



Report No. : HCT1401010FCC

File reference No: 2014-01-11

Applicant: Addon Technology

Product: Mushroom

Brand Name: Mushroom, ELSONIC, Addon, TELEFUNKEN,
Mushroom Wireless, Mushroom BT SP1, Freecom, Digix

Model No: Mushroom, Mushroom BT SP1, EFT-BTS1, BT-100, BT-200,
BT-300, BT-400, BT-500, TOUGH SPEAKER

Test Standards: FCC Part 15 Subpart C, Paragraph 15.247

Test result: It is herewith confirmed and found to comply with the
requirements set up by ANSI C63.4&FCC Part 15 Subpart C,
Paragraph 15.247 regulations for the evaluation of
electromagnetic compatibility

Approved By

Eric Lin
Manager

Dated: Jan 11, 2014

Results appearing herein relate only to the sample tested

**The technical reports is issued errors and omissions exempt and is subject to
withdrawal at**

Shenzhen HCT Technology Co.,Ltd.

Room104, Number3, Lane14, Shangshatangyan Village, Futian District, Shenzhen



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1.0 General Details

1.1 Applicant Details

Applicant: Addon Technology
Address: 1F.,NO.14,Ln.,53,Sec.4,XinYi Rd.,TaiPei,Taiwan
Telephone: 886-2-2917-5726
Fax: 886-2-2917-5921

1.2 Description of EUT

Product: Mushroom
Manufacturer: Addon Technology
Address: 1F.,NO.14,Ln.,53,Sec.4,XinYi Rd.,TaiPei,Taiwan
Brand Name: Mushroom
Model Number: Mushroom
Additional Model Name: Mushroom BT SP1, EFT-BTS1, BT-100, BT-200, BT-300, BT-400, BT-500, TOUGH SPEAKER
Additional Trade Name: ELSONIC,Addon, TELEFUNKEN, Mushroom Wireless, Mushroom BT SP1, Freecom, Digix
Rating: 3.7V with 400 mAh powered by Li-ion Battery
Power Supply: N/A
Type of Modulation: GFSK, II/4QPSK, 8DPSK
Frequency range: 2402-2480MHz
Number of Channel: 79
Frequency Selection: By software
Antenna type: PCB Printed antenna, and the maximum Gain of this antenna is 1.13dBi

1.3 Submitted Sample: 2 Samples

1.4 Test Duration: 2014-01-02 to 2014-01-10

1.5 Test Uncertainty

Conducted Emissions Uncertainty =3.6dB
Radiated Emissions Uncertainty =4.7dB

1.6 Test Engineer

The sample tested by _____

A handwritten signature in black ink that reads 'Willis Gui'.

Print Name: Willis Gui

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2.0	Test Equipments				
Instrument Type	Manufacturer	Model	Serial No.	Date of Cal.	Due Date
ESPI Test Receiver	ROHDE&SCHWARZ	ESPI 3	100379	2013-08-26	2014-08-25
EMI Test Receiver	Rohde & Schwarz	ESU	1302.6005.26	2013-08-26	2014-08-25
Impuls-Begrenzer	ROHDE&SCHWARZ	ESH3-Z2	100281	2013-08-26	2014-08-25
Loop Antenna	EMCO	6502	00042960	2013-08-26	2014-08-25
ESPI Test Receiver	ROHDE&SCHWARZ	ESI26	838786/013	2013-08-26	2014-08-25
3m OATS	--	--	N/A	2013-08-26	2014-08-25
Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170399	2013-08-26	2014-08-25
Horn Antenna	SCHWARZBECK	BBHA 9120	D143	2013-08-26	2014-08-25
Power meter	Anritsu	ML2487A	6K00003613	2013-08-26	2014-08-25
Power sensor	Anritsu	MA2491A	32263	2013-08-26	2014-08-25
Bilog Antenna	Schwarebeck	VULB916 3	9163/142	2013-08-26	2014-08-25
LISN (Three Phase)	Schwarebeck	NSLK 8126	8126453	2013-08-26	2014-08-25
9*6*6 Anechoic	--	--	N/A	2013-08-26	2014-08-25
EMI Test Receiver	RS	ESCS30	100139	2013-08-26	2014-08-25
LISN	RS	ESH2-Z5	100225	2013-08-26	2014-08-25
LISN (Three Phase)	Schwarebeck	NSLK 8126	8126453	2013-08-26	2014-08-25
Pre-Amplifier	A.H.	PAM-0126	1415261	2013-08-26	2014-08-25

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3.0 Technical Details

3.1 Summary of test results

The EUT has been tested according to the following specifications:			
Requirement	CFR 47 Section	Result	Notes
Antenna Requirement	15.203, 15.247(b)(4)	PASS	Complies
Maximum Peak Out Power	15.247 (b)(1), (4)	PASS	Complies
Carrier Frequency Separation	15.247(a)(1)	PASS	Complies
20dB Channel Bandwidth	15.247 (a)(1)	PASS	Complies
Number of Hopping Channels	15.247(a)(iii), 15.247(b)(1)	PASS	Complies
Time of Occupancy (Dwell Time)	15.247(a)(iii)	PASS	Complies
Spurious Emission, Band Edge, and Restricted bands	15.247(d),15.205(a), 15.209 (a),15.109	PASS	Complies
Conducted Emissions	15.207(a), 15.107	PASS	Complies
RF Exposure	15.247(i), 1.1307(b)(1)	PASS	Complies

3.2 Test Standards

FCC Part 15 Subpart & Subpart C, Paragraph 15.247

4.0 Test Lab Details

Name: Shenzhen Emttek Co., Ltd.

Address: Bldg. 69, Majialong Industry Zone,,Nanshan District,Shenzhen, Guangdong, 518052China

FCC Registration Number: 406365

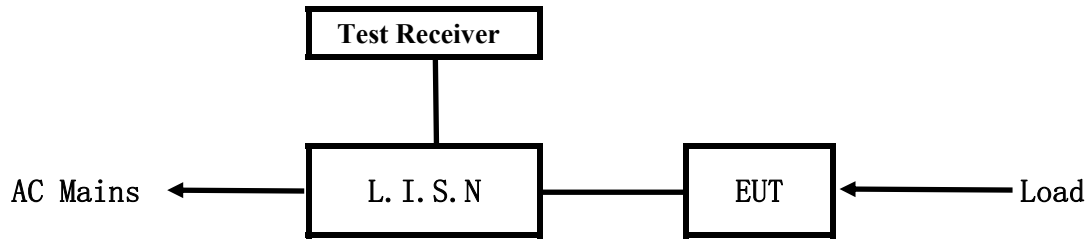
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5. Power Line Conducted Emission Test

5.1 Schematics of the test



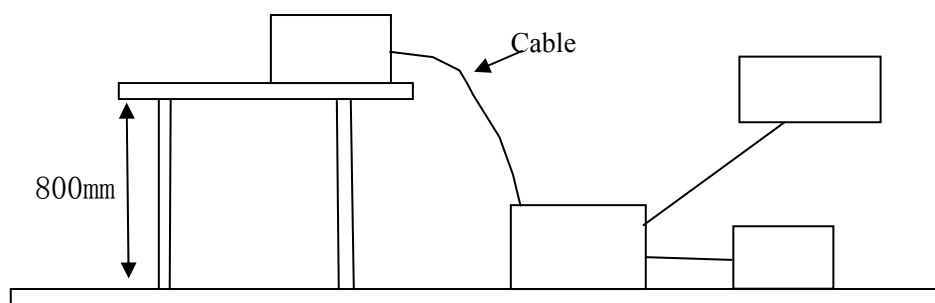
EUT: Equipment Under Test

5.2 Test Method and test Procedure

The EUT was tested according to ANSI C63.4-2003. The Frequency spectrum From 0.15MHz to 30MHz was investigated. The LISN used was 50ohm/50uH as specified by section 5.1 of ANSI C63.4 –2003.

Test Voltage: 120V~, 60Hz

Block diagram of Test setup



5.3 Configuration of The EUT

The EUT was configured according to ANSI C63.4-2003. All interface ports were connected to the appropriate peripherals. All peripherals and cables are listed below.

79 channels are provided to the EUT

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A. EUT

Device	Manufacturer	Model	FCC ID
Mushroom	Addon Technology	Mushroom, Mushroom BT SP1, EFT-BTS1, BT-100, BT-200, BT-300, BT-400, BT-500, TOUGH SPEAKER	Z2HMS438

B. Internal Device

Device	Manufacturer	Model	FCC ID/DOC
N/A			

C. Peripherals

Device	Manufacturer	Model	FCC ID/DOC	Cable
Note Book	IBM	R4	FCC DOC	--
Power Supply	Great Wall	GA90SC1-194730	FCC DOC	--

5.4 EUT Operating Condition

Operating condition is according to ANSI C63.4 -2003.

A Setup the EUT and simulators as shown on follow

B Enable AF signal and confirm EUT active to normal condition

5.5 Power line conducted Emission Limit according to Paragraph 15.107, 15.207and RSS-210

Frequency (MHz)	Class A Limits (dB μ V)		Class B Limits (dB μ V)	
	Quasi-peak Level	Average Level	Quasi-peak Level	Average Level
0.15 ~ 0.50	79.0	66.0	66.0~56.0*	56.0~46.0*
0.50 ~ 5.00	73.0	60.0	56.0	46.0
5.00 ~ 30.00	73.0	60.0	60.0	50.0

- Notes: 1. *Decreasing linearly with logarithm of frequency.
2. The tighter limit shall apply at the transition frequencies

5.6 Test Results

The frequency spectrum from 0.15MHz to 30MHz was investigated. All reading are quasi-peak values with a resolution bandwidth of 9kHz.

Note: the worse cases was selected to conducted the test

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A: Conducted Emission on Neutral Terminal (150kHz to 30MHz)

EUT Operating Environment

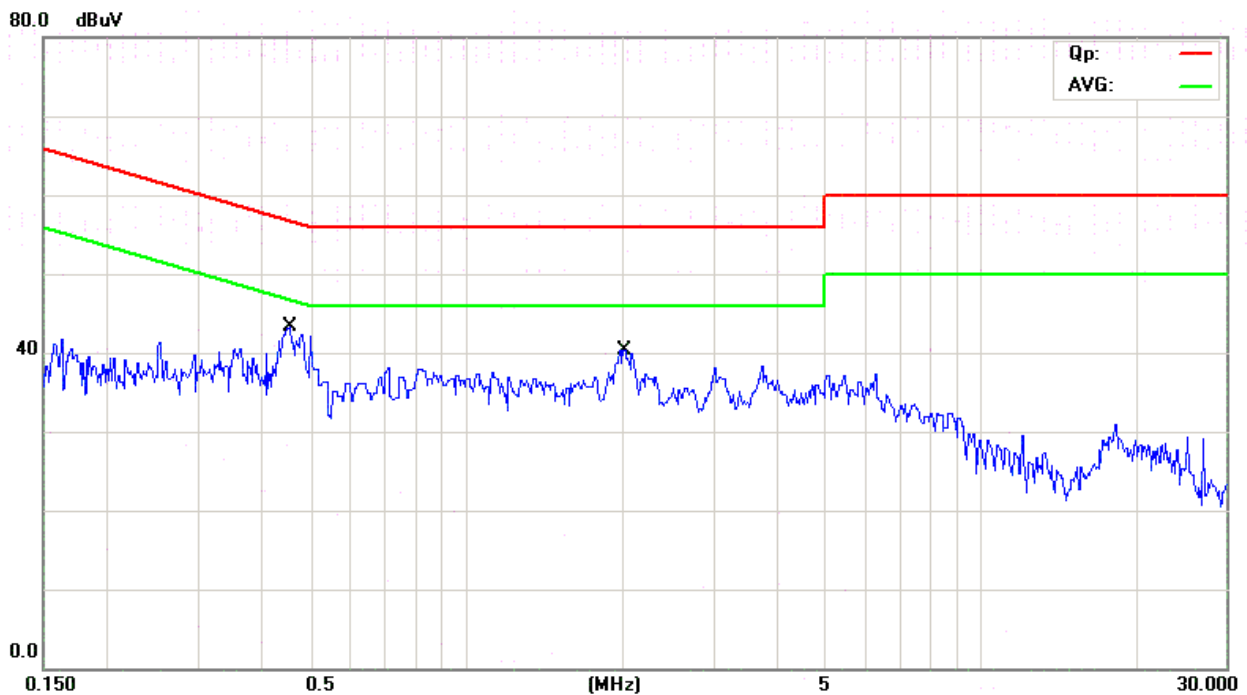
Temperature: 26°C Humidity: 65%RH Atmospheric Pressure: 101 KPa

EUT set Condition: Charging Mode (powered by PC)

Equipment Level: Class B

Results: Pass

Please refer to following diagram for individual



Frequency (MHz)	Line	Reading(dBμV)		Limit(dBμV)	
		Quasi-peak	Average	Quasi-peak	Average
0.449	Neutral	37.32	30.62	56.89	46.89
2.019	Neutral	35.31	27.51	56.00	46.00

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B: Conducted Emission on Live Terminal (150kHz to 30MHz)

EUT Operating Environment

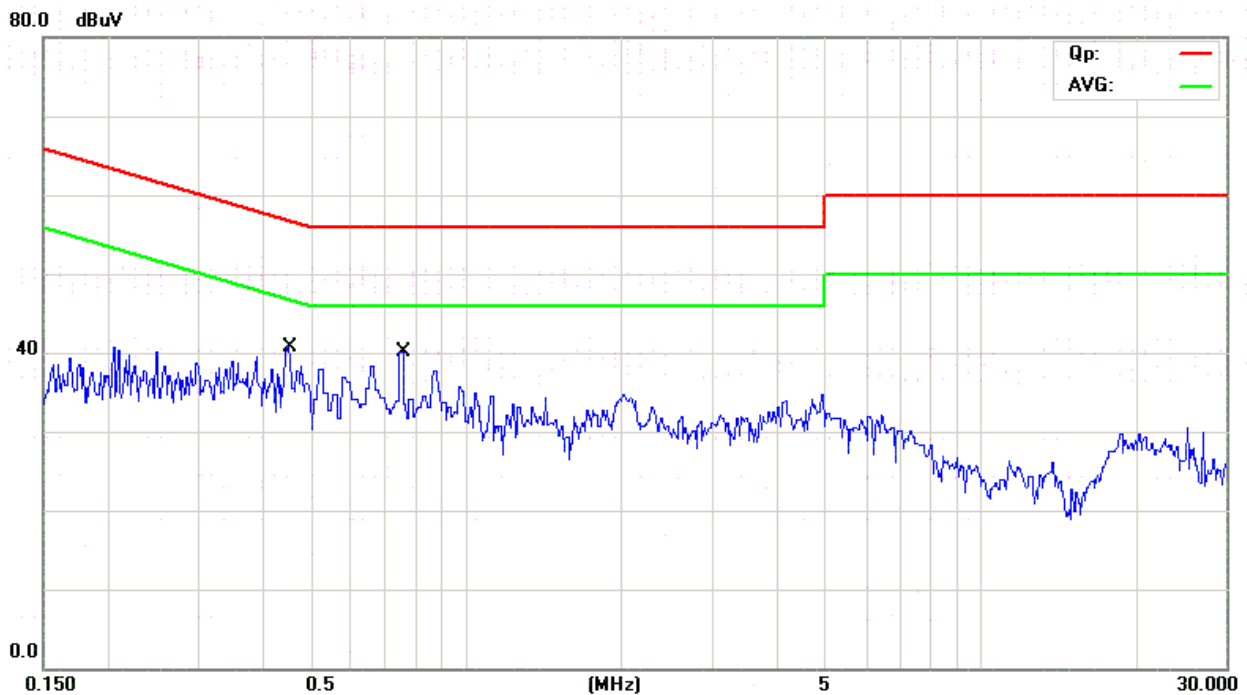
Temperature: 26°C Humidity: 65%RH Atmospheric Pressure: 101 kPa

EUT set Condition: Charging Mode (powered by PC)

Equipment Level: Class B

Results: Pass

Please refer to following diagram for individual



Frequency (MHz)	Line	Reading(dBμV)		Limit(dBμV)	
		Quasi-peak	Average	Quasi-peak	Average
0.444	Live	34.21	31.21	56.98	46.98
0.750	Live	26.64	16.64	56.00	46.00

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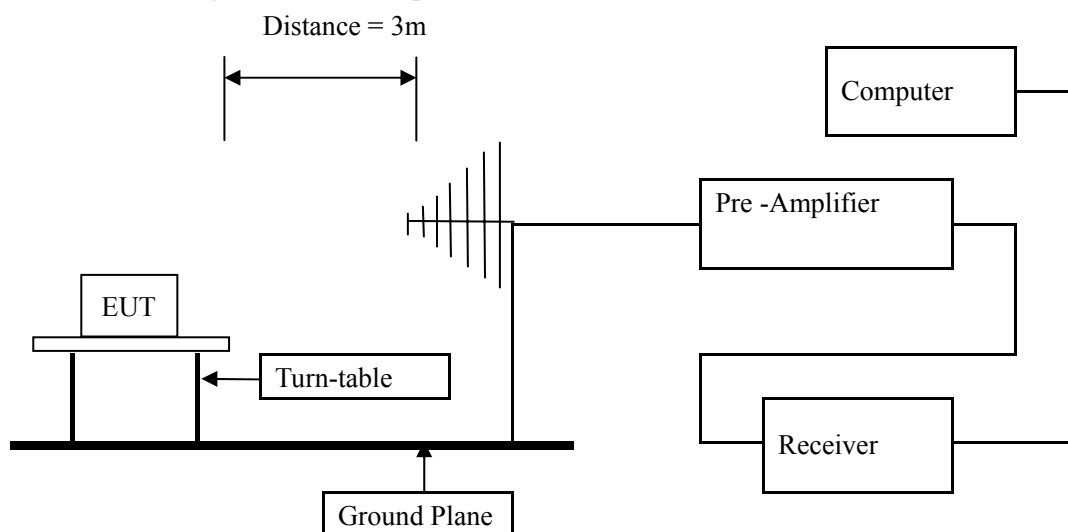
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6 Radiated Emission Test

6.1 Test Method and test Procedure:

- (1) The EUT was tested according to ANSI C63.4 –2003. The radiated test was performed at Timeway Laboratory. This site is on file with the FCC laboratory division, Registration No.899988
- (2) The EUT, peripherals were put on the turntable which table size is 1m x 1.5 m, table high 0.8 m. All set up is according to ANSI C63.4-2003.
- (3) The frequency spectrum from 30 MHz to 1 GHz was investigated. All readings from 30 MHz to 1 GHz are quasi-peak values with a resolution bandwidth of 120 kHz. For measurement above 1GHz, peak values with RBW=VBW=1MHz and PK detector. AV value with RBW=1MHz, VBW=10Hz and PK detector. Measurements were made at 3 meters.
- (4) The antenna high is varied from 1 m to 4 m high to find the maximum emission for each frequency.
- (5) Maximizing procedure was performed on the six (6) highest emissions to ensure EUT compliance is with all installation combinations. All data was recorded in the peak detection mode. Quasi-peak readings was performed only when an emission was found to be marginal (within -4 dB of specification limit), and are distinguished with a "QP" in the data table.
- (6) The antenna polarization: Vertical polarization and Horizontal polarization.

Block diagram of Test setup



6.2 Configuration of The EUT

Same as section 5.3 of this report

6.3 EUT Operating Condition

Same as section 5.4 of this report.

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6.4 Radiated Emission Limit

All emission from a digital device, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strength specified below:

Frequencies in restricted band are complied to limit on Paragraph 15.109. 15.209

Frequency Range (MHz)	Distance (m)	Field strength (dB μ V/m)
30-88	3	40.0
88-216	3	43.5
216-960	3	46.0
Above 960	3	54.0

- Note:
1. RF Voltage (dBuV) = 20 log RF Voltage (μ V)
 2. In the Above Table, the higher limit applies at the band edges.
 3. Distance refers to the distance in meters between the measuring instrument antenna and the EUT
 4. This is a handheld device. The radiated emissions should be tested under 3-axes position (Lying, Side, and Stand), After pre-test. It was found that the worse radiated emission was get at the lying position.
 5. Battery was fully charged during the radiated test.
 6. After pre-scan, GFSK modulation mode was the worse case and it was selected to conduct the radiated emission tests.

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Test result

General Radiated Emission Data and Harmonics Radiated Emission Data

Radiated Emission In Horizontal (30MHz---1000MHz)

EUT set Condition: Transmitting Mode (GFSK)

Results: **Pass**

Frequency (MHz)	Level@3m (dB μ V/m)	Antenna Polarity	Limit@3m (dB μ V/m)
--	--	H	--
51.825	27.69	V	40.00

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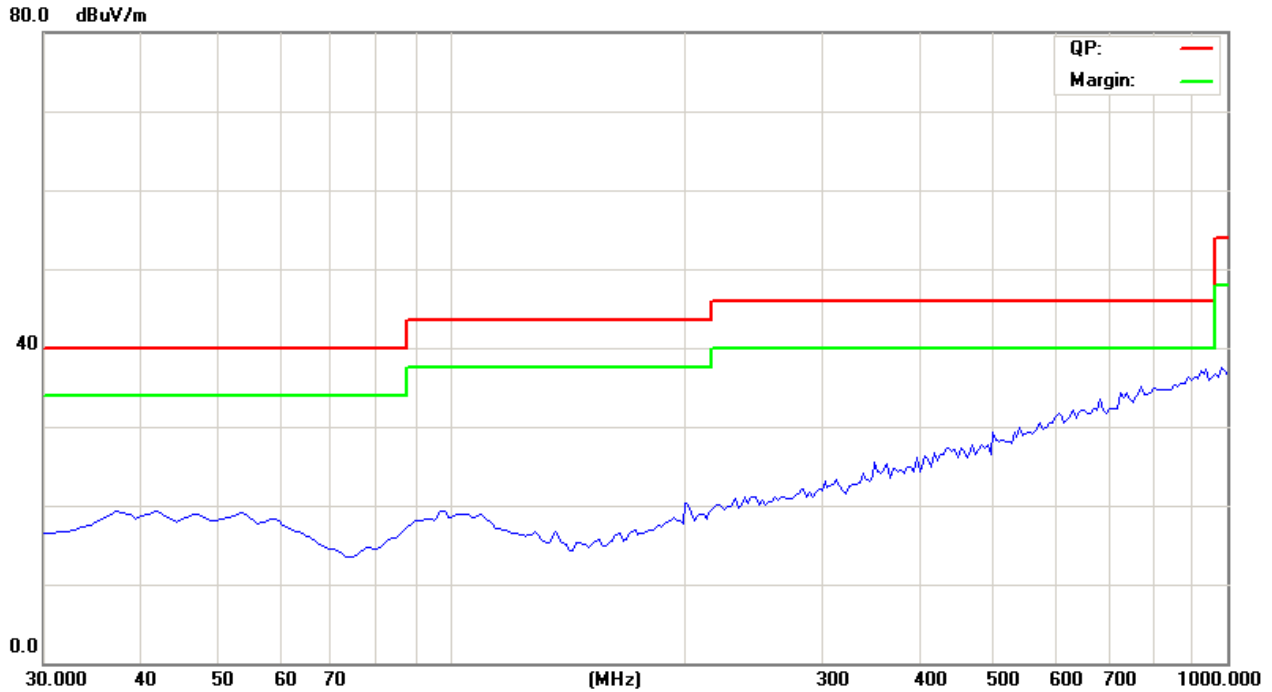
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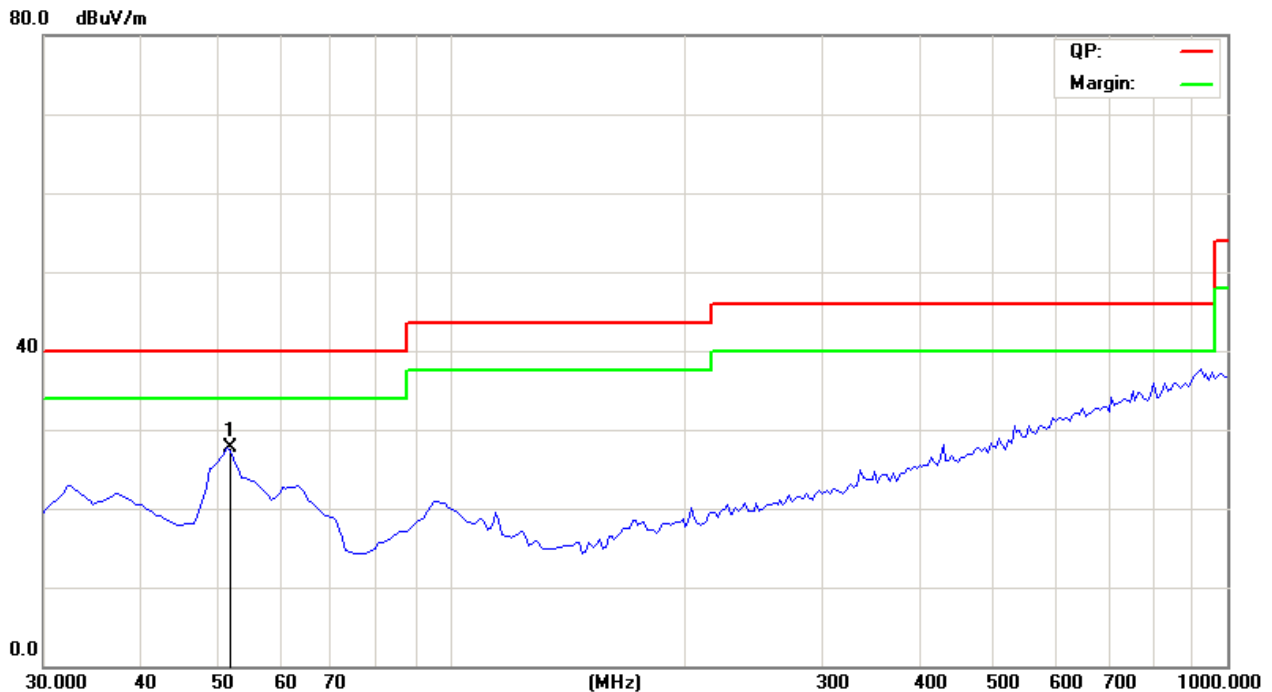


