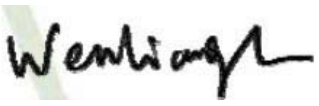
FCC PART 15 SUBPART C TEST REPORT

FCC PART 15.247

Report Reference No.....:	**NTI2015110101**
FCC ID.....:	**2ACRLH097**
Issue Date.....:	**Nov 13, 2015**
Testing Laboratory Name .....:	**NQSTC for Information Network Products**
Address .....:	1368#, Wuzhong Avenue, Suzhou Jiangsu province, China
Applicant's name.....:	**Harman Automotive Electronic Systems (Suzhou) Co., Ltd**
Address .....:	No125 Fangzhou Rd, Suzhou SIP, Jiangsu, China
Test specification .....:	
Standard .....:	**FCC Part 15.247: Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz**
TRF Originator.....:	NQSTC for Information Network Products

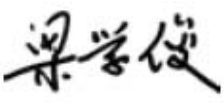
Test item description .....:	**Headunit**
Trade Mark .....:	/
Manufacturer.....:	**Harman Automotive Electronic Systems (Suzhou) Co., Ltd**
Model/Type reference.....:	P.AVN3.0 NA
Listed Models .....:	H097, H087
Modulation Type .....:	GFSK,8DPSK,π/4DQPSK
Operation Frequency.....:	From 2402MHz to 2480MHz
Rating .....:	DC 12.0V from Battery
Hardware version .....:	D
Software version .....:	R10
Result.....:	**PASS**

Compiled by:



Wenliang Li / Test Engineer

Approved by:



Xuejun Liang / Director

TEST REPORT

Test Report No. :	**NTI2015110101**	Nov 13, 2015 Date of issue

Equipment under Test	:	Headunit
Model /Type	:	P.AVN3.0 NA
Listed Models	:	H097, H087
Applicant	:	**Harman Automotive Electronic Systems (Suzhou) Co., Ltd**
Address	:	No125 Fangzhou Rd, Suzhou SIP, Jiangsu, China
Manufacturer	:	**Harman Automotive Electronic Systems (Suzhou) Co., Ltd**
Address	:	No125 Fangzhou Rd, Suzhou SIP, Jiangsu, China

Test Result:	**PASS**

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

Revison History

Revision	Issue Date	Revisions	Revised By
00	2015-11-13	Initial Issue	Xuejun Liang
01	2015-11-27	a. add internal photos remove shield b. add states of LTE modular in internal photos	Xuejun Liang

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1. TEST STANDARDS

The tests were performed according to following standards:

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

ANSI C63.10:2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

DA 00-705: Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems

2 . SUMMARY

2.1. General Remarks

Date of receipt of test sample	:	Oct 20, 2015
Testing commenced on	:	Oct 22, 2015
Testing concluded on	:	Oct 26, 2015

2.2. Product Description

The **Harman Automotive Electronic Systems (Suzhou) Co., Ltd's** Model: P.AVN3.0 NA or the "EUT" as referred to in this report; more general information as follows, for more details, refer to the user's manual of the EUT.

Name of EUT	Headunit
FCC ID	2ACRLH097 Contains FCC ID: YZP-VL2000
Model number	P.AVN3.0 NA
BT Modulation Type	GFSK,8DPSK,π/4DQPSK
Bluetooth	Supported BT V3.0
Antenna type	Internal and maximum antenna gain is 0.1dBi for BT modular
Hardware version	D
Software version	R10
BT FCC Operation frequency	2402MHz-2480MHz
Power supply	DC 12.0V from battery

2.3. Equipment under Test

Power supply system utilised

Power supply voltage	:	○	120V / 60 Hz	○	115V / 60Hz
		●	12 V DC	○	24 V DC
		○	Other (specified in blank below)		

2.4. Short description of the Equipment under Test (EUT)

2.4.1 General Description
P.AVN3.0 NA is Headunit with LTE modular (FCC ID: YZP-VL2000) and Bluetooth V3.0 modular, P.AVN3.0 NA also support AM/FM receive, DAB, SXM, HD Media etc function.

NOTE: Unless otherwise noted in the report, the functional boards installed in the units shall be selected from the below list, but not means all the functional boards listed below shall be installed in one unit.

2.5. EUT operation mode

The EUT has been tested under typical operating condition. There are EDR (Enhanced Data Rate) and BDR (Basic Data Rate) mode.The Applicant provides communication tools software to control the EUT for staying in continous transmitting and receiving mode for testing. There are 79 channels of EUT, and the test carried out at the lowest channel, middle channel and highest channel .

Channel	Frequency(MHz)	Channel	Frequency(MHz)
0	**2402**	40	2442
1	2403	41	2443
2	2404	42	2444
3	2405	43	2445

4	2406	44	2446
5	2407	45	2447
6	2408	46	2448
7	2409	47	2449
8	2410	48	2450
9	2411	49	2451
10	2412	50	2452
11	2413	51	2453
12	2414	52	2454
13	2415	53	2455
14	2416	54	2456
15	2417	55	2457
16	2418	56	2458
17	2419	57	2459
18	2420	58	2460
19	2421	59	2461
20	2422	60	2462
21	2423	61	2463
22	2424	62	2464
23	2425	63	2465
24	2426	64	2466
25	2427	65	2467
26	2428	66	2468
27	2429	67	2469
28	2430	68	2470
29	2431	69	2471
30	2432	70	2472
31	2433	71	2473
32	2434	72	2474
33	2435	73	2475
34	2436	74	2476
35	2437	75	2477
36	2438	76	2478
37	2439	77	2479
38	2440	**78**	**2480**
39	**2441**		

2.6. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: 2ACRLH097** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

2.7. Modifications

No modifications were implemented to meet testing criteria.

2.8. Note

1. The Headunit with Bluetooth and LTE modular (FCC ID: YZP-VL2000), the functions of the EUT listed as below:

	Test Standards	Reference Report
BT	FCC Part 15 C 15.247	NTI2015110101
MPE	FCC Part 2.1091(d)	NTI2015110102

3. TEST ENVIRONMENT

3.1. Address of the test laboratory

NQSTC for Information Network Products

1368#, Wuzhong Avenue, Suzhou Jiangsu province, China
The sites are constructed in conformance with the requirements of ANSI C63.4 (2009) and CISPR Publication 22.

3.2. Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

FCC-Registration No.: 640166
NQSTC for Information NetworkProducts 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 640166, valid time is until Aug 21, 2017.

3.3. Environmental conditions

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

Temperature:	15-35 ° C
Humidity:	30-60 %
Atmospheric pressure:	950-1050mbar

3.4. Test Conditions

Test Case	Test Conditions	
	Configuration	Description
20dB Emission Bandwidth (EBW)	Meas. Method	ANSI C63.10:2013
	Test Environment	NTNV
	EUT Conf.	TM1_DH5_Ch00,TM1_DH5_Ch39,TM1_DH5_Ch78, TM3_3DH5_Ch00,TM3_3DH5_Ch39,TM3_3DH5_Ch78,
Carrier Frequency Separation	Meas. Method	ANSI C63.10:2013
	Test Environment	NTNV
	EUT Conf.	TM1_DH5_Hop, TM3_3DH5_Hop,
Number of Hopping Channel	Meas. Method	ANSI C63.10:2013
	Test Environment	NTNV
	EUT Conf.	TM1_DH5_Hop ,TM3_3DH5_Hop,
Time of Occupancy (Dwell Time)	Meas. Method	ANSI C63.10:2013
	Test Environment	NTNV
	EUT Conf.	TM1_DH5_Ch39 ,TM3_3DH5_Ch39.
Maximum Peak Conducted Output Power	Meas. Method	ANSI C63.10:2013
	Test Environment	NTNV
	EUT Conf.	TM1_DH3_Ch00,TM1_DH3_Ch39,TM1_DH3_Ch78,TM2_2DH3_Ch00,TM2_2DH3_Ch39,TM2_2DH3_Ch78,TM3_3DH3_Ch00,TM3_3DH3_Ch39,TM3_3DH3_Ch78,
Bandedge spurious emission (Conducted)	Meas. Method	ANSI C63.10:2013
	Test Environment	NTNV
	EUT Conf.	TM1_DH3_Ch00,TM1_DH3_Ch78, TM3_3DH3_Ch00,TM3_3DH3_Ch78,
Conducted RF Spurious Emission	Meas. Method	ANSI C63.10:2013
	Test Environment	NTNV
	EUT Conf.	TM1_DH5_Ch00, TM1_DH5_Ch39, TM1_DH5_Ch78, TM3_3DH5_Ch39, TM3_3DH5_Ch78.
Radiated Emissions in the Restricted Bands	Meas. Method	ANSI C63.10:2013 30 MHz to 1 GHz: Pre: RBW=100kHz; VBW=300kHz; Det. = Peak.

		Final: RBW=120kHz; Det. = CISPR Quasi-Peak. 1 GHz to 26.5GHz: Average: RBW=1 MHz; VBW= 10Hz; Det. = Peak; Sweep-time= Auto; Trace = Single. Peak: RBW=1 MHz; VBW= 3 MHz; Det. = Peak; Sweep-time= Auto; Trace≥ MaxHold * 100.
	Test Environment	NTNV
	EUT Conf.	30 MHz-1GHz TM1_DH5_Ch00 (Worst Conf.).
		1-18 GHz: TM1_DH5_Ch00, TM1_DH5_Ch39, TM1_DH5_Ch78, (Worst Conf.).

Remark:
1. For π/4 QPSK its same modulation type with 8-DPSK, and based exploratory test, there is no significant difference of that two types test result, so except output power, all other items final test were only performed with the worse case 8-DPSK and GFSK.

3.5. Summary of measurement results

Test Specification clause	Test case	Test Mode	Test Channel	Recorded In Report		Pass	Fail	NA	NP	Remark
§15.247(b)(4)	Antenna gain	-/-	-/-	-/-	-/-	☒	☐	☐	☐	Declared by Manufacturer
§15.247(e)	Power spectral density	-/-	-/-	-/-	-/-	☐	☐	☒	☐	Not applicable for FHSS!
§15.247(a)(1)	Carrier Frequency separation	GFSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	☒ ☒	☐	☐	☐	complies
§15.247(a)(1)	Number of Hopping channels	GFSK 8DPSK	☒ Full (Hopping)	GFSK 8DPSK	☒ Full (Hopping)	☒ ☒	☐	☐	☐	complies
§15.247(a)(1)	Time of Occupancy (dwell time)	GFSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	☒ ☒	☐	☐	☐	complies
§15.247(a)(1)	Spectrum bandwidth of a FHSS system 20dB bandwidth	GFSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	☒ ☒	☐	☐	☐	complies
§15.247(b)(1)	Maximum output power	GFSK π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	☒ ☒ ☒	☐	☐	☐	complies
§15.247(d)	Band edge compliance conducted	GFSK 8DPSK	☒ Lowest ☒ Highest ☒Hopping	GFSK 8DPSK	☒ Lowest ☒ Highest ☒Hopping	☒ ☒	☐	☐	☐	complies
§15.205	Band edge compliance radiated	GFSK 8DPSK	☒ Lowest ☒ Highest ☒Hopping	GFSK	☒ Lowest ☒ Highest	☒	☐	☐	☐	complies
§15.247(d)	TX spurious emissions conducted	GFSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	☒ ☒	☐	☐	☐	complies
§15.247(d)	TX spurious emissions radiated	GFSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	☒	☐	☐	☐	complies
§15.109	RX spurious emissions radiated	-/-	-/-	-/-	-/-	☒	☐	☐	☐	complies
§15.209(a)	TX spurious Emissions radiated < 30 MHz	GFSK	-/-	GFSK	-/-	☒	☐	☐	☐	complies
§15.107(a) §15.207	Conducted Emissions < 30 MHz	GFSK	-/-	GFSK	-/-	☐	☐	☒	☐	Not applicable for powered DC battery

Remark:
1. The measurement uncertainty is not included in the test result.
2. NA = Not Applicable; NP = Not Performed
3. We tested all test mode and recorded worst case in report

3.6. Measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to ETSI TR 100 028 " Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics" and is documented in the NQSTC for Information Network Products quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for NQSTC for Information Network Products is reported:

Test	Range	Measurement Uncertainty	Notes
Radiated Emission	30~1000MHz	4.23 dB	(1)
Radiated Emission	1~18GHz	5.12 dB	(1)
Radiated Emission	18-40GHz	5.55 dB	(1)
Conducted Disturbance	0.15~30MHz	3.27 dB	(1)
Conducted Power	9KHz~18GHz	0.58 dB	(1)
Spurious RF Conducted Emission	9KHz~40GHz	1.45 dB	(1)
Band Edge Compliance of RF Emission	9KHz~40GHz	1.45 dB	(1)
Occuiped Bandwidth	9KHz~40GHz	-	(1)
Dwell Time	9KHz~40GHz	-	(1)

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=1.96.

