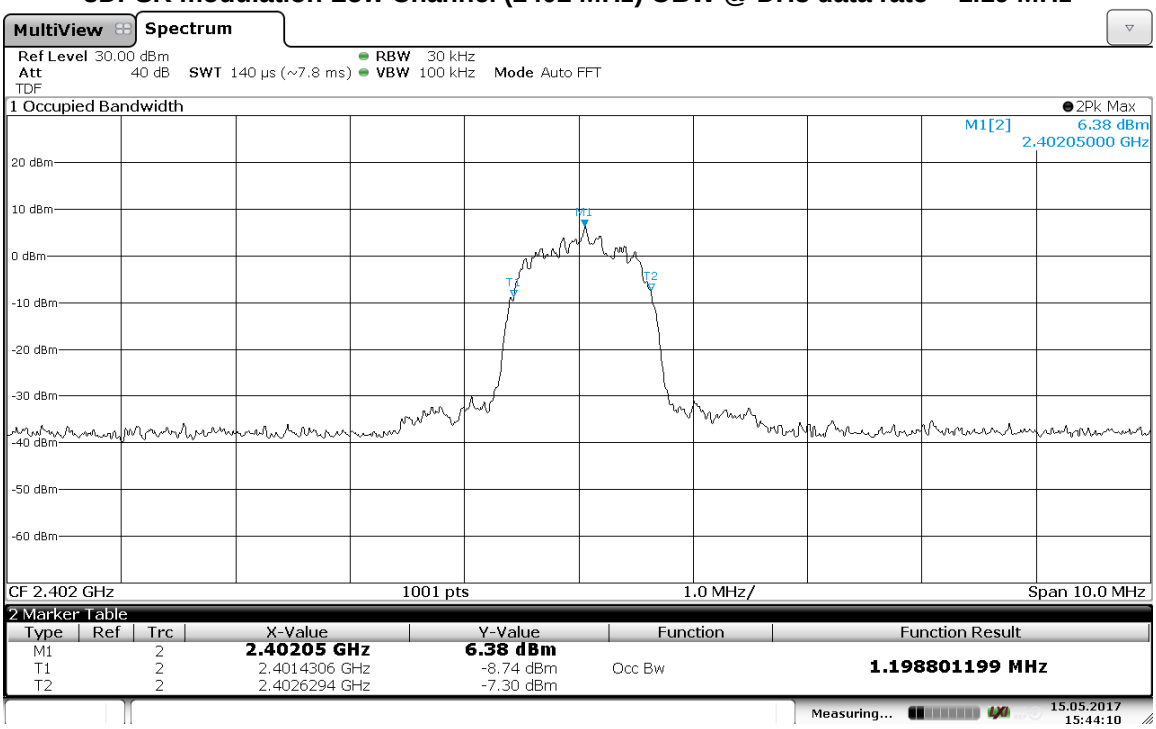


8DPSK modulation Low Channel (2402 MHz) OBW @ DH1 data rate = 1.16 MHz

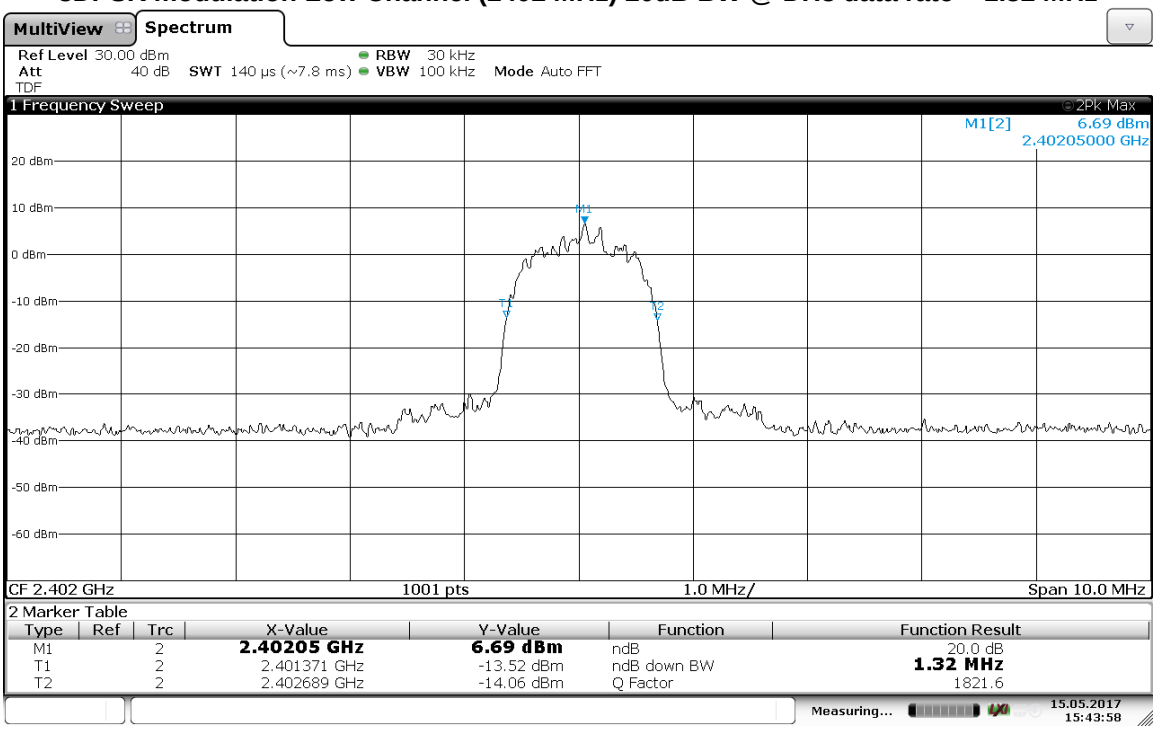
8DPSK modulation Low Channel (2402 MHz) 20dB BW @ DH1 data rate = 1.27 MHz



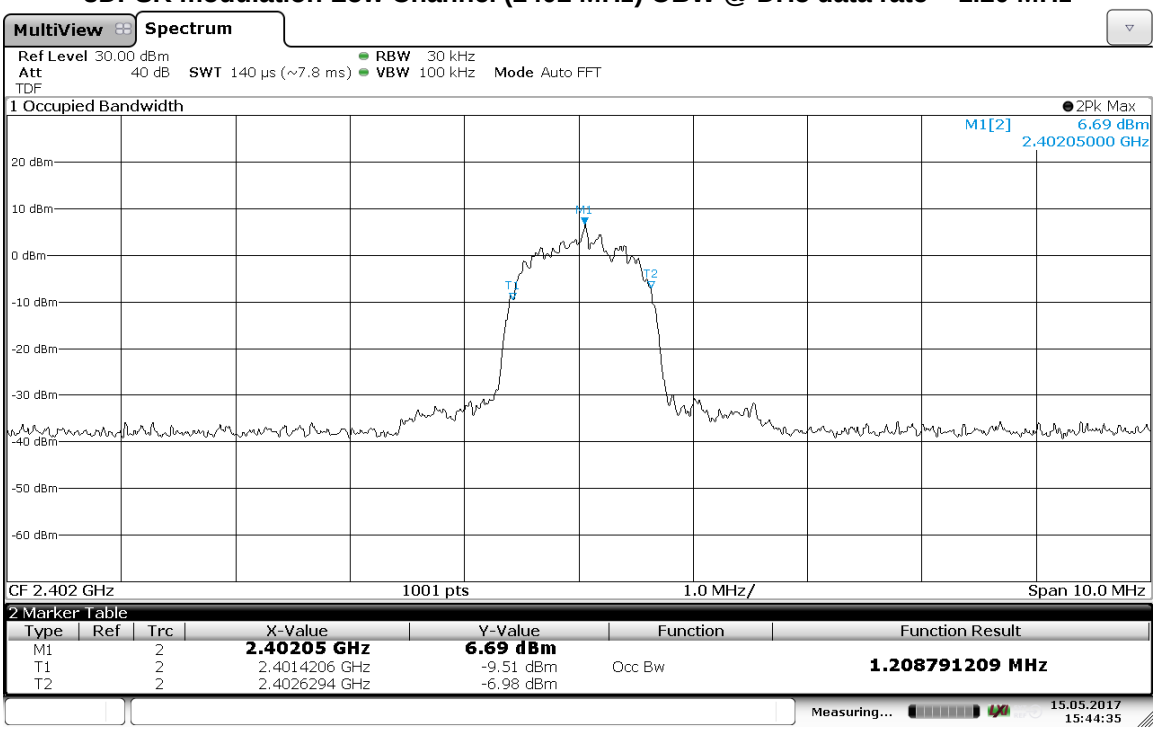
8DPSK modulation Low Channel (2402 MHz) OBW @ DH3 data rate = 1.19 MHz



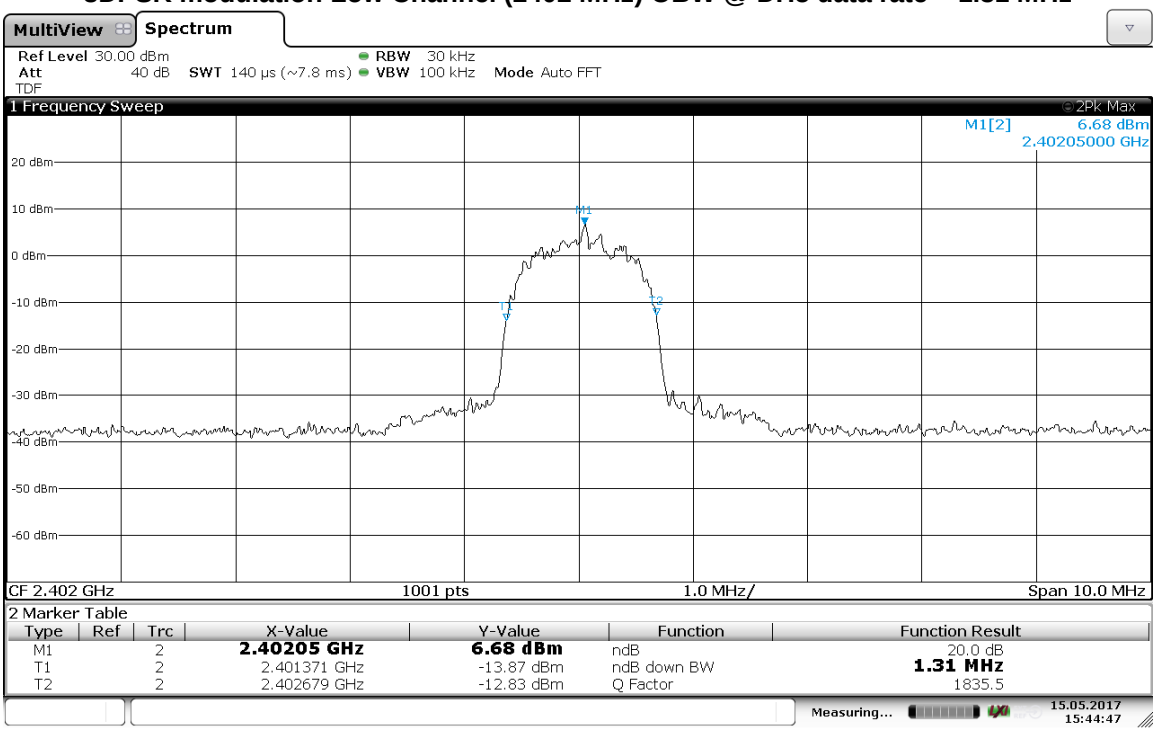
8DPSK modulation Low Channel (2402 MHz) 20dB BW @ DH3 data rate = 1.32 MHz



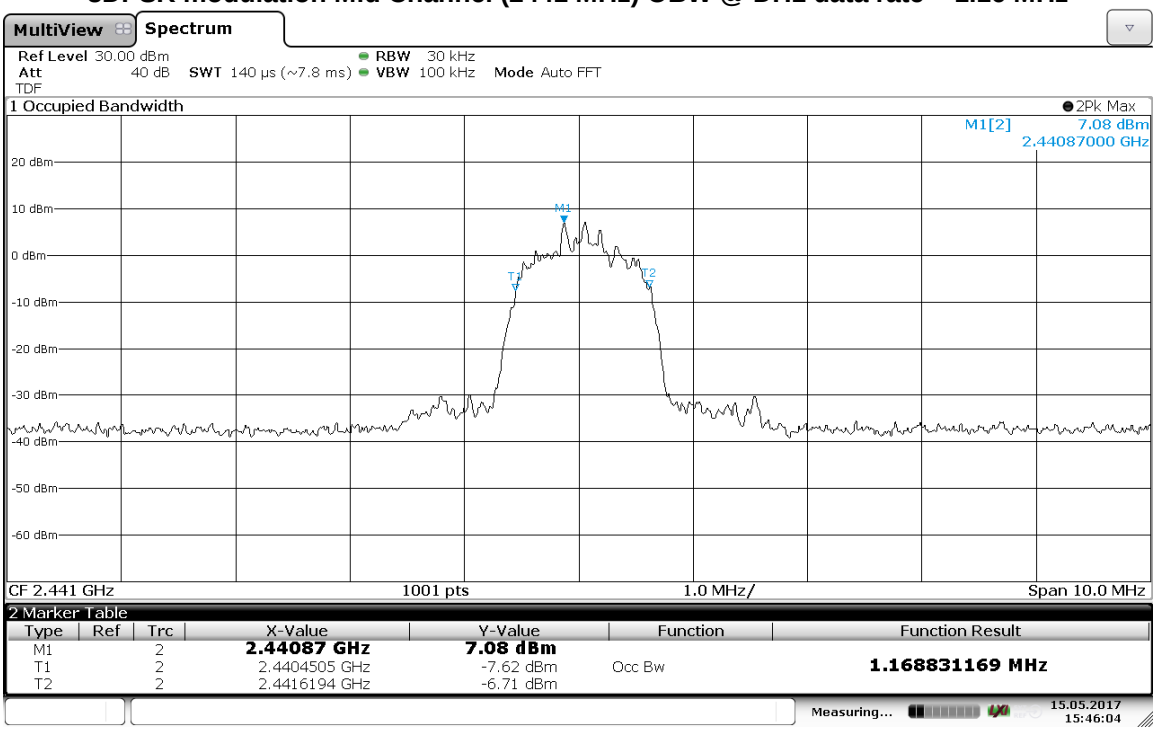
8DPSK modulation Low Channel (2402 MHz) OBW @ DH5 data rate = 1.20 MHz



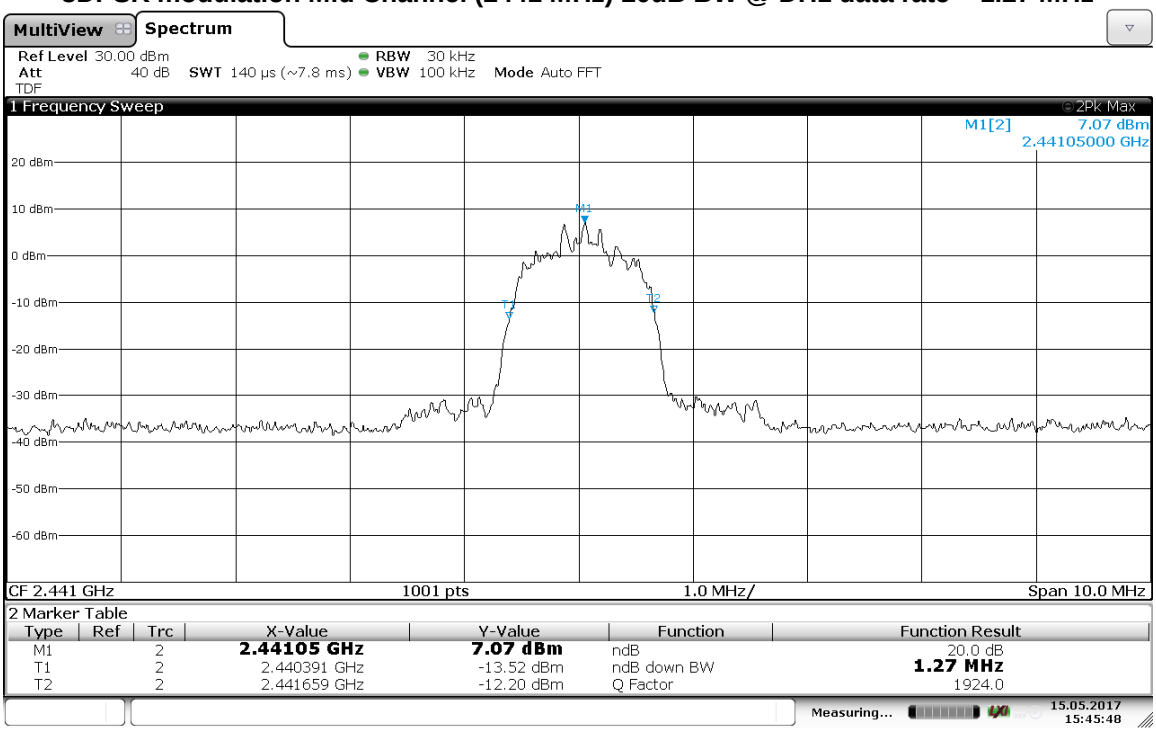
8DPSK modulation Low Channel (2402 MHz) OBW @ DH5 data rate = 1.31 MHz



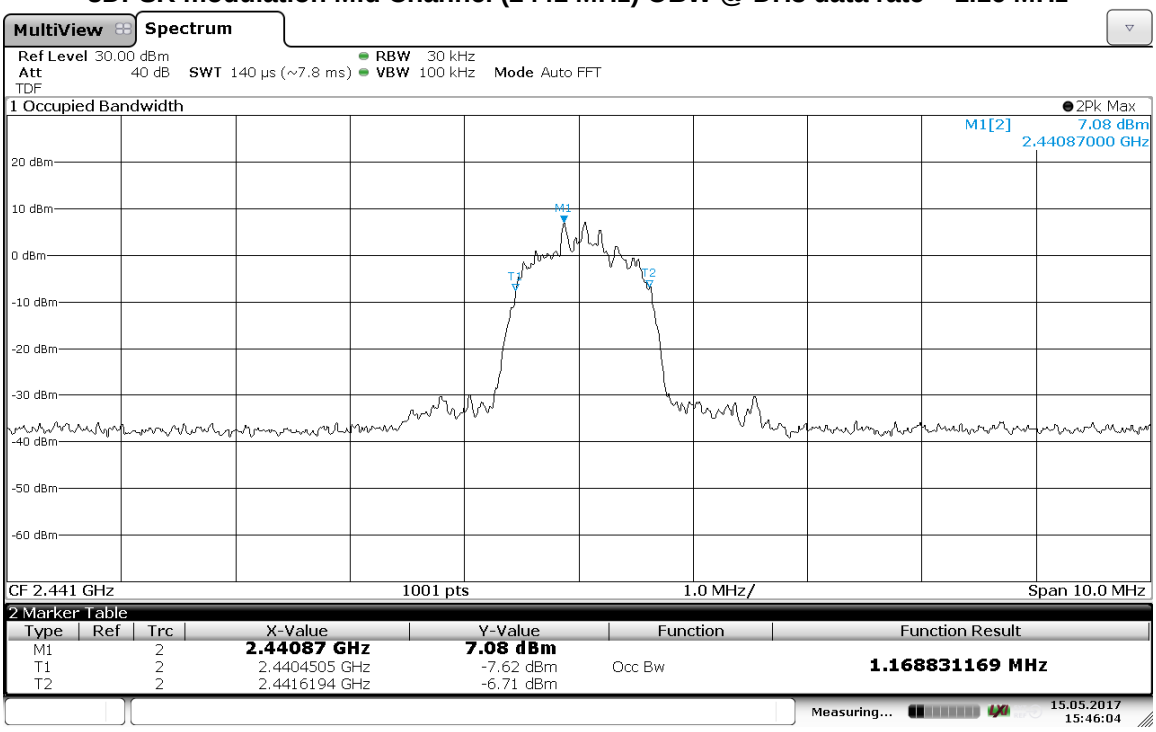
8DPSK modulation Mid Channel (2441 MHz) OBW @ DH1 data rate = 1.16 MHz



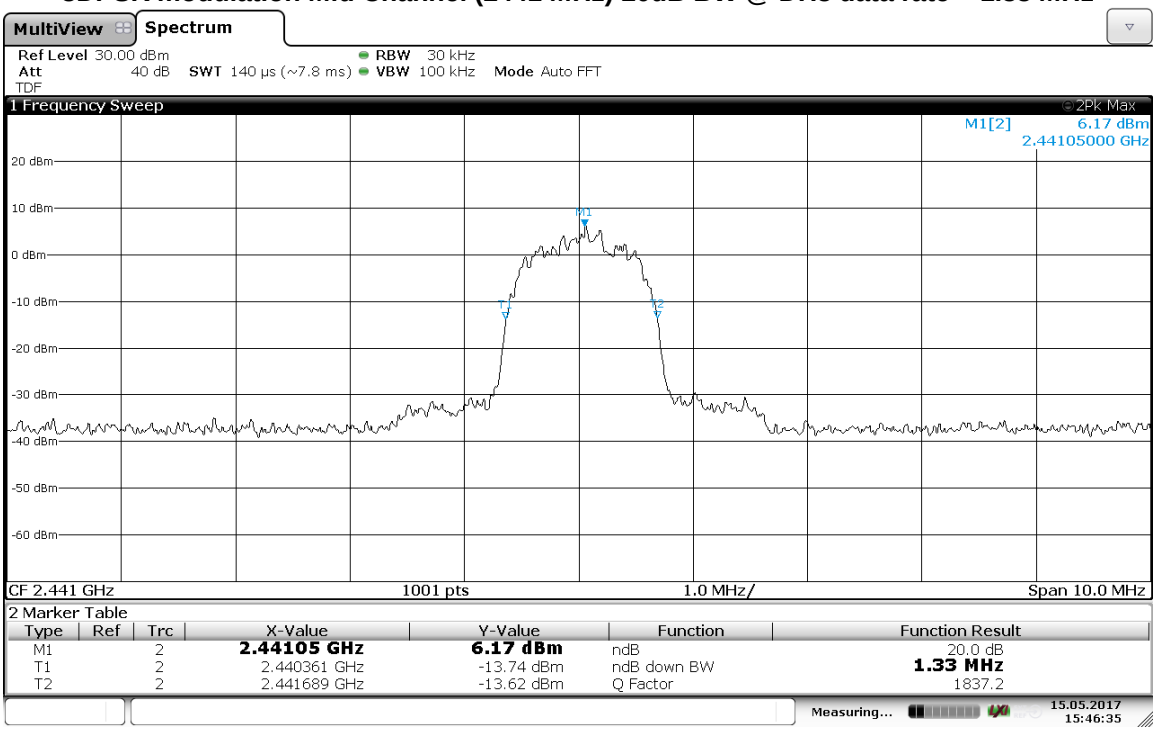
8DPSK modulation Mid Channel (2441 MHz) 20dB BW @ DH1 data rate = 1.27 MHz