Test Figure: Transmitting mode

H



V



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Operation Mode: Transmitting under Low Channel (2402MHz)

Frequency (MHz)	Level@3m (dB μ V/m)	Antenna Polarity	Limit@3m (dB μ V/m)
2402	90.42 (PK)	V	Fundamental Frequency
2402	90.37 (PK)	H	
4804	--	H	74(Peak)/ 54(AV)
4804	--	V	74(Peak)/ 54(AV)
7206	--	H/V	74(Peak)/ 54(AV)
9608	--	H/V	74(Peak)/ 54(AV)
12010	--	H/V	74(Peak)/ 54(AV)
14412	--	H/V	74(Peak)/ 54(AV)
16814	--	H/V	74(Peak)/ 54(AV)
19216	--	H/V	74(Peak)/ 54(AV)
21618	--	H/V	74(Peak)/ 54(AV)
24020	--	H/V	74(Peak)/ 54(AV)

Note: 1. Level = Reading + AF + Cable - Preamp + Filter - Dist, Margin = Level - Limit
2. Remark "---" means that the emissions level is too low to be measured

Operation Mode: Transmitting g under Middle Channel (2441MHz)

Frequency (MHz)	Level@3m (dB μ V/m)	Antenna Polarity	Limit@3m (dB μ V/m)
2441	88.86 (PK)	H	Fundamental Frequency
2441	88.84 (PK)	V	
4882	--	H	74(Peak)/ 54(AV)
4882	--	V	74(Peak)/ 54(AV)
7323	--	H/V	74(Peak)/ 54(AV)
9764	--	H/V	74(Peak)/ 54(AV)
12205	--	H/V	74(Peak)/ 54(AV)
14646	--	H/V	74(Peak)/ 54(AV)
17087	--	H/V	74(Peak)/ 54(AV)
19528	--	H/V	74(Peak)/ 54(AV)
21969	--	H/V	74(Peak)/ 54(AV)
24410	--	H/V	74(Peak)/ 54(AV)

Note: 1. Level = Reading + AF + Cable - Preamp + Filter - Dist, Margin = Level - Limit
2. Remark "---" means that the emissions level is too low to be measured

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Operation Mode: Transmitting under High Channel

Frequency (MHz)	Level@3m (dB μ V/m)	Antenna Polarity	Limit@3m (dB μ V/m)
2480	89.48 (PK)	H	Fundamental Frequency
2480	89.32 (PK)	V	
4960	--	H	74(Peak)/ 54(AV)
4960	--	V	74(Peak)/ 54(AV)
7440	--	H/V	74(Peak)/ 54(AV)
9920	--	H/V	74(Peak)/ 54(AV)
12400	--	H/V	74(Peak)/ 54(AV)
14880	--	H/V	74(Peak)/ 54(AV)
17360	--	H/V	74(Peak)/ 54(AV)
19840	--	H/V	74(Peak)/ 54(AV)
22320	--	H/V	74(Peak)/ 54(AV)
24800	--	H/V	74(Peak)/ 54(AV)

Note: 1. Level = Reading + AF + Cable - Preamp + Filter - Dist, Margin = Level - Limit

2. Remark "---" means that the emissions level is too low to be measured

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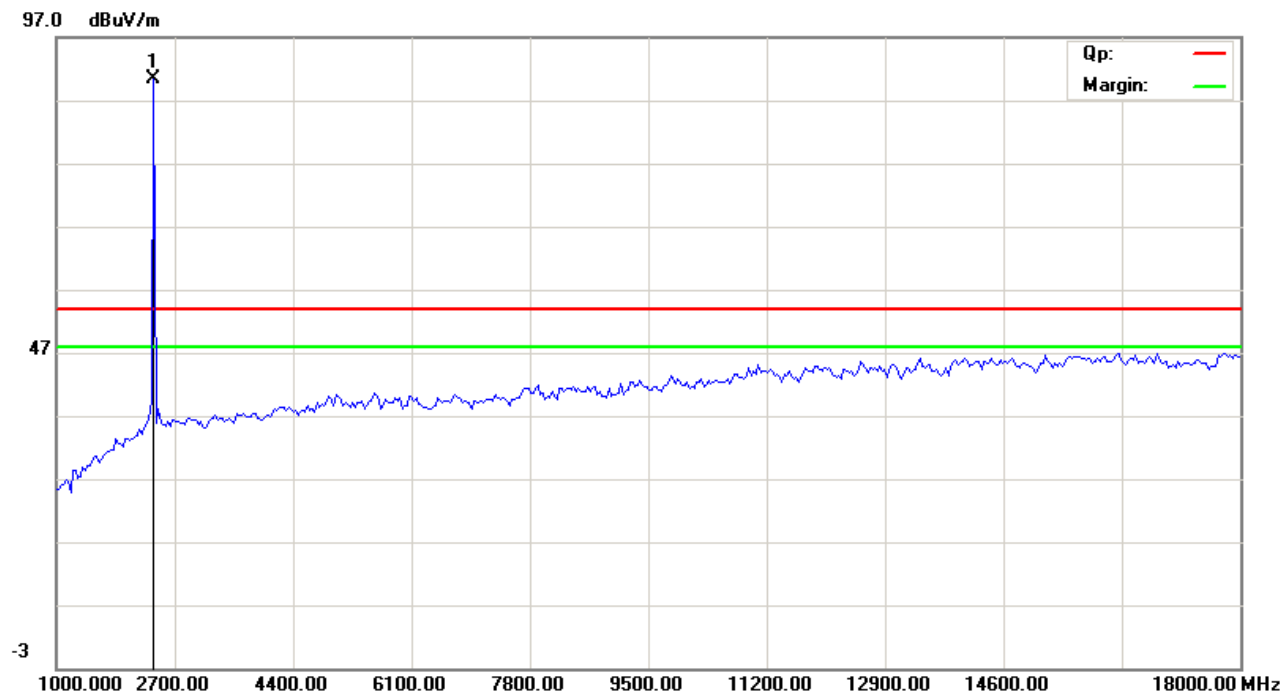
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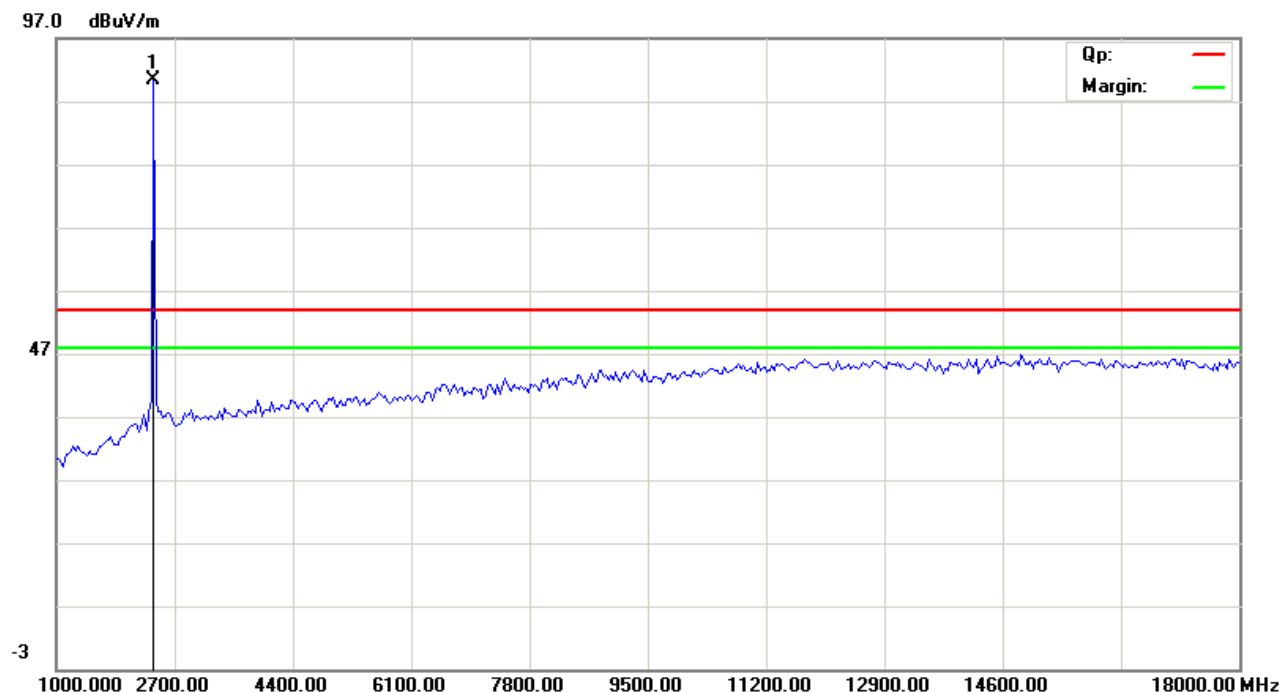


Please refer to the following test plots for details:

Low Channel: Vertical



Low Channel : Horizontal



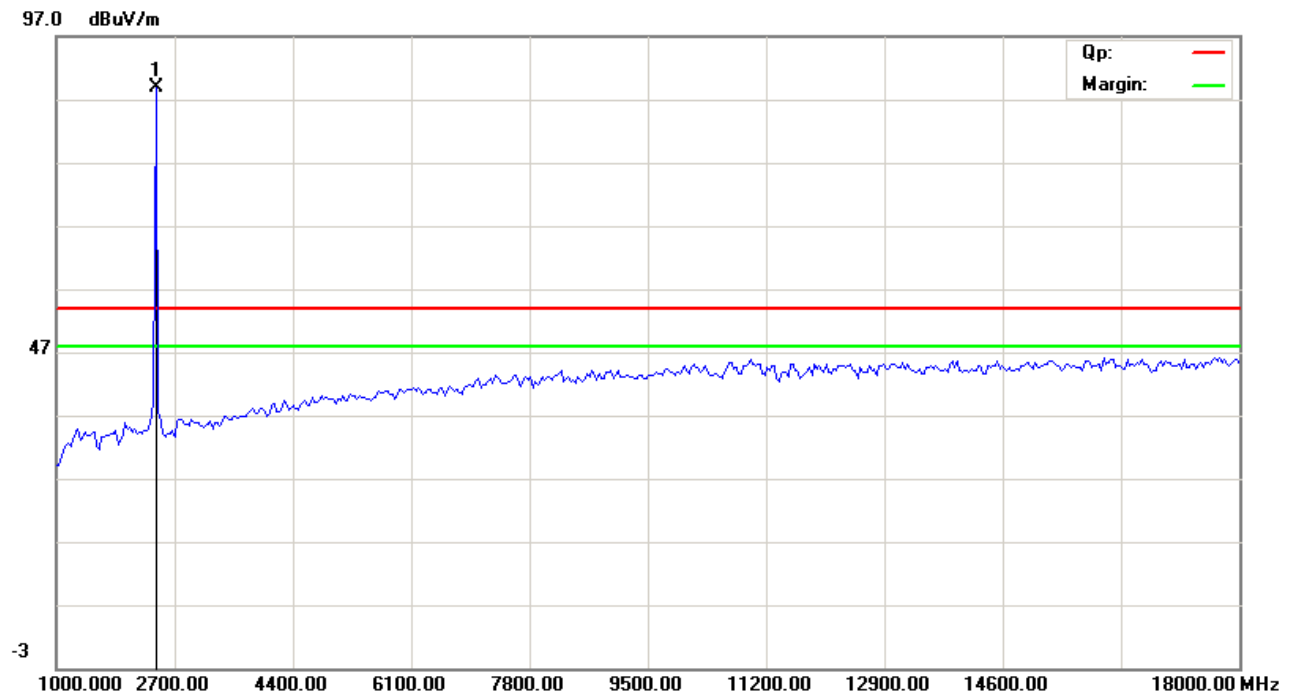
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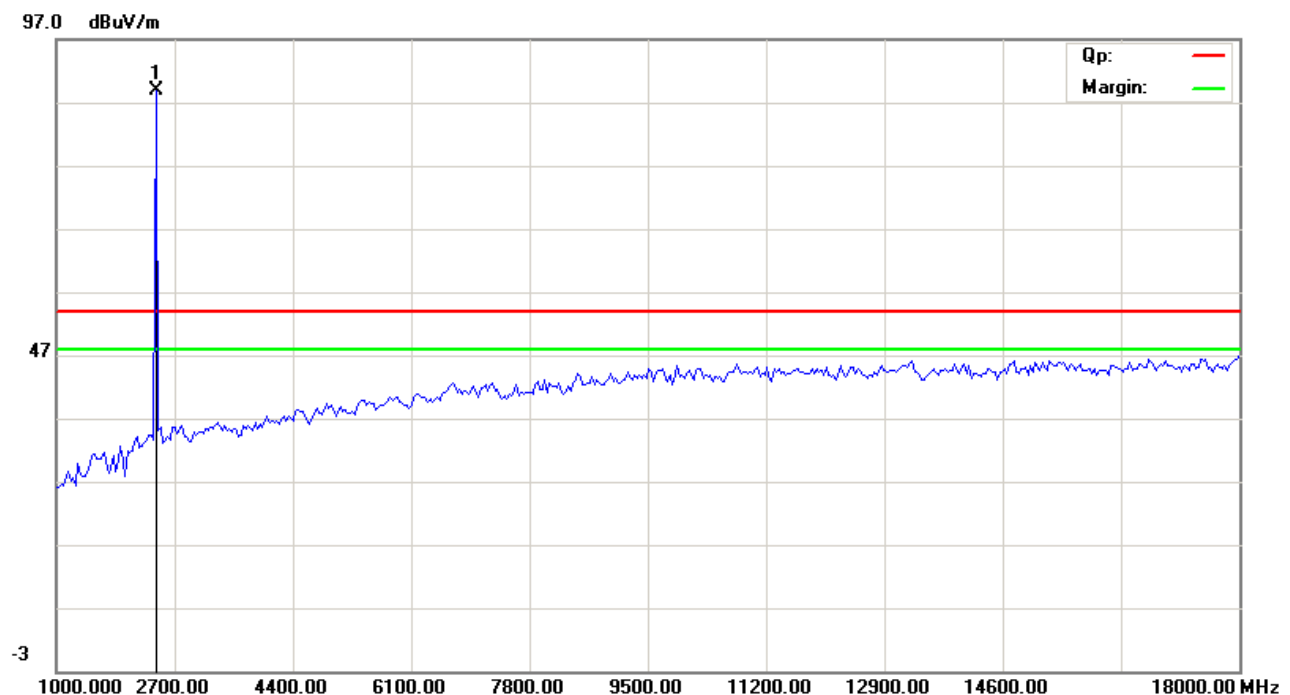
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Middle Channel : Horizontal



Middle Channel :: Vertical



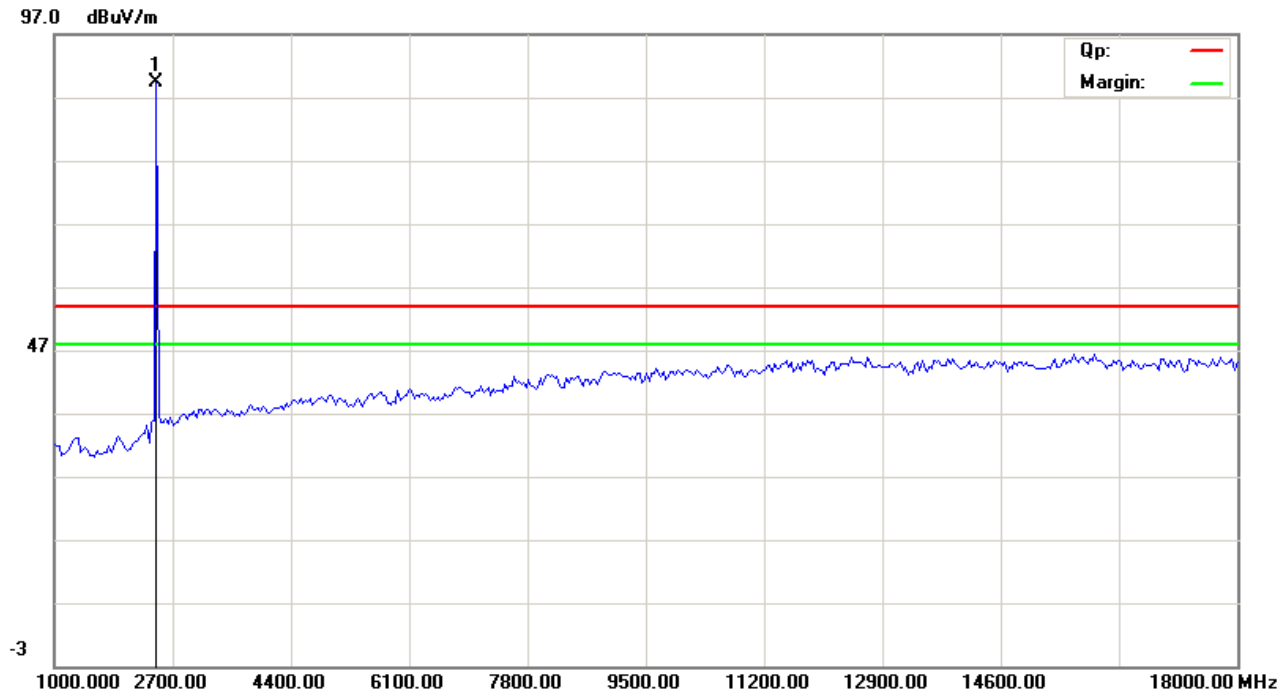
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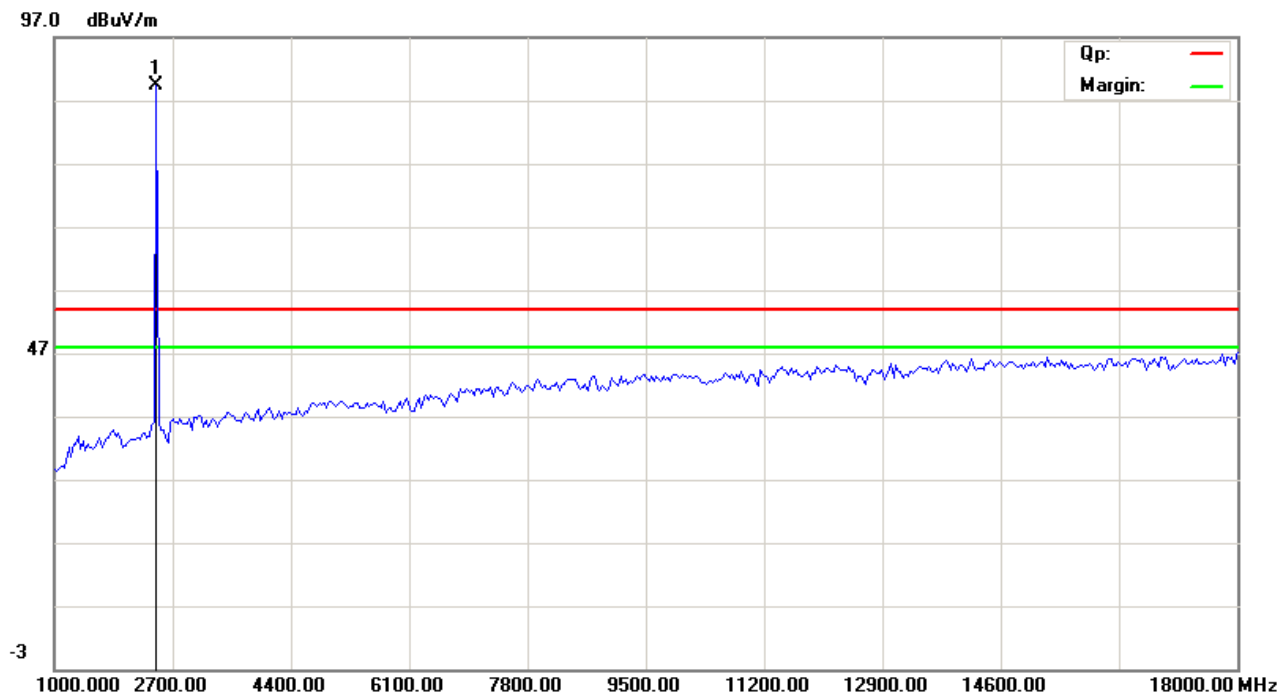
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High Channel : Horizontal



High Channel : Vertical



Note: For the radiated emissions from 18GHz-25GHz, it is the floor noise that meets the requirement of FCC rule.

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7.0 20dB Bandwidth Measurement

7.1 Regulation

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

7.2 Limits of 20dB Bandwidth Measurement

N/A

7.3 Test Procedure.

1. Check the calibration of the measuring instrument (spectrum analyzer) using either an internal calibrator or a known signal from an external generator.
2. Set the spectrum analyzer as follows: Span = 3MHz, RBW=30 kHz, VBW=100 kHz,
Sweep = auto Detector function = peak Trace = max hold
3. Measure the highest amplitude appearing on spectral display and record the level to calculate results. Repeat above procedures until all frequencies measured were complete.

7.4 Test Result:

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GFSK Modulation

EUT		Mushroom		Model		Mushroom	
Mode		Keep Transmitting		Input Voltage		DC3.7V	
Temperature		24 deg. C,		Humidity		56% RH	
Channel	Channel Frequency (MHz)	20 dB	Channel Bandwidth (kHz)	Maximum Limit (kHz)		Pass/ Fail	
Low	2402		852	--		Pass	
Middle	2441		846	--		Pass	
High	2480		864	--		Pass	

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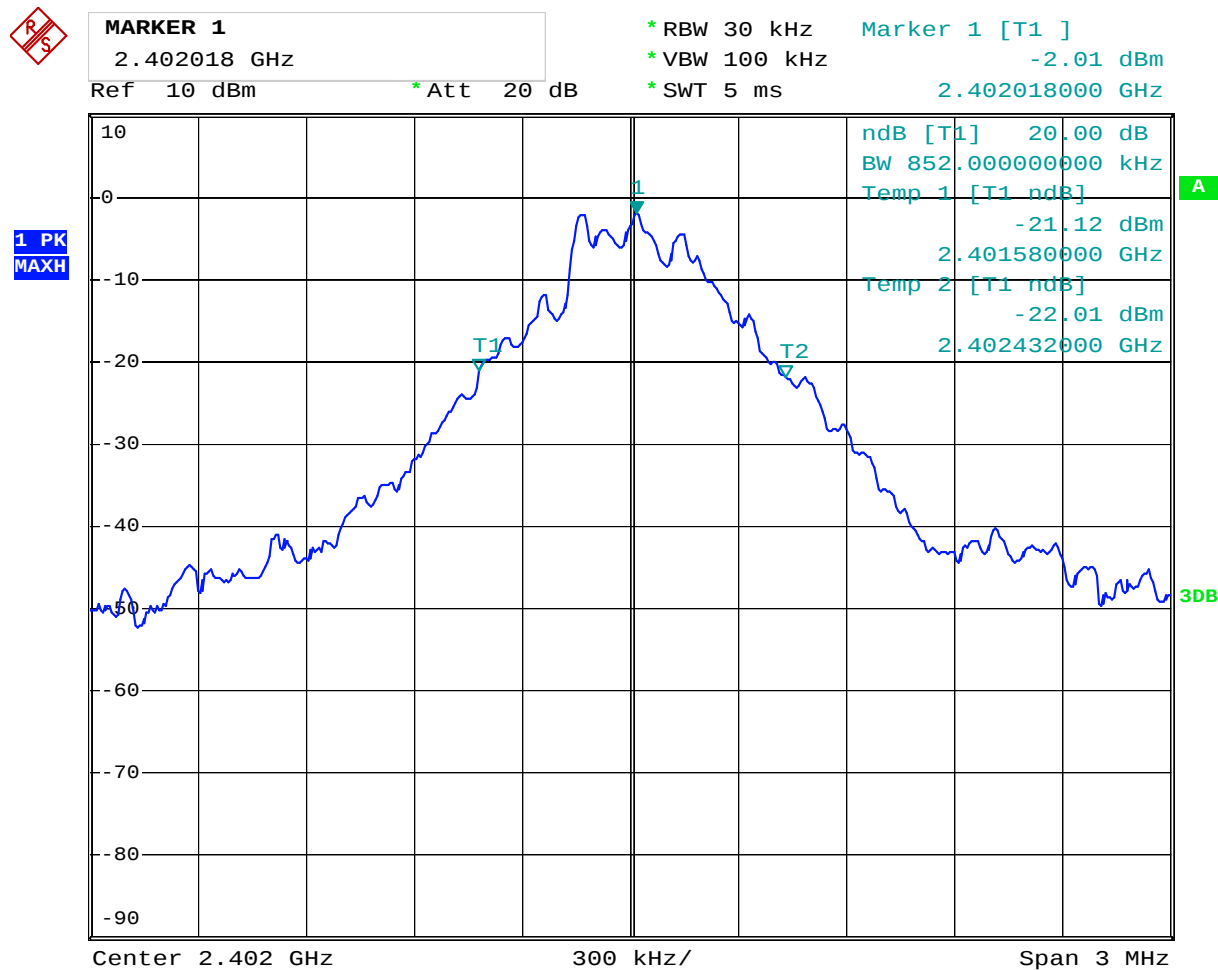
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Test Figure:

1. Condition: Low Channel



Date: 8.JAN.2014 17:53:32

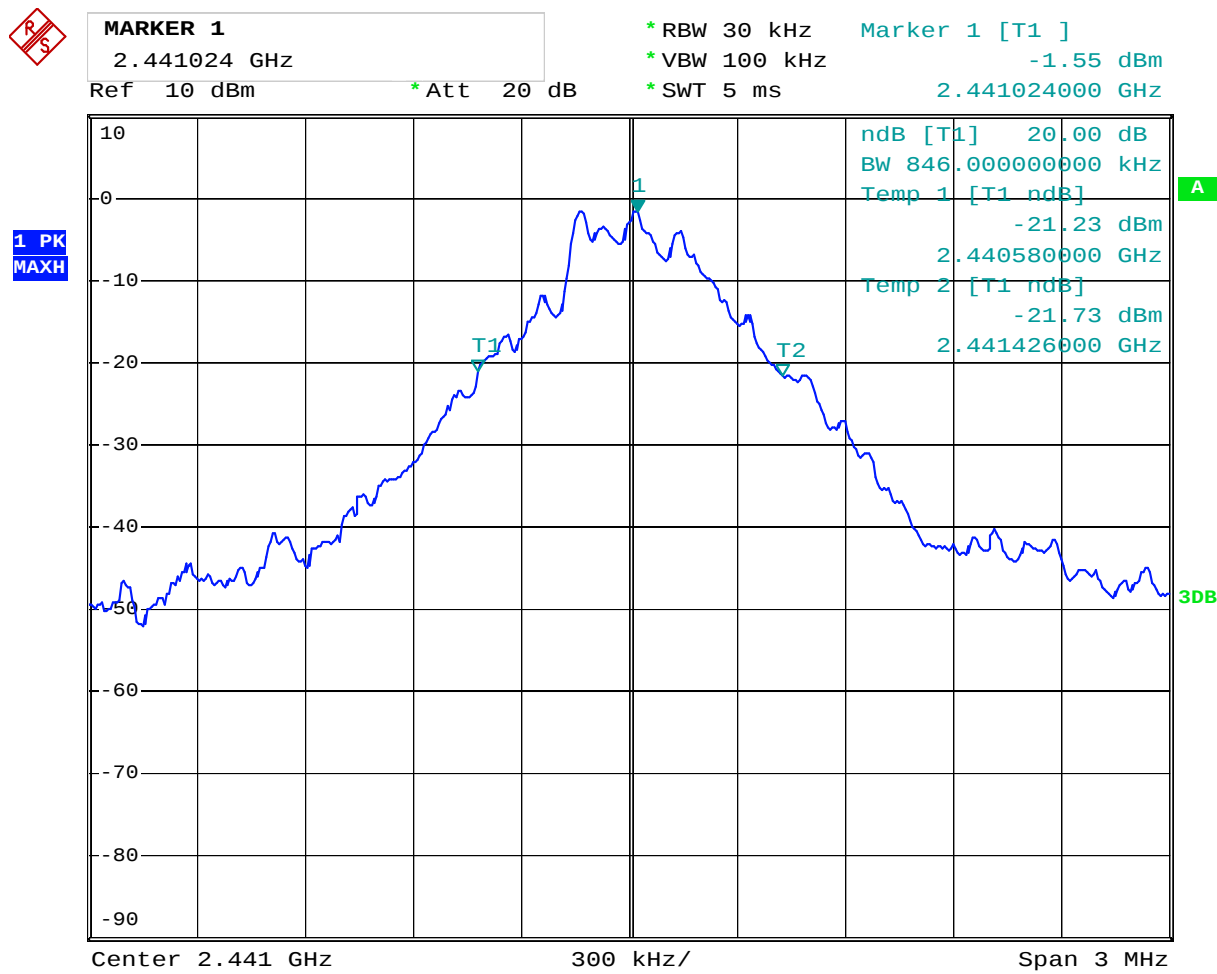
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2. Condition: Middle Channel



Date: 8.JAN.2014 17:54:20

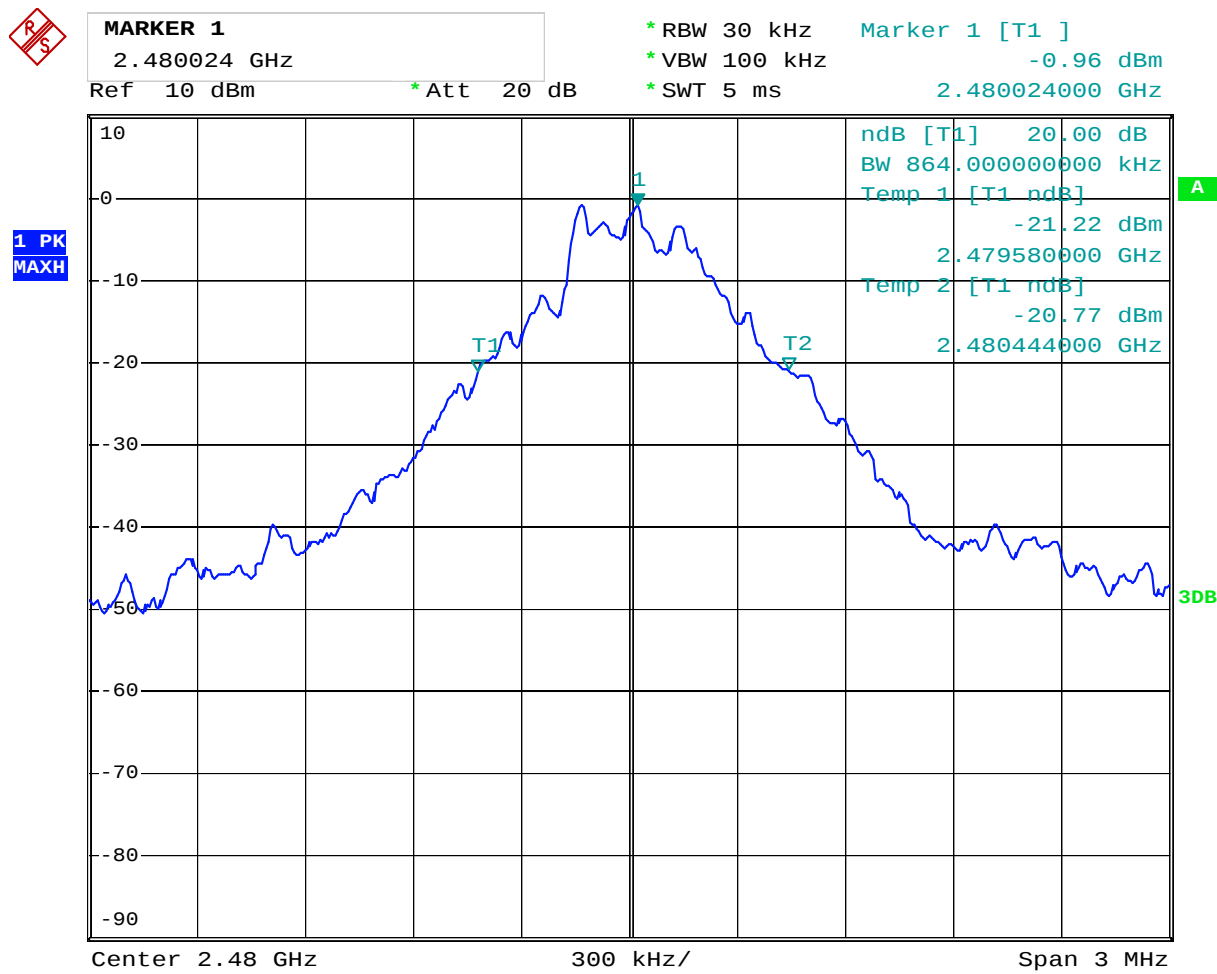
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3. Condition: High Channel



Date: 8.JAN.2014 17:55:05

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π/4QPSK Modulation

EUT		Mushroom		Model		Mushroom	
Mode		Keep Transmitting		Input Voltage		DC3.7V	
Temperature		24 deg. C,		Humidity		56% RH	
Channel	Channel Frequency (MHz)	20 dB	Channel Bandwidth (kHz)	Maximum Limit (kHz)		Pass/ Fail	
Low	2402		1254	--		Pass	
Middle	2441		1254	--		Pass	
High	2480		1242	--		Pass	

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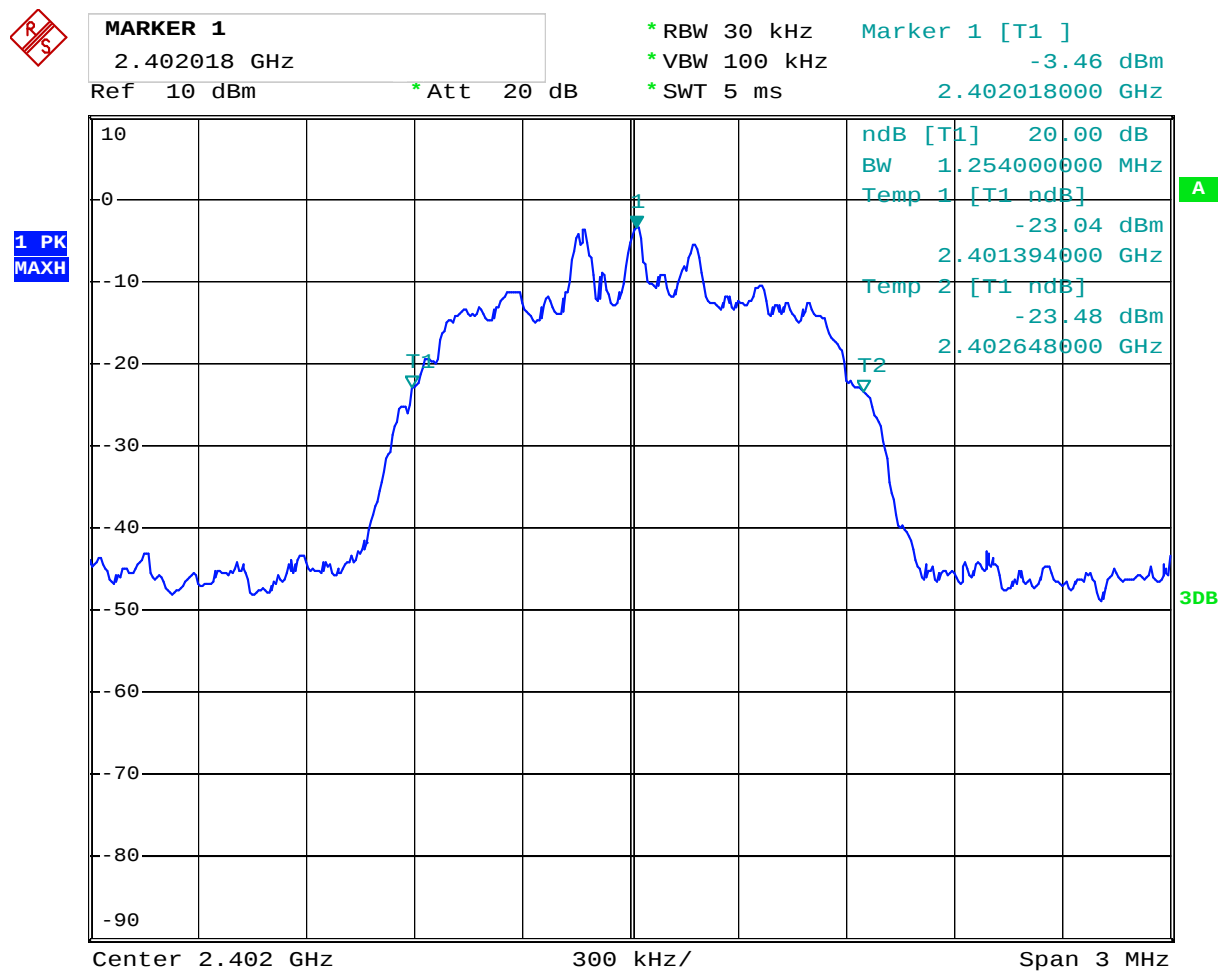
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Test Figure:

Low Channel



Date: 8. JAN. 2014 18:05:43

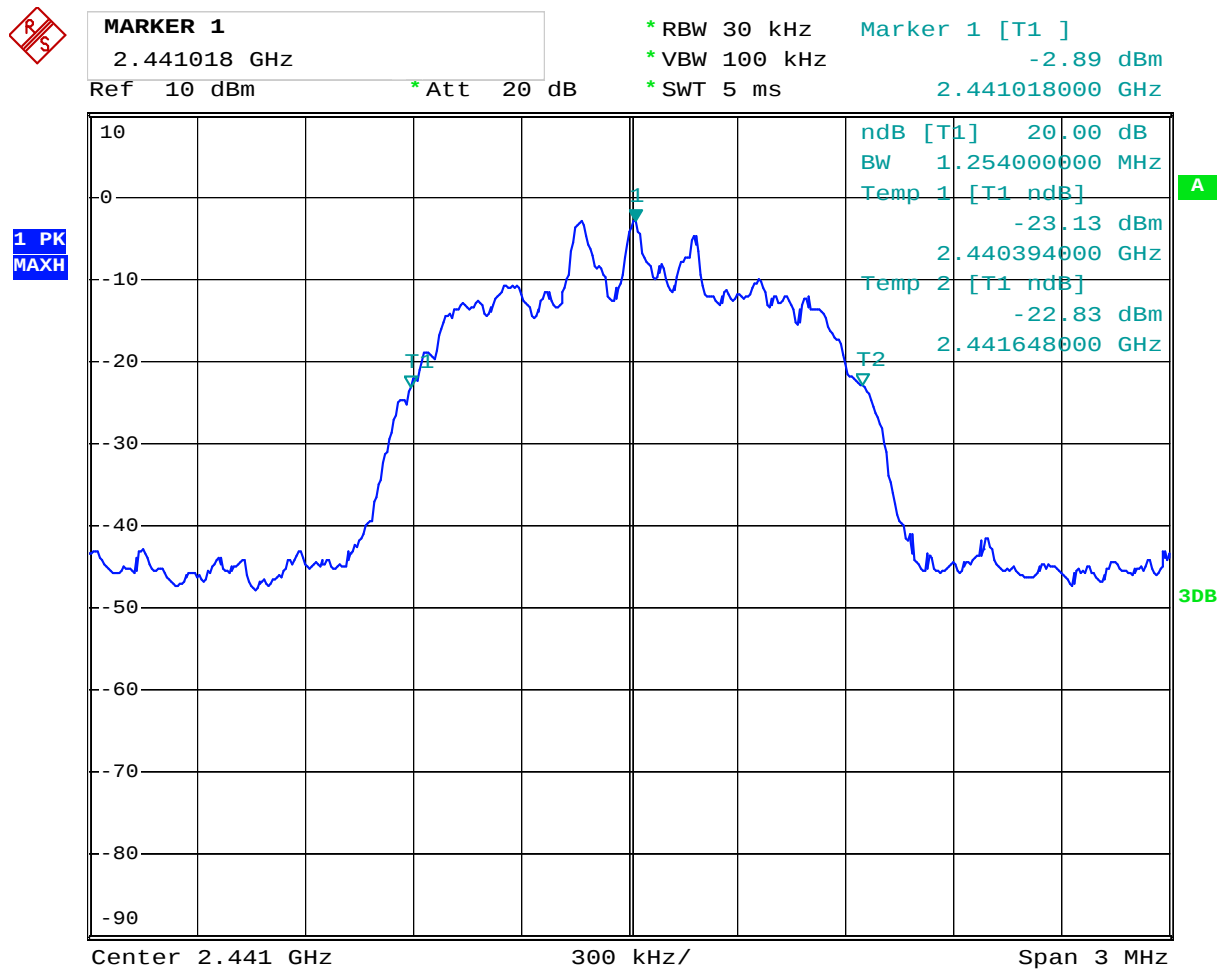
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Middle Channel



Date: 8.JAN.2014 18:06:29

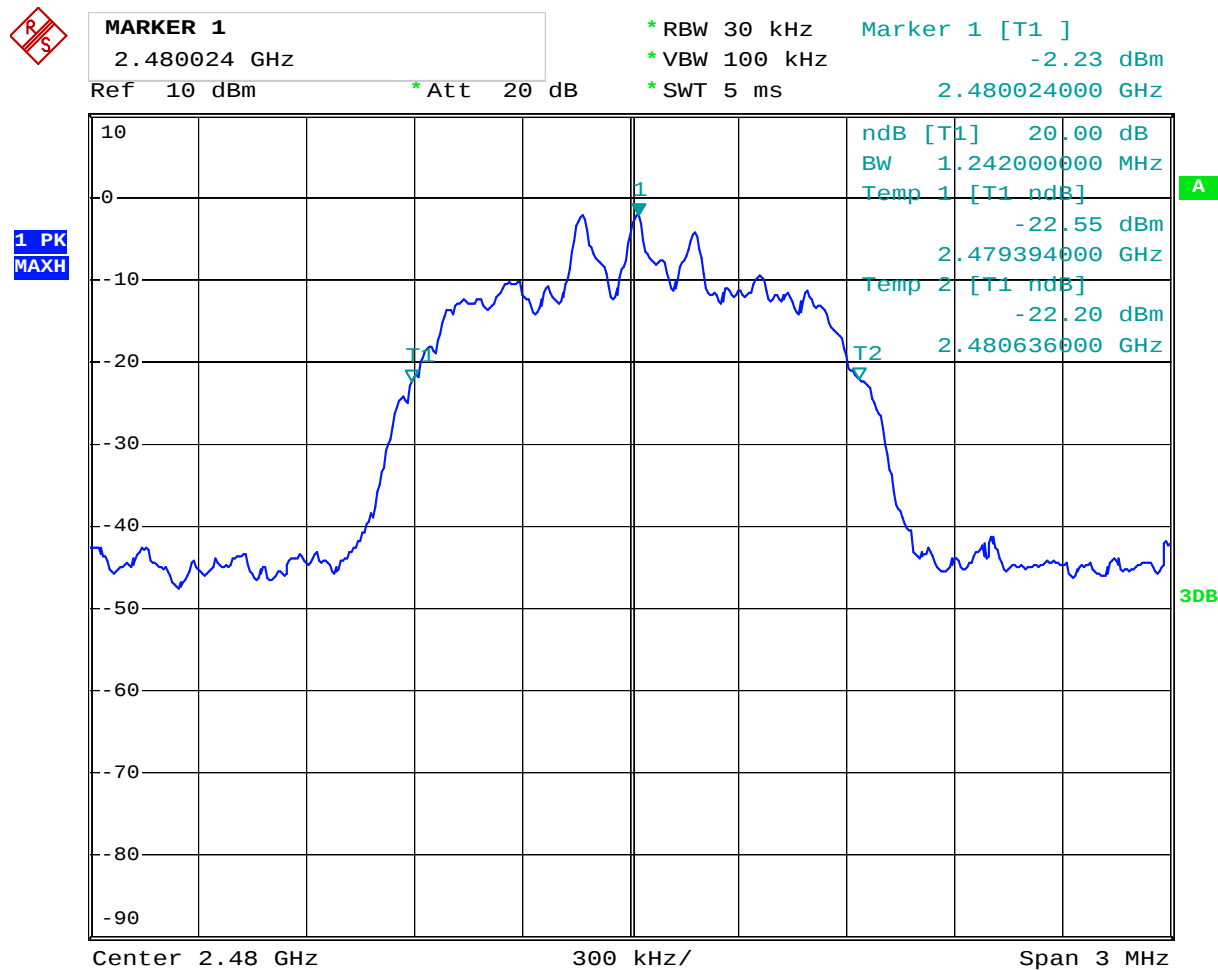
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High Channel



Date: 8.JAN.2014 18:07:26

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8DPSK Modulation

EUT		Mushroom		Model		Mushroom	
Mode		Keep Transmitting		Input Voltage		DC3.7V	
Temperature		24 deg. C,		Humidity		56% RH	
Channel	Channel Frequency (MHz)	20 dB	Channel Bandwidth (kHz)	Maximum Limit (kHz)		Pass/ Fail	
Low	2402		1266	--		Pass	
Middle	2441		1266	--		Pass	
High	2480		1266	--		Pass	

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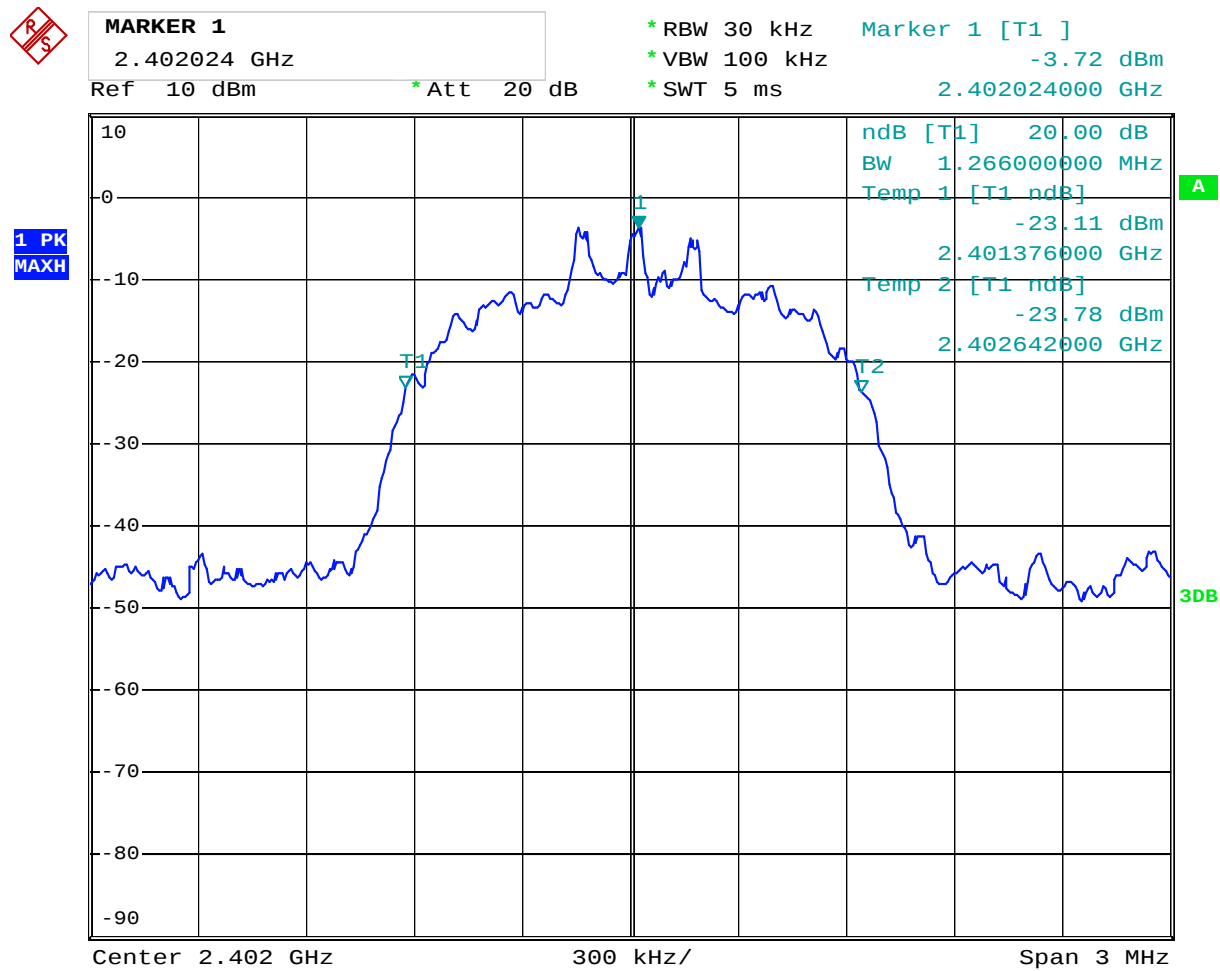
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Test Figure:

Low Channel



Date: 8. JAN. 2014 18:09:21

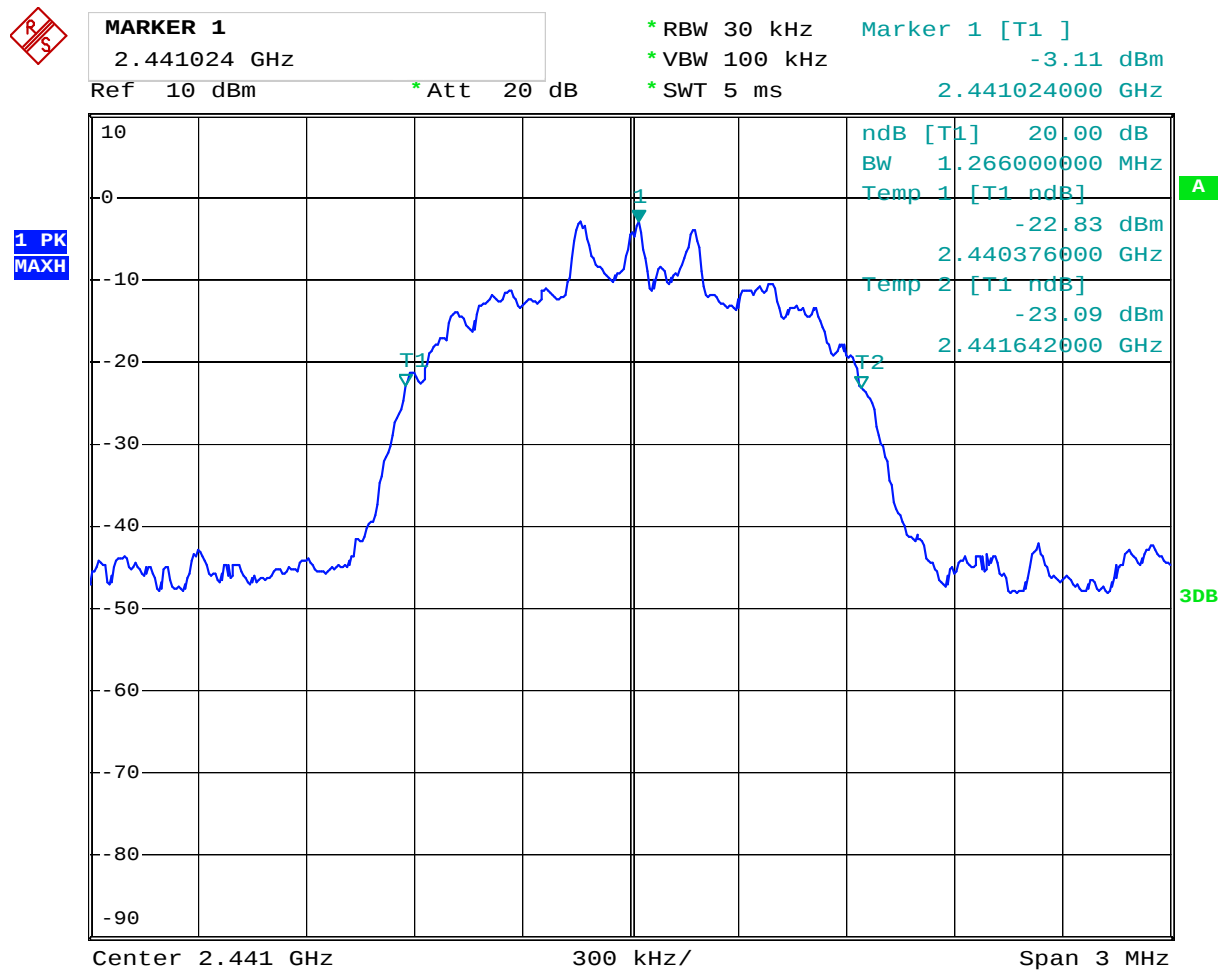
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Middle Channel



Date: 8.JAN.2014 18:08:42

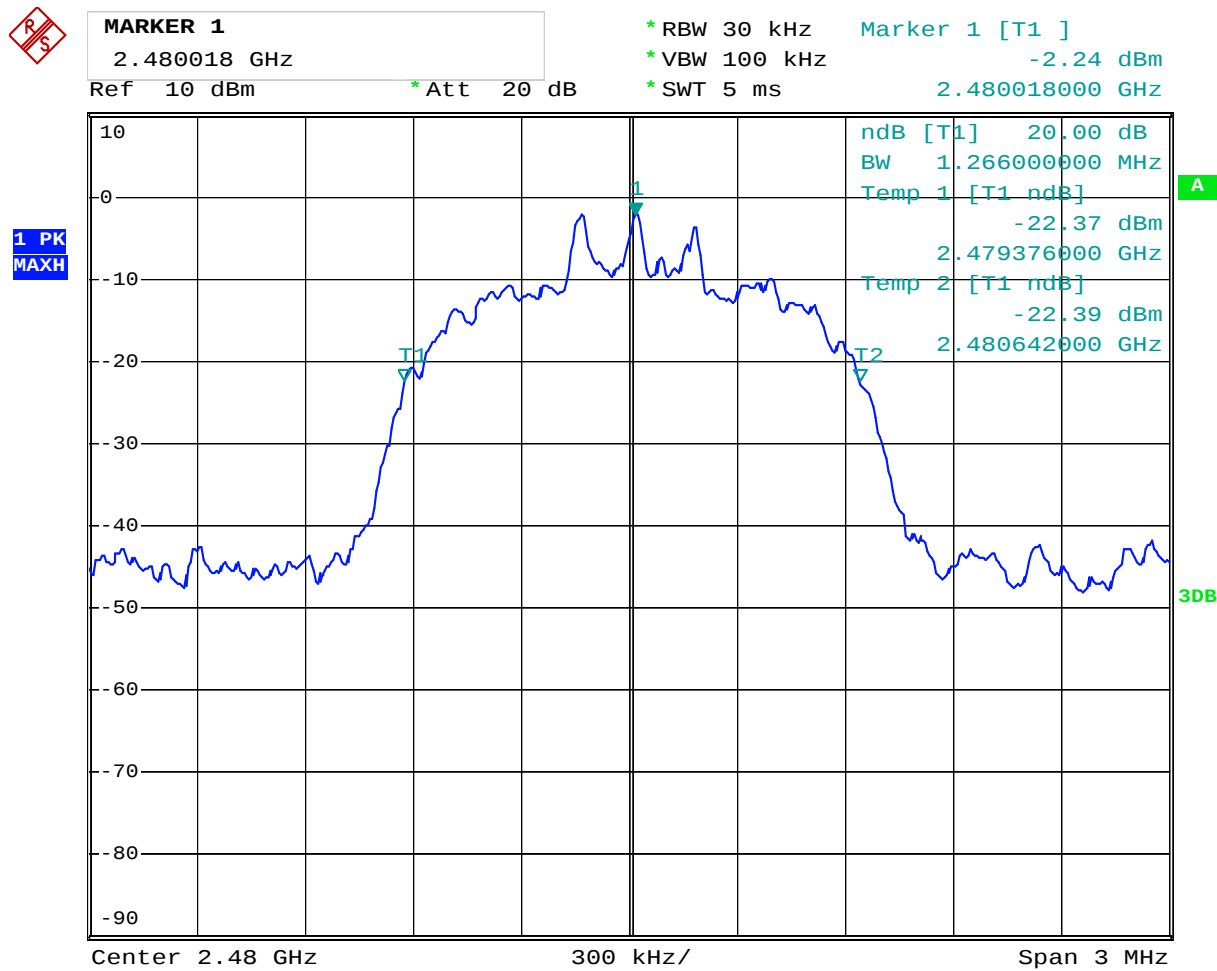
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High Channel



Date: 8.JAN.2014 18:08:07

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8. Maximum Peak Output Power

8.1 Regulation

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 2400-2483.5MHz band:0.125 watts. According to §15.247(b)(4), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

8.2 Limits of Maximum Peak Output Power

The Maximum Peak Output Power Measurement is 30dBm.

8.3 Test Procedure

1. Check the calibration of the measuring instrument (spectrum analyzer) using either an internal calibrator or a known signal from an external generator.
2. Set the spectrum analyzer as follows: 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
3. Measure the highest amplitude appearing on spectral display and record the level to calculate results.
4. Repeat above procedures until all frequencies measured were complete.

8.4Test Results (GFSK MODE)

EUT	Mushroom		Model	Mushroom	
Mode	Keep Transmitting		Input Voltage	DC3.7V	
Temperature	24 deg. C,		Humidity	56% RH	
Channel	Channel Frequency (MHz)	Peak Power Output (dBm)	Peak Power Limit (dBm)	Pass/ Fail	
Low	2402	0.08	30	Pass	
Middle	2441	0.57	30	Pass	
High	2480	1.12	30	Pass	

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8.5 Test Results (II/4QPSK MODE)

EUT		Mushroom	Model	Mushroom
Mode		Keep Transmitting	Input Voltage	DC3.7V
Temperature		24 deg. C,	Humidity	56% RH
Channel	Channel Frequency (MHz)	Peak Power Output (dBm)	Peak Power Limit (dBm)	Pass/ Fail
Low	2402	-1.20	30	Pass
Middle	2441	-0.74	30	Pass
High	2480	-0.25	30	Pass

8.6 Test Results (8DPSK MODE)

EUT		Mushroom	Model	Mushroom
Mode		Keep Transmitting	Input Voltage	DC3.7V
Temperature		24 deg. C,	Humidity	56% RH
Channel	Channel Frequency (MHz)	Peak Power Output (dBm)	Peak Power Limit (dBm)	Pass/ Fail
Low	2402	-0.96	30	Pass
Middle	2441	-0.47	30	Pass
High	2480	0.14	30	Pass

Note: the result basic equation calculation as follow:

$$\text{Peak Power Output} = \text{Peak Power Reading} + \text{Cable loss} + \text{Attenuator}$$

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9. Carrier Frequency Separation

9.1 Regulation

According to §15.247(a)(1), frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

9.2 Limits of Carrier Frequency Separation

The Maximum Power Spectral Density Measurement is 25kHz or two-thirds of the 20dB bandwidth of the hopping Channel which is great.

9.3 Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Set the spectrum analyzer as follows: 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
3. Measure the separation between the peaks of the adjacent channels using the marker-delta function.
4. Repeat above procedures until all frequencies measured were complete.

9.4 Test Result

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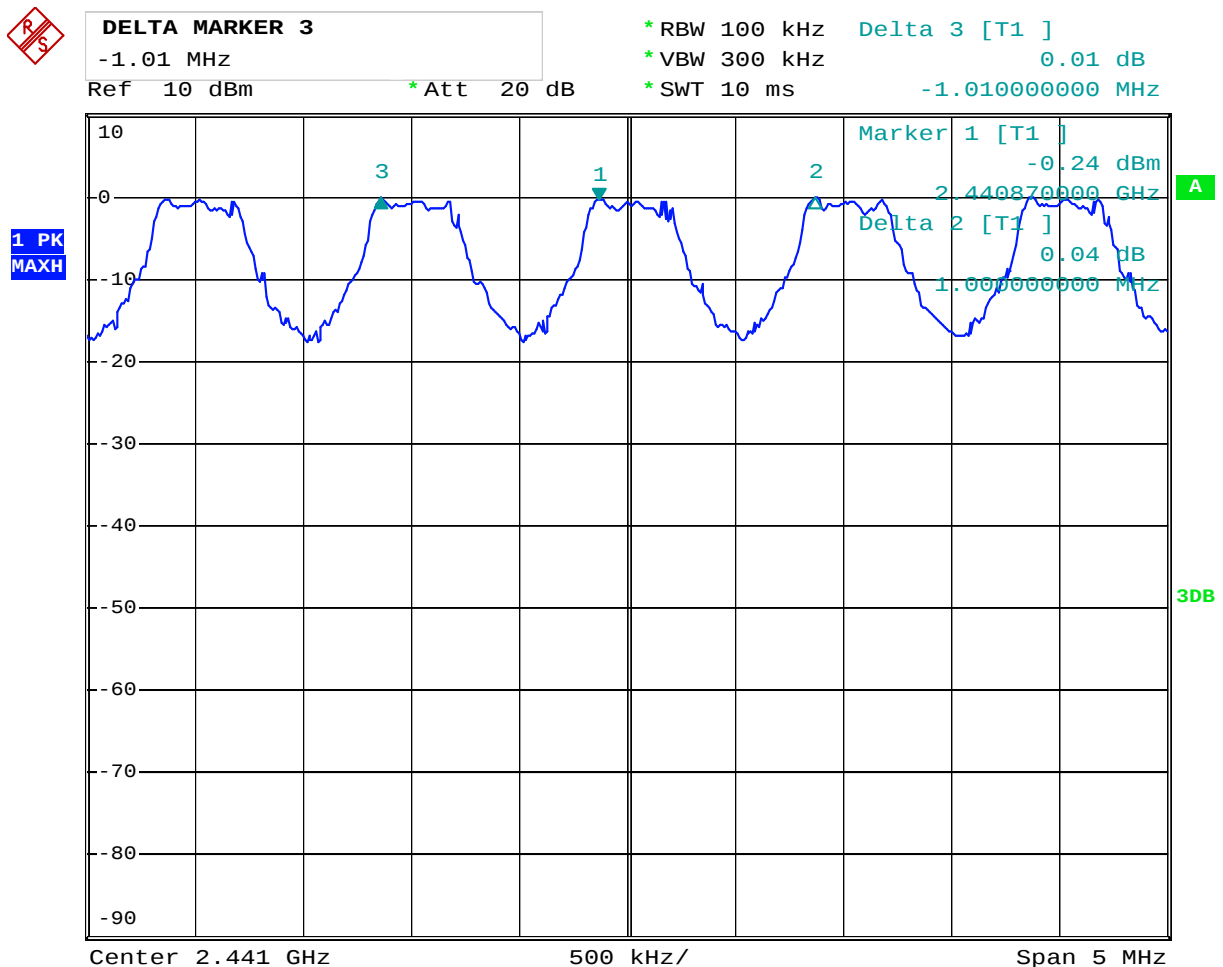


GFSK Modulation

EUT		Mushroom	Model	Mushroom
Mode		Hopping On	Input Voltage	DC3.7V
Temperature		24 deg. C,	Humidity	56% RH
Channel	Channel Frequency (MHz)	Carrier Frequency Separation	Limit	Pass/ Fail
Middle	2441	1.000MHz	≥ 25 kHz or two-thirds of 20 dB bandwidth	Pass

Test Plots

Middle Channel



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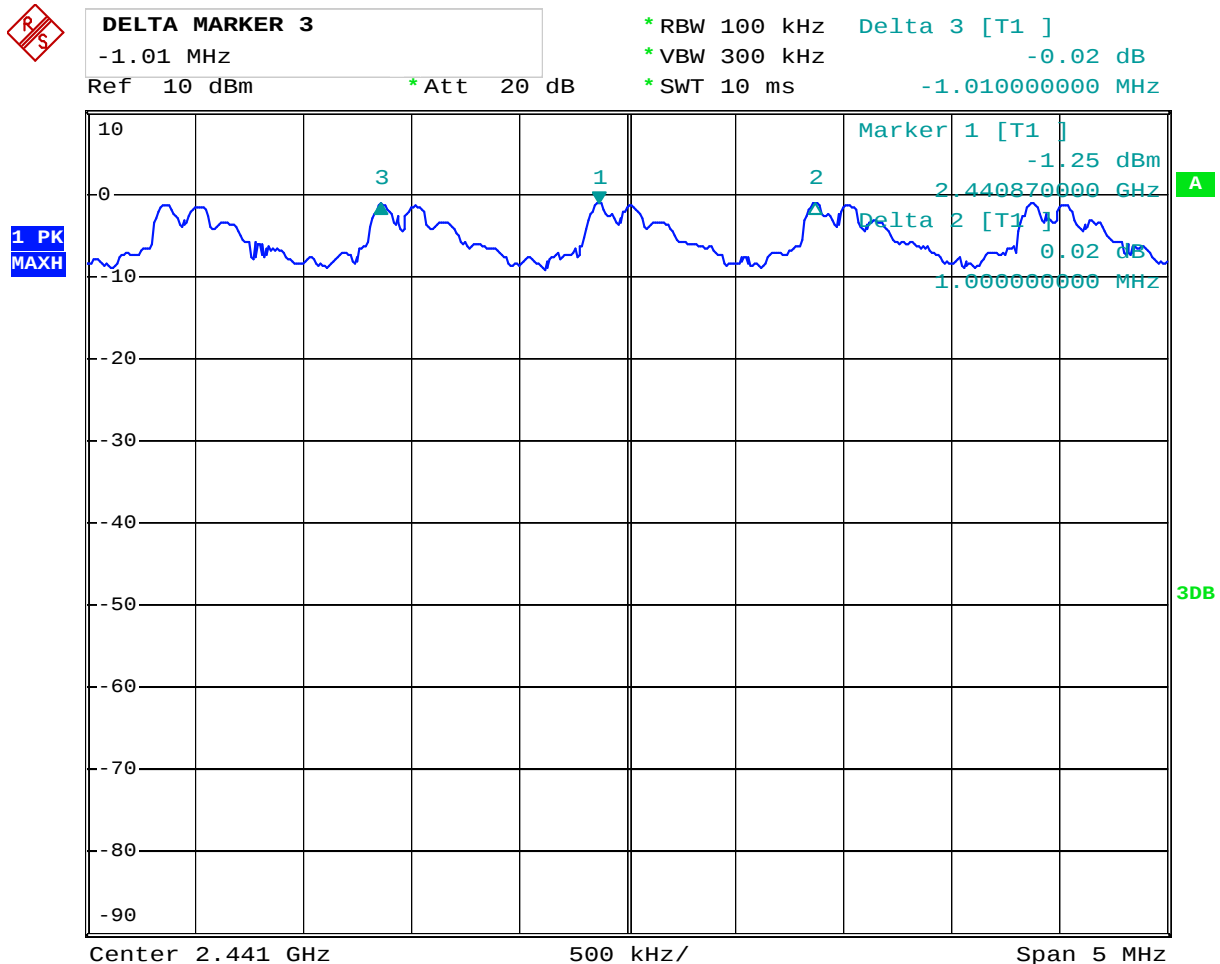


π/4QPSK Modulation

EUT		Mushroom	Model	Mushroom
Mode		Hopping On	Input Voltage	DC3.7V
Temperature		24 deg. C,	Humidity	56% RH
Channel	Channel Frequency (MHz)	Carrier Frequency Separation	Limit	Pass/ Fail
Middle	2441	1.000MHz	≥ 25 kHz or two-thirds of 20 dB bandwidth	Pass

Test Plots

Middle Channel



Date: 8. JAN. 2014 17:19:25

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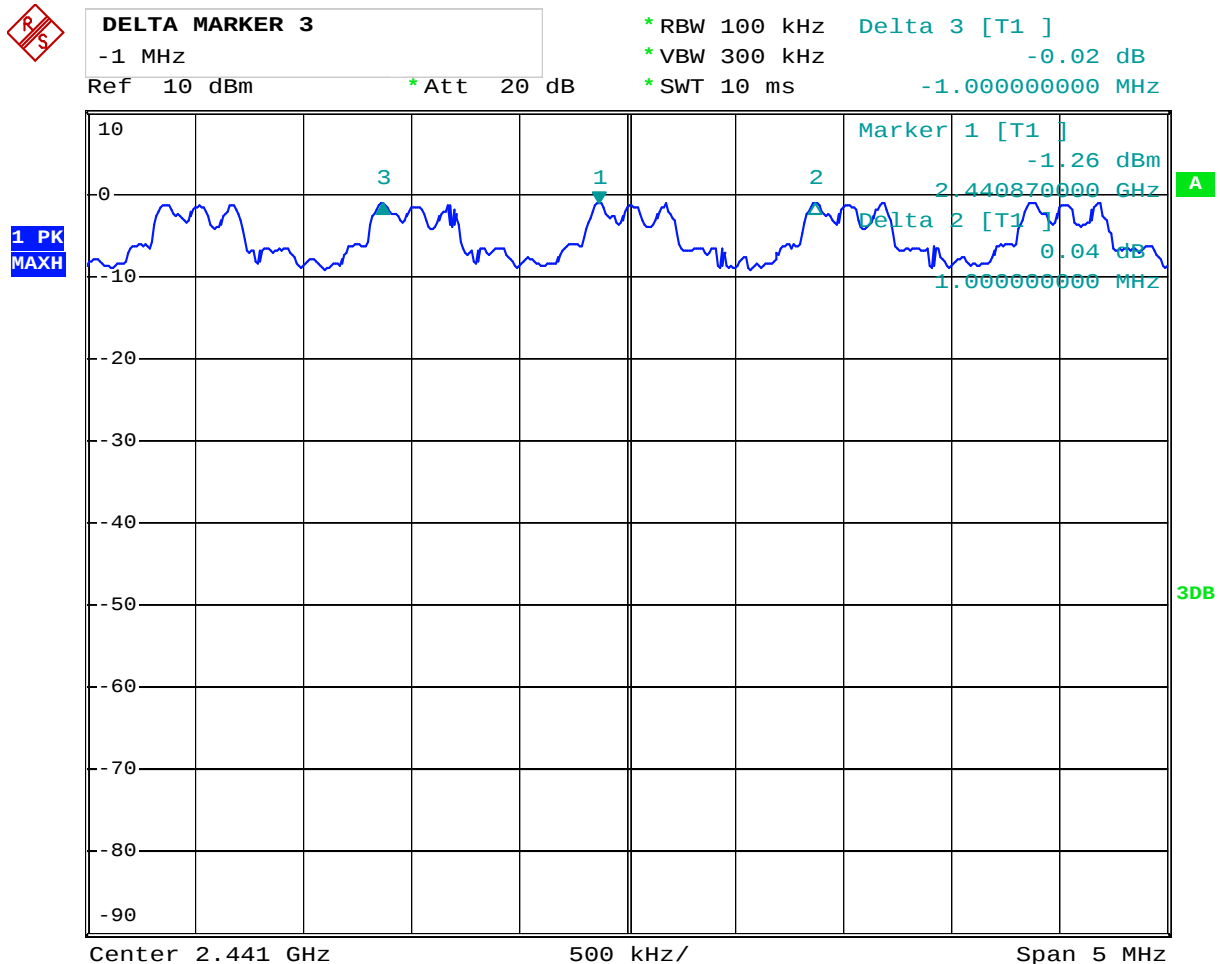


8DPSK Modulation

EUT		Mushroom	Model	Mushroom
Mode		Hopping On	Input Voltage	DC3.7V
Temperature		24 deg. C,	Humidity	56% RH
Channel	Channel Frequency (MHz)	Carrier Frequency Separation	Limit	Pass/ Fail
Middle	2441	1.000MHz	≥ 25 kHz or two-thirds of 20 dB bandwidth	Pass

Test Plots

Middle Channel



Date: 8. JAN. 2014 17:13:56

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10. Number of Hopping Channels

10.1 Regulation

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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used. 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.

10.2 Limits of Number of Hopping Channels

The frequency hopping systems in the 2400-2483.5MHz band shall use at least 15 channels.

10.3 Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Set the spectrum analyzer as follows: Span = the frequency band of operation; $RBW \geq 1\%$ of the span; $VBW \geq RBW$; Sweep = auto; Detector function = peak; Trace = max hold
3. Record the number of hopping channels.

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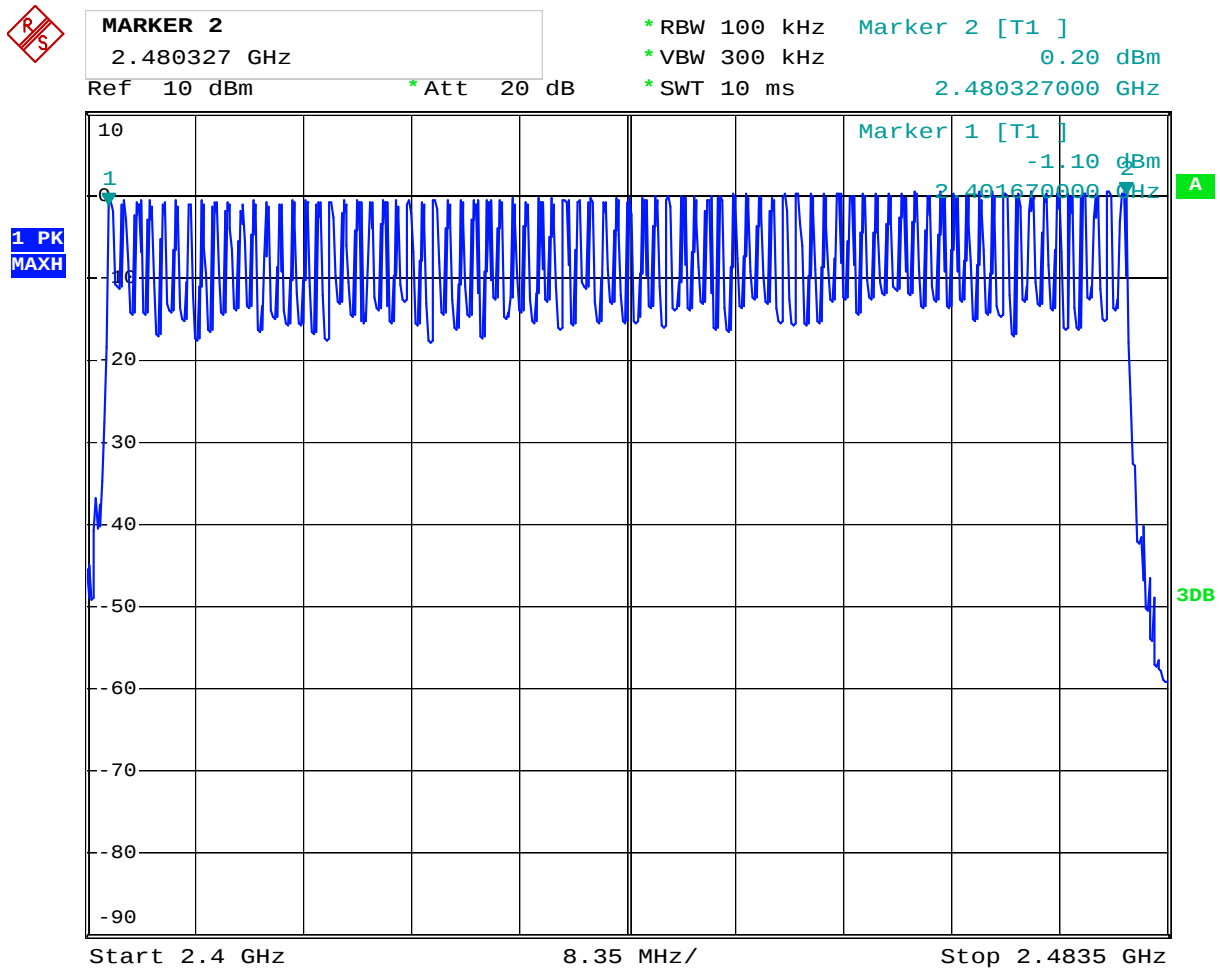
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10.4 Test Result (GFSK MODE)

EUT	Mushroom	Model	Mushroom
Mode	Hopping On	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH
Operating Frequency	Number of hopping channels	Limit	Pass/ Fail
2402-2480MHz	79	≥ 15	Pass

Test Plot (GFSK MODE)