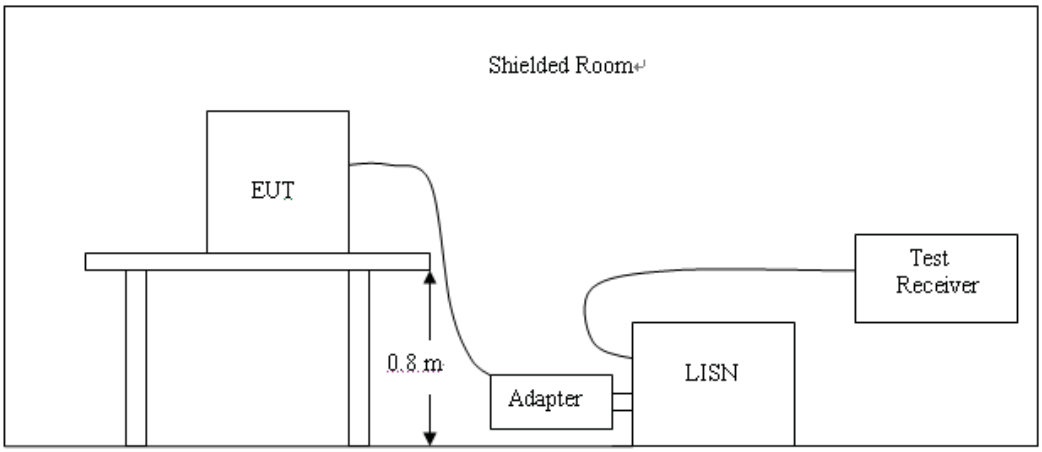
3.7. Equipments Used during the Test

Description	Manufacturer	Model	Serial No.	Calibration date	Calibration interval
Semi-anechoic Chamber	EMC	EMCT-10	NTIe-511-060-00-P	2013/5/16	3 year
EMI Test Receiver	R&S	ESU26	NTIe-511-001-01-P	2015-10-20	1 year
Broadband Antenna	Schwarzbeck	VULB 9163	NTIe-511-001-02-P	2013-11-06	3 year
Pre-amplifier	R&S	SCU03	NTIe-511-001-03-P	2015-10-20	1 year
Horn Antenna	R&S	HF907	NTIe-511-001-04-P	2013-11-04	3 year
Pre-amplifier	R&S	SCU18	NTIe-511-001-05-P	2015-10-20	1 year
Loop Antenna	R&S	HFH2-Z2	NTIe-511-001-06-P	2013-11-30	3 year
Pre-amplifier	R&S	SCU18	NTIe-511-011-11-P	2015-10-20	1 year
EMC Test Software	R&S	EMC32	/	/	/
Power Sensor	Aglient	N8481H	NTIe-511-001-20-P	2015-10-20	1 year
Power Meter	Aglient	N1914A	NTIe-511-001-19-P	2015-10-20	1 year

4. TEST CONDITIONS AND RESULTS

4.1. AC Power Conducted Emission (Not Applicable)

TEST CONFIGURATION



TEST PROCEDURE

1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system; a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10-2013.
2. Support equipment, if needed, was placed as per ANSI C63.10-2013
3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2013
4. The EUT received DC5V power from the adapter, the adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5. All support equipments received AC power from a second LISN, if any.
6. The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7. Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8. During the above scans, the emissions were maximized by cable manipulation.

AC Power Conducted Emission Limit

For intentional device, according to § 15.207(a) AC Power Conducted Emission Limits is as following：

Frequency (MHz)	Maximum RF Line Voltage (dBμV)			
	CLASS A		CLASS B	
	Q.P.	Ave.	Q.P.	Ave.
0.15 - 0.50	79	66	66-56*	56-46*
0.50 - 5.00	73	60	56	46
5.00 - 30.0	73	60	60	50

* Decreasing linearly with the logarithm of the frequency

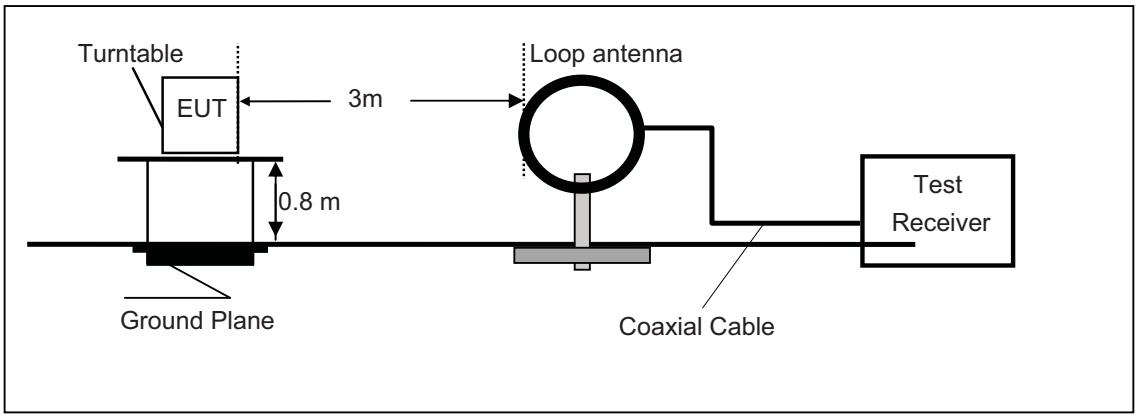
TEST RESULTS

Not Applicable (The sample was powered by DC battery)

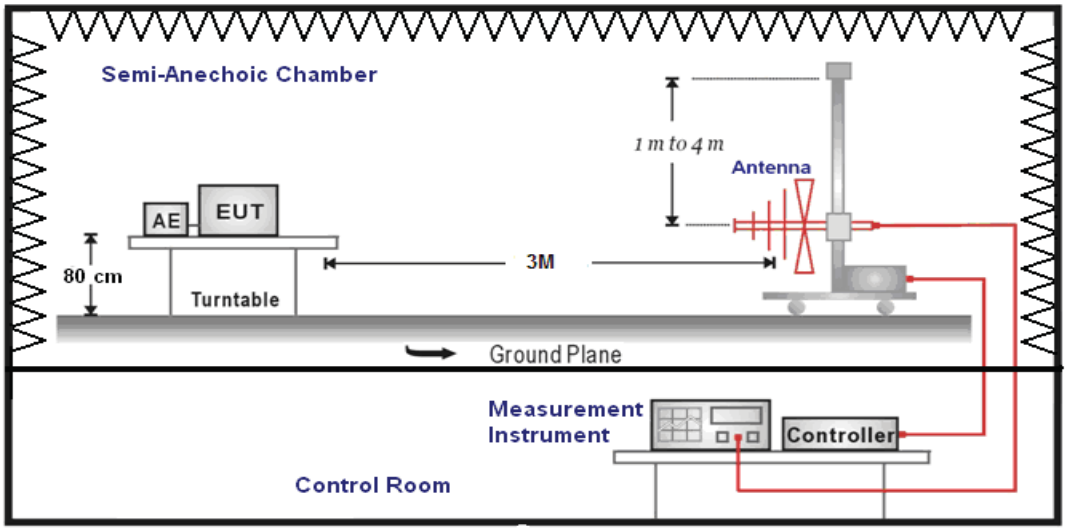
4.2. Radiated Emission

TEST CONFIGURATION

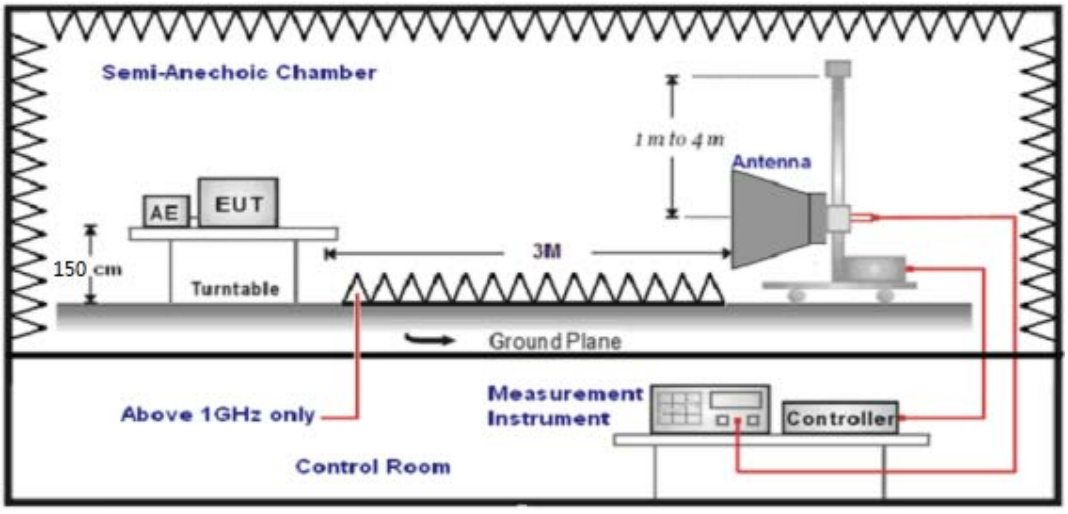
Frequency range 9 KHz – 30MHz



Frequency range 30MHz – 1000MHz



Frequency range above 1GHz-25GHz



TEST PROCEDURE

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0℃ to 360℃ to acquire the highest emissions from EUT.
3. For the radiated emission test above 1GHz:
   Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.
4. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
5. Repeat above procedures until all frequency measurements have been completed.
6. The EUT maximum operation frequency was 2480MHz.so radiated emission test frequency band from 9 KHz to 26.5GHz.
7. The distance between test antenna and EUT as following table states:

Test Frequency range	Test Antenna Type	Test Distance
9KHz-30MHz	Active Loop Antenna	3
30MHz-1GHz	Ultra-Broadband Antenna	3
1GHz-18GHz	Double Ridged Horn Antenna	3
18GHz-26.5GHz	Double Ridged Horn Antenna	1

8. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
9KHz-150KHz	RBW=200Hz/VBW=3KHz,Sweep time=Auto	QP
150KHz-30MHz	RBW=9KHz/VBW=100KHz,Sweep time=Auto	QP
30MHz-1GHz	RBW=120KHz/VBW=1000KHz,Sweep time=Auto	QP
1GHz-26.5GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto	Peak
	Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Average (Receiver)

9. More descrition of radiated emission as:

a. Sequence of testing 9 kHz to 30 MHz

Setup:

---The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

---If the EUT is a tabletop system, a rotatable table with 0.8m height is used.

---If the EUT is a floor standing device, it is placed on the ground.

---Auxiliary equipment and cables were positioned to simulate normal operation conditions.

---The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

---The measurement distance is 3 meter.

---The EUT was set into operation.

Premeasurement:

---The turntable rotates from 0° to 315° using 45° steps.

---The antenna height is 0.8meter.

---At each turntable position the analyzer sweeps with peak detection to find the maximum of all emissions

Final measurement:

---Identified emissions during the premeasurement the software maximizes by rotating the turntable position (0° to 360°) and by rotating the elevation axes (0° to 360°).

---The final measurement will be done in the position (turntable and elevation) causing the highest emissions with QPK detector.

---The final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

b. Sequence of testing 30 MHz to 1 GHz

Setup:

---The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

---If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.

---If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

---Auxiliary equipment and cables were positioned to simulate normal operation conditions

---The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

---The measurement distance is 3 meter.
---The EUT was set into operation.

Premeasurement:

---The turntable rotates from 0° to 315° using 45° steps.
---The antenna is polarized vertical and horizontal.
---The antenna height changes from 1 to 3 meter.
---At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement:

---The final measurement will be performed with minimum the six highest peaks.
---According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meter.
---The final measurement will be done with QP detector with an EMI receiver.
---The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

c. Sequence of testing 1 GHz to 10 GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.
--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
--- Auxiliary equipment and cables were positioned to simulate normal operation conditions
--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
--- The measurement distance is 3 meter.
--- The EUT was set into operation.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.
--- The antenna is polarized vertical and horizontal.
--- The antenna height scan range is 1 meter to 2.5 meter.
--- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.
--- Meausure three axis (X, Y and Z) position of EUT.