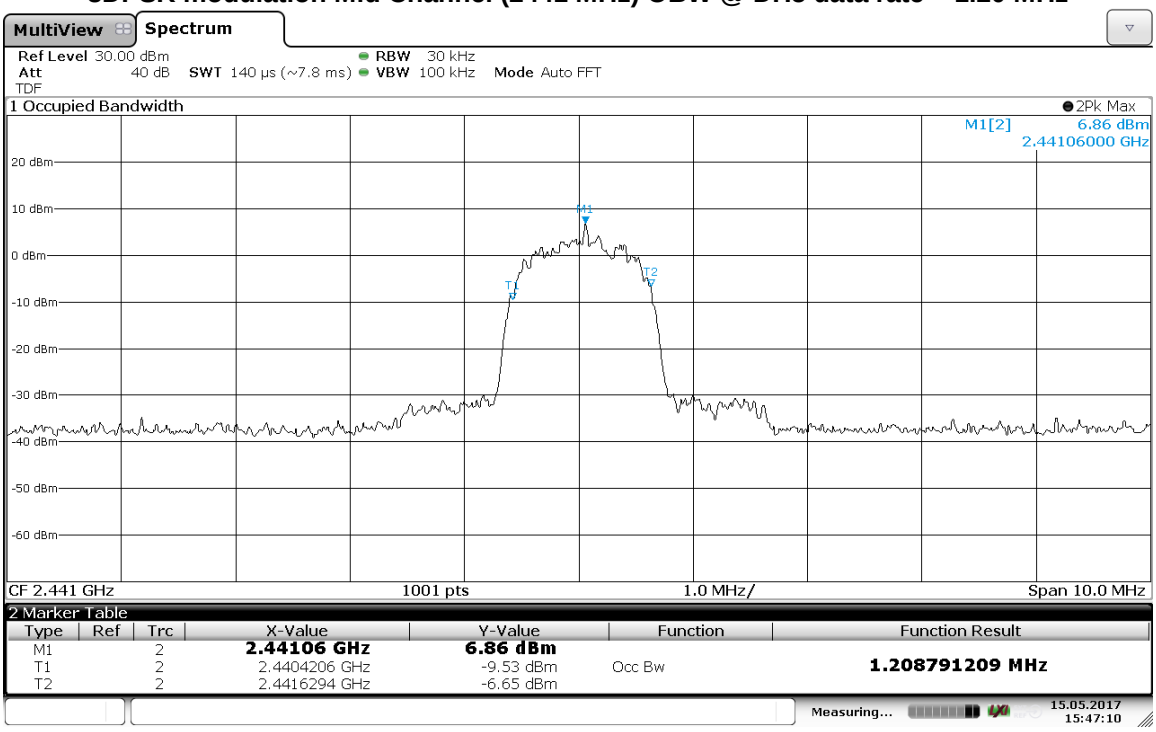
8DPSK modulation Mid Channel (2441 MHz) OBW @ DH3 data rate = 1.16 MHz



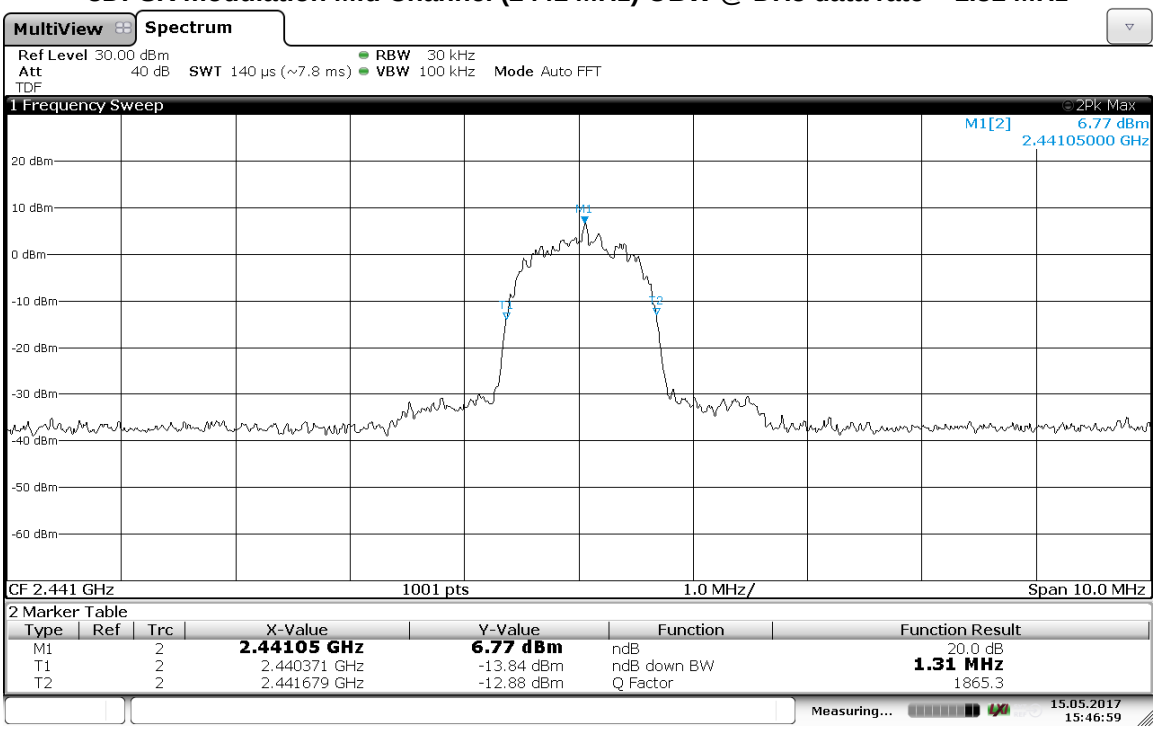
8DPSK modulation Mid Channel (2441 MHz) 20dB BW @ DH3 data rate = 1.33 MHz



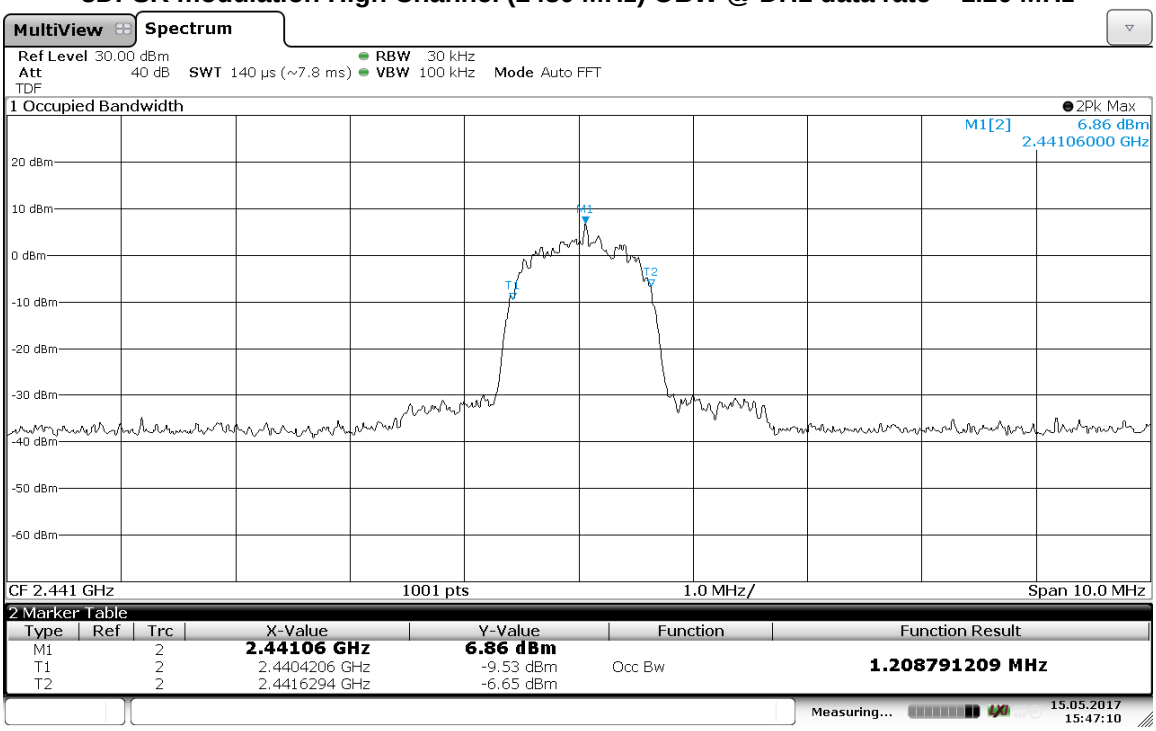
8DPSK modulation Mid Channel (2441 MHz) OBW @ DH5 data rate = 1.20 MHz



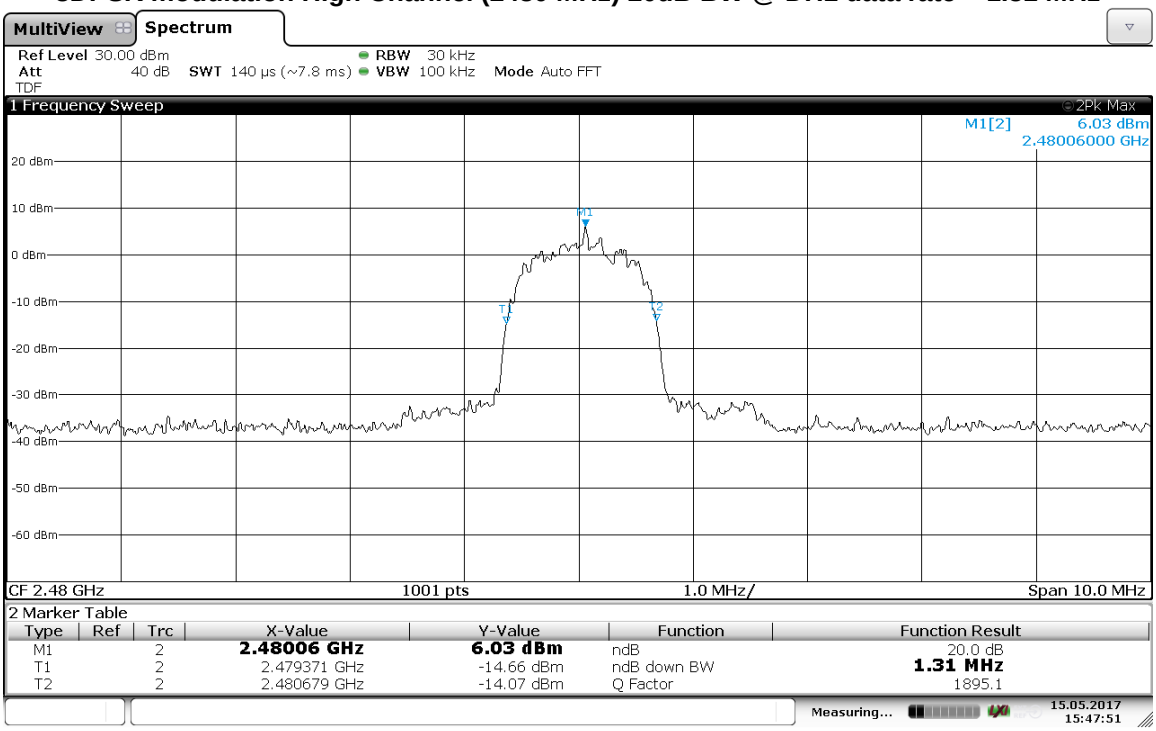
8DPSK modulation Mid Channel (2441 MHz) OBW @ DH5 data rate = 1.31 MHz



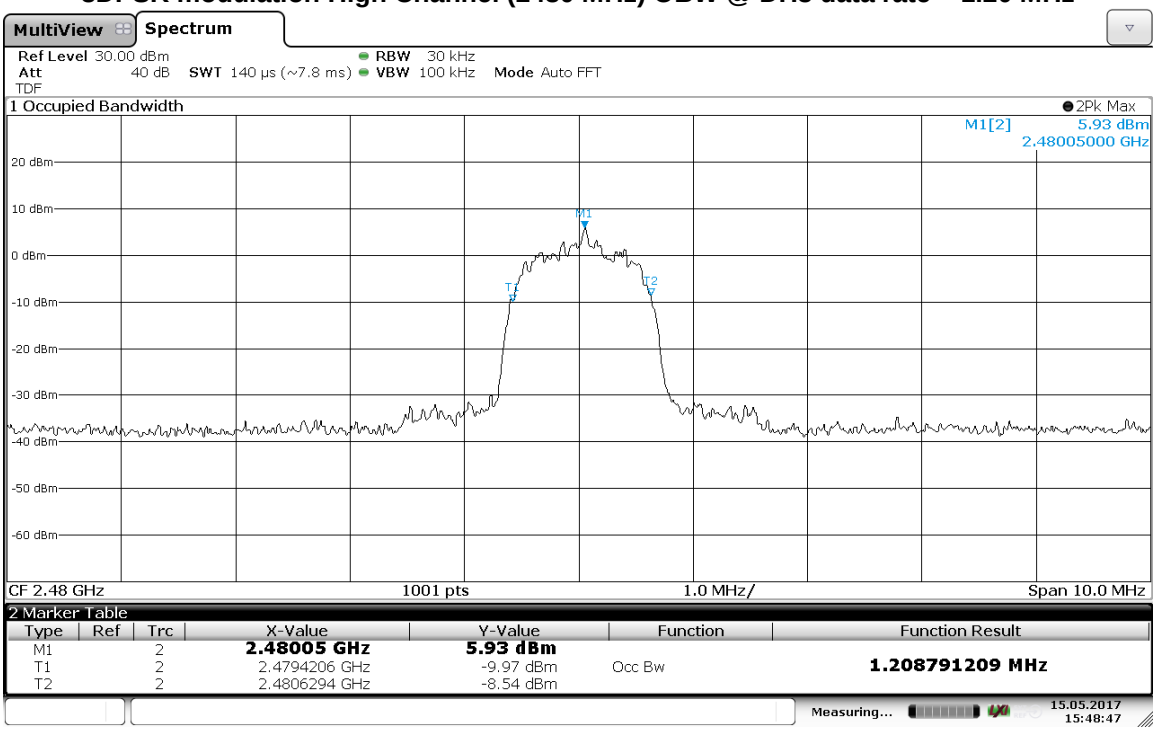
8DPSK modulation High Channel (2480 MHz) OBW @ DH1 data rate = 1.20 MHz



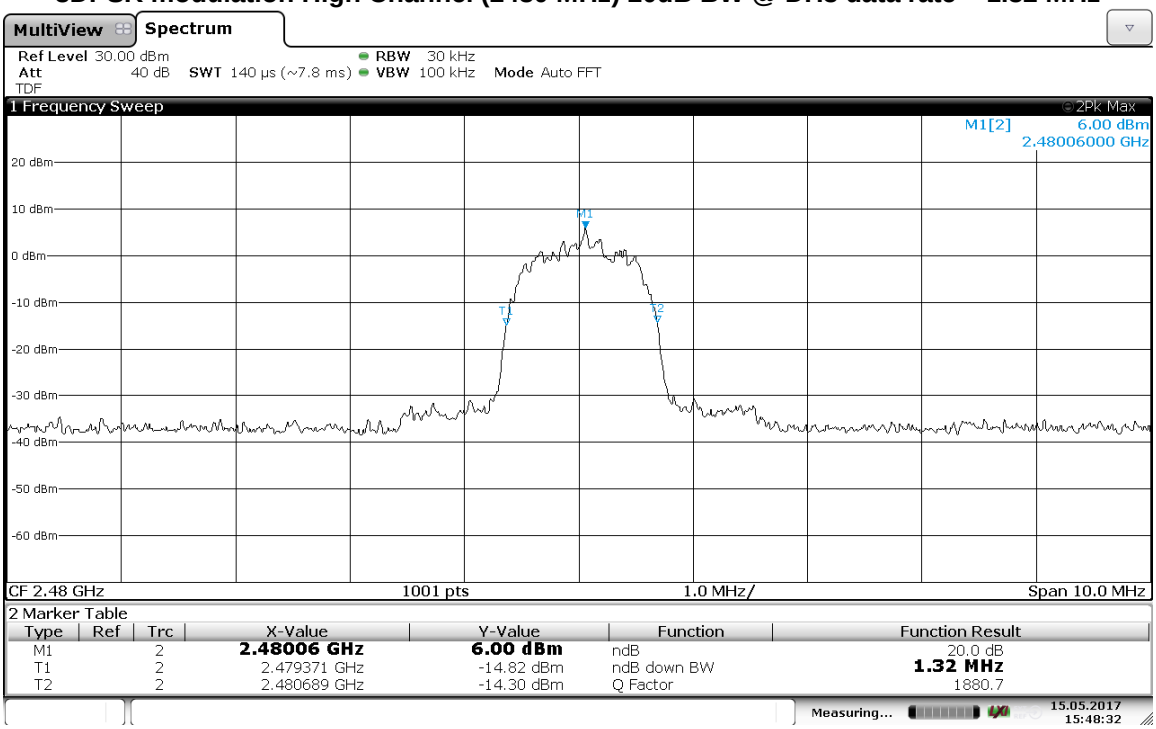
8DPSK modulation High Channel (2480 MHz) 20dB BW @ DH1 data rate = 1.31 MHz



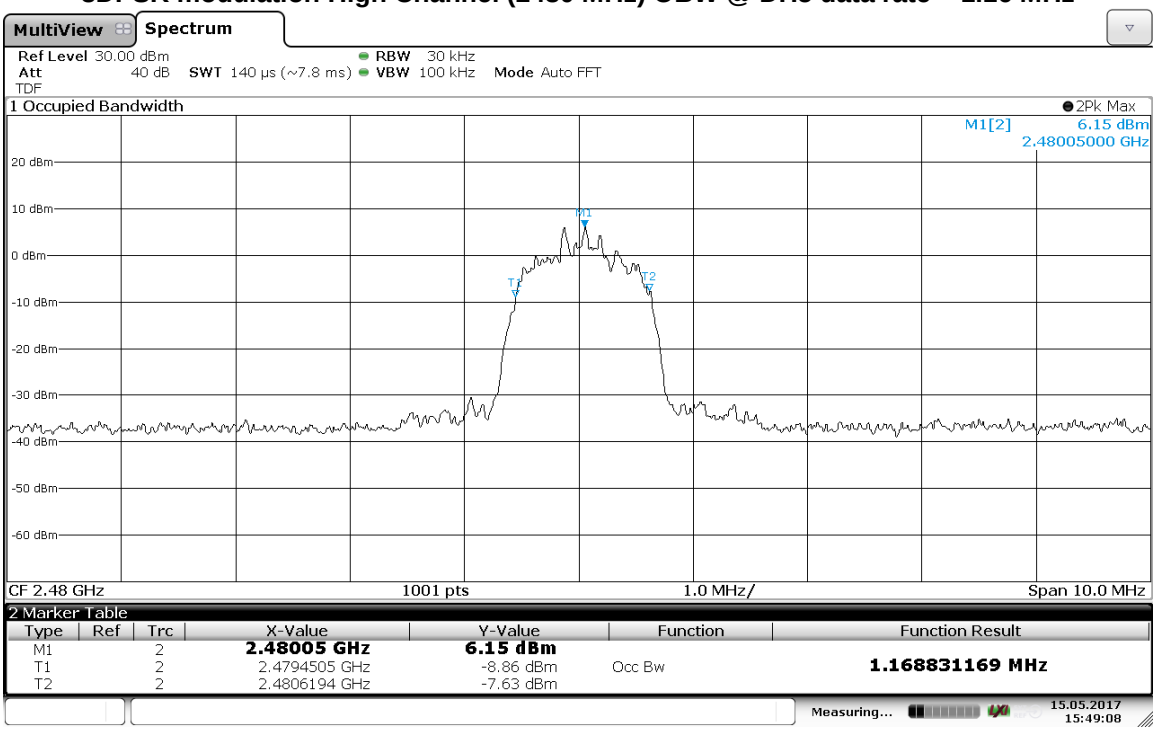
8DPSK modulation High Channel (2480 MHz) OBW @ DH3 data rate = 1.20 MHz



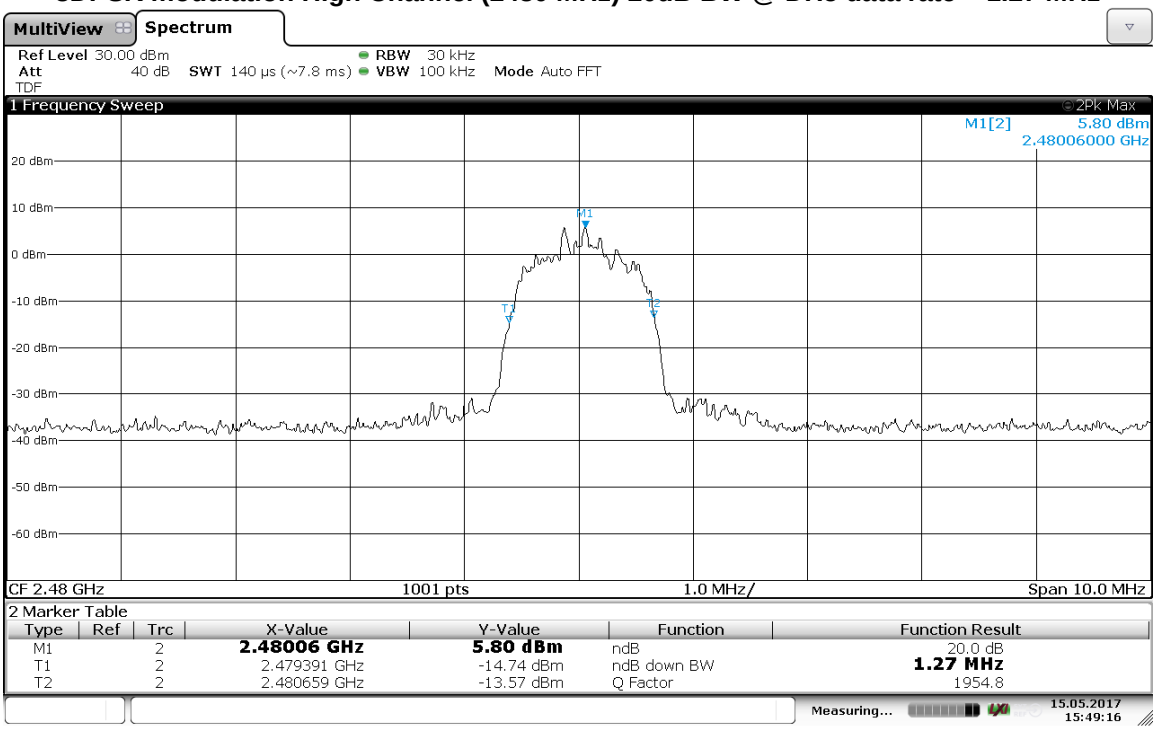
8DPSK modulation High Channel (2480 MHz) 20dB BW @ DH3 data rate = 1.32 MHz



8DPSK modulation High Channel (2480 MHz) OBW @ DH5 data rate = 1.16 MHz



8DPSK modulation High Channel (2480 MHz) 20dB BW @ DH5 data rate = 1.27 MHz



Date: 15.MAY.2017 15:49:15

Test Personnel:	Naga Suryadevara N.S	Test Date:	06/07/2017
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC 15.247 RSS 247	Limit Applied:	See section 7.3
Input Voltage:	120VAC 60Hz		
		Ambient Temperature:	22 ºC
Pretest Verification:	N/A	Relative Humidity:	33 %
		Atmospheric Pressure:	1008mbars

Deviations, Additions, or Exclusions: None

8 Transmitter Antenna Port Conducted Spurious Emissions

8.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C and RSS 247.