Date: 8.JAN.2014 16:04:03

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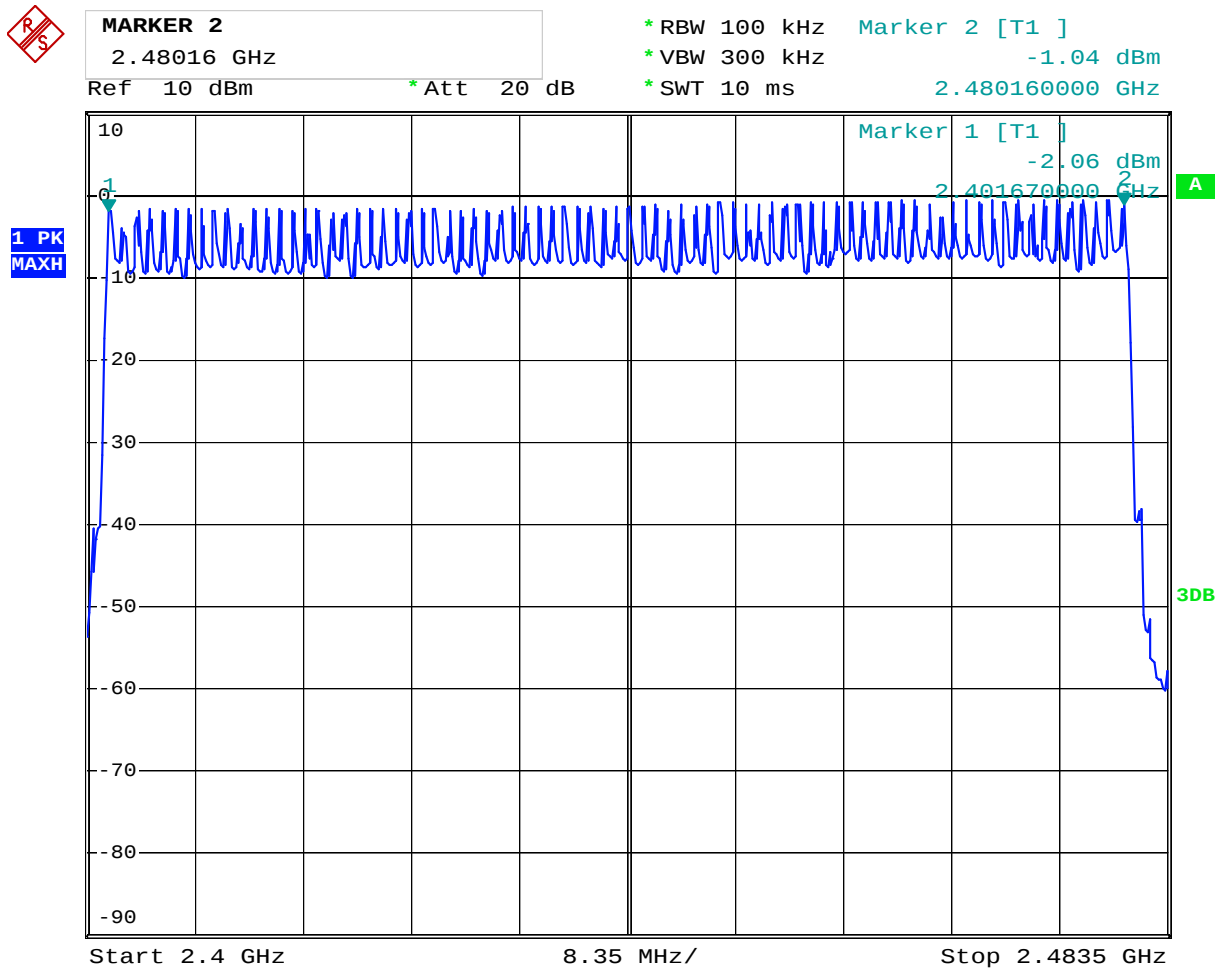
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10.5 Test Result (Π/4QPSK MODE)

EUT	Mushroom	Model	Mushroom
Mode	Hopping On	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH
Operating Frequency	Number of hopping channels	Limit	Pass/ Fail
2402-2480MHz	79	≥ 15	Pass

Test Plot (Π/4QPSK MODE)



Date: 8.JAN.2014 17:01:18

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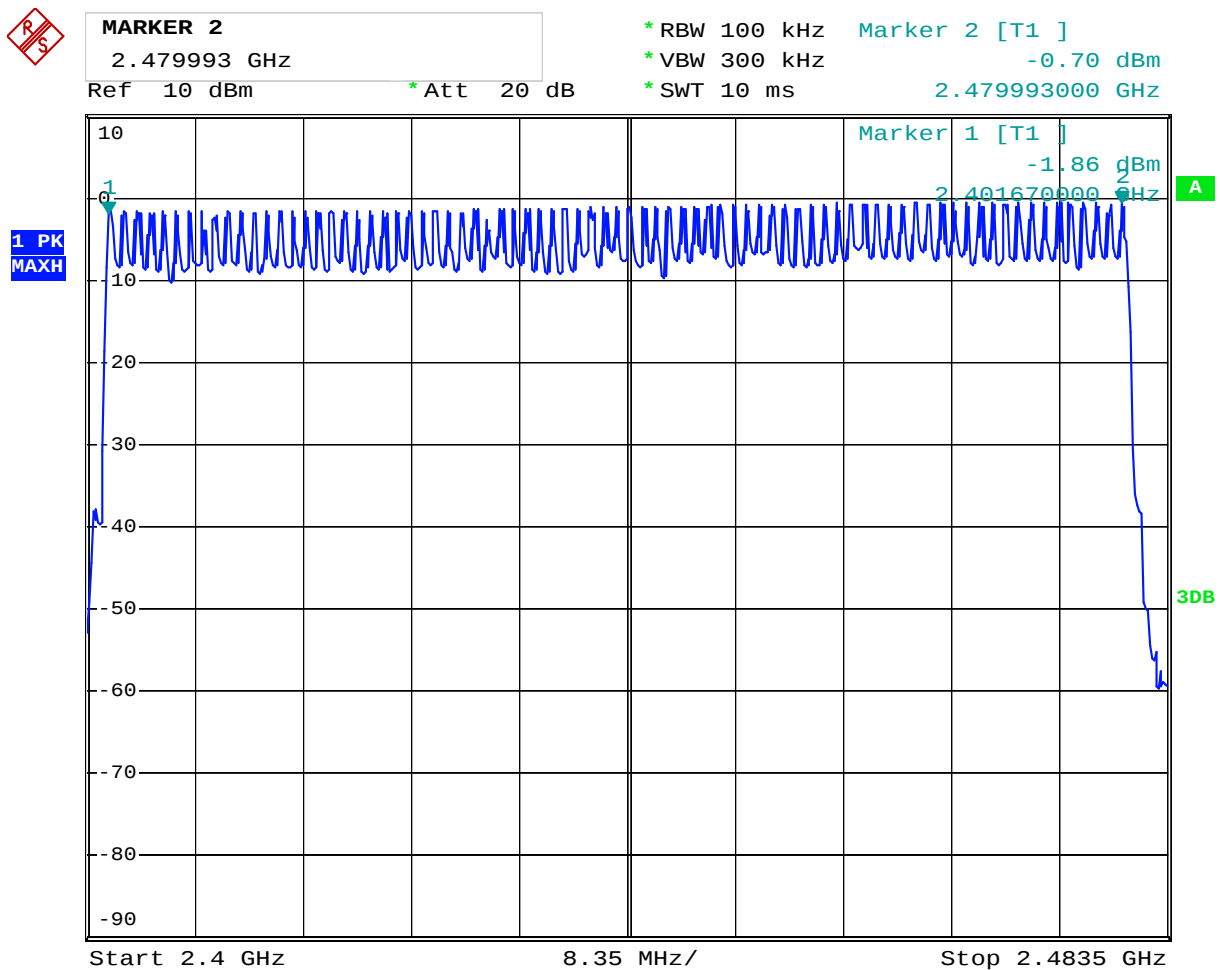
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10.5 Test Result (8DSK MODE)

EUT	Mushroom	Model	Mushroom
Mode	Hopping On	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH
Operating Frequency	Number of hopping channels	Limit	Pass/ Fail
2402-2480MHz	79	≥ 15	Pass

Test Plot (8DPSK MODE)



Date: 8. JAN. 2014 17:06:56

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11. Time of Occupancy (Dwell Time)

11.1 Regulation

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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

11.2 Limits of Carrier Frequency Separation

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

11.3 Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Set the spectrum analyzer as follows: 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
3. Measure the dwell time using the marker-delta function.
4. Repeat above procedures until all frequencies measured were complete.
5. Repeat this test for different modes of operation (e.g., data rate, modulation format, etc.), if applicable.

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11.4 Test Result

GFSK Modulation

EUT	Mushroom			Model	Mushroom
Mode	Keep Transmitting			Input Voltage	DC3.7
Temperature	24 deg. C,			Humidity	56% RH
Channel	Reading	Hopping Rate	Actual	Limit	
Low	3.02	266.667 hop/s	0.322	0.4s	
Middle	3.04	266.667 hop/s	0.324	0.4s	
High	2.96	266.667 hop/s	0.316	0.4s	

Actual = Reading $\times$ (Hopping rate / Number of channels) $\times$ Test period, Test period = 0.4 [seconds / channel] $\times$ 79 [channel] = 31.6 [seconds] NOTE: The EUT makes worst case 1600 hops per second or 1 time slot has a length of 625 μ s with 79 channels. A DH1 Packet needs 5 time slot for transmitting and 1 time slot for receiving. Then the EUT makes worst case 266.667 hops per second with 79 channels.

Note: DH5 is the worse case

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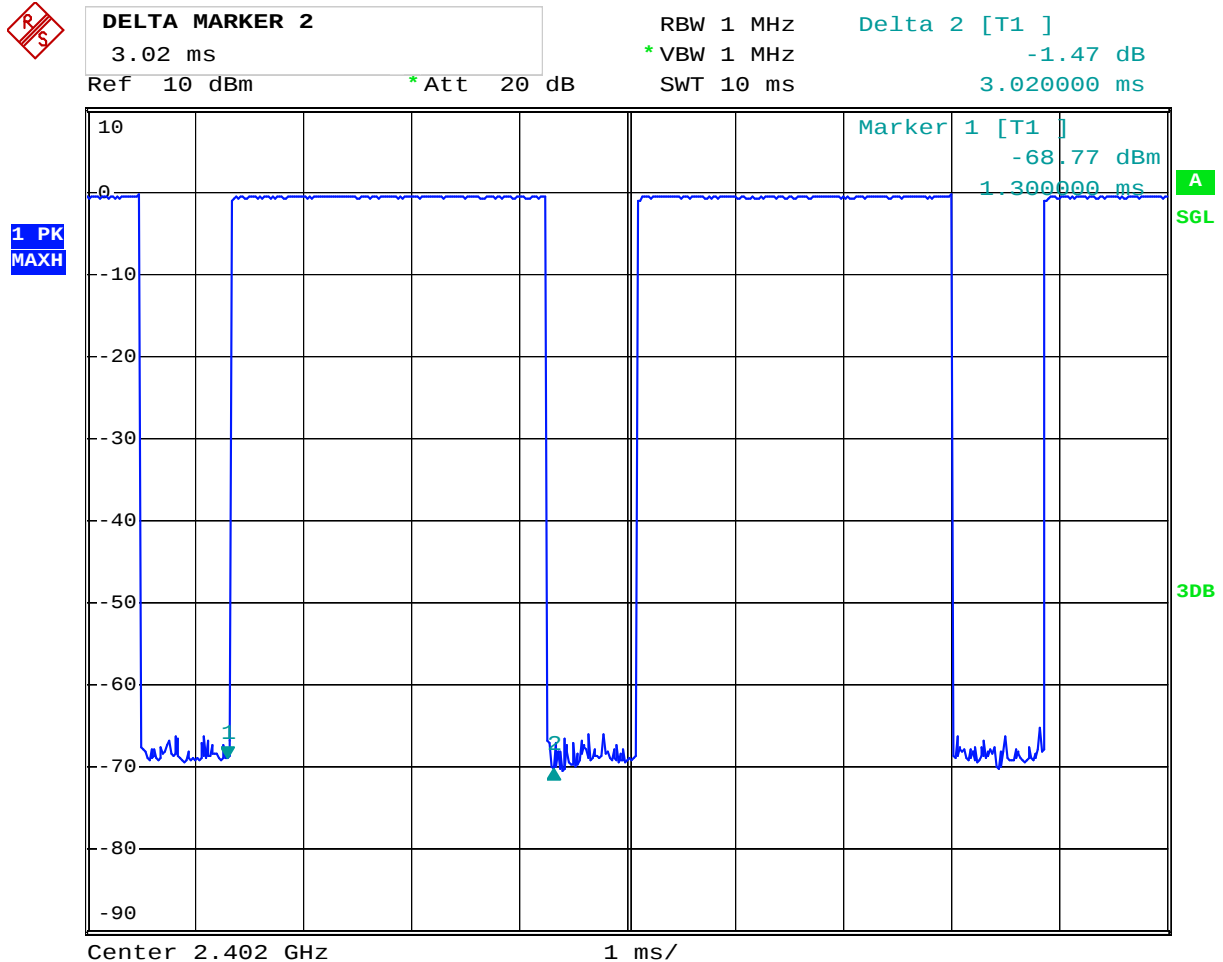
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Test Plots:

Low Channel:



Date: 8.JAN.2014 17:59:35

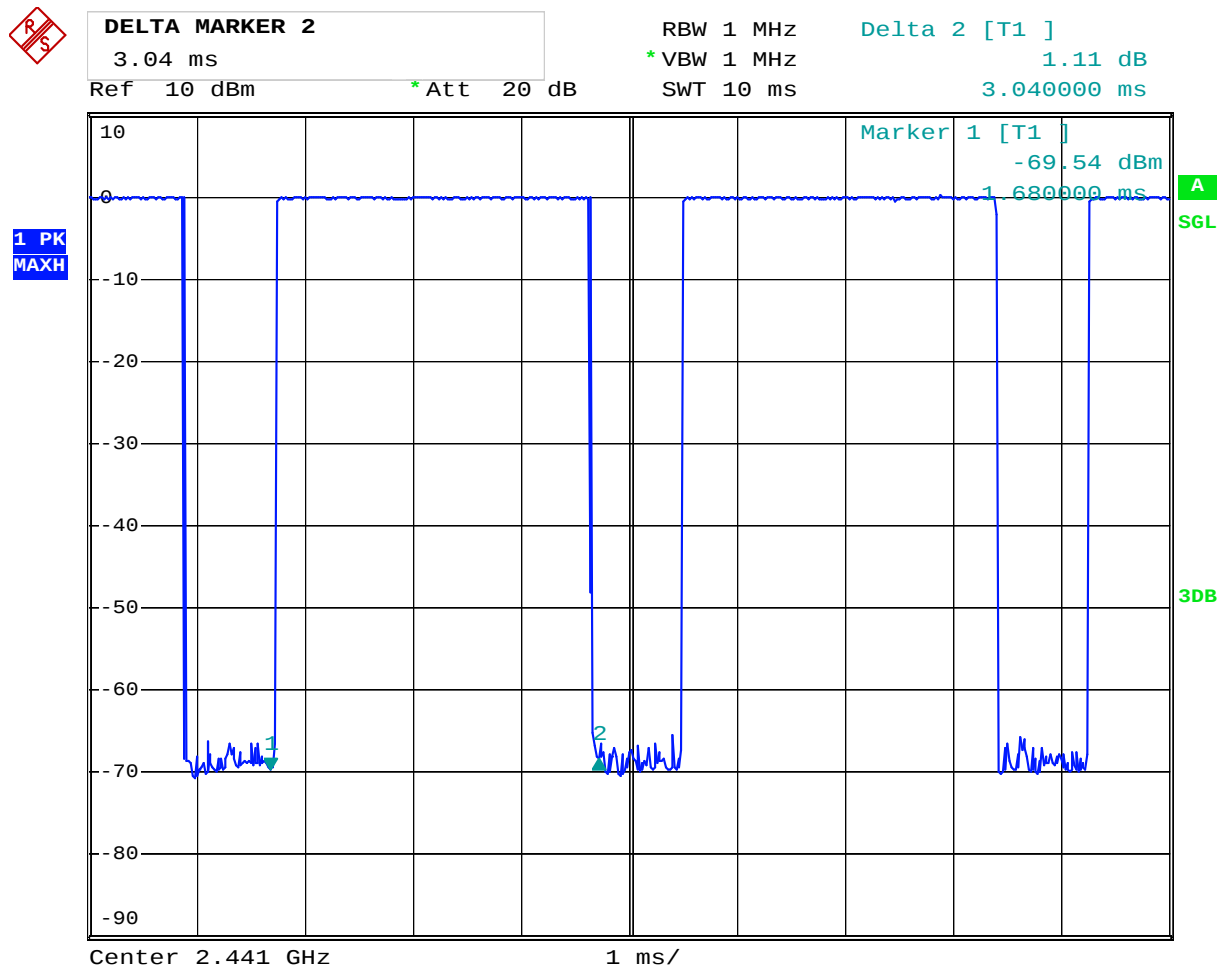
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Middle Channel:



Date: 8.JAN.2014 17:58:28

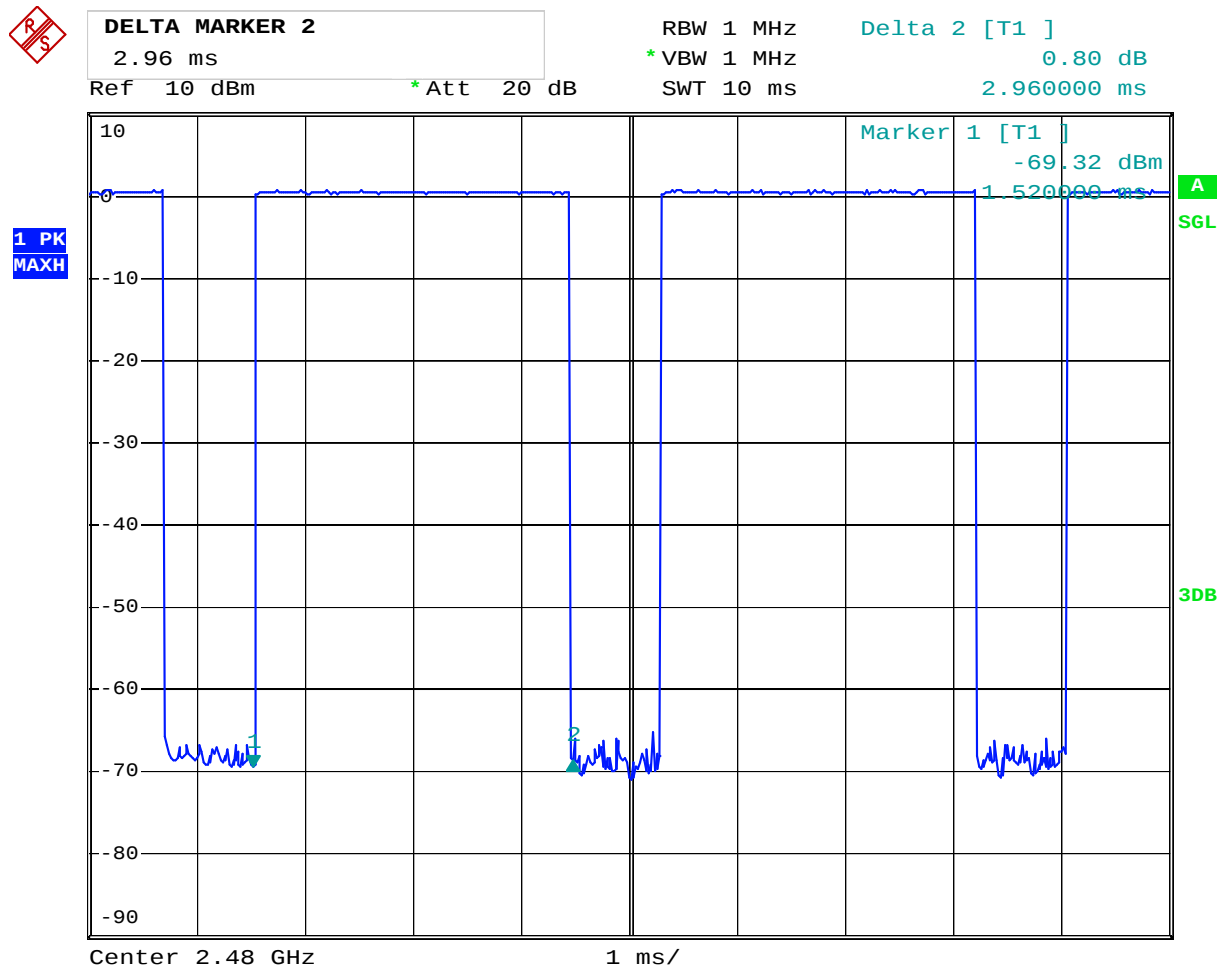
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High Channel



Date: 8.JAN.2014 17:57:22

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π/4QPSK Modulation

EUT	Mushroom			Model	Mushroom
Mode	Keep Transmitting			Input Voltage	DC3.7
Temperature	24 deg. C,			Humidity	56% RH
Channel	Reading	Hopping Rate	Actual	Limit	
Low	2.98	266.667 hop/s	0.318	0.4s	
Middle	2.96	266.667 hop/s	0.316	0.4s	
High	3.00	266.667 hop/s	0.320	0.4s	

Actual = Reading × (Hopping rate / Number of channels) × Test period, Test period = 0.4 [seconds / channel] × 79 [channel] = 31.6 [seconds] NOTE: The EUT makes worst case 1600 hops per second or 1 time slot has a length of 625μs with 79 channels. A DH1 Packet needs 5 time slot for transmitting and 1 time slot for receiving. Then the EUT makes worst case 266.667 hops per second with 79 channels.

Note: DH5 is the worse case

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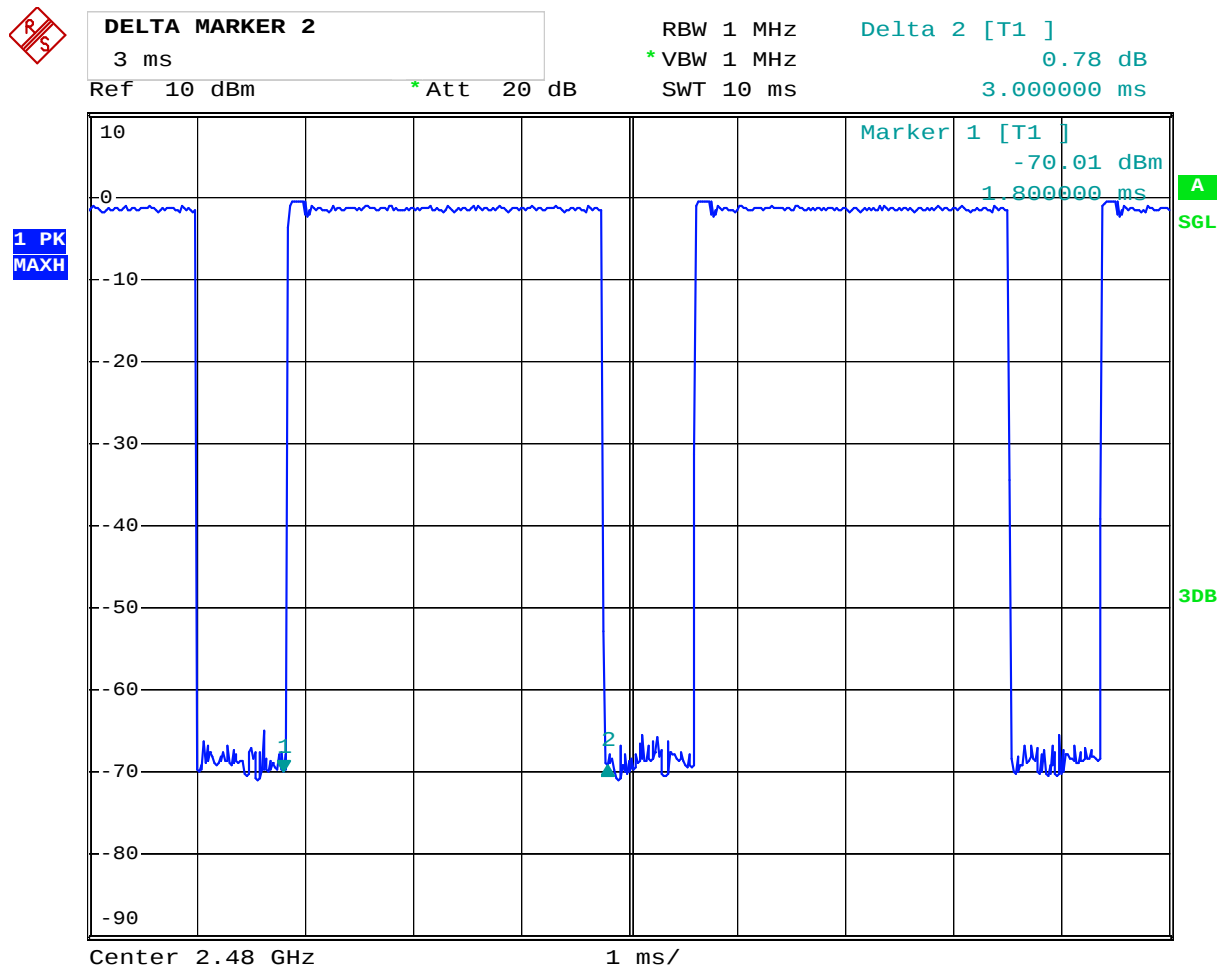
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High Channel



Date: 8.JAN.2014 18:02:49

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8DPSK Modulation

EUT	Mushroom			Model	Mushroom
Mode	Keep Transmitting			Input Voltage	DC3.7
Temperature	24 deg. C,			Humidity	56% RH
Channel	Reading	Hopping Rate	Actual	Limit	
Low	3.00	266.667 hop/s	0.320	0.4s	
Middle	3.00	266.667 hop/s	0.320	0.4s	
High	3.00	266.667 hop/s	0.320	0.4s	

Actual = Reading $\times$ (Hopping rate / Number of channels) $\times$ Test period, Test period = 0.4 [seconds / channel] $\times$ 79 [channel] = 31.6 [seconds] NOTE: The EUT makes worst case 1600 hops per second or 1 time slot has a length of 625 μ s with 79 channels. A DH1 Packet needs 5 time slot for transmitting and 1 time slot for receiving. Then the EUT makes worst case 266.667 hops per second with 79 channels.