Final measurement:

--- The final measurement will be performed with minimum the six highest peaks.
--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meter. This procedure is repeated for both antenna polarizations.
--- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and Average detector.
--- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

Field Strength Calculation

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

FS = RA + AF + CL - AG

Where FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	AG = Amplifier Gain
AF = Antenna Factor	

For example

Frequency (MHz)	FS (dBμV/m)	RA (dBμV/m)	AF (dB)	CL (dB)	AG (dB)	Transd (dB)
300.00	40	58.1	12.2	1.6	31.90	-18.1

Transd=AF +CL-AG

RADIATION LIMIT

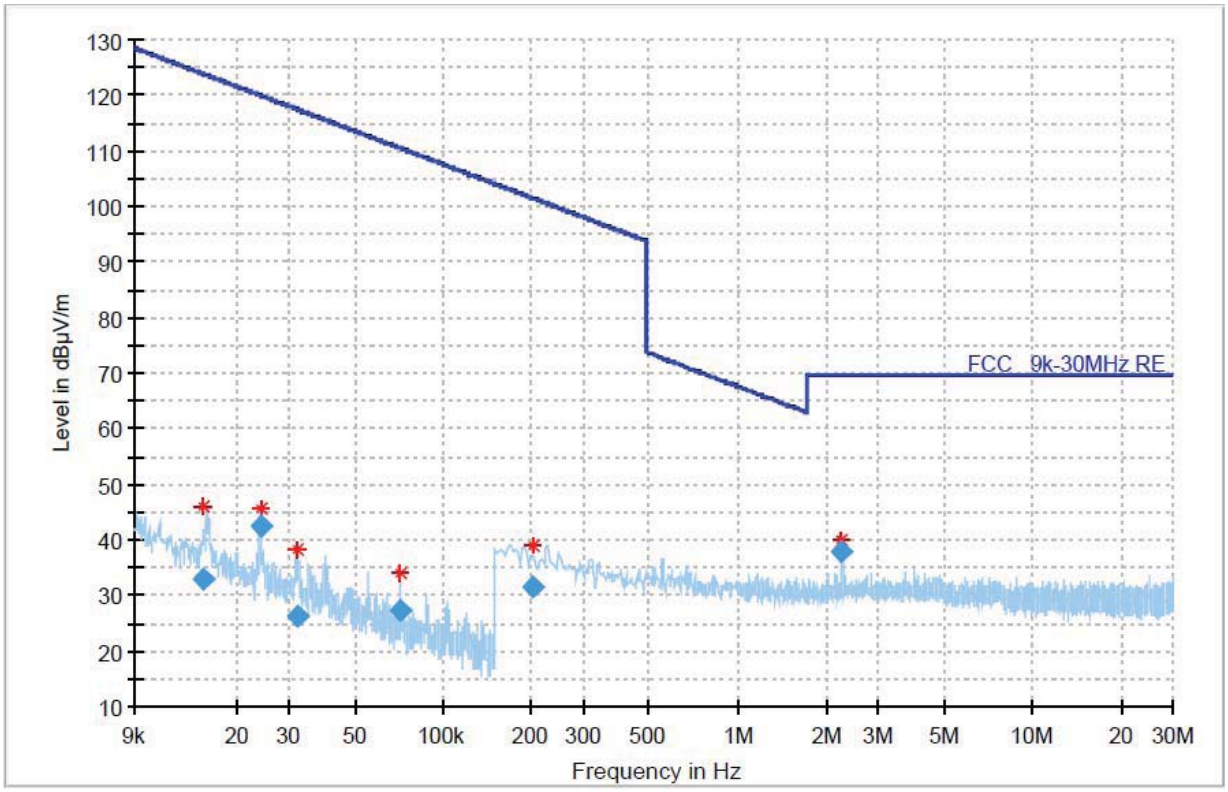
For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission from intentional radiators at a distance of 3 meters shall not exceed the following table. According to § 15.247(d), in any 100kHz bandwidth outside the frequency band in which the EUT is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the100kHz bandwidth within the band that contains the highest level of desired power.
The pre-test have done for the EUT in three axes and found the worst emission at position shown in test setup photos.

Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
0.009-0.49	300	20log(2400/F(KHz))+80	2400/F(KHz)
0.49-1.705	30	20log(24000/F(KHz))+40	24000/F(KHz)
1.705-30	30	20log(30)+40	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

TEST RESULTS

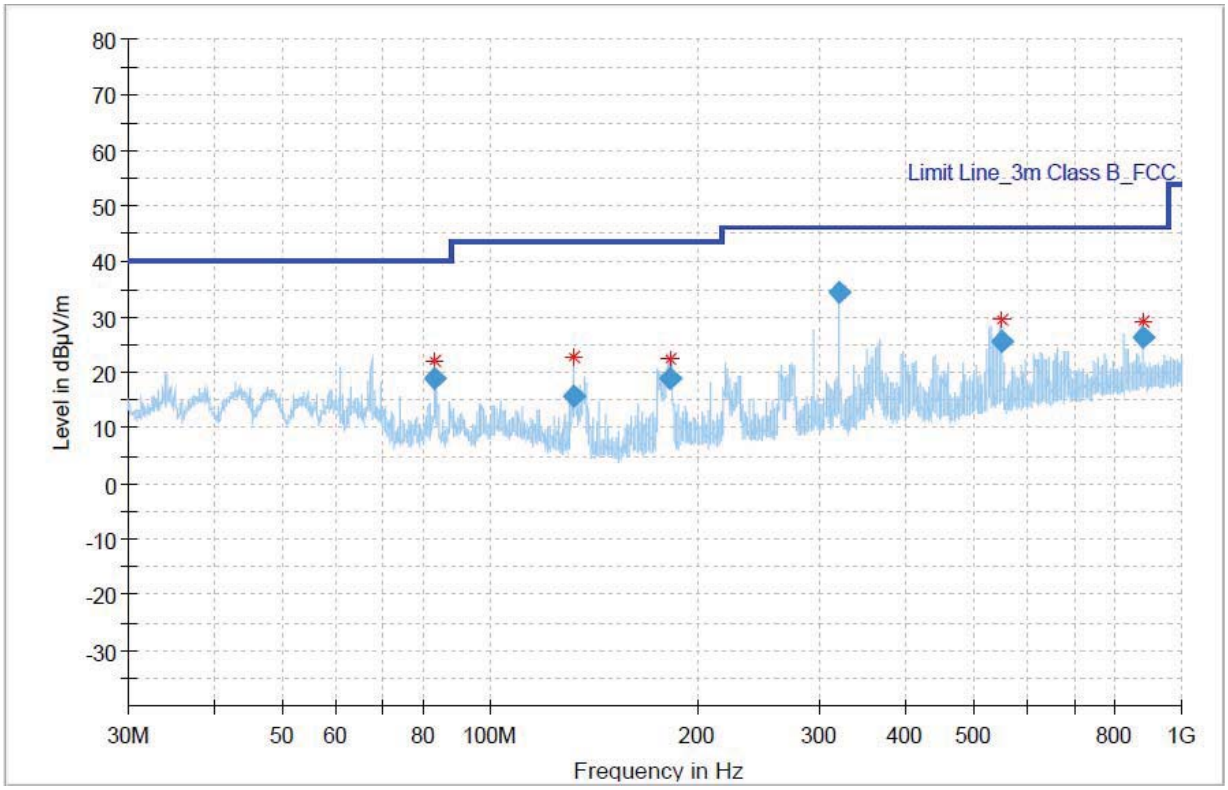
Remark:
1. The radiated measurement are performed the each channel (low/mid/high) at all Packet type (DH1, DH3 and DH5) also for difference modulation type (GFSK, 8DPSK), recorded worst case at GFSK_DH5_Low channel (Channel 00) for below 1GHz and GFSK_DH5_Low channel (Channel 00), GFSK_DH5_Middle channel (Channel 39), GFSK_DH5_High channel (Channel 78).
2. ULTRA-BROADBAND ANTENNA for the radiation emission test below 1G.
3. HORN ANTENNA for the radiation emission test above 1G.
4. We tested radiated emission from 9 KHz to 26.5 GHz, recorded from 9 KHz to 18 GHz.
5. "---" means not recorded as emission levels lower than limit.
6. Margin= Limit - Level

For 9KHz to 30MHz



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas.Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB)
0.015328	32.83	123.90	91.07	1000.0	0.200	H	300.0	20.0
0.023986	42.37	120.00	77.64	1000.0	0.200	H	174.0	20.2
0.032122	26.38	117.50	91.09	1000.0	0.200	H	157.0	20.2
0.071982	27.25	110.50	83.21	1000.0	0.200	H	253.0	20.2
0.202610	31.50	101.50	69.97	1000.0	0.200	H	64.0	20.2
2.245365	38.05	69.50	31.49	1000.0	0.200	H	258.0	20.5

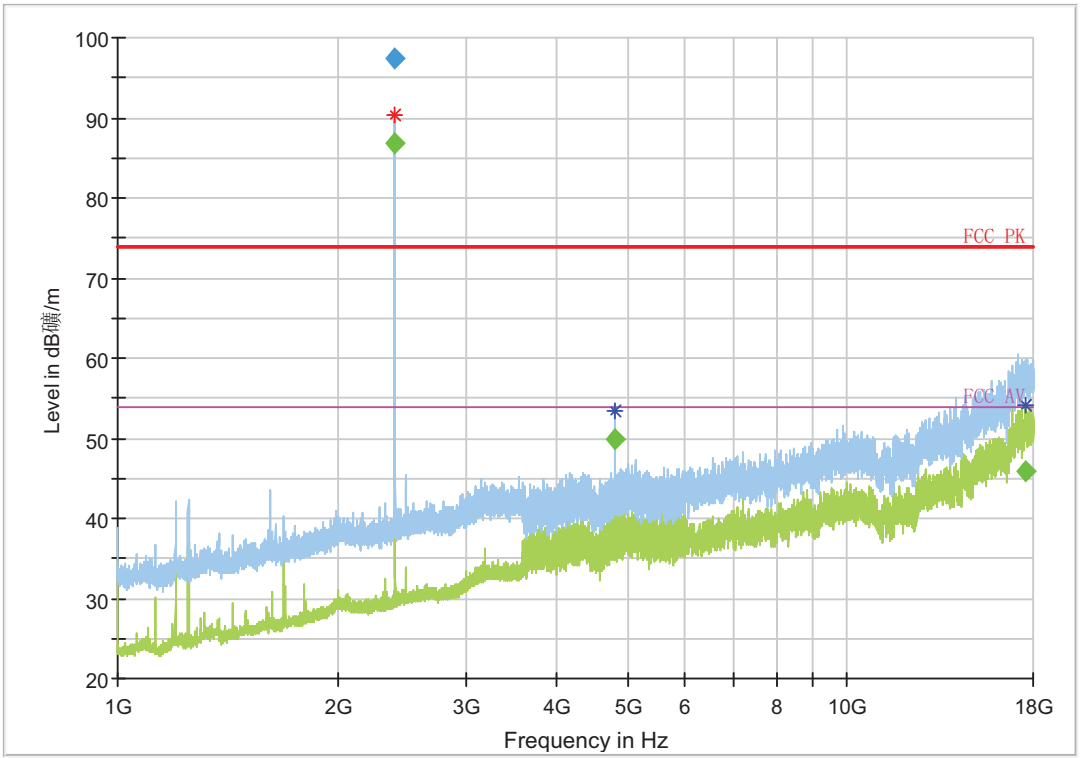
For 30MHz to 1000MHz



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas.Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
83.350000	18.84	40.00	21.16	1000.0	120.000	100.0	V	266.0	-29.0
131.884000	15.70	43.50	27.80	1000.0	120.000	106.0	V	348.0	-28.8
181.857000	18.91	43.50	24.59	1000.0	120.000	100.0	V	0.0	-27.6
319.981500	34.39	46.00	11.61	1000.0	120.000	106.0	H	330.0	-23.0
549.112500	25.74	46.00	20.26	1000.0	120.000	100.0	V	0.0	-18.5
880.519000	26.37	46.00	19.63	1000.0	120.000	207.0	V	0.0	-13.7