TEST SITE: EMC Lab (Boxborough, MA)

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

8.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV004'	Weather Station	Davis Instruments	7400	PE80529A61A	05/10/2017	05/10/2018
ROS005'	ETSI Test System	Rhode & Schwartz	TS8997	N/A	09/15/2016	09/15/2017
MIN23'	Attenuator 2 watt 20dB DC-26GHz	Mini Circuits	BW-S20-2W263+	MIN23	05/20/2017	05/20/2018
CBLHF2012-2M-1'	2m 9kHz-40GHz Coaxial Cable - SET1	Huber & Suhner	SF102	252675001	02/08/2017	02/08/2018

Software Utilized:

Name	Manufacturer	Version
None (Spectrum Analyzer Firmware)		

8.3 Results:

The sample tested was found to Comply.

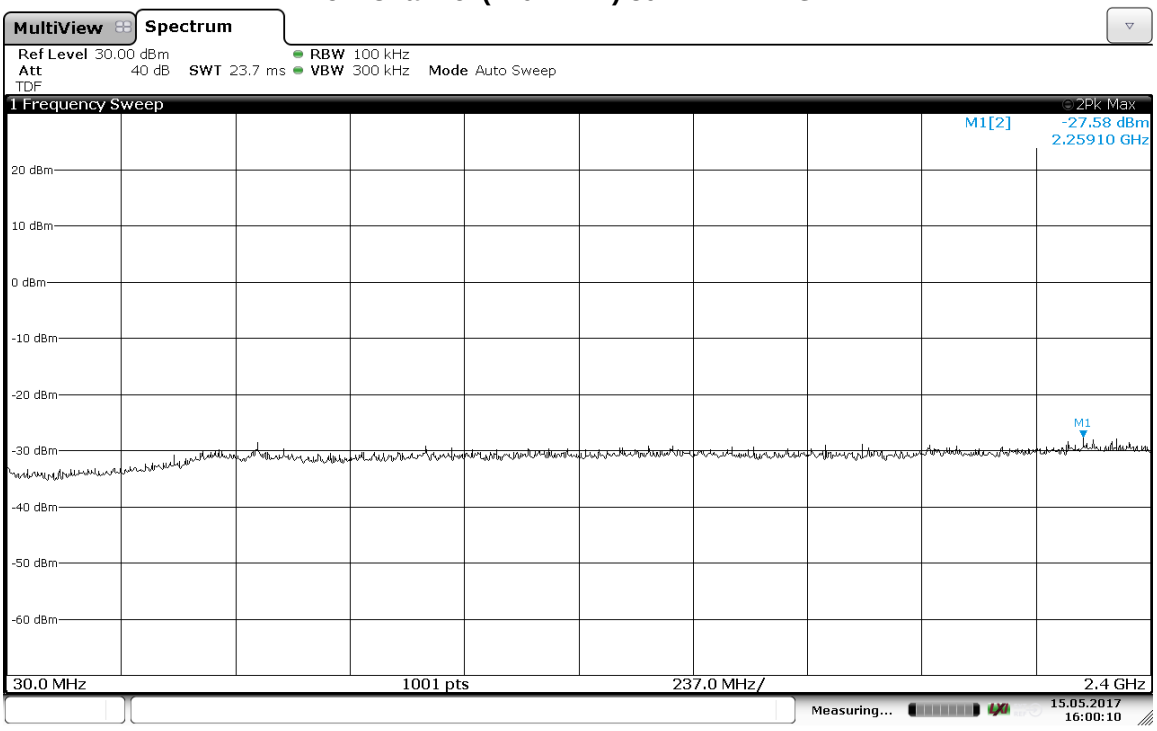
FCC Part 15.247(d)
In any 100 kHz bandwidth outside the frequency band , the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. 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)).

RSS-247 Section 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 5.4(d), 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.

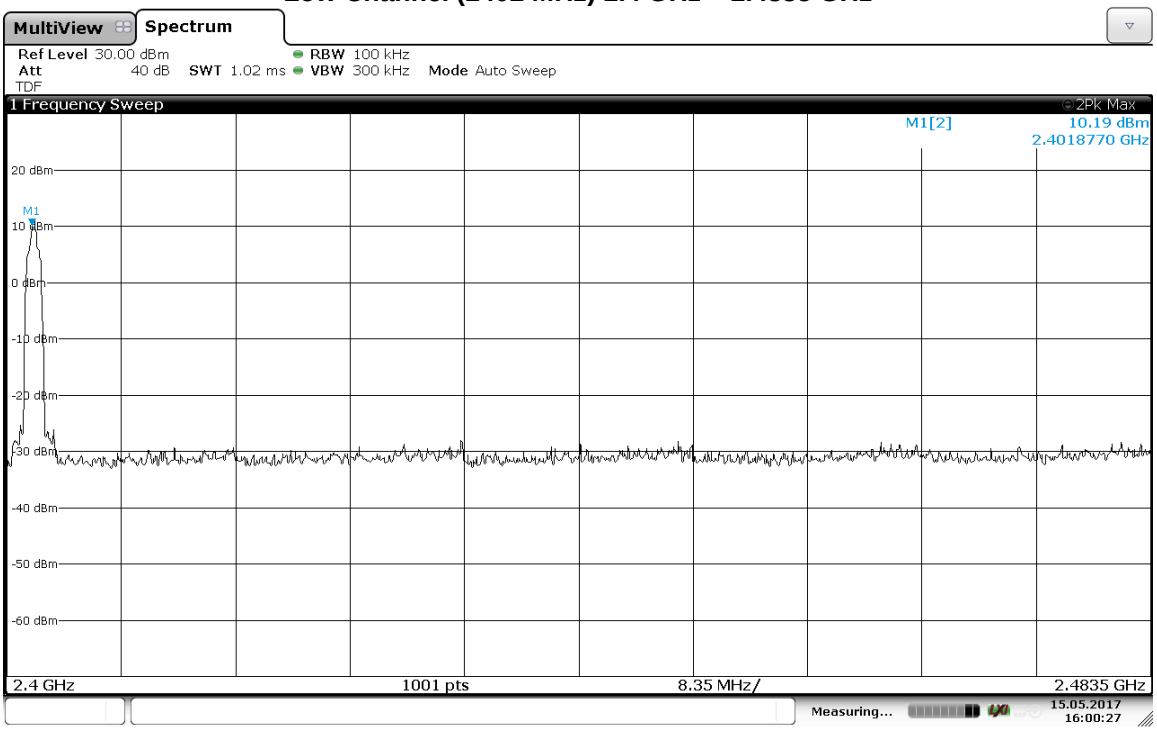
8.4 Plots/Data:

Note: 8DPSK Modulation and DH1 data rate was used for conducted spurious emissions where highest output power was measured.

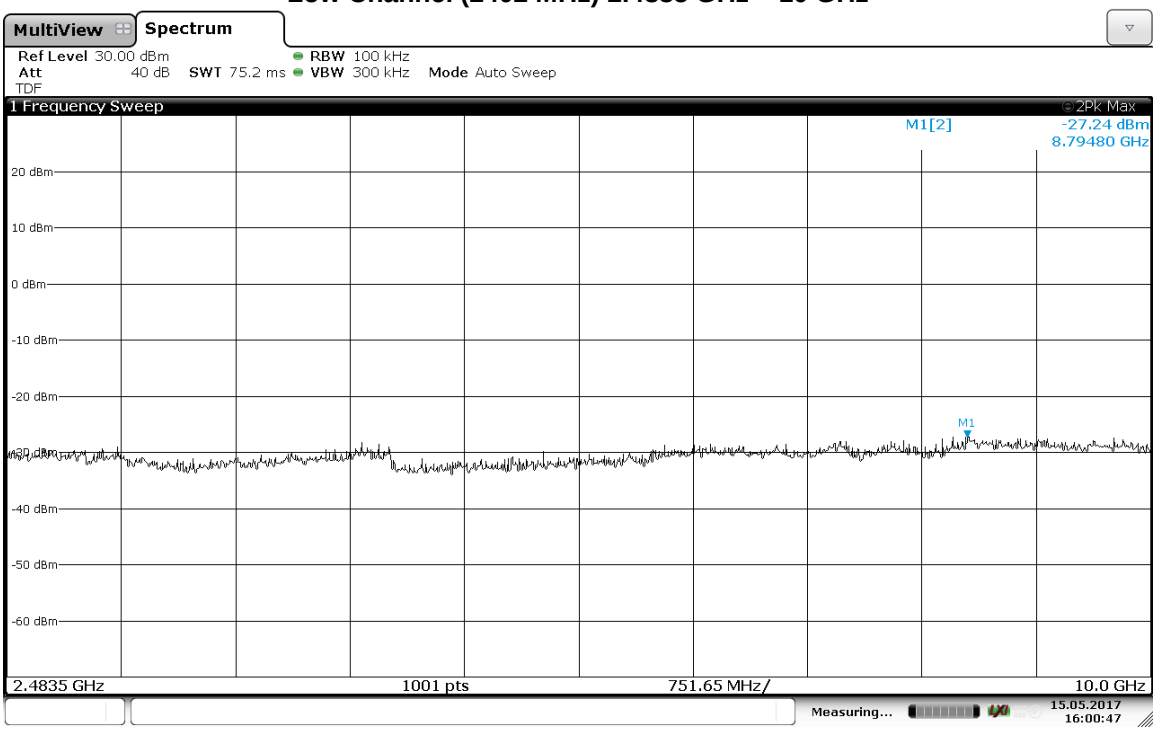
Low Channel (2402 MHz) 30 MHz – 2.4 GHz



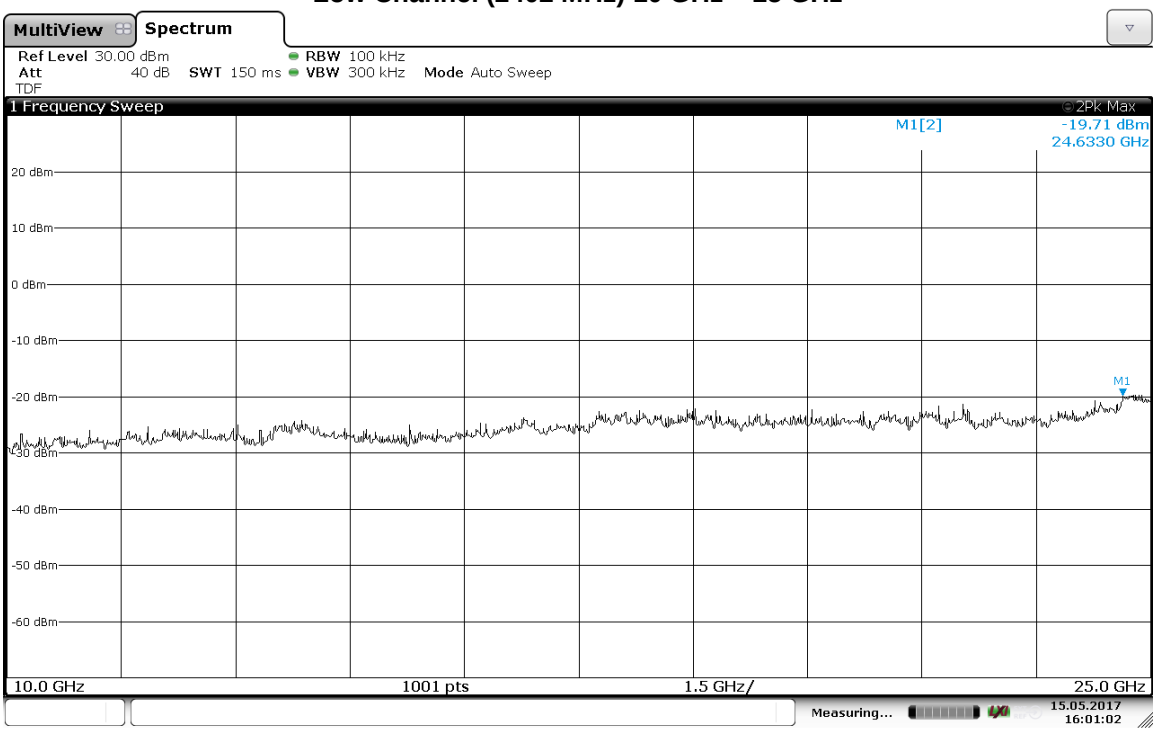
Low Channel (2402 MHz) 2.4 GHz – 2.4835 GHz



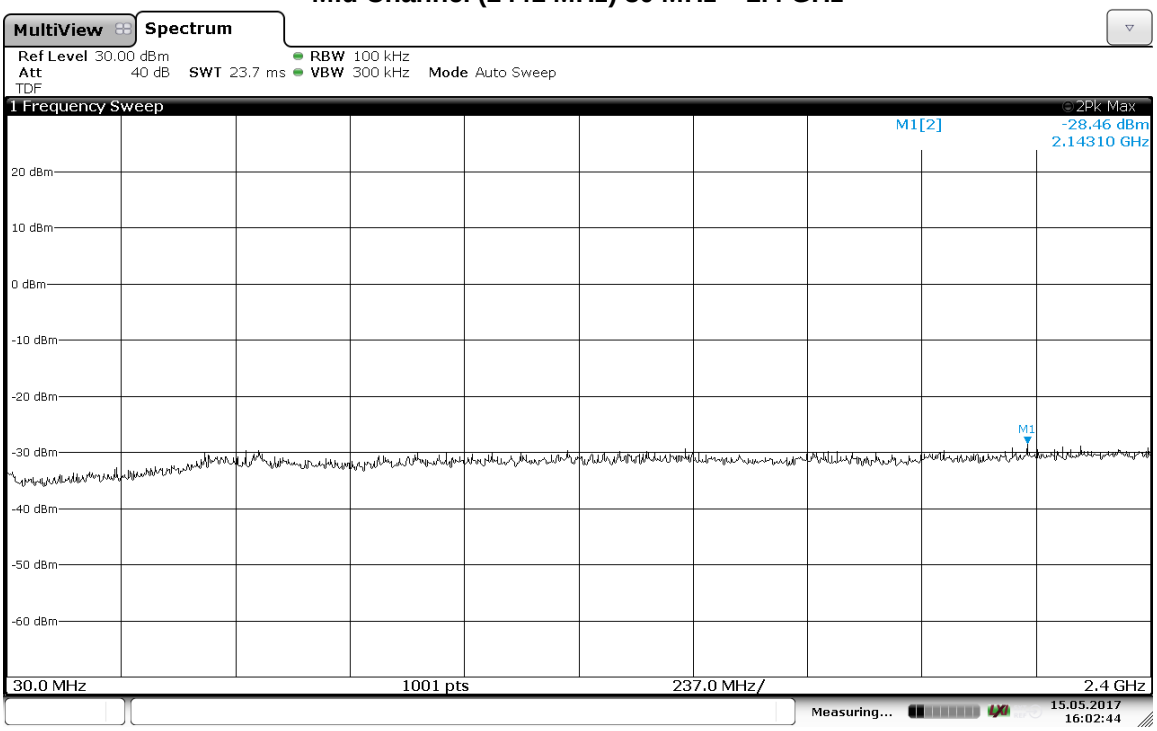
Low Channel (2402 MHz) 2.4835 GHz – 10 GHz



