RF TEST REPORT

Report No.:	SET2016-12624
Product Name:	Connected Handheld RFID Reader
FCC ID:	P65ALR-H450B
IC:	4370A-ALRH450B
Model No. :	ALR-H450
Applicant:	Alien Technology, LLC
Address：	845 Embedded Way, San Jose, CA 95138-1030, United States
Dates of Testing:	06/20/2016 — 06/29/2016
Issued by:	CCIC-SET
Lab Location:	Electronic Testing Building, Shahe Road, Xili, Nanshan District, Shenzhen, 518055, P. R. China **Tel:** 86 755 26627338 **Fax:** 86 755 26627238

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Test Report

Product Name.....:	Connected Handheld RFID Reader
Brand Name.....:	ALIEN
Trade Name.....:	ALIEN®
Applicant.....:	Alien Technology, LLC
Applicant Address.....:	845 Embedded Way, San Jose, CA 95138-1030, United States
Manufacturer .....:	Alien Technology, LLC
Manufacturer Address .....:	845 Embedded Way, San Jose, CA 95138-1030, United States
Test Standards.....:	47 CFR Part 15 Subpart C 2013：Radio Frequency Devices ANSI C63.10:2013：American National Standard for Testing Unlicensed Wireless Devices RSS-247:Issue 1,December2015 / RSS-GEN Issue 4, November 2014 DA 00-705: Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
Test Result.....:	PASS
Tested by .....:	 2016.06.30 Lu Lei， Test Engineer
Reviewed by .....:	 2016.06.30 Zhu Qi, Senior Engineer
Approved by .....:	 2016.06.30 Wu Li'an, Manager

Table of contents

Change History		
Issue	Date	Reason for change
1.0	2016.06.30	First edition

1. General Information

1.1. EUT Description

EUT Type	Connected Handheld RFID Reader	
Hardware Version	C4050_MB_V5.0	
Software Version	V1.0.0_10040006582_20151221	
EUT supports Radios application	GSM/GPRS/EDGE/WCDMA WLAN2.4GHz 802.11b/g/n (HT20/HT40) Bluetooth V3.0+EDR / Bluetooth V4.0LE	
Frequency Range	Bluetooth EDR	2402MHz~2480MHz
Channel Number	Bluetooth EDR	79
Bit Rate of Transmitter	Bluetooth EDR	1/2/3Mbps
Modulation Type	Bluetooth EDR	GFSK, π /4-DQPSK,8DPSK
Antenna Type	Linearly Polarization antenna	
Antenna Gain	-2dBi	

Note 1: The EUT is a mobile phone, it contains Bluetooth Module operating at 2.4GHz ISM band; the frequencies allocated for the Bluetooth Module is F(MHz)=2402+1*n (0<=n<=78). The lowest, middle, highest channel numbers of the Bluetooth Module used and tested in this report are separately 0 (2402MHz), 39 (2441MHz) and 78 (2480MHz).

Note 2: For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.

Note 3: a. When power on, the EUT will scan the whole frequency until a Connection command from the other BT devices.

b. When receiving the signal from the other BT devices, The EUT transmit are sponse signal.

c. The other devices receive the response signal and recognize it, then send a connection command to establish the connection.

d. After the connection establish successfully, the data transmission is beginning. At the same time, the both devices will shift frequencies in synchronization per a same pseudo randomly ordered list of hopping frequencies, the hopping rate is1600 times per second. This device conforms to the criteria in FCC Public Notice DA 00-705.

e. The bandwidth of the receiver, which is set to a fixed width by the software.

Note 4: Bluetooth signal has 9 packages 1DH1, 1DH3, 1DH5, 2DH1, 2DH3, 2DH5, 3DH1, 3DH3, 3DH5, DH5 package is largest, we are testing DH5 in the document.

1.2. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart C (Bluetooth, 2.4GHz ISM band radiators) for the EUT FCC ID Certification:

No.	Identity	Document Title
1	47 CFR Part 15 Subpart C 2013	Radio Frequency Devices
2	ANSI C63.10 2013	American National Standard for Testing Unlicensed Wireless Devices
3	RSS-GEN: Issue 4,November 2014	General Requirements and Information for the Certification of Radio Apparatus
4	RSS-247:Issue 1,December2015:	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Test detailed items/section required by FCC rules and results are as below:

No.	Standard(s) Section		Description	Result
	FCC	IC		
1	15.203	8.3	Antenna Requirement	PASS
2	15.247(a)	RSS-247 Issue1 - 5.1	Number of Hopping Frequency	PASS
3	15.247(b)	RSS-247 Issue1 - 5.4	Peak Output Power	PASS
4	15.247(a)	RSS-247 Issue1 - 5.1	Bandwidth	PASS
5	15.247(a)	RSS-247 Issue1 - 5.1	Carrier Frequency Separation	PASS
6	15.247(a)	RSS-247 Issue1 - 5.1	Time of Occupancy (Dwell time)	PASS
7	15.247(d)	RSS-247 Issue1 - 5.5	Conducted Spurious Emission	PASS
8	15.247(d)	RSS-247 Issue1 - 5.5 RSS - Gen	Conducted Band Edge	PASS
9	15.207	RSS-GEN	Conducted Emission	PASS
10	15.209 15.247(c)	RSS-247 Issue1 - 5.5 RSS - Gen	Radiated Band Edges and Spurious Emission	PASS

Note 1: The tests were performed according to the method of measurements prescribed in DA-00-705.

Note 2: The test of Radiated Emission was performed according to the method of measurements prescribed in ANSI C63.10 2013.

1.3. Frequency Hopping System Requirements

1.3.1. 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.

1.3.2. 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.

1.3.3. 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.

1.4. Facilities and Accreditations

1.4.1. Facilities

CNAS-Lab Code: L1659
CCIC Southern Electronic Product Testing (Shenzhen) Co., Ltd. CCIC is a third party testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L1659. A 12.8*6.8*6.4 (m) fully anechoic chamber was used for the radiated spurious emissions test.
FCC-Registration No.: 406086

CCIC Southern Electronic Product Testing (Shenzhen) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files. Registration 406086, valid time is until October 28, 2017.

IC-Registration No.: 11185A-1

CCIC Southern Electronic Product Testing (Shenzhen) Co., Ltd. EMC Laboratory has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No. 11185A-1 on July. 15, 2013, valid time is until July. 15, 2016.

1.4.2. Test Environment Conditions

During the measurement, the environmental conditions were within the listed ranges:

Temperature (°C):	15 - 35
Relative Humidity (%):	30 -60
Atmospheric Pressure (kPa):	86KPa-106KPa

2. 47 CFR Part 15C Requirements

2.1. Antenna requirement

2.1.1. Applicable Standard

According to FCC 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.

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

2.1.2. Antenna Information

Antenna Category: Linearly Polarization antenna

An Linearly Polarization antenna was soldered to the antenna port of EUT via an adaptor cable, can't be removed.

Antenna General Information:

No.	EUT	Ant. Type	Gain(dBi)
1	Connected Handheld RFID Reader	Internal	-2

2.1.3. Result: comply

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.

2.2. Number of Hopping Frequency

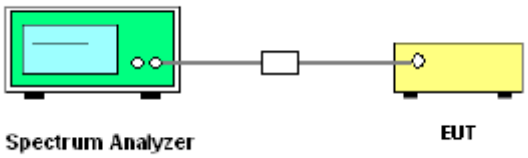
2.2.1. Limit of Number of Hopping Frequency

Frequency hopping systems operating in the 2400MHz to 2483.5MHz bands shall use at least 15 hopping frequencies.

2.2.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.2.3. Test Setup



2.2.4. Test Procedure

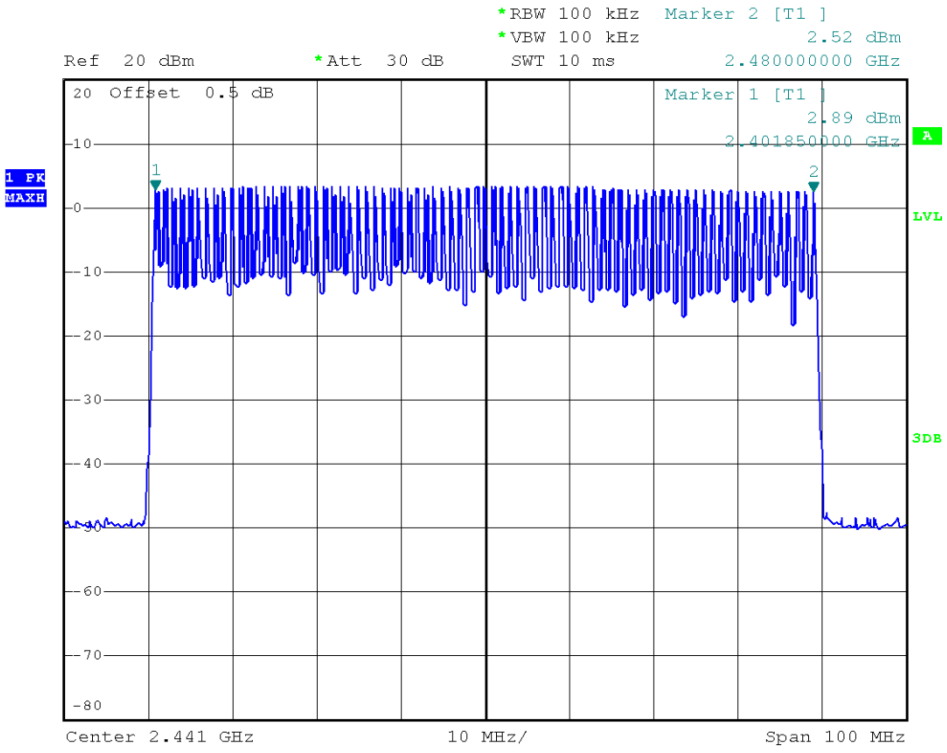
1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings: Span = the frequency band of operation; RBW≥100KHz; VBW≥RBW; Sweep = auto; Detector function = peak; Trace = max hold.
6. The number of hopping frequency used is defined as the number of total channel.
7. Record the measurement data derived from spectrum analyzer.

2.2.5. Test Results of Number of Hopping Frequency

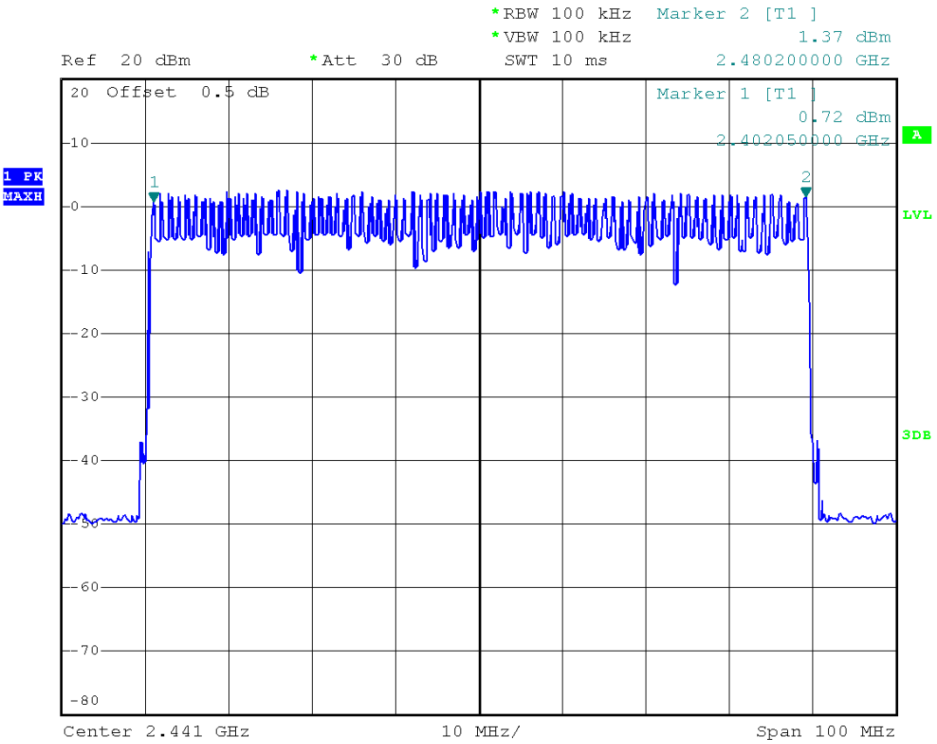
The Bluetooth Module operates at hopping-on test mode; the frequencies number employed is counted to verify the Module's using the number of hopping frequency.

Test Mode	Frequency Block (MHz)	Measured Channel Numbers	Min. Limit	Refer to Plot	Verdict
GFSK	2400 - 2483.5	79	15	Plot A	PASS
π/4-DQPSK	2400 - 2483.5	79	15	Plot B	PASS
8-DPSK	2400 - 2483.5	79	15	Plot C	PASS

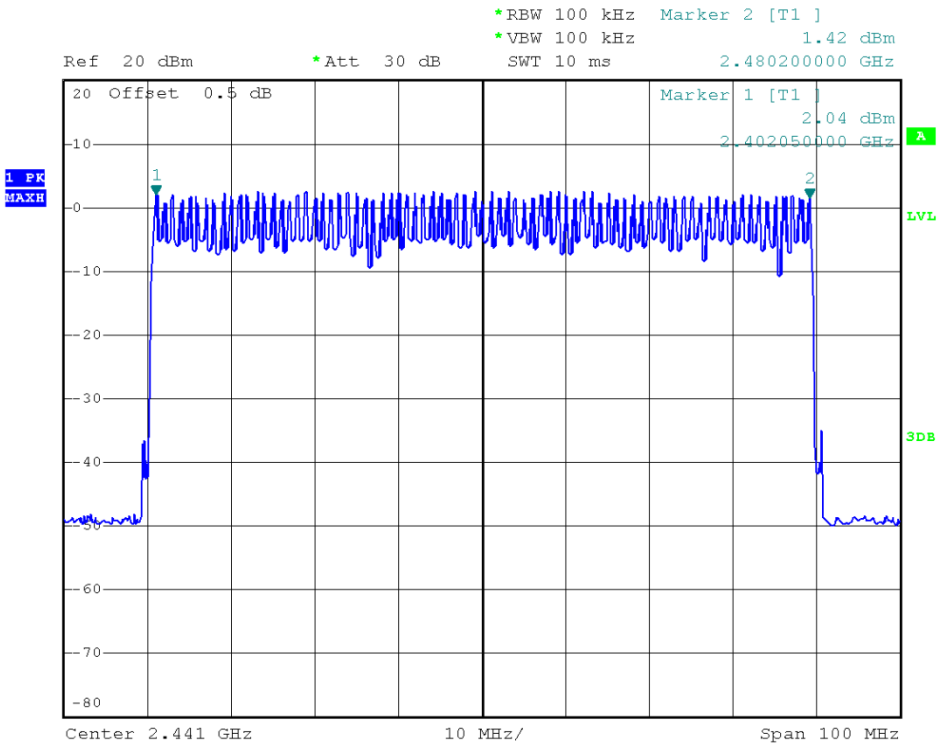
2.2.6. Test Results (plots) of Number of Hopping Frequency



(Plot A: GFSK)



(Plot B: π/4-DQPSK)



(Plot C: 8- DPSK)

2.3. Peak Output Power

2.3.1. Limit of Peak Output Power

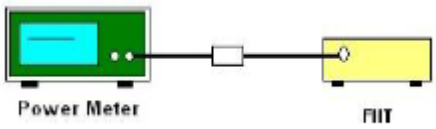
Section 15.247 (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band 0.125 watts.

Requency 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

2.3.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.3.3. Test Setup



2.3.4. Test Procedures

1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power with cable loss and record the results in the test report.
5. Measure and record the results in the test report.

2.3.5. Test Result of Output Power

Test Mode	Channel	Frequency (MHz)	Measured Output Peak Power (dBm)	Limit (dBm)	Verdict
GFSK	0	2402	3.22	21	PASS
	39	2441	3.47		PASS
	78	2480	2.78		PASS
π/4-DQPSK	0	2402	2.45		PASS
	39	2441	2.75		PASS
	78	2480	2.03		PASS
8- DPSK	0	2402	2.34		PASS
	39	2441	2.65		PASS
	78	2480	2.01		PASS

2.4. Bandwidth

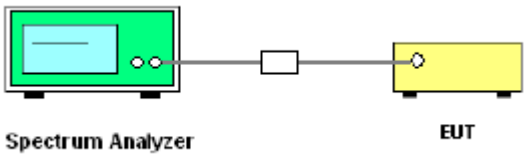
2.4.1. Definition

According to FCC §15.247(a)(1), the 20dB bandwidth is known as the 99% emission bandwidth, or 20dB bandwidth (10*log1% = 20dB) taking the total RF output power.

2.4.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.4.3. Test Setup



2.4.4. Test Procedure

1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Use the following spectrum analyzer settings for 20dB Bandwidth measurement.

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

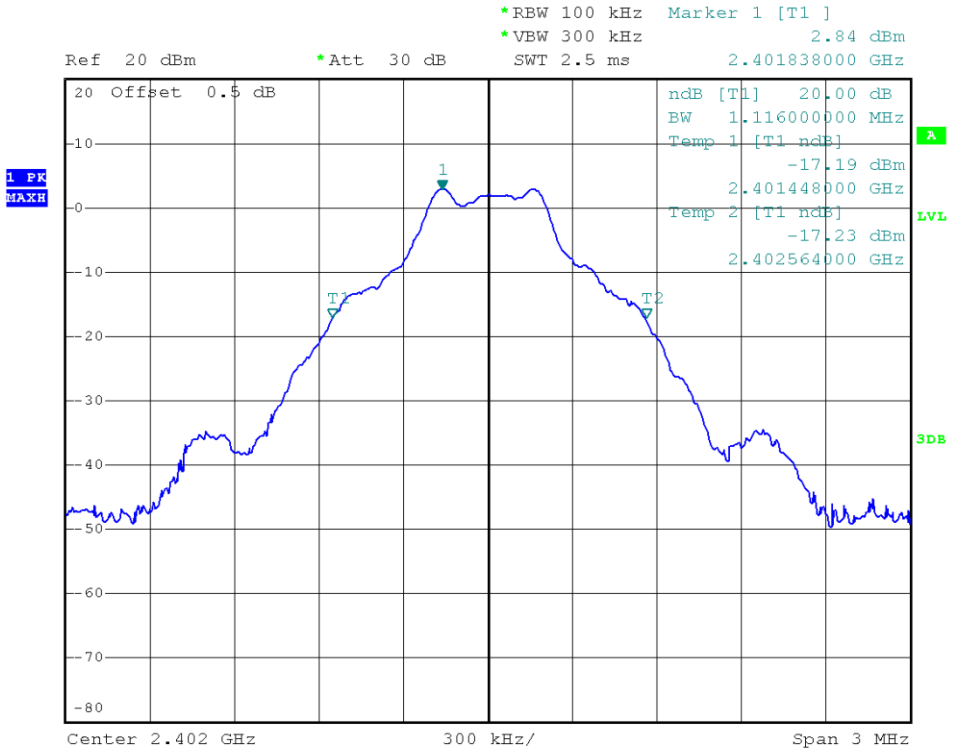
   RBW≥1% of the 20 dB bandwidth; VBW≥RBW; Sweep = auto; Detector function = peak;

   Trace = max hold.
5. Measure and record the results in the test report.

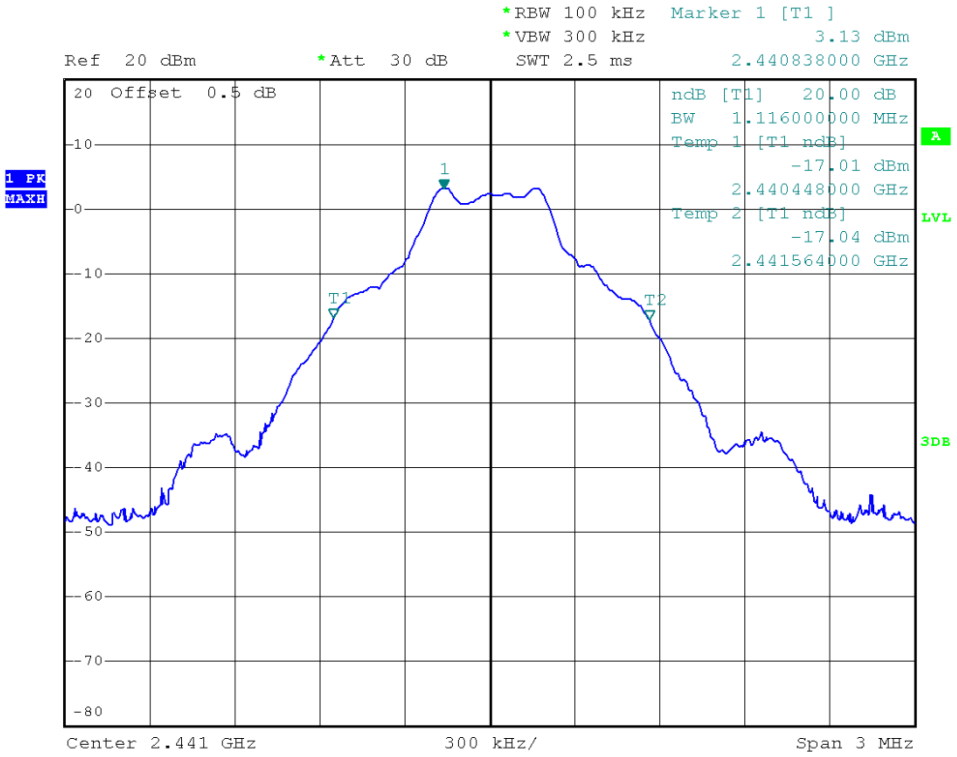
2.4.5. Test Results of 20dB Bandwidth

Mode	Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% bandwidth (MHz)
GFSK	0	2402	1.116	0.930
	39	2441	1.116	0.930
	78	2480	1.110	0.942
π/4-DQPSK	0	2402	1.290	1.194
	39	2441	1.290	1.188
	78	2480	1.296	1.194
8-DPSK	0	2402	1.278	1.188
	39	2441	1.284	1.188
	78	2480	1.278	1.194

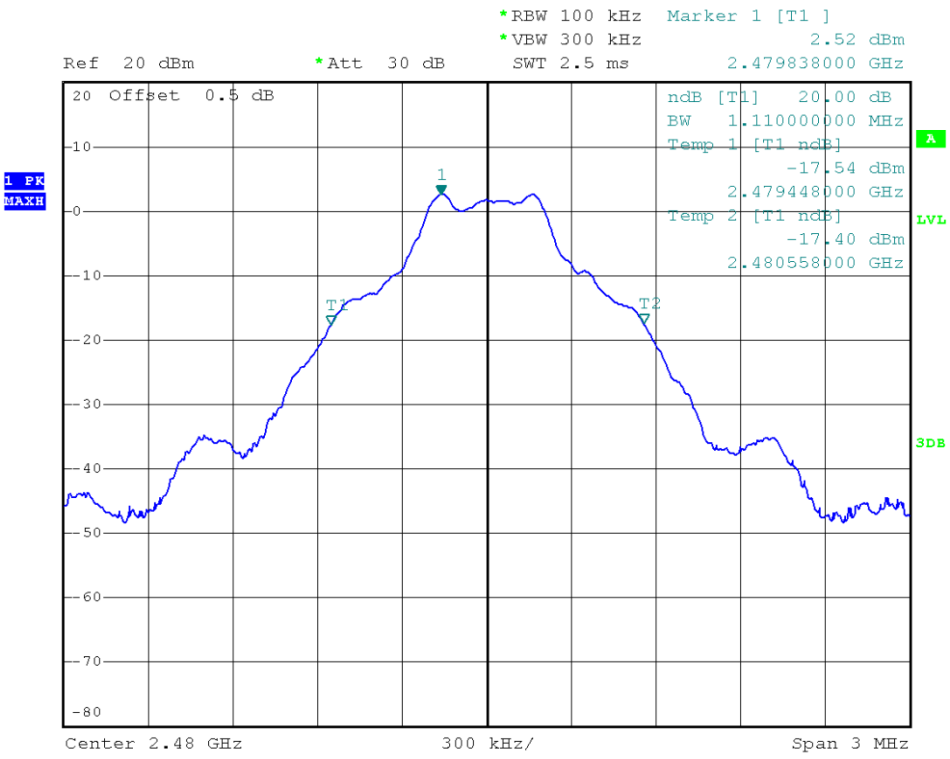
2.4.6. Test Results (plots) of 20dB Bandwidth