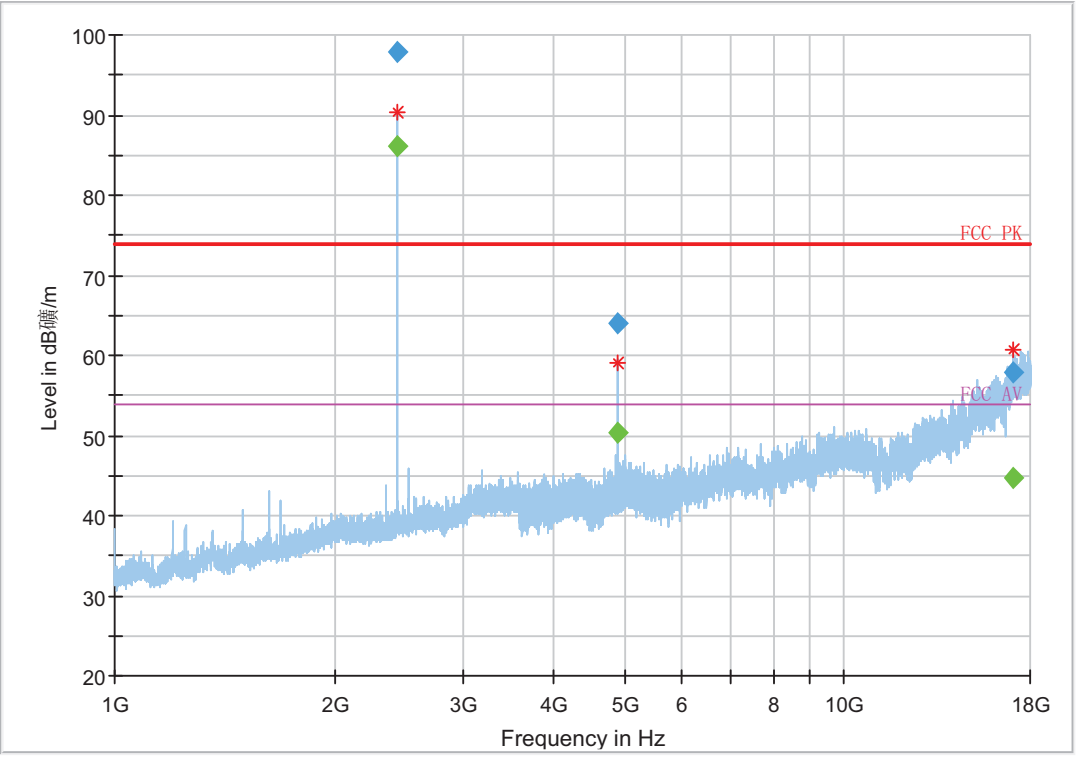
For 1GHz to 18GHz

Test mode:	2402MHz (GFSK)	Polarization	Horizontal & Vertical



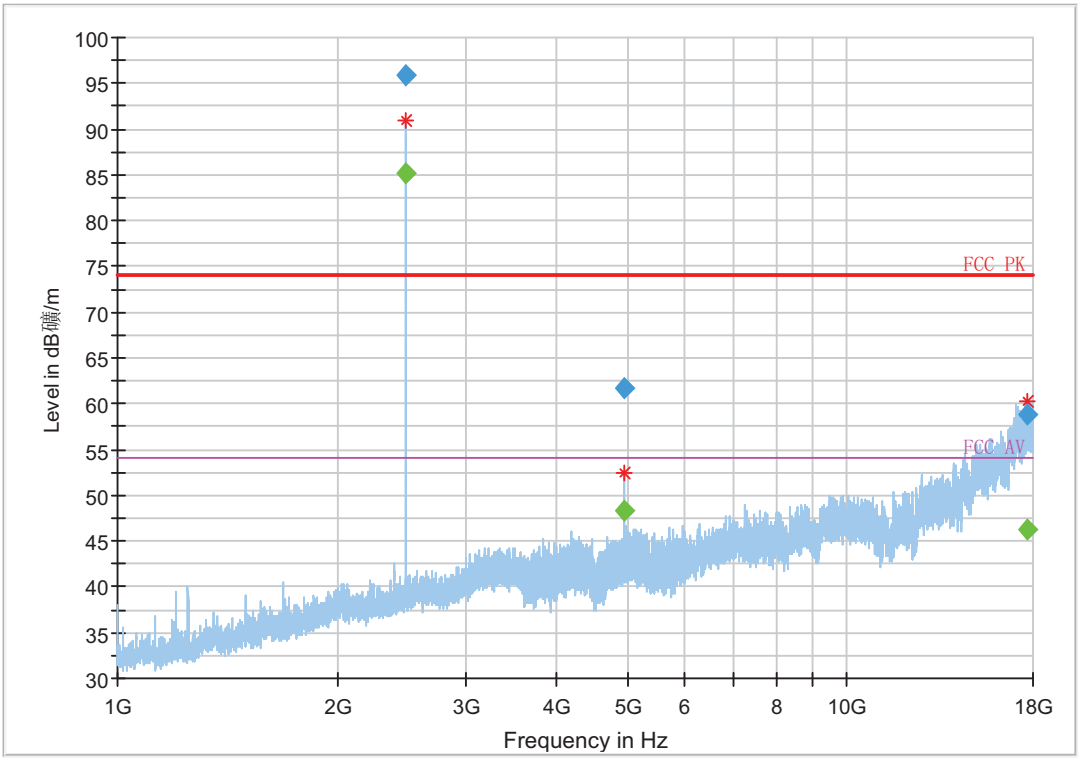
Frequency (MHz)	MaxPeak (dBuV /m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
2402.000000	---	86.77	54.00	-32.77	1000.0	1000.000	150.0	V	290.0
2402.000000	97.43	---	74.00	-23.43	1000.0	1000.000	150.0	V	290.0
4804.000000	---	49.94	54.00	4.06	1000.0	1000.000	150.0	V	-17.0
17559.600000	---	45.91	54.00	8.09	1000.0	1000.000	150.0	V	315.0
2402.000000	---	86.77	54.00	-32.77	1000.0	1000.000	150.0	V	290.0

Test mode:	2441MHz (GFSK)	Polarization	Horizontal & Vertical



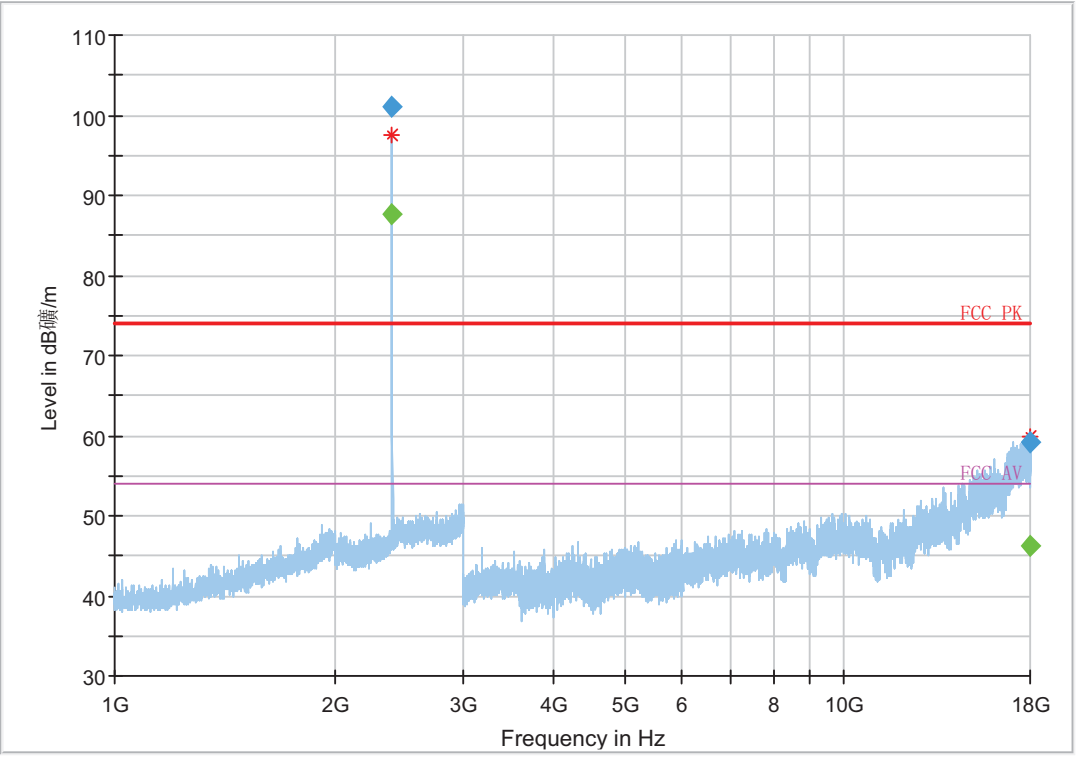
Frequency (MHz)	MaxPeak (dBuV /m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
2441.200000	---	86.13	54.00	-32.13	1000.0	1000.000	150.0	H	63.0
2441.200000	97.85	---	74.00	-23.85	1000.0	1000.000	150.0	H	63.0
4882.300000	63.99	---	74.00	10.01	1000.0	1000.000	150.0	H	45.0
4882.300000	---	50.29	54.00	3.71	1000.0	1000.000	150.0	H	45.0
17068.800000	57.83	---	74.00	16.17	1000.0	1000.000	150.0	H	24.0
17068.800000	---	44.67	54.00	9.33	1000.0	1000.000	150.0	H	24.0

Test mode:	2480MHz (GFSK)	Polarization	Horizontal & Vertical



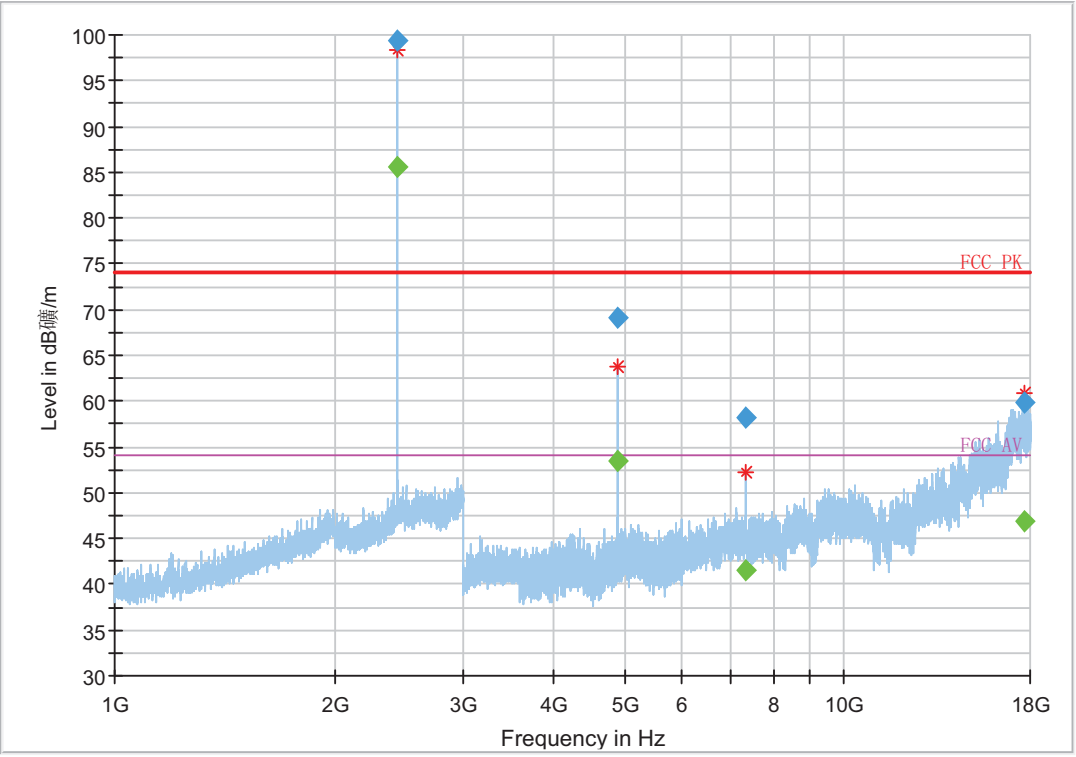
Frequency (MHz)	MaxPeak (dBuV /m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
2480.000000	95.83	---	74.00	-21.83	1000.0	1000.000	150.0	V	184.0
2480.000000	---	85.15	54.00	-31.15	1000.0	1000.000	150.0	V	184.0
4959.700000	---	48.39	54.00	5.61	1000.0	1000.000	150.0	V	125.0
4959.700000	61.70	---	74.00	12.30	1000.0	1000.000	150.0	V	125.0
17711.200000	58.73	---	74.00	15.27	1000.0	1000.000	150.0	H	-23.0
17711.200000	---	46.18	54.00	7.82	1000.0	1000.000	150.0	H	-23.0

Test mode:	2402MHz (8DPSK)	Polarization	Horizontal & Vertical



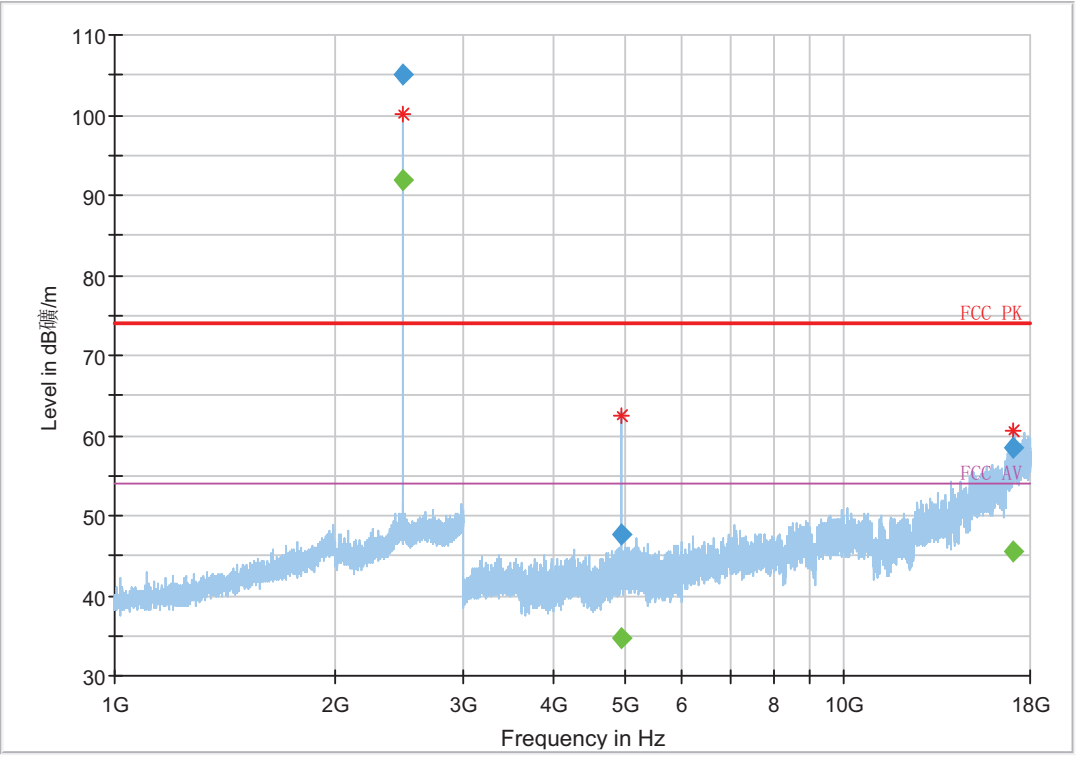
Frequency (MHz)	MaxPeak (dBuV /m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
2402.000000	101.01	---	74.00	-27.01	1000.0	1000.000	150.0	V	288.0
2402.000000	---	87.58	54.00	-33.58	1000.0	1000.000	150.0	V	288.0
17988.400000	59.24	---	74.00	14.76	1000.0	1000.000	150.0	H	-30.0
17988.400000	---	46.25	54.00	7.75	1000.0	1000.000	150.0	H	-30.0