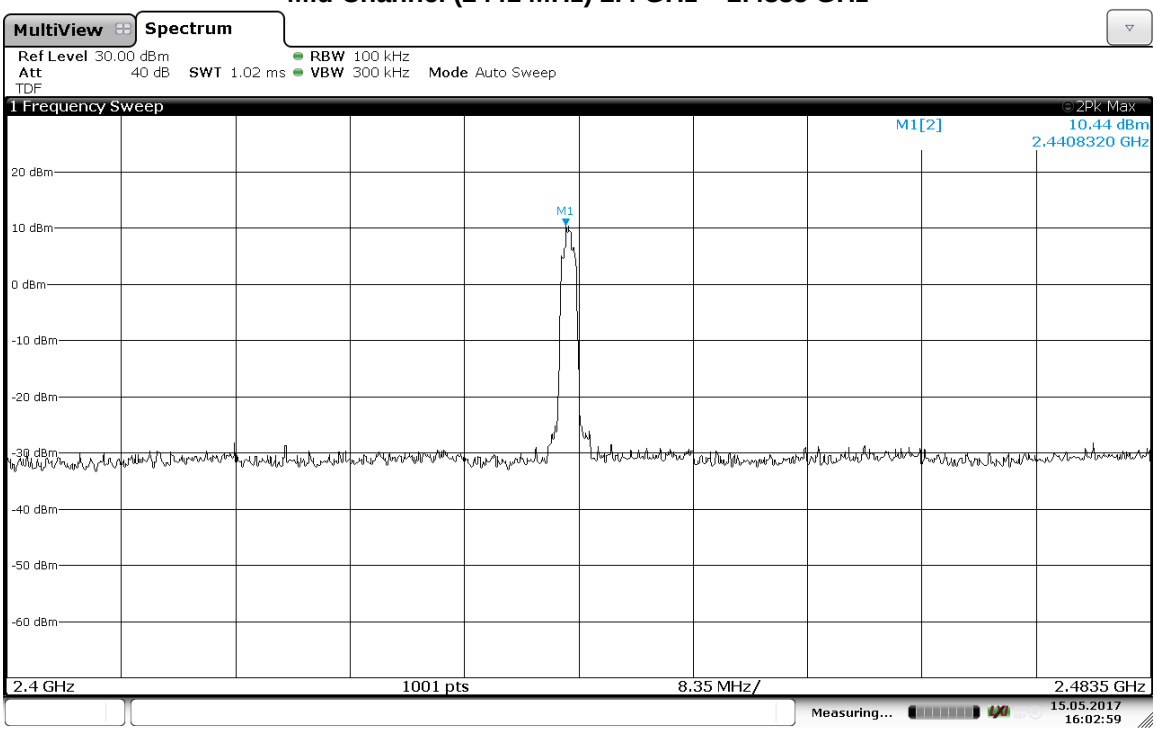
Low Channel (2402 MHz) 10 GHz – 25 GHz



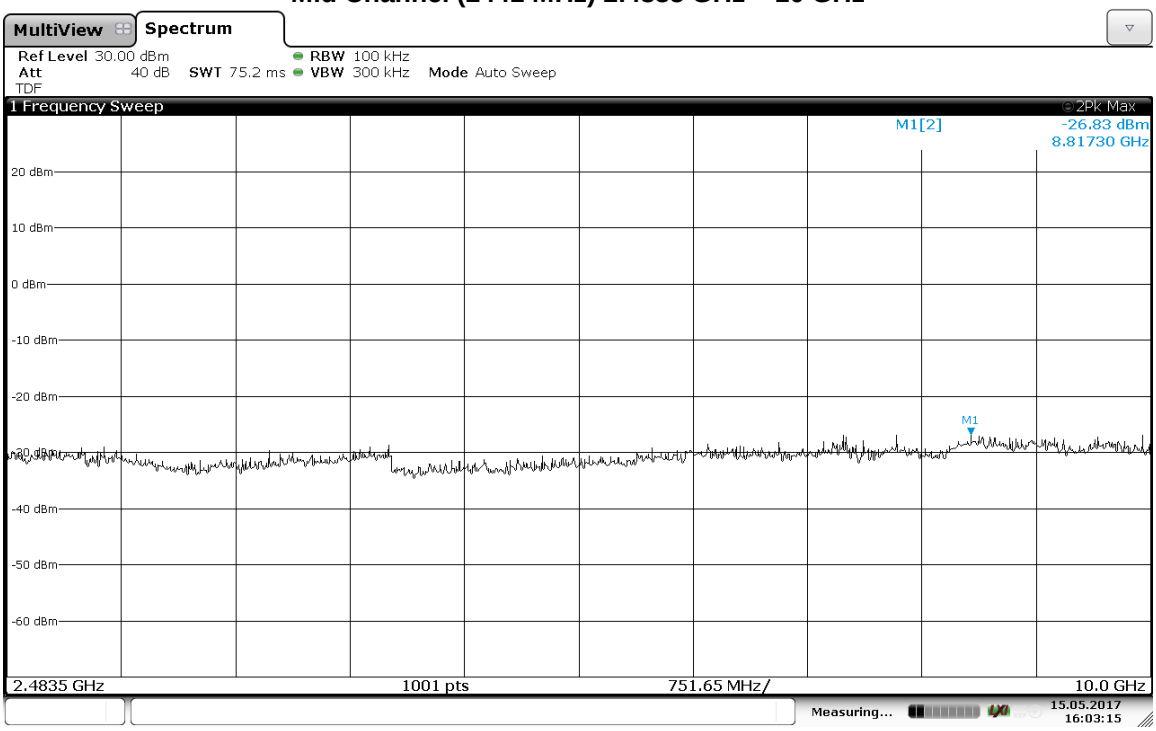
Mid Channel (2441 MHz) 30 MHz – 2.4 GHz



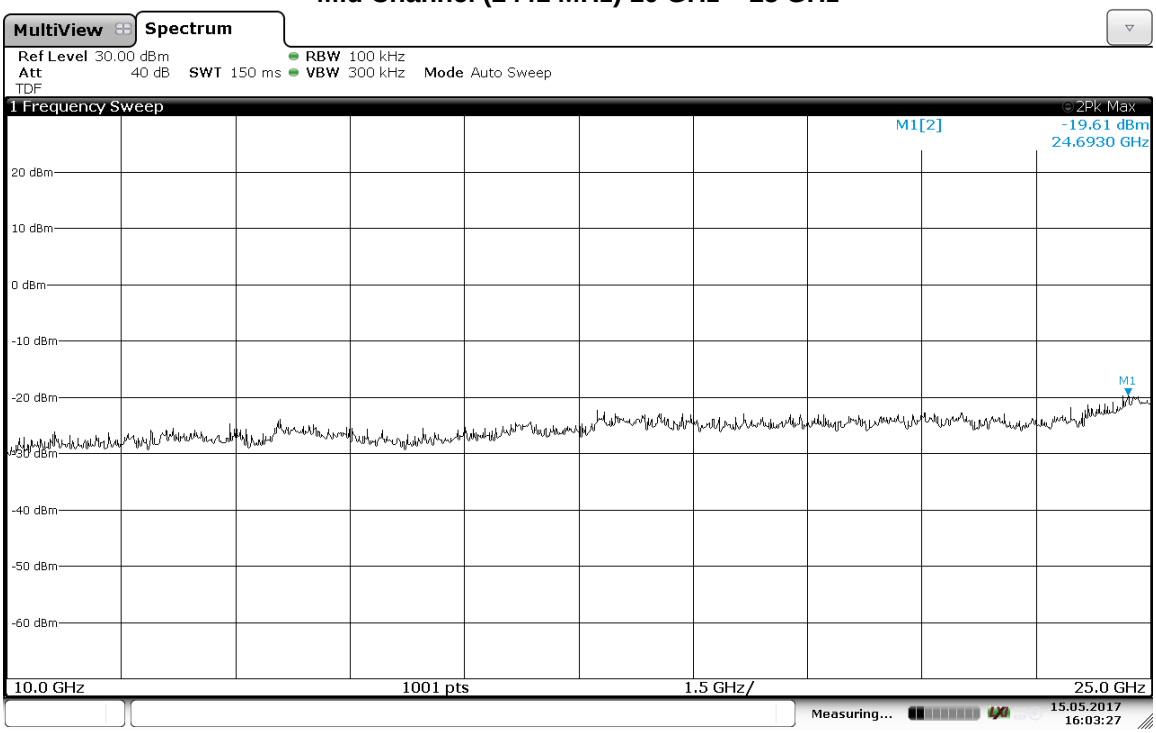
Mid Channel (2441 MHz) 2.4 GHz – 2.4835 GHz



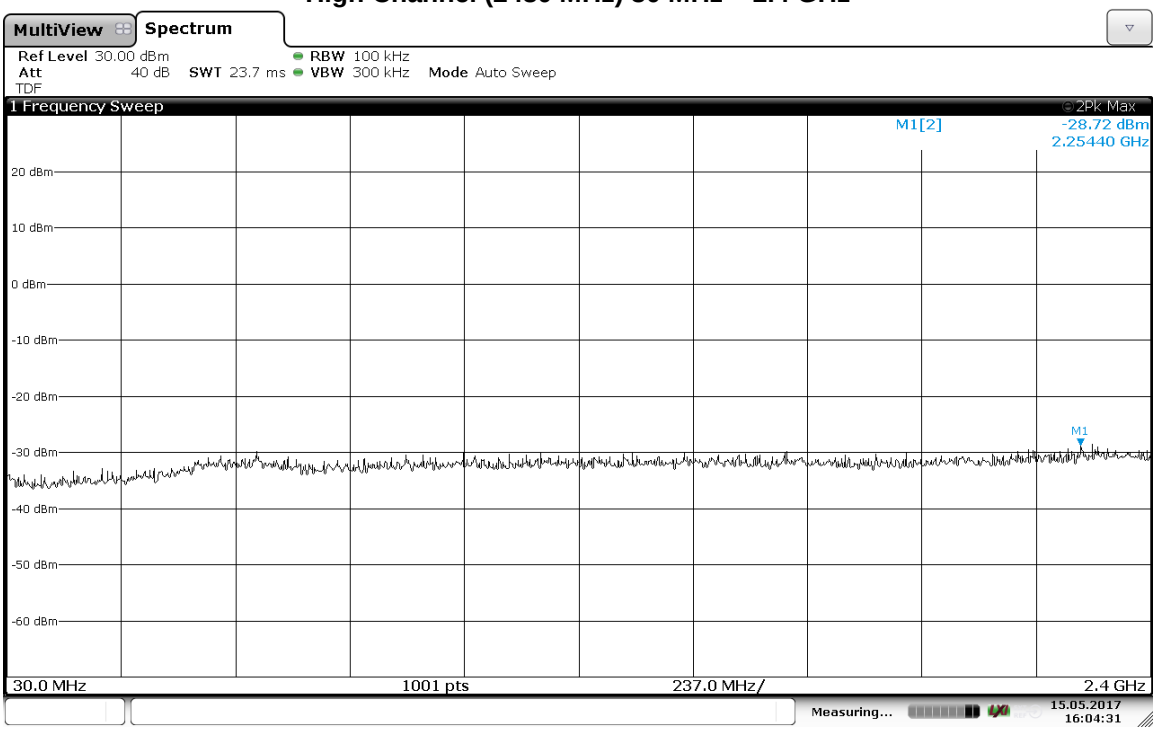
Mid Channel (2441 MHz) 2.4835 GHz – 10 GHz



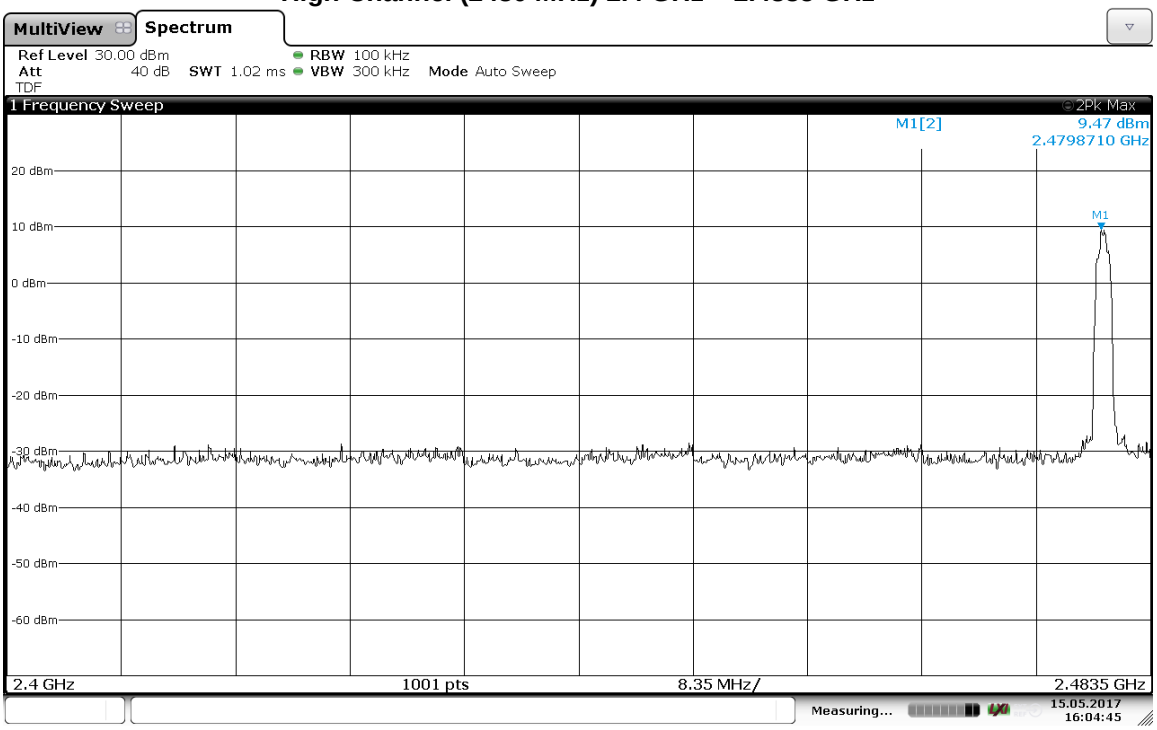
Mid Channel (2441 MHz) 10 GHz – 25 GHz



High Channel (2480 MHz) 30 MHz – 2.4 GHz

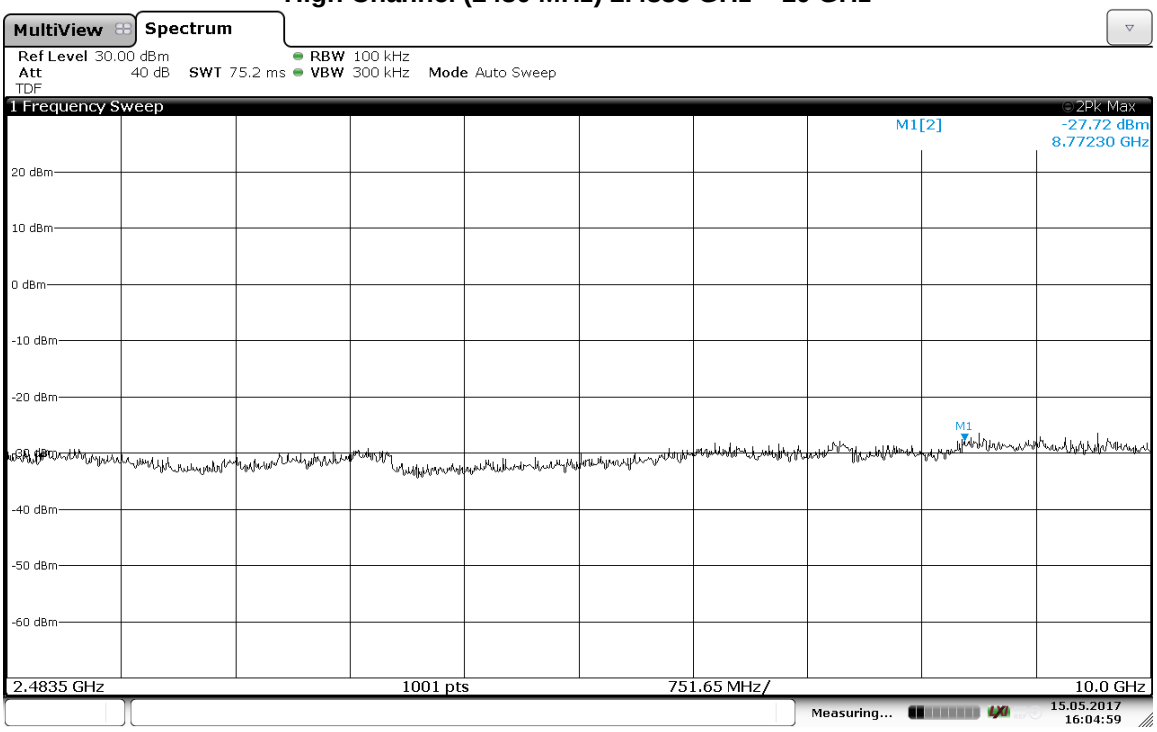


High Channel (2480 MHz) 2.4 GHz – 2.4835 GHz

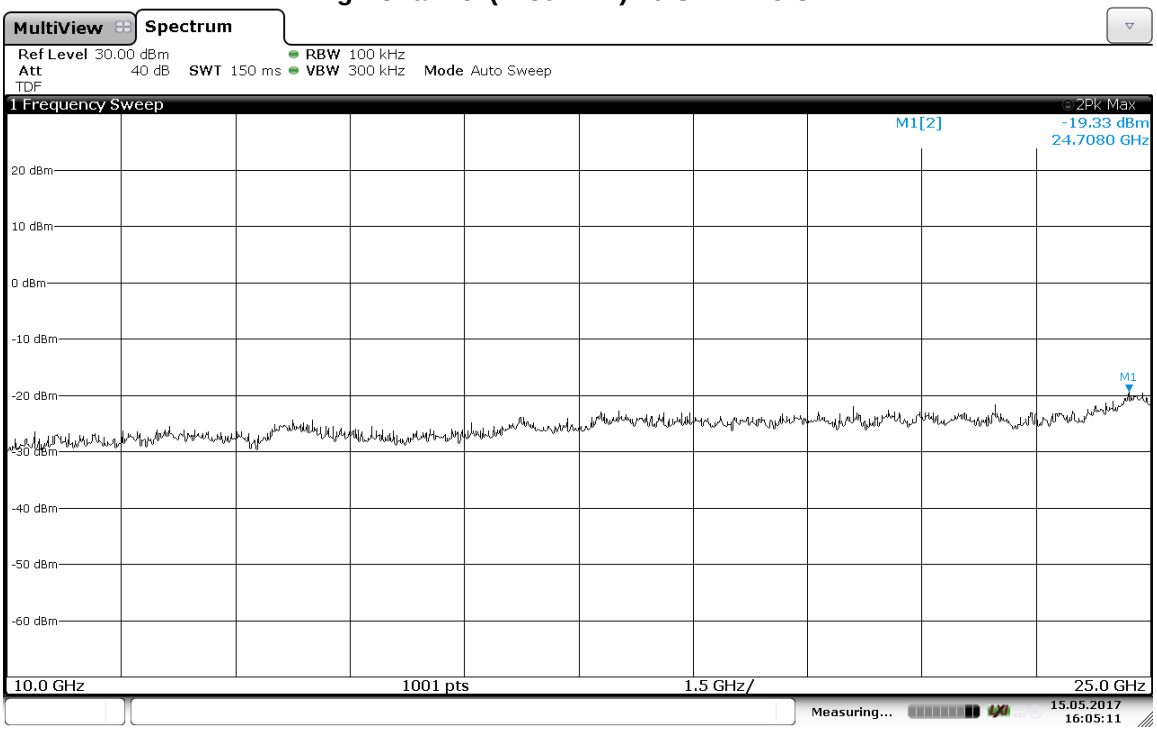


Date: 15.MAY.2017 16:04:44

High Channel (2480 MHz) 2.4835 GHz – 10 GHz

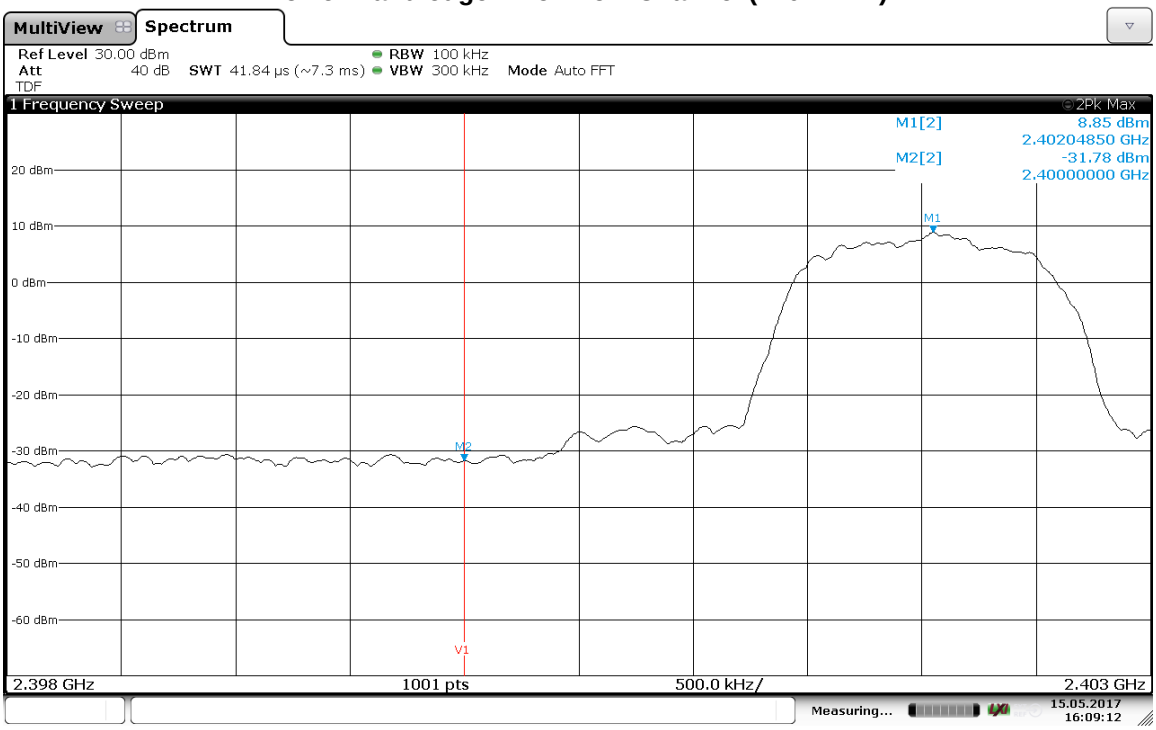


High Channel (2480 MHz) 10 GHz – 25 GHz

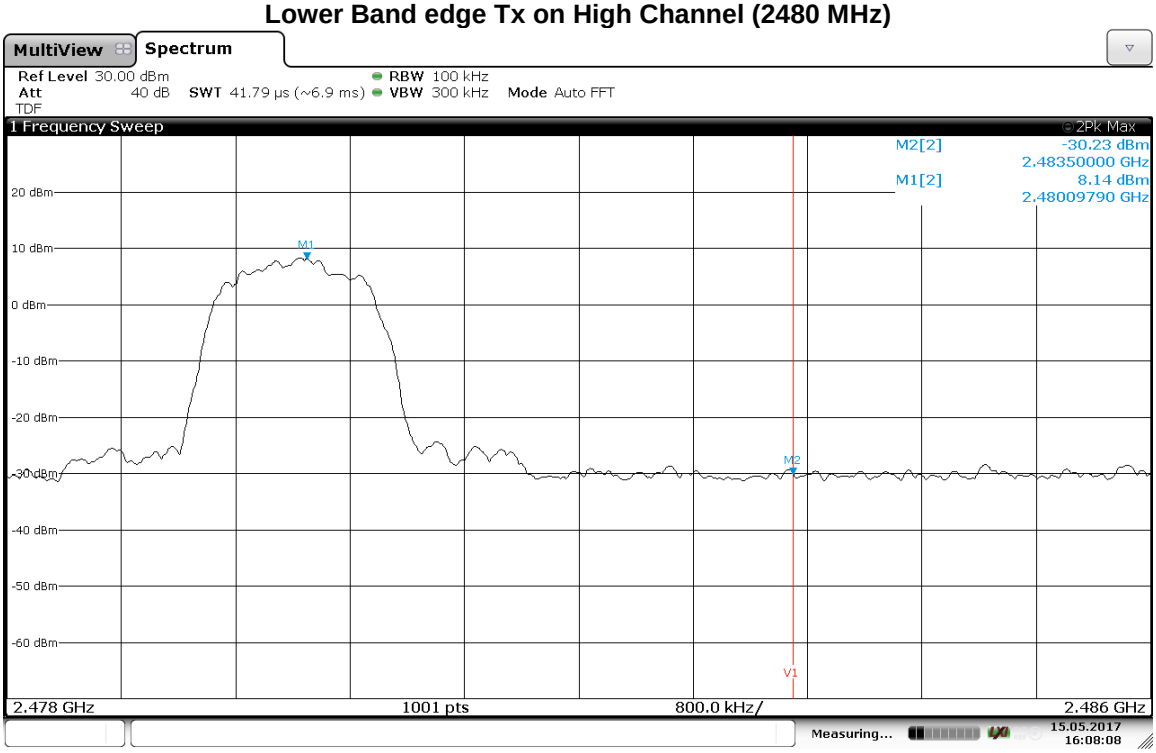


Note: Band edge test was performed on pi/4 DPSK modulation and DH5 data rate which recorded worst case 20 dB BW.