Note: DH5 is the worse case

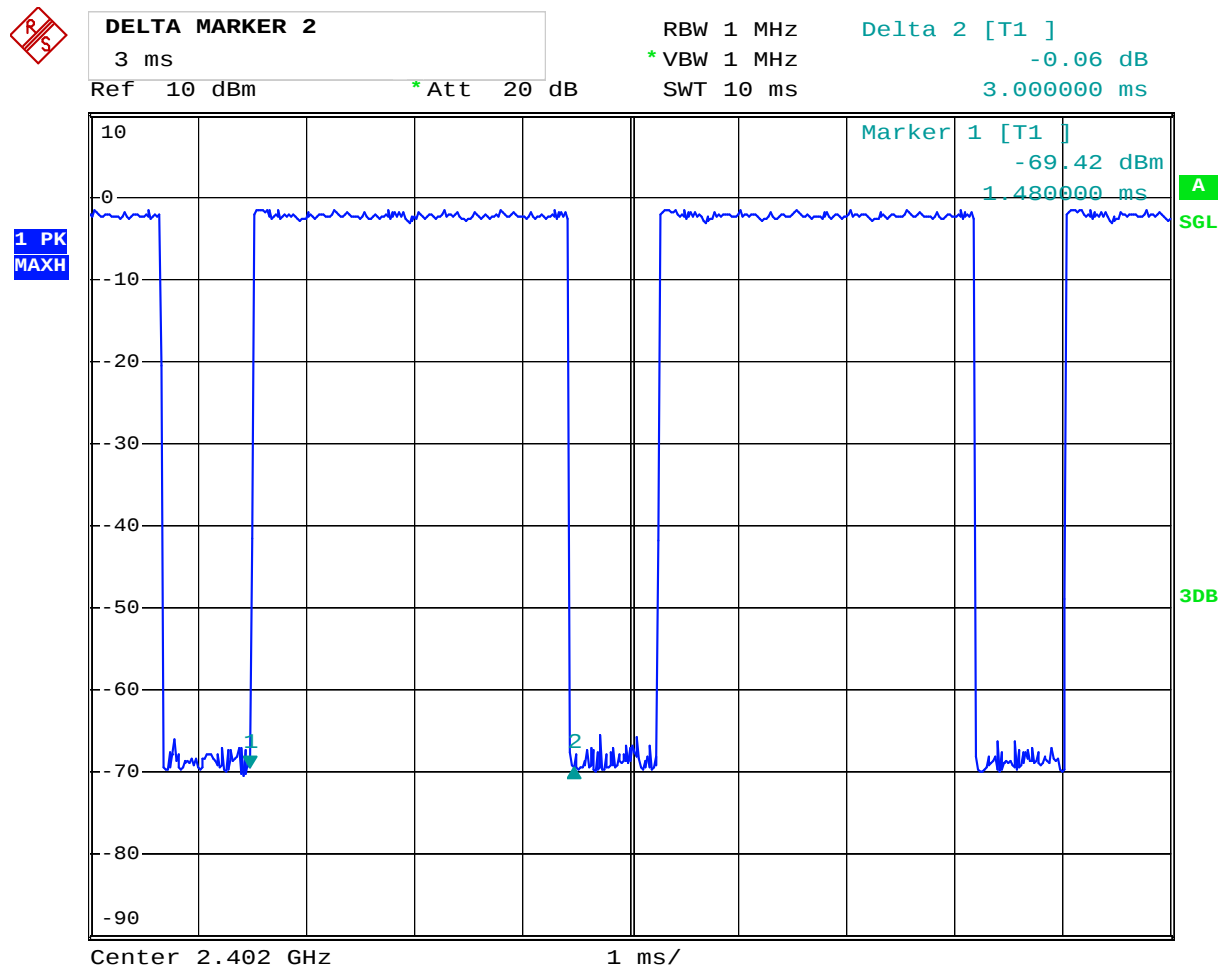
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Low Channel



Date: 8.JAN.2014 18:14:16

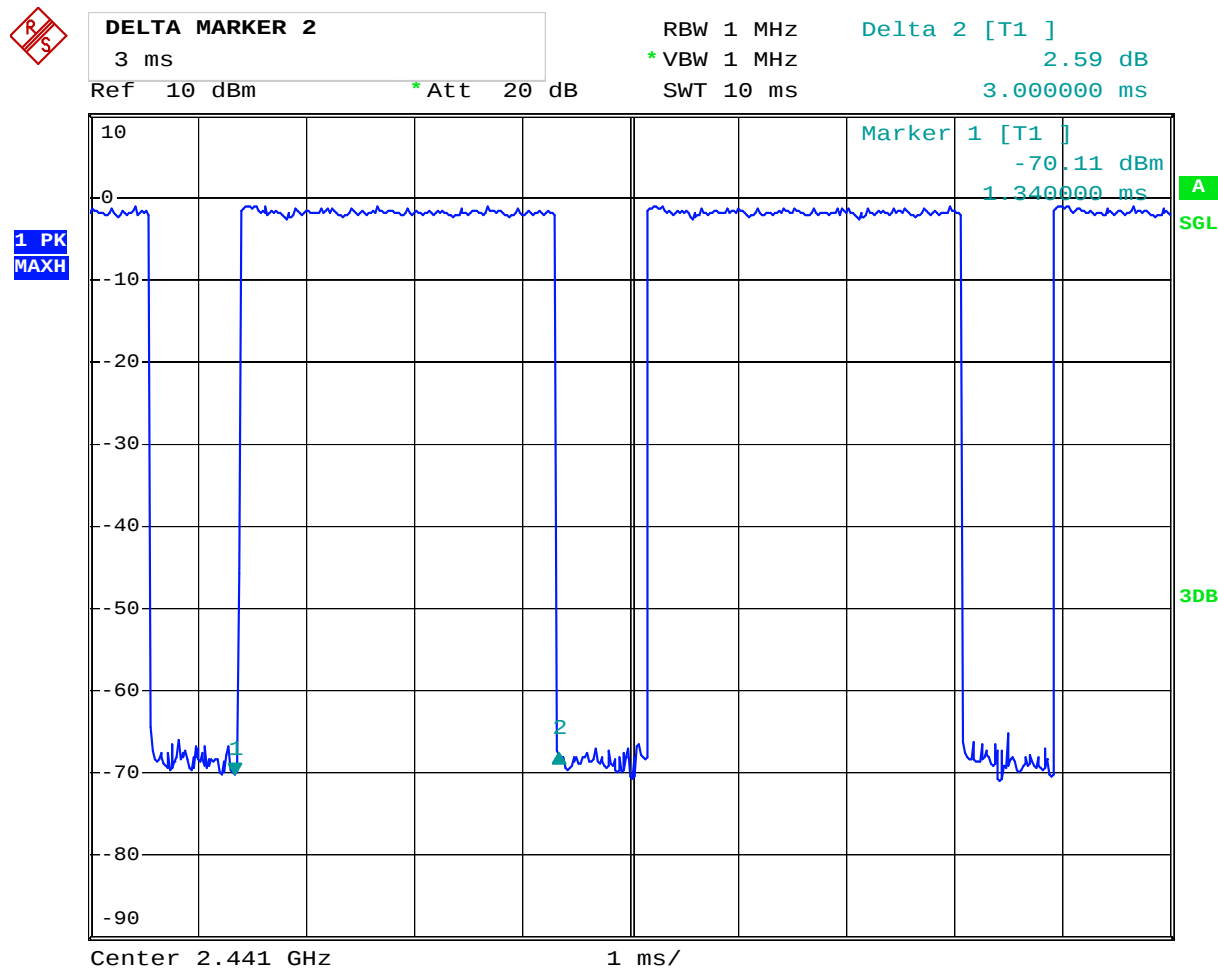
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Middle Channel



Date: 8.JAN.2014 18:13:23

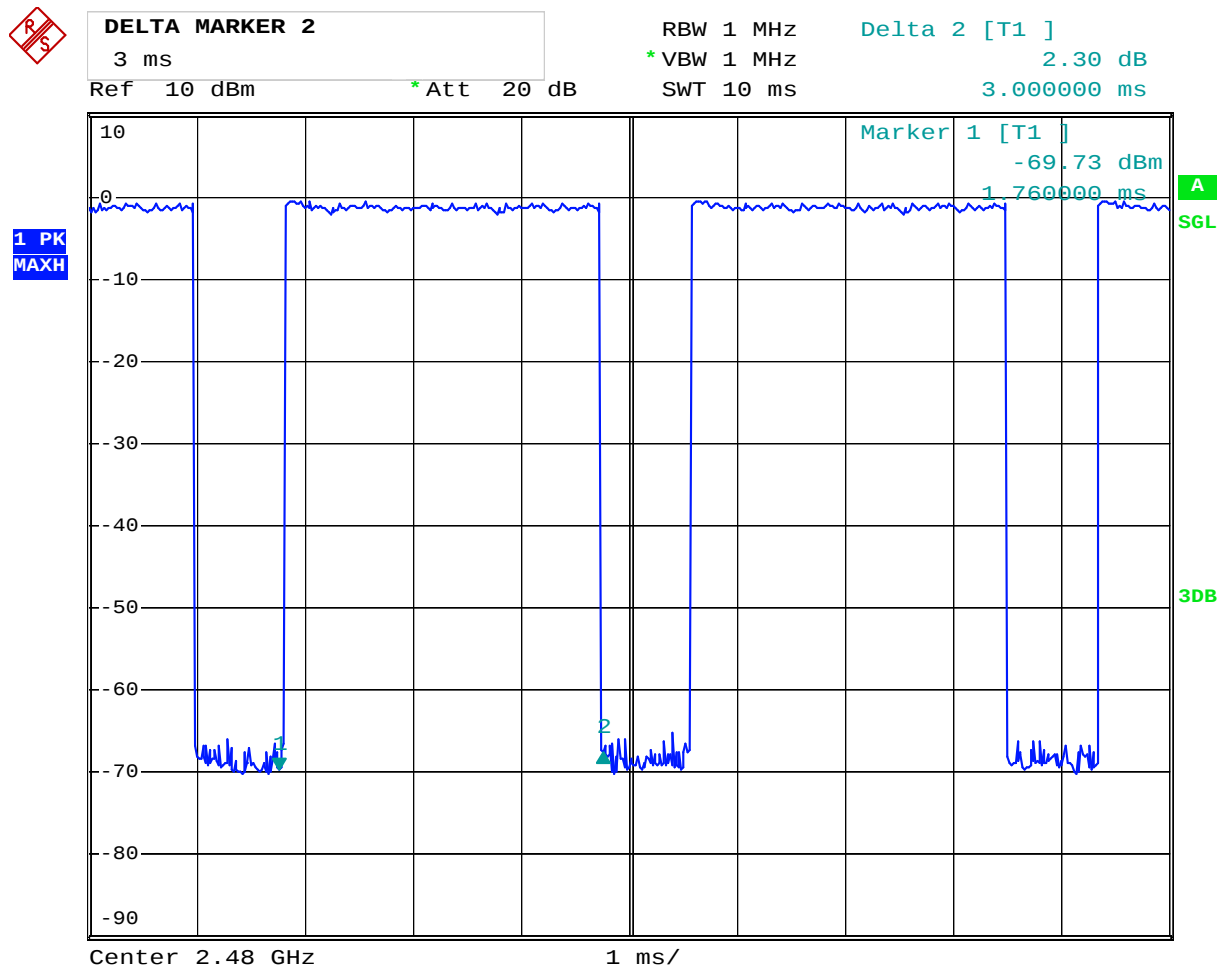
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High Channel



Date: 8.JAN.2014 18:12:15

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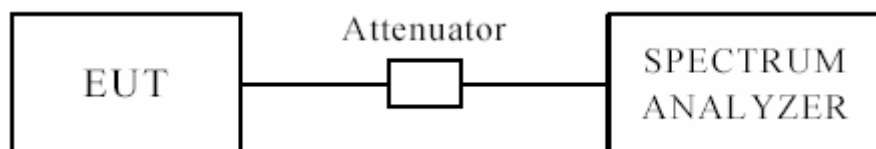
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12 Out of Band Measurement

12.1 Test Setup



The restricted band requirement based on radiated emission test; please see the clause 6 for the test setup

12.2 Limits of Out of Band Emissions Measurement

1. Below -20dB of the highest emission level of operating band (in 100kHz Resolution Bandwidth).
2. Fall in the restricted bands listed in section 15.205. The maximum permitted average field strength is listed in section 15.209.

12.3 Test Procedure

For signals in the restricted bands above and below the 2.4-2.483GHz allocated band a measurement was made of radiated emission test. (Peak values with $\text{RBW}=\text{VBW}=1\text{MHz}$ and PK detector. AV value with $\text{RBW}=1\text{MHz}$, $\text{VBW}=10\text{Hz}$ and PK detector)

For bandage test, the spectrum set as follows: $\text{RBW}=\text{VBW}=100\text{ kHz}$. A conducted measurement used

Note: 1. For band-edge measurement, the frequency from 30MHz-25GHz was tested. And It met the FCC rule.

2. This is a handheld device. The radiated emissions should be tested under 3-axes position (Lying, Side, and Stand), After pre-test. It was found that the worse radiated emission was get at the lying position.

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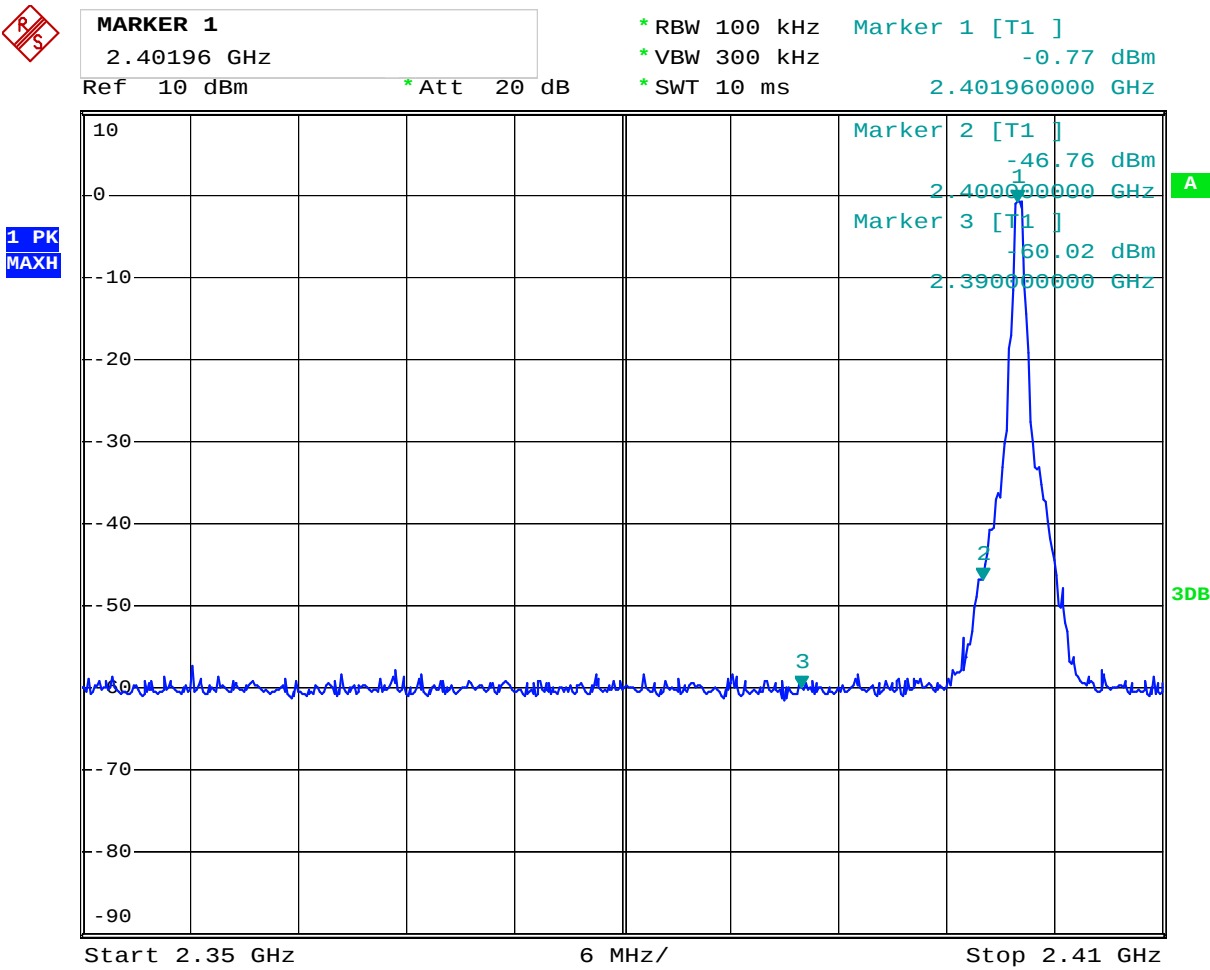


Type of Modulation: GFSK

12.4 Out of Band Test Result

Product:	Mushroom		Test Mode:	Low Channel
Mode	Keeping Transmitting		Input Voltage	DC3.7V
Temperature	24 deg. C		Humidity	56% RH
Test Result:	Pass		Detector	PK
The Max. FS in Restrict Band 2390MHz	PK (dBμV/m)	39.5	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

Test Figure:



Date: 8. JAN. 2014 17:27:48

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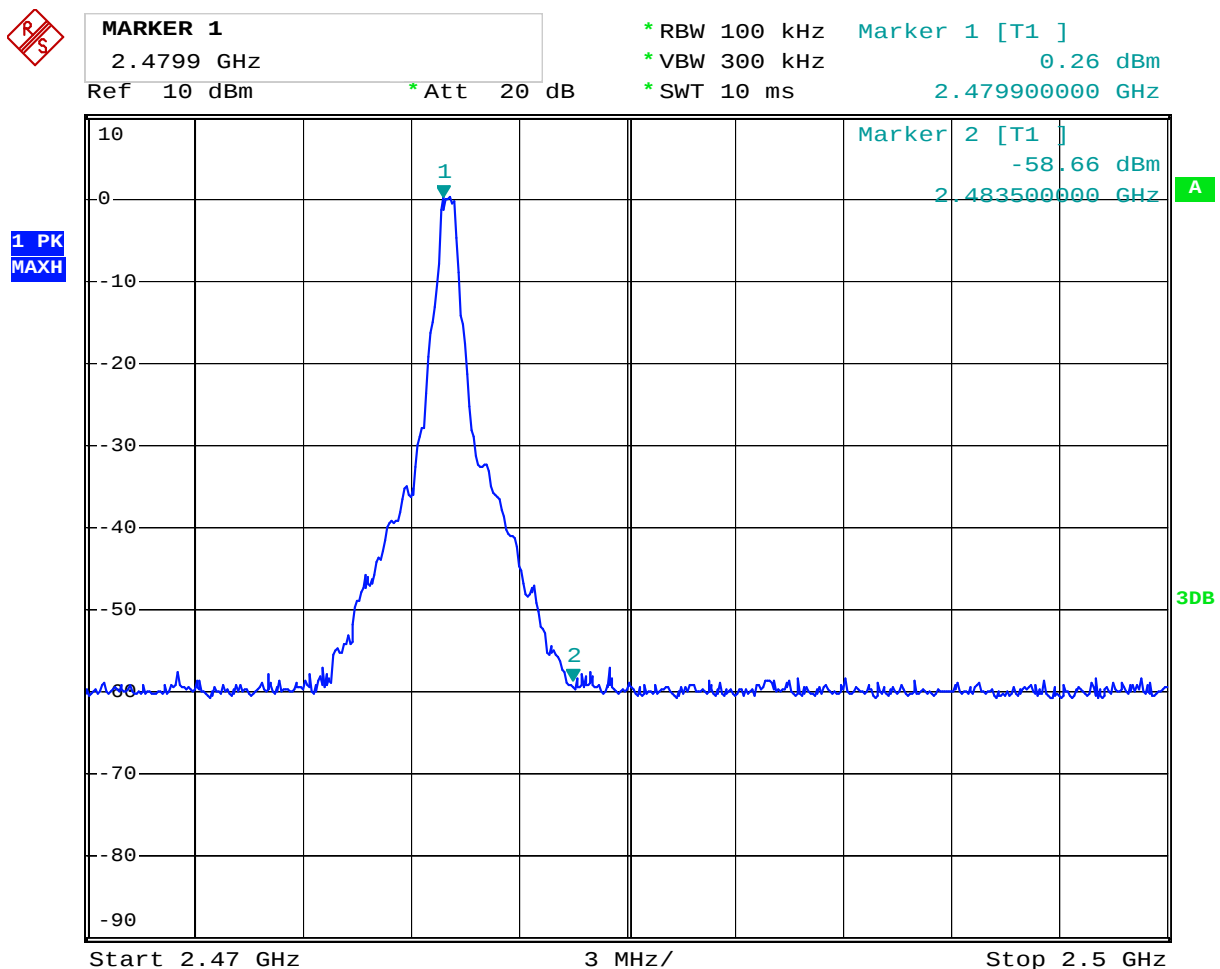


Type of Modulation: GFSK

12.4 Out of Band Test Result

Product:	Mushroom		Test Mode:	High Channel
Mode	Keeping Transmitting		Input Voltage	DC3.7V
Temperature	24 deg. C,		Humidity	56% RH
Test Result:	Pass		Detector	PK
The Max. FS in Restrict Band 2483.5MHz	PK (dBμV/m)	40.8	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

Test Figure:



Date: 8. JAN. 2014 17:26:36

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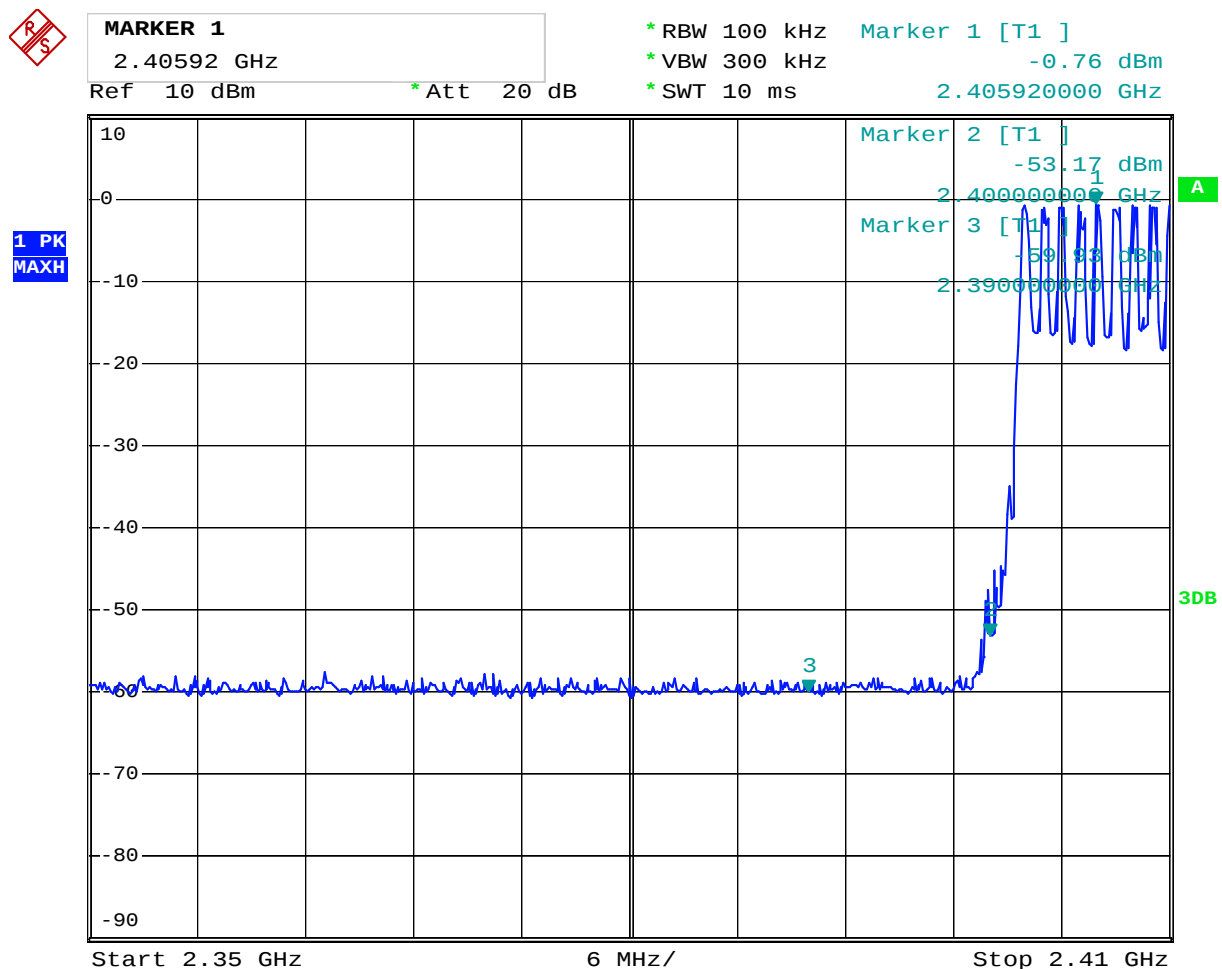


