



RADIO TEST REPORT

For

Xiamen Foowoo Mobile Telecom Technique Co., Ltd

Product Name:	laser projection keyboard
Model :	F1
Series Model:	F1A
FCC ID:	2ABZT-F1
Prepared By :	Shenzhen BST Technology Co., Ltd. Building No.23-24, Zhiheng Industrial Park, Guankouer Road, Nantou, Nanshan District, Shenzhen, Guangdong, China
Test Date:	May. 08-19, 2017
Date of Report :	May.19, 2017
Test Result	pass
Report No.:	BST170449659A0001Y-ER-2

TEST RESULT CERTIFICATION



Applicant's name : Xiamen Foowoo Mobile Telecom Technique Co.,Ltd
Address : Room 316B, 3/F, Chuangye Building, Pioneering
Park For Overseas Chinese Scholars, Xiamen, China
Manufacture's Name..... : Xiamen Foowoo Mobile Telecom Technique Co.,Ltd
Address : Room 316B, 3/F, Chuangye Building, Pioneering
Park For Overseas Chinese Scholars, Xiamen, China

Product description ;

Product name : laser projection keyboard
Model and/or type reference : F1
Series Model : F1A
Standards : FCC Part15.247
Test procedure : ANSI C63.10-2013, ANSI C63.4-2014

Testing Engineer :

Technical Manager :

Authorized Signatory :



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1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant:

Xiamen Foowoo Mobile Telecom Technique Co.,Ltd

Address of applicant:

Room 316B, 3/F, Chuangye Building, Pioneering
Park For Overseas Chinese Scholars, Xiamen, China

General Description of EUT

Product Name:	laser projection keyboard
Trade Name:	
Model No.:	F1
Adding Model(s):	F1A
Rated Voltage:	3.7V



Technical Characteristics of EUT

Bluetooth Version:	V4.0
Frequency Range:	2402-2480MHz
RF Output Power:	2.81 dBm (Conducted)
Data Rate:	1Mbps, 2Mbps, 3Mbps
Modulation:	GFSK, Pi/4 QDPSK, 8DPSK
Quantity of Channels:	79
Channel Separation:	1MHz
Type of Antenna:	PCB
Antenna Gain:	1dBi
Lowest Internal Frequency of EUT:	26MHz

1.2 Test Standards

The following report is prepared on behalf of the Rider best, Inc in accordance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 of the Federal Communication Commissions rules.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product, which result in lowering the emission, should be checked to ensure compliance has been maintained.

1.3 Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard for Testing Unlicensed Wireless Devices, and 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. The measurement guide DA 00-705 for frequency hopping spread spectrum systems shall be performed also.



1.4 Test Facility

Shenzhen Asia Test Technology Co.,Ltd..

Add. : 7 / F, Xinwei Building, Gushu Village, Xixiang Town, Baoan

District, Shenzhen, China

FCC Registration No.: 348715

1.5 EUT Setup and Test Mode

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. All testing shall be performed under maximum output power condition, and to measure its highest possible emissions level, more detailed description as follows:

Test Mode List		
Test Mode	Description	Remark
TM1	Low Channel	2402MHz
TM2	Middle Channel	2441MHz
TM3	High Channel	2480MHz
TM4	Hopping	2402-2480MHz

Modulation Configure			
Modulation	Packet	Packet Type	Packet Size
GFSK	DH1	4	27
	DH3	11	183
	DH5	15	339
Pi/4 DQPSK	2DH1	20	54
	2DH3	26	367
	2DH5	30	379
8DPSK	3DH1	24	83
	3DH3	27	552
	3DH5	31	1021
Normal mode: the Bluetooth has been tested on the modulation of GFSK, (Pi/4)DQPSK and 8DPSK, compliance test and record the worst case.			

EUT Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
/	/	/	/



Special Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
/	/	/	/

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
/	/	/	/

1.6 Measurement Uncertainty

Measurement uncertainty		
Parameter	Conditions	Uncertainty
RF Output Power	Conducted	$\pm 0.42\text{dB}$
Occupied Bandwidth	Conducted	$\pm 1.5\%$
Conducted Spurious Emission	Conducted	$\pm 2.17\text{dB}$
Conducted Emissions	Conducted	$\pm 2.88\text{dB}$
Transmitter Spurious Emissions	Radiated	$\pm 5.1\text{dB}$

1.7 Test Equipment List and Details

Description	Manufacturer	Model	Serial Number	Cal Date	Due Date
Spectrum Analyzer	Agilent	E4407B	US44300368	2016-06-04	2017-06-03
Spectrum Analyzer	Rohde & Schwarz	FSP	836079/035	2016-06-04	2017-06-03
EMI Test Receiver	Rohde & Schwarz	ESVB	825471/005	2016-06-04	2017-06-03
Amplifier	Agilent	8447F	3113A06717	2016-06-04	2017-06-03
Amplifier	C&D	PAP-1G8	2002	2016-06-04	2017-06-03
Broadband Antenna	Schwarz beck	VULB9163	9163-333	2016-06-04	2017-06-03
Horn Antenna	ETS	3117	00086197	2016-06-04	2017-06-03
Horn Antenna	ETS	3116B	00088203	2016-06-04	2017-06-03
Loop Antenna	Schwarz beck	FMZB 1516	9773	2016-06-04	2017-06-03
EMI Test Receiver	Rohde & Schwarz	ESPI	101611	2016-06-04	2017-06-03
L.I.S.N	Schwarz beck	NSLK8126	8126-224	2016-06-04	2017-06-03
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100911	2016-06-04	2017-06-03



2. SUMMARY OF TEST RESULTS

FCC Rules	Description of Test Item	Result
§ 2.1093	RF Exposure	Compliant
§ 15.203; § 15.247(b)(4)(i)	Antenna Requirement	Compliant
§ 15.205	Restricted Band of Operation	Compliant
§ 15.207(a)	Conducted Emission	Compliant
§ 15.209(a)	Radiated Spurious Emissions	Compliant
§ 15.247(a)(1)(iii)	Quantity of Hopping Channel	Compliant
§ 15.247(a)(1)	Channel Separation	Compliant
§ 15.247(a)(1)(iii)	Time of Occupancy (Dwell time)	Compliant
§ 15.247(a)	20dB Bandwidth	Compliant
§ 15.247(b)(1)	RF Power Output	Compliant
§ 15.247(d)	Band Edge (Out of Band Emissions)	Compliant
§ 15.247(a)(1)	Frequency Hopping Sequence	Compliant
§ 15.247(g), (h)	Frequency Hopping System	Compliant

3. RF Exposure

3.1 Standard Applicable

According to § 1.1307 and § 2.1093, the portable transmitter must comply the RF exposure requirements.

3.2 Test Result

This product complied with the requirement of the RF exposure, please see the RF Exposure Report.



4. Antenna Requirement

4.1 Standard Applicable

According to FCC Part 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

4.2 Evaluation Information

This product has a PCB antenna, fulfill the requirement of this section.



5. Frequency Hopping System Requirements

5.1 Standard Applicable

According to FCC Part 15.247(a)(1), 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.

(g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

(h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

5.2 Frequency Hopping System

This transmitter device is frequency hopping device, and complies with FCC part 15.247 rule.

This device uses Bluetooth radio which operates in 2400-2483.5 MHz band. Bluetooth uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it on up to 79 bands (1 MHz each; centred from 2402 to 2480 MHz) in the range 2,400-2,483.5 MHz. The transmitter switches hop frequencies 1,600 times per second to assure a high degree of data security. All Bluetooth devices participating in a given piconet are synchronized to the frequency-hopping channel for the piconet. The frequency hopping sequence is determined by the master's device address and the phase of the hopping sequence (the frequency to hop at a specific time) is determined by the master's internal clock. Therefore, all slaves in a piconet must know the master's device address and must synchronize their clocks with the master's clock.

Adaptive Frequency Hopping (AFH) was introduced in the Bluetooth specification to provide an effective way for a Bluetooth radio to counteract normal interference. AFH identifies "bad" channels, where either other wireless



devices are interfering with the Bluetooth signal or the Bluetooth signal is interfering with another device. The AFH-enabled Bluetooth device will then communicate with other devices within its piconet to share details of any identified bad channels. The devices will then switch to alternative available "good" channels, away from the areas of interference, thus having no impact on the bandwidth used. This device was tested with a Bluetooth system receiver to check that the device maintained hopping synchronization, and the device complied with these requirements for DA 00-705 and FCC Part 15.247 rule.

5.3 EUT Pseudorandom Frequency Hopping Sequence

Pseudorandom Frequency Hopping Sequence Table as below:

Channel: 08, 24, 40, 56, 40, 56, 72, 09, 01, 09, 33, 41, 33, 41, 65, 73, 53, 69, 06, 22, 04, 20, 36, 52, 38, 46, 70, 78, 68, 76, 21, 29, 10, 26, 42, 58, 44, 60, 76, 13, 03, 11, 35, 43, 37, 45, 69, 77, 55, 71, 08, 24, 08, 24, 40, 56, 40, 48, 72, 01, 72, 01, 25, 33, 12, 28, 44, 60, 42, 58, 74, 11, 05, 13, 37, 45 etc.

The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.



6. Quantity of Hopping Channels and Channel Separation

6.1 Standard Applicable

According to FCC 15.247(a)(1), 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, and frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

6.2 Test Procedure

According to the DA 00-705, the number of hopping frequencies test method as follows.

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

Set span = the frequency band of operation (2400MHz to 2483.5MHz)

RBW $\geq$ 1% of the span

VBW $\geq$ RBW Sweep = auto

Detector function = peak Trace = max hold

Allow the trace to stabilize, observed the band of 2400MHz to 2483.5MHz, than count it out the number of channels for comparing with the FCC rules.

The channel spacing test method as follows:

Set span = wide enough to capture the peaks of two adjacent channels

Resolution (or IF) Bandwidth (RBW) $\geq$ 1% of the span

Video (or Average) Bandwidth (VBW) $\geq$ RBW

Sweep = auto; Detector function = peak; Trace = max hold

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section. Submit this plot.

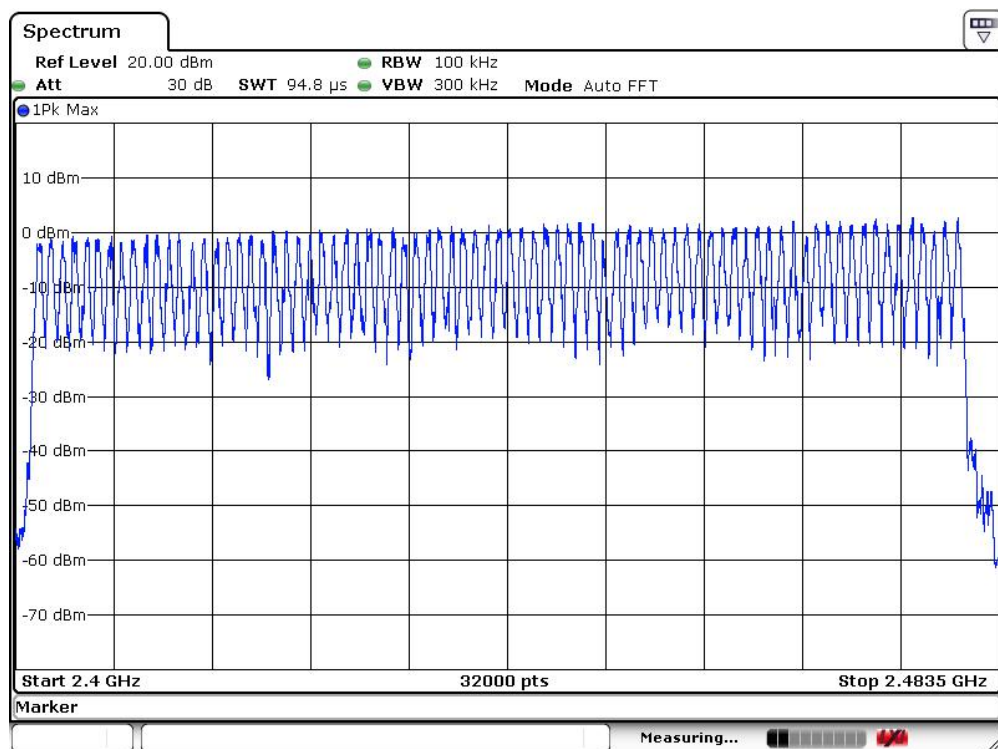
6.3 Environmental Conditions

Temperature:	22°C
Relative Humidity:	53%
ATM Pressure:	101.1 mbar



6.4 Summary of Test Results/Plots

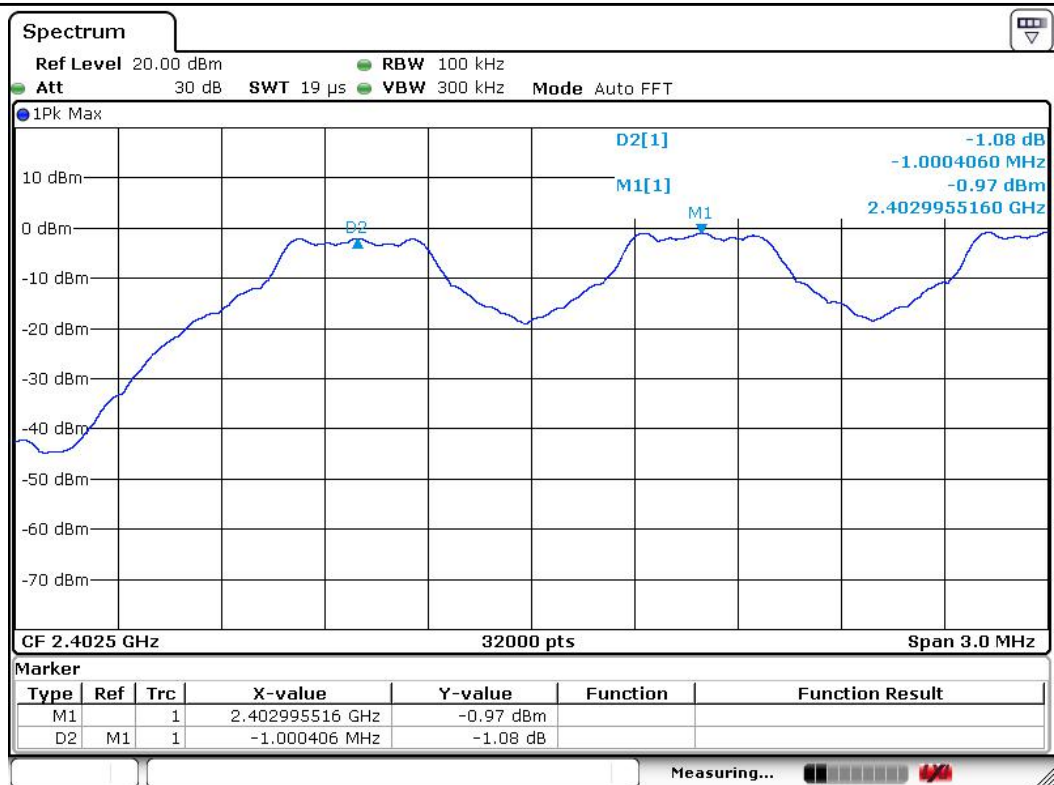
No. of Channel = 79



Date: 16 MAY 2017 17:29:27

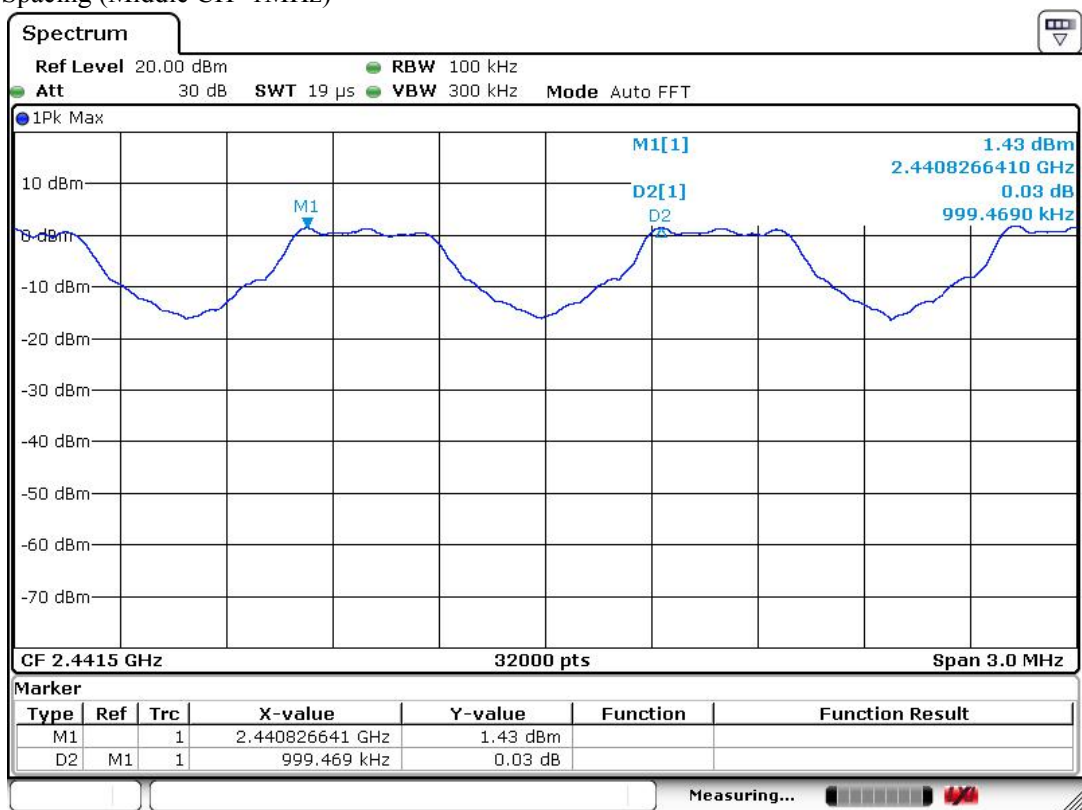
For GFSK mode

Channel Spacing (Low CH=1MHz)