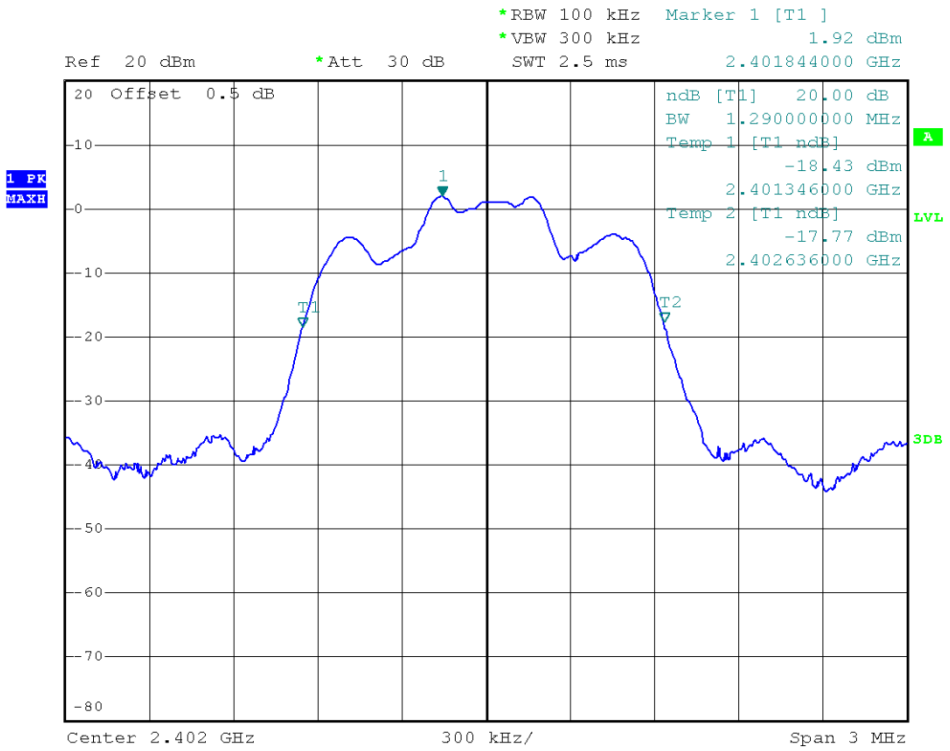
Channel @ GFSK



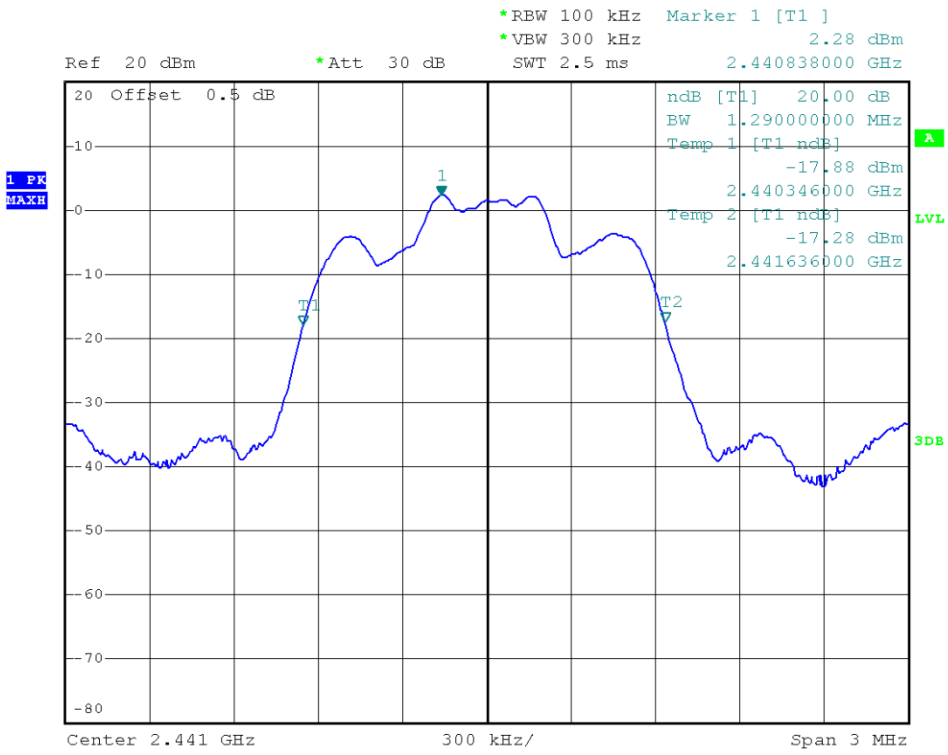
39 Channel @ GFSK



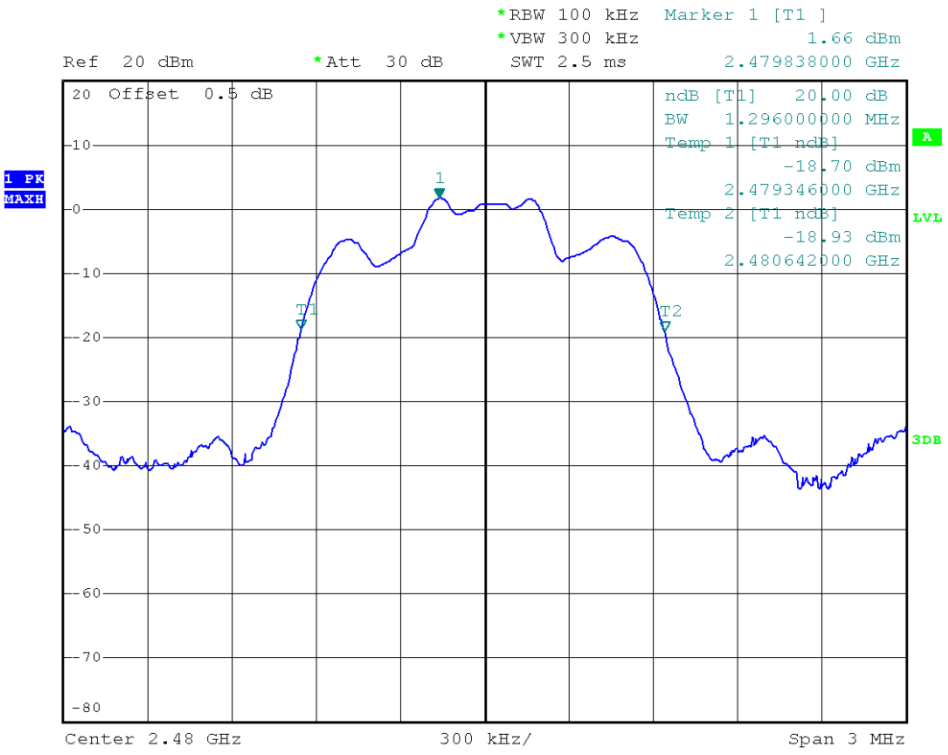
78 Channel @ GFSK



0 Channel @ π/4-DQPSK



39 Channel @ π/4-DQPSK



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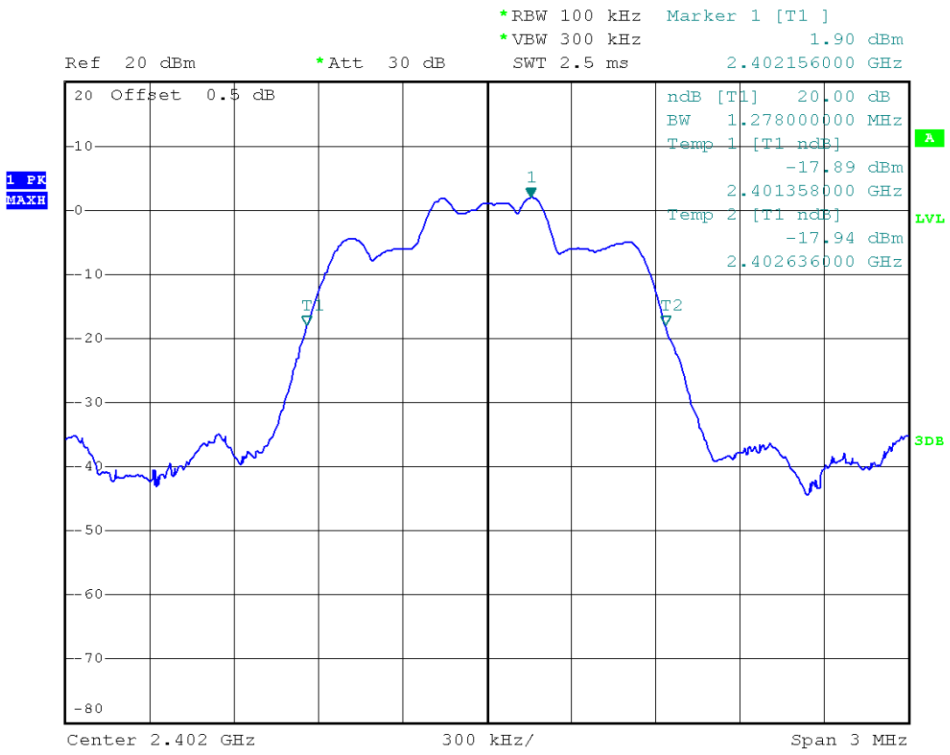
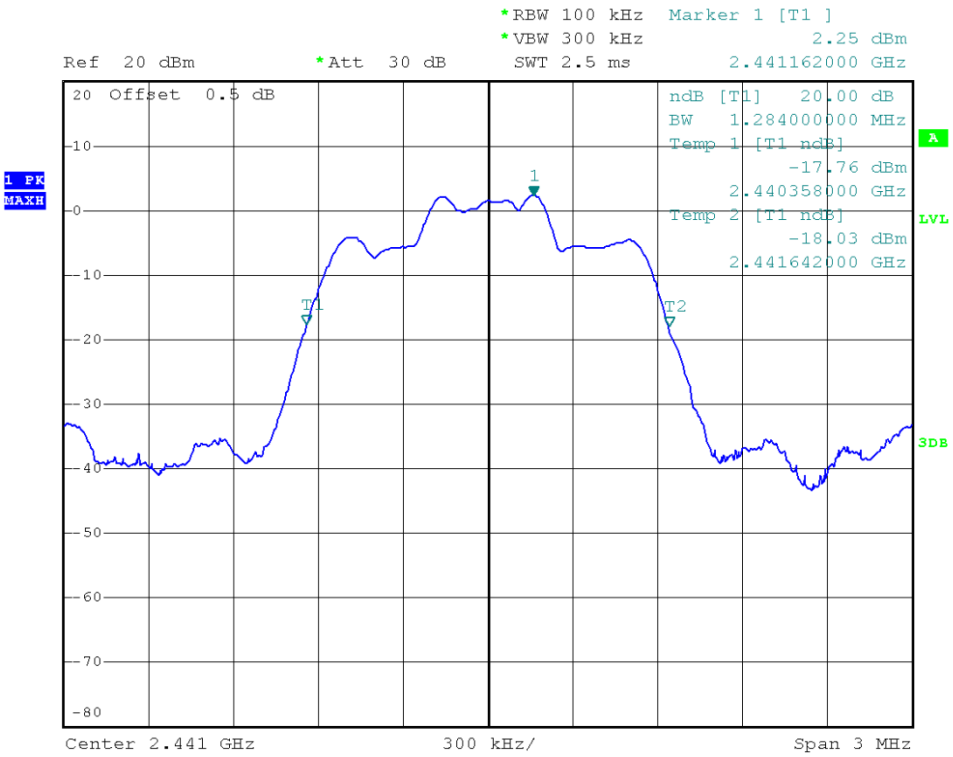
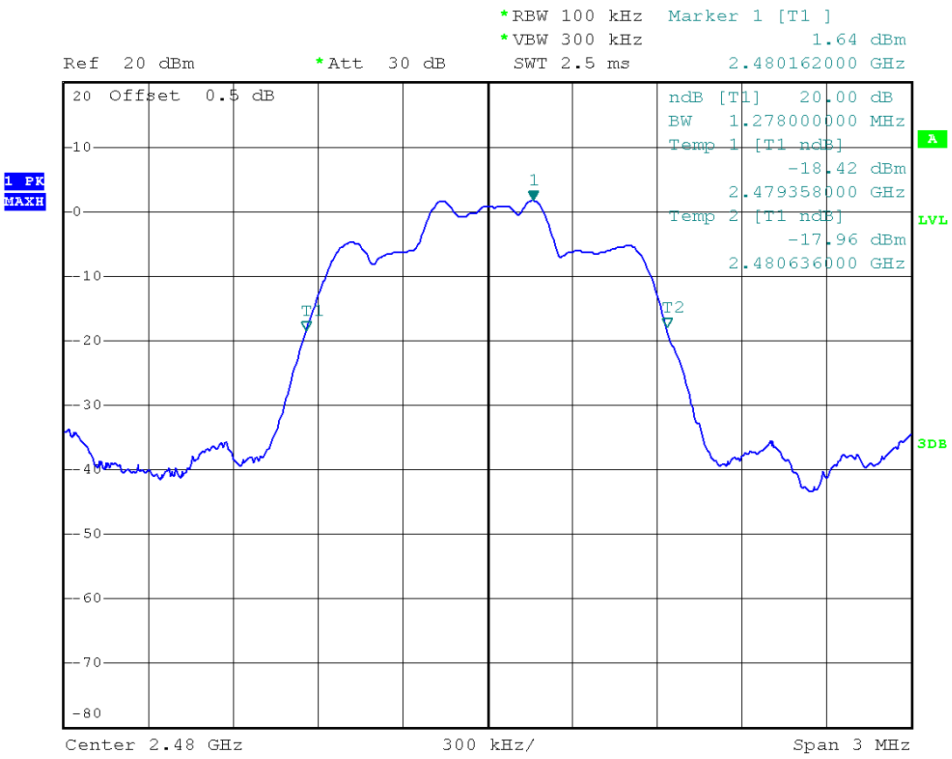


0 Channel @ 8-DPSK

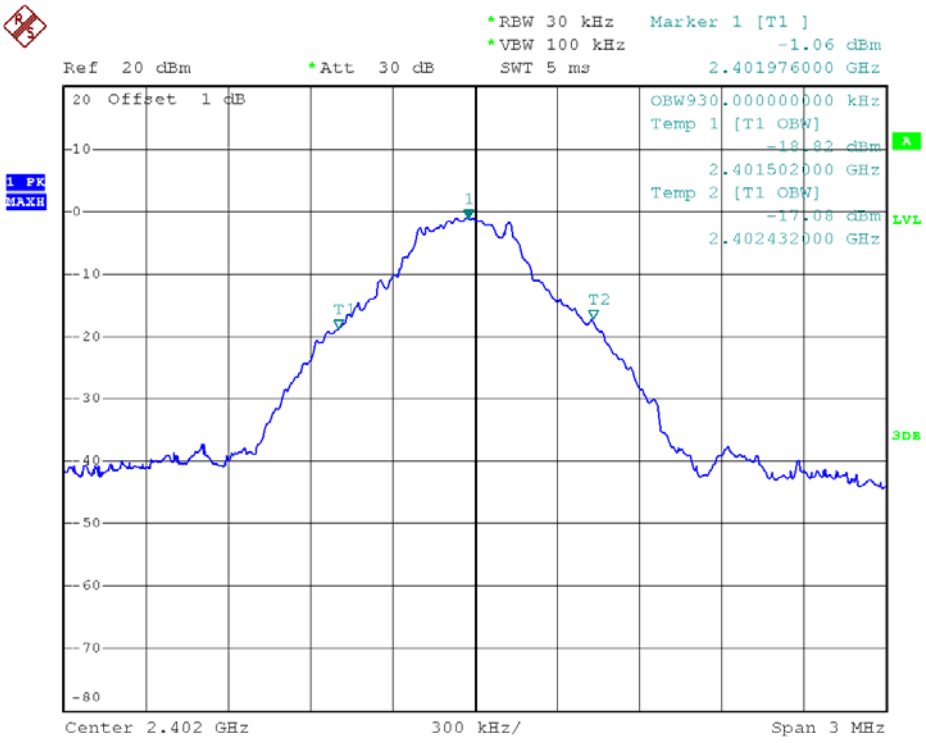


39 Channel @ 8-DPSK

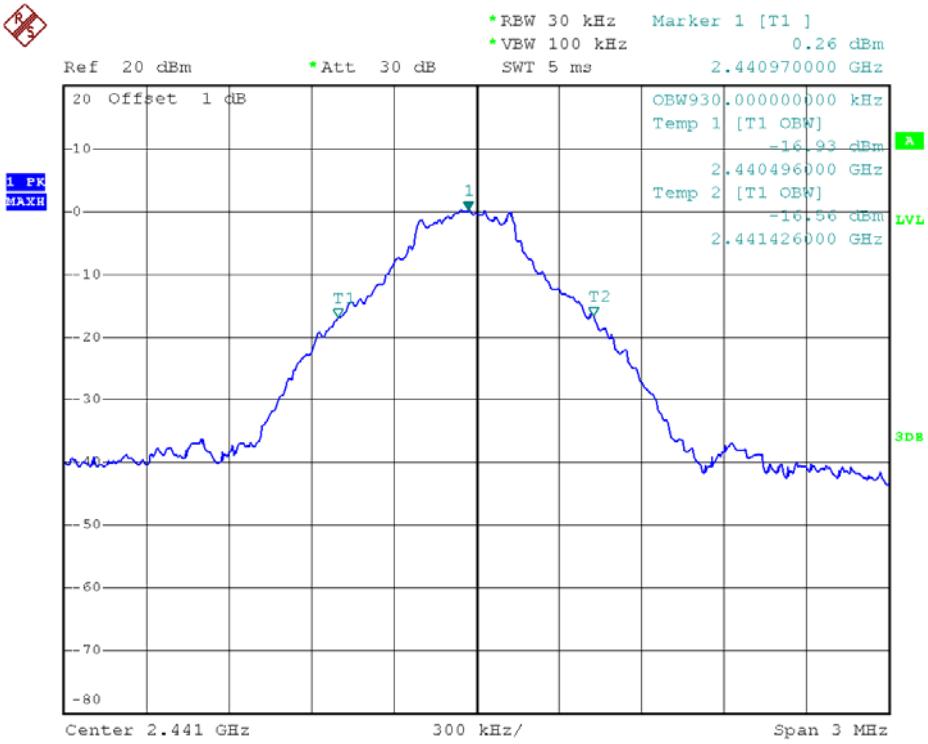


78 Channel @ 8-DPSK

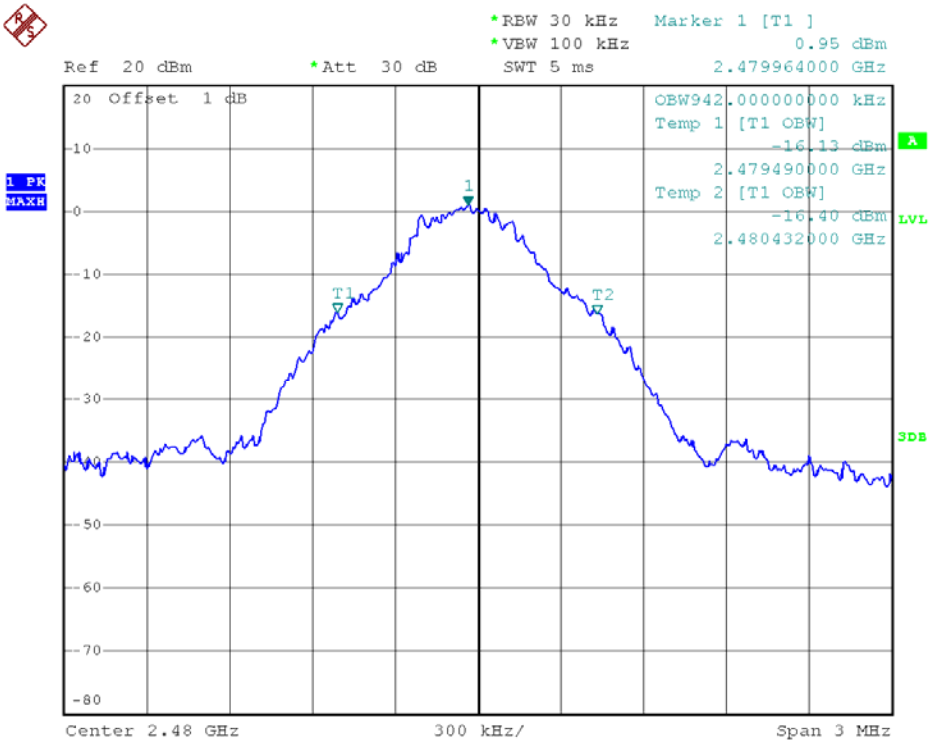
2.4.7. Test Results (plots) of 99% Bandwidth