Type of Modulation: GFSK

12.4 Out of Band Test Result

Product:	Mushroom		Test Mode:	Hopping mode
Mode	Hopping On		Input Voltage	DC3.7V
Temperature	24 deg. C,		Humidity	56% RH
Test Result:	Pass		Detector	PK
The Max. FS in Restrict Band 2390MHz	PK (dBμV/m)	38.7	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

Test Figure:



Date: 8.JAN.2014 17:29:42

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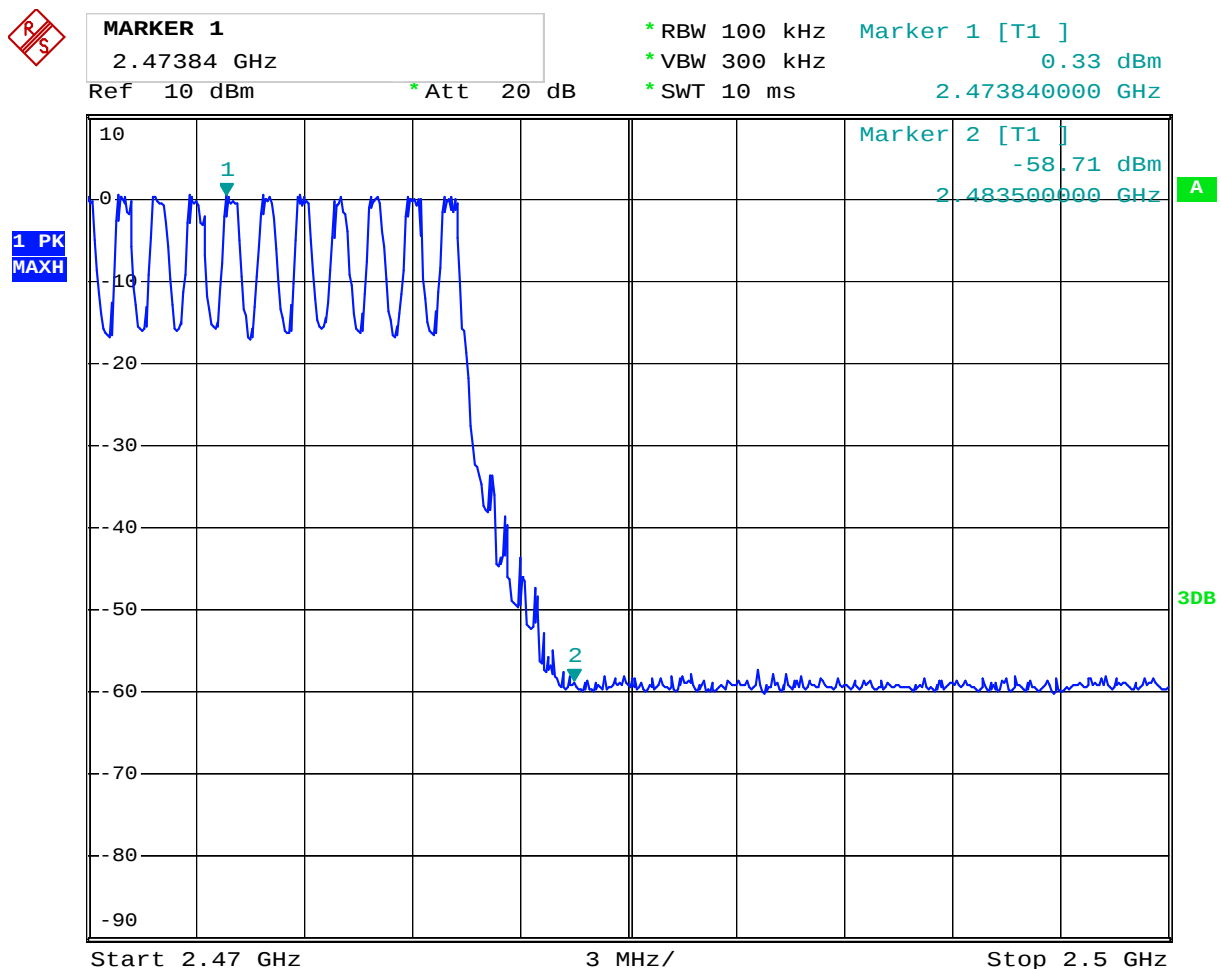


Type of Modulation: GFSK

12.4 Out of Band Test Result

Product:	Mushroom		Test Mode:	Hopping mode
Mode	Hopping On		Input Voltage	DC3.7V
Temperature	24 deg. C,		Humidity	56% RH
Test Result:	Pass		Detector	PK
The Max. FS in Restrict Band 2483.5MHz	PK (dBμV/m)	39.6	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

Test Figure:



Date: 8.JAN.2014 17:25:37

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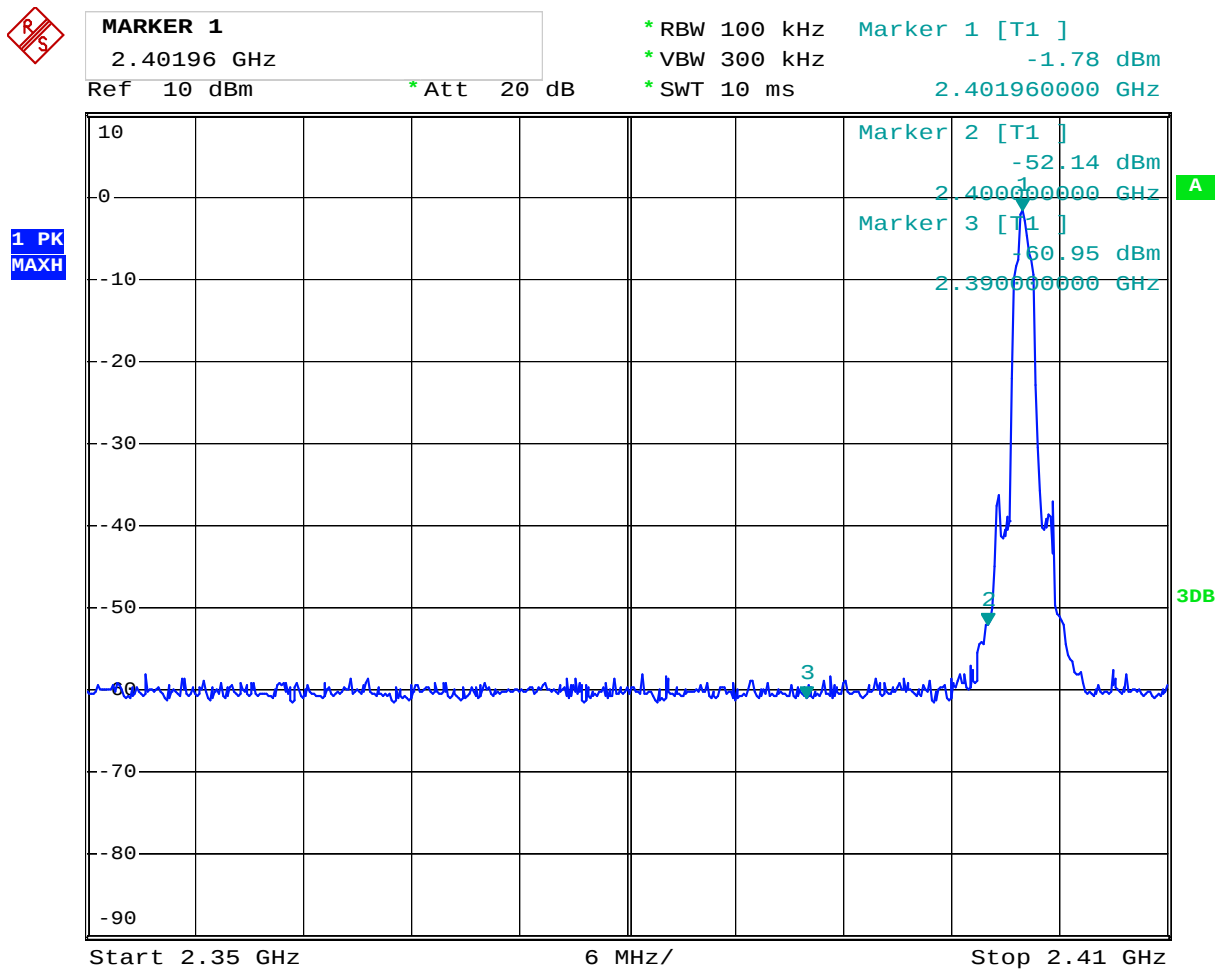


Type of Modulation: $\pi/4$ QPSK

12.4 Out of Band Test Result

Product:	Mushroom		Test Mode:	Low Channel
Mode	Keeping Transmitting		Input Voltage	DC3.7V
Temperature	24 deg. C		Humidity	56% RH
Test Result:	Pass		Detector	PK
The Max. FS in Restrict Band 2390MHz	PK (dB μ V/m)	38.7	Limit	74(dB μ V/m)
	AV(dB μ V/m)	--		54(dB μ V/m)

Test Figure:



Date: 8. JAN. 2014 17:32:38

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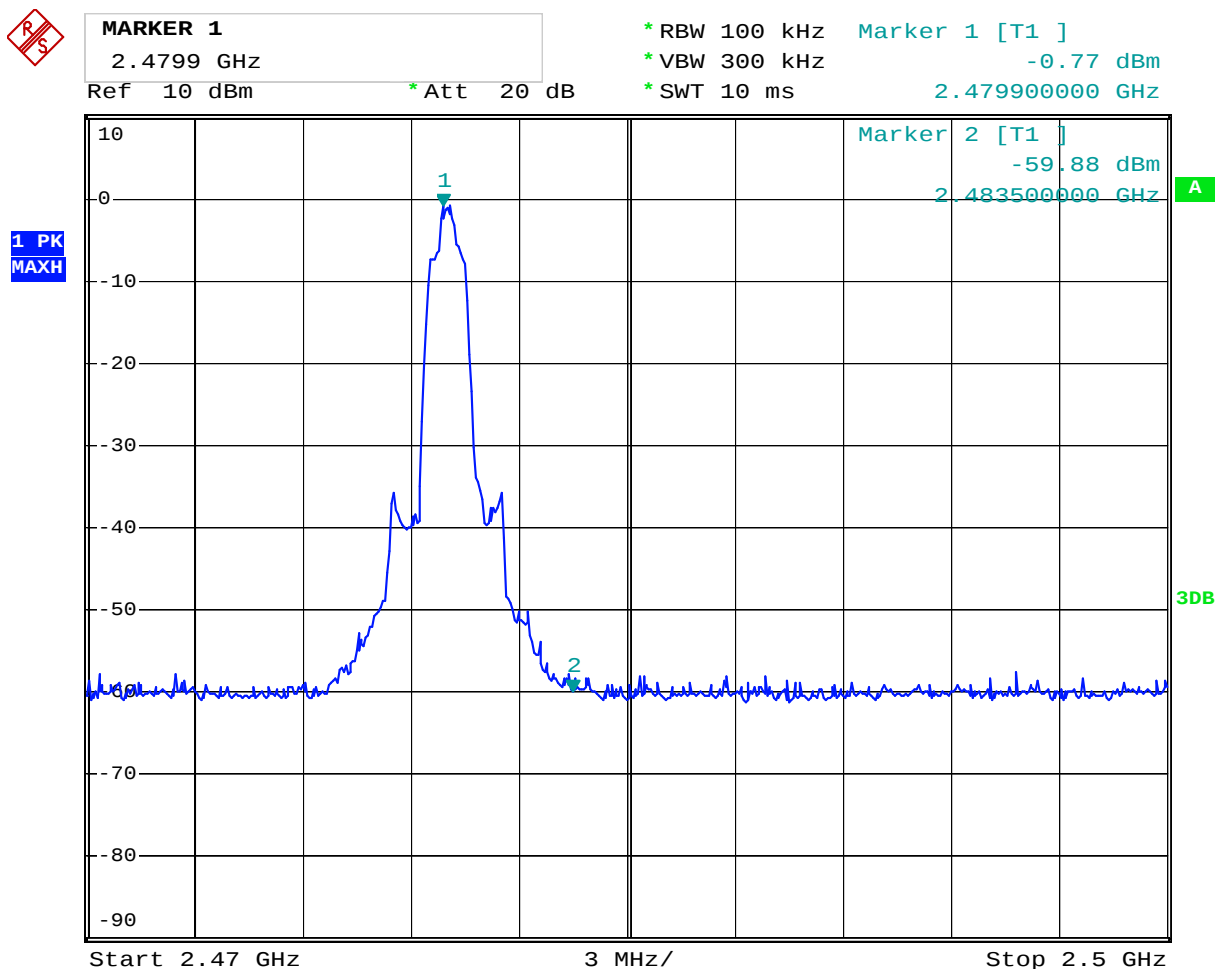


Type of Modulation: $\pi/4$ QPSK

12.4 Out of Band Test Result

Product:	Mushroom		Test Mode:	High Channel
Mode	Keeping Transmitting		Input Voltage	DC3.7V
Temperature	24 deg. C,		Humidity	56% RH
Test Result:	Pass		Detector	PK
The Max. FS in Restrict Band 2483.5MHz	PK (dB μ V/m)	40.5	Limit	74(dB μ V/m)
	AV(dB μ V/m)	--		54(dB μ V/m)

Test Figure:



Date: 8. JAN. 2014 17:33:35

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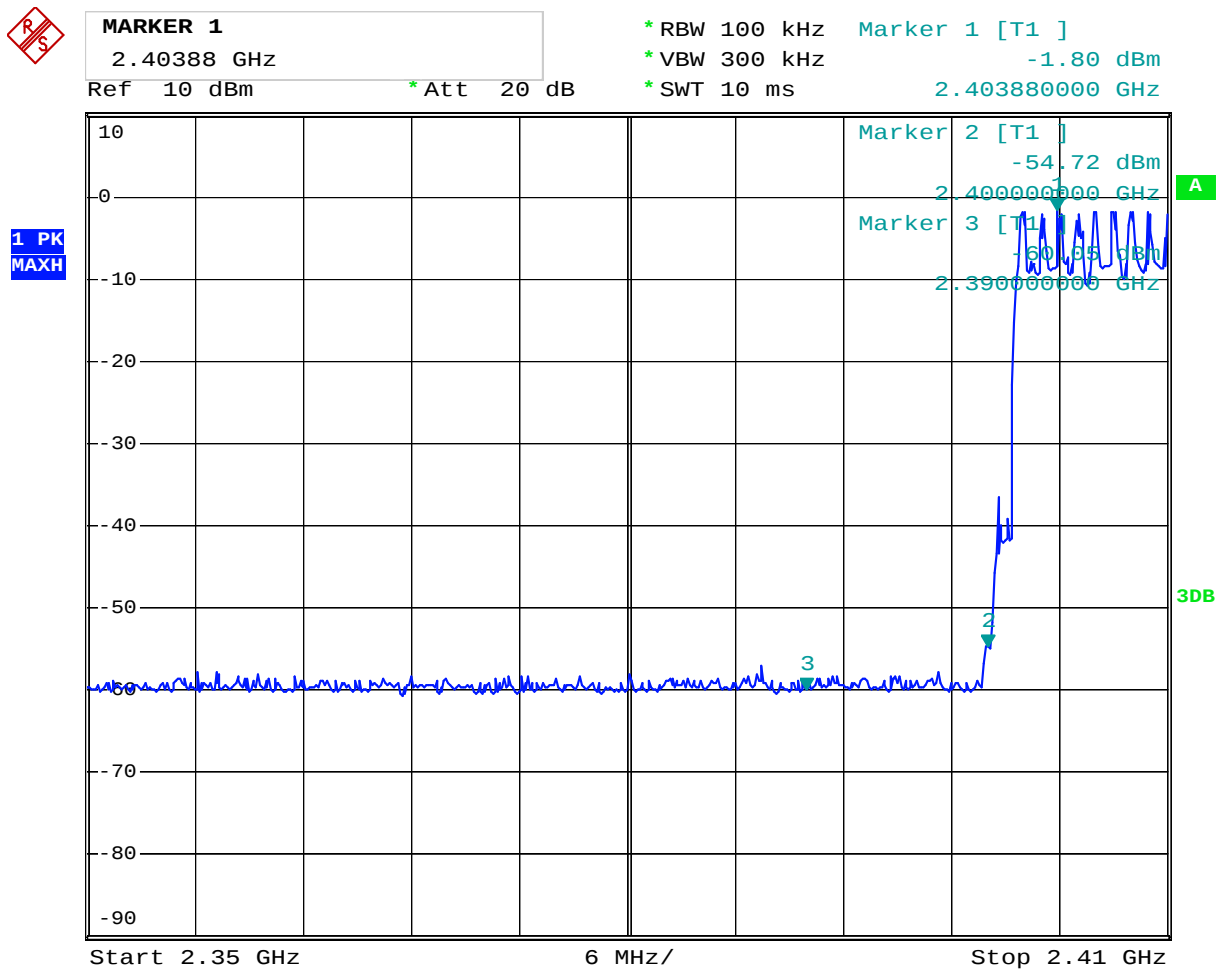


Type of Modulation: $\pi/4$ QPSK

12.4 Out of Band Test Result

Product:	Mushroom		Test Mode:	Hopping mode
Mode	Hopping On		Input Voltage	DC3.7V
Temperature	24 deg. C,		Humidity	56% RH
Test Result:	Pass		Detector	PK
The Max. FS in Restrict Band 2390MHz	PK (dB μ V/m)	38.4	Limit	74(dB μ V/m)
	AV(dB μ V/m)	--		54(dB μ V/m)

Test Figure:



Date: 8.JAN.2014 17:31:42

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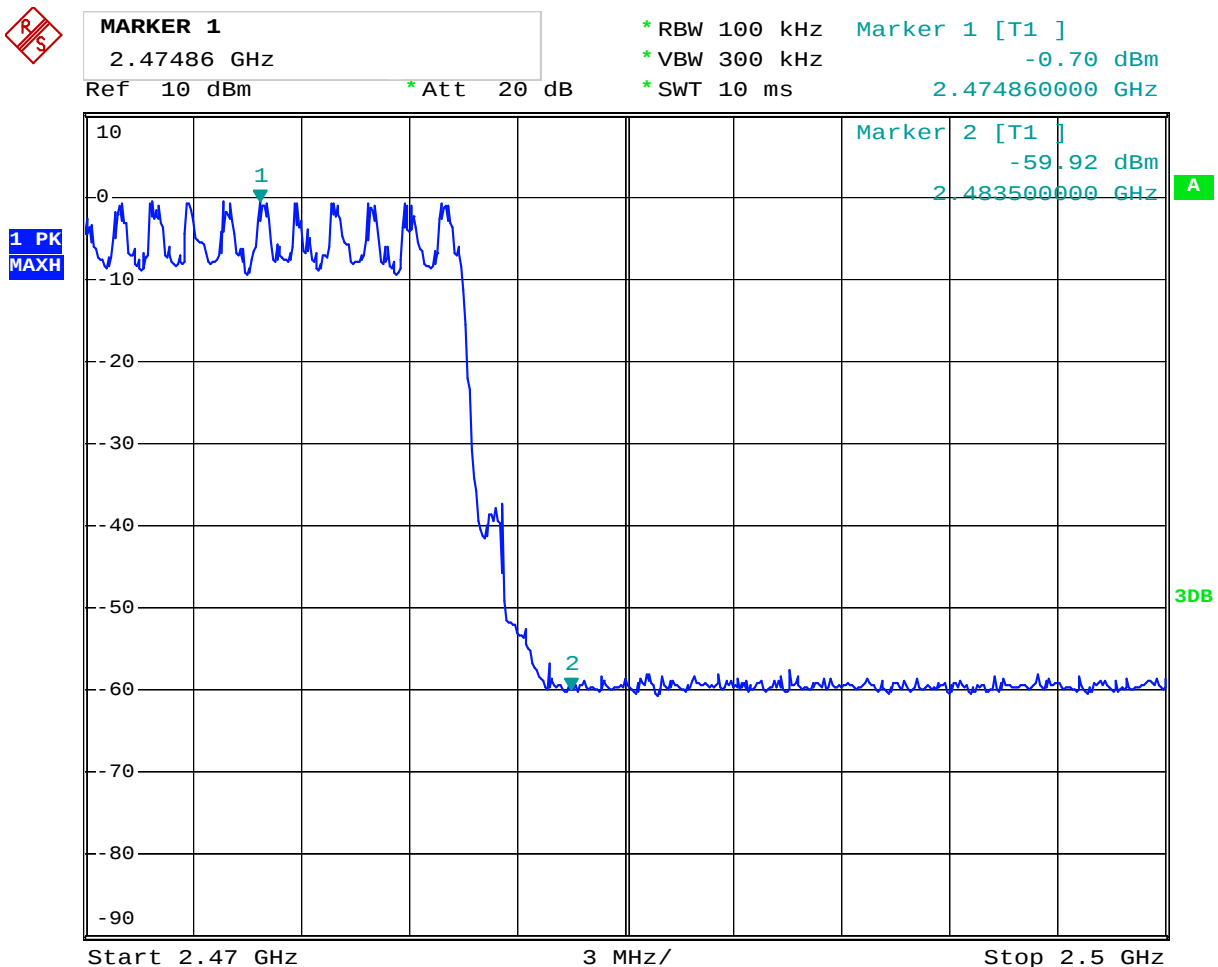


Type of Modulation: $\pi/4$ QPSK

12.4 Out of Band Test Result

Product:	Mushroom		Test Mode:	Hopping mode
Mode	Hopping On		Input Voltage	DC3.7V
Temperature	24 deg. C,		Humidity	56% RH
Test Result:	Pass		Detector	PK
The Max. FS in Restrict Band 2483.5MHz	PK (dB μ V/m)	39.9	Limit	74(dB μ V/m)
	AV(dB μ V/m)	--		54(dB μ V/m)

Test Figure:



Date: 8.JAN.2014 17:35:17

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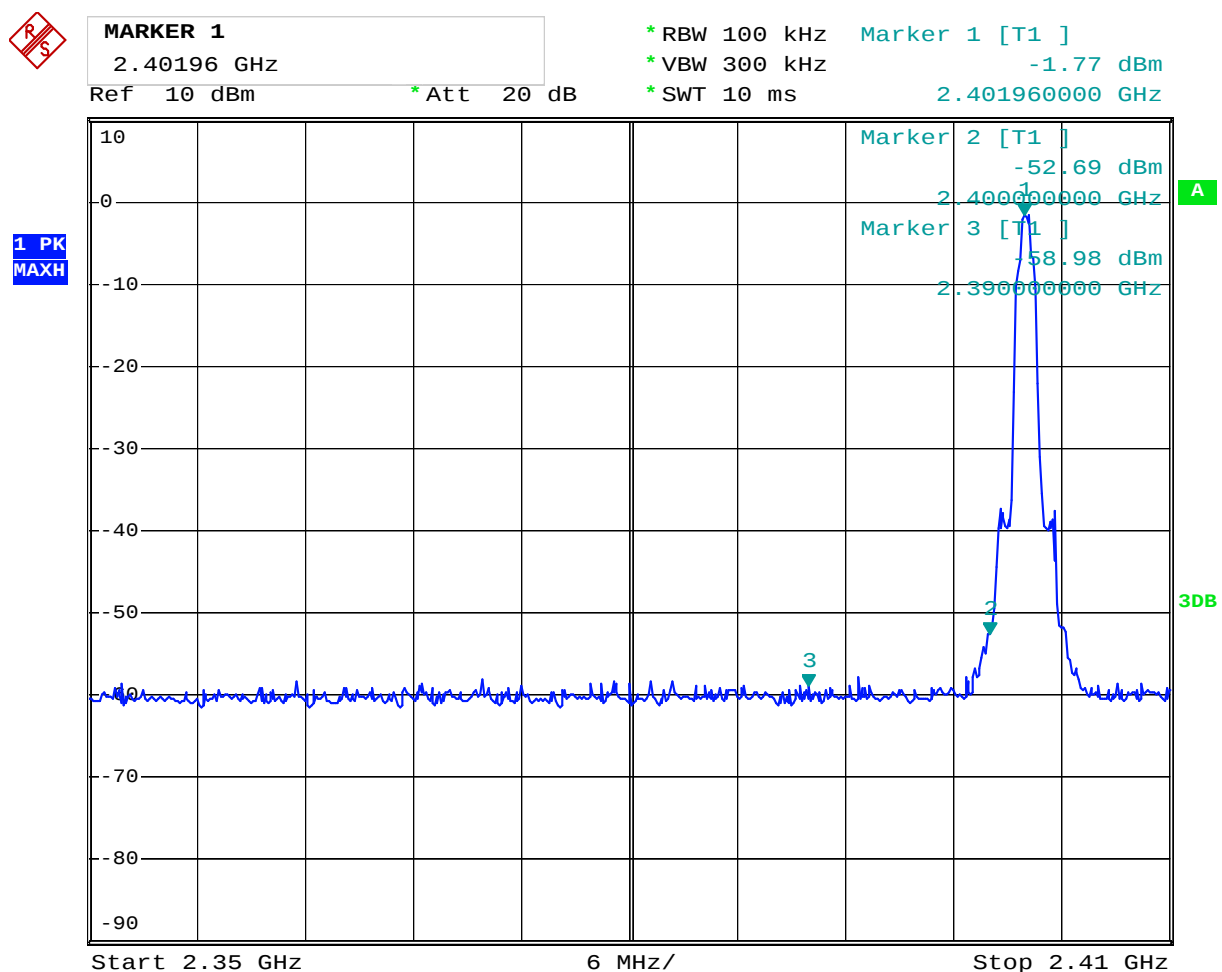