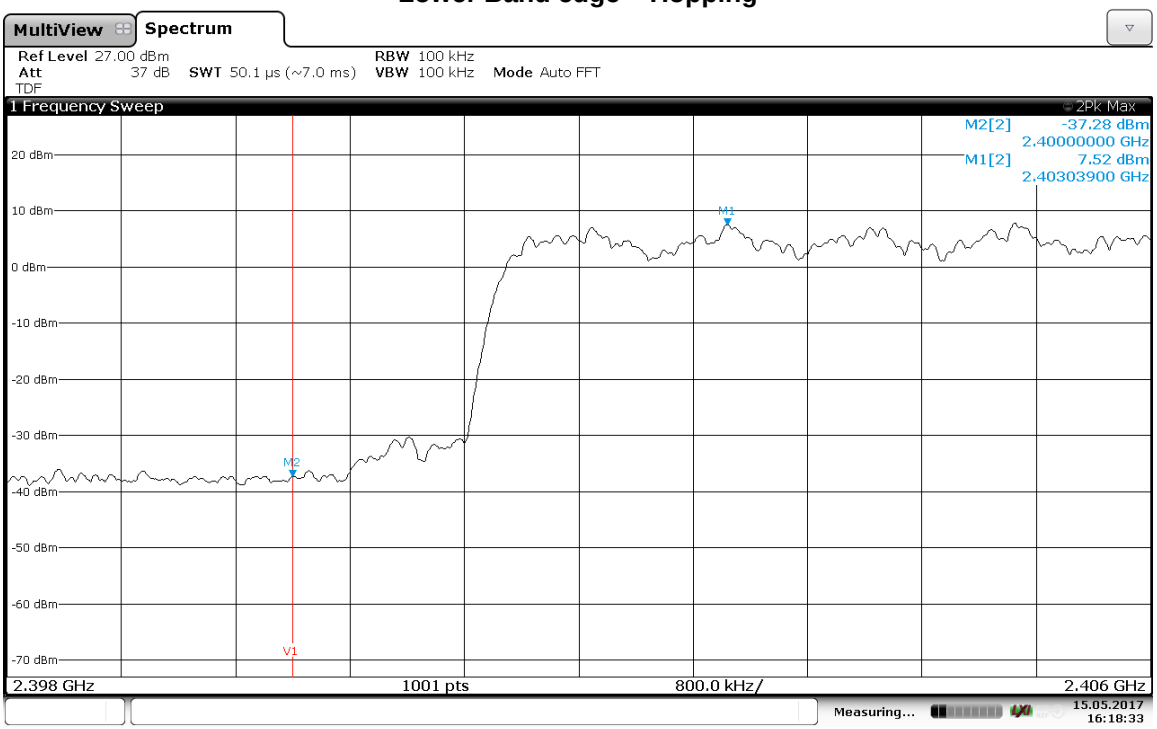
Lower Band edge Tx on Low Channel (2402 MHz)



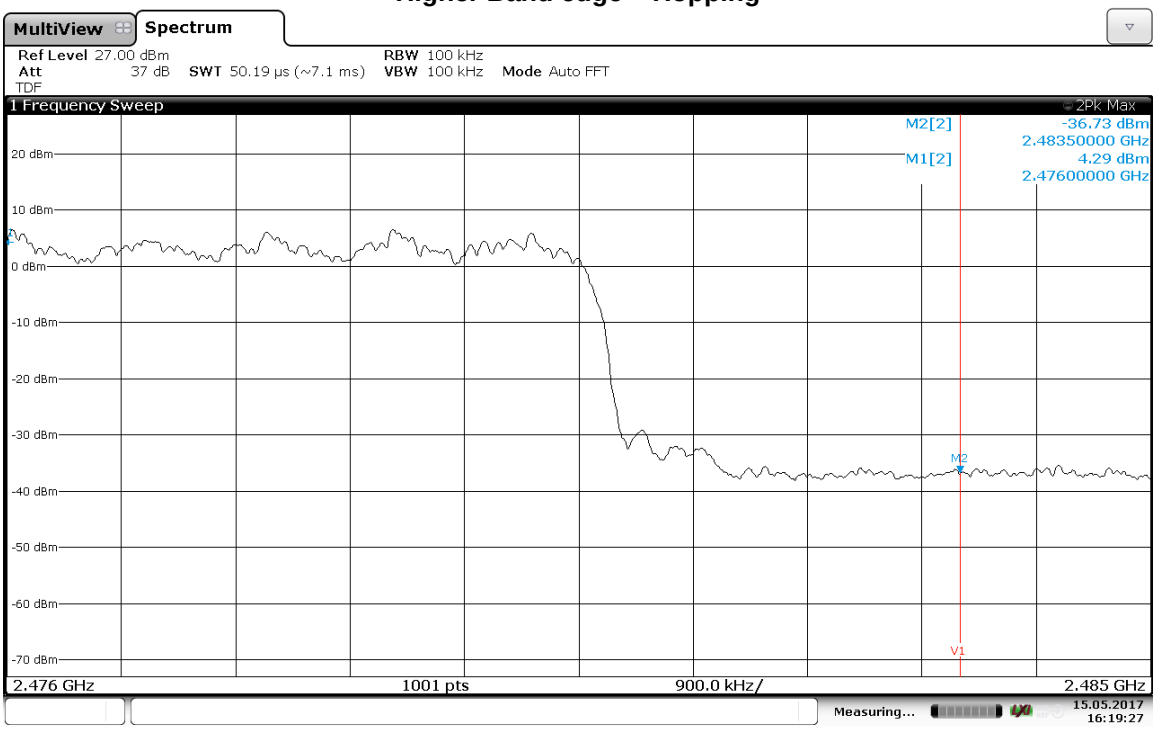
Lower Band edge Tx on High Channel (2480 MHz)



Lower Band edge – Hopping



Higher Band edge – Hopping



Test Personnel:	Naga Suryadevara N.S	Test Date:	06/07/2017
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC 15.247 RSS 247	Limit Applied:	See section 8.3
Input Voltage:	120VAC 60Hz		
		Ambient Temperature:	22 ºC
Pretest Verification:	N/A	Relative Humidity:	33 %
		Atmospheric Pressure:	1008mbars

Deviations, Additions, or Exclusions: None

9 Carrier Frequency Separation

9.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C and RSS 247.

TEST SITE: EMC Lab (Duluth, GA)

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

9.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
212104'	Barometric Pressure/Humidity/Temperature Datalogger	Extech	SD700	A.074980	10/21/2016	10/21/2017
MC1'	RF Coax Cable 10KHz-26.5GHz	MINI CIRCUITS	CBL10SMQ-SM+	131208	06/13/2016	06/13/2017
03169'	EMC Analyzer	Agilent	E7405A	US40240205	09/21/2016	09/21/2017

Software Utilized:

Name	Manufacturer	Version
None (Spectrum Analyzer Firmware)		

9.3 Results:

The sample tested was found to Comply. Carrier frequency separation is 990 kHz.

FCC 15.247(a)(1)

(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

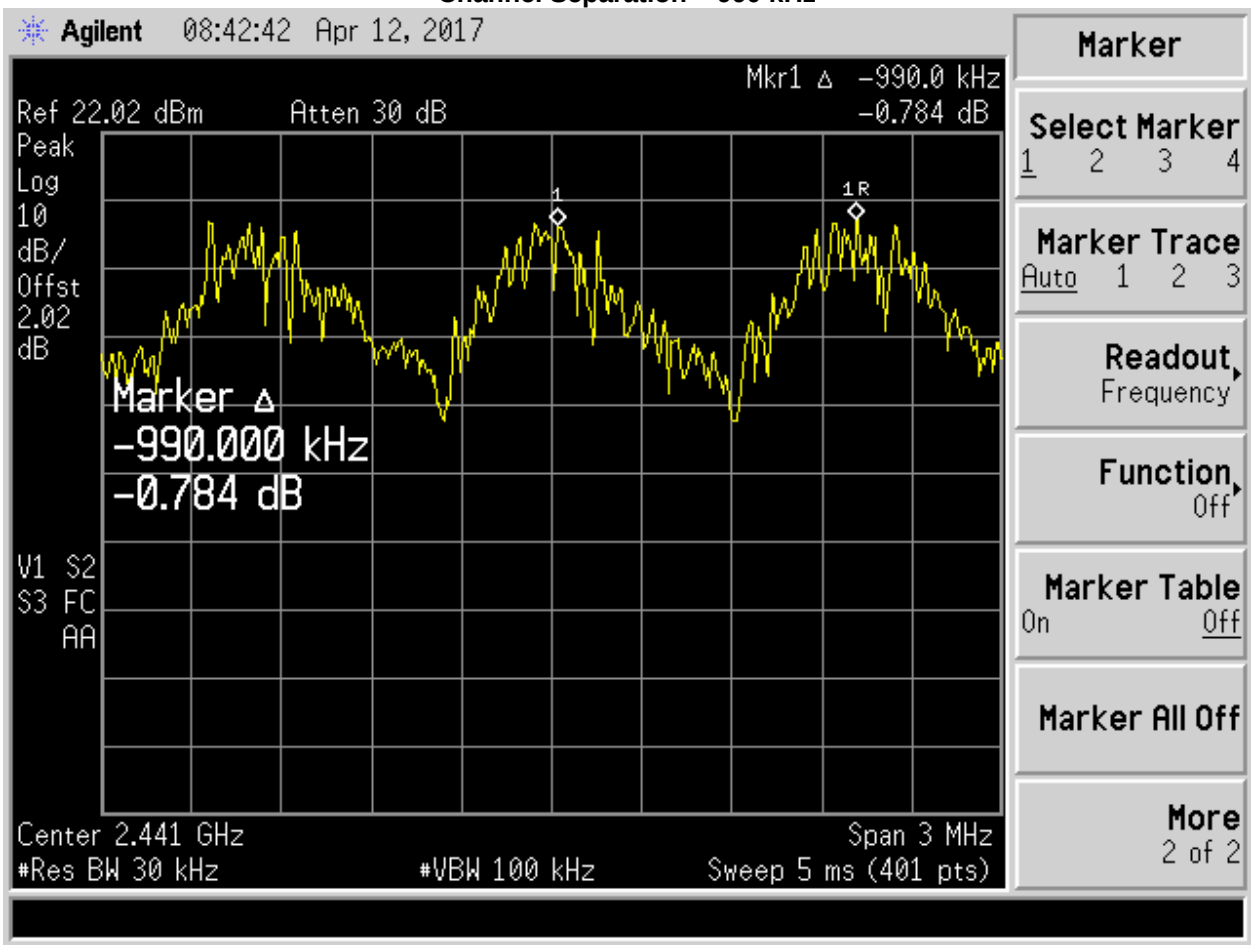
(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies 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.

RSS-247 Section 5.1(b)

b) FHSs 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, FHSs operating in the band 2400-2483.5 MHz 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 that the systems operate with an output power no greater than 0.125 W.

9.4 Plots/Data:

Channel Separation = 990 kHz



Test Personnel:	Mary T Sampson MTS	Test Date:	04/12/2017
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC 15.247 RSS 247	Limit Applied:	See Section 9.3
Input Voltage:	120VAC 60Hz		
		Ambient Temperature:	22.8 ºC
Pretest Verification:	N/A	Relative Humidity:	43.8 %
		Atmospheric Pressure:	990.6 mbars

Deviations, Additions, or Exclusions: None

10 Number of Hopping Frequencies

10.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C and RSS 247.

TEST SITE: EMC Lab (Duluth, GA)

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

10.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
212104'	Barometric Pressure/Humidity/Temperature Datalogger	Extech	SD700	A.074980	10/21/2016	10/21/2017
MC1'	RF Coax Cable 10KHz-26.5GHz	MINI CIRCUITS	CBL10SMQ-SM+	131208	06/13/2016	06/13/2017
03169'	EMC Analyzer	Agilent	E7405A	US40240205	09/21/2016	09/21/2017

Software Utilized:

Name	Manufacturer	Version
None (Spectrum Analyzer Firmware)		

10.3 Results:

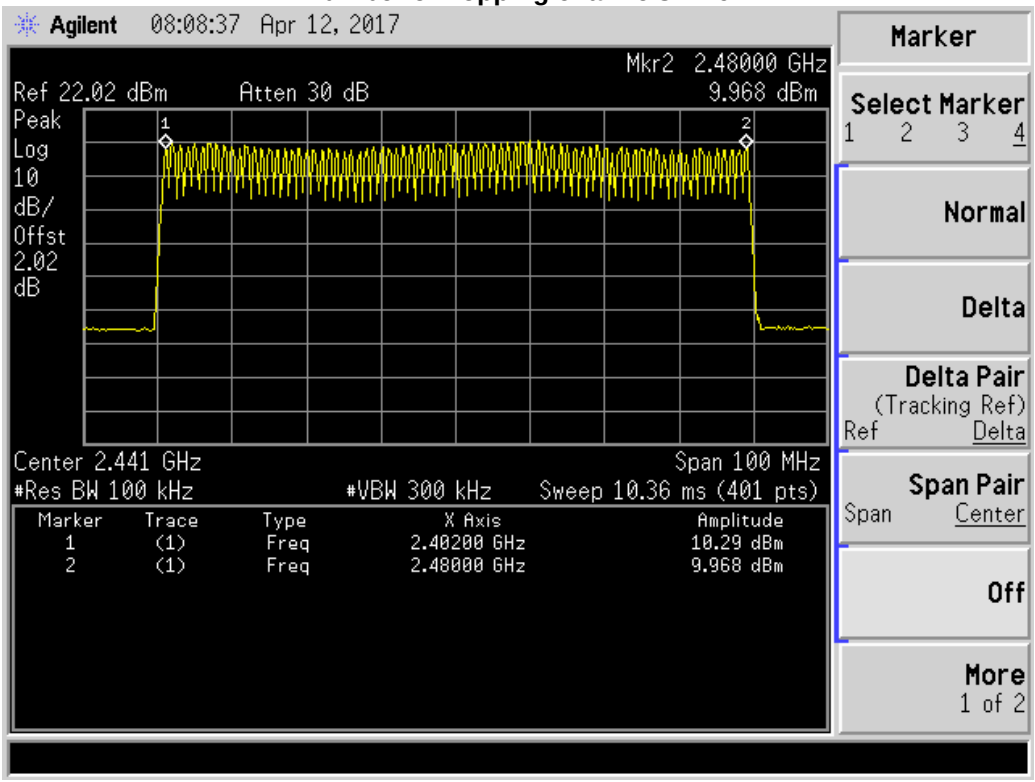
The sample tested was found to Comply. Number of hopping frequencies is 79.

FCC 15.247(a)(1)(i)
(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

RSS-247 Section 5.1(d)
d) FHSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping 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. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

10.4 Plots/Data:

Number of hopping channels = 79



Test Personnel:	Mary T Sampson MTS	Test Date:	04/12/2017
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC 15.247 RSS 247	Limit Applied:	See Section 10.3
Input Voltage:	120VAC 60Hz	Ambient Temperature:	22.8 ºC
Pretest Verification:	**N/A**	Relative Humidity:	43.8 %
		Atmospheric Pressure:	990.6 mbars

11 Time of Occupancy (Dwell Time)

11.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C and RSS 247.

TEST SITE: EMC Lab (Boxborough, MA)

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

11.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV004'	Weather Station	Davis Instruments	7400	PE80529A61A	05/10/2017	05/10/2018
ROS005'	ETSI Test System	Rhode & Schwartz	TS8997	N/A	09/15/2016	09/15/2017
MIN23'	Attenuator 2 watt 20dB DC-26GHz	Mini Circuits	BW-S20-2W263+	MIN23	05/20/2017	05/20/2018
CBLHF2012-2M-1'	2m 9kHz-40GHz Coaxial Cable - SET1	Huber & Suhner	SF102	252675001	02/08/2017	02/08/2018

Software Utilized:

Name	Manufacturer	Version
None (Spectrum Analyzer Firmware)		

11.3 Results:

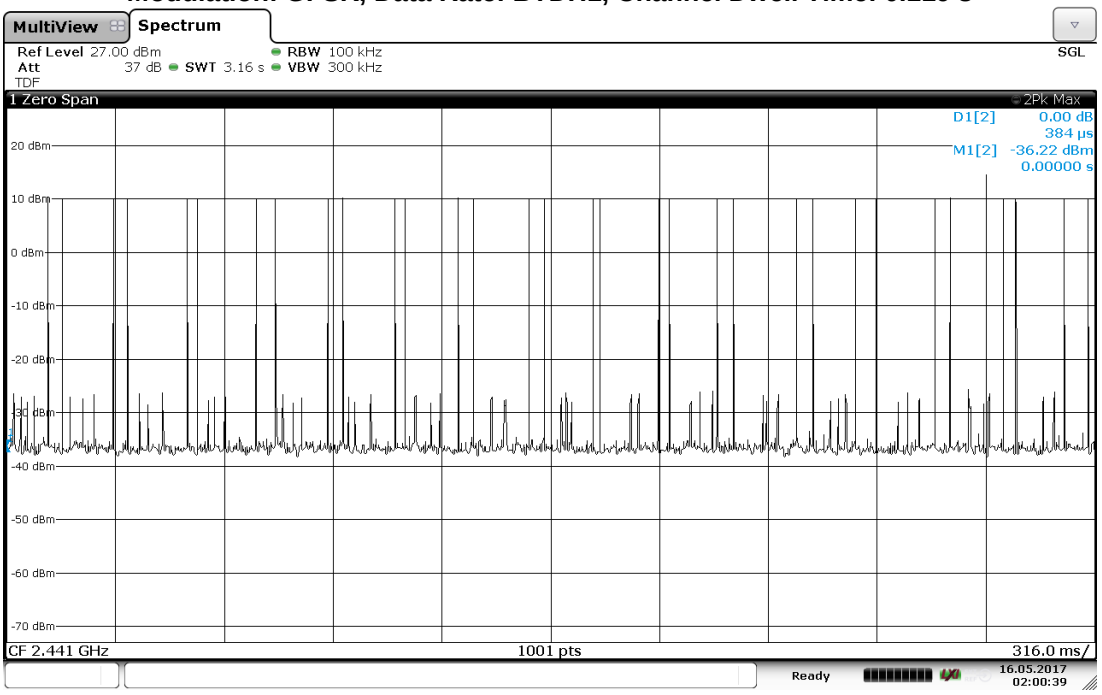
The sample tested was found to Comply.