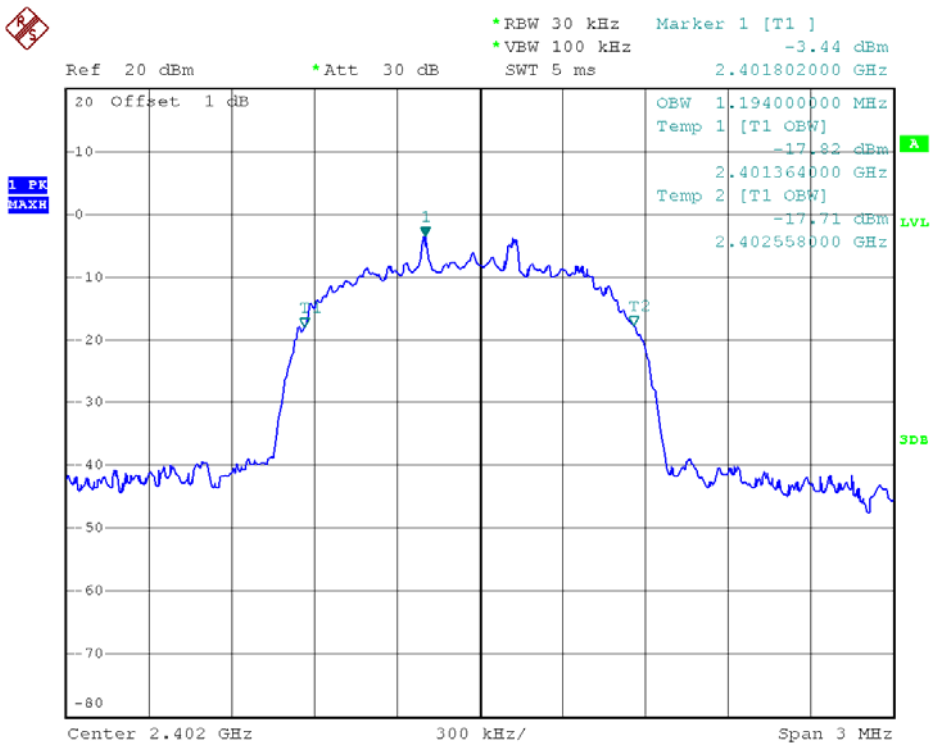
0 Channel @ GFSK



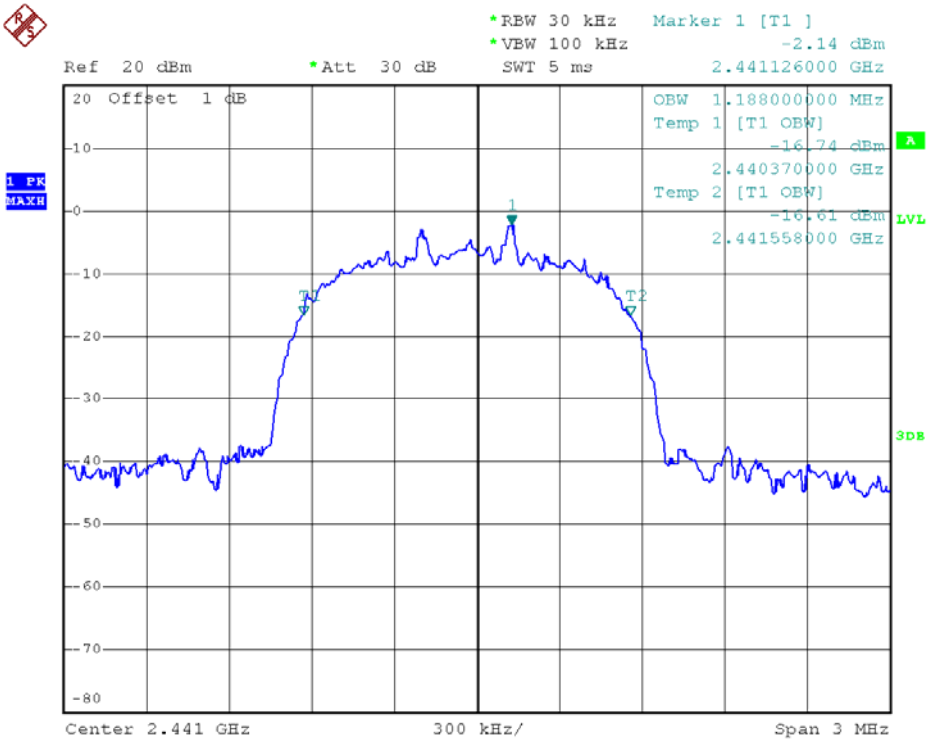
39 Channel @ GFSK



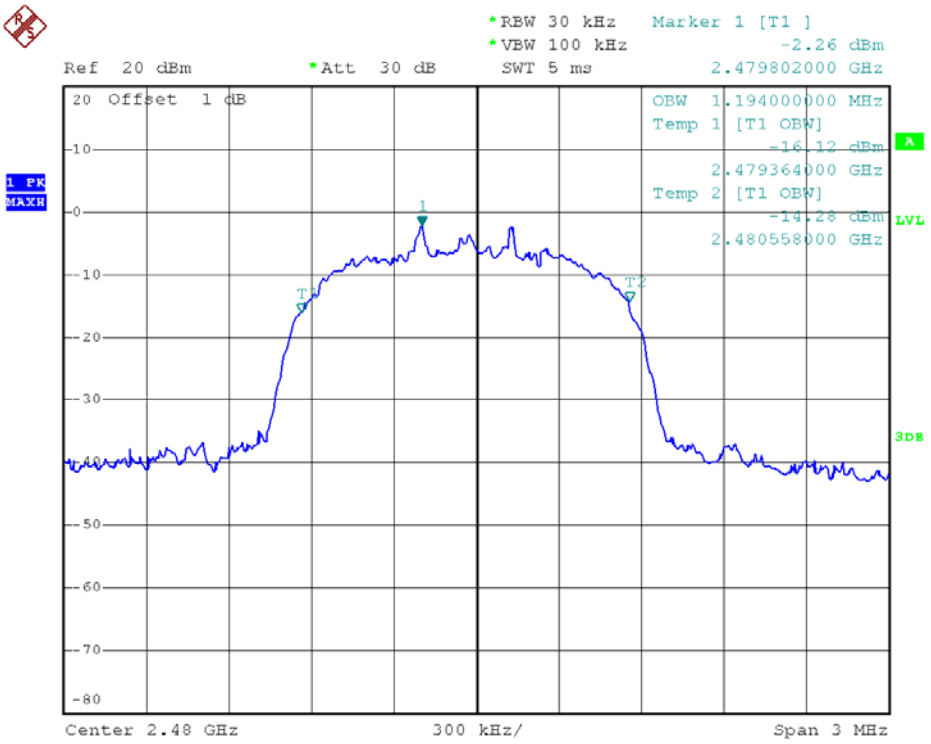
78 Channel @ GFSK



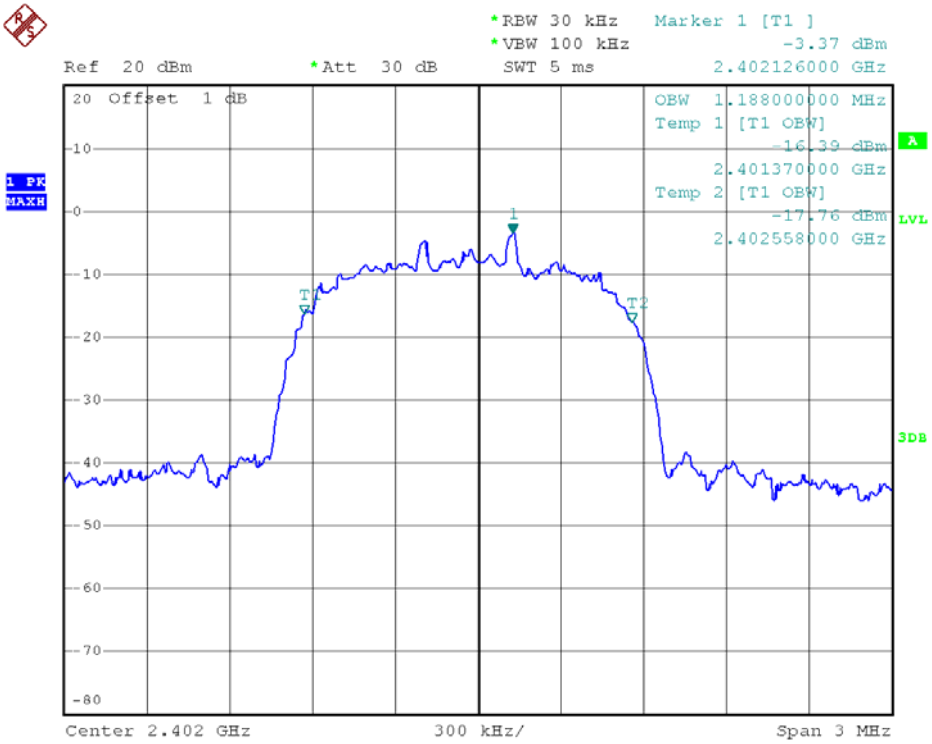
0 Channel @ π/4-DQPSK



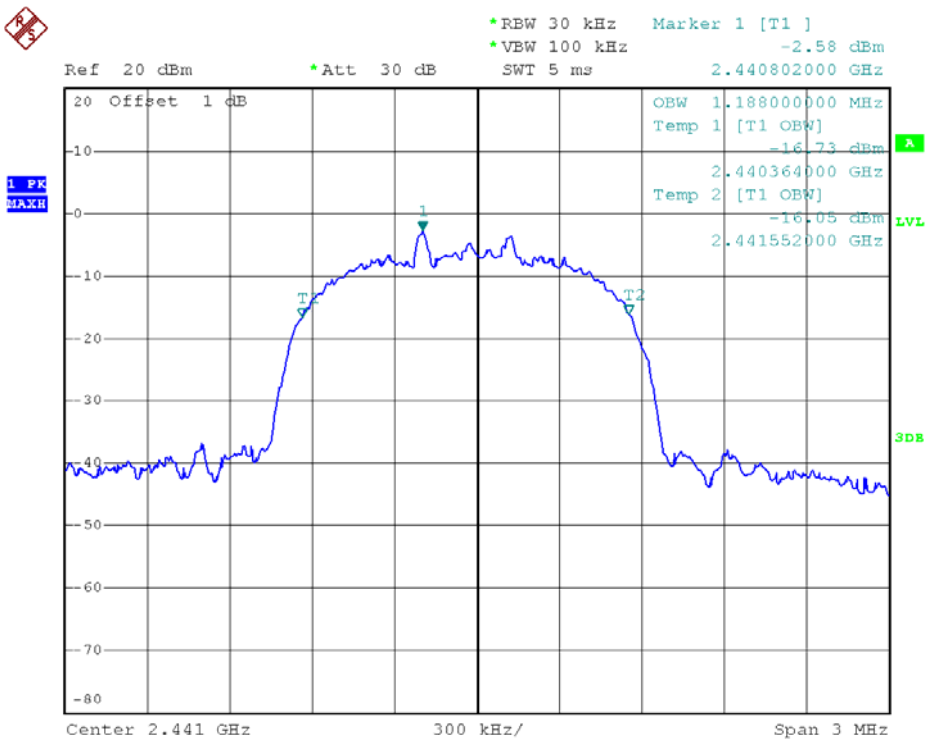
39 Channel @ π/4-DQPSK



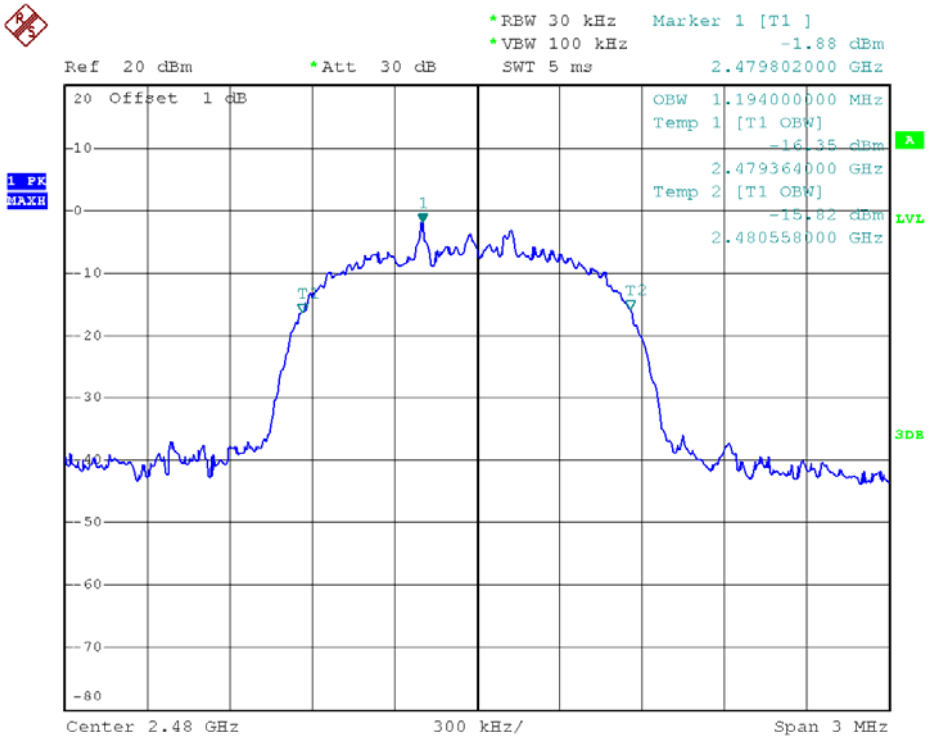
78 Channel @ π/4-DQPSK



0 Channel @ 8-DPSK



39 Channel @ 8-DPSK



78 Channel @ 8-DPSK

2.5. Carried Frequency Separation

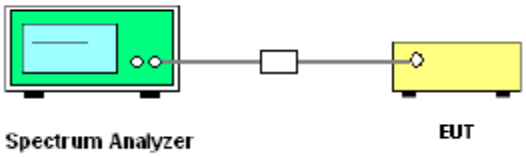
2.5.1. Limit of Carried Frequency Separation

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater.

2.5.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.5.3. Test Setup



2.5.4. Test Procedure

1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.

2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.

3. Set to the maximum power setting and enable the EUT transmit continuously.

4. Enable the EUT hopping function.

5. Use the following spectrum analyzer settings:

   Span = wide enough to capture the peaks of two adjacent channels; RBW≥1% of the span;

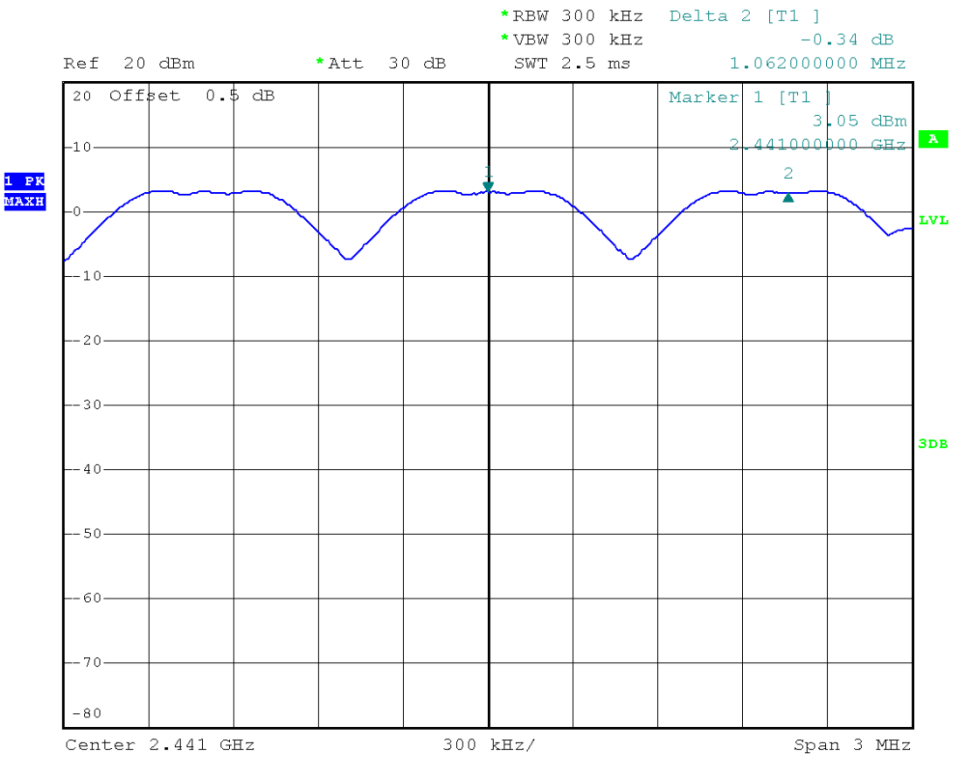
   VBW≥RBW; Sweep = auto; Detector function = peak; Trace = max hold.

6. Measure and record the results in the test report.

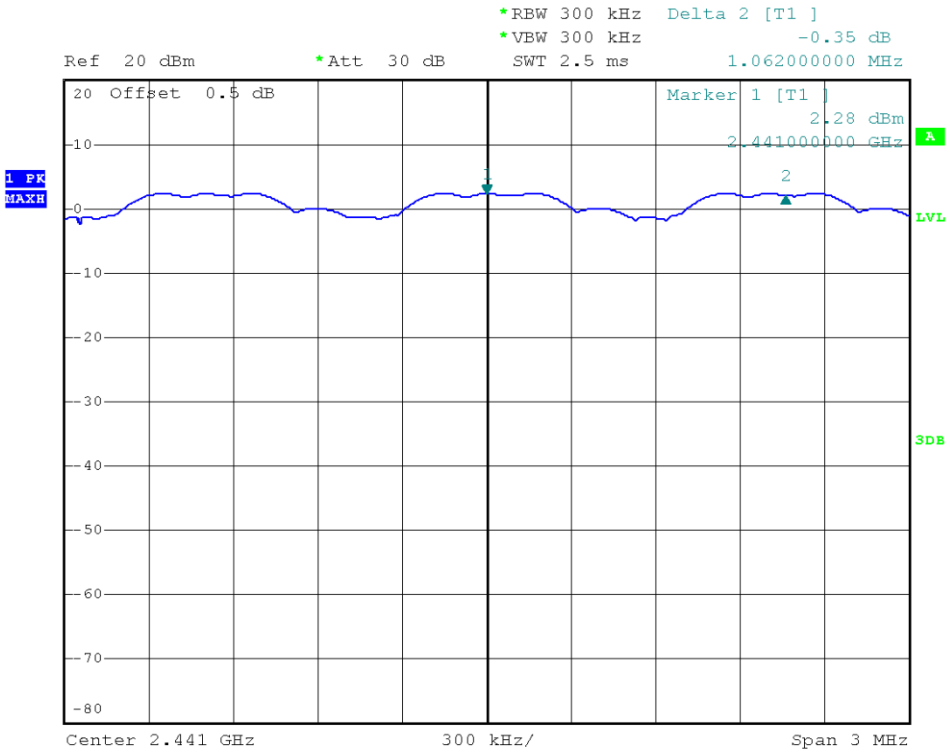
2.5.5. Test Results of Carried Frequency Separation

Test mode	Frequency Separation(MHz)	(2/3 of 20dB BW) Limits (MHz)	Verdict
GFSK	1.062	0.744	PASS
π/4-DQPSK	1.062	0.864	PASS
8-DPSK	1.062	0.856	PASS

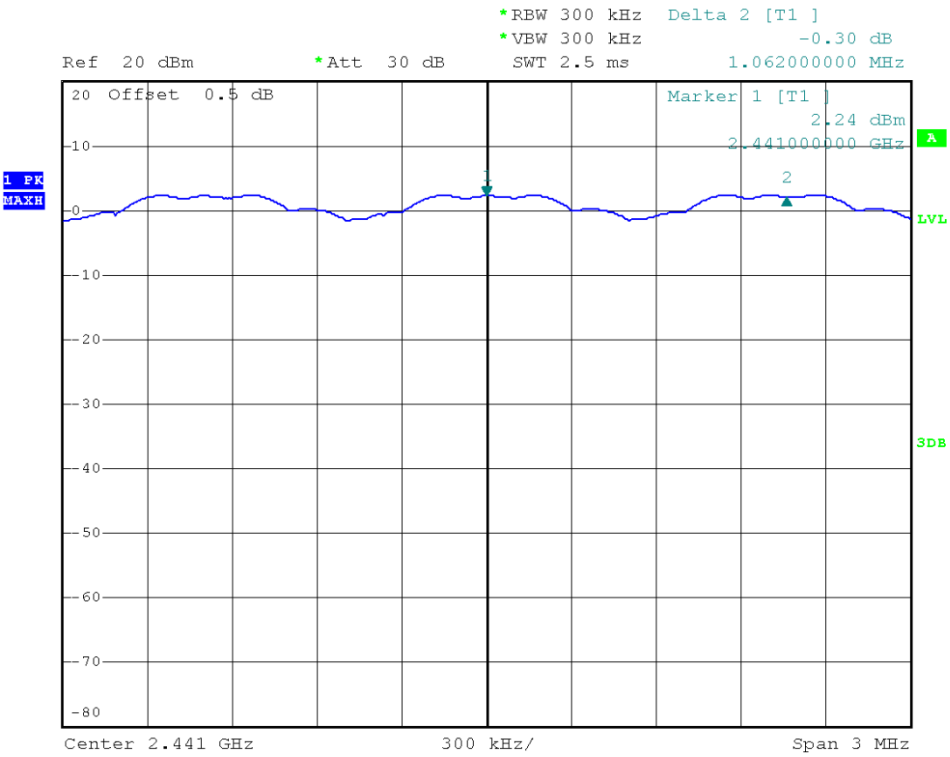
2.5.6. Test Results (plots) of Carried Frequency Separation



GFSK Mode



π/4-DQPSK Mode



8-DPSK Mode

2.6. Dwell time

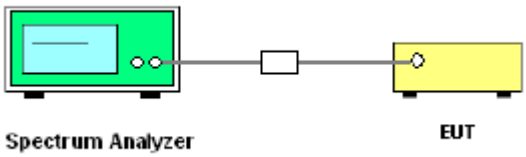
2.6.1. Limit of Dwell Time

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.

2.6.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.6.3. Test Setup



2.6.4. Test Procedure

1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator.

   The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings: Span = zero span, centered on a hopping channel; RBW = 1 MHz; VBW≥RBW; Sweep = as necessary to capture the entire dwell time per hopping channel; Detector function = peak; Trace = max hold.
6. Measure and record the results in the test report.

2.6.5. Test Results of Dwell Time

For DH1 package type:

{Total of Dwell} = {Pulse Time} * (1600 / 2) / {Number of Hopping Frequency} * {Period}

{Period} = 0.4s * {Number of Hopping Frequency}

For DH3 package type:

{Total of Dwell} = {Pulse Time} * (1600 / 4) / {Number of Hopping Frequency} * {Period}

{Period} = 0.4s * {Number of Hopping Frequency}

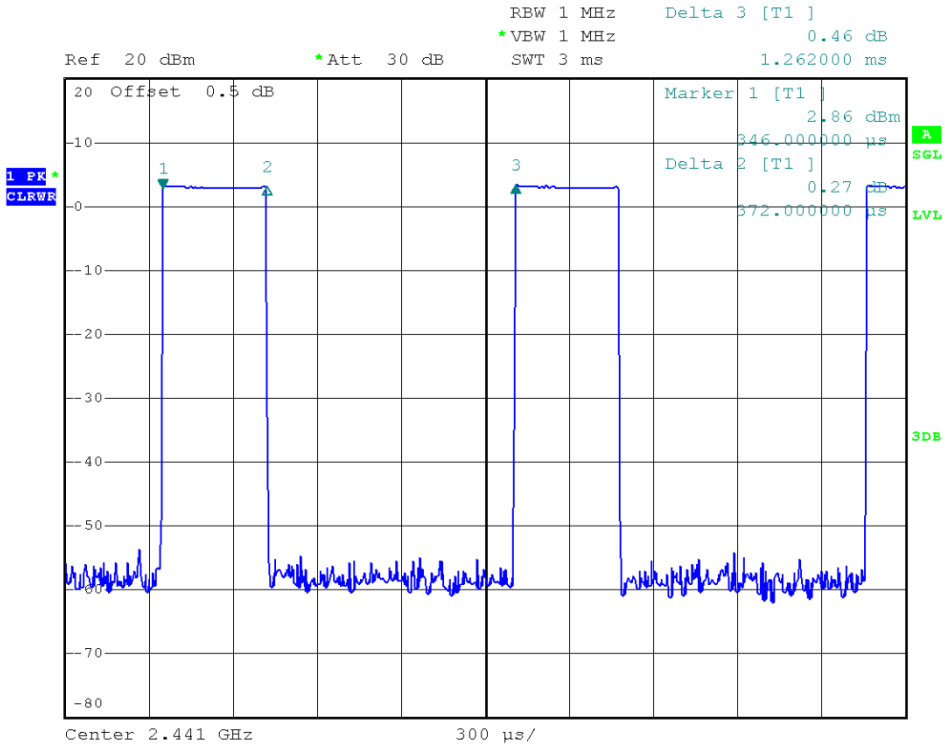
For DH3 package type:

{Total of Dwell} = {Pulse Time} * (1600 / 6) / {Number of Hopping Frequency} * {Period}

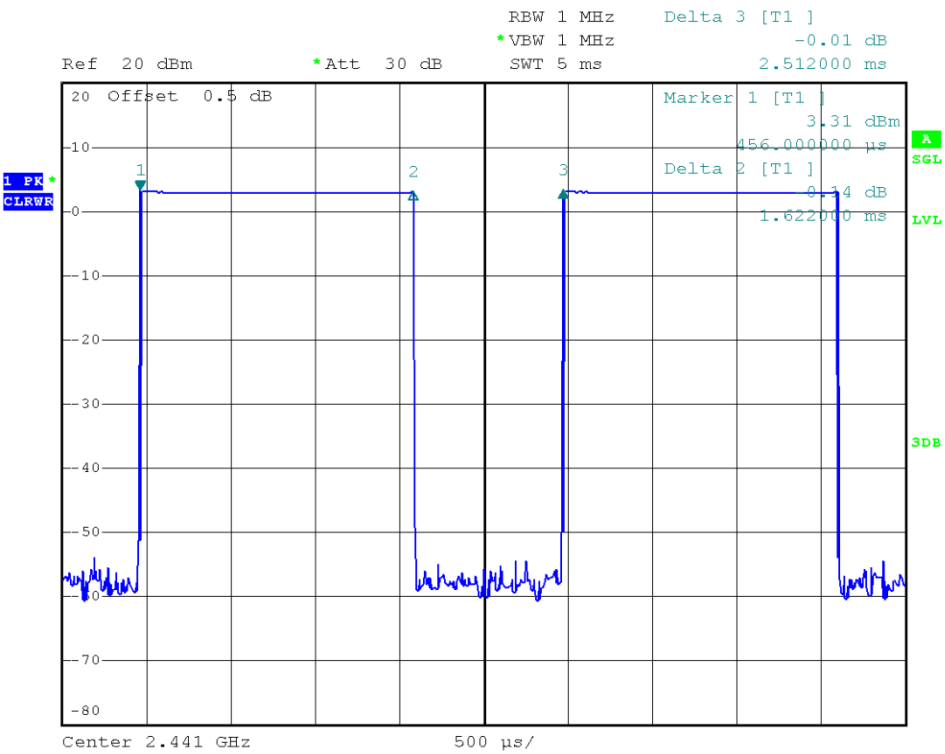
{Period} = 0.4s * {Number of Hopping Frequency}

Modulation	Packet Type	Channel	Pulse Time (ms)	Dwell Time (ms)	Limit (ms)	Verdict
GFSK	DH1	39	0.372	119.04	400	PASS
	DH3	39	1.622	259.52		PASS
	DH5	39	2.882	307.41		PASS
π/4-DQPSK	DH1	39	0.380	121.60		PASS
	DH3	39	1.630	260.80		PASS
	DH5	39	2.890	308.27		PASS
8-DPSK	DH1	39	0.376	120.32		PASS
	DH3	39	1.636	261.76		PASS
	DH5	39	2.876	306.77		PASS