Date: 16 MAY 2017 16:52:51

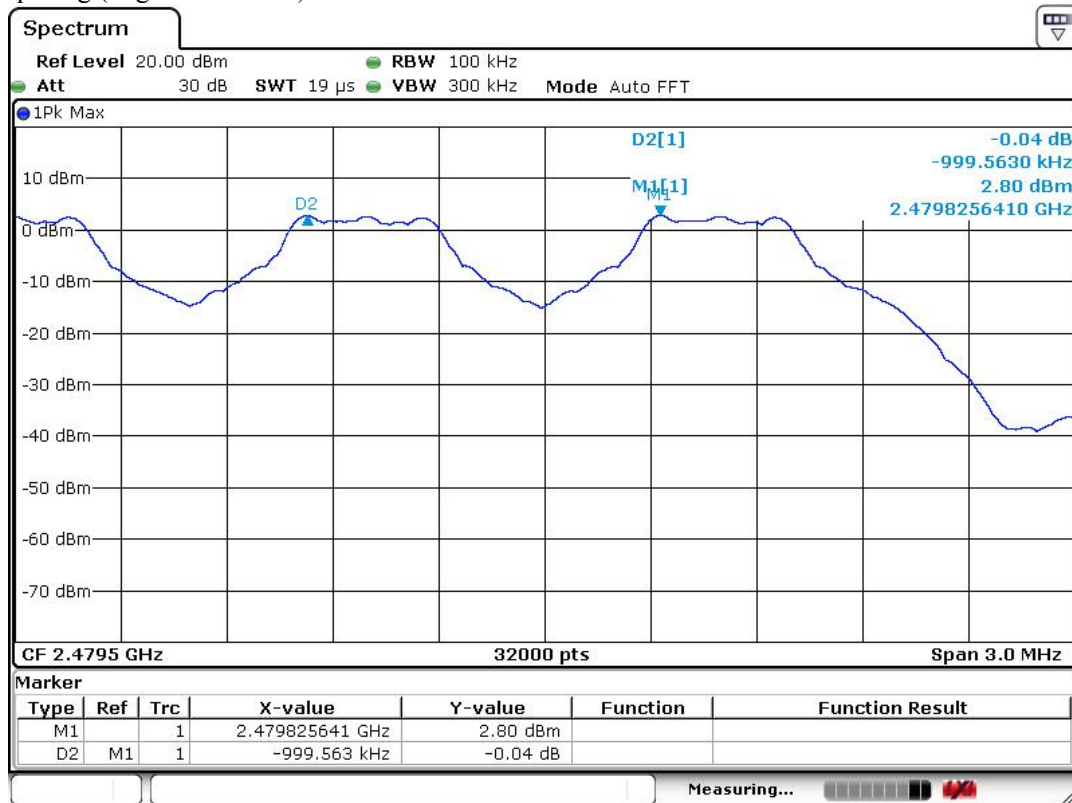
Channel Spacing (Middle CH=1MHz)



Date: 16 MAY 2017 16:53:20



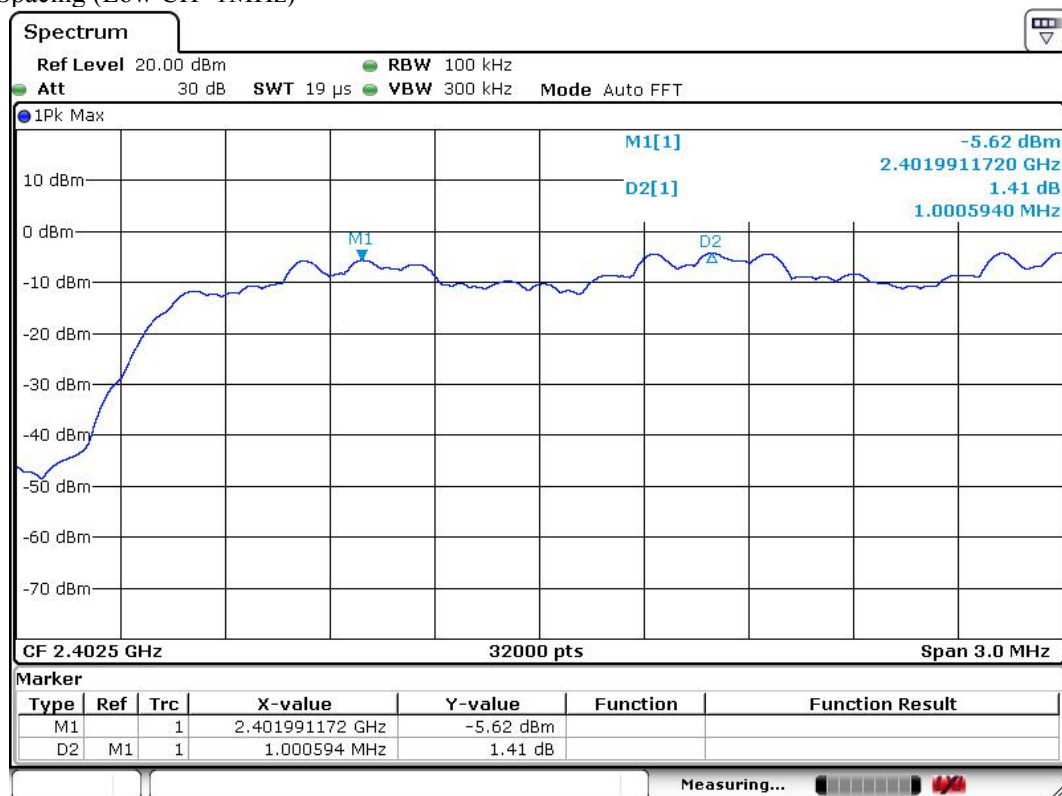
Channel Spacing (High CH=1MHz)



Date: 16 MAY 2017 16:53:59

For 8DPSK mode

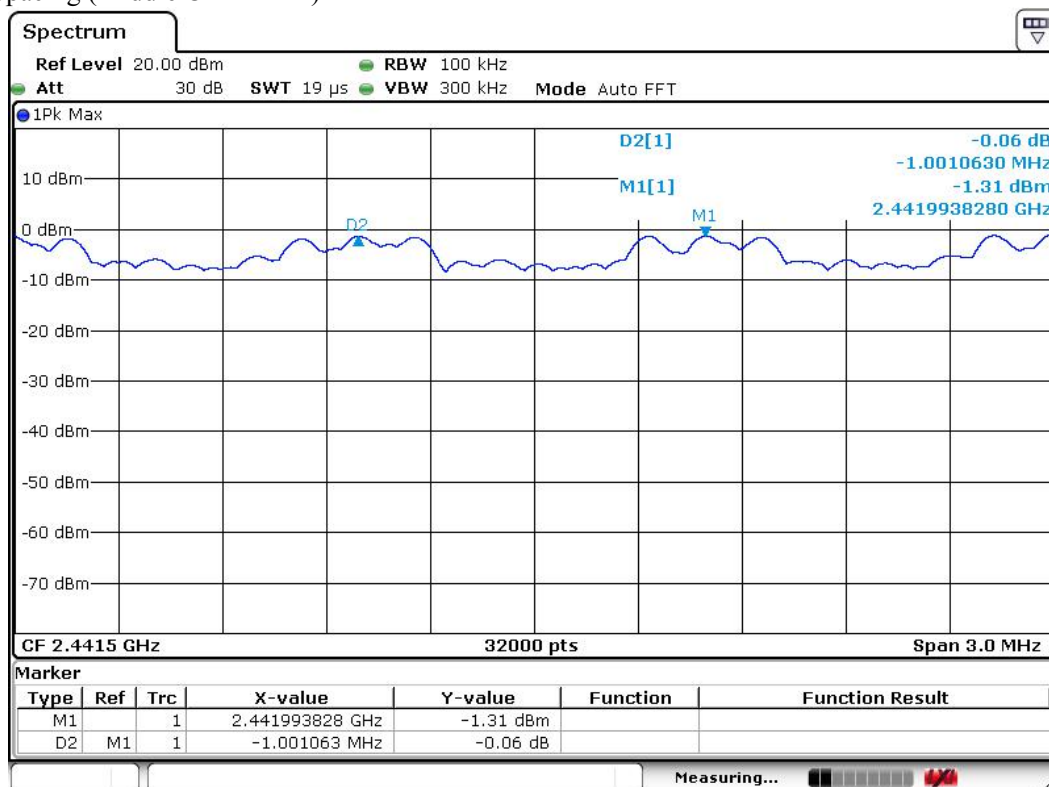
Channel Spacing (Low CH=1MHz)



Date: 16 MAY 2017 16:56:14

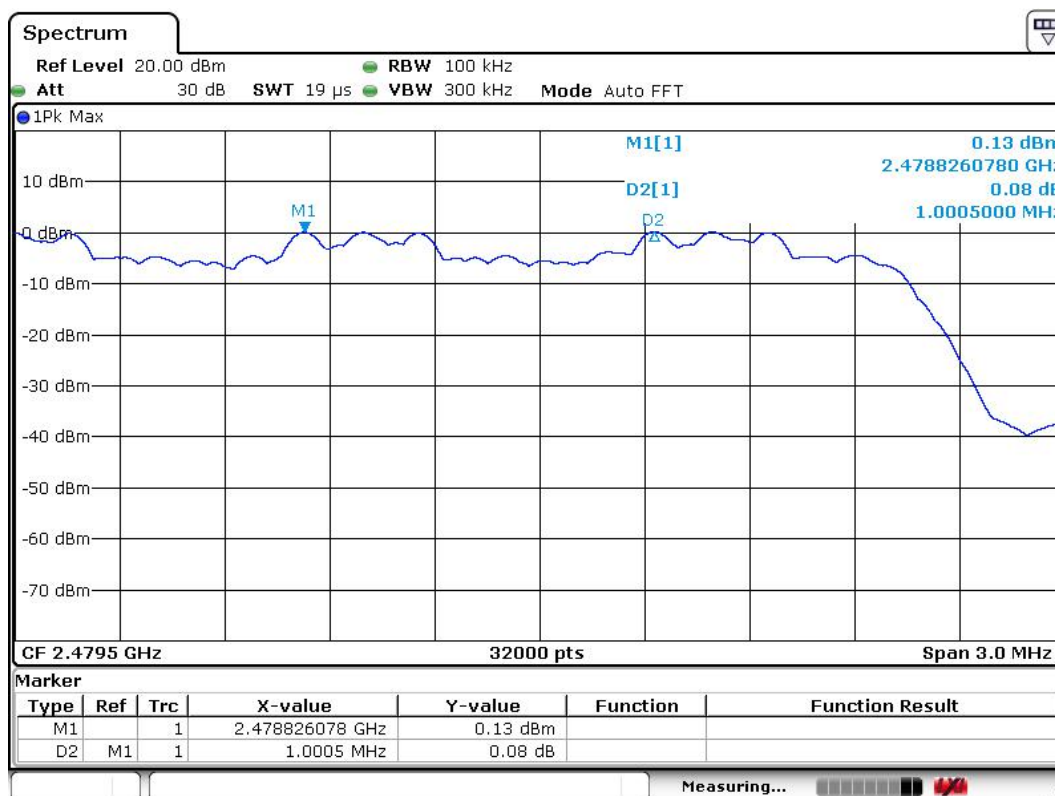


Channel Spacing (Middle CH=1MHz)



Date: 16 MAY 2017 16:55:03

Channel Spacing (High CH=1MHz)



Date: 16 MAY 2017 16:54:36



7. Dwell Time of Hopping Channel

7.1 Standard Applicable

According to 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.

7.2 Test Procedure

According to the DA 00-705, the dwell time of a hopping channel test method as follows.

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

Span = zero span, centered on a hopping channel

RBW = 1 MHz

VBW $\geq$ RBW

Sweep = as necessary to capture the entire dwell time per hopping channel

Detector function = peak

Trace = max hold

Use the marker-delta function to determine the dwell time

7.3 Environmental Conditions

Temperature:	22°C
Relative Humidity:	53%
ATM Pressure:	101.1 mbar

7.4 Summary of Test Results/Plots

The dwell time within a period in data mode is independent from the packet type (packet length).

Test data is corrected with the worse case, which the packet length is DH1, DH3, and DH5.

The test period: $T = 0.4 \text{ Second} * 79 \text{ Channel} = 31.6 \text{ s}$

Dwell time

DH1: Measured time*(1600/2/79)*31.6

DH3: Measured time*(1600/4/79)*31.6

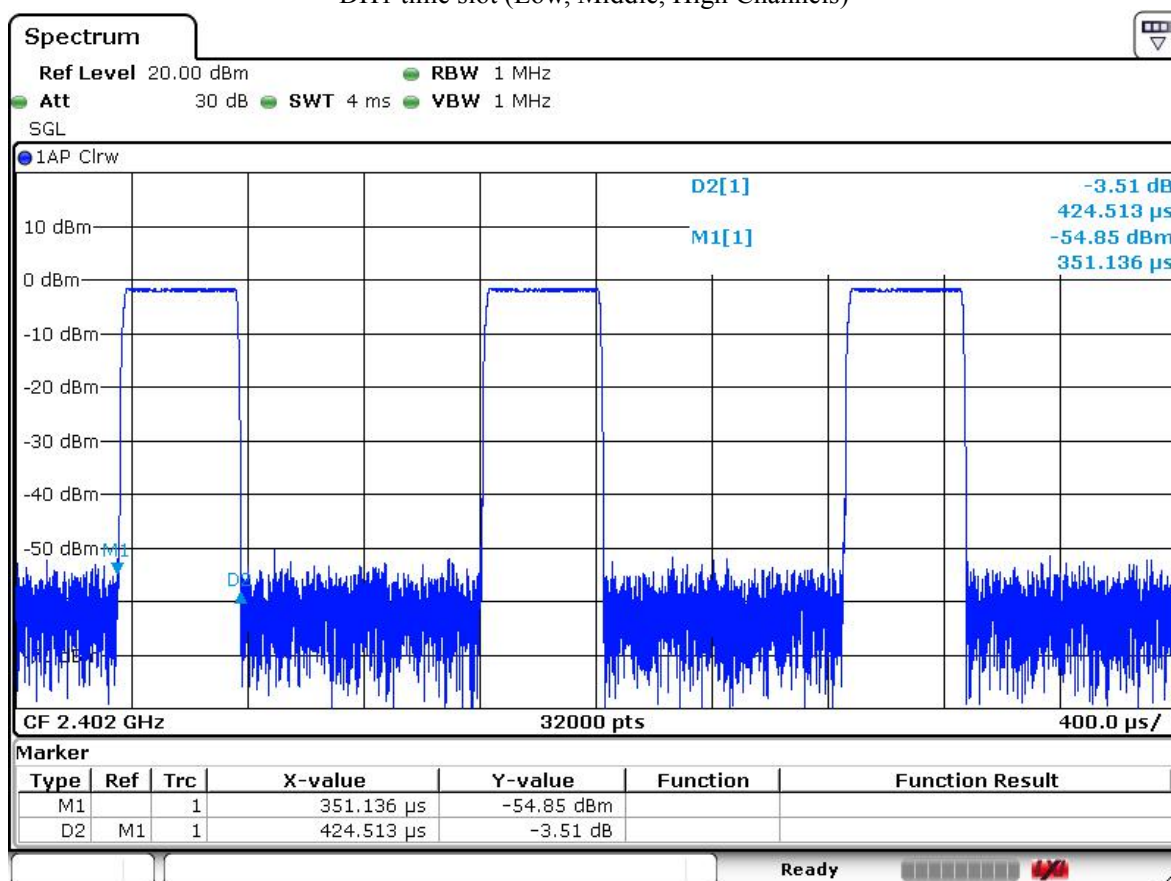
DH5: Measured time*(1600/6/79)*31.6



Modulation	Test Channel	packet	Time Slot Length(ms)	Dwell Time(ms)	Limit(ms)
GFSK	2402	DH1	0.425	136.00	400
		DH3	1.677	268.32	400
		DH5	2.930	312.53	400
8DPSK	2402	3DH1	0.434	138.88	400
		3DH3	1.683	269.28	400
		3DH5	2.940	313.6	400

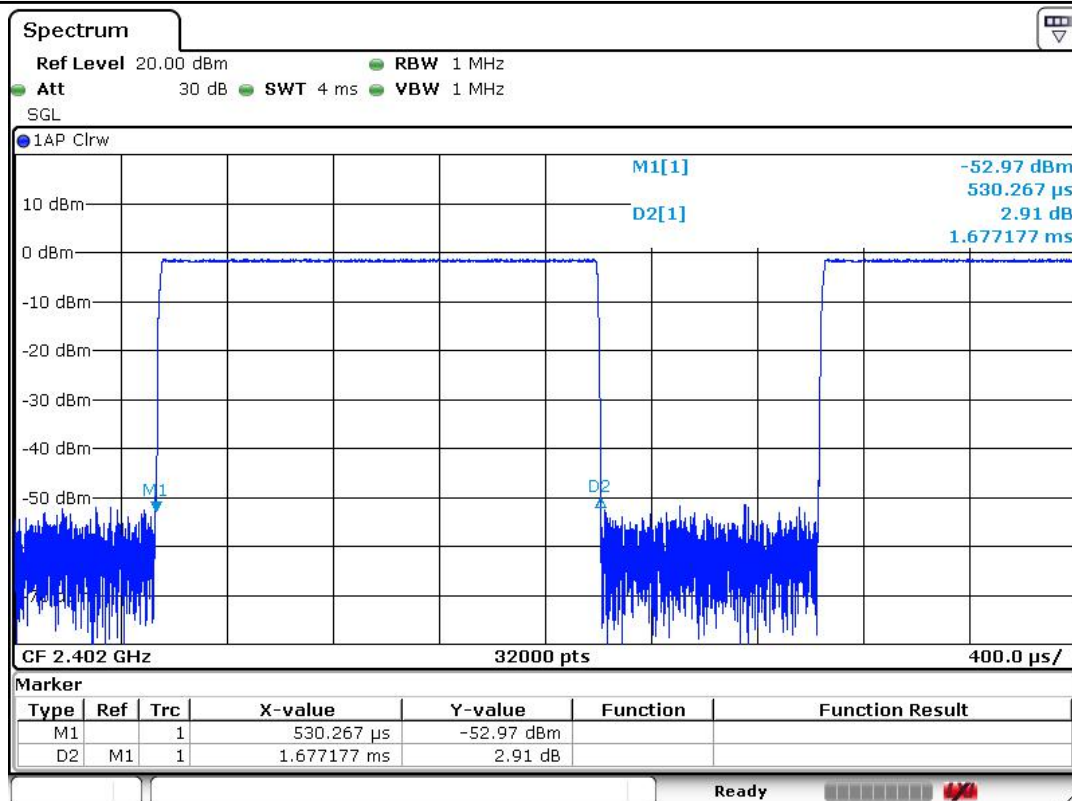
Please refer to the test plots as below:

DH1 time slot (Low, Middle, High Channels)



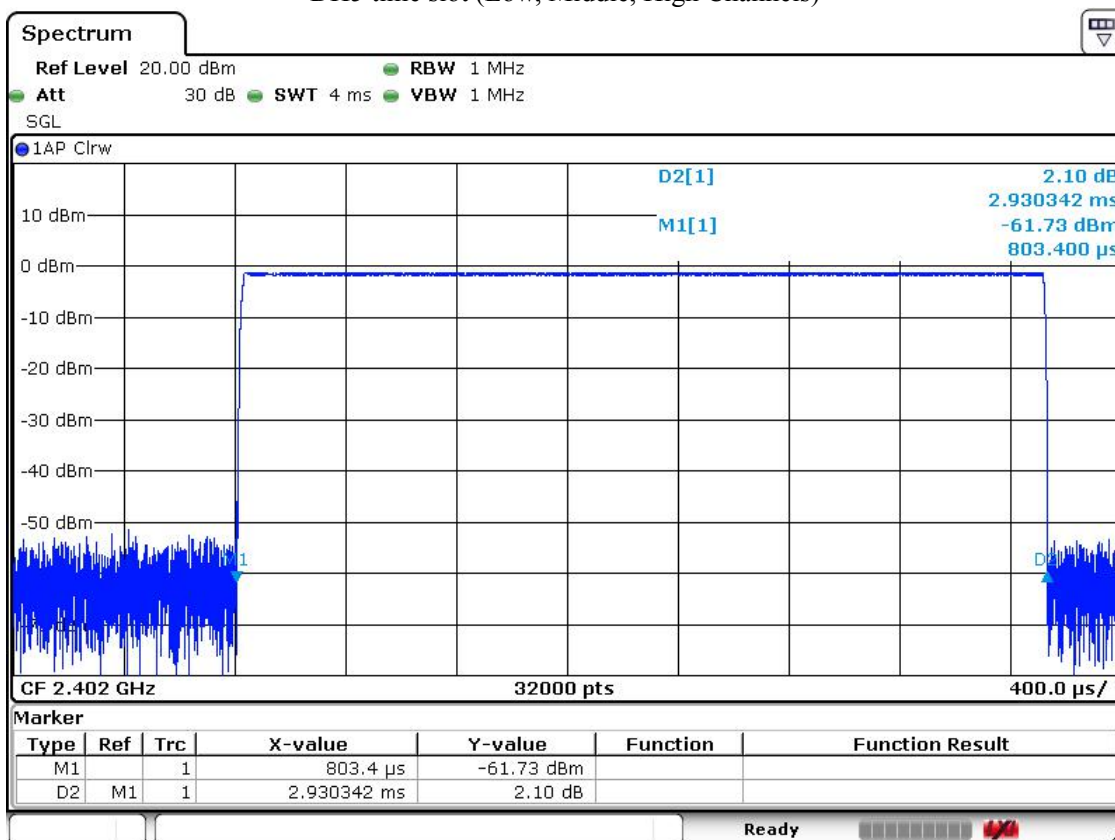
Date:16 MAY 2017 17:36:12

DH3 time slot (Low, Middle, High Channels)



Date: 16 MAY 2017 17:41:32

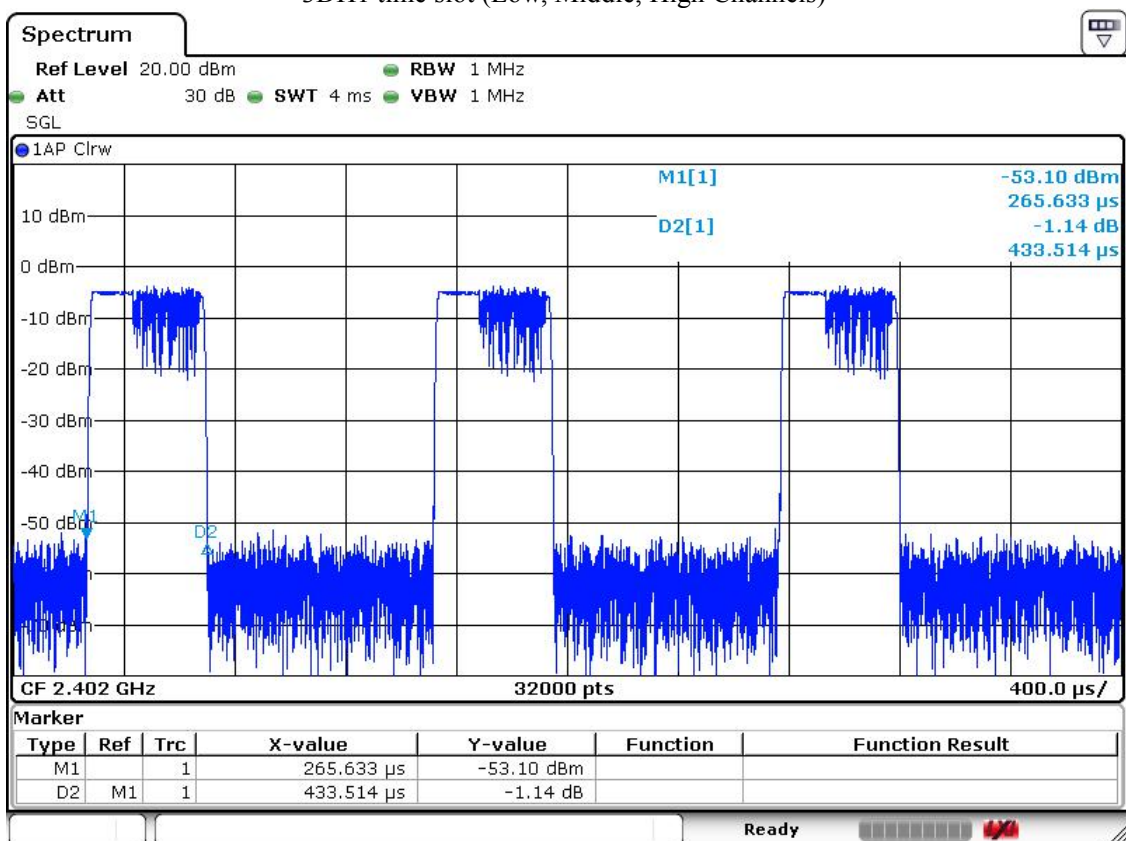
DH5 time slot (Low, Middle, High Channels)



Date: 16 MAY 2017 17:42:25

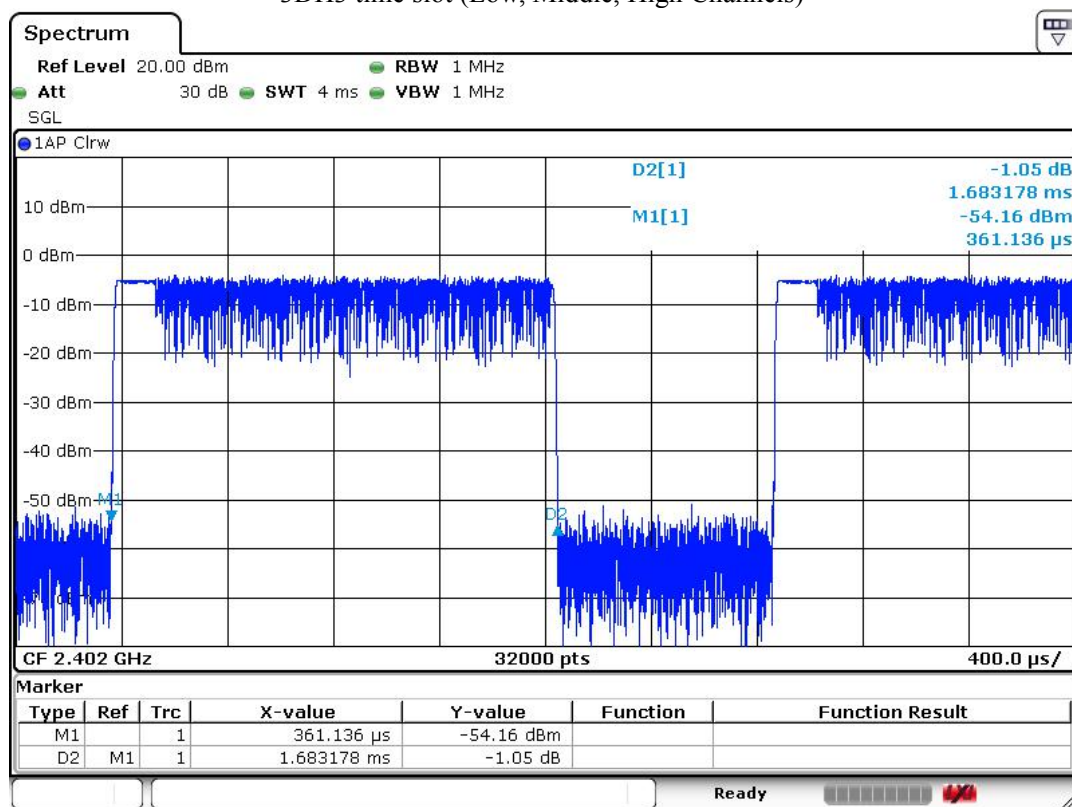


3DH1 time slot (Low, Middle, High Channels)



Date: 16 MAY 2017 17:44:17

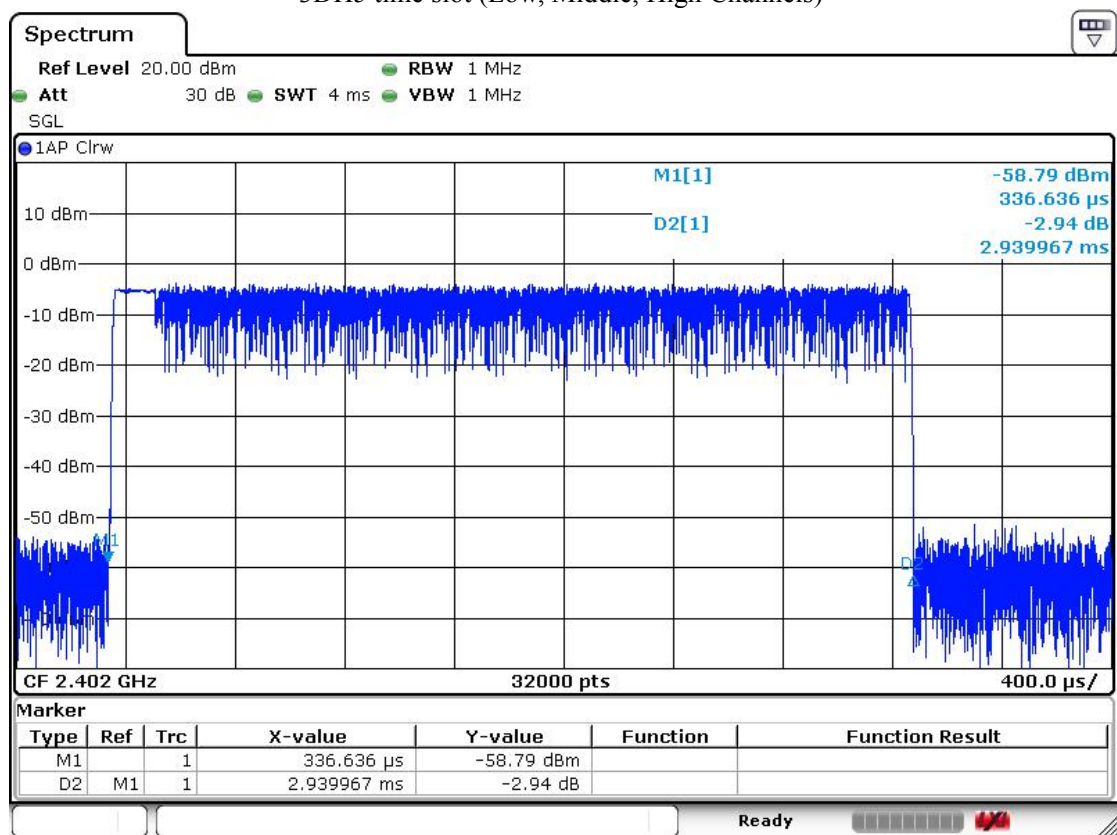
3DH3 time slot (Low, Middle, High Channels)



Date: 16 MAY 2017 17:43:46



3DH5 time slot (Low, Middle, High Channels)



Date: 16 MAY 2017 17:43:15



8. 20dB Bandwidth

8.1 Standard Applicable

According to 15.247(a) and 15.215(c). 20dB bandwidth is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

8.2 Test Procedure

According to the DA 00-705, the 20dB bandwidth test method as follows.

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel

RBW $\geq$ 1% of the 20 dB bandwidth

VBW $\geq$ RBW

Sweep = auto; Detector function = peak

Trace = max hold

All the trace to stabilize, use the marker-to-peak function to set the marker to the peak of the emission, use the marker-delta function to measure and record the 20dB down bandwidth of the emission.

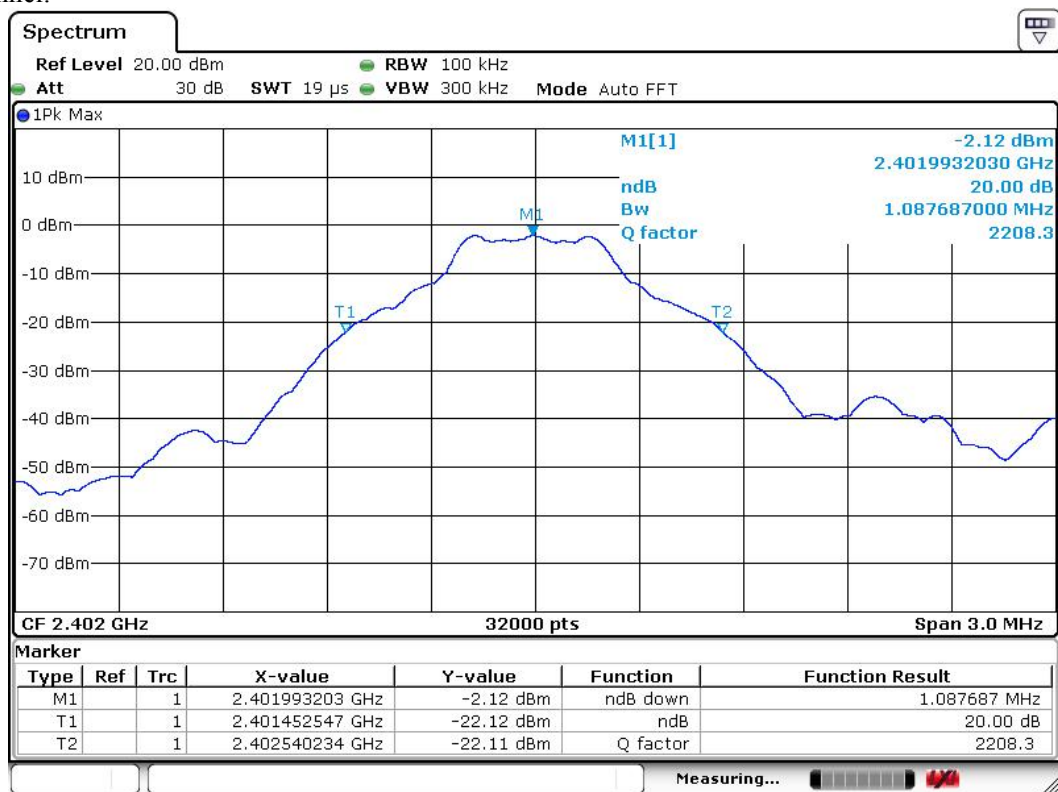
8.3 Environmental Conditions

Temperature:	22°C
Relative Humidity:	53%
ATM Pressure:	101.1 mbar



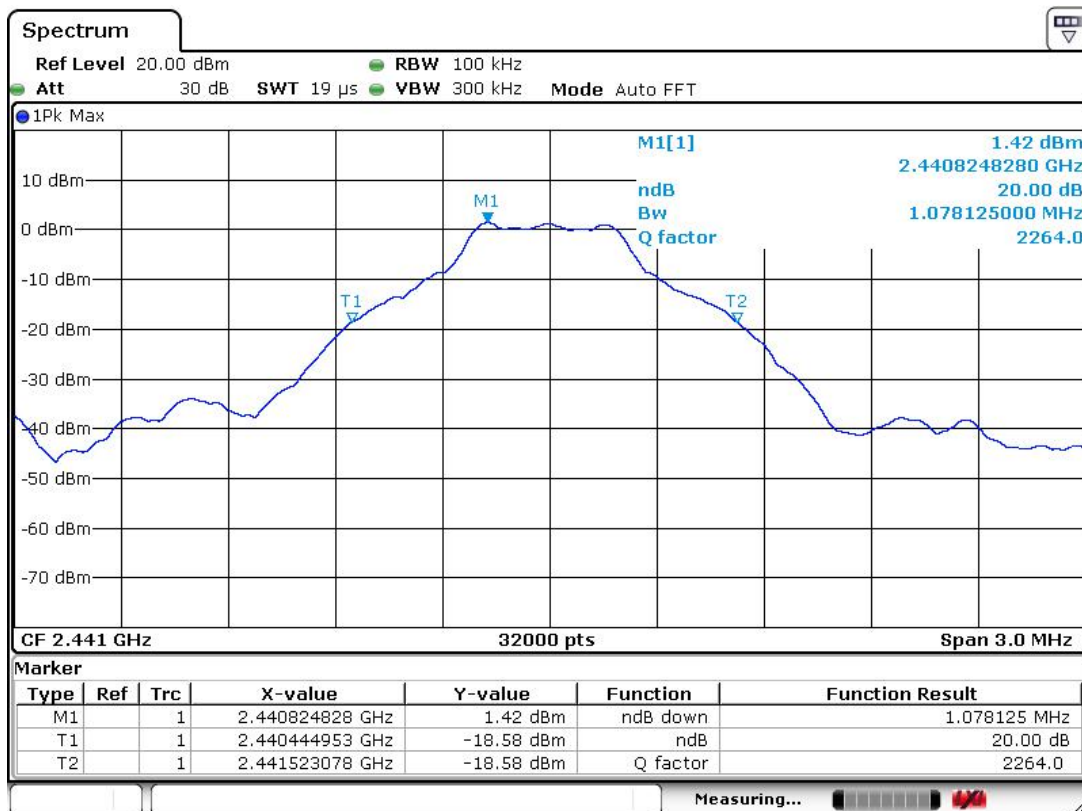
For GFSK

Low Channel:



Date:16 MAY 2017 16:50:54

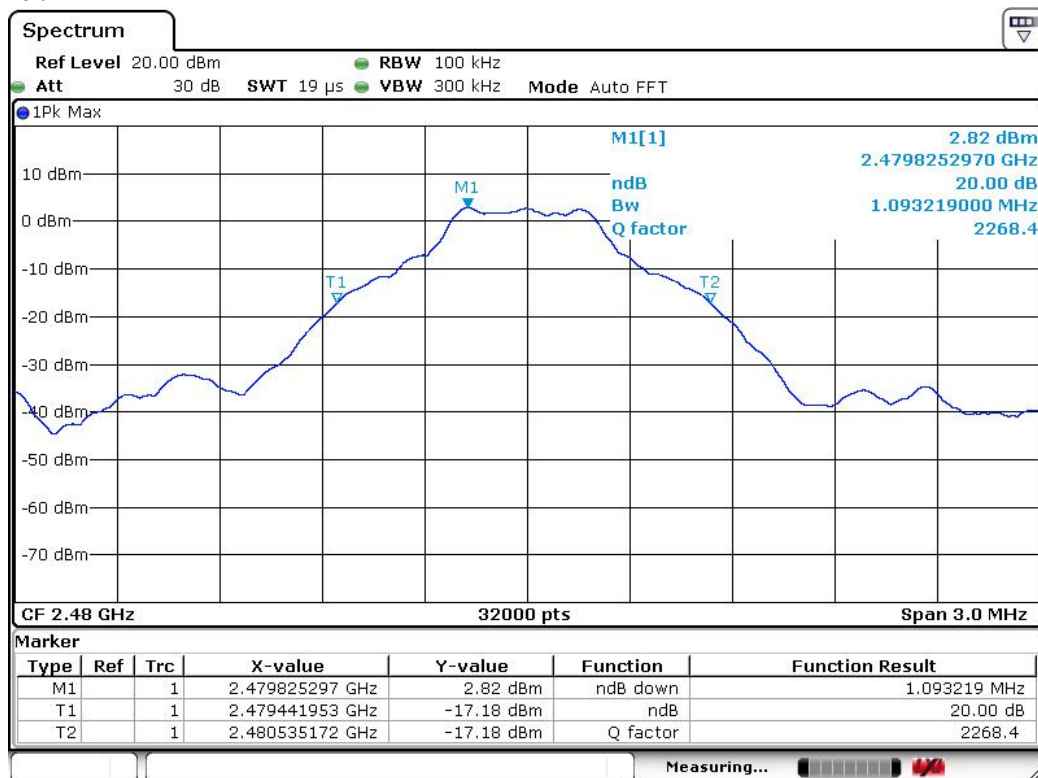
Middle Channel:



Date:16 MAY 2017 16:50:40



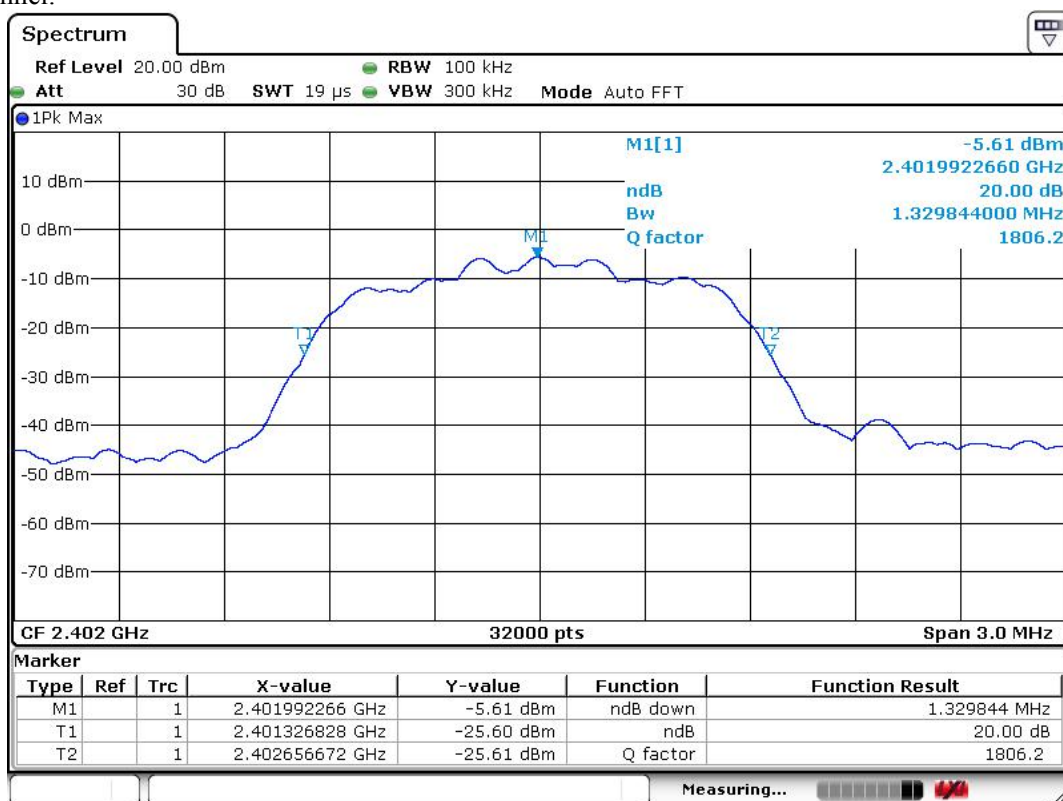
High Channel:



Date:16 MAY 2017 16:50:25

For 8DPSK

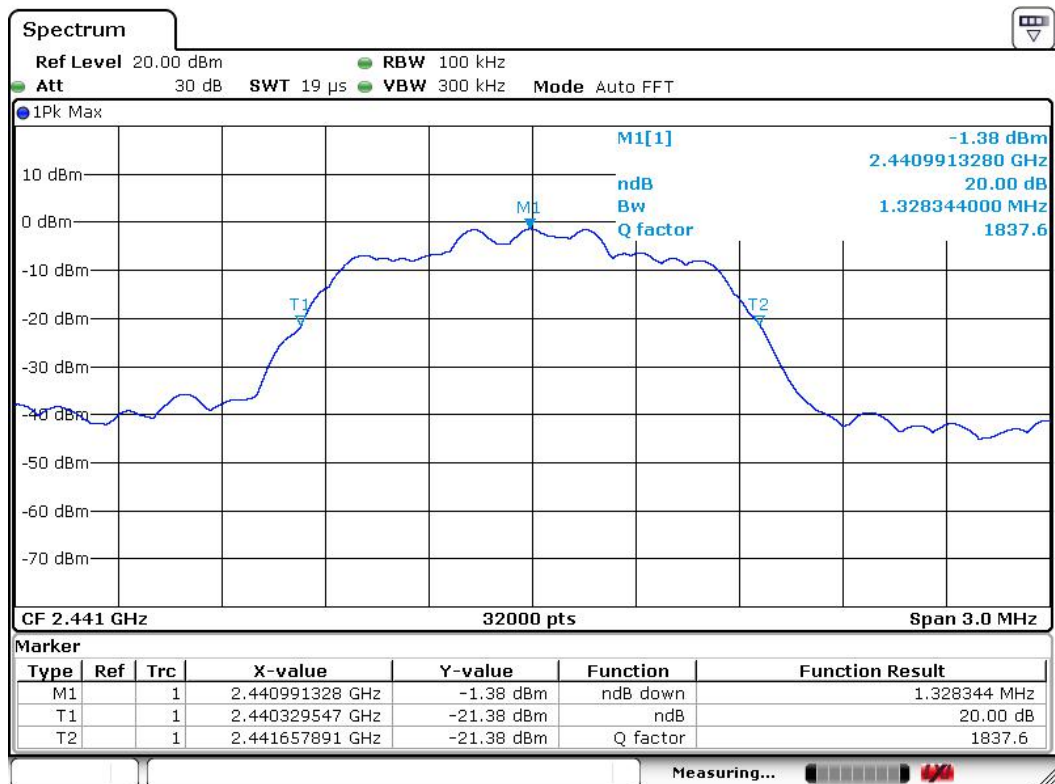
Low Channel:



Date:16 MAY 2017 16:49:12

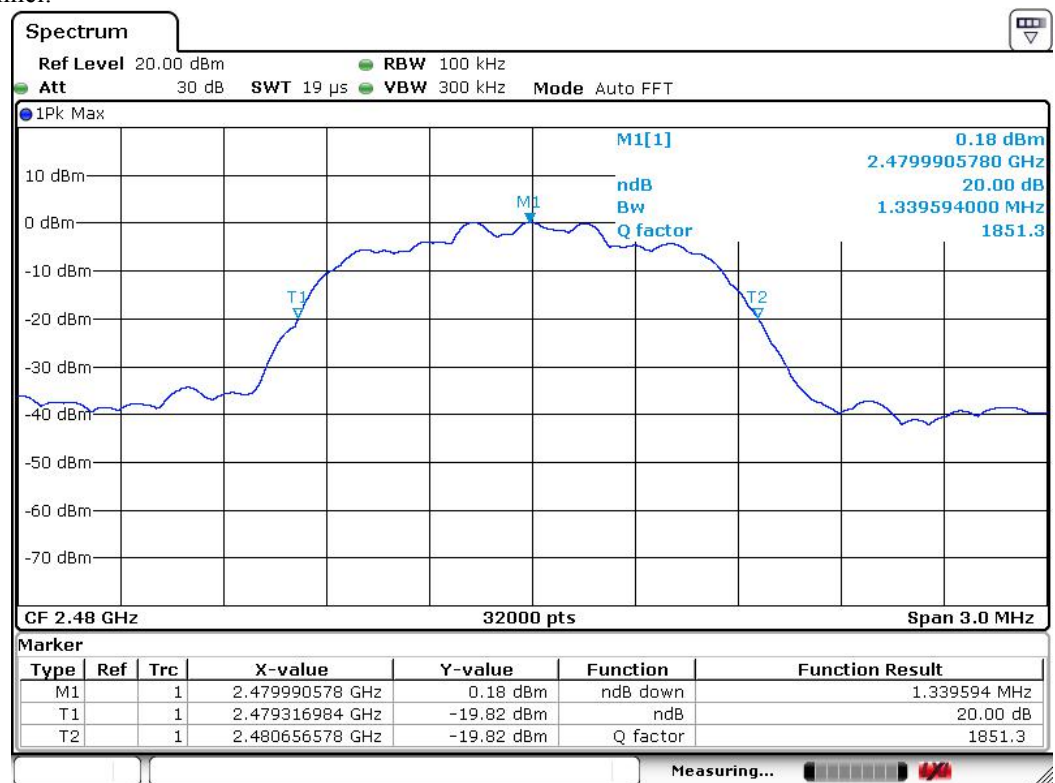


Middle Channel:



Date: 16 MAY 2017 16:48:57

High Channel:



Date: 16 MAY 2017 16:48:41



9. RF Output Power

9.1 Standard Applicable

According to 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.

9.2 Test Procedure

According to the DA 00-705, the peak output power test method as follows.

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel

RBW > the 20 dB bandwidth of the emission being measured

VBW $\geq$ RBW Sweep = auto

Detector function = peak Trace = max hold

All the trace to stabilize, use the marker-to-peak function to set the marker to the peak of the emission, the indicated level is the peak output power (the external attenuation and cable loss shall be considered).

9.3 Environmental Conditions

Temperature:	22°C
Relative Humidity:	53%
ATM Pressure:	101.1 mbar



9.4 Summary of Test Results/Plots

For GFSK

Channel	Frequency MHz	Measured Value dBm	Output Power mW	Limit mW
Low Channel	2402	-1.87	0.65	1000
Middle Channel	2441	1.37	1.37	1000
High Channel	2480	2.81	1.91	1000

For Pi/4 QDPSK

Channel	Frequency MHz	Measured Value dBm	Output Power mW	Limit mW
Low Channel	2402	-4.43	0.36	1000
Middle Channel	2441	-0.64	0.86	1000
High Channel	2480	1.10	1.29	1000

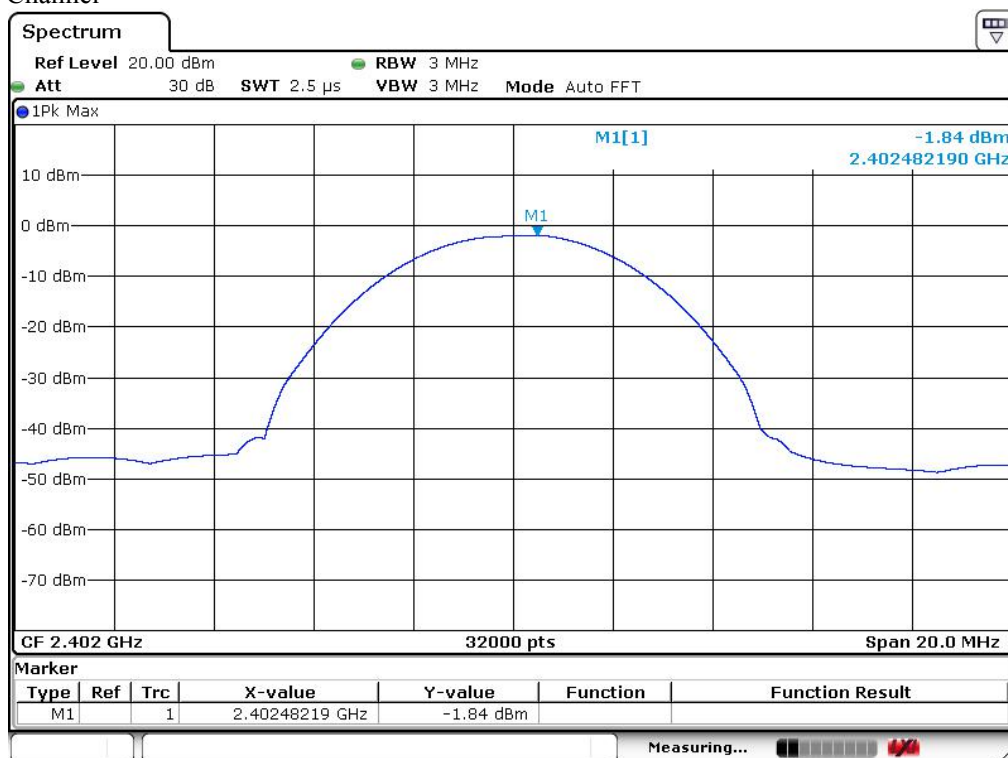
For 8DPSK

Channel	Frequency MHz	Measured Value dBm	Output Power mW	Limit mW
Low Channel	2402	-4.07	0.39	1000
Middle Channel	2441	-0.05	0.99	1000
High Channel	2480	1.13	1.30	1000

Note: the antenna gain of 1dBi less than 6dBi maximum permission antenna gain value based on 1 watt peak output power limit.