Test mode:	2441MHz (8DPSK)	Polarization	Horizontal & Vertical



Frequency (MHz)	MaxPeak (dBuV /m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
2440.800000	---	85.69	54.00	-31.69	1000.0	1000.000	150.0	V	183.0
2440.800000	99.45	---	74.00	-25.45	1000.0	1000.000	150.0	V	183.0
4881.900000	69.21	---	74.00	4.79	1000.0	1000.000	150.0	H	45.0
4881.900000	---	53.40	54.00	0.60	1000.0	1000.000	150.0	H	45.0
7323.200000	---	41.46	54.00	12.54	1000.0	1000.000	150.0	V	184.0
7323.200000	58.15	---	74.00	15.85	1000.0	1000.000	150.0	V	184.0
17660.800000	59.85	---	74.00	14.15	1000.0	1000.000	150.0	H	-23.0
17660.800000	---	46.93	54.00	7.07	1000.0	1000.000	150.0	H	-23.0

Test mode:	2480MHz (8DPSK)	Polarization	Horizontal & Vertical

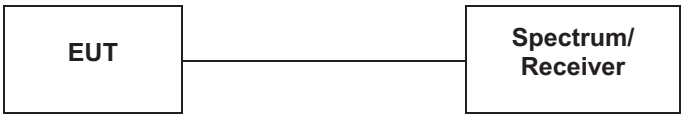


Frequency (MHz)	MaxPeak (dBuV /m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
2480.000000	---	91.77	54.00	-37.77	1000.0	1000.000	150.0	H	69.0
2480.000000	105.15	---	74.00	-31.15	1000.0	1000.000	150.0	H	69.0
4960.100000	47.71	---	74.00	26.29	1000.0	1000.000	150.0	H	45.0
4960.100000	---	34.71	54.00	19.29	1000.0	1000.000	150.0	H	45.0
17064.000000	58.49	---	74.00	15.51	1000.0	1000.000	150.0	H	4.0
17064.000000	---	45.57	54.00	8.43	1000.0	1000.000	150.0	H	4.0

Remark:
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
3. The other emission levels were very low against the limit.
4. Margin value = Limit value- Emission level.
5. The average measurement was not performed when the peak measured data under the limit of average detection
.

4.3. Maximum Peak Output Power

TEST CONFIGURATION



TEST PROCEDURE

According to ANSI C63.10:2013 7.8.5 Output power test procedure for frequency-hopping spread-spectrum (FHSS) devices; this is an RF-conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation. The hopping shall be disabled for this test:

a) Use the following spectrum analyzer settings:
1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
2) RBW > 20 dB bandwidth of the emission being measured.
3) VBW ≥ RBW.
4) Sweep: Auto.
5) Detector function: Peak.
6) Trace: Max hold.
b) Allow trace to stabilize.
c) Use the marker-to-peak function to set the marker to the peak of the emission.
d) The indicated level is the peak output power, after any corrections for external attenuators and cables.

LIMIT

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.

TEST RESULTS

Remark:
1. We test maximum peak output power at difference Packet Type (DH1, DH3 and DH5), recorded worst case at DH1

4.3.1 GFSK Test Mode

A. Test Verdict

Channel	Frequency (MHz)	Measured Output Peak Power (dBm)	Limits (dBm)	Verdict
0	2402	-0.83	30	PASS
39	2441	-1.08	30	PASS
78	2480	-0.79	30	PASS

4.3.2 π/4 DQPSK Test Mode

A. Test Verdict

Channel	Frequency (MHz)	Measured Output Peak Power (dBm)	Limits (dBm)	Verdict
0	2402	3.99	21	PASS
39	2441	3.93	21	PASS
78	2480	4.42	21	PASS

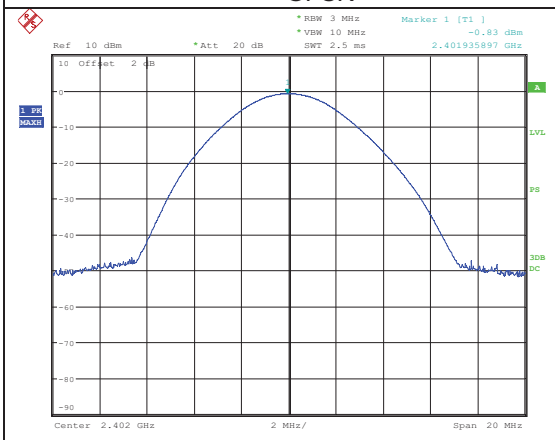
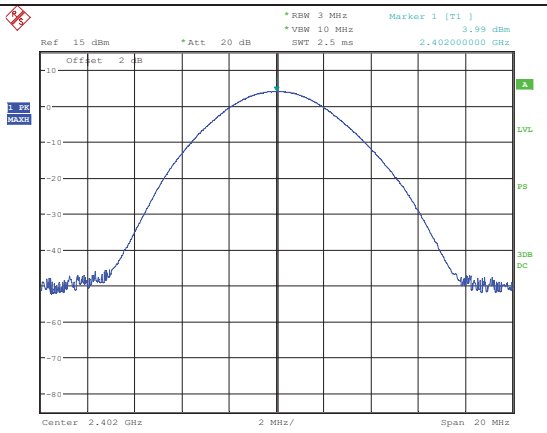
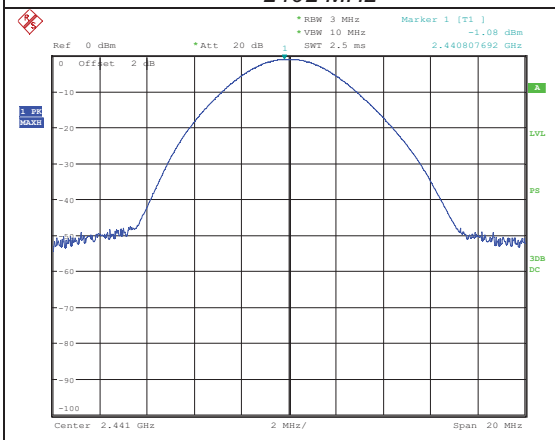
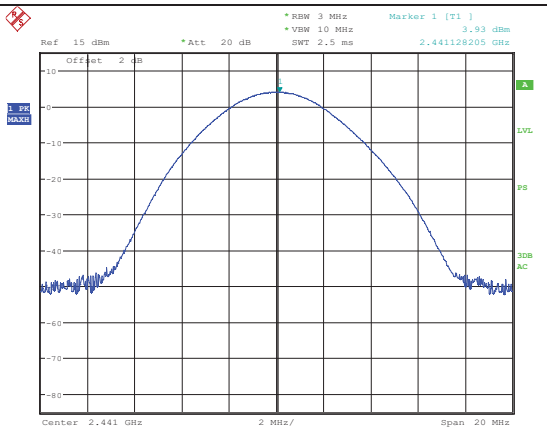
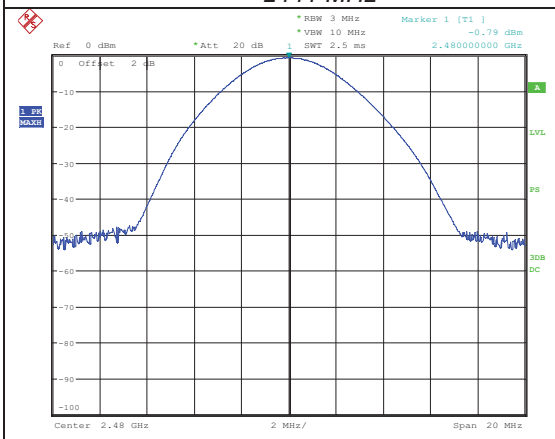
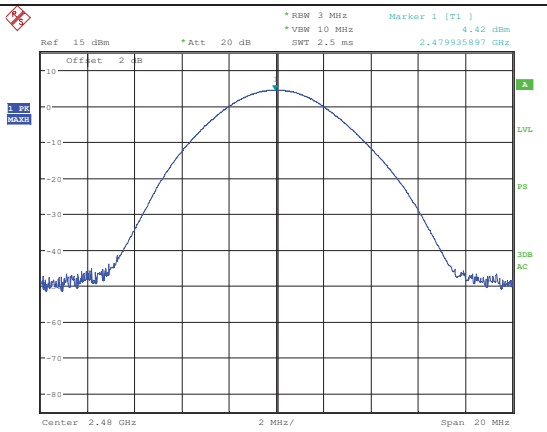
4.3.3 8DPSK Test Mode

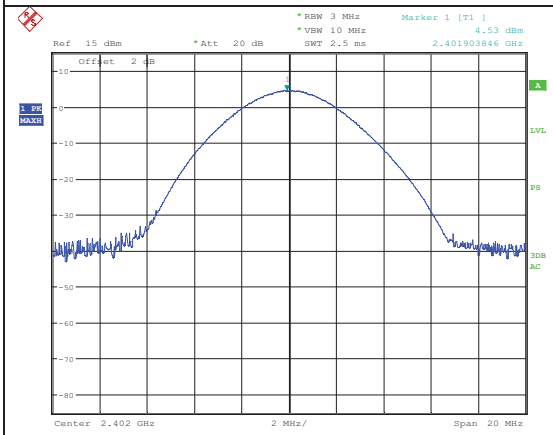
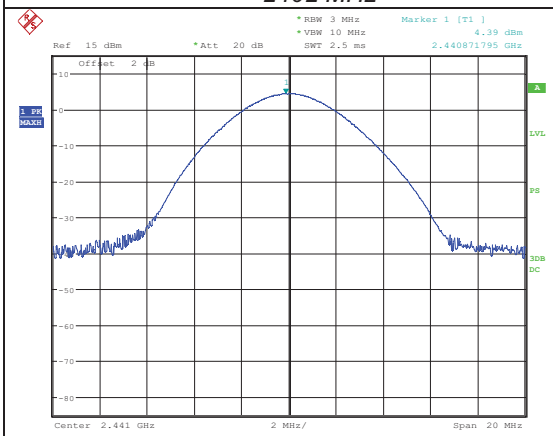
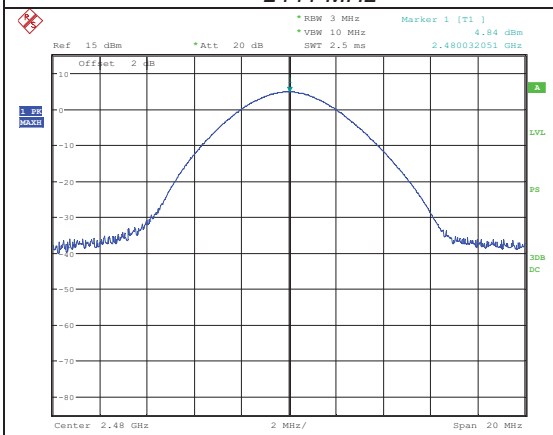
A. Test Verdict

Channel	Frequency (MHz)	Measured Output Peak Power (dBm)	Limits (dBm)	Verdict
0	2402	4.53	21	PASS
39	2441	4.39	21	PASS
78	2480	4.84	21	PASS

Remark:
1. Test results including cable loss;
2. please refer to next plots;

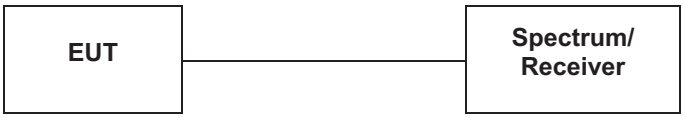
Maximum Peak Output Power

GFSK	π/4DQPSK
	
2402 MHz	*2402 MHz*
	
2441 MHz	*2441 MHz*
	
2480 MHz	*2480 MHz*

Maximum Peak Output Power	
8DPSK	
	
2402 MHz	
	
2441 MHz	
	
2480 MHz	

4.4. 20dB Bandwidth

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with RBW=30 KHz and VBW=100KHz.
The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

LIMIT

For frequency hopping systems operating in the 2400MHz-2483.5MHz no limit for 20dB bandwith.