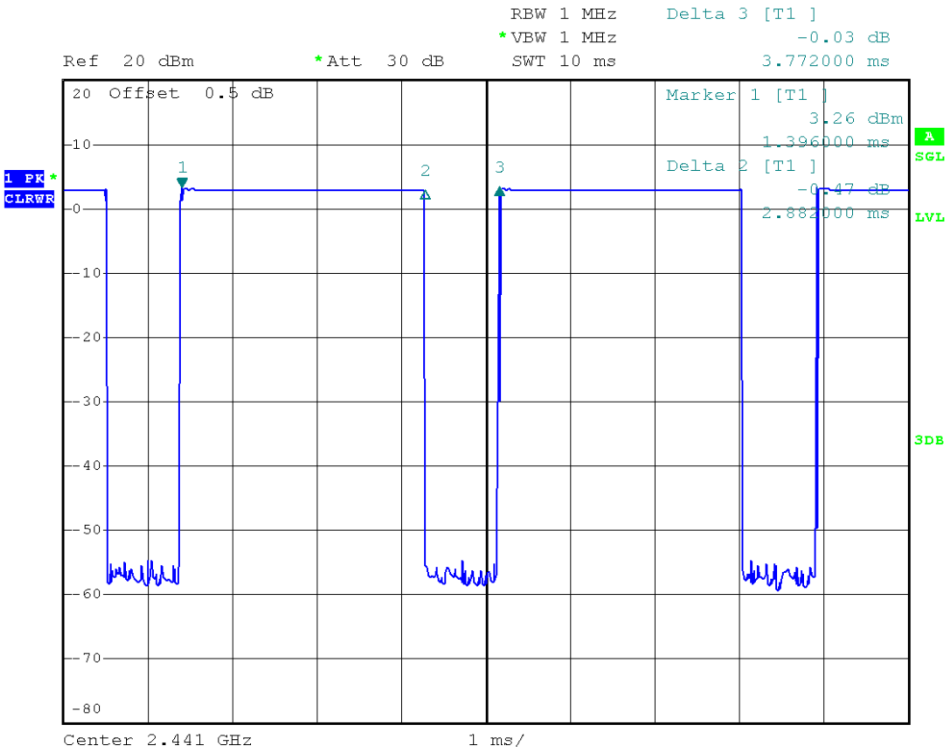
2.6.6. Test Results (plots) of Dwell Time



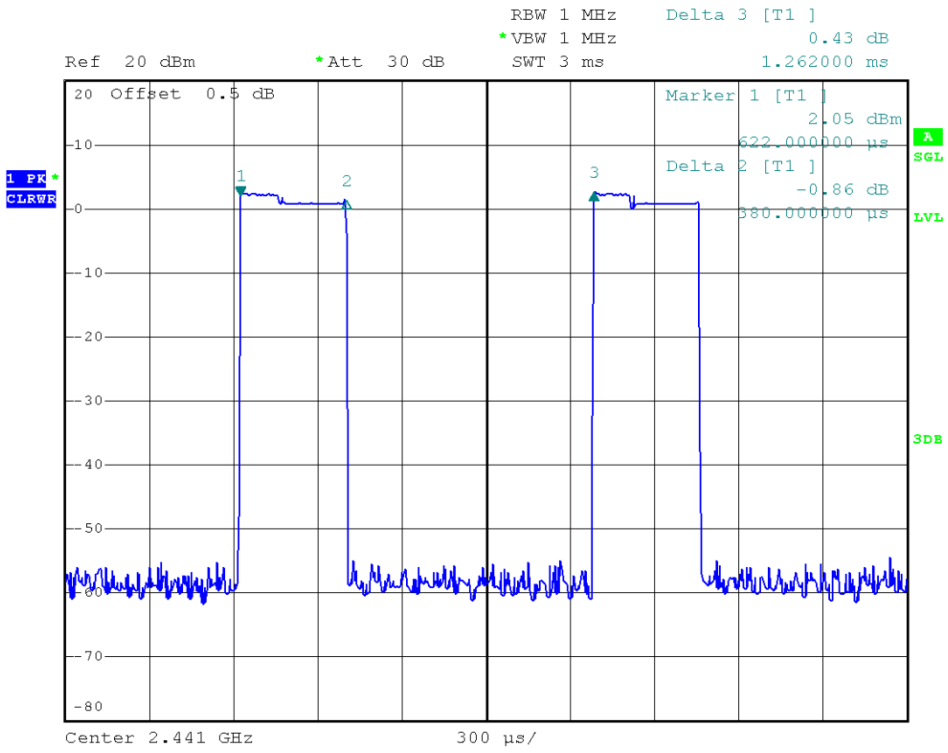
39 Channel @ DH1



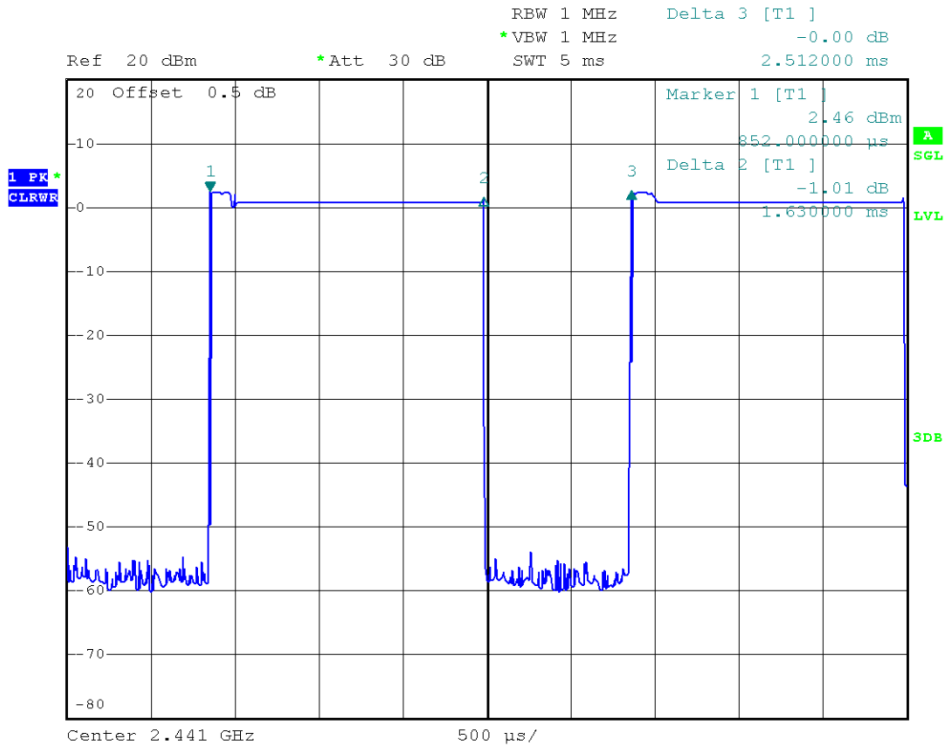
39 Channel @ DH3



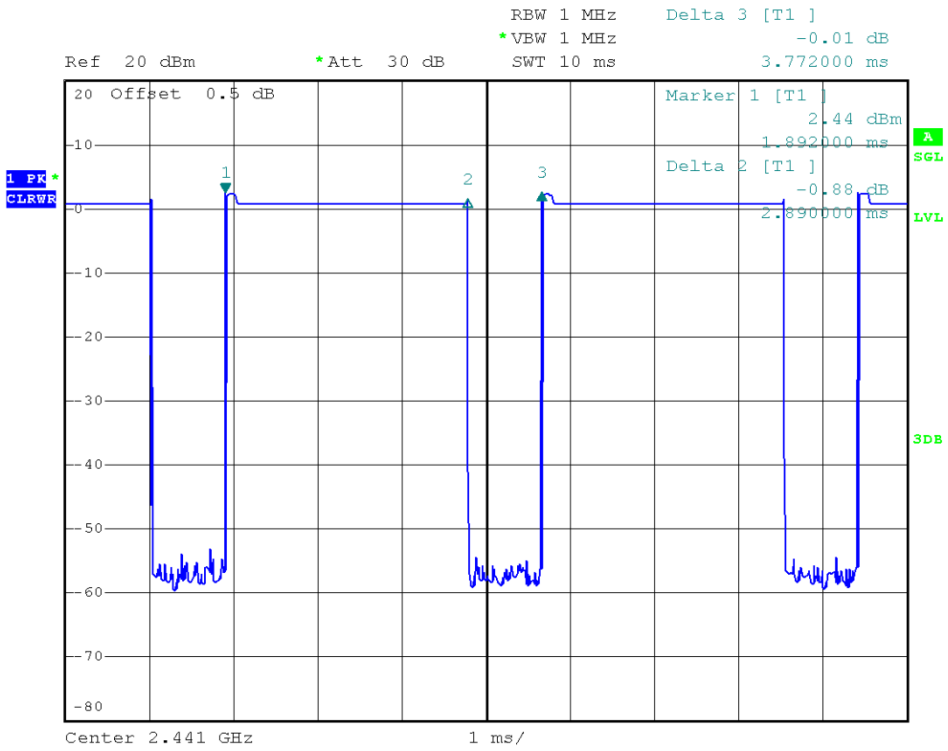
39 Channel @ DH5



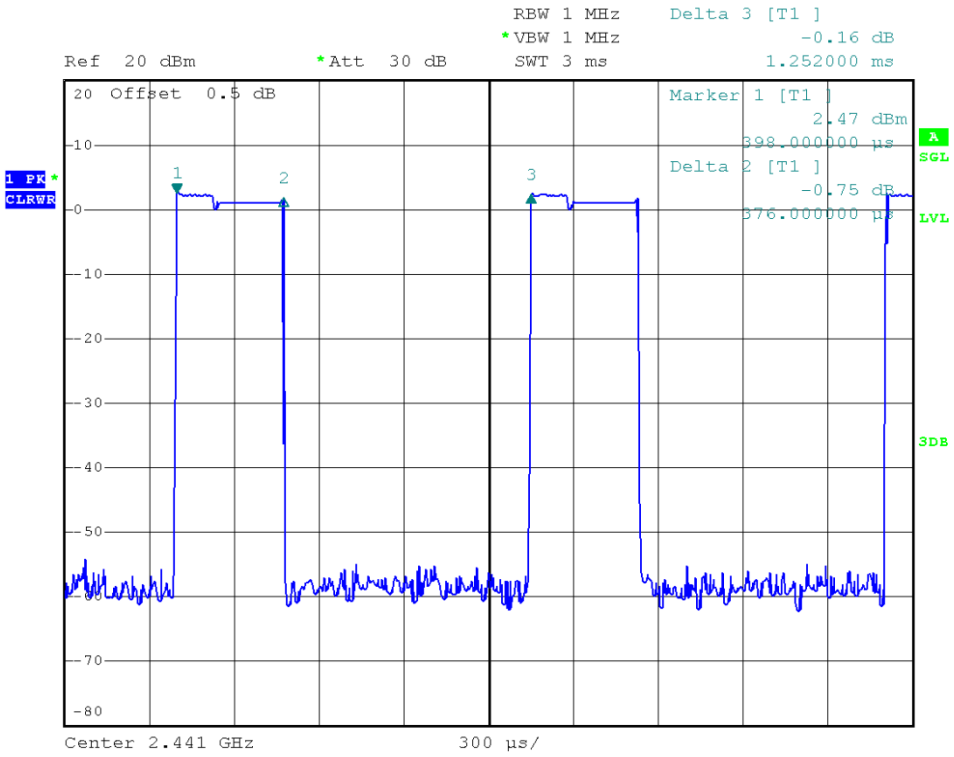
39 Channel @ 2DH1



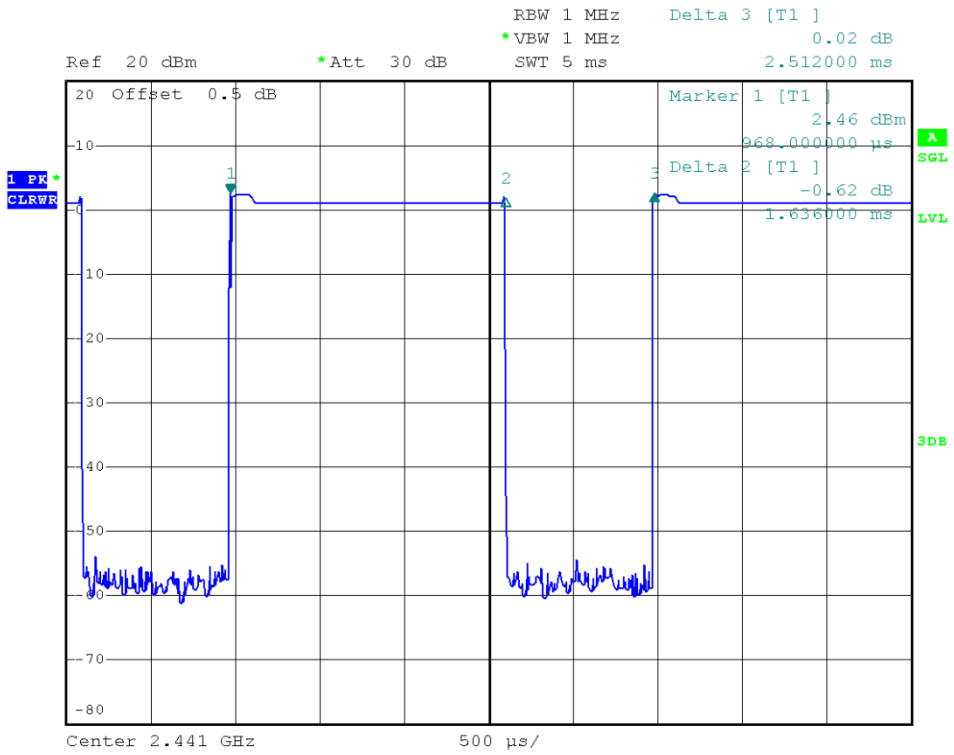
39 Channel @ 2DH3



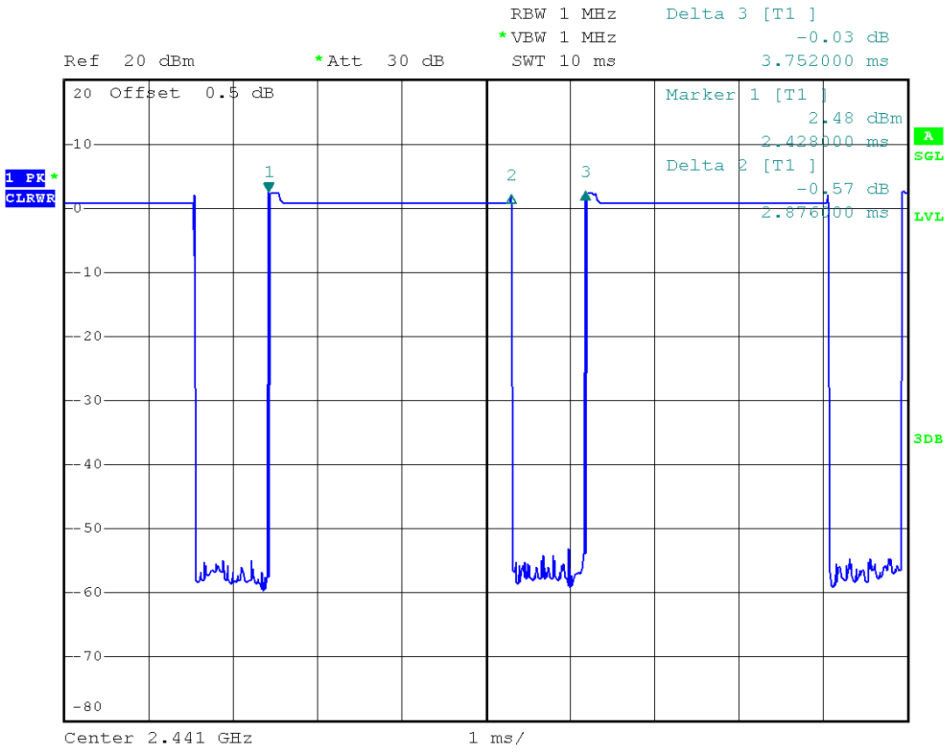
39 Channel @ 2DH5



39 Channel @ 3DH1



39 Channel @ 3DH3



39 Channel @ 3DH5

2.7. Conducted Spurious Emissions

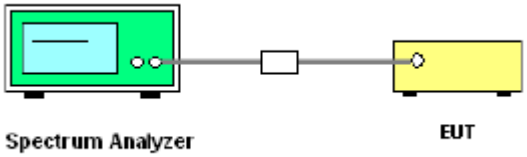
2.7.1. Limit of Spurious Emission

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

2.7.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.7.3. Test Setup



2.7.4. Test Procedure

1. The testing follows the guidelines in Spurious RF Conducted Emissions of FCC Public Notice DA 00-705 Measurement Guidelines

2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.

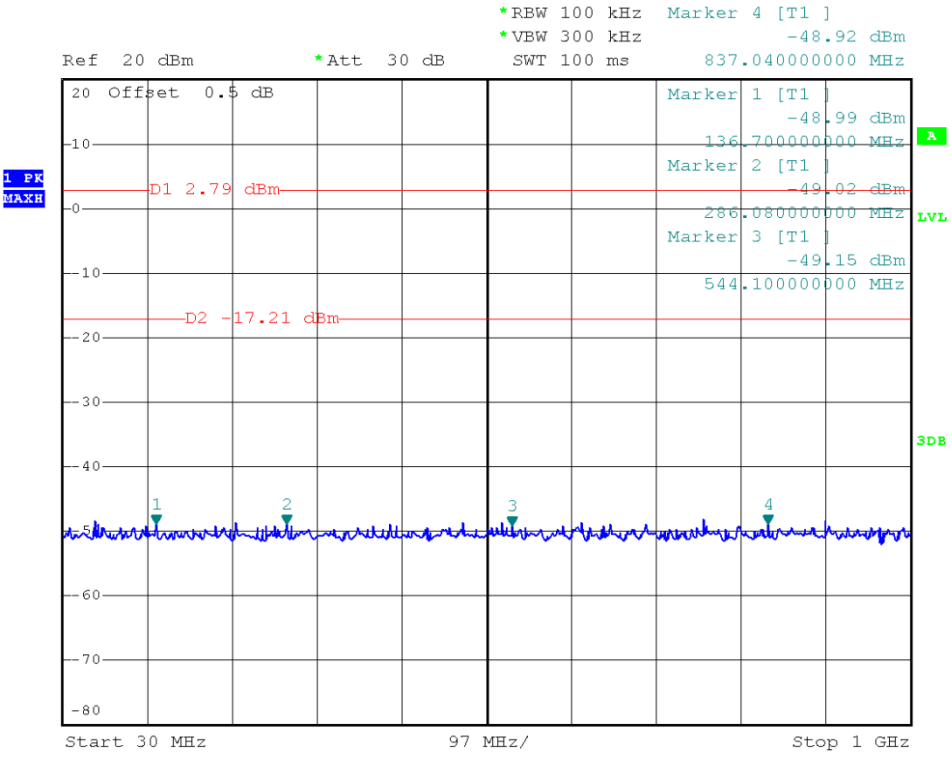
3. Set to the maximum power setting and enable the EUT transmit continuously.

4. Set RBW = 100 kHz, VBW = 300 kHz, scan up through 10th harmonic. All harmonics / spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.

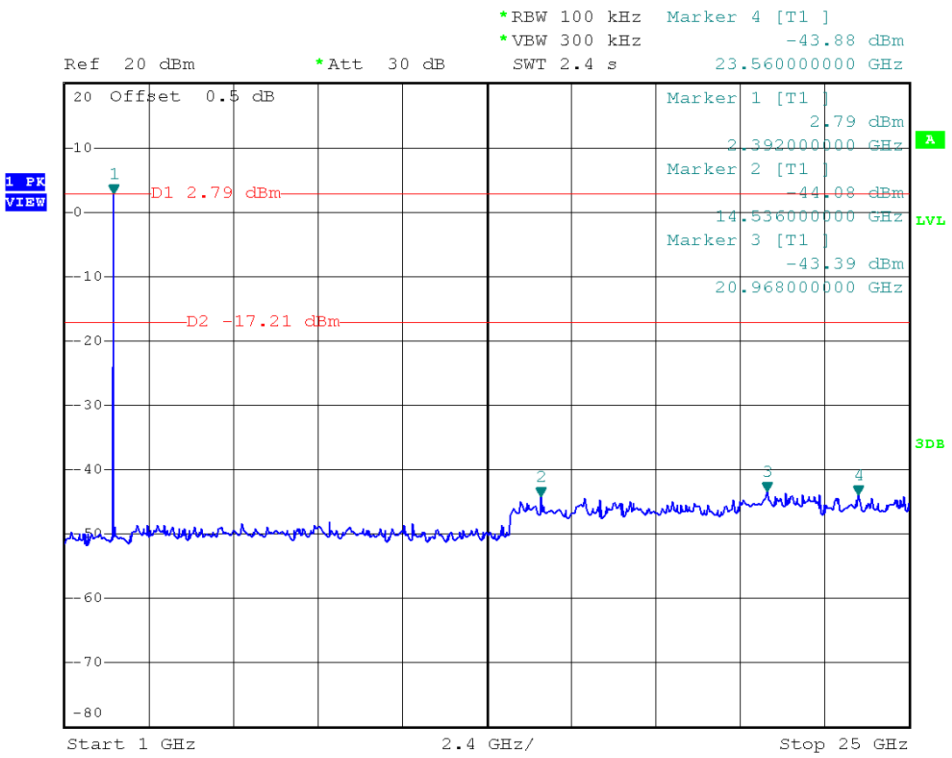
5. Measure and record the results in the test report.