FCC 15.247(a)(1)(i)
(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

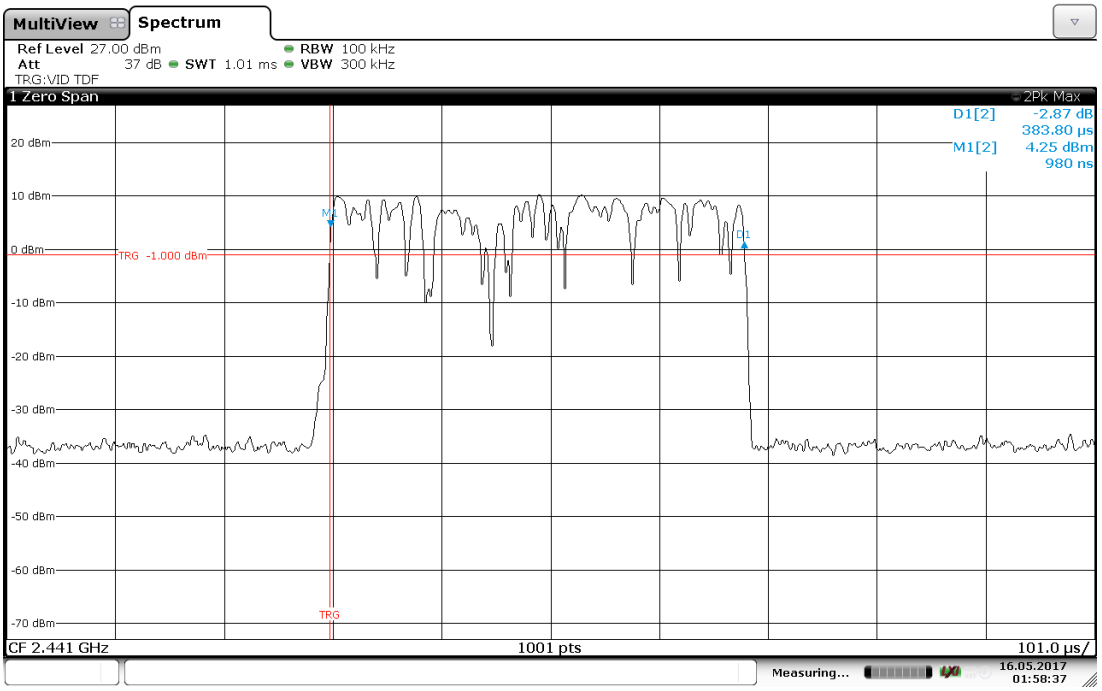
RSS-247 Section 5.1(d)
d) FHSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