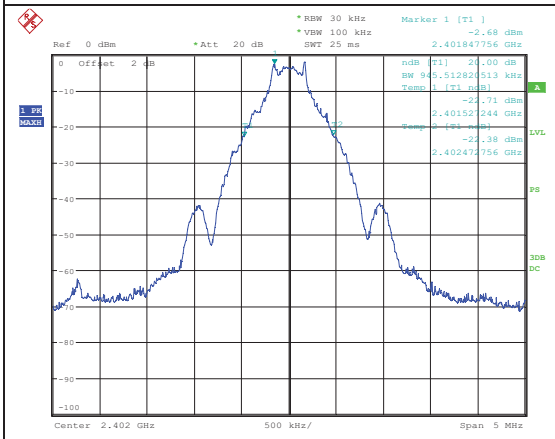
TEST RESULTS

Channel	Frequency (MHz)	20dB Bandwidth (KHz)		Limits (KHz)	Verdict
		GFSK	8DPSK		
0	2402	945.51	1306.01	/	PASS
39	2441	961.54	1314.10	/	PASS
78	2480	945.51	1330.13	/	PASS

Remark:
1.The test results including the cable lose.
2. Test Plots for next page

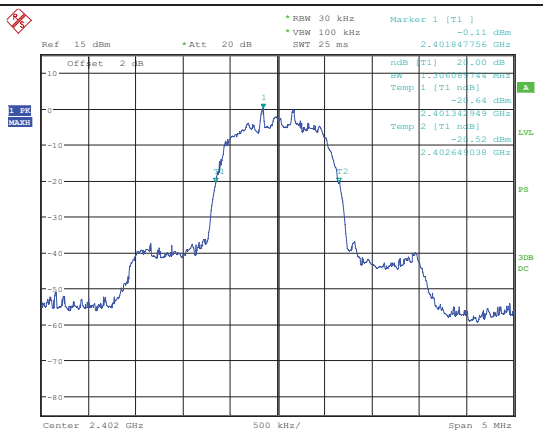
20dB Bandwidth

GFSK



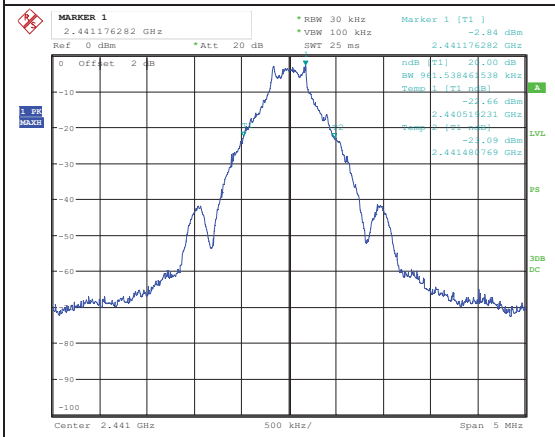
Date: 22.OCT.2015 09:15:43

8DPSK



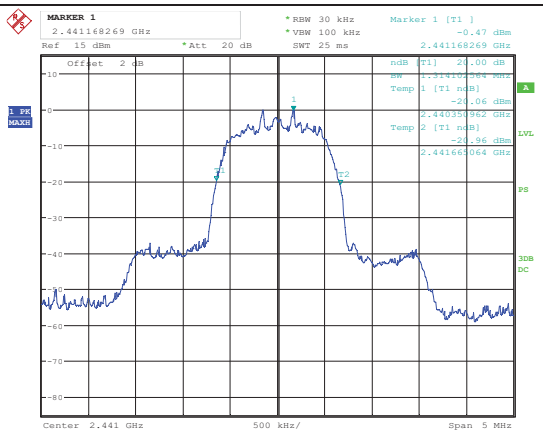
Date: 22.OCT.2015 10:02:19

2402 MHz



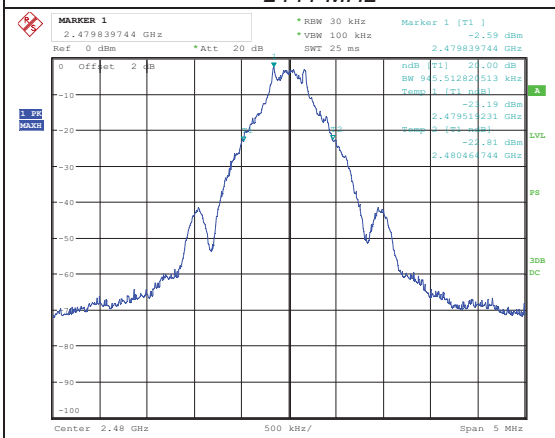
Date: 22.OCT.2015 09:27:51

2402 MHz



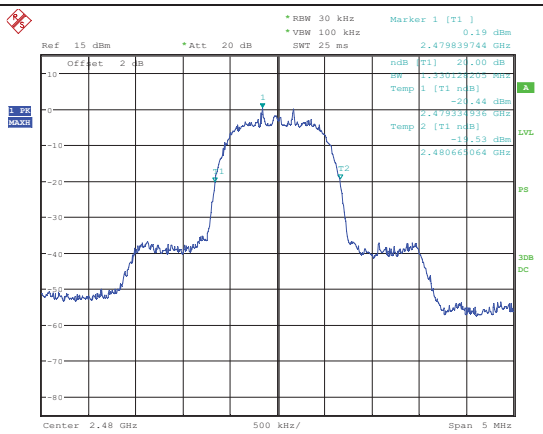
Date: 22.OCT.2015 10:18:42

2441 MHz



Date: 22.OCT.2015 09:36:57

2441 MHz



Date: 22.OCT.2015 10:28:37

2480 MHz

2480 MHz

4.5. Band Edge

Applicable Standard

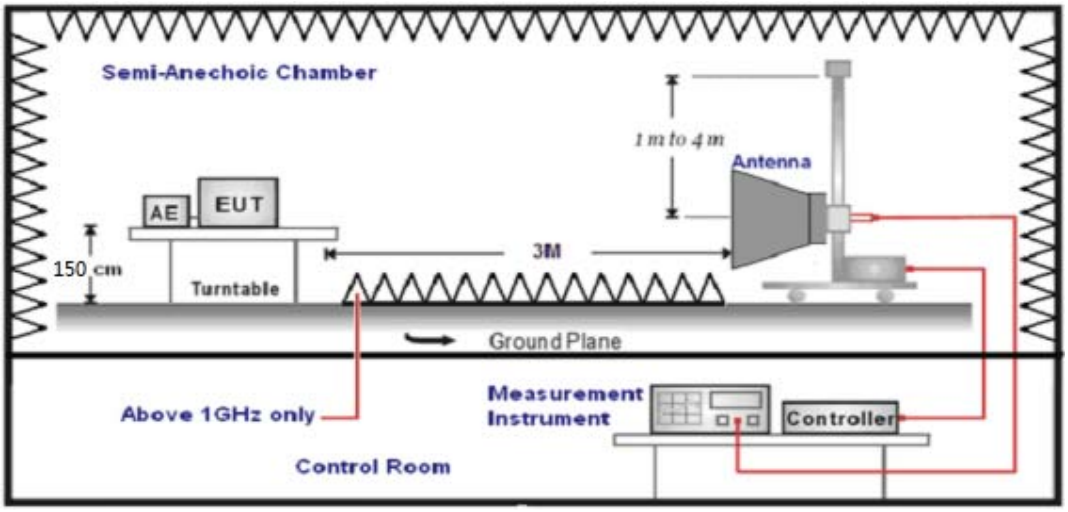
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

TEST PROCEDURE

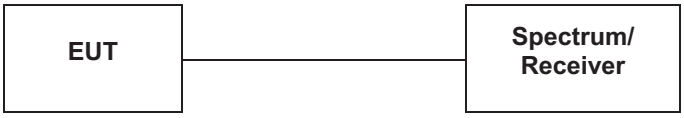
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to a EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz bandwidth from band edge, for Radiated emissions restricted band RBW=1MHz, VBW=3MHz.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

TEST CONFIGURATION

For Radiated



For Conducted



TEST PROCEDURE

Radiated

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0℃ to 360℃ to acquire the highest emissions from EUT.

3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed..
5. The distance between test antenna and EUT was 3 meter:
6. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto	Peak (Receiver)
1GHz-40GHz	Average Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto	Average (Receiver)

Conducted:

Band-edge measurements shall be tested both on single channels, and with the EUT hopping. Use the following spectrum analyzer settings:
a) Span: The frequency band of operation. It can see band frequency clearly;
b) RBW: 100 KHz;
c) VBW: 300 KHz.
d) Sweep: Auto.
e) Detector function: Peak.
f) Trace: Max hold.
g) Allow the trace to stabilize.

LIMIT

Below -20dB of the highest emission level in operating band.
Radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a)

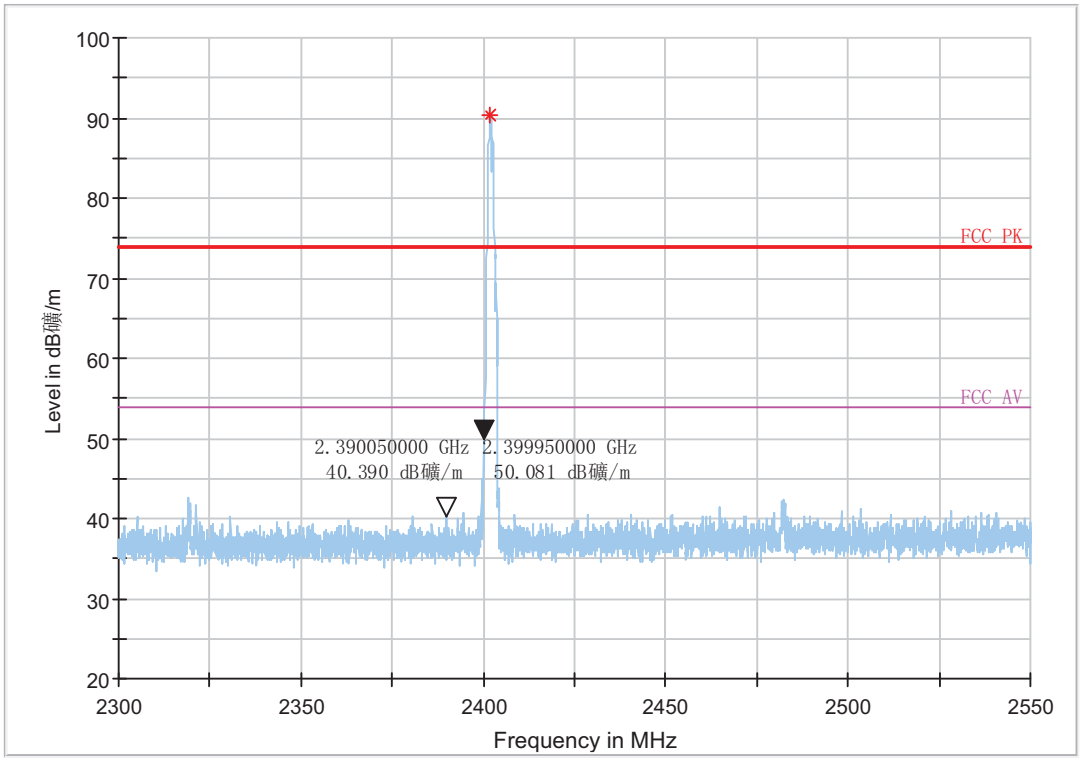
TEST RESULTS

Remark:
1. We test Band Edge at difference Packet Type (DH1, DH3 and DH5), recorded worst case at DH1.
2. "---" means not recorded as emission levels lower than limit.
3. Average Radiated values not tested as Peak Radiated values lower than Average limits.
4. Radiated Bandedge tested both Hopping and No-Hopping mode, recorded worst case at No-Hopping mode.