6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

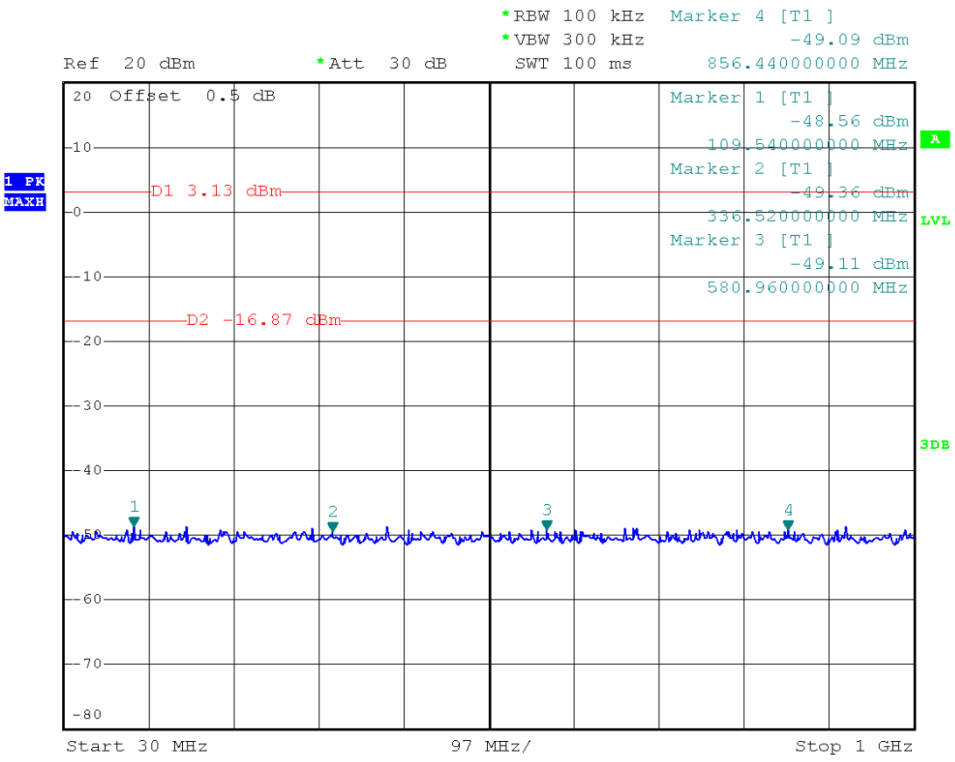
2.7.5. Test Results of Conducted Spurious Emissions