Type of Modulation: 8DPSK

12.4 Out of Band Test Result

Product:	Mushroom		Test Mode:	Low Channel
Mode	Keeping Transmitting		Input Voltage	DC3.7V
Temperature	24 deg. C		Humidity	56% RH
Test Result:	Pass		Detector	PK
The Max. FS in Restrict Band 2390MHz	PK (dBμV/m)	37.2	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

Test Figure:



Date: 8. JAN. 2014 17:40:42

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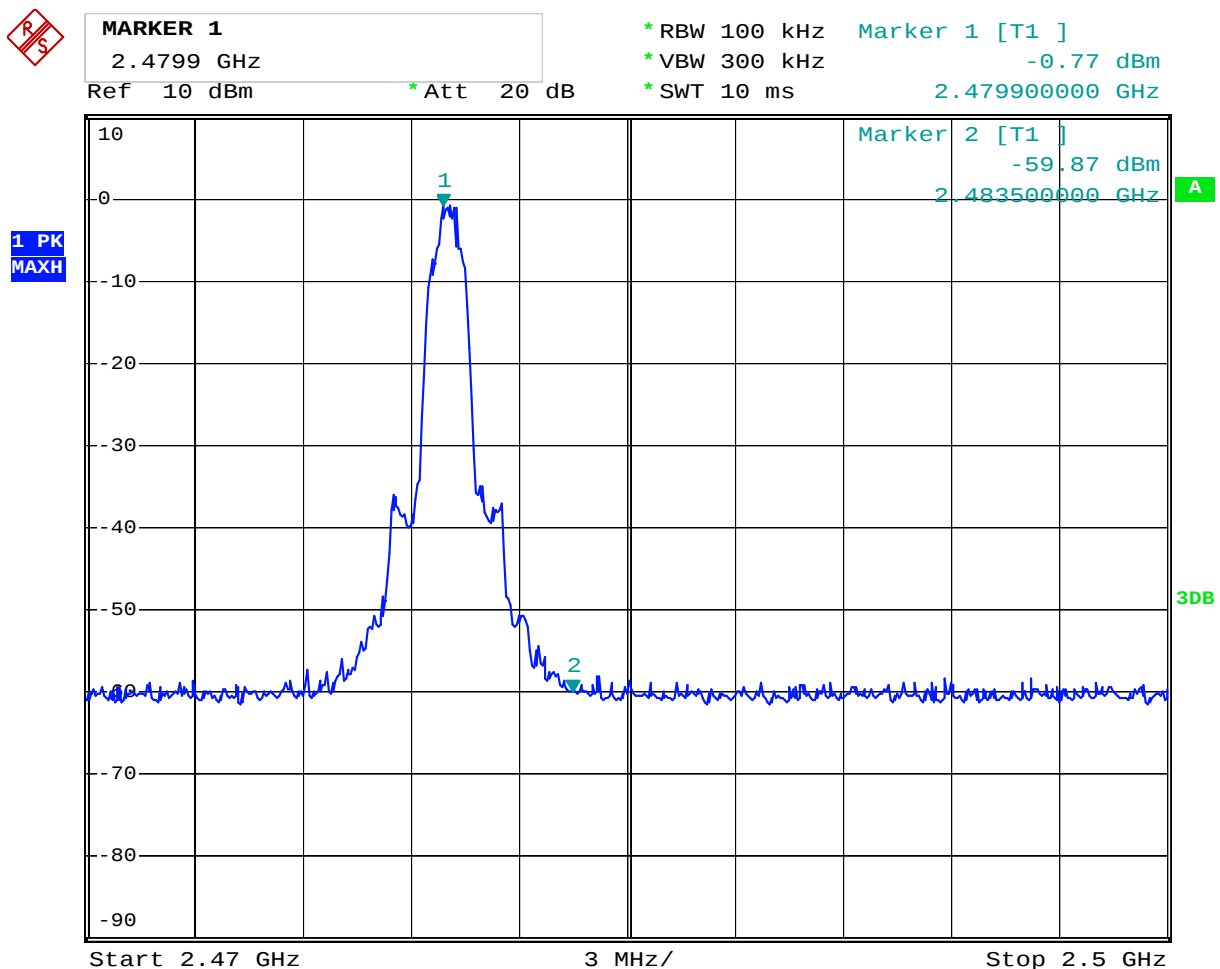


Type of Modulation: 8DPSK

12.4 Out of Band Test Result

Product:	Mushroom		Test Mode:	High Channel
Mode	Keeping Transmitting		Input Voltage	DC3.7V
Temperature	24 deg. C,		Humidity	56% RH
Test Result:	Pass		Detector	PK
The Max. FS in Restrict Band 2483.5MHz	PK (dBμV/m)	38.8	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

Test Figure:



Date: 8. JAN. 2014 17:39:32

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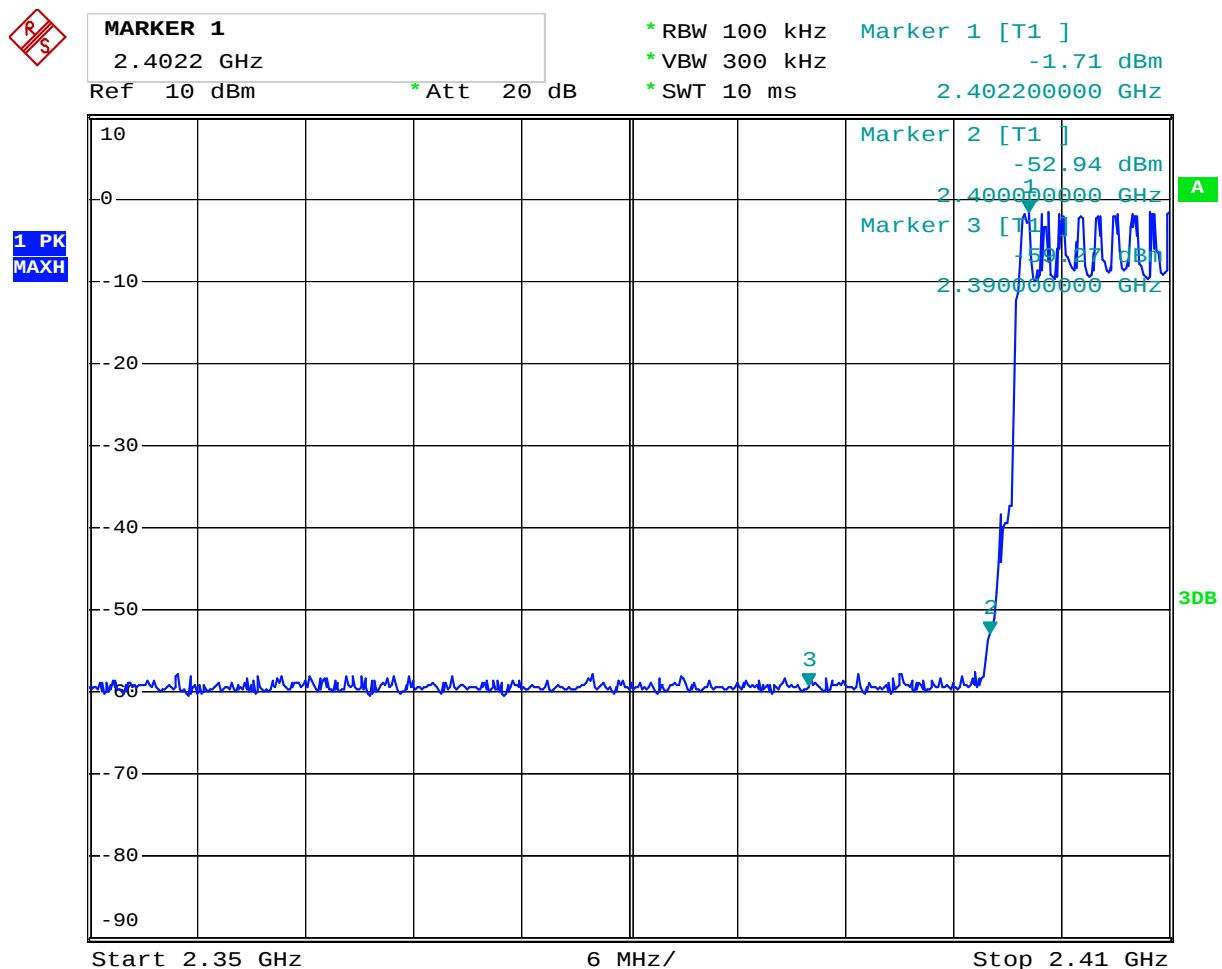


Type of Modulation: 8DPSK

12.4 Out of Band Test Result

Product:	Mushroom		Test Mode:	Hopping mode
Mode	Hopping On		Input Voltage	DC3.7V
Temperature	24 deg. C,		Humidity	56% RH
Test Result:	Pass		Detector	PK
The Max. FS in Restrict Band 2390MHz	PK (dBμV/m)	37.4	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

Test Figure:



Date: 8.JAN.2014 17:43:46

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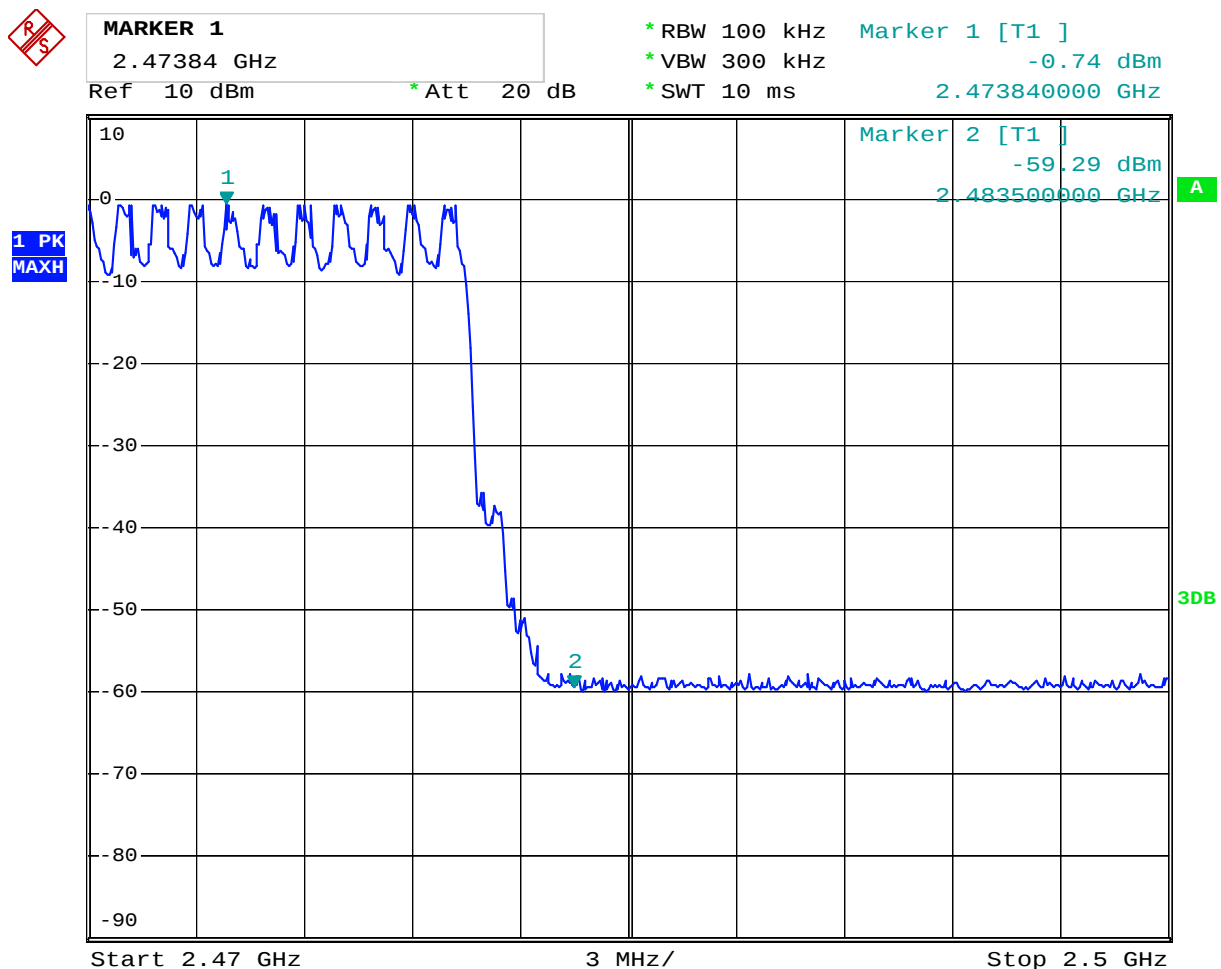


Type of Modulation: 8DPSK

12.4 Out of Band Test Result

Product:	Mushroom		Test Mode:	Hopping mode
Mode	Hopping On		Input Voltage	DC3.7V
Temperature	24 deg. C,		Humidity	56% RH
Test Result:	Pass		Detector	PK
The Max. FS in Restrict Band 2483.5MHz	PK (dBμV/m)	39.4	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

Test Figure:



Date: 8.JAN.2014 17:38:58

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13.0 Antenna Requirement

13.1 Standard Applicable

For intentional device, according to FCC 47 CFR Section 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.

And according to FCC 47 CFR Section 15.247 (b), if transmitter antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

13.2 Antenna Connected construction

There is a PCB printed antenna, and the maximum Gain of this antenna is 1.13dBi.

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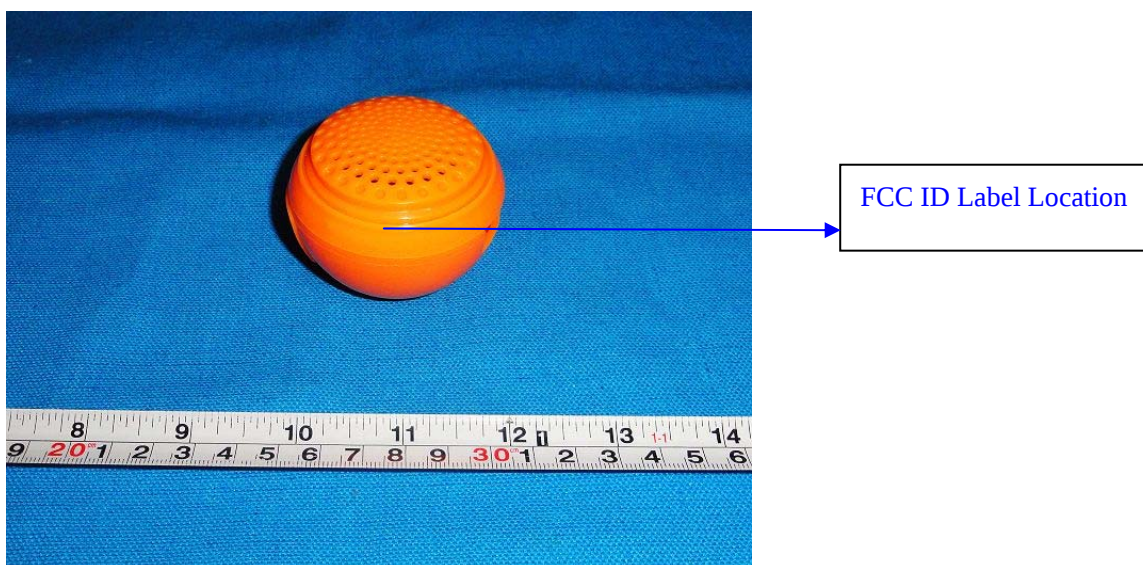


14.0 FCC ID Label

FCC ID: Z2HMS438

The label on these products must be permanently affixed to the product and readily visible at the time of purchase and must last the expected lifetime of the equipment not be readily detachable.

Mark Location:



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15.0 Photo of testing

15.1 Conducted test View



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15.2 Emission Radiated test View



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Photos of the Product



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Photos of the Product



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Photos of the Product

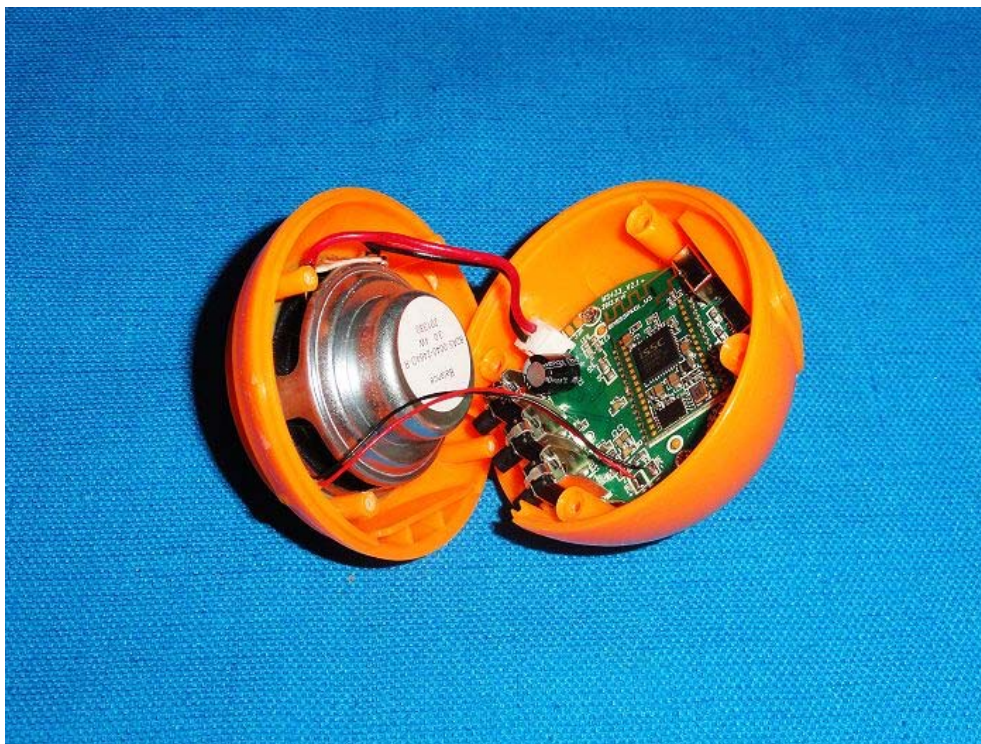


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Photos of the Product

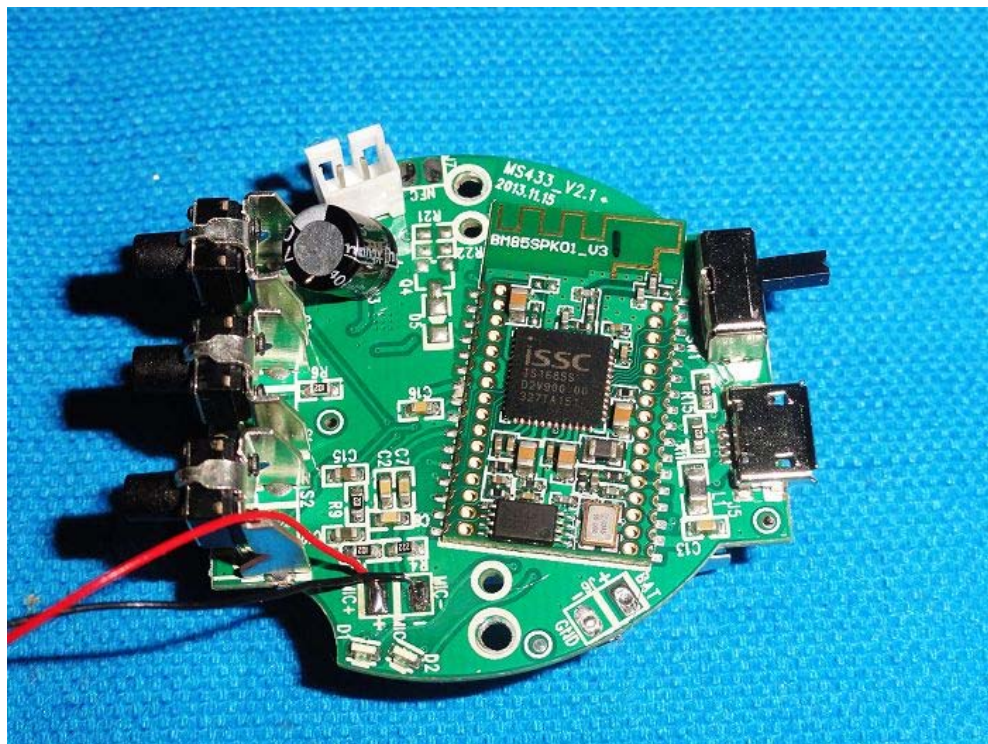


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Photos of the Product

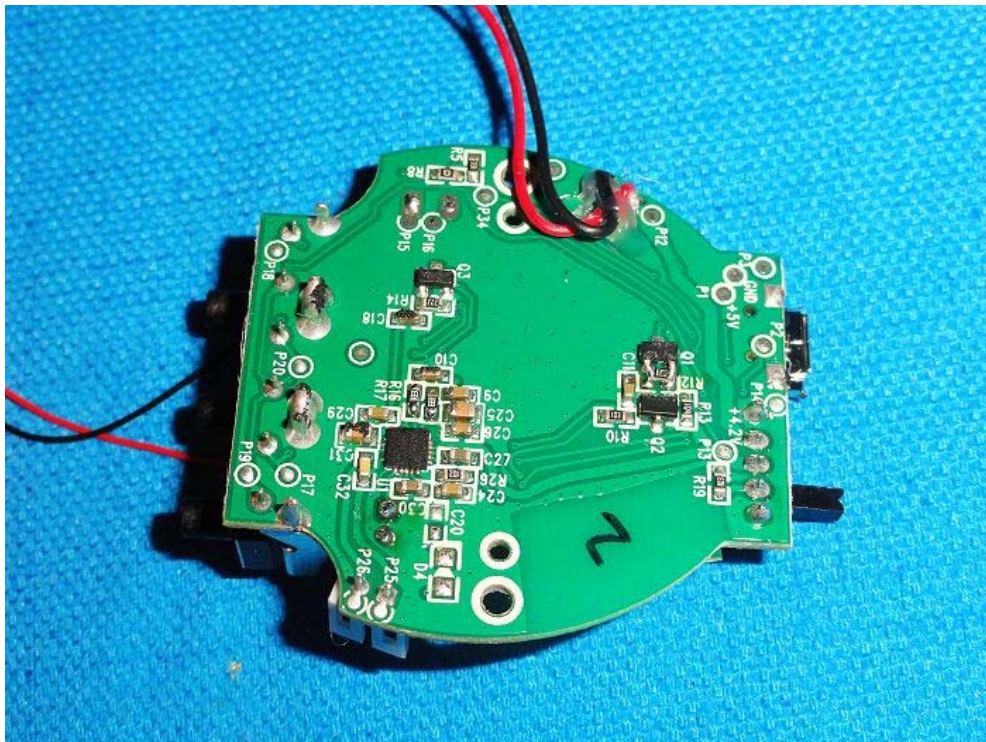
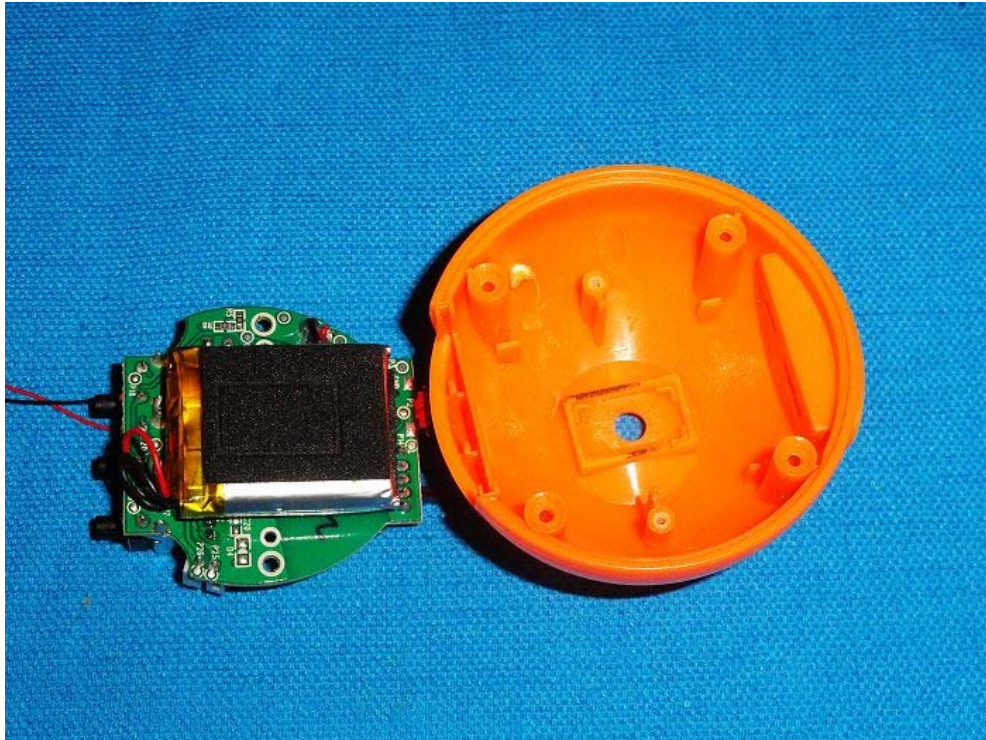


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Photos of the Product



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Photos of the Product (Black Encloure)



End of the report

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