11.4 Plots/Data:

Modulation: GFSK, Data Rate: BTDH1, Channel Dwell Time: 0.119 s



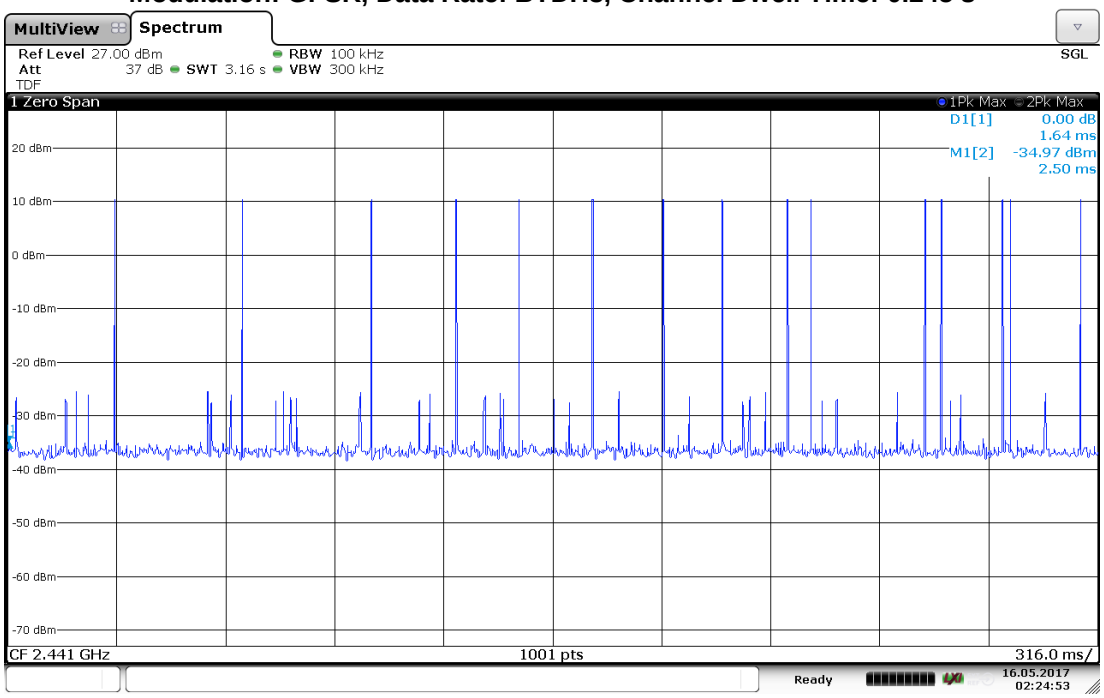
Date: 16.MAY.2017 02:00:38



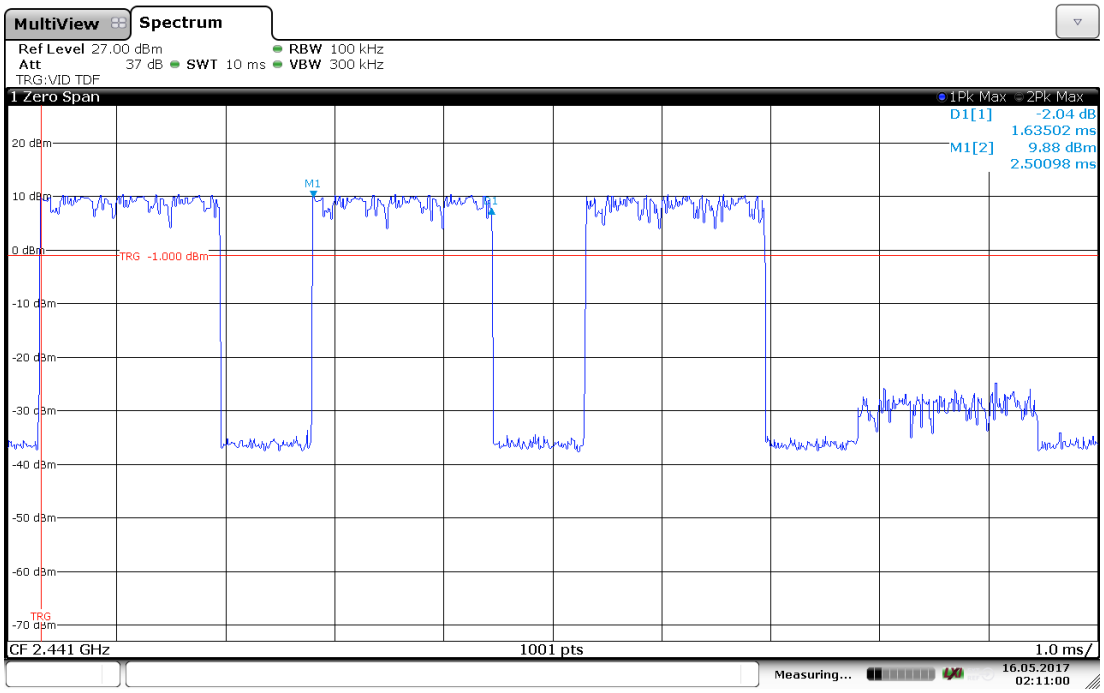
Date: 16.MAY.2017 01:58:37

Channel Dwell Time: 31 x 0.38380 x 10 = 118.978 ms or 0.119 s, **Limit:** 0.4 s

Modulation: GFSK, Data Rate: BTDH3, Channel Dwell Time: 0.245 s



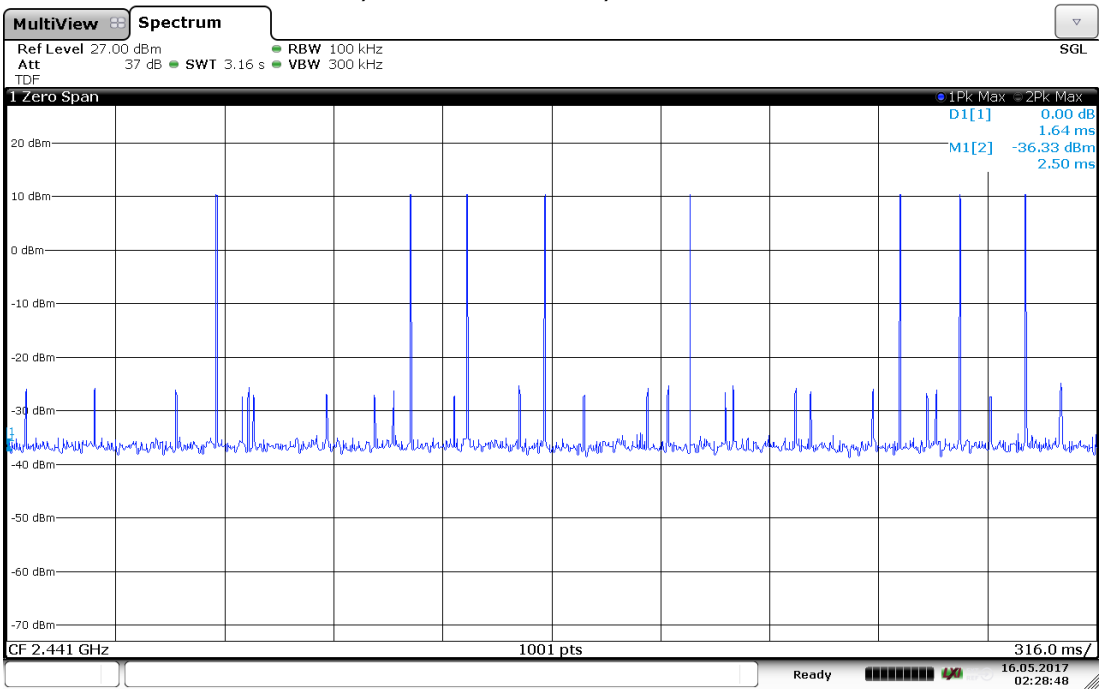
Date: 16.MAY.2017 02:24:52



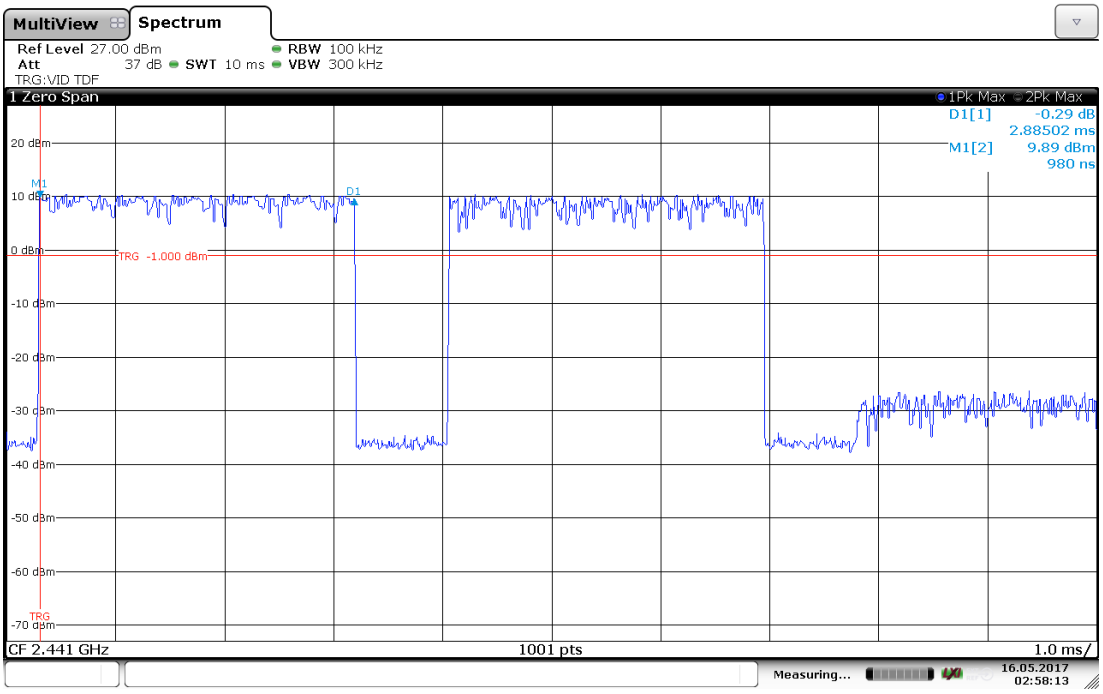
Date: 16.MAY.2017 02:11:00

Channel Dwell Time: 15 x 1.63502 x 10 = 245.253 ms or 0.245 s, **Limit:** 0.4 s

Modulation: GFSK, Data Rate: BTDH5, Channel Dwell Time: 0.231 s



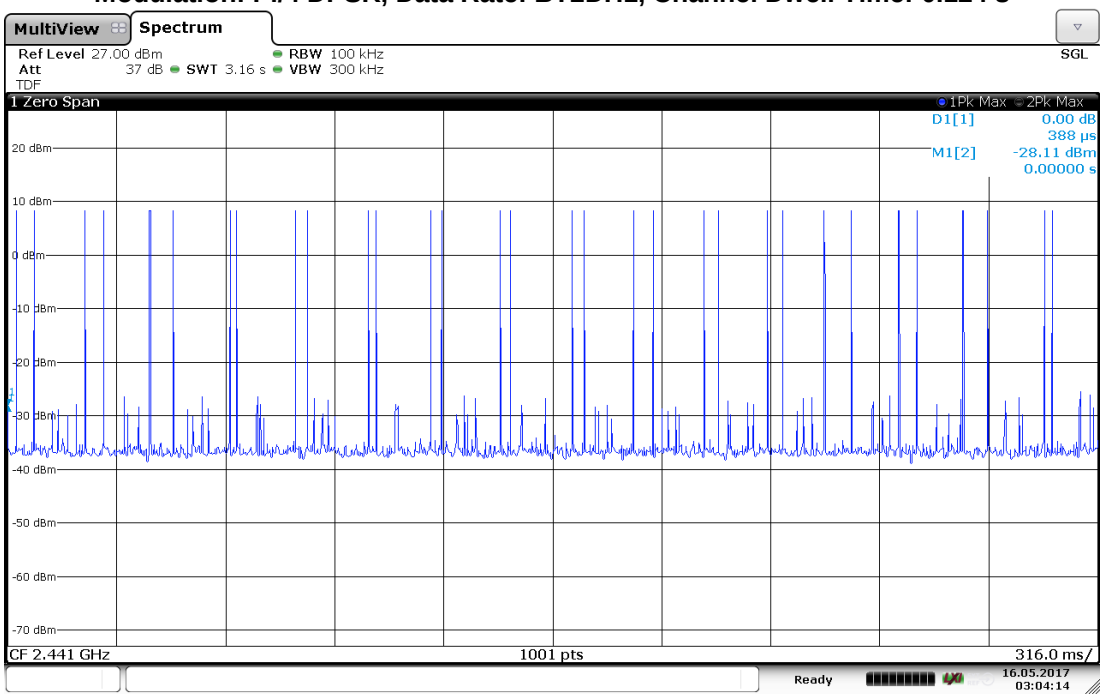
Date: 16.MAY.2017 02:28:48



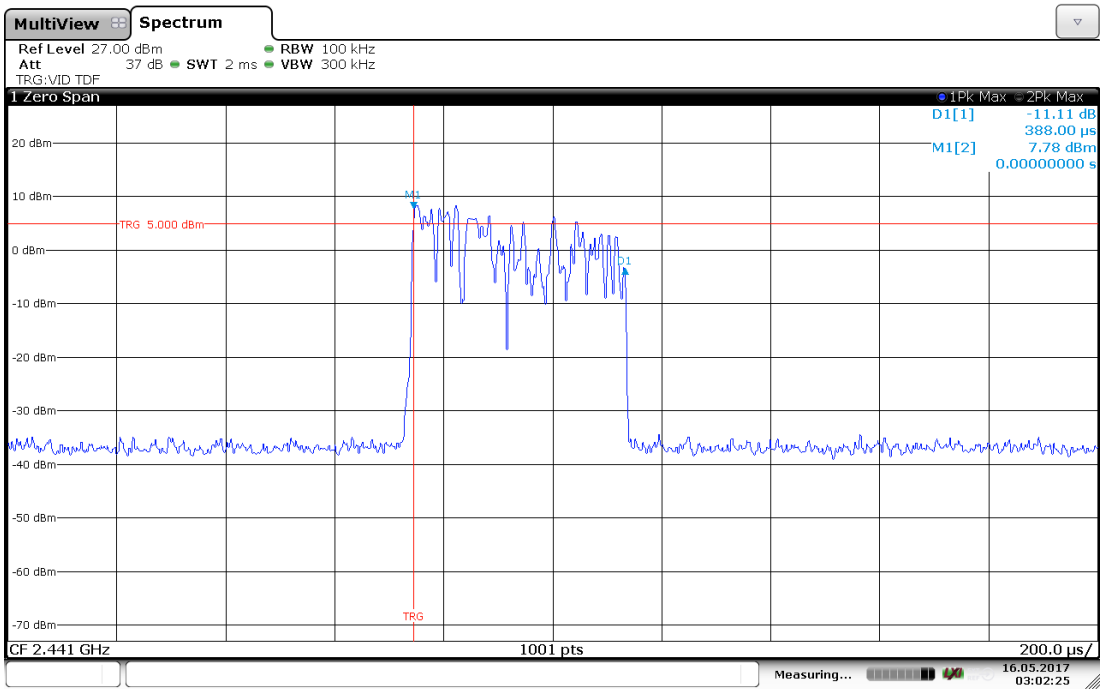
Date: 16.MAY.2017 02:58:13

Channel Dwell Time: 8 x 2.88502 x 10 = 230.802 ms or 0.231 s, **Limit:** 0.4 s

Modulation: Pi/4 DPSK, Data Rate: BT2DH1, Channel Dwell Time: 0.124 s



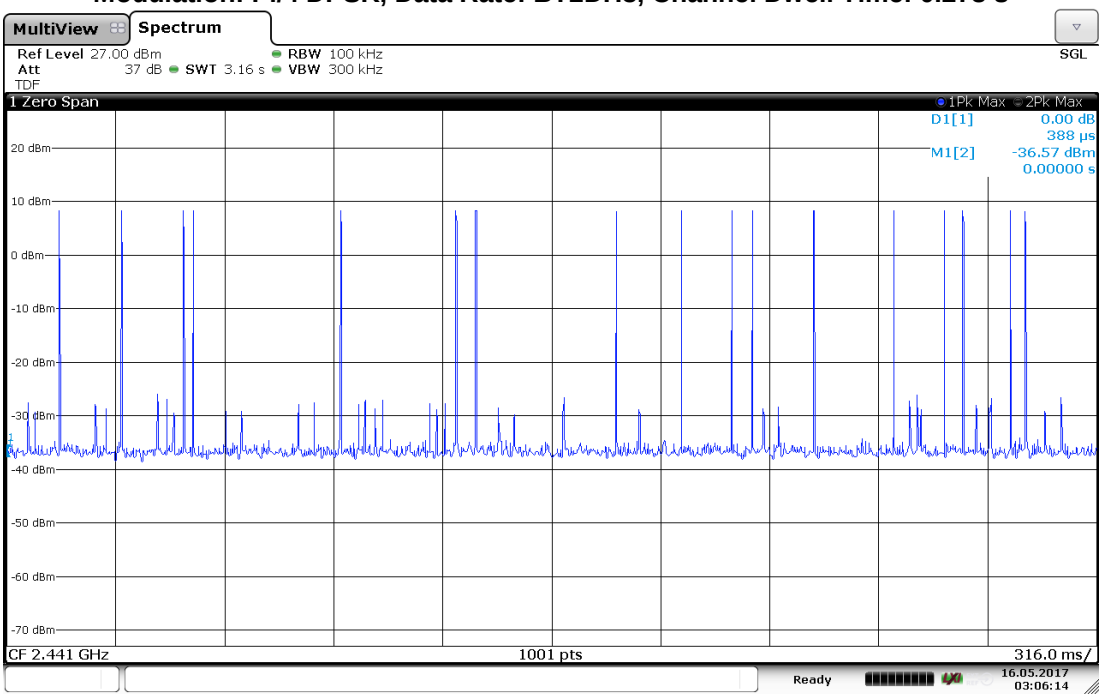
Date: 16.MAY.2017 03:04:13



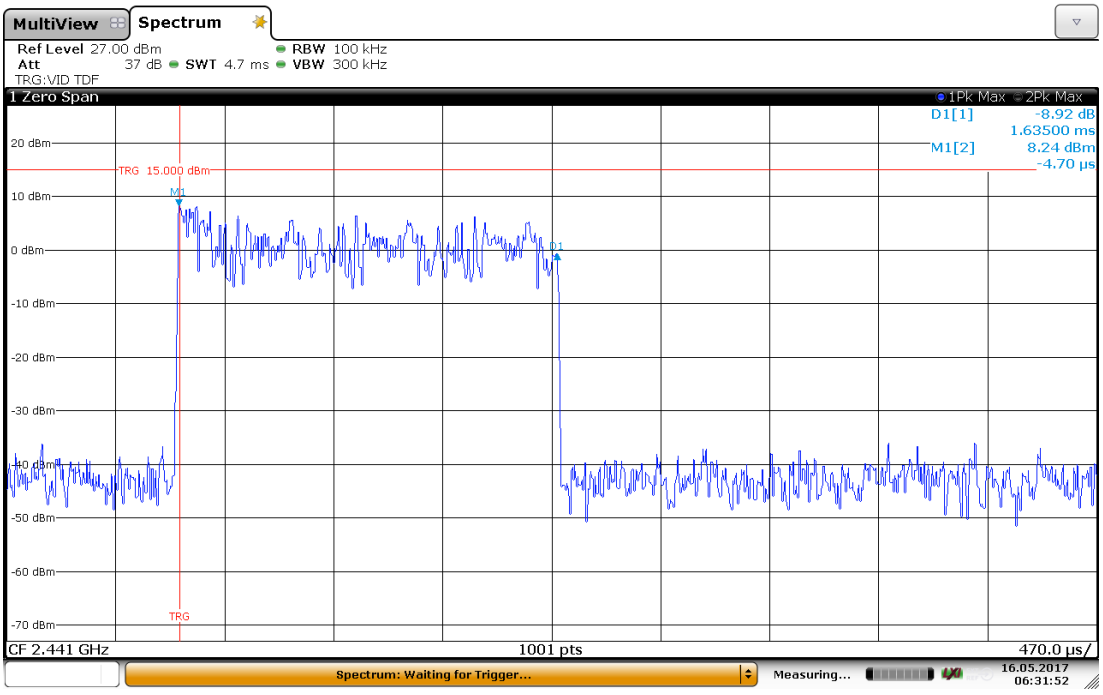
Date: 16.MAY.2017 03:02:24

Channel Dwell Time: 32 x 0.388 x 10 = 124.16 ms or 0.124 s, **Limit:** 0.4 s

Modulation: Pi/4 DPSK, Data Rate: BT2DH3, Channel Dwell Time: 0.278 s



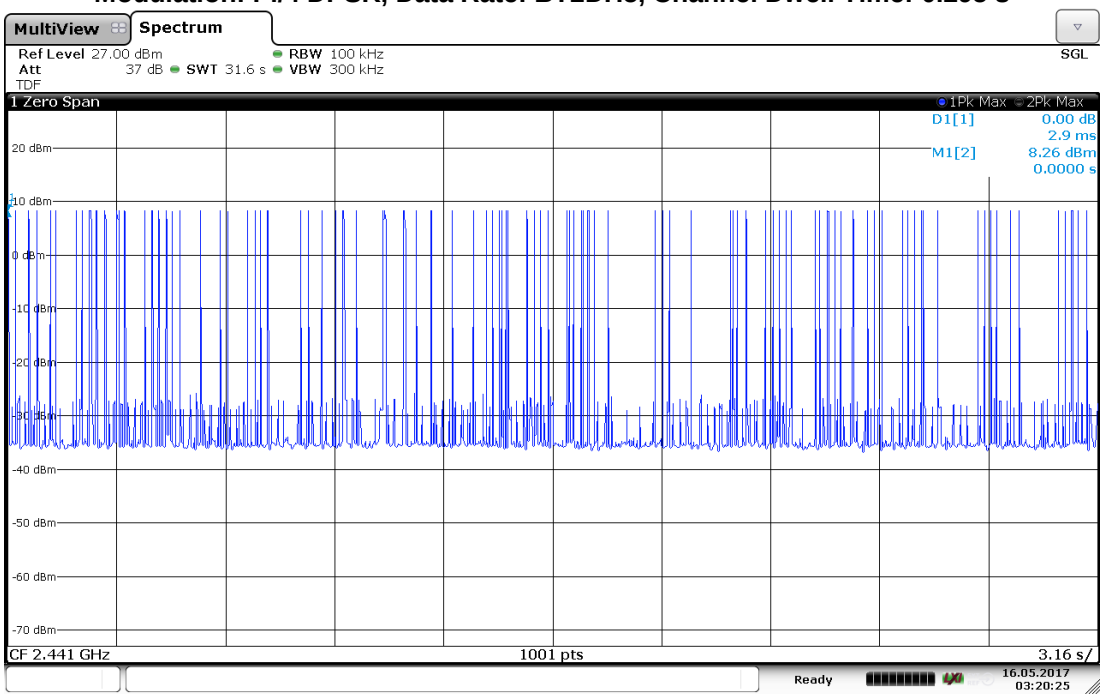
Date: 16.MAY.2017 03:06:14



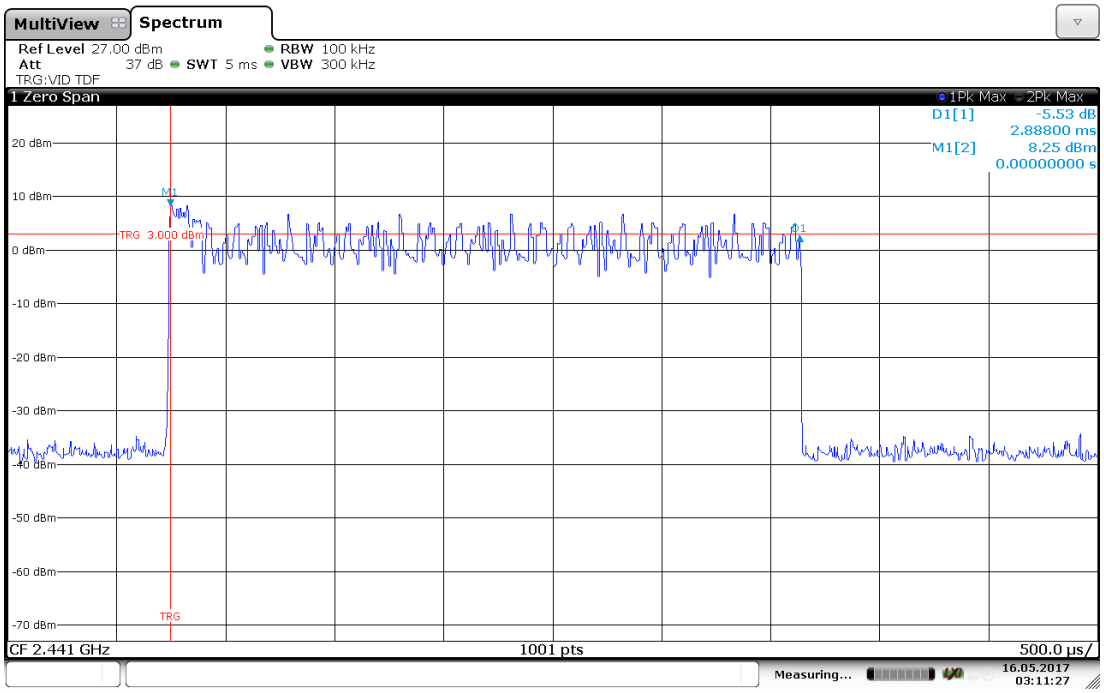
Date: 16.MAY.2017 06:31:52

Channel Dwell Time: 17 x 1.635 x 10 = 277.95 ms or 0.278 s, **Limit:** 0.4 s

Modulation: Pi/4 DPSK, Data Rate: BT2DH5, Channel Dwell Time: 0.295 s



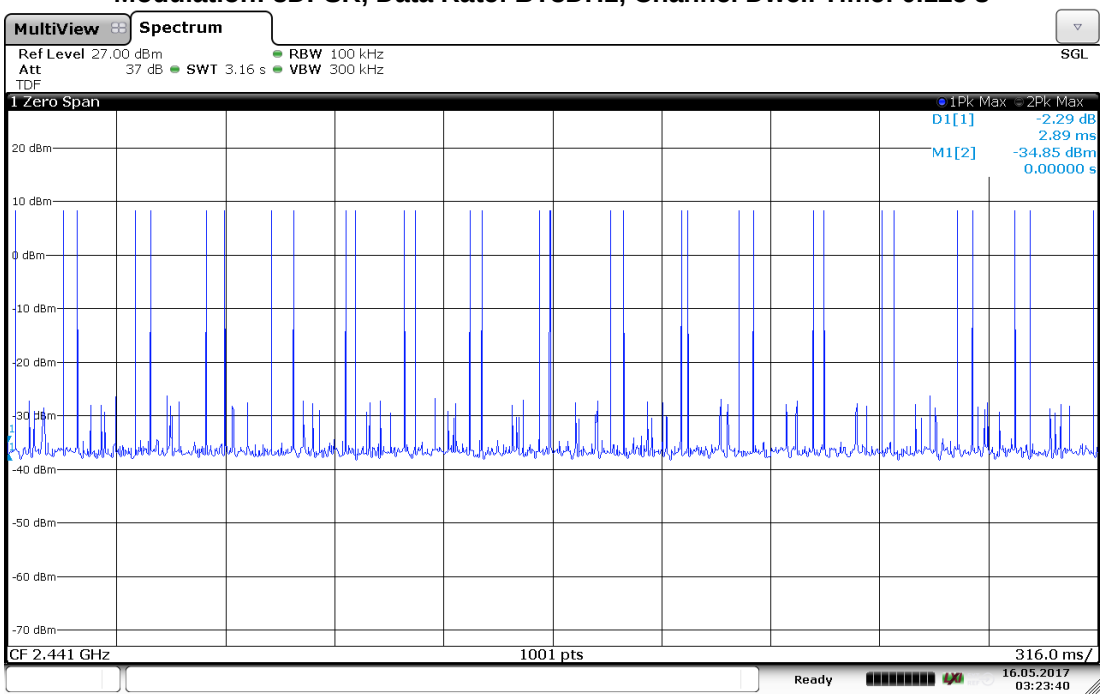
Date: 16.MAY.2017 03:20:24



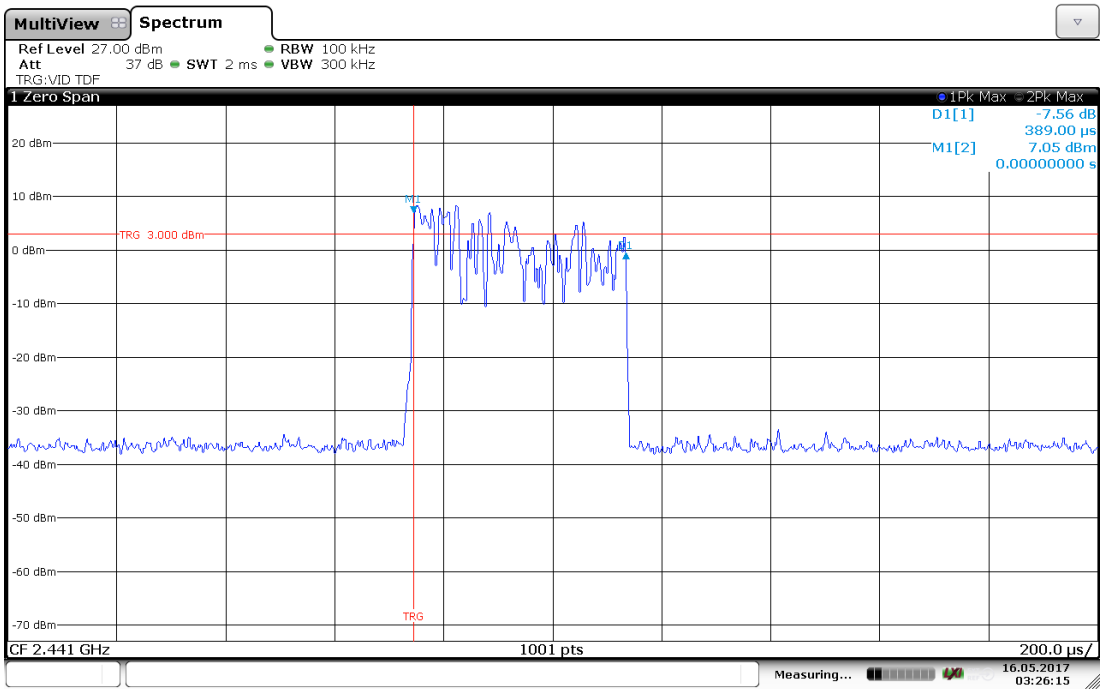
Date: 16.MAY.2017 03:11:26

Channel Dwell Time: 102 x 2.888 = 294.576 ms or 0.295 s, **Limit:** 0.4 s

Modulation: 8DPSK, Data Rate: BT3DH1, Channel Dwell Time: 0.125 s



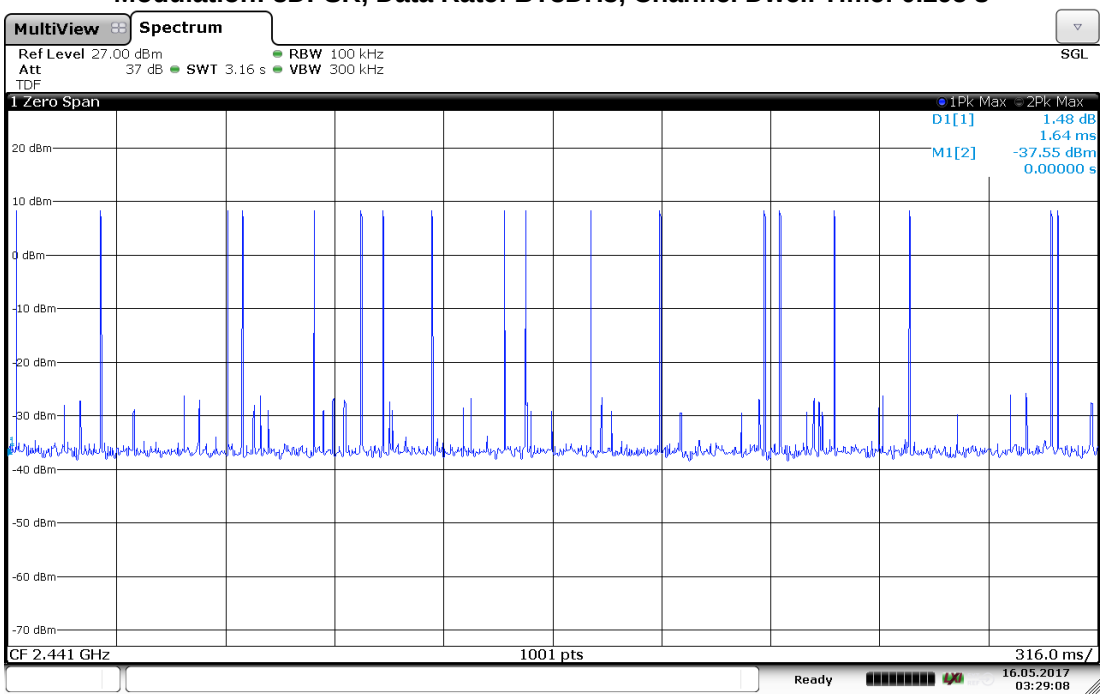
Date: 16.MAY.2017 03:23:40



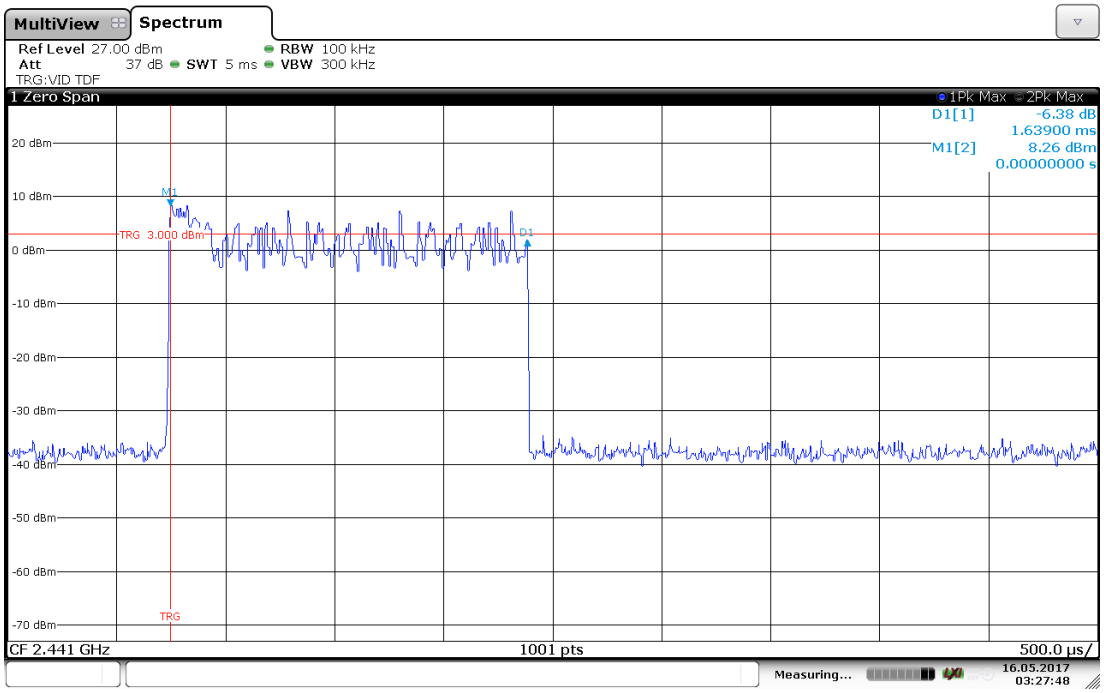
Date: 16.MAY.2017 03:26:15

Channel Dwell Time: 32 x 0.389 x 10 = 124.48 ms or 0.125 s, **Limit:** 0.4 s

Modulation: 8DPSK, Data Rate: BT3DH3, Channel Dwell Time: 0.295 s



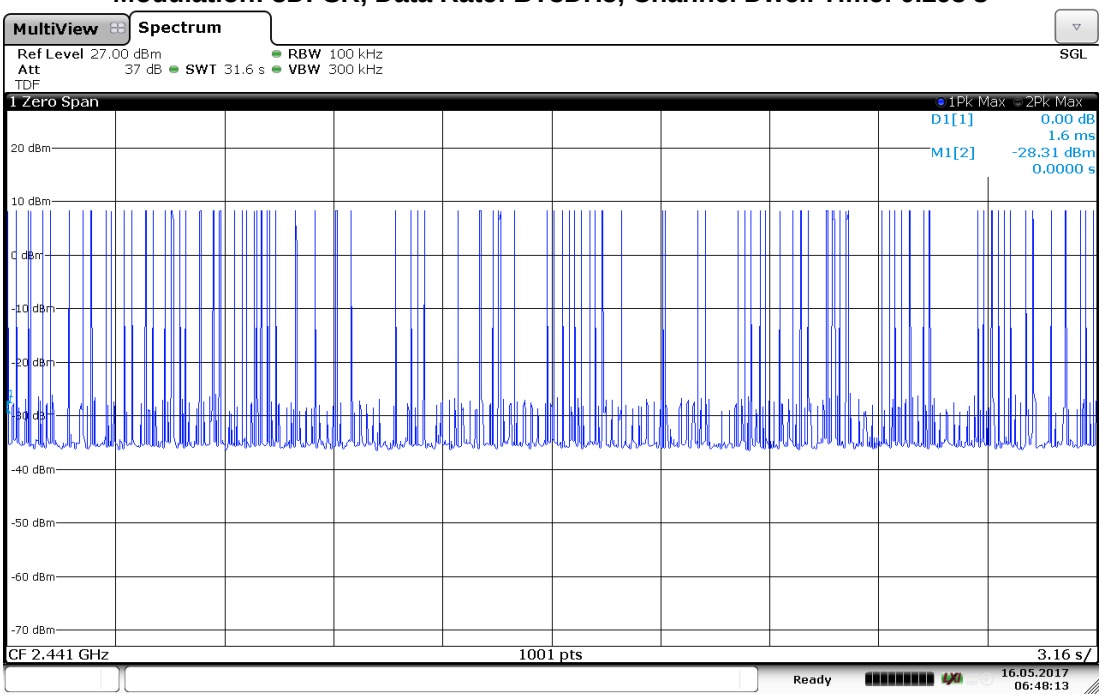
Date: 16.MAY.2017 03:29:08



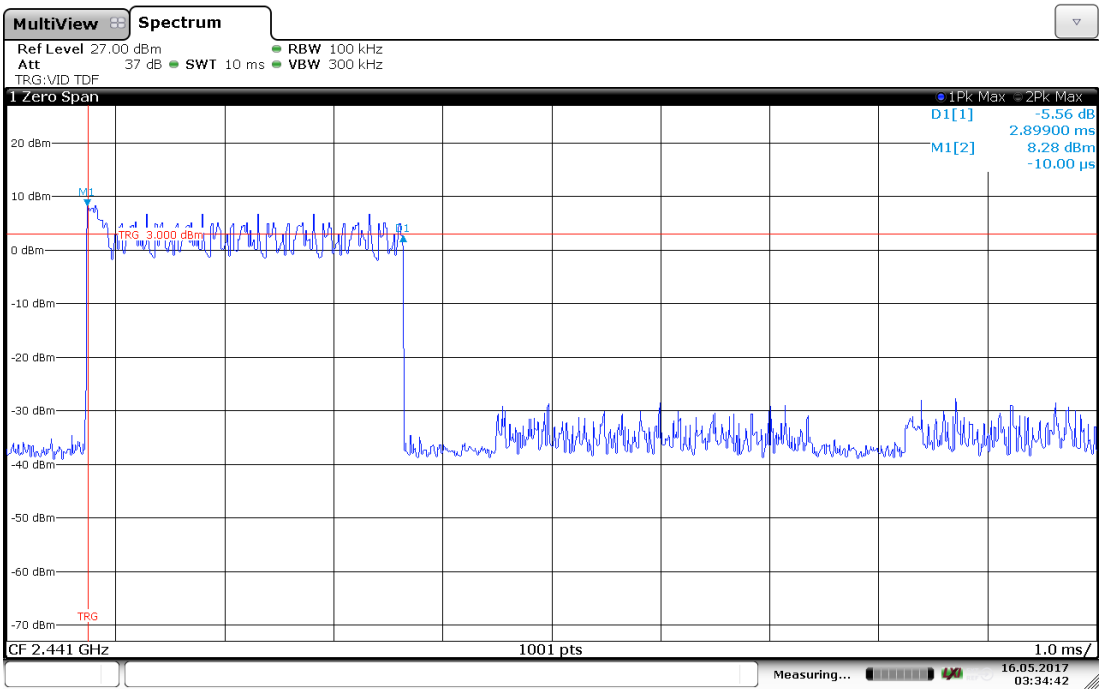
Date: 16.MAY.2017 03:27:48

Channel Dwell Time: 18 x 1.639 x 10 = 295.02 ms or 0.295 s, **Limit:** 0.4 s

Modulation: 8DPSK, Data Rate: BT3DH5, Channel Dwell Time: 0.293 s



Date: 16.MAY.2017 06:48:13



Date: 16.MAY.2017 03:34:41

Channel Dwell Time: 101 x 2.899 = 292.799 ms or 0.293 s, **Limit:** 0.4 s

Test Personnel:	Naga Suryadevara N·S	Test Date:	06/07/2017
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC 15.247 RSS 247	Limit Applied:	See section 11.3
Input Voltage:	120VAC 60Hz		
		Ambient Temperature:	22 ºC
Pretest Verification:	N/A	Relative Humidity:	33 %
		Atmospheric Pressure:	1008mbars

12 Radiated Emissions (Transmitter Spurious, Digital Device and Receiver)

12.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C (15.247), RSS 247, FCC Part 15 Subpart B and ICES 003.

TEST SITE: 10M ALSE (Boxborough, MA)

10 Meter Semi-Anechoic Chamber The test site for radiated emissions is located at 1950 Evergreen Blvd, Suite 100, Duluth, Georgia 30096. It is a 10 meter semi-anechoic chamber manufactured by Panashield. Embedded in the floor is a 3 meter diameter turntable.

Measurement Uncertainty Boxborough, Massachusetts

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.6 dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	5.3 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.5 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	5.2 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	5.0 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	5.0 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

12.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV003'	Weather Station	Davis Instruments	7400	PE80529A39A	11/28/2016	11/28/2017
145145'	Broadband Hybrid Antenna 30 MHz - 3 GHz	Sunol Sciences Corp.	JB3	A122313	05/02/2017	05/02/2018
145-410'	Cables 145-420 145-421 145-422 145-406	Huber + Suhner	10m Track A Cables	multiple	07/30/2016	07/30/2017
PRE10'	30-1000MHz pre-amp	ITS	PRE10	PRE10	12/16/2016	12/16/2017
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/15/2017	03/15/2018
ETS001'	1-18GHz DRG Horn Antenna	ETS-Lindgren	3117	00143259	02/13/2017	02/13/2018
145020'	Preamplifier (1 GHz to 26.5 GHz)	Hewlett Packard	8449B	3008A00948	08/26/2016	08/26/2017
EMC04'	ANTENNA, RIDGED GUIDE, 18-40 GHZ	EMCO	3116	2090	09/14/2016	09/14/2017
REA004'	3GHz High Pass Filter	Reactel, Inc	7HSX-3G/18G-S11	06-1	02/17/2017	02/17/2018
PRE9'	100MHz-40GHz Preamp	MITEQ	NSP4000-NFG	1260417	08/23/2016	08/23/2017
CBLHF2012-2M-1'	2m 9kHz-40GHz Coaxial Cable - SET1	Huber & Suhner	SF102	252675001	02/08/2017	02/08/2018
CBLHF2012-5M-1'	5m 9kHz-40GHz Coaxial Cable - SET 1	Huber & Suhner	SF102	252676001	02/08/2017	02/08/2018
145-416'	Cables 145-420 145-423 145-424 145-408	Huber + Suhner	3m Track B cables	multiple	07/30/2016	07/30/2017

Software Utilized:

Name	Manufacturer	Version
EMI Boxborough.xlsx	Intertek Boxborough	08/27/2010

12.3 Results:

The sample tested was found to Comply.