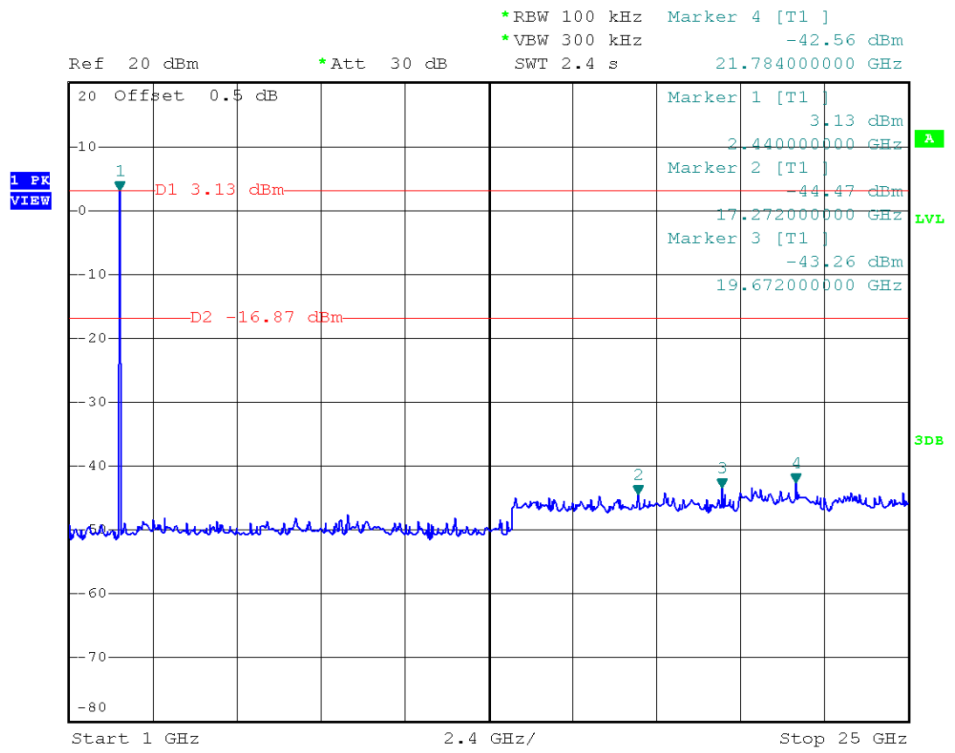
Low Channel 30MHz to 1GHz @ GFSK Mode



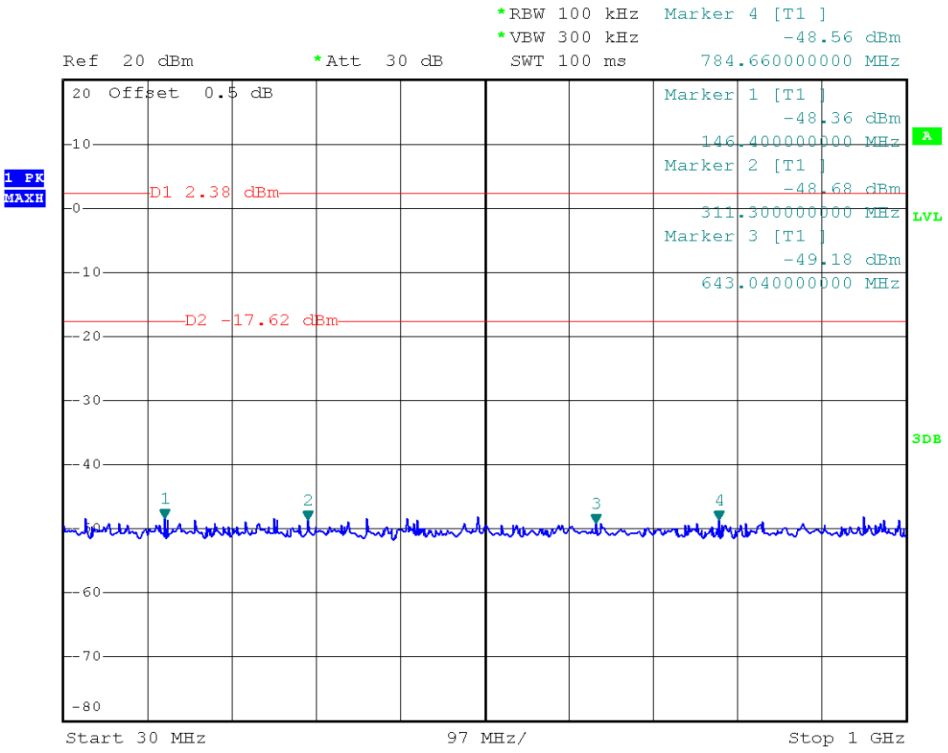
Low Channel 1GHz to 25GHz @ GFSK Mode



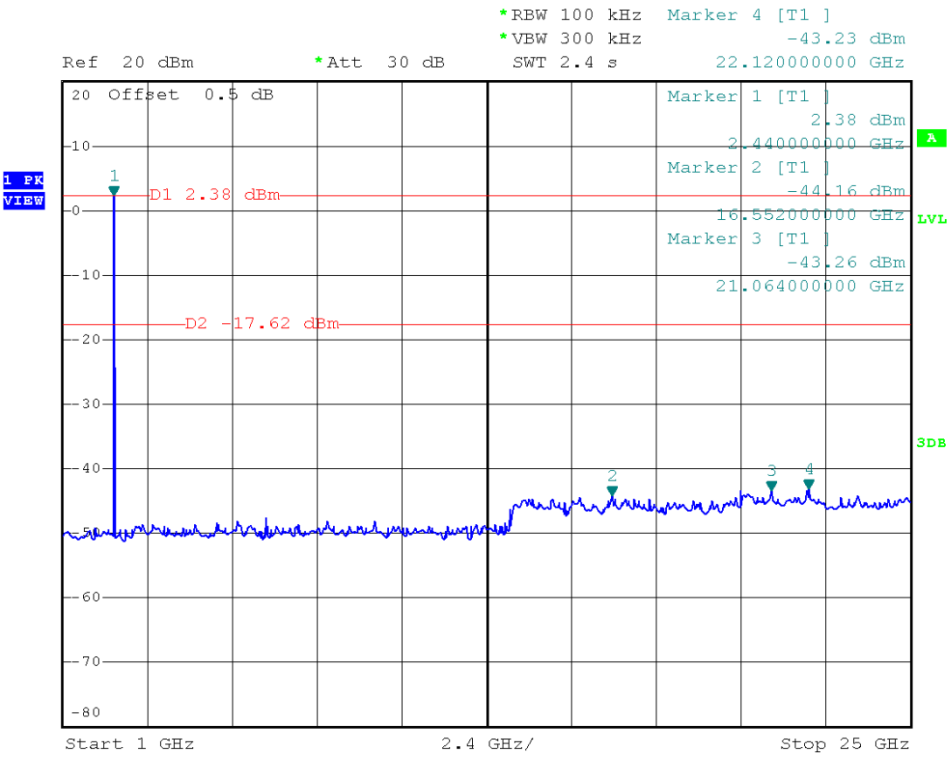
Mid Channel 30MHz to 1GHz @ GFSK Mode



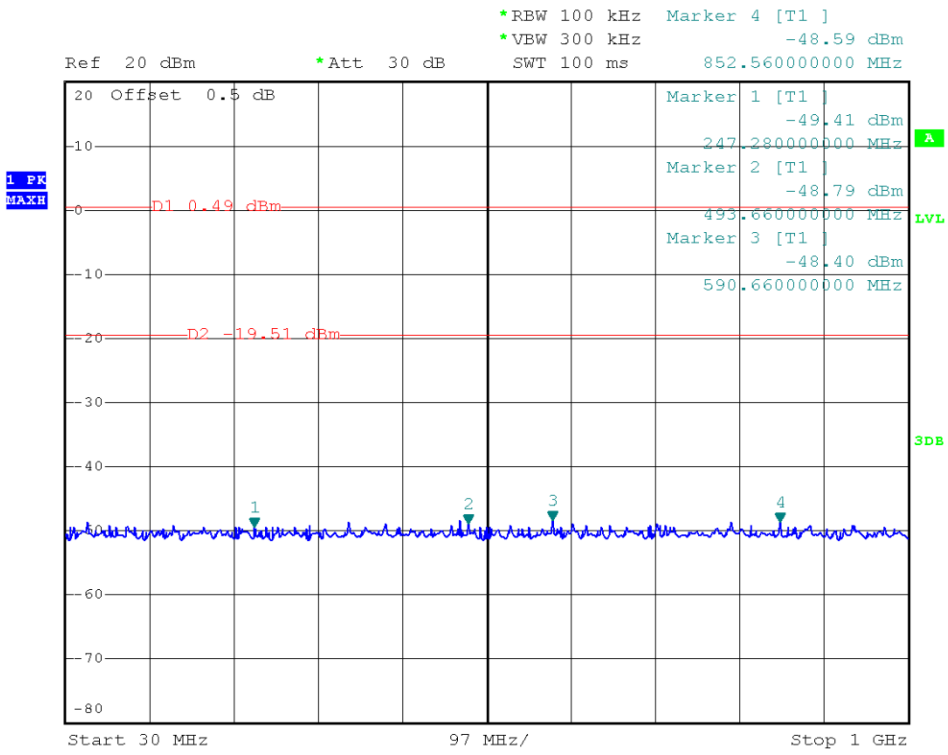
Mid Channel 1GHz to 25GHz @ GFSK Mode



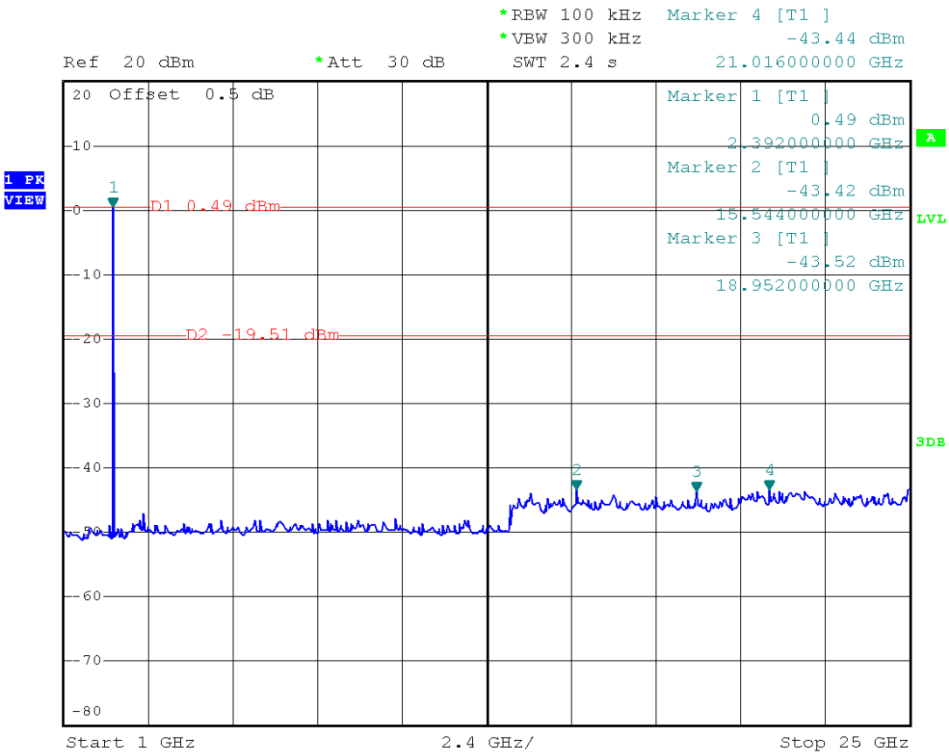
High Channel 30MHz to 1GHz @ GFSK Mode



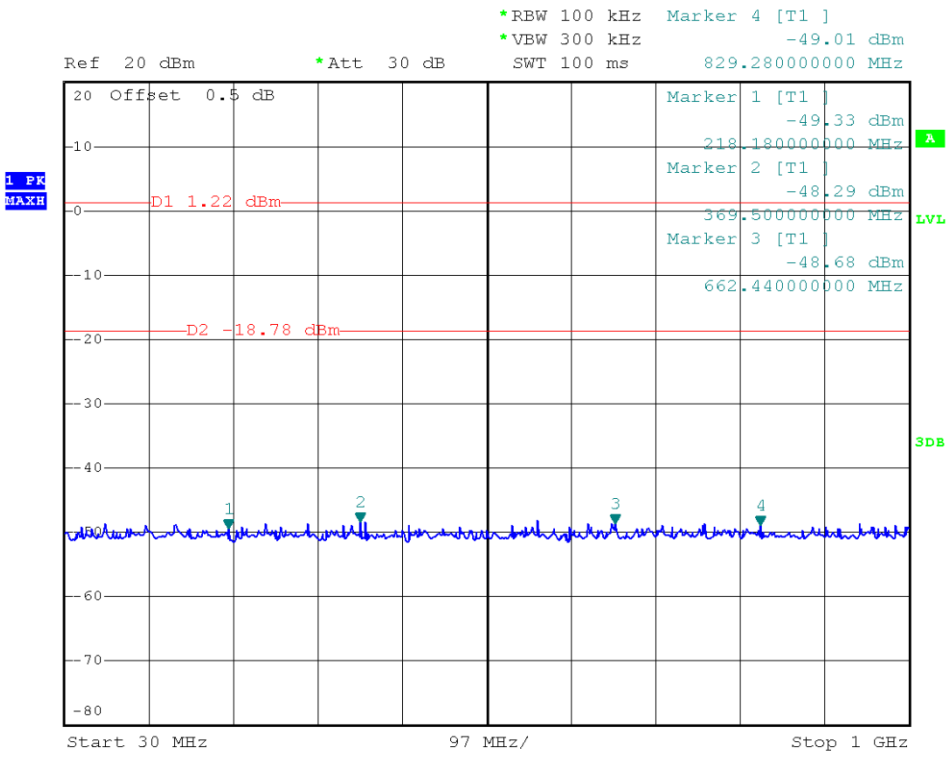
High Channel 1GHz to 25GHz @ GFSK Mode



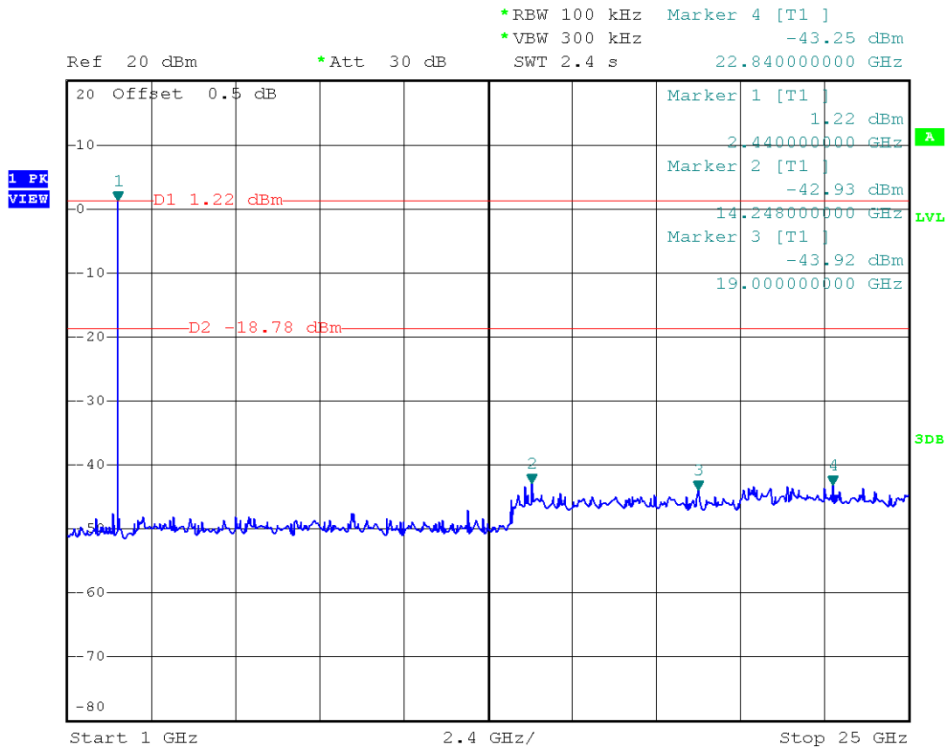
Low Channel 30MHz to 1GHz @π/4-DQPSK



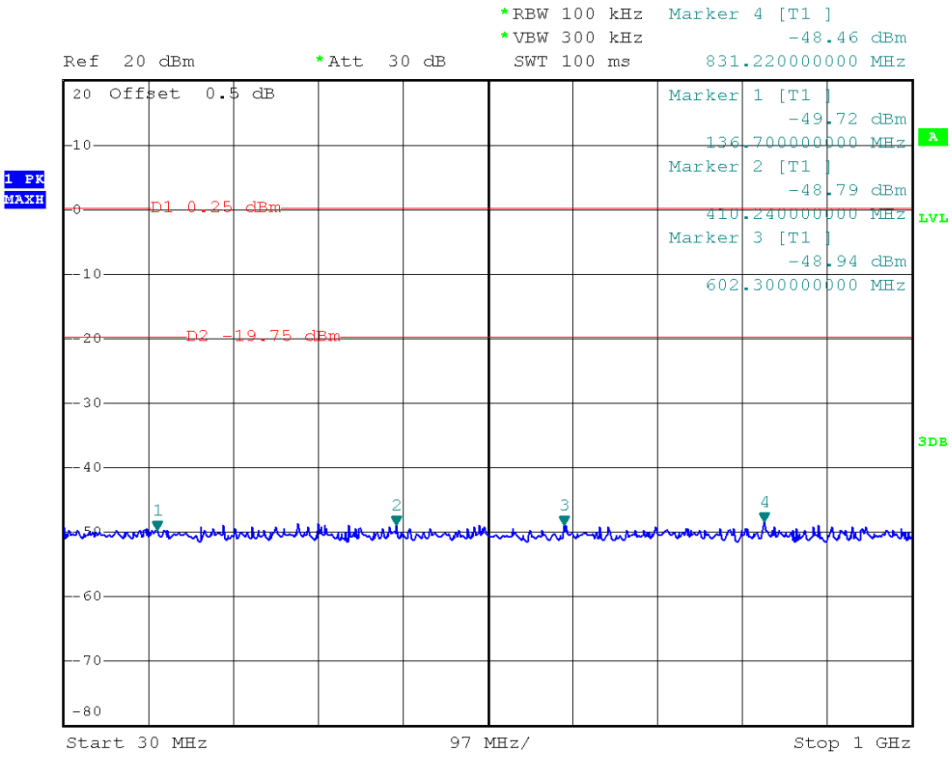
Low Channel 1GHz to 25GHz @π/4-DQPSK



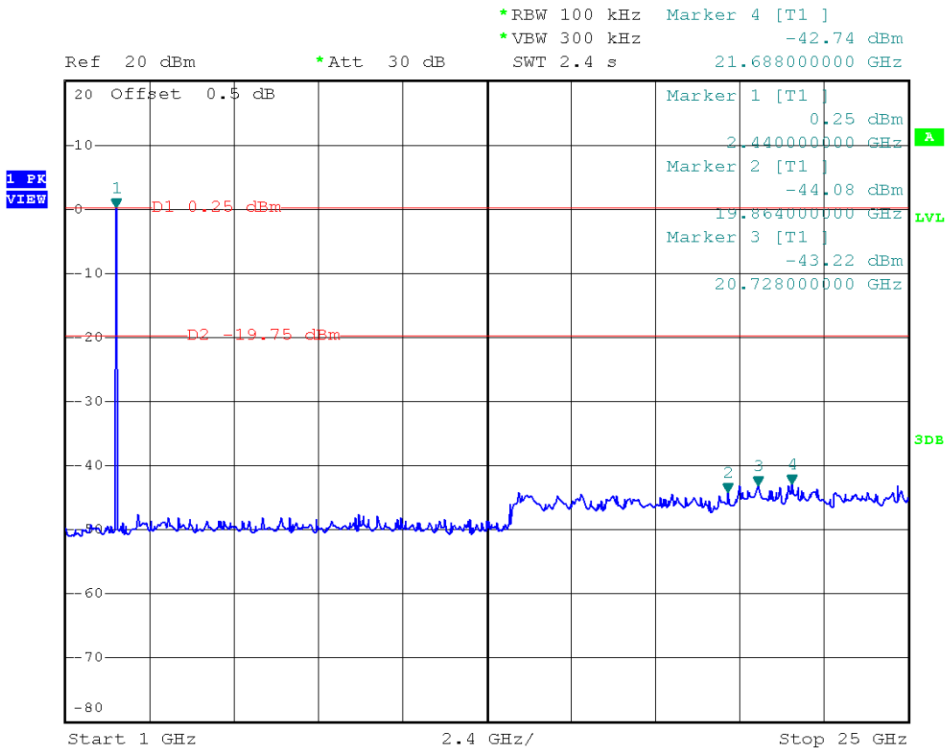
Mid Channel 30MHz to 1GHz @π/4-DQPSK



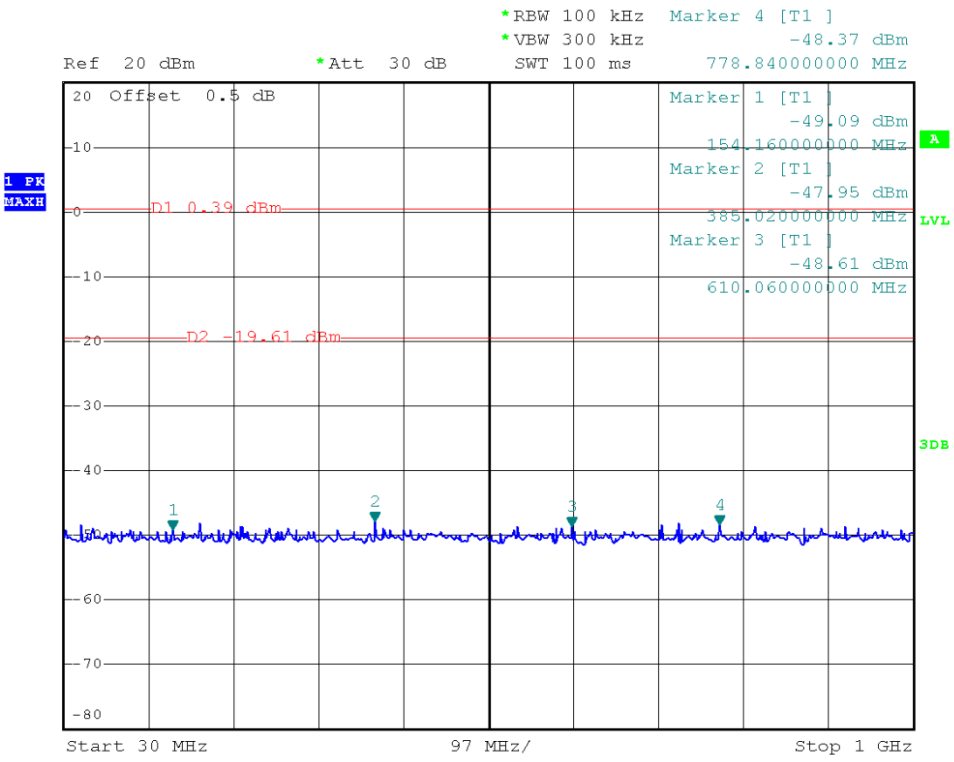
Mid Channel 1GHz to 25GHz @π/4-DQPSK



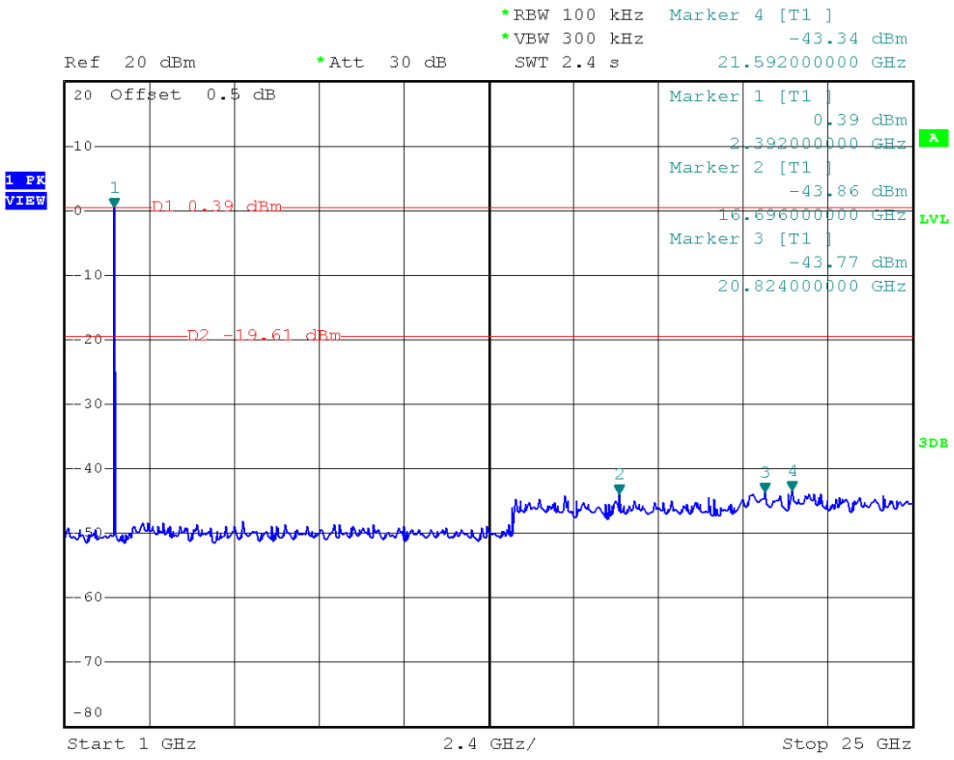
High Channel 30MHz to 1GHz @π/4-DQPSK



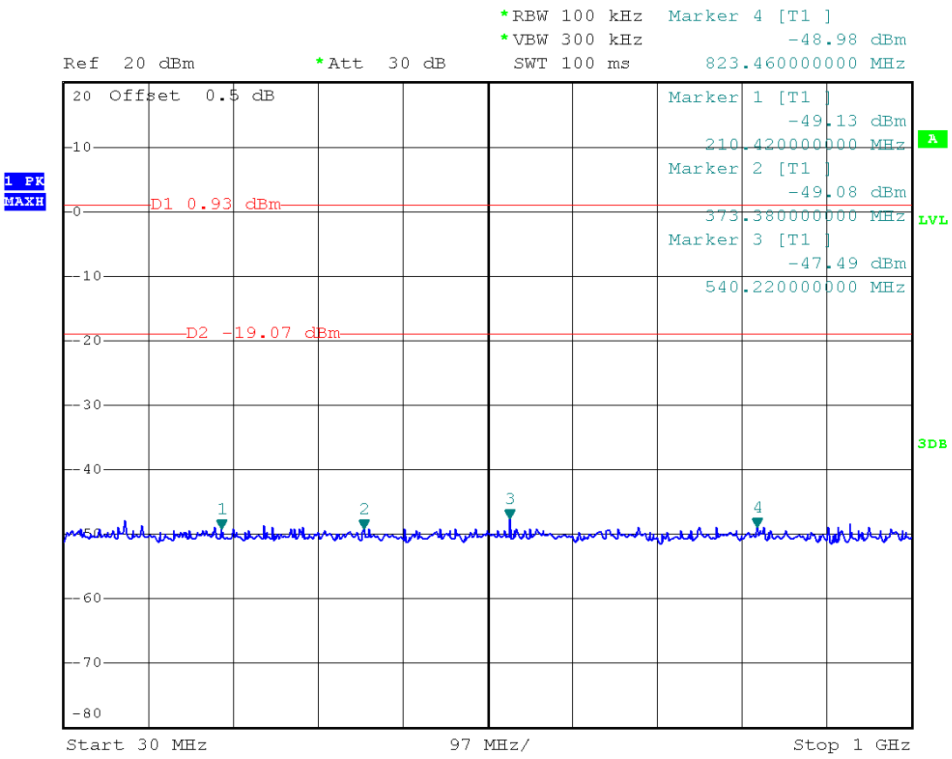
High Channel 1GHz to 25GHz @π/4-DQPSK



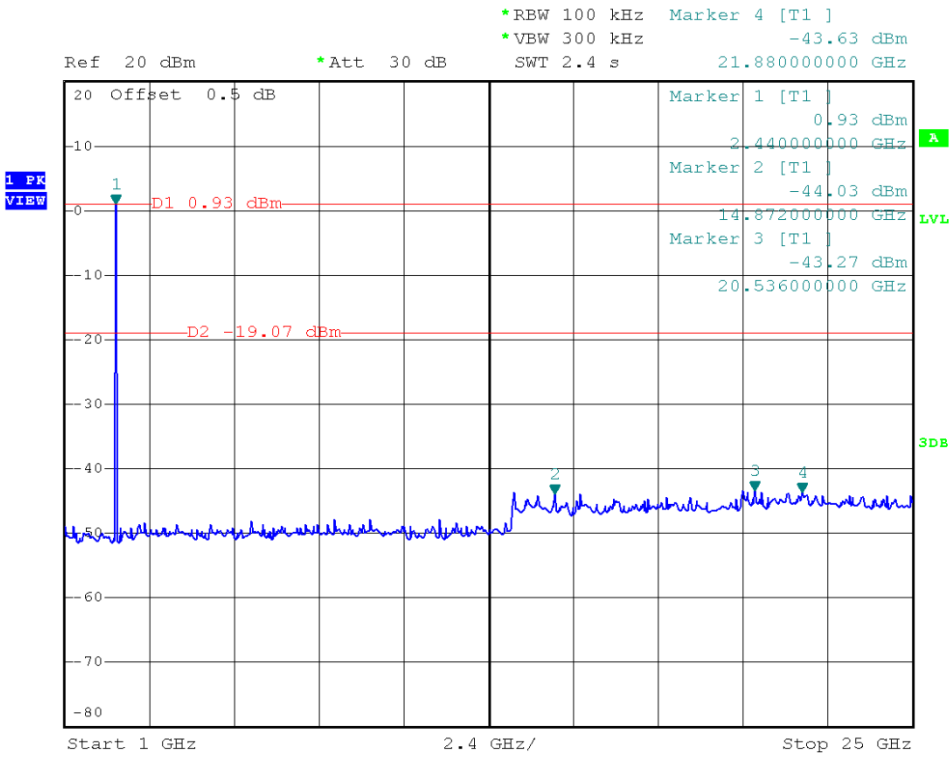
Low Channel 30MHz to 1GHz @ 8-DPSK



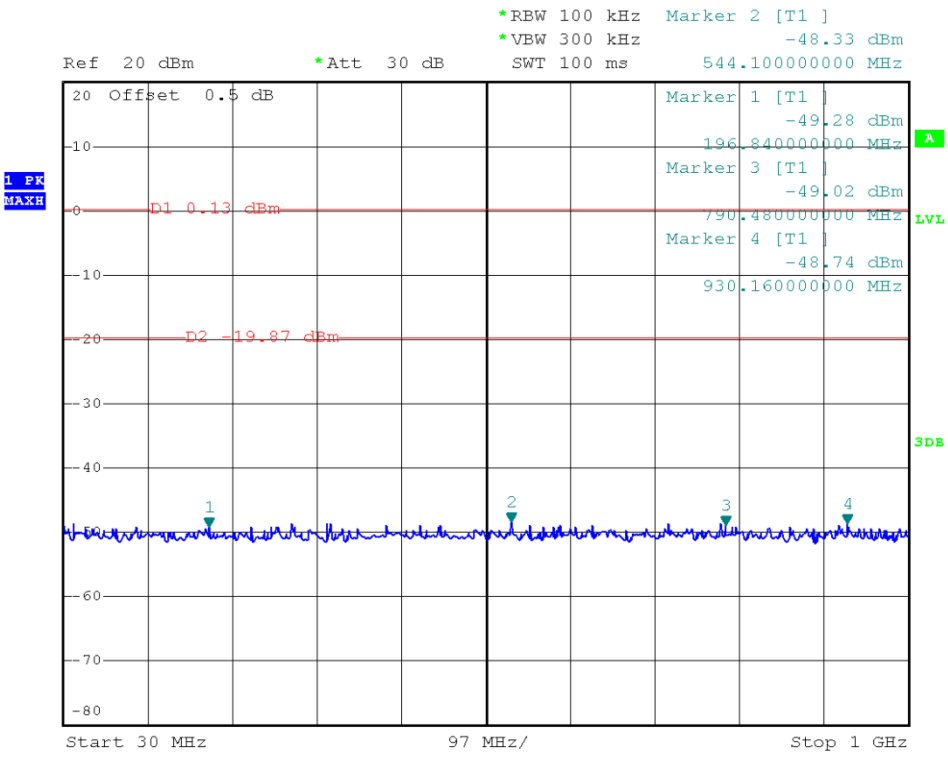
Low Channel 1GHz to 25GHz @ 8-DPSK



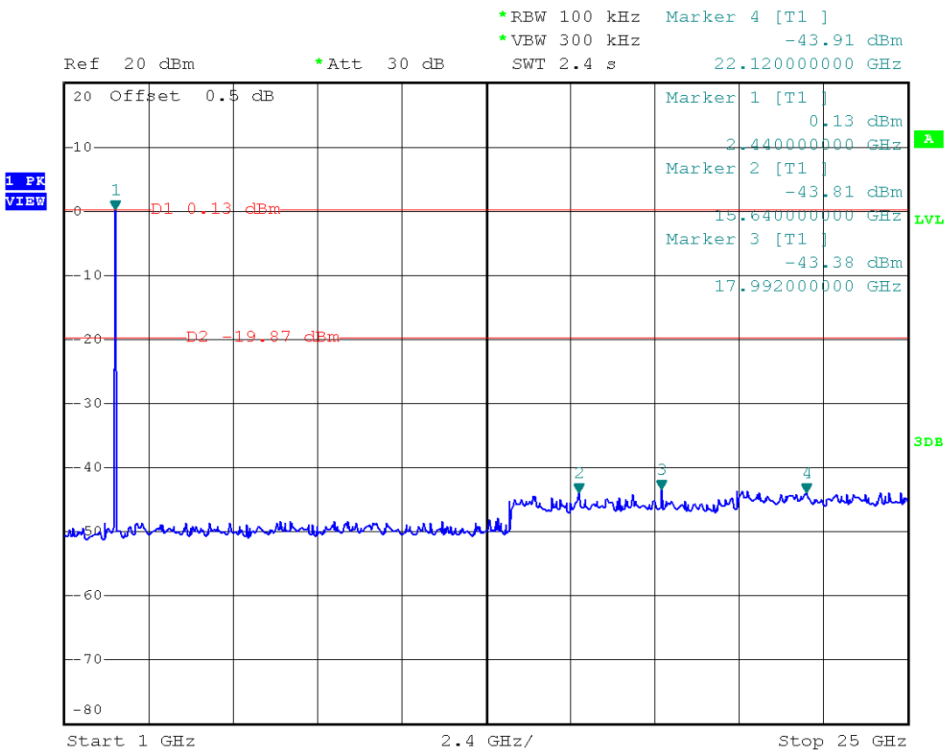
Mid Channel 30MHz to 1GHz @ 8-DPSK



Mid Channel 1GHz to 25GHz @ 8-DPSK



High Channel 30MHz to 1GHz @ 8-DPSK



High Channel 1GHz to 25GHz @ 8-DPSK

2.8. Conducted Band Edge

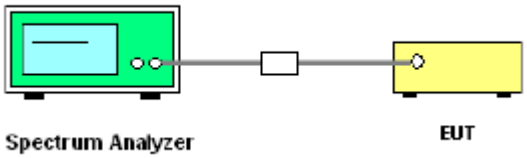
2.8.1. Limit of Band Edges

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

2.8.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.8.3. Test Setup

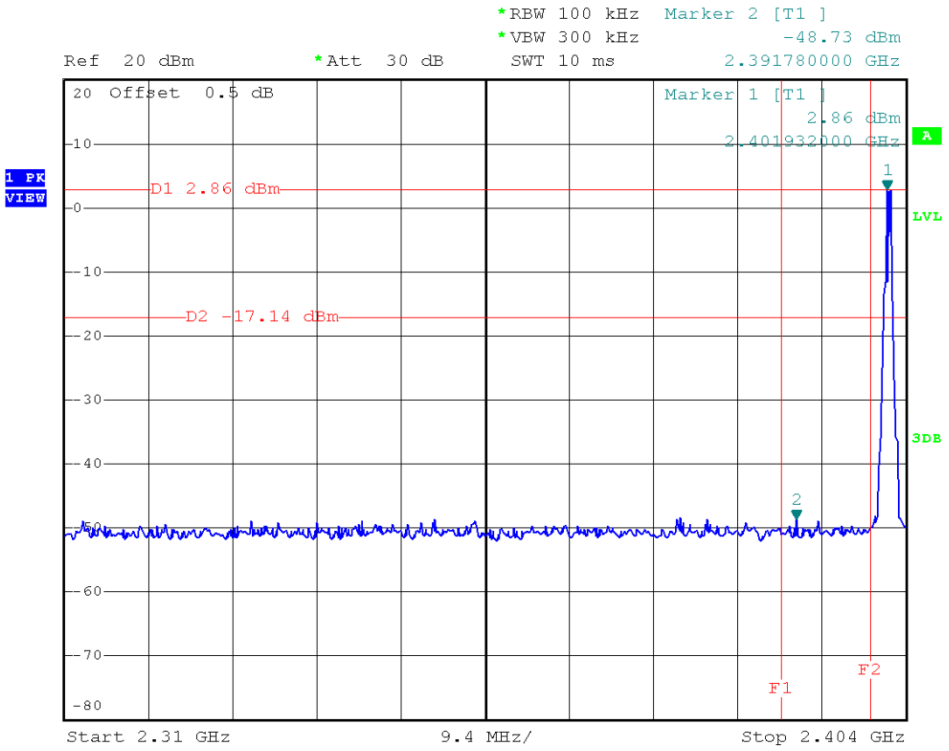


2.8.1. Test Procedure

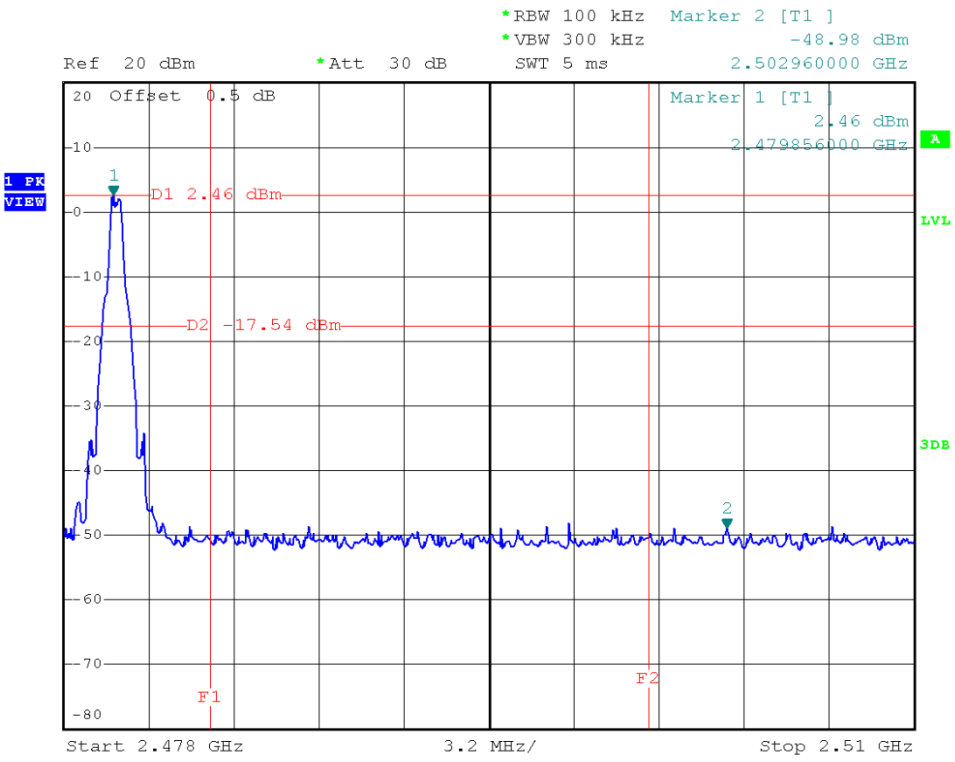
1. The testing follows the guidelines in Band-edge Compliance of RF Conducted Emissions of FCC Public Notice DA 00-705 Measurement Guidelines.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Set RBW = 100kHz (≥1% span=10MHz), VBW = 300kHz (≥RBW). Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100kHz RBW. The attenuation shall be 30 dB instead of 20 dB when RMS conducted output power procedure is used.
4. Enable hopping function of the EUT and then repeat step 2. and 3.
5. Measure and record the results in the test report.

2.8.2. Test Results of Conducted Band Edge

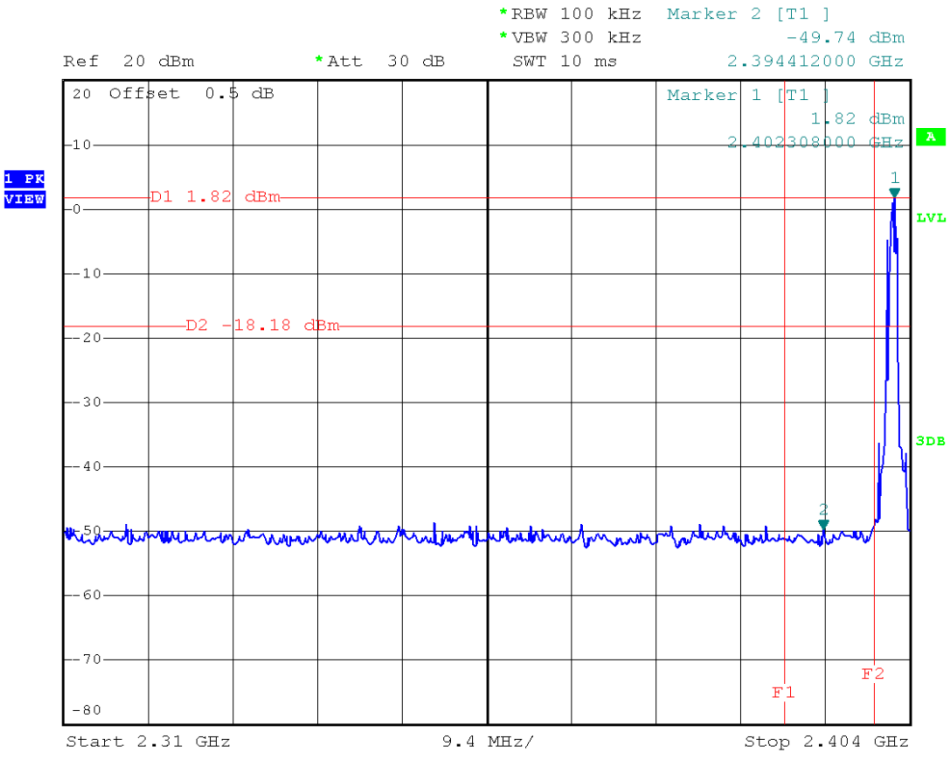
Band edge – Conducted (Un-hopping)



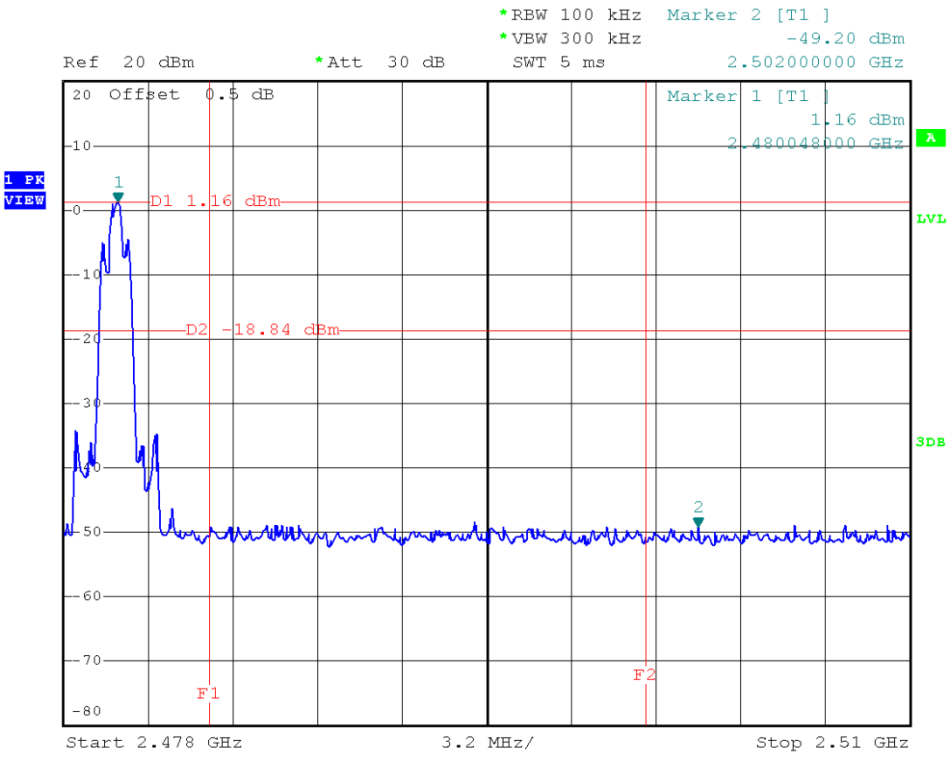
Low Band Edge Plot on channel 0 @ GFSK



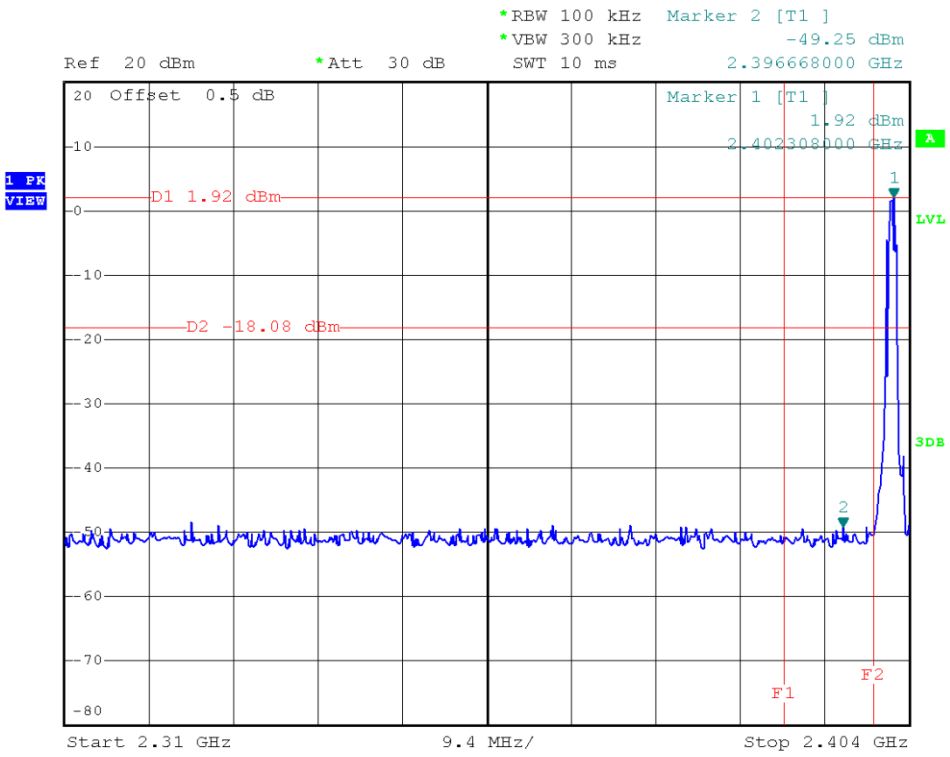
High Band Edge Plot on channel 78 @ GFSK



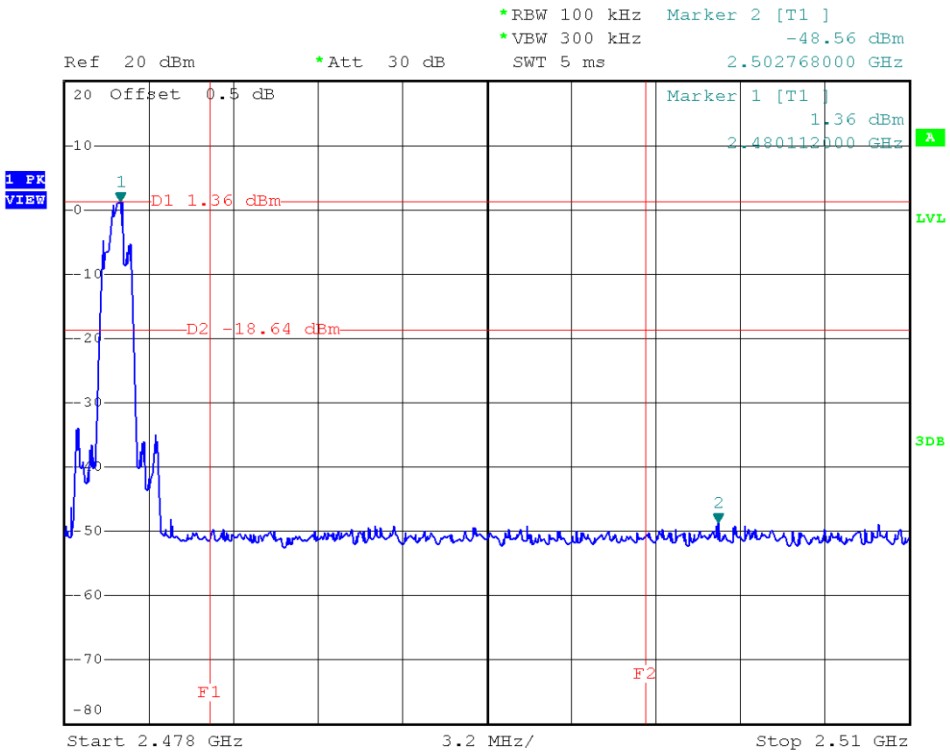
Low Band Edge Plot on channel 0 @π/4-DQPSK