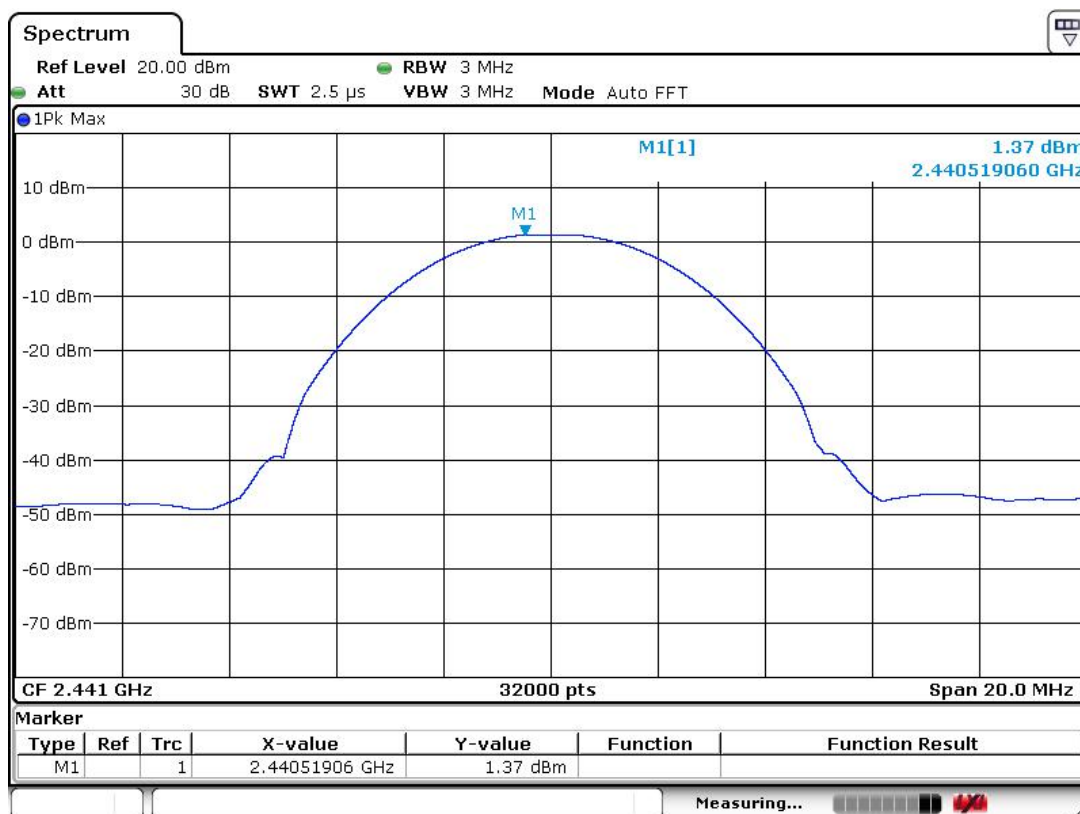


GFSK Low Channel



Date: 16 MAY 2017 16:46:08

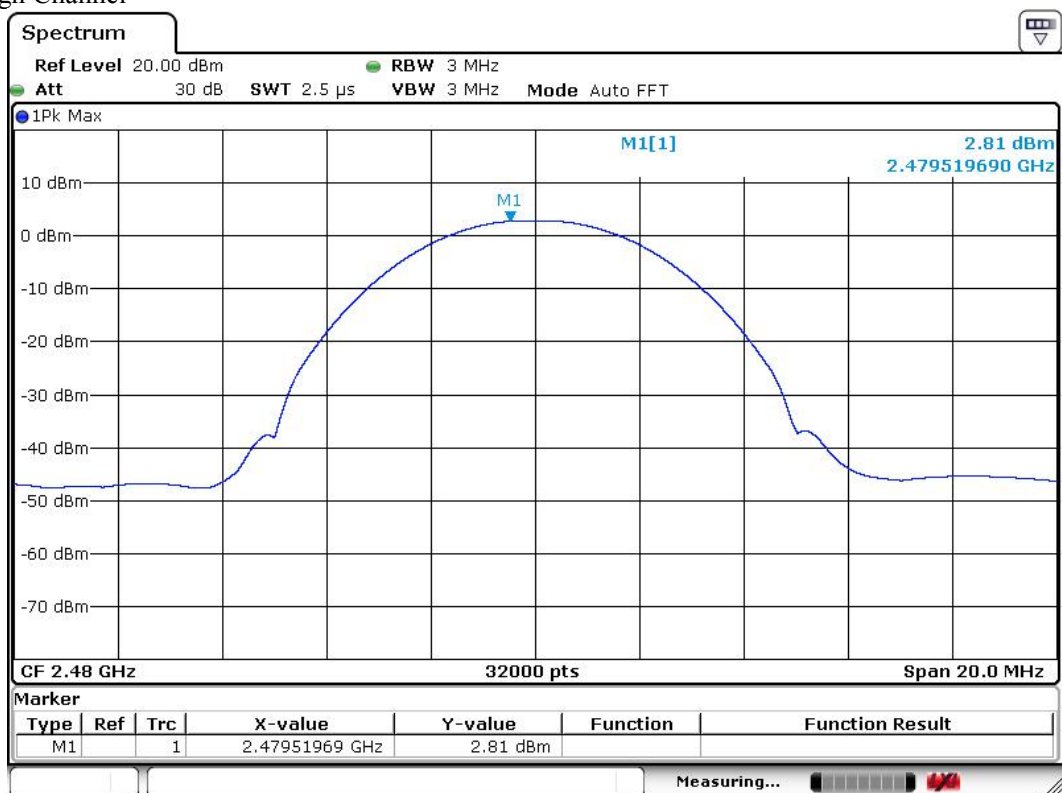
GFSK Middle Channel



Date: 16 MAY 2017 16:46:30

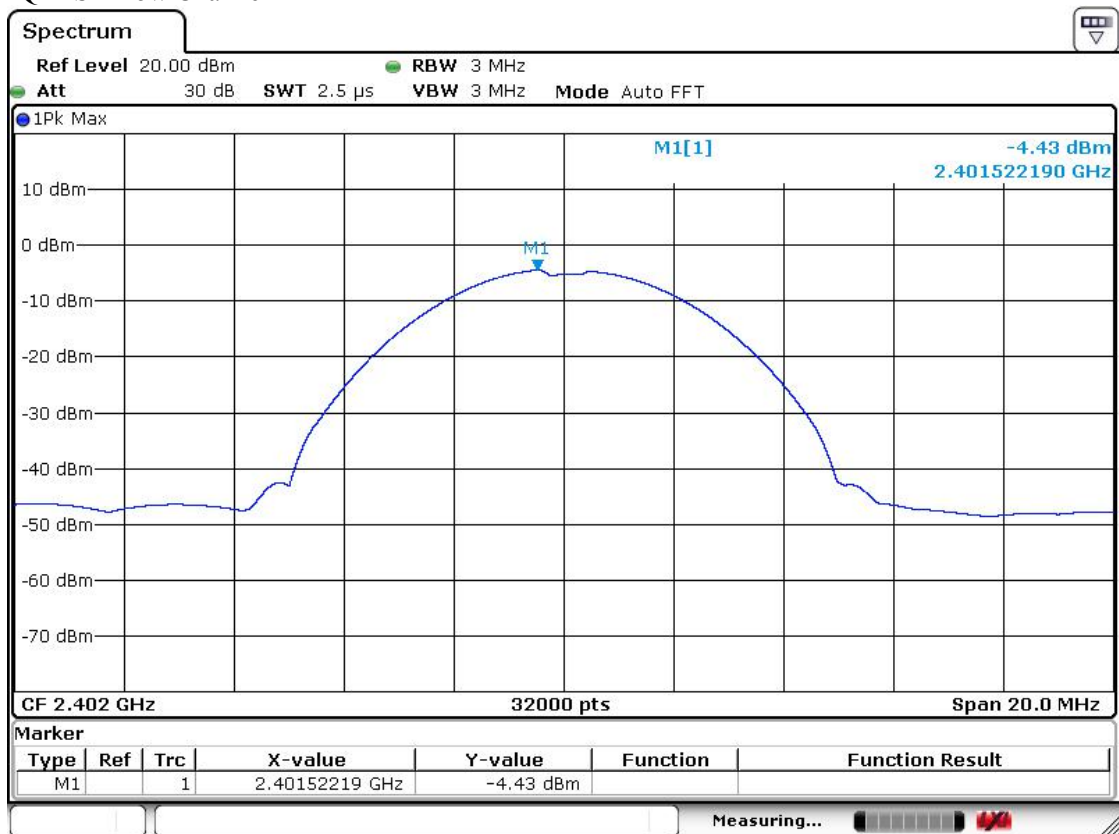


GFSK High Channel



Date: 16 MAY 2017 16:46:46

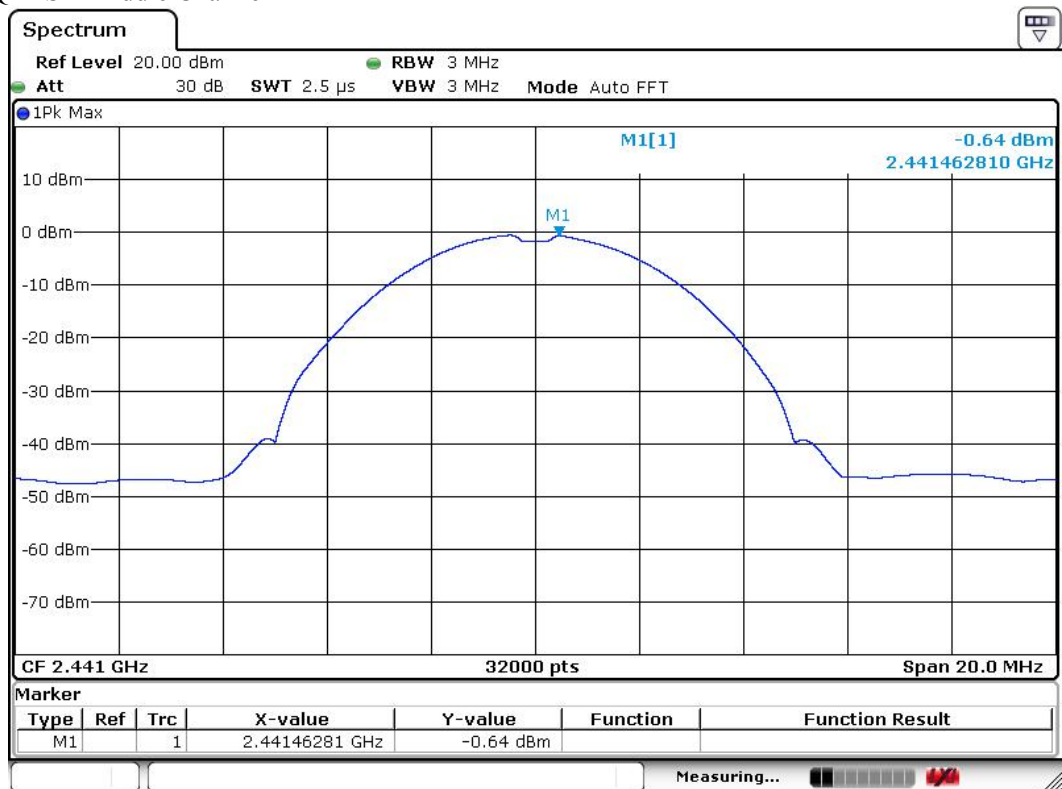
For Pi/4 QDPSK Low Channel



Date: 16 MAY 2017 16:47:40

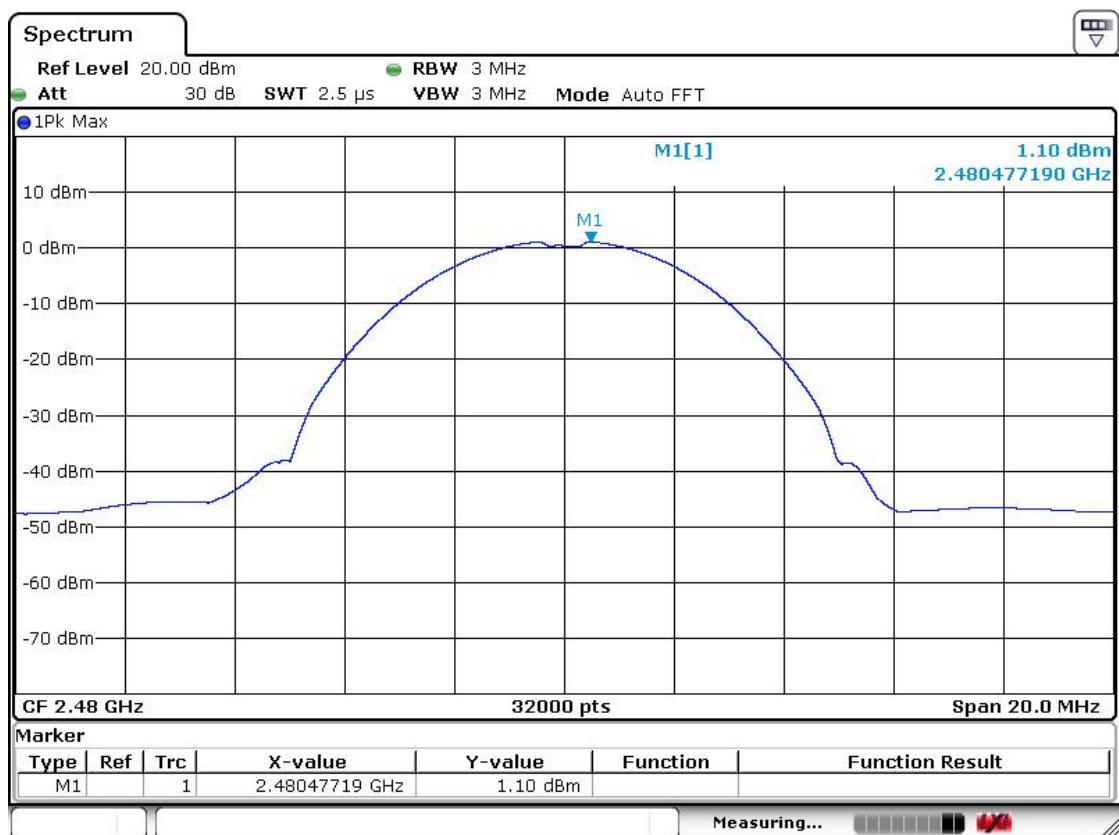


For Pi/4 QDPSK Middle Channel



Date: 16 MAY 2017 16:47:14

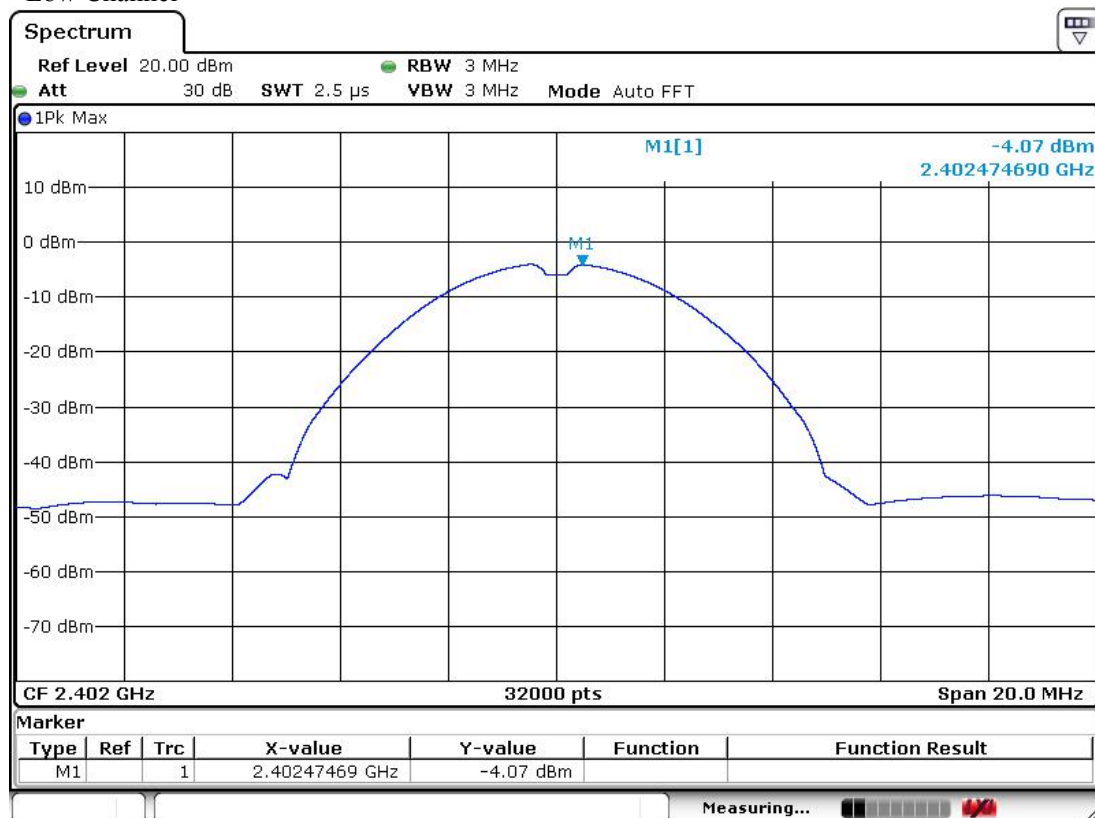
For Pi/4 QDPSK High Channel



Date: 16 MAY 2017 16:47:02

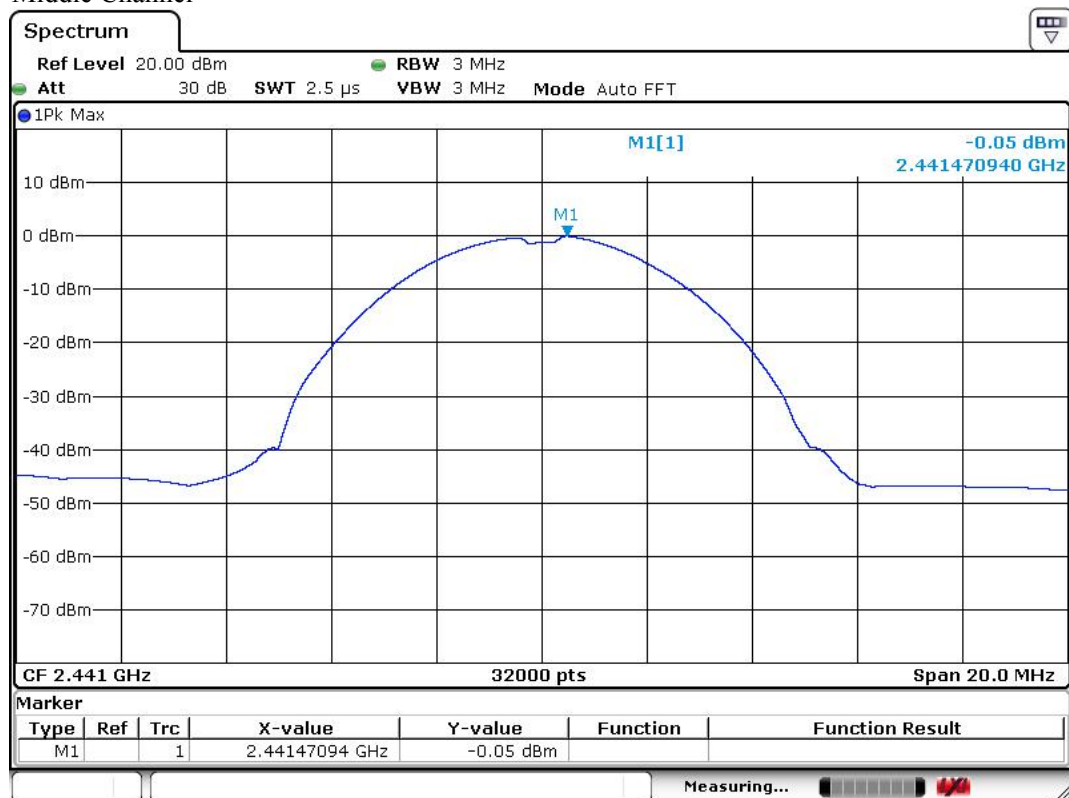


8DPSK Low Channel



Date: 16 MAY 2017 16:47:56

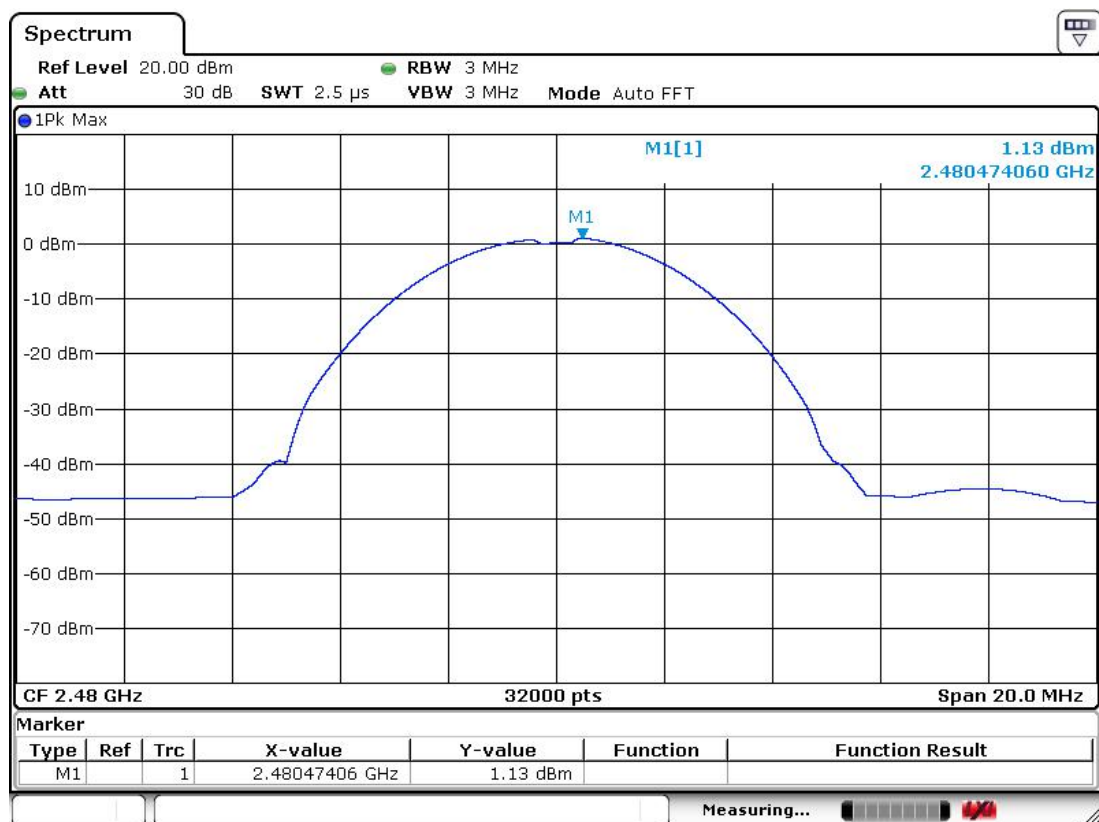
8DPSK Middle Channel



Date: 16 MAY 2017 16:48:14



8DPSK High Channel



Date: 16 MAY 2017 16:48:27



10. Field Strength of Spurious Emissions

10.1 Standard Applicable

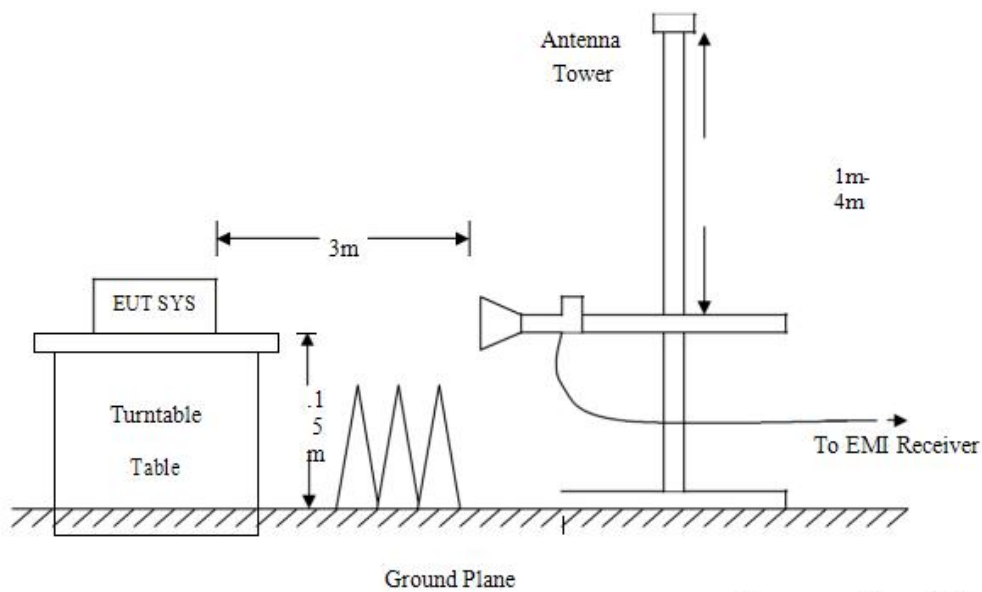
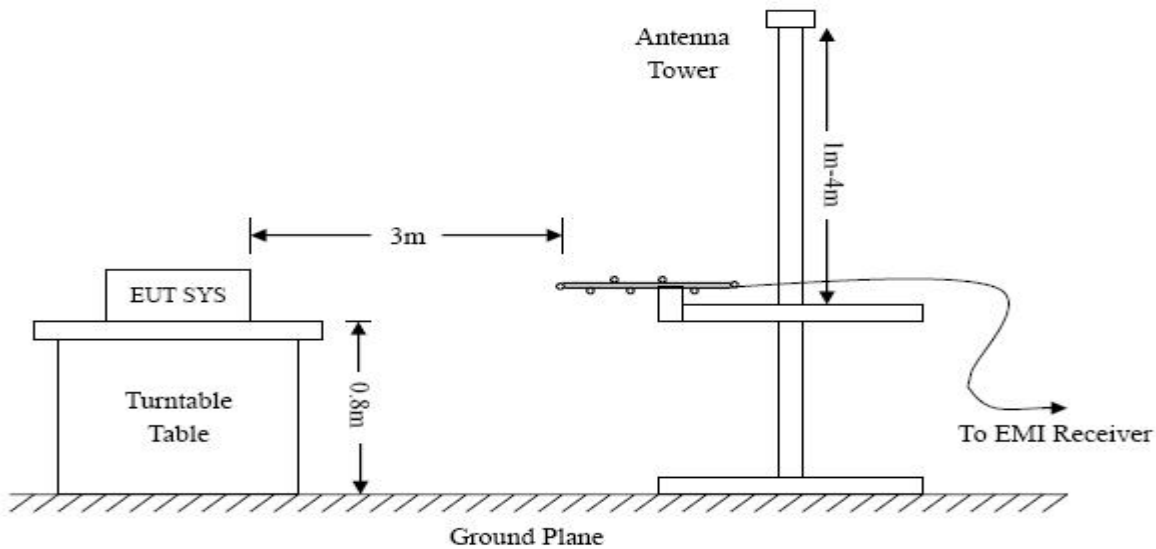
According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within 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).

The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

10.2 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.205 15.247(a) and FCC Part 15.209 Limit.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle. The spacing between the peripherals was 10 cm.



Frequency :9kHz-30MHz
RBW=10KHz,
VBW =30KHz
Sweep time= Auto
Trace = max hold
Detector function = peak

Frequency :30MHz-1GHz
RBW=120KHz,
VBW=300KHz
Sweep time= Auto
Trace = max hold
Detector function = peak, QP

Frequency :Above 1GHz
RBW=1MHz,
VBW=3MHz(Peak), 10Hz(AV)
Sweep time= Auto
Trace = max hold
Detector function = peak, AV



10.3 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and the Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Ant. Factor} + \text{Cable Loss} - \text{Ampl. Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -6dBμV means the emission is 6dBμV below the maximum limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corr. Ampl.} - \text{FCC Part 15 Limit}$$

10.4 Environmental Conditions

Temperature:	22°C
Relative Humidity:	53%
ATM Pressure:	101.1 mbar

10.5 Summary of Test Results/Plots

Test Specification: *Vertical*



Radiated Emission Measurement

File :20170511
80.0 dBuV/m

Data #1

Date: 2017-05-11

Time: 1:57:23 PM



Site: Polarization: *Vertical* Temperature: 25
Limit: FCC_PART15_B_03m_QP_ Power: Humidity: 50 %
EUT: Distance: 3m
M/N:
Mode:
Note:

No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	Antenna	Table	
		MHz	Level	Factor	ment			Height	Degree	Comment
			dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	
1		35.0048	30.74	-16.80	13.94	40.00	-26.06	QP		
2		103.8055	31.68	-13.65	18.03	43.50	-25.47	QP		
3		263.8190	32.49	-12.91	19.58	46.00	-26.42	QP		
4		400.4319	30.07	-5.93	24.14	46.00	-21.86	QP		
5	*	547.0977	35.94	-3.71	32.23	46.00	-13.77	QP		
6		798.9797	28.50	3.44	31.94	46.00	-14.06	QP		

Test Specification: Horizontal



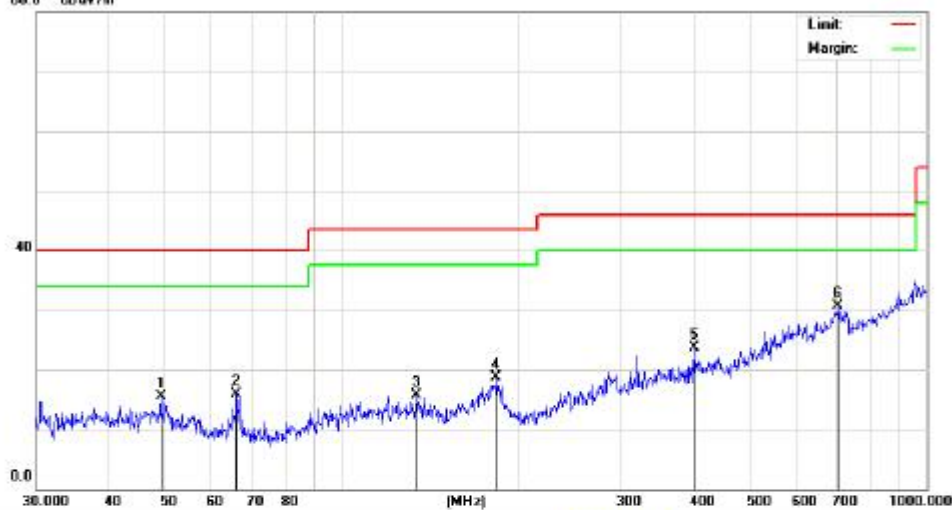
Radiated Emission Measurement

File: 20170511
80.0 dBuV/m

Data #2

Date: 2017-05-11

Time: 1:57:47 PM



Site

Polarization: *Horizontal*

Temperature: 25

Limit: FCC_PART15_B_03m_QP_

Power:

Humidity: 50 %

EUT:

Distance: 3m

M/N:

Mode:

Note:

No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	Antenna	Table	
		MHz	Level	Factor	ment			Height	Degree	Comment
			dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	
1		49.0145	29.78	-14.21	15.57	40.00	-24.43	QP		
2		66.0342	33.57	-17.73	15.84	40.00	-24.16	QP		
3		134.0882	30.54	-14.75	15.79	43.50	-27.71	QP		
4		183.8440	30.52	-11.72	18.80	43.50	-24.70	QP		
5		400.4319	30.58	-8.89	23.69	46.00	-22.31	QP		
6	*	706.6999	30.77	-0.16	30.61	46.00	-15.39	QP		

**Spurious Emissions Above 1GHz**

Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-2402MHz							
4815	53.20	-3.59	49.61	74	-24.37	H	PK
4815	36.24	-3.59	32.65	54	-21.61	H	AV
7211	52.54	-0.52	52.02	74	-22.96	H	PK
7211	32.51	-0.52	31.99	54	-22.88	H	AV
4815	53.14	-3.59	49.55	74	-25.03	V	PK
4815	36.84	-3.59	33.25	54	2-1.38	V	AV
7211	53.01	-0.52	52.49	74	-19.50	V	PK
7211	35.66	-0.52	40.78	54	-18.98	V	AV
Middle Channel-2441MHz							
4875	53.56	-3.49	50.07	74	-25.13	H	PK
4875	41.24	-3.49	37.75	54	-15.19	H	AV
7320	54.21	-0.47	53.74	74	-21.27	H	PK
7320	41.14	-0.47	40.67	54	-12.58	H	AV
4875	53.15	-3.49	49.66	74	-23.14	V	PK
4875	41.57	-3.49	38.08	54	-15.11	V	AV
7320	54.25	-0.47	53.78	74	-20.19	V	PK
7320	41.52	-0.47	41.05	54	-9.11	V	AV
High Channel-2480MHz							
4954	56.00	-3.41	52.59	74	-22.28	H	PK
4954	42.31	-3.41	38.90	54	-13.65	H	AV
7436	50.28	-0.42	49.86	74	-23.19	H	PK
7436	43.24	-0.42	42.82	54	-10.23	H	AV
4954	55.33	-3.41	51.92	74	-22.97	V	PK
4954	40.21	-3.41	36.80	54	-16.29	V	AV
7436	51.05	-0.42	50.63	74	-22.39	V	PK
7436	42.35	-0.42	41.93	54	-10.91	V	AV

Note: Testing is carried out with frequency rang 9kHz to the tenth harmonics, other than listed in the table above are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured



11. Out of Band Emissions

11.1 Standard Applicable

According to §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).

11.2 Test Procedure

According to the DA 00-705, the band-edge radiated test method as follows.

Set span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation (2310MHz to 2410MHz for low bandedge, 2470MHz to 2500MHz for the high bandedge)

RBW = 1MHz, VBW = 1MHz for peak value measured RBW

= 1MHz, VBW = 10Hz for average value measured Sweep =

auto; Detector function = peak; Trace = max hold

All the trace to stabilize, set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. Those emission must comply with the 15.209 limit for fall in the restricted bands listed in section 15.205. Note that the method of measurement KDB publication number: 913591 may be used for the radiated bandedge measurements.

According to the DA 00-705, the band-edge conducted test method as follows:

Set span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation (2380MHz to 2410MHz for low bandedge, 2470MHz to 2500MHz for the high bandedge)

RBW = 100kHz, VBW = 300kHz



Sweep = auto; Detector function = peak; Trace = max hold

All the trace to stabilize, set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. Those emission must comply with the limit specified in this section (at least 20dB attenuation).

11.3 Environmental Conditions

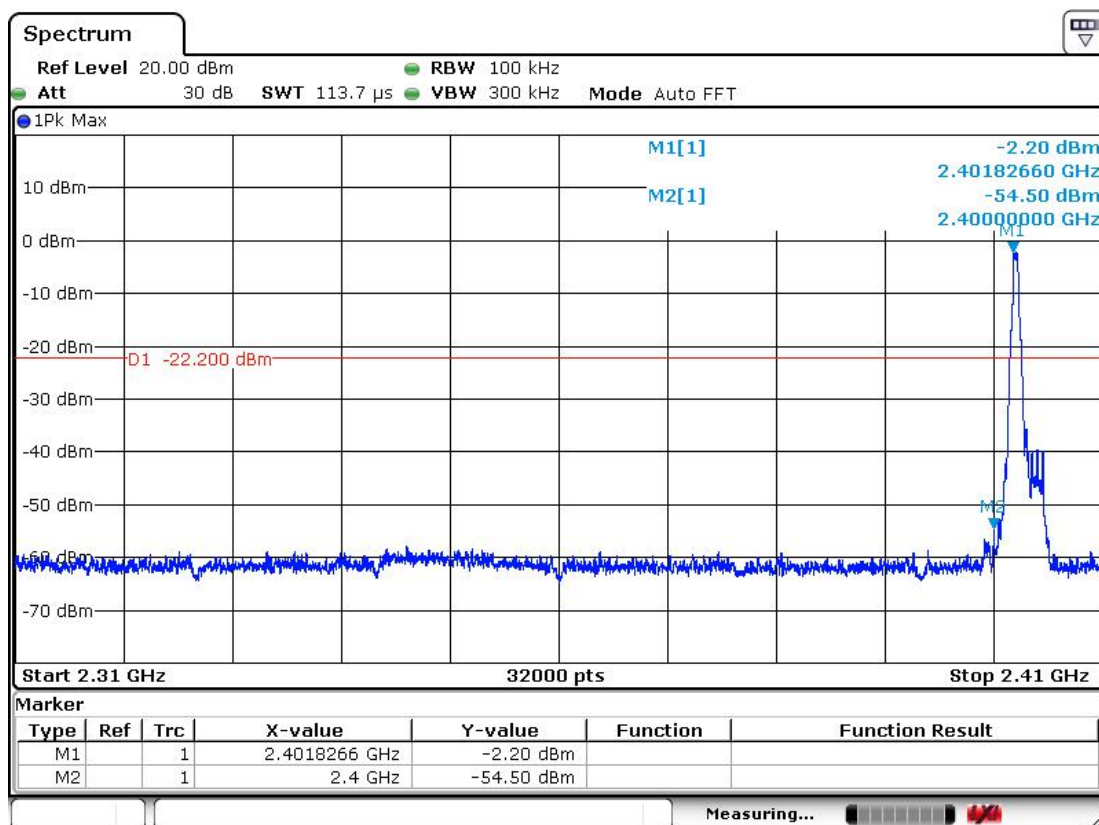
Temperature:	22°C
Relative Humidity:	53%
ATM Pressure:	101.1 mbar

11.4 Summary of Test Results/Plots

GFSK

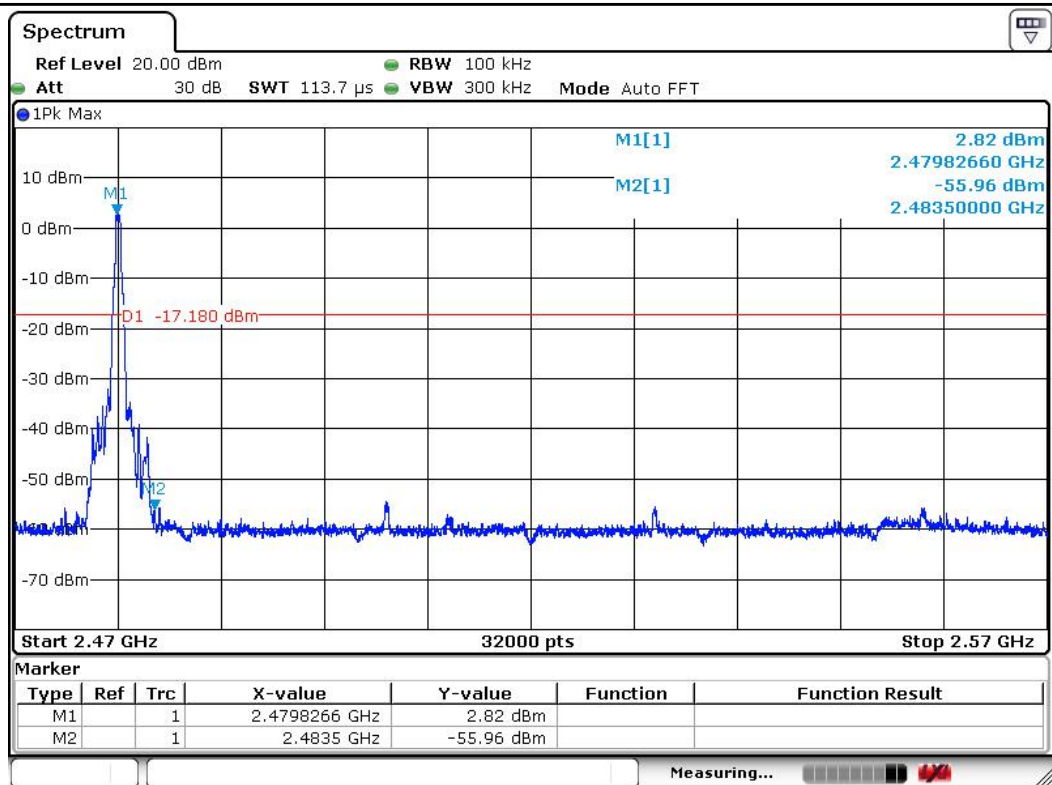
Bandedge (Conducted)