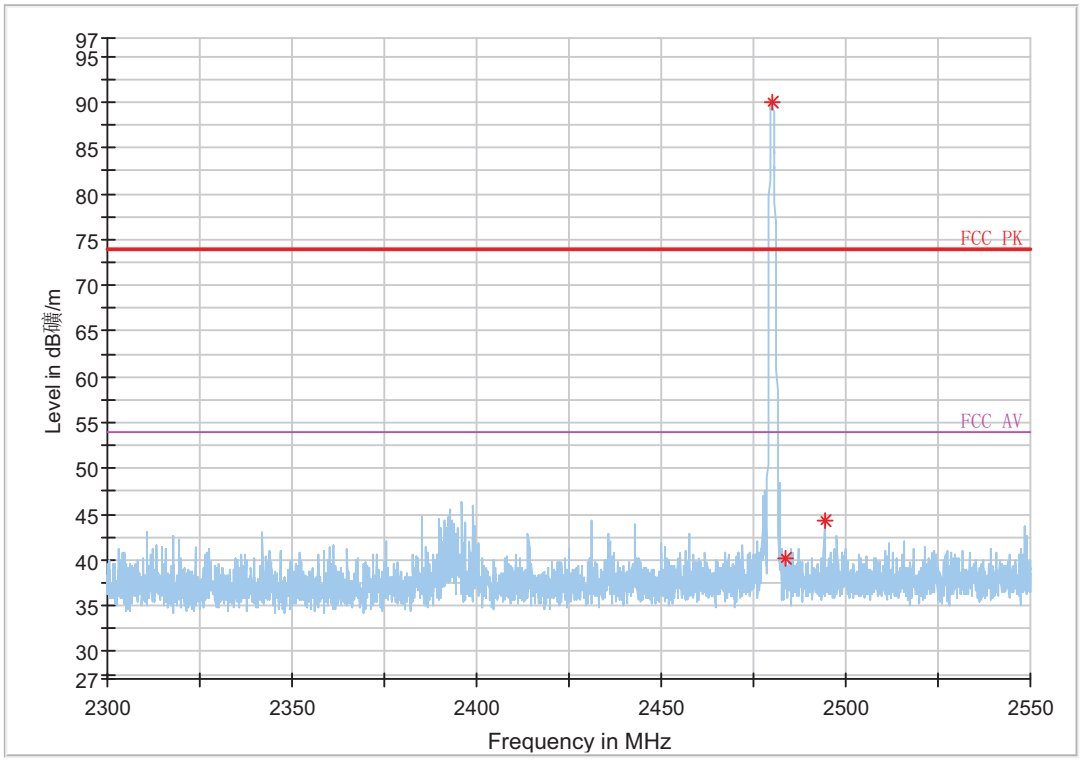
4.5.1 For Radiated Bandedge Measurement

4.5.1.1 GFSK Test Mode

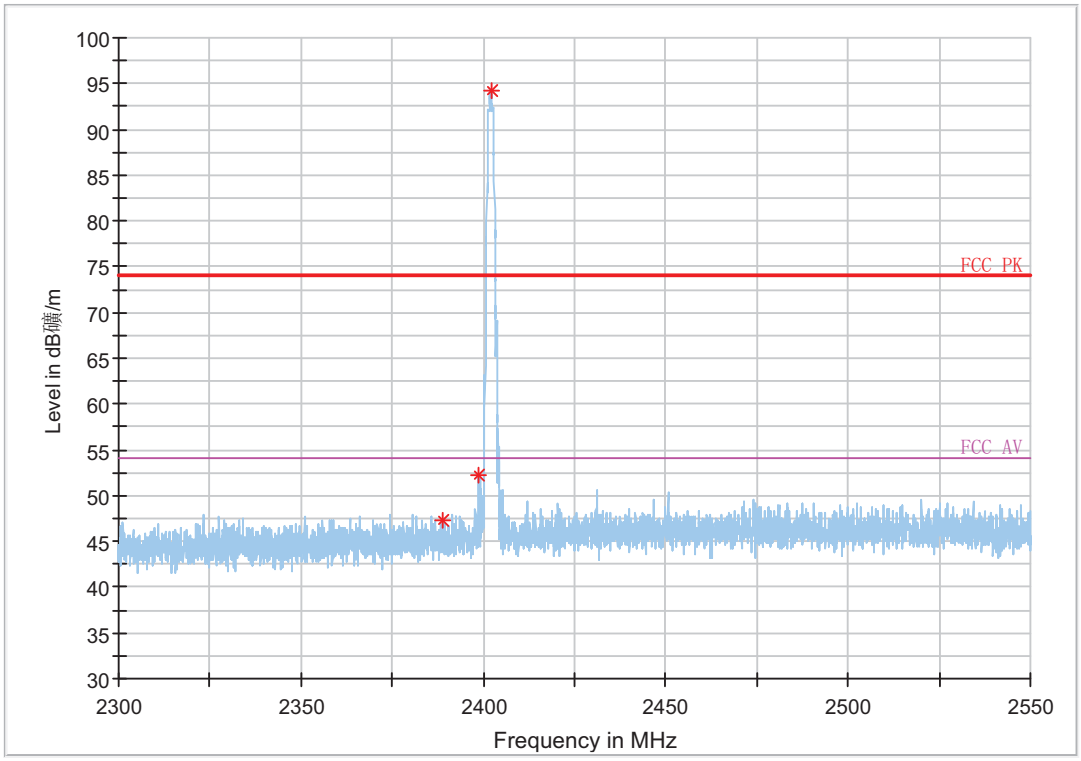
Test mode:	2402 MHz (GFSK)	Polarization	Horizontal & Vertical



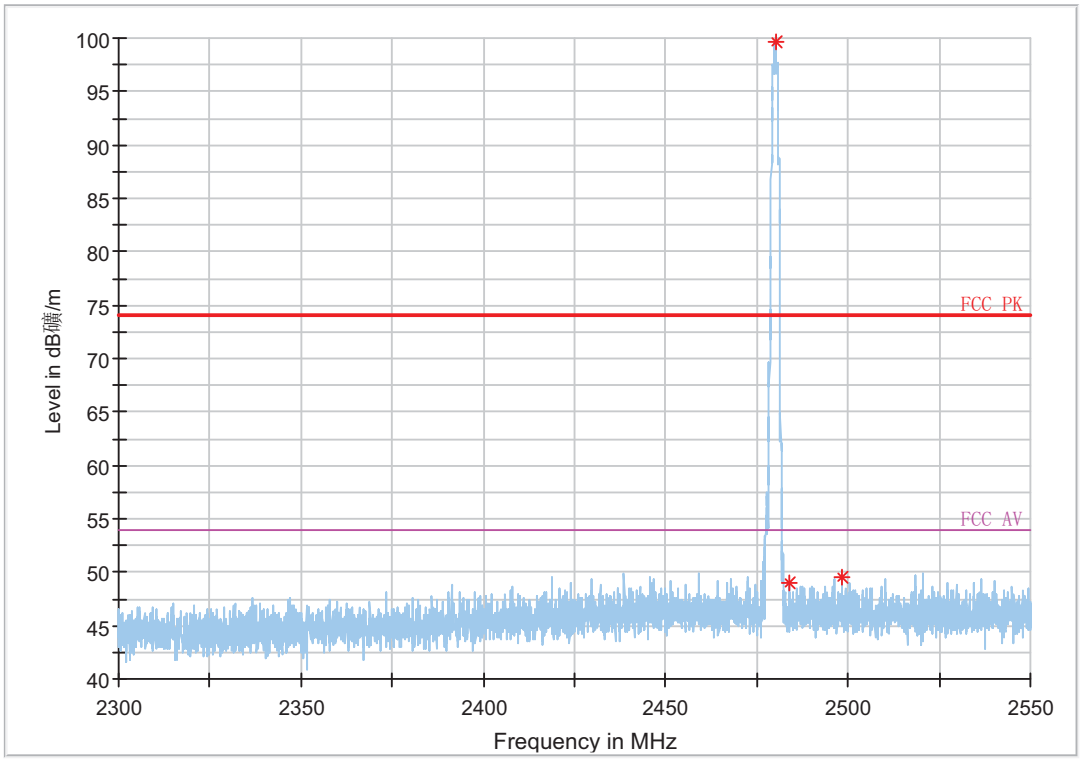
Test mode:	2480 MHz (GFSK)	Polarization	Horizontal & Vertical



Test mode:	2402 MHz (8DPSK)	Polarization	Horizontal & Vertical



Test mode:	2480 MHz (8DPSK)	Polarization	Horizontal & Vertical



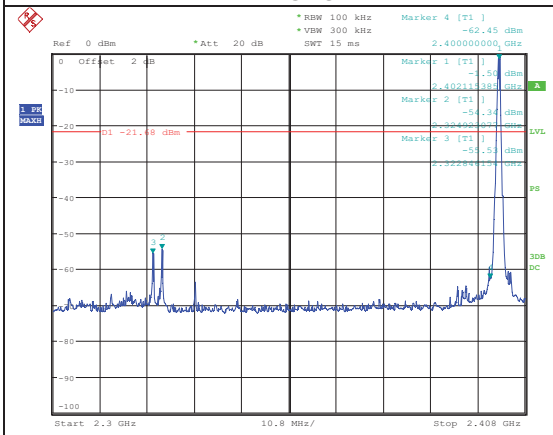
4.5.2 For Conducted Bandedge Measurement

Test Mode	Channel	Frequency (MHz)	Conductd Band-edge Emission (dBc)	Limits (dBc)	Verdict
GFSK	Lowest	2402	<-20dBc	-20	PASS
	Highest	2480	<-20dBc	-20	
	Hopping	2402-2480	<-20dBc	-20	
8DPSK	Lowest	2402	<-20dBc	-20	PASS
	Highest	2480	<-20dBc	-20	
	Hopping	2402-2480	<-20dBc	-20	

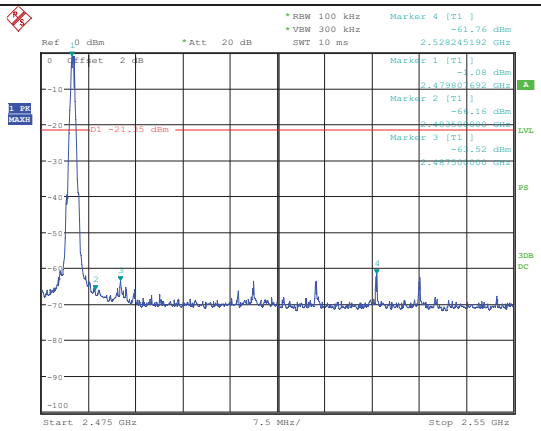
Remark:
1.The test results including the cable lose.
2. Test Plots for following page