High Band Edge Plot on channel 78 @π/4-DQPSK

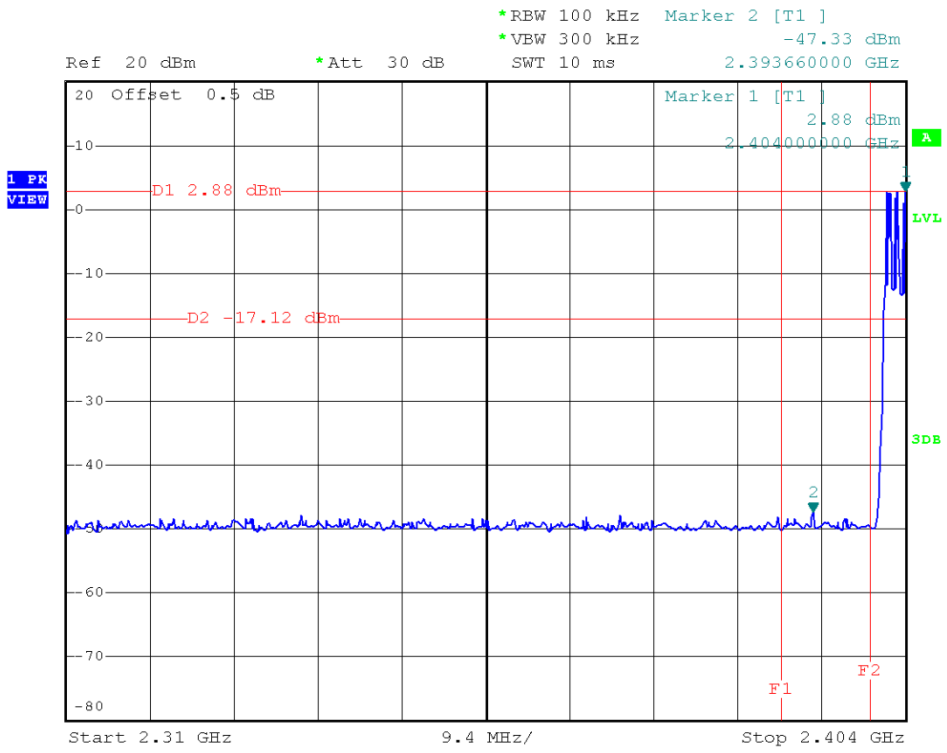


Low Band Edge Plot on channel 0 @8-DPSK

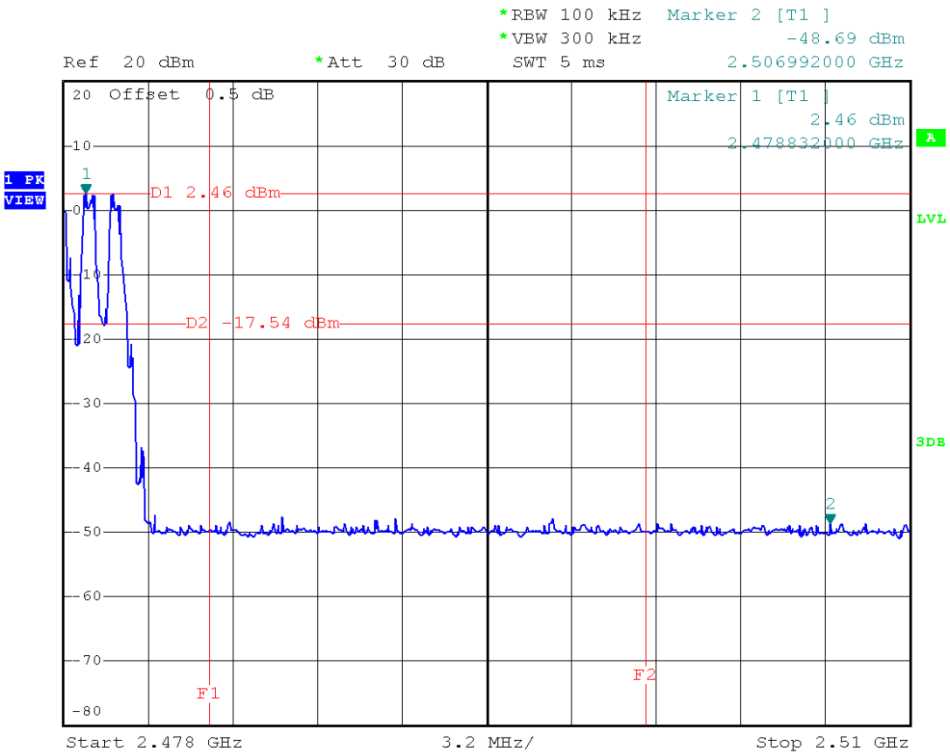


High Band Edge Plot on channel 78 @8-DPSK

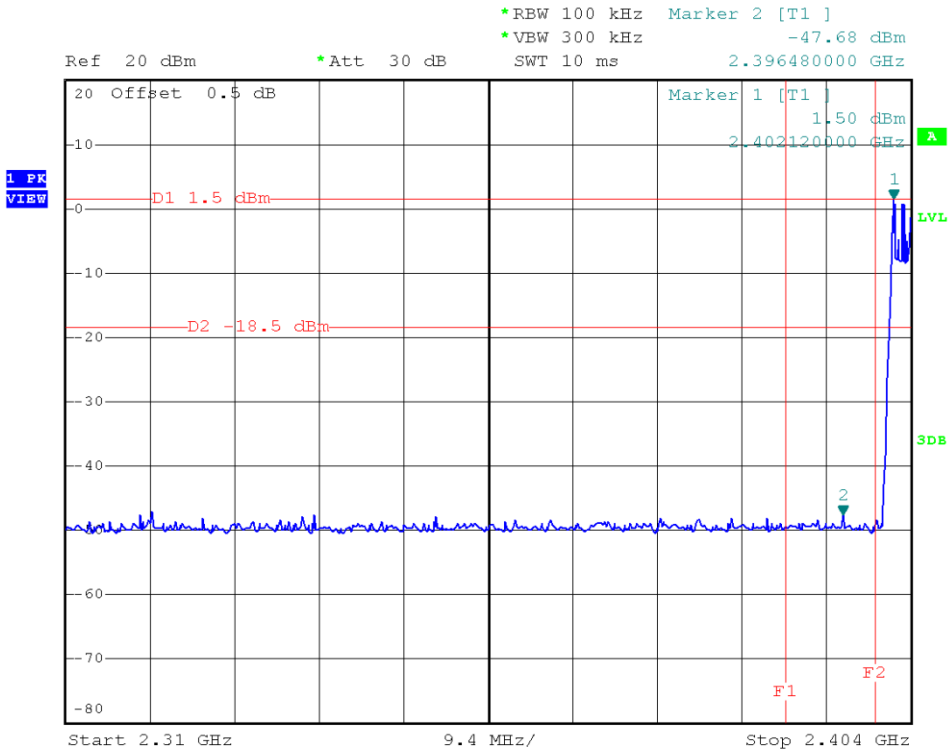
Band edge - Conducted (hopping)



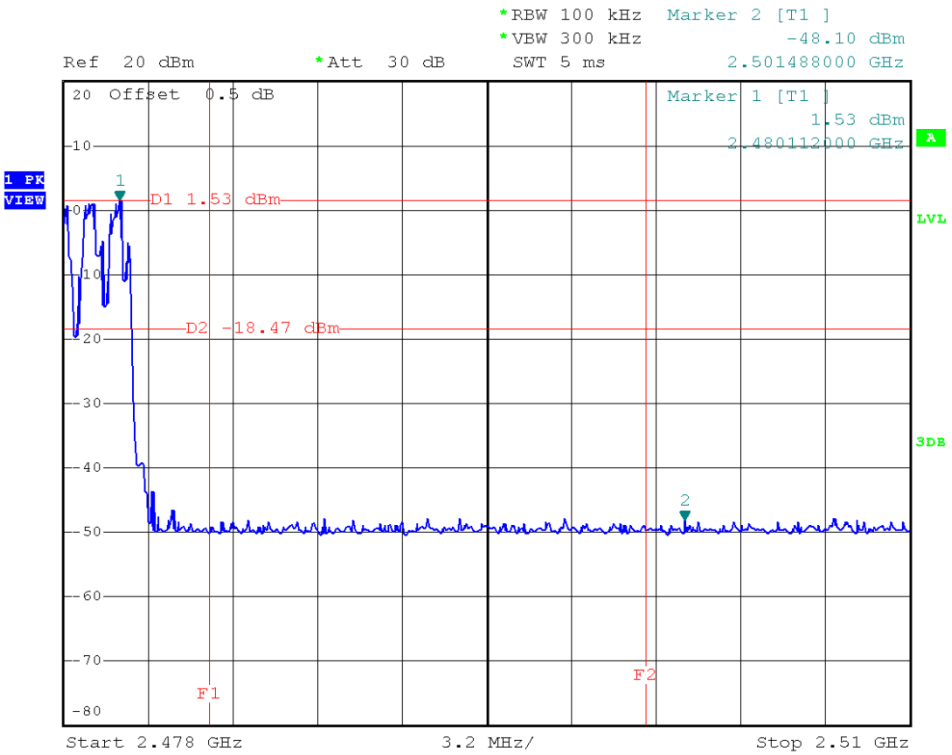
Low Band Edge Plot on channel 0 @ GFSK



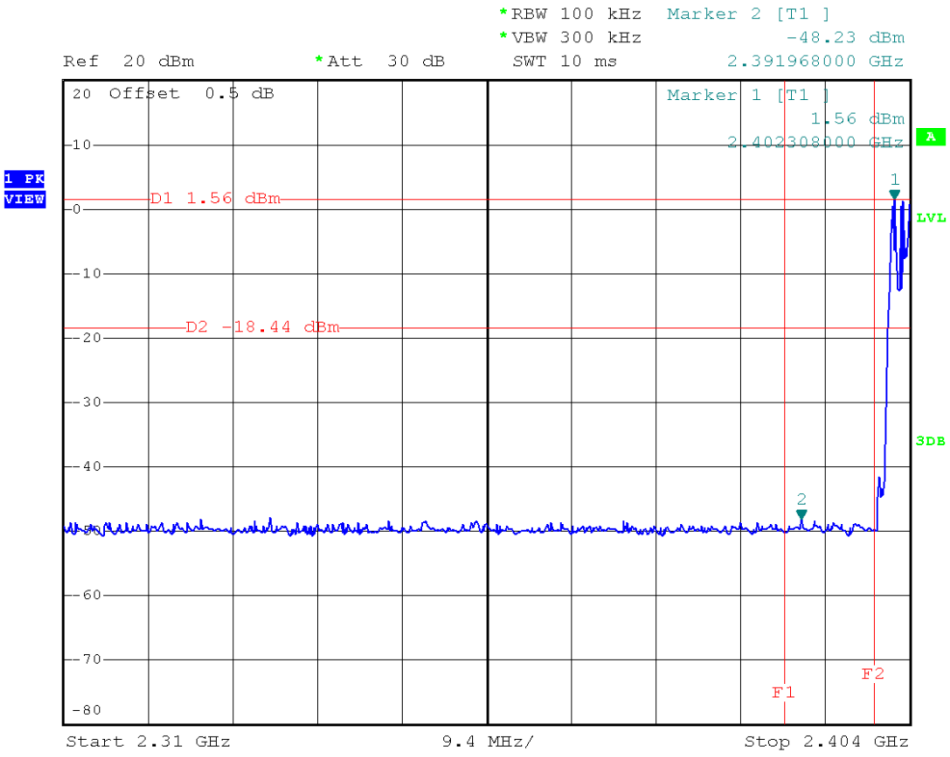
High Band Edge Plot on channel 78 @ GFSK



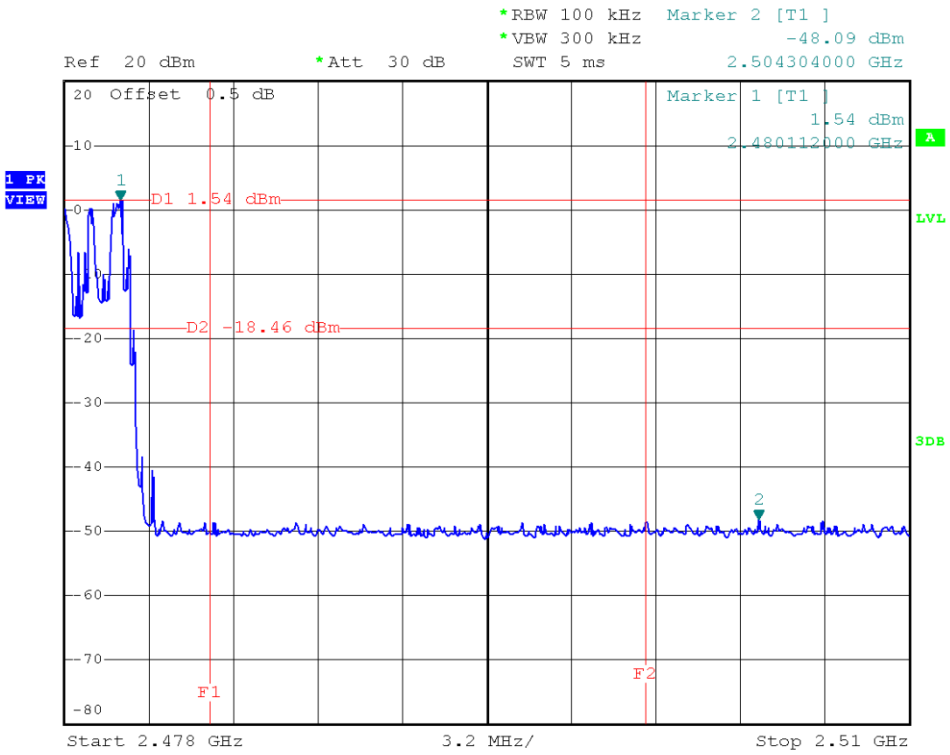
Low Band Edge Plot on channel 0 @π/4-DQPSK



High Band Edge Plot on channel 0 @π/4-DQPSK



Low Band Edge Plot on channel 0 @8-DPSK



High Band Edge Plot on channel 0 @8-DPSK

2.9. Conducted Emission

2.9.1. Limit of Conducted Emission

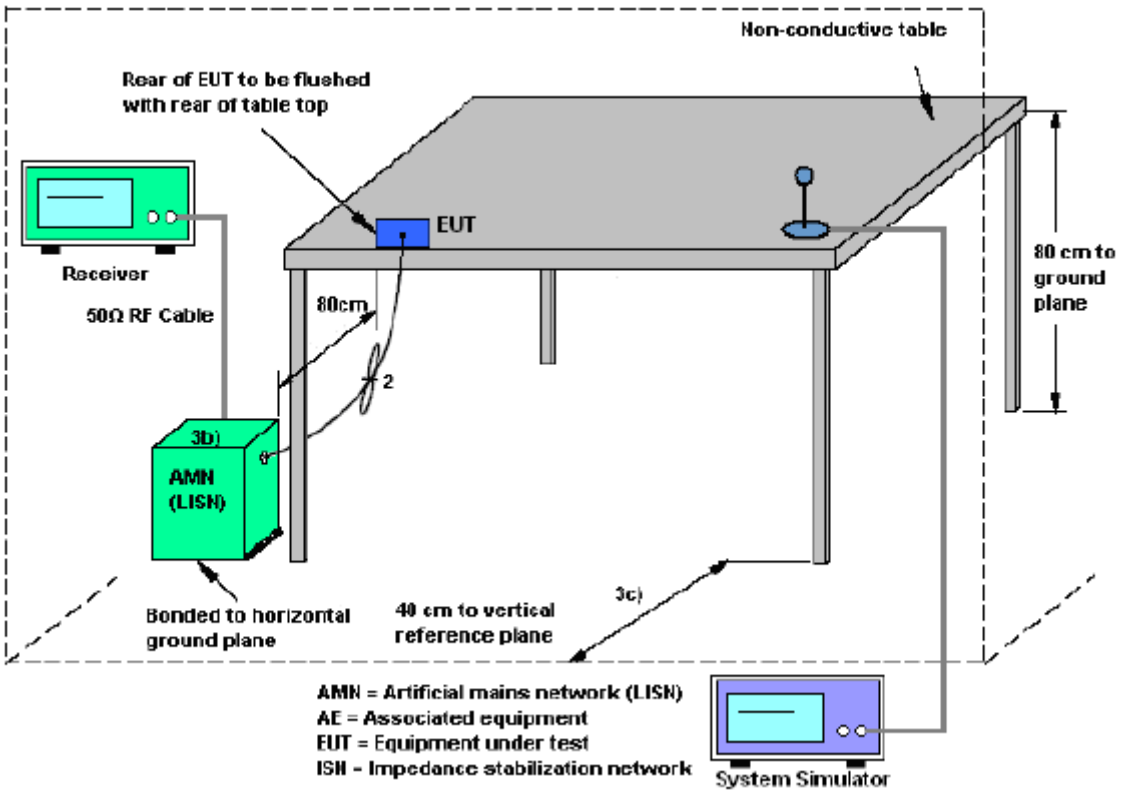
For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency range (MHz)	Conducted Limit (dBμV)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
0.50 - 30	60	50

2.9.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.9.3. Test Setup

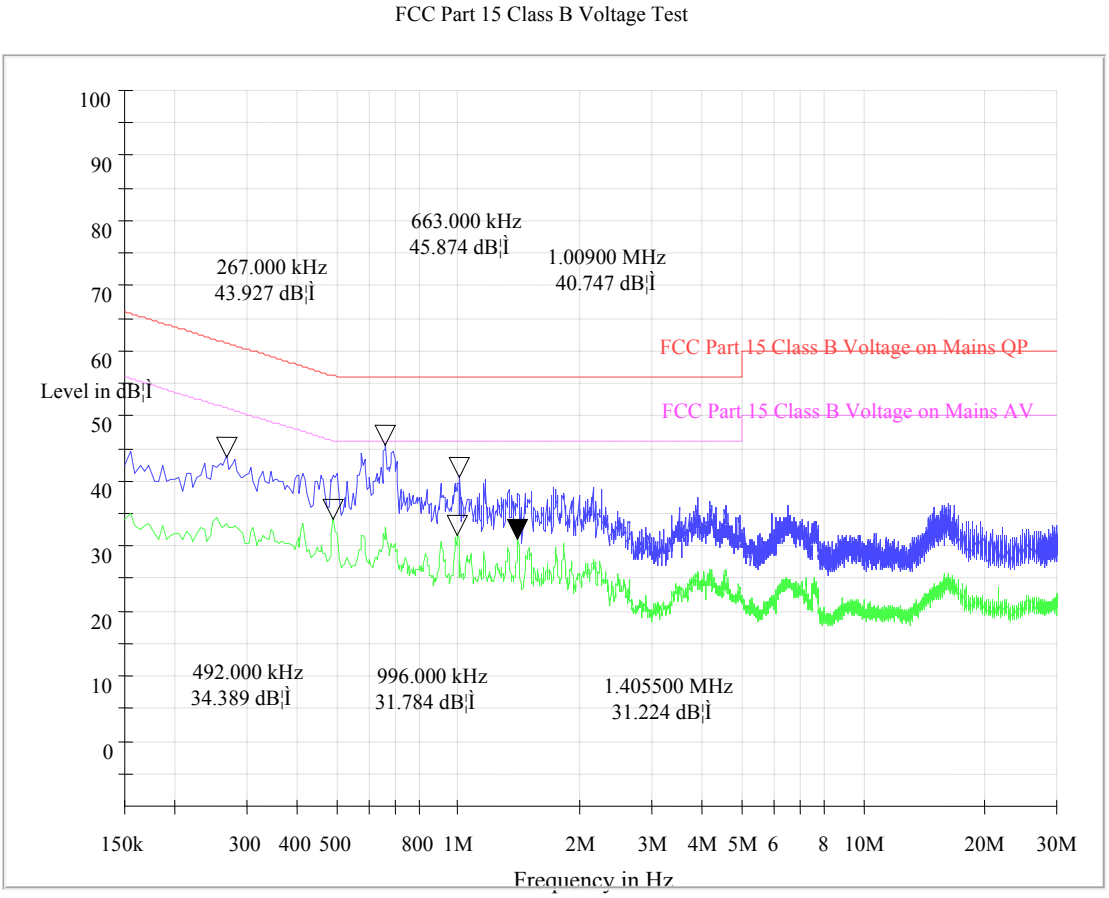


2.9.4. Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 micrometry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

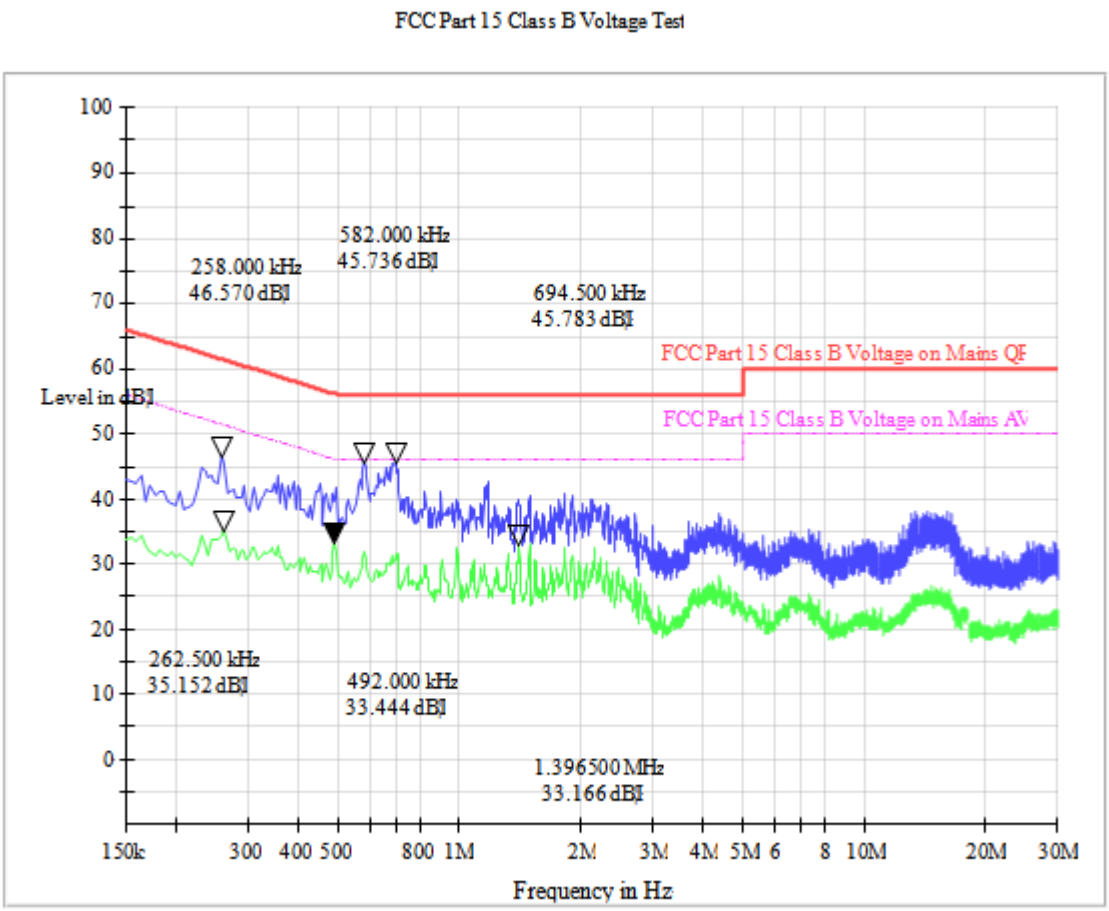
2.9.3. Test Results of Conducted Emission

The EUT configuration of the emission tests is Bluetooth Link + USB Cable (Charging from Adapter) + Earphone.



(Plot A: L Phase)

Conducted Disturbance at Mains Terminals					
L Test Data					
QP			AV		
Frequency (MHz)	Limits (dBµV)	Measurement Value (dBµV)	Frequency (MHz)	Limits (dBµV)	Measurement Value (dBµV)
0.267	61.2	43.927	0.492	46.1	34.389
0.663	56.0	45.874	0.996	46.0	31.784
1.009	56.0	40.747	1.406	46.0	31.224



(Plot B: N Phase)

Conducted Disturbance at Mains Terminals					
N Test Data					
QP			AV		
Frequency (MHz)	Limits (dBµV)	Measurement Value (dBµV)	Frequency (MHz)	Limits (dBµV)	Measurement Value (dBµV)
0.258	61.5	46.570	0.263	51.3	35.152
0.582	56.0	45.736	0.492	46.1	33.444
0.695	56.0	45.783	1.397	46.0	33.166

Test Result: PASS

2.10. Radiated Band Edges and Spurious Emission

2.10.1. Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209 limits as below.