Lowest



Date: 16 MAY 2017 17:02:06

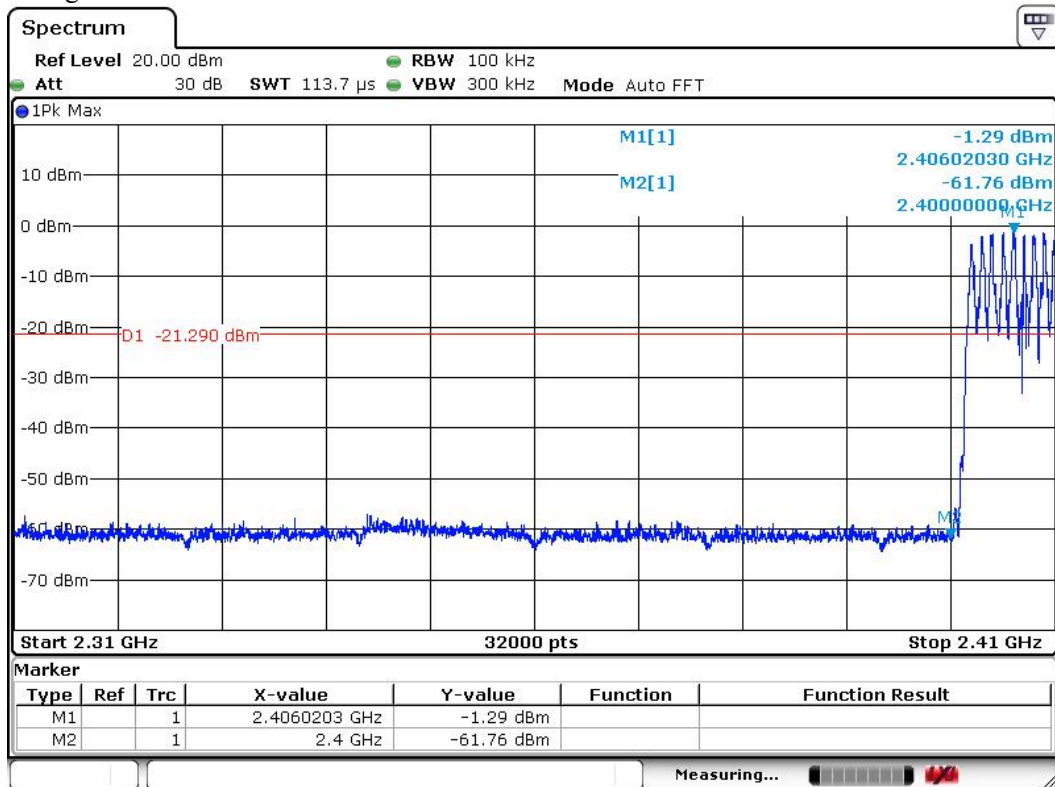
Highest



Date: 16 MAY 2017 17:00:53

Hopping Bandedge (Conducted)

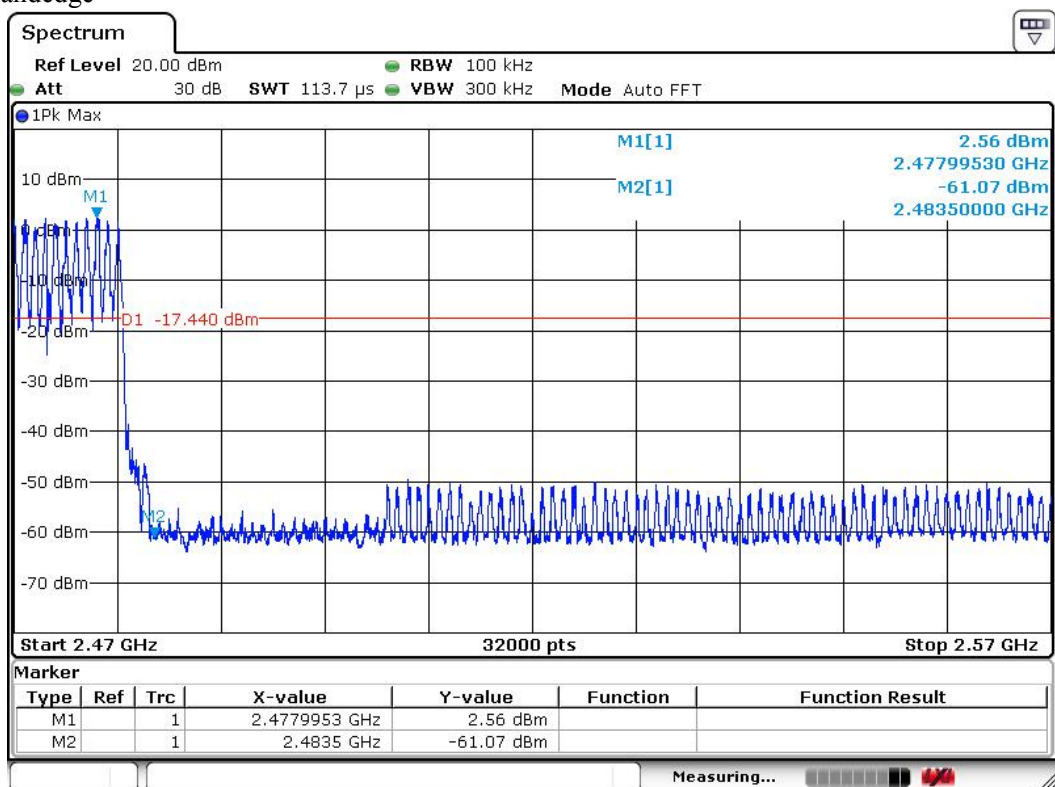
Lowest Bandedge



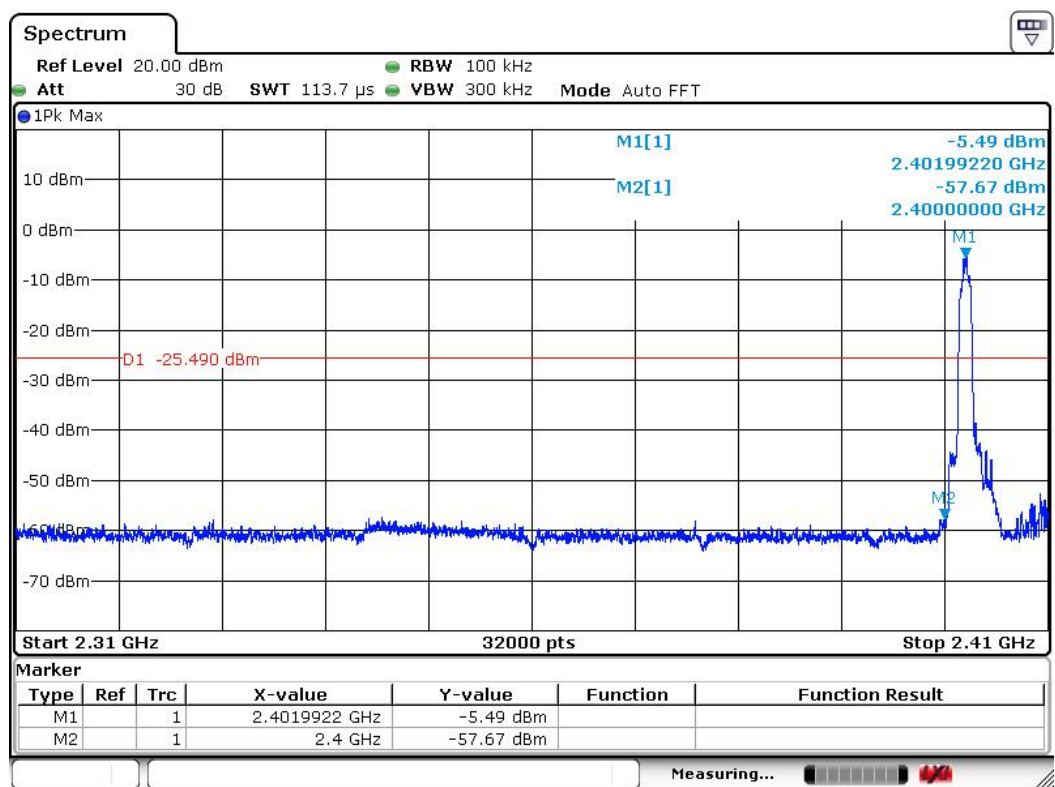
Date: 16 MAY 2017 17:01:45



Highest Bandedge



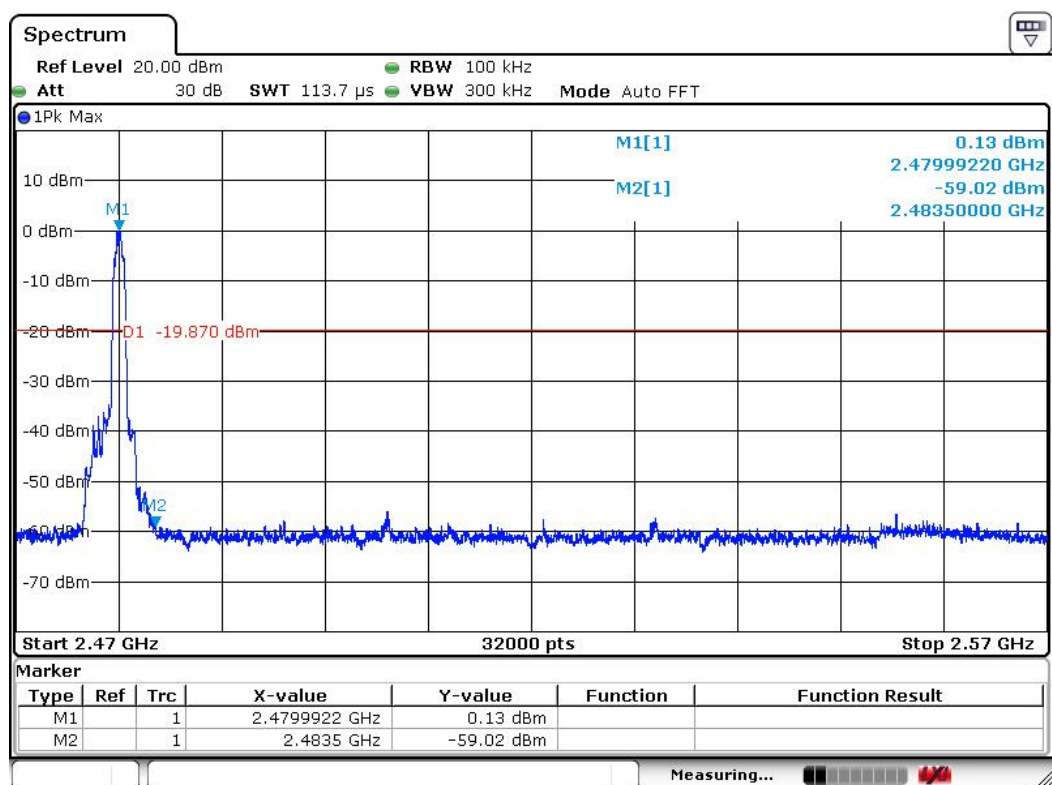
Date: 16 MAY 2017 17:01:20

8DPSK
Bandedge (Conducted)
Lowest

Date: 16 MAY 2017 16:57:12



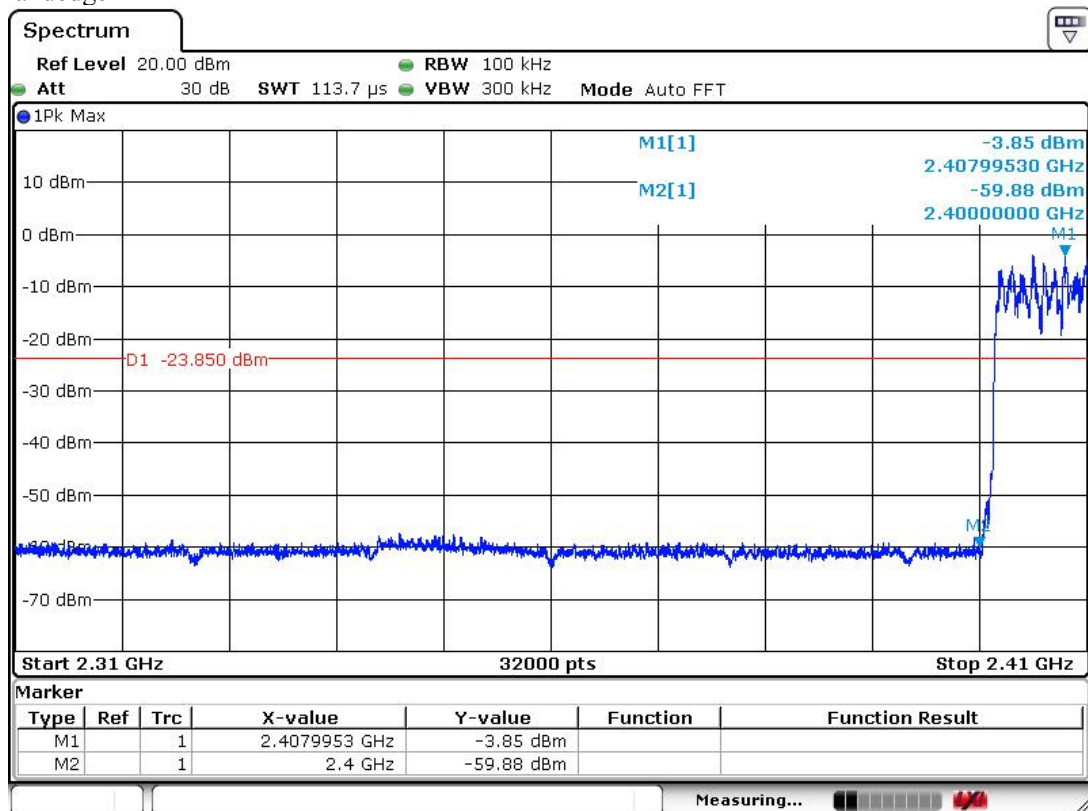
Highest



Date: 16 MAY 2017 16:58:50

Hopping Bandedge (Conducted)