FCC Part 15.247(d)
In any 100 kHz bandwidth outside the frequency band , 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. 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)).

RSS-247 Section 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 5.4(d), 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.

FCC Part 15.209(a) & RSS-210 A8.5 – Restricted Band Radiated Spurious/Harmonics Limits

Frequency	**Field Strength**		**Test Distance**
(MHz)	µV/m	dBµV/m	(meters)
30–88	100	40.00	3
88–216	150	43.52	3
216–960	200	46.02	3
Above 960	500	53.98	3

12.4 Plots/Data:

Note: 8DPSK Modulation and DH1 data rate was used for conducted spurious emissions where highest output power was measured.

BT-EDR Tx mode 30-1000 MHz (Tx on Mid Channel)

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
QP	V	34.229	33.12	17.84	1.29	40.73	0.00	11.52	30.00	-18.48	120/300 kHz
QP	H	38.998	32.19	14.80	1.29	40.72	0.00	7.56	30.00	-22.44	120/300 kHz
QP	H	277.190	28.98	13.44	3.04	40.68	0.00	4.78	36.00	-31.22	120/300 kHz
QP	V	281.190	36.17	13.48	3.05	40.68	0.00	12.02	36.00	-23.98	120/300 kHz
QP	H	356.760	27.19	14.74	3.44	40.75	0.00	4.62	36.00	-31.38	120/300 kHz
QP	V	404.120	34.12	15.88	3.61	40.77	0.00	12.85	36.00	-23.15	120/300 kHz

BT-EDR Tx mode 1-25 GHz (Tx on Low, Mid and High Channel)

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
			BT-EDR Low Channel @ 2402 MHz @ DH1 data rate								
PK	V	4804.000	45.46	33.98	8.25	33.88	0.00	53.81	74.00	-20.19	1/3 MHz
AVG	V	4804.000	31.98	33.98	8.25	33.88	0.00	40.33	54.00	-13.67	1/3 MHz
PK	V	7206.000	42.83	35.71	10.75	34.63	0.00	54.66	74.00	-19.34	1/3 MHz
AVG	V	7206.000	29.70	35.71	10.75	34.63	0.00	41.53	54.00	-12.47	1/3 MHz
PK	V	9608.000	41.74	36.66	12.99	35.06	0.00	56.33	74.00	-17.67	1/3 MHz
AVG	V	9608.000	28.41	36.66	12.99	35.06	0.00	43.00	54.00	-11.00	1/3 MHz
			BT-EDR Mid Channel @ 2441 MHz @ DH1 data rate								
PK	V	4882.000	46.42	34.00	8.41	33.89	0.00	54.94	74.00	-19.06	1/3 MHz
AVG	V	4882.000	33.19	34.00	8.41	33.89	0.00	41.71	54.00	-12.29	1/3 MHz
PK	V	7323.000	41.18	35.74	11.07	34.73	0.00	53.26	74.00	-20.74	1/3 MHz
AVG	V	7323.000	30.09	35.74	11.07	34.73	0.00	42.17	54.00	-11.83	1/3 MHz
PK	V	9764.000	40.22	36.87	13.20	35.04	0.00	55.25	74.00	-18.75	1/3 MHz
AVG	V	9764.000	27.76	36.87	13.20	35.04	0.00	42.79	54.00	-11.21	1/3 MHz
			BT-EDR High Channel @ 2480 MHz @ DH1 data rate								
PK	V	4960.000	45.33	34.11	8.57	33.90	0.00	54.10	74.00	-19.90	1/3 MHz
AVG	V	4960.000	31.22	34.11	8.57	33.90	0.00	39.99	54.00	-14.01	1/3 MHz
PK	V	7440.000	40.98	35.71	11.23	34.82	0.00	53.10	74.00	-20.90	1/3 MHz
AVG	V	7440.000	28.86	35.71	11.23	34.82	0.00	40.98	54.00	-13.02	1/3 MHz
PK	V	9920.000	40.19	37.05	13.27	35.02	0.00	55.49	74.00	-18.51	1/3 MHz
AVG	V	9920.000	28.02	37.05	13.27	35.02	0.00	43.32	54.00	-10.68	1/3 MHz

BT-EDR Rx mode 30-1000 MHz

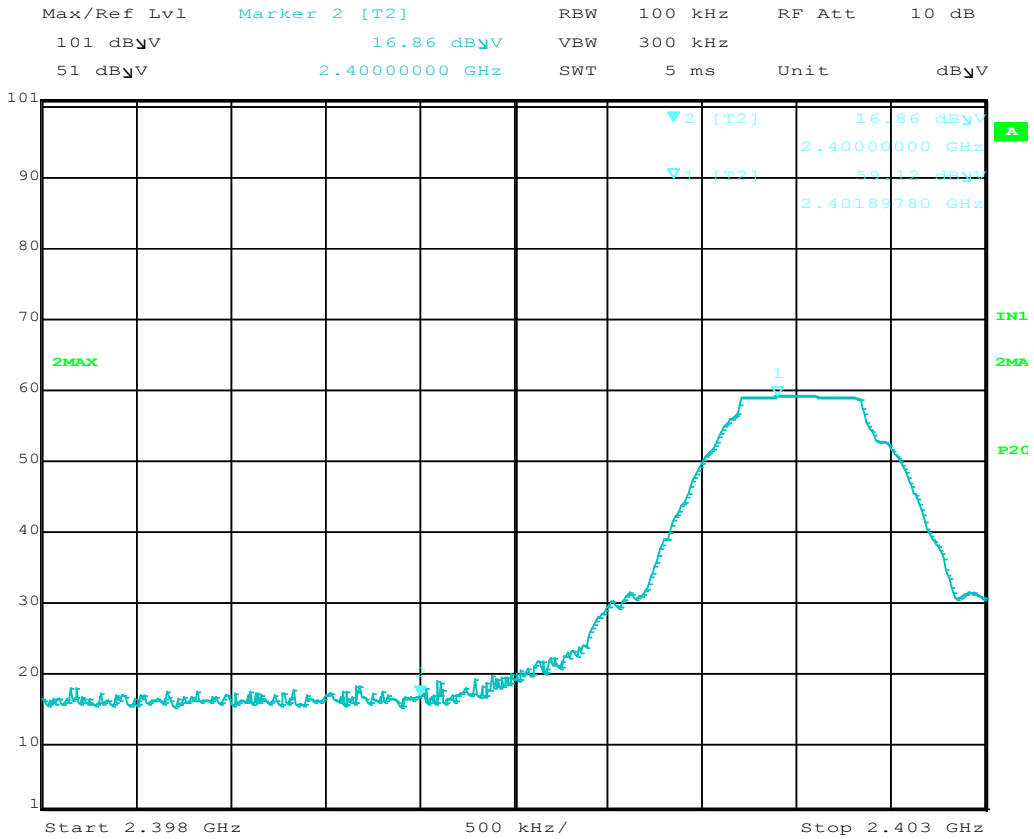
Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
QP	V	31.229	36.19	19.94	1.29	40.74	0.00	16.68	30.00	-13.32	120/300 kHz
QP	V	39.262	35.12	14.49	1.29	40.72	0.00	10.18	30.00	-19.82	120/300 kHz
QP	V	287.190	37.17	13.44	3.08	40.68	0.00	13.01	36.00	-22.99	120/300 kHz
QP	H	298.760	30.19	13.50	3.13	40.69	0.00	6.14	36.00	-29.86	120/300 kHz
QP	H	420.120	32.12	16.30	3.67	40.76	0.00	11.33	36.00	-24.67	120/300 kHz
QP	V	432.130	33.19	16.74	3.72	40.75	0.00	12.90	36.00	-23.10	120/300 kHz

BT-EDR Rx mode 1-25.0 GHz

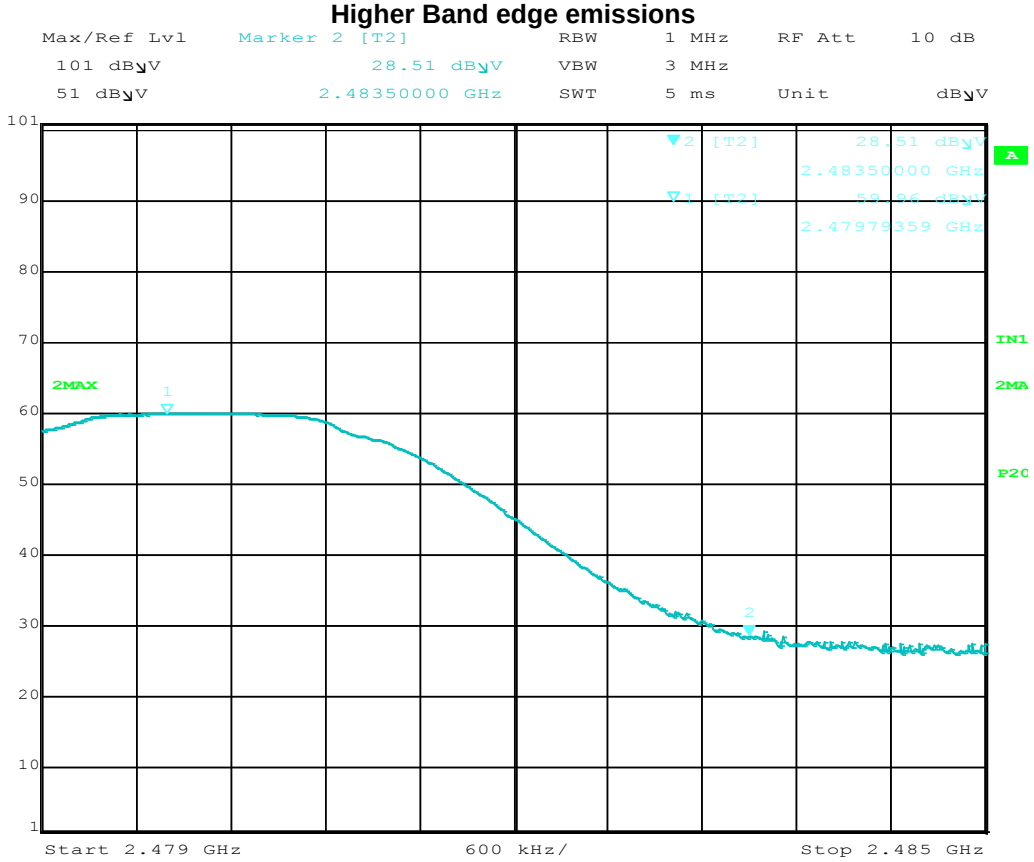
Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
				BT-EDR Rx mode							
PK	V	1129.920	37.89	27.76	3.40	33.47	0.00	35.57	74.00	-38.43	1/3 MHz
AVG	V	1129.920	28.79	27.76	3.40	33.47	0.00	26.47	54.00	-27.53	1/3 MHz
PK	V	2364.570	35.24	31.94	5.07	33.24	0.00	39.01	74.00	-34.99	1/3 MHz
AVG	V	2364.570	26.23	31.94	5.07	33.24	0.00	30.00	54.00	-24.00	1/3 MHz
PK	V	9769.890	36.78	36.89	13.20	35.04	0.00	51.83	74.00	-22.17	1/3 MHz
AVG	V	9769.890	25.19	36.89	13.20	35.04	0.00	40.24	54.00	-13.76	1/3 MHz

Lower Band edge emissions

Note: Band edge test was performed on pi/4 DPSK modulation and DH5 data rate which recorded worst case 20dB BW.



Higher Band edge emissions



Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
PK	V	2483.500	28.35	32.30	5.18	0.00	0.00	65.83	74.00	-8.17	1/3 MHz
AVG	V	2483.500	14.22	32.30	5.18	0.00	0.00	51.70	54.00	-2.30	1/3 MHz

Test Personnel: Naga Suryadevara N.S
Test Date: 06/10/2017
Supervising/Reviewing Engineer: (Where Applicable) N/A
Product Standard: FCC 15.247 RSS 247
Limit Applied: See Section 12.3
Input Voltage: 120VAC 60Hz
Pretest Verification w/ Ambient Signals or BB Source: BB source
Ambient Temperature: 24 ºC
Relative Humidity: 37 %
Atmospheric Pressure: 1003 mbars

Deviations, Additions, or Exclusions: None

13 AC Mains Conducted Emissions

13.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C, FCC Part 15 Subpart B, RSS 247 and ICES 003.

TEST SITE: EMC Lab (Boxborough, MA)

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
AC Line Conducted Emissions	150 kHz - 30 MHz	2.8dB	3.4dB
Telco Port Emissions	150 kHz - 30 MHz	3.2dB	5.0dB

As shown in the table above our conducted emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculations

The following is how net line-conducted readings were determined:

NF = RF + LF + CF + AF
Where NF = Net Reading in dBμV
RF = Reading from receiver in dBμV
LF = LISN or ISN Correction Factor in dB
CF = Cable Correction Factor in dB
AF = Attenuator Loss Factor in dB

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 dBμV
$UF = 10^{(49.1\ dB\mu V / 20)}$ = 285.1 μV/m

Alternately, when C5 Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. “TF” is the Transducer Factor; in this case LISN or ISN loss.

13.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002'	Weather Station	Davis Instruments	7400	PE80519A93	06/01/2016	06/01/2017
ROS002'	9kHz to 3GHz EMI Test Receiver	Rohde & Schwartz	ESCI 1166.5950K03	100067	07/29/2016	07/29/2017
DS22'	Attenuator, 20dB	Mini Circuits	20dB, 50 ohm	DS22	09/08/2016	09/08/2017
CBLBNC7'	30 ft 50 ohm coax, BNC - BNC	ITT Pomona	RG 58 C/U	CBLBNC7	01/10/2017	01/10/2018
LISN34'	LISN - CISPR16 Compliant 9kHz-30MHz	Com-Power	LI-215A	191956	06/27/2016	06/27/2017

Software Utilized:

Name	Manufacturer	Version
Compliance 5	Teseq	5.26.46.46

13.3 Results:

The sample tested was found to Comply.

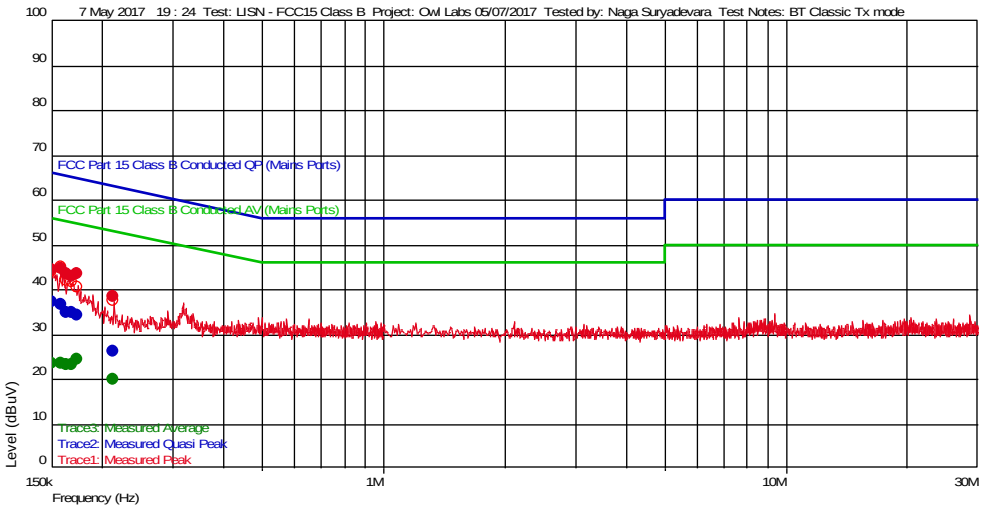
13.4 Plots/Data:

Transmit Mode

Test Information

Test Details	User Entry	Additional Information
Test:	LISN - FCC15 Class B	
Project:	Owl Labs 05/07/2017	
Test Notes:	BT Classic Tx mode	
Temperature:	22 C	
Humidity:	29% 992 mbars	
Tested by:	Naga Suryadevara	
Test Started:	7 May 2017 19 : 24	

Prescan Emission Graph



Measured Peak Value
Measured Quasi Peak Value
Measured Average Value
Maximum Value of Mast and Turntable
Swept Peak Data
Swept Quasi Peak Data
Swept Average Data

Emissions Test Data

Trace2: Measured Quasi Peak

Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
213.75 k	26.22	1.235	20.042	63.058	-36.83	9 k		N
173.8 k	34.25	2.075	20.037	64.777	-30.53	9 k		N
163.6 k	34.92	2.368	20.036	65.279	-30.36	9 k		N
168.7 k	34.86	2.221	20.037	65.024	-30.17	9 k		L1
158.5 k	36.51	2.515	20.036	65.542	-29.03	9 k		N
150.85 k	37.23	2.736	20.035	65.953	-28.72	9 k		L1

Trace3: Measured Average

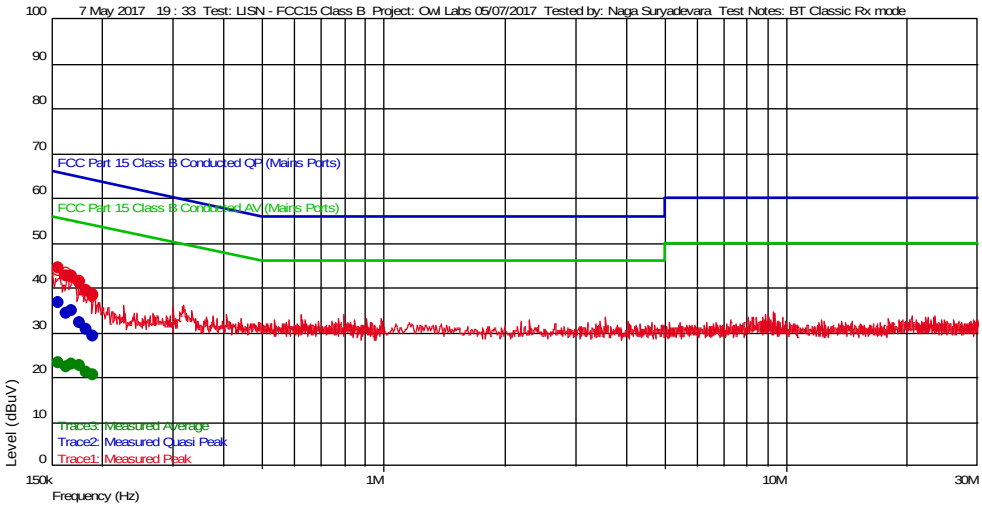
Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
213.75 k	19.85	1.235	20.042	53.058	-33.21	9 k		N
150.85 k	23.55	2.736	20.035	55.953	-32.41	9 k		L1
163.6 k	23.09	2.368	20.036	55.279	-32.19	9 k		N
158.5 k	23.45	2.515	20.036	55.542	-32.10	9 k		N
168.7 k	23.01	2.221	20.037	55.024	-32.02	9 k		L1
173.8 k	24.35	2.075	20.037	54.777	-30.43	9 k		N

Receive Mode

Test Information

Test Details	User Entry	Additional Information
Test:	LISN - FCC15 Class B	
Project:	Owl Labs 05/07/2017	
Test Notes:	BT Classic Rx mode	
Temperature:	22 C	
Humidity:	29% 992 mbars	
Tested by:	Naga Suryadevara	
Test Started:	7 May 2017 19 : 33	

Prescan Emission Graph



- Measured Peak Value
- Measured Quasi Peak Value
- Measured Average Value
- Maximum Value of Mast and Turntable
- Swept Peak Data
- Swept Quasi Peak Data
- Swept Average Data

Emissions Test Data

Trace2: Measured Quasi Peak

Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
190.8 k	29.12	1.585	20.039	64.002	-34.88	9 k		N
184.0 k	30.62	1.781	20.039	64.303	-33.69	9 k		N
177.2 k	32.17	1.977	20.038	64.616	-32.44	9 k		N
163.6 k	34.15	2.368	20.036	65.279	-31.13	9 k		N
168.7 k	34.68	2.221	20.037	65.024	-30.34	9 k		N
156.8 k	36.42	2.564	20.036	65.632	-29.21	9 k		N

Trace3: Measured Average

Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
190.8 k	20.52	1.585	20.039	54.002	-33.48	9 k		N
184.0 k	21.07	1.781	20.039	54.303	-33.23	9 k		N
163.6 k	22.34	2.368	20.036	55.279	-32.94	9 k		N
156.8 k	23.00	2.564	20.036	55.632	-32.63	9 k		N
177.2 k	22.41	1.977	20.038	54.616	-32.21	9 k		N
168.7 k	22.94	2.221	20.037	55.024	-32.08	9 k		N

Test Personnel:	Naga Suryadevara N·S	Test Date:	05/07/2017
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC Part 15 Subpart B ICES 003	Limit Applied:	All Class B
Input Voltage:	120VAC 60Hz		
Pretest Verification w/ Ambient Signals or BB Source:	Yes	Ambient Temperature:	22 ºC
		Relative Humidity:	29 %
		Atmospheric Pressure:	992 mbars

Deviations, Additions, or Exclusions: None

14 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	06/17/2017	102966681ATL-011	NS	KPS	Original Issue