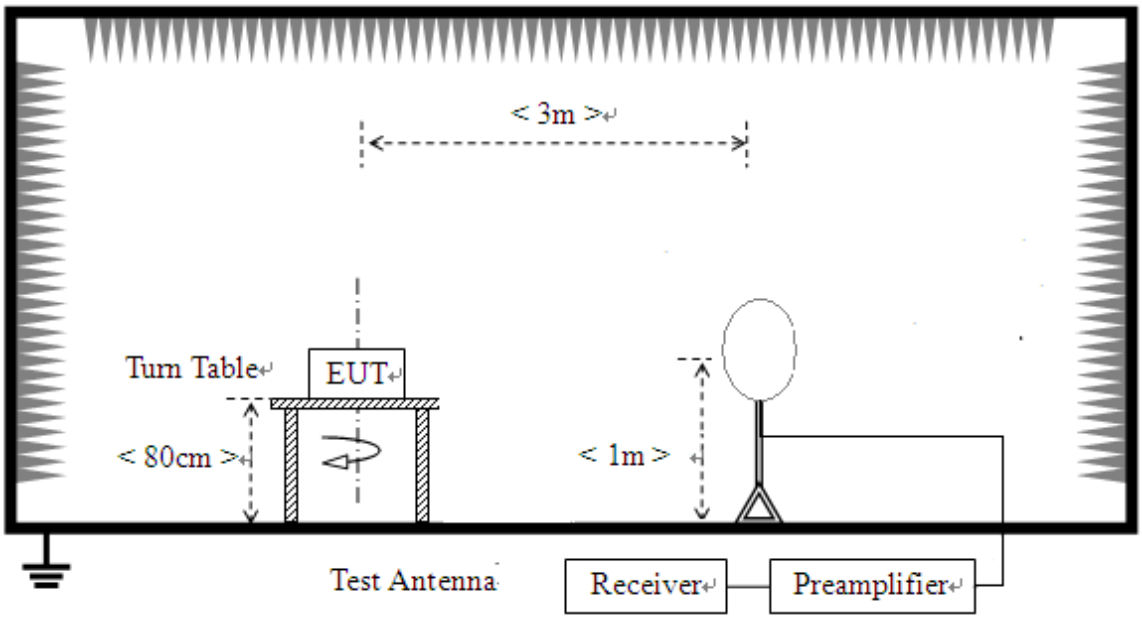
Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

2.10.2. Measuring Instruments

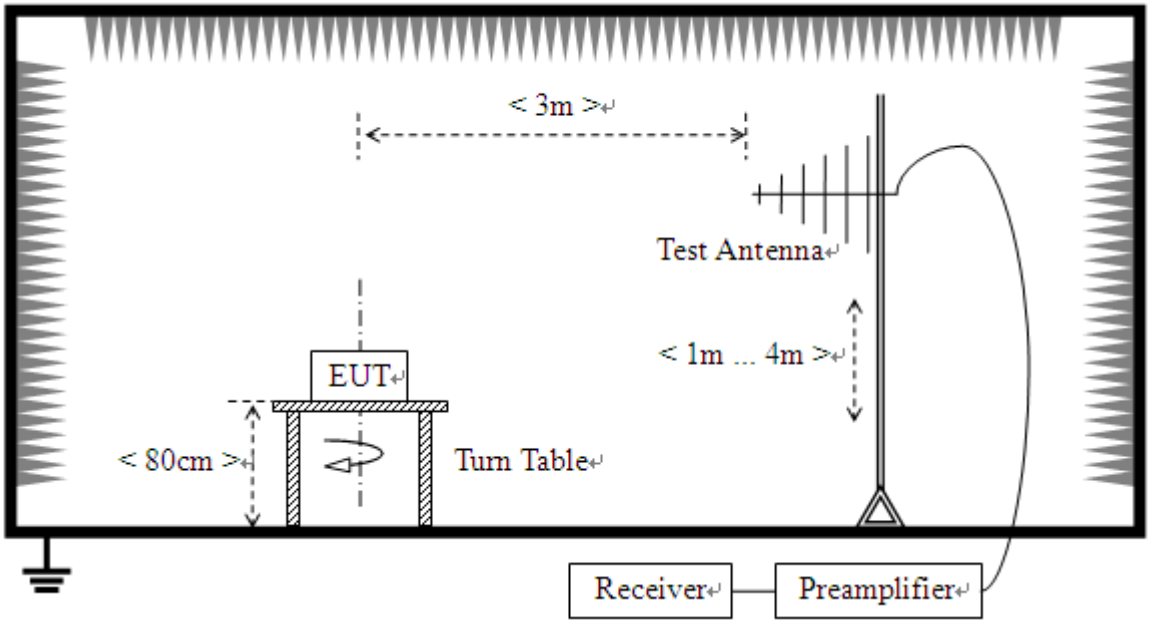
The measuring equipment is listed in the section 3 of this test report.

2.10.3. Test Setup

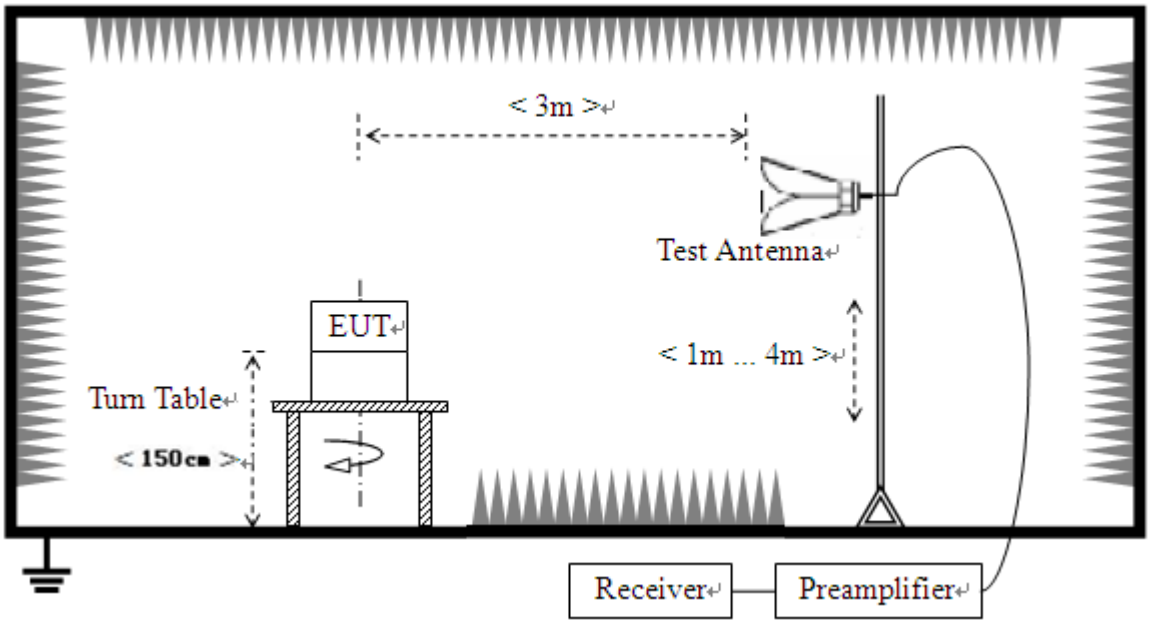
1) For radiated emissions from 9kHz to 30MHz



2) For radiated emissions from 30MHz to1GHz



3) For radiated emissions above 1GHz



2.10.4. Test Procedure

1. The testing follows the guidelines in Spurious Radiated Emissions of FCC Public Notice DA 00-705 Measurement Guidelines.
2. The EUT was placed on a turntable with 0.8 meter above ground.
3. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
4. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
5. Set to the maximum power setting and enable the EUT transmit continuously.
6. Use the following spectrum analyzer settings:

(1) Span shall wide enough to fully capture the emission being measured;

(2) Set RBW=100 kHz for f < 1 GHz, RBW=1MHz for f>1GHz ; VBW≥RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak

(3) For average measurement: use duty cycle correction factor method per 15.35(c).

Duty cycle = On time/100 milliseconds

On time = $N_1*L_1+N_2*L_2+...+N_{n-1}*LN_{n-1}+Nn*Ln$

Where N_1 is number of type 1 pulses, L1 is length of type 1 pulses, etc.

Average Emission Level = Peak Emission Level + 20*log(Duty cycle)

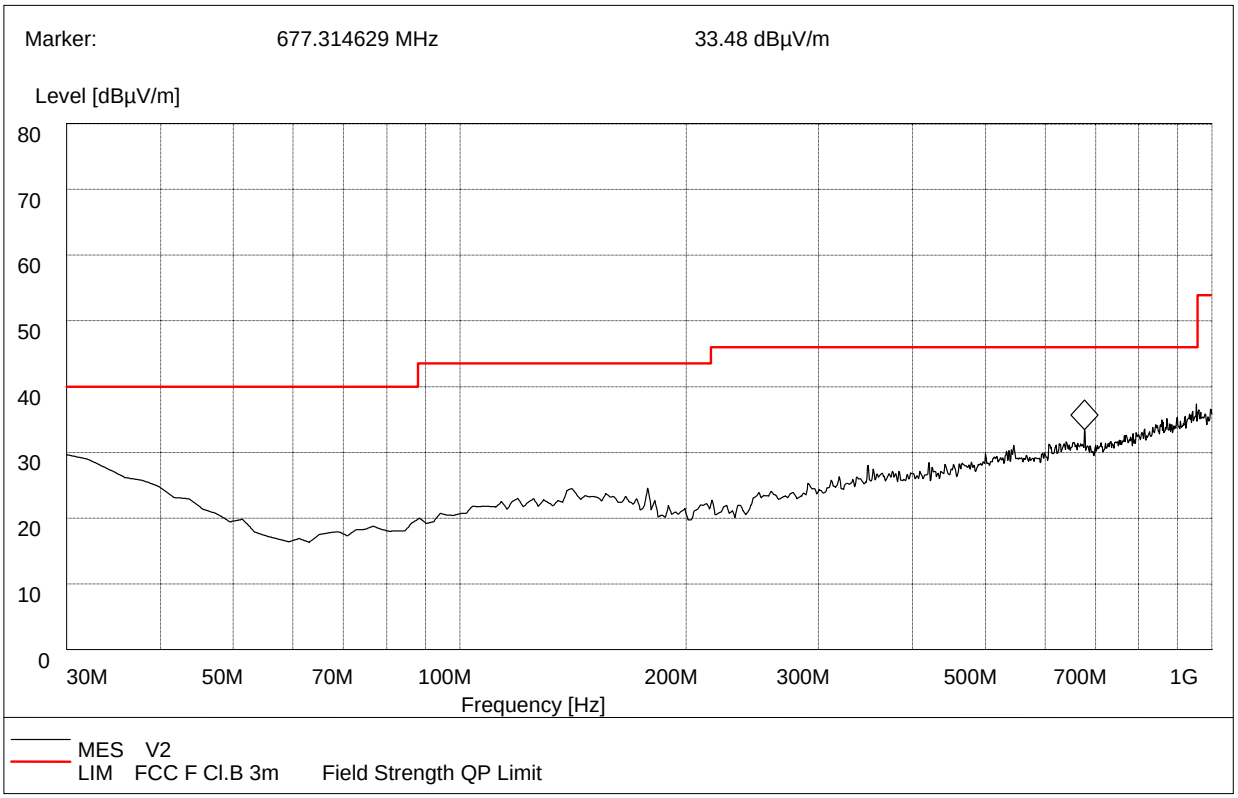
7. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

2.10.5. Test Results of Radiated Band Edge and Spurious Emission

For 9 KHz to 30MHz

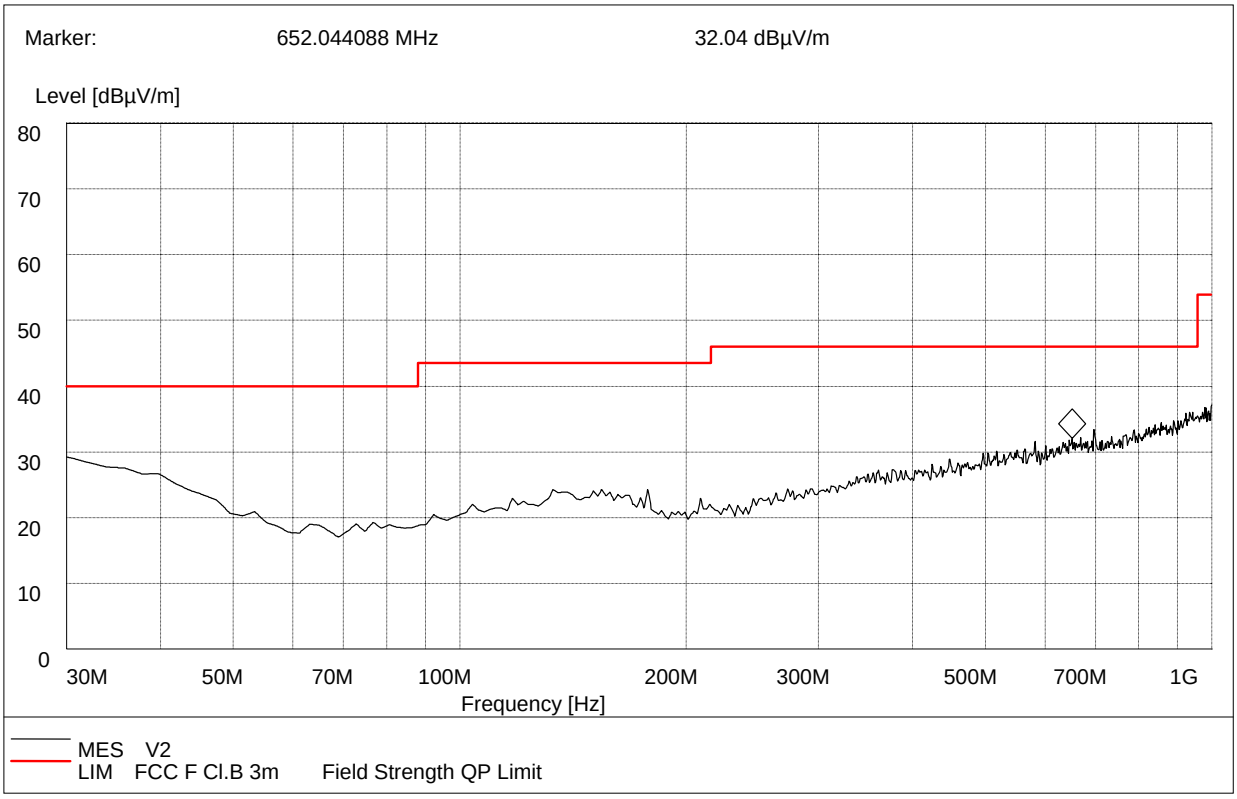
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

For 30MHz to 1000MHz



Frequency (MHz)	QuasiPeak (dB µ V/m)	Bandwidth (kHz)	Antenna height (cm)	Limit (dB µ V/m)	Antenna	Verdict
677.315	33.48	120.000	100.0	46.00	Vertical	Pass

(Plot A: 30MHz to 1GHz, Antenna Vertical)



Frequency (MHz)	QuasiPeak (dB µ V/m)	Bandwidth (kHz)	Antenna height (cm)	Limit (dB µ V/m)	Antenna	Verdict
652.044	32.04	120.000	100.0	46.0	Horizontal	Pass

(Plot B: 30MHz to 1GHz, Antenna Horizontal)

For 1GHz to 25GHz

Mode: GFSK (Worst Case)

L Channel (2402 MHz) (GFSK Worst Case)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M（GFSK-2402MHz）											
No.	Frequency (MHz)	Emssion Level		Limit (dBuV/m)	Margin (dB)	Antenna Height	Table Angle	Raw Value	Antenna Factor	Cable Factor	Pre-amplifier
1	*2402.00	103.11	PK	/	/	1.00 H	360	106.51	28.3	4.90	36.6
1	*2402.00	92.69	AV	/	/	1.00 H	360	96.09	28.3	4.90	36.6
2	4804.00	48.95	PK	74.00	25.05	1.00 H	359	45.75	32.7	7.00	36.5
2	4804.00	39.92	AV	54.00	14.08	1.00 H	359	36.72	32.7	7.00	36.5
3	7206.00	51.82	PK	74.00	22.18	1.00 H	152	42.42	35.8	8.90	35.3
3	7206.00	43.79	AV	54.00	10.21	1.00 H	152	34.39	35.8	8.90	35.3
4	9608.00	49.88	PK	74.00	24.12	1.00 H	140	37.28	37.2	10.20	34.8
4	9608.00	45.30	AV	54.00	8.70	1.00 H	140	32.7	37.2	10.20	34.8

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M（GFSK_2402MHz）											
No.	Frequency (MHz)	Emssion Level		Limit (dBuV/m)	Margin (dB)	Antenna Height	Table Angle	Raw Value	Antenna Factor	Cable Factor	Pre-amplifier
1	*2402.00	101.54	PK	/	/	1.00 V	124	104.94	28.3	4.90	36.6
1	*2402.00	90.32	AV	/	/	1.00 V	124	93.72	28.3	4.90	36.6
2	4804.00	49.62	PK	74.00	24.38	1.00 V	339	46.42	32.7	7.00	36.5
2	4804.00	43.88	AV	54.00	10.12	1.00 V	339	40.68	32.7	7.00	36.5
3	7206.00	49.94	PK	74.00	24.06	1.00 V	340	40.54	35.8	8.90	35.3
3	7206.00	41.69	AV	54.00	12.31	1.00 V	340	32.29	35.8	8.90	35.3
4	9608.00	52.12	PK	74.00	21.88	1.00 V	20	39.52	37.2	10.20	34.8
4	9608.00	44.72	AV	54.00	9.28	1.00 V	20	32.12	37.2	10.20	34.8

M Channel (2441 MHz) (GFSK Worst Case)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M（GFSK_2441MHz）											
No.	Frequency (MHz)	Emssion Level		Limit (dBuV/m)	Margin (dB)	Antenna Height	Table Angle	Raw Value	Antenna Factor	Cable Factor	Pre-amplifier
1	*2441.00	104.28	PK	/	/	1.00 H	153	107.48	28.3	5.10	-36.6
1	*2441.00	91.96	AV	/	/	1.00 H	153	95.16	28.3	5.10	-36.6
2	4882.00	45.99	PK	74.00	28.01	1.00 H	202	42.59	32.3	7.60	-36.5
2	4882.00	34.98	AV	54.00	19.02	1.00 H	202	31.58	32.3	7.60	-36.5
3	7323.00	49.96	PK	74.00	24.04	1.00 H	355	40.56	36.1	8.60	-35.3
3	7323.00	42.31	AV	54.00	11.69	1.00 H	355	32.91	36.1	8.60	-35.3
4	9764.00	50.02	PK	74.00	23.98	1.00 H	28	37.42	37.2	10.20	-34.8
4	9764.00	41.84	AV	54.00	12.16	1.00 H	28	29.24	37.2	10.20	-34.8

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M（GFSK_2441MHz）											
No.	Frequency (MHz)	Emssion Level		Limit (dBuV/m)	Margin (dB)	Antenna Height	Table Angle	Raw Value	Antenna Factor	Cable Factor	Pre-amplifier
1	*2441.00	103.12	PK	/	/	1.00 V	121	106.32	28.3	5.10	-36.6
1	*2441.00	91.96	AV	/	/	1.00 V	121	95.16	28.3	5.10	-36.6
2	4882.00	47.71	PK	74.00	26.29	1.00 V	97	44.31	32.3	7.60	-36.5
2	4882.00	36.90	AV	54.00	17.10	1.00 V	97	33.5	32.3	7.60	-36.5
3	7323.00	56.76	PK	74.00	17.24	1.00 V	288	47.36	36.1	8.60	-35.3
3	7323.00	42.60	AV	54.00	11.40	1.00 V	288	33.2	36.1	8.60	-35.3
4	9764.00	49.94	PK	74.00	24.06	1.00 V	89	37.34	37.2	10.20	-34.8
4	9764.00	34.89	AV	54.00	19.11	1.00 V	89	22.29	37.2	10.20	-34.8

H Channel (2480 MHz) (GFSK Worst Case)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M（GFSK_2480MHz）											
No.	Frequency (MHz)	Emssion Level		Limit (dBuV/m)	Margin (dB)	Antenna Height	Table Angle	Raw Value	Antenna Factor	Cable Factor	Pre-amplifier
1	*2480.00	103.89	PK	/	/	1.00 H	154	107.19	28.6	4.70	-36.6
1	*2480.00	89.97	AV	/	/	1.00 H	154	93.27	28.6	4.70	-36.6
2	4960.00	49.79	PK	74.00	24.21	1.00 H	100	45.99	33	7.00	-36.2
2	4960.00	35.13	AV	54.00	18.87	1.00 H	100	31.33	33	7.00	-36.2
3	7440.00	51.10	PK	74.00	22.90	1.00 H	190	41.7	36.2	8.50	-35.3
3	7440.00	42.04	AV	54.00	11.96	1.00 H	190	32.64	36.2	8.50	-35.3
4	9920.00	50.00	PK	74.00	24.00	1.00 H	113	37.4	37.2	10.20	-34.8
4	9920.00	37.04	AV	54.00	16.96	1.00 H	113	24.44	37.2	10.20	-34.8

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M（GFSK_2480MHz）											
No.	Frequency (MHz)	Emssion Level		Limit (dBuV/m)	Margin (dB)	Antenna Height	Table Angle	Raw Value	Antenna Factor	Cable Factor	Pre-amplifier
1	*2480.00	98.90	PK	/	/	1.00 V	247	102.2	28.6	4.70	-36.6
1	*2480.00	87.25	AV	/	/	1.00 V	247	90.55	28.6	4.70	-36.6
2	4960.00	51.96	PK	74.00	22.04	1.00 V	90	48.16	33	7.00	-36.2
2	4960.00	46.88	AV	54.00	7.12	1.00 V	90	43.08	33	7.00	-36.2
3	7440.00	53.17	PK	74.00	20.83	1.00 V	29	43.77	36.2	8.50	-35.3
3	7440.00	41.99	AV	54.00	12.01	1.00 V	29	32.59	36.2	8.50	-35.3
4	9920.00	50.91	PK	74.00	23.09	1.00 V	222	38.31	37.2	10.20	-34.8
4	9920.00	40.43	AV	54.00	13.57	1.00 V	222	27.83	37.2	10.20	-34.8

REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
   － Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level － Limit value
5. " * ": Fundamental frequency.

3. List of measuring equipment

Description	Manufacturer	Model	Serial No.	Test Date	Due Date	Remark
EMI Test Receiver	R&S	ESIB26	A0304218	2016.06.02	2017.06.01	Radiation
Full-Anechoic Chamber	Albatross	12.8m*6.8m* 6.4m	A0412372	2016.06.02	2017.06.01	Radiation
Loop Antenna	Schwarz beck	HFH2-Z2	100047	2016.06.02	2017.06.01	Radiation
Bilog Antenna	Schwarzbeck	VULB 9163	9163-274	2016.06.02	2017.06.01	Radiation
Double ridge horn antenna	R&S	HF906	100150	2016.06.02	2017.06.01	Radiation
Ultra-wideband antenna	R&S	HL562	100089	2016.06.02	2017.06.01	Radiation
Test Antenna – Horn (18-26.5GHz)	ETS	3160-09	A0902607	2016.06.02	2017.06.01	Radiation
Amplifier 20M~3GHz	R&S	PAP-0203H	22018	2016.06.02	2017.06.01	Radiation
Ampilier 1G~18GHz	R&S	MITEQ AFS42-00101 800	25-S-42	2016.06.02	2017.06.01	Radiation
Ampilier 18G~40GHz	R&S	JS42-180026 00-28-5A	12111.0980.00	2016.06.02	2017.06.01	Radiation
Spectrum Analyzer	R&S	FSP40	1164.4391.40	2016.06.02	2017.06.01	Conducted
Power Meter	R&S	NRVS	1020.1809.02	2016.06.02	2017.06.01	Conducted
Power Sensor	R&S	NRV-Z4	823.3618.03	2016.06.02	2017.06.01	Conducted
LISN	ROHDE&SCHWARZ	ESH2-Z5	A0304221	2016.06.02	2017.06.01	Conducted
Test Receiver	R&S	ESCS30	A0304260	2016.06.02	2017.06.01	Conducted
Cable	SUNHNER	SUCOFLEX 100	/	2016.06.02	2017.06.01	Radiation
Cable	SUNHNER	SUCOFLEX 104	/	2016.06.02	2017.06.01	Radiation

4. Uncertainty of Evaluation

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2

Measurement	Frequency	Uncertainty
Conducted emissions	9kHz~30MHz	2.35dB
Radiated emissions	30MHz~1000MHz	2.45dB
	1G~18GHz	2.21dB
	18G~40GHz	1.96dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

** END OF REPORT **