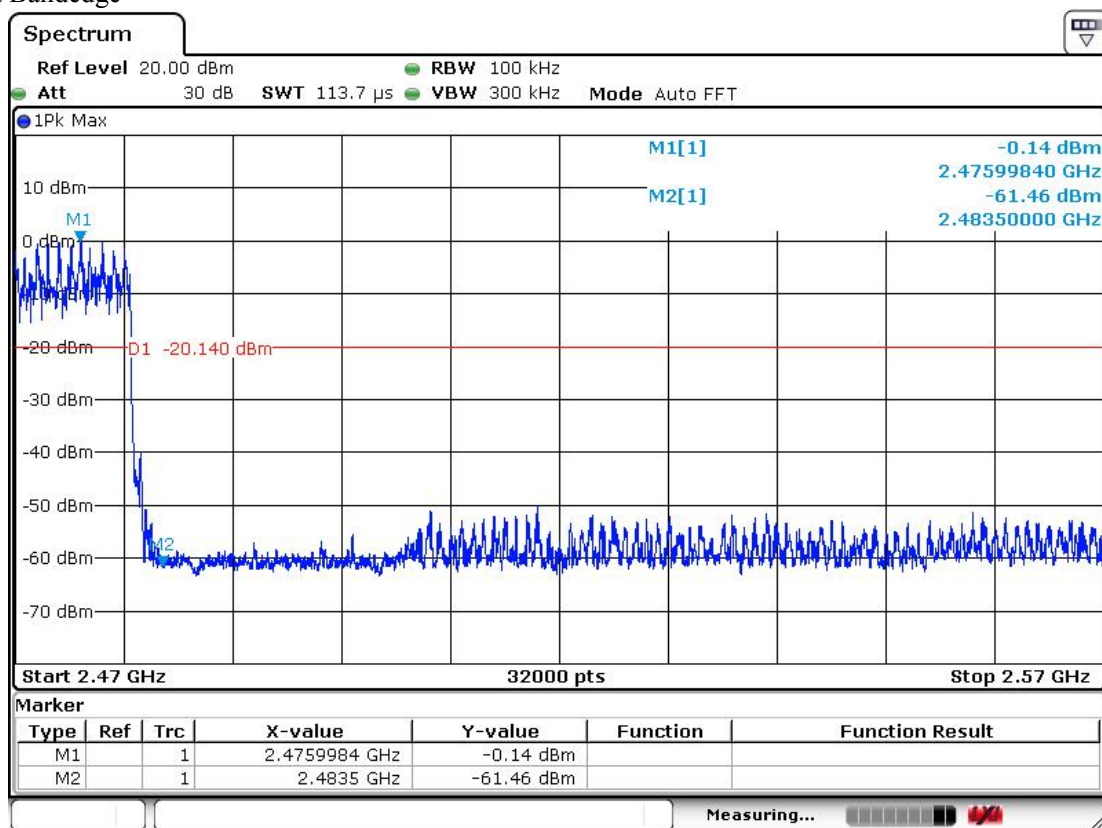
Lowest Bandedge



Date: 16 MAY 2017 16:57:53



Highest Bandedge



Date: 16 MAY 2017 16:58:21



12. Conducted Emissions

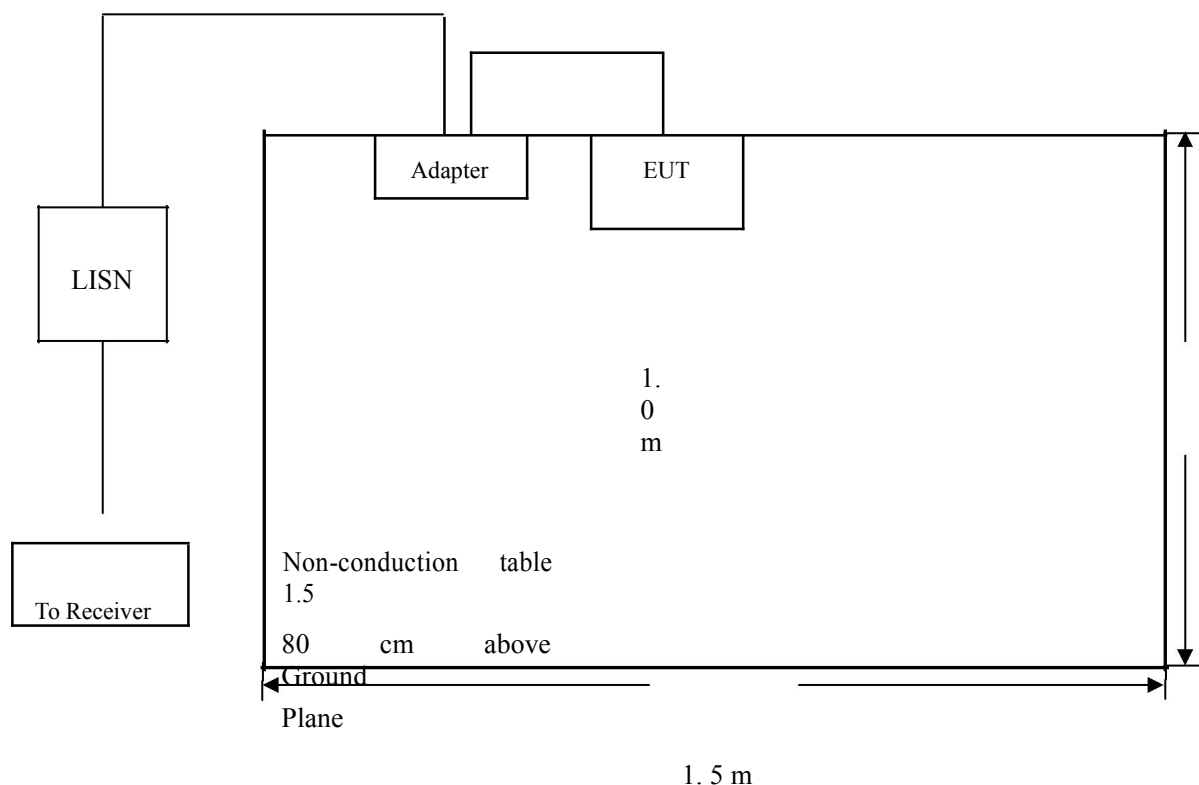
12.1 Test Procedure

The setup of EUT is according with per ANSI C63.4-2014 measurement procedure. The specification used was with the FCC Part 15.207 Limit.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

12.2 Basic Test Setup Block Diagram





12.3 Environmental Conditions

Temperature:	22°C
Relative Humidity:	53%
ATM Pressure:	101.1 mbar

12.4 Test Receiver Setup

During the conducted emission test, the test receiver was set with the following configurations:

Start Frequency 150 kHz
Stop Frequency..... 30 MHz
Sweep Speed Auto
IF Bandwidth 10 kHz
Quasi-Peak Adapter Bandwidth 9 kHz
Quasi-Peak Adapter Mode Normal

12.5 Summary of Test Results/Plots

According to the data in section 12.6, the EUT complied with the FCC Part 15.207 Conducted margin for this device, with the *worst* margin reading of:

-5.05 dB at 0.6419 MHz in the Neutral mode, peak detector, 0.15-30MHz

12.6 Conducted Emissions Test Data



Conducted Emission Measurement

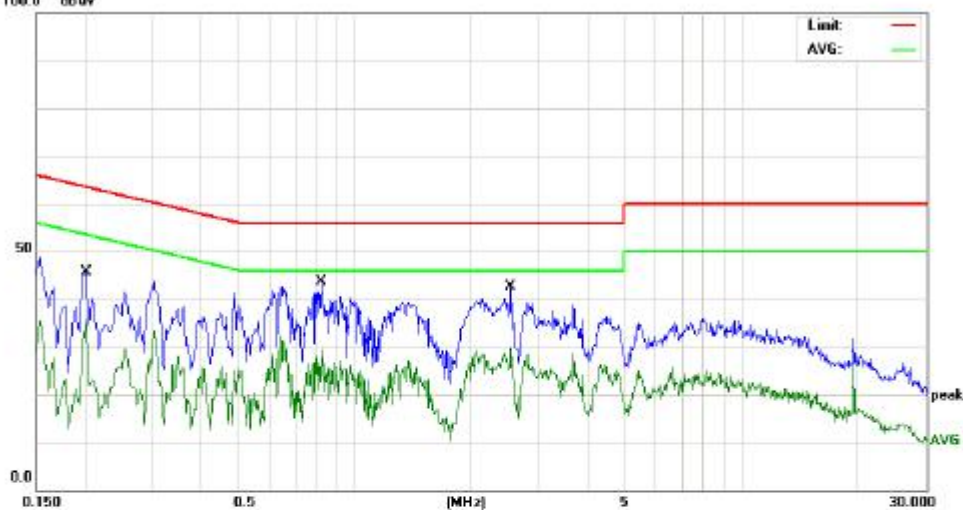
File: 20170509

Data: #1

Date: 2017/05/09

Time: 16:52:48

100.0 dBuV



Site:

Limit: FCC Part15 CE-Class B_QP

EUT:

M/N:

Mode:

Note:

Phase:

L1

Power: AC 120V/60Hz

Temperature: 26

Humidity: 56 %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector	Comment
		MHz	dBuV	dB	dBuV	dBuV	dB		
1		0.2020	34.52	11.12	45.64	63.52	-17.88	QP	
2		0.2020	24.56	11.12	35.68	53.52	-17.84	AVG	
3	*	0.8180	33.73	9.98	43.69	56.00	-12.31	QP	
4		0.8180	19.41	9.98	29.37	46.00	-16.63	AVG	
5		2.5380	32.53	10.01	42.54	56.00	-13.46	QP	
6		2.5380	19.81	10.01	29.82	46.00	-16.18	AVG	



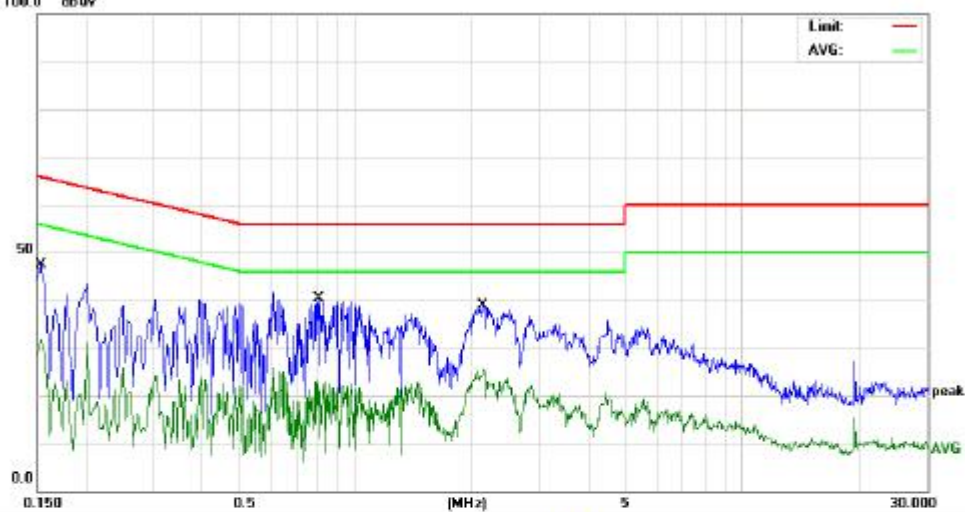
Conducted Emission Measurement

File :20170509
100.0 dBuV

Data :#2

Date: 2017/05/09

Time: 16:53:47



Site

Phase: N

Temperature: 26

Limit: FCC Part15 CE-Class B_QP

Power: AC 120V/60Hz

Humidity: 56 %

EUT:

M/N:

Mode:

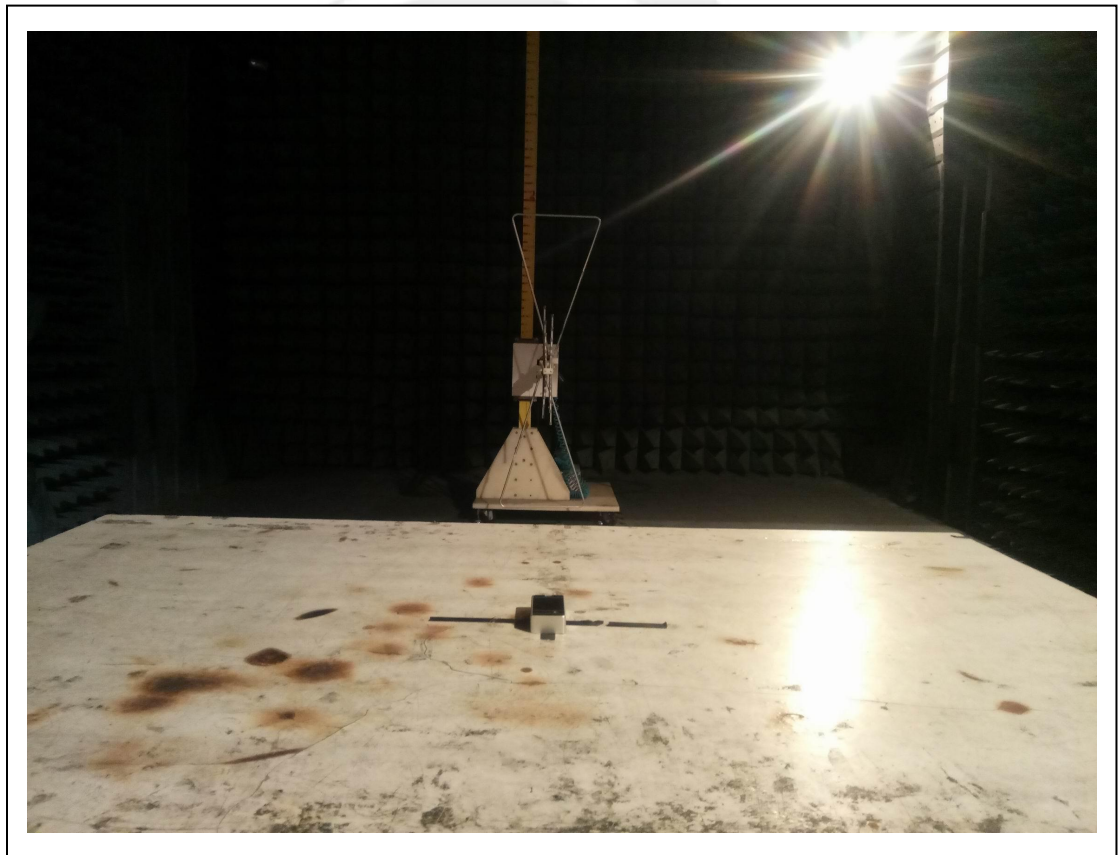
Note:

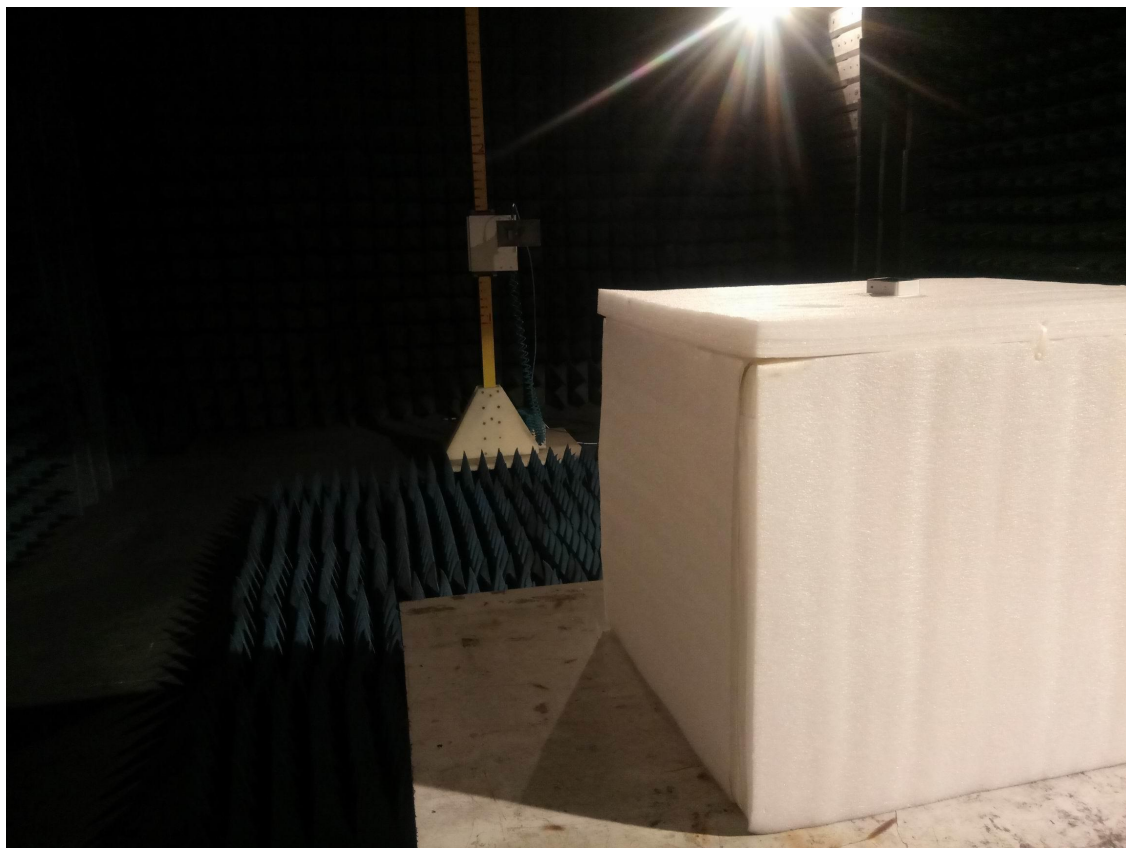
No. Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1	0.1539	35.61	11.84	47.45	65.78	-18.33	QP	
2	0.1539	19.89	11.84	31.73	55.78	-24.05	AVG	
3	0.7980	13.13	9.96	23.09	46.00	-22.91	AVG	
4 *	0.8059	30.40	9.96	40.36	56.00	-15.64	QP	
5	2.1420	28.89	10.00	38.89	56.00	-17.11	QP	
6	2.1540	15.75	10.00	25.75	46.00	-20.25	AVG	

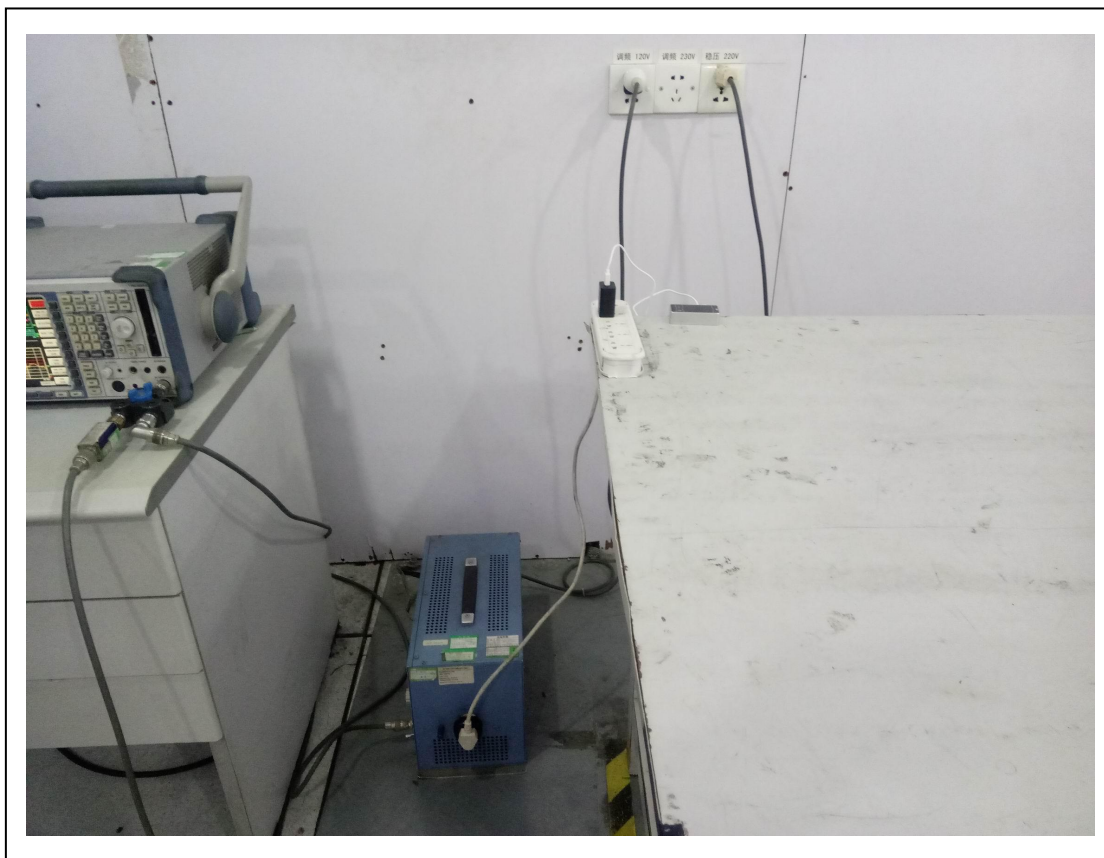


13 test photo

Radiated Measurement Photos







***** END OF REPORT *****