RF Conducted Bandedge

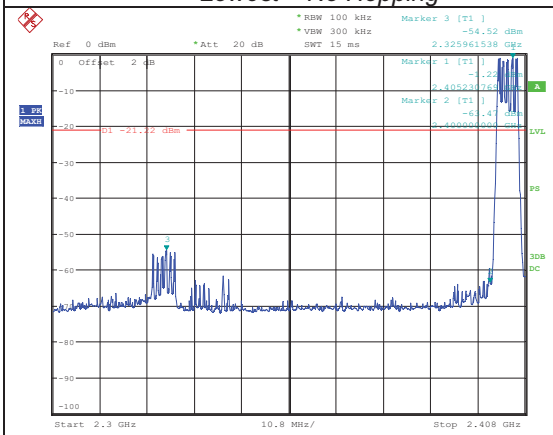
GFSK



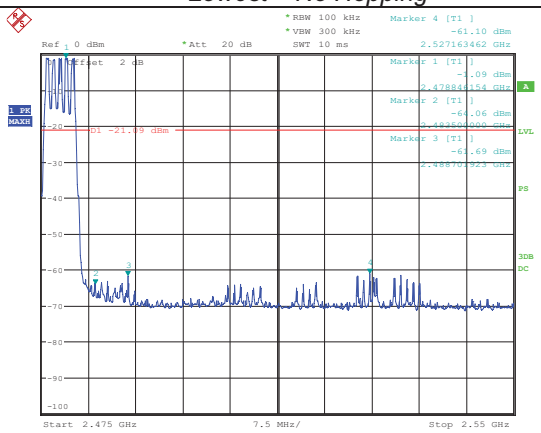
8DPSK



Lowest – No Hopping



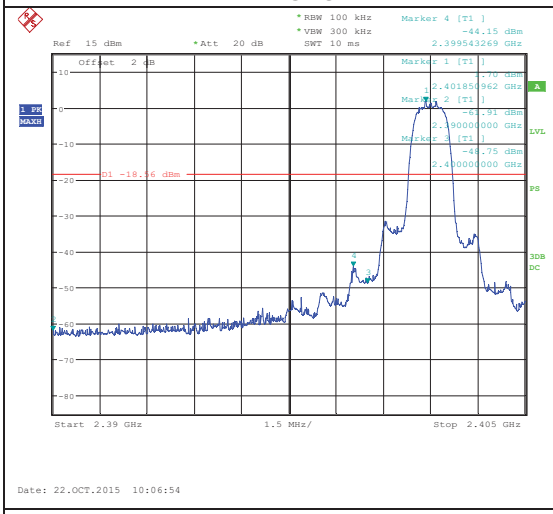
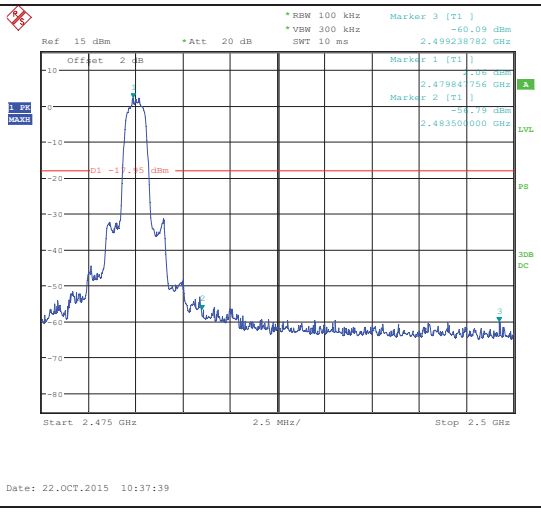
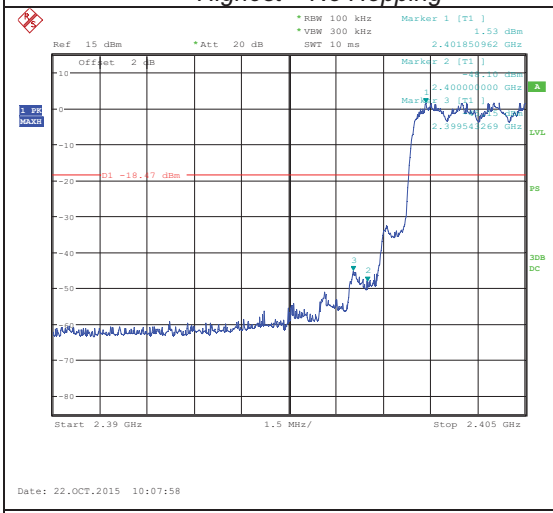
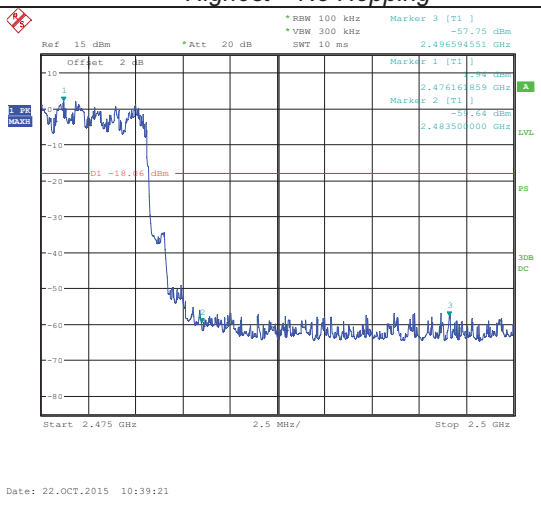
Lowest – No Hopping



Lowest –Hopping

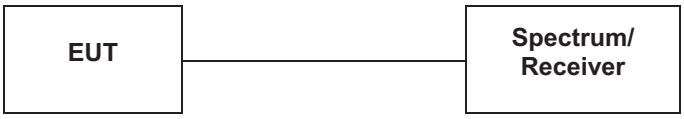
Lowest –Hopping

RF Conducted Bandedge

GFSK	8DPSK
	
Highest – No Hopping	*Highest – No Hopping*
	
Highest –Hopping	*Highest – No Hopping*

4.6. Frequency Separation

TEST CONFIGURATION



TEST PROCEDURE

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:
a) Span: Wide enough to capture the peaks of two adjacent channels.
b) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
c) Video (or average) bandwidth (VBW) ≥ RBW.
d) Sweep: Auto.
e) Detector function: Peak.
f) Trace: Max hold.
g) Allow the trace to stabilize.

LIMIT

According to 15.247(a)(1),frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25KHz or the 2/3*20dB bandwidth of the hopping channel, whichever is greater.

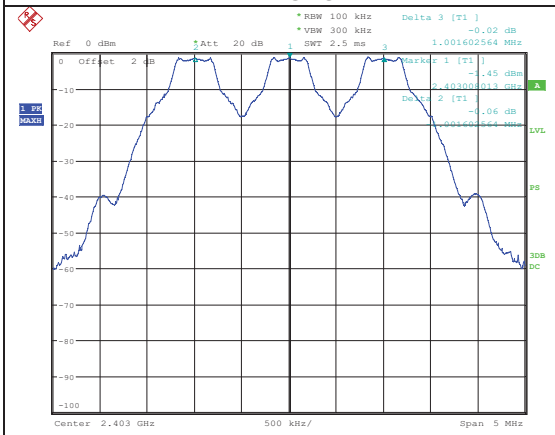
TEST RESULTS

Remark:
1. We test Frequency Separation at difference Packet Type (DH1, DH3 and DH5) and all test channels, recorded worst case at DH5 and middle channel.

Test Mode	Channel	Frequency (MHz)	Frequency Separation (MHz)	Limits (MHz)	Verdict
GFSK	0	2402	1.002	0.630	PASS
	1	2403			
	2	2404			
	38	2440	1.002	0.641	
	39	2441			
	40	2442			
	76	2478	1.002	0.630	
	77	2479			
	78	2480			
8DPSK	0	2402	1.002	0.871	PASS
	1	2403			
	2	2404			
	38	2440	1.002	0.876	
	39	2441			
	40	2442			
	76	2478	1.001	0.887	
	77	2479			
	78	2480			

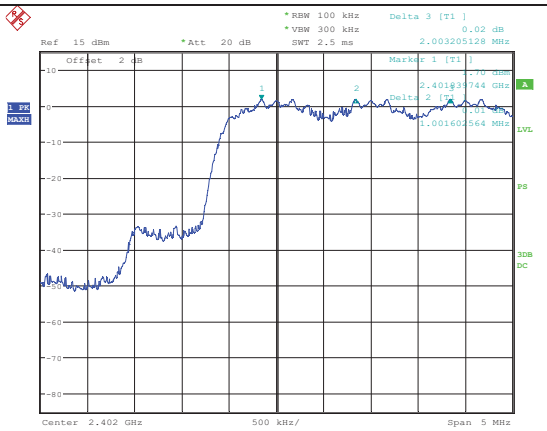
Frequency Separation

GFSK



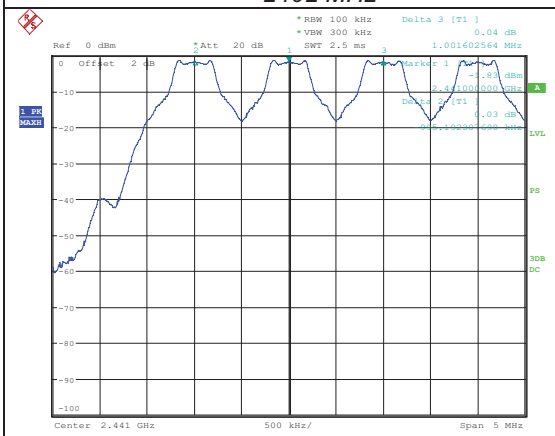
Date: 22.OCT.2015 09:20:48

8DPSK



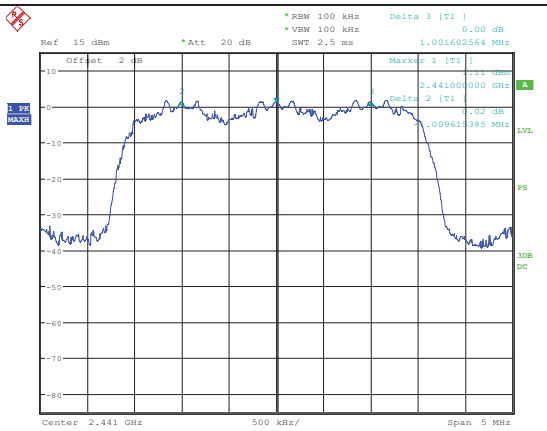
Date: 22.OCT.2015 10:03:45

2402 MHz



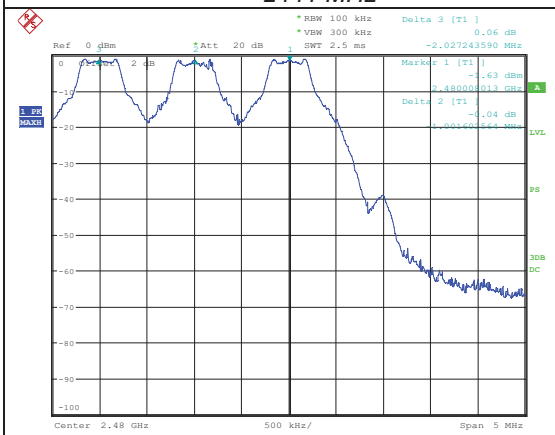
Date: 22.OCT.2015 09:29:31

2402 MHz



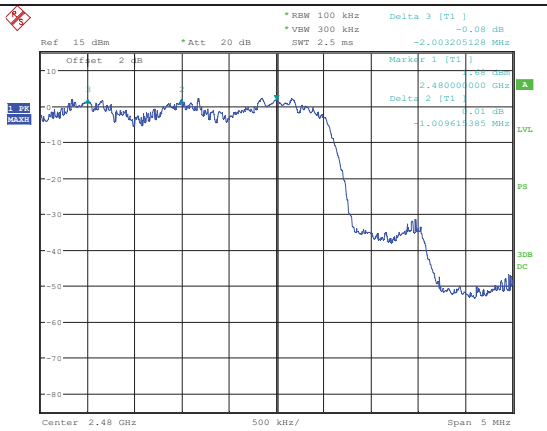
Date: 22.OCT.2015 10:19:36

2441 MHz



Date: 22.OCT.2015 09:38:02

2441 MHz



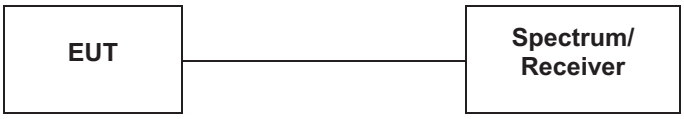
Date: 22.OCT.2015 10:34:05

2480 MHz

2480 MHz

4.7. Number of Hopping Frequency

TEST CONFIGURATION



TEST PROCEDURE

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:
a) Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
b) RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth;
c) VBW ≥ RBW.
d) Sweep: Auto.
e) Detector function: Peak.
f) Trace: Max hold.
g) Allow the trace to stabilize.

LIMIT

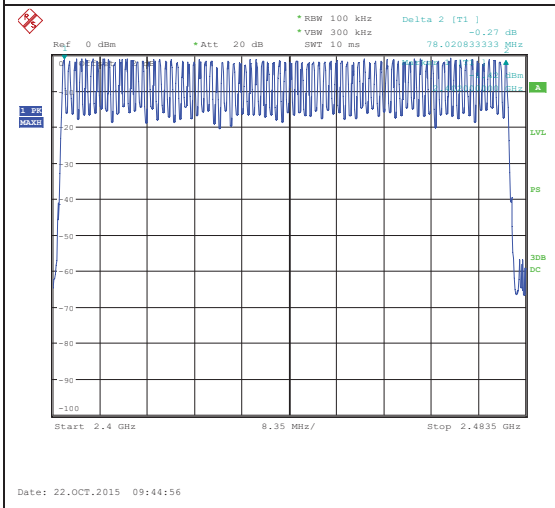
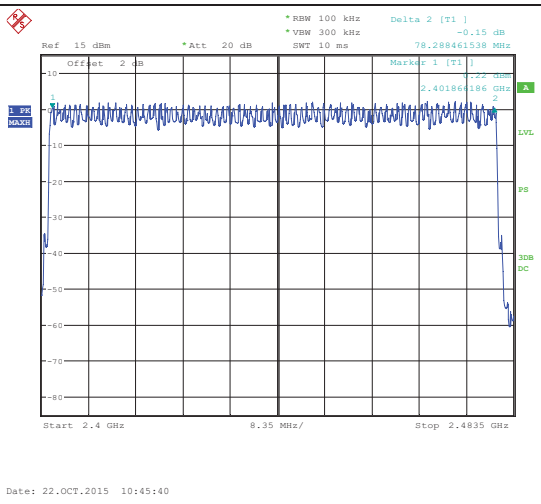
Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

TEST RESULTS

Test Mode	Channel	Frequency (MHz)	Numbers of Channel	Limits	Verdict
GFSK	Full (hopping)	2402-2480	79	15	PASS
8DPSK	Full (hopping)	2402-2480	79	15	PASS

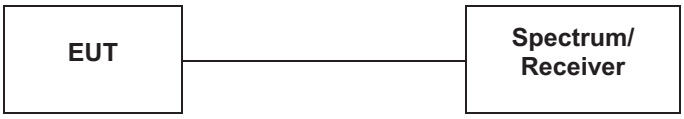
Remark:
1. We test Frequency Separation at difference Packet Type (DH1, DH3 and DH5), recorded worst case at DH5.
2.The test results including the cable lose.
3. Test Plots for page

Number of Hopping Frequencies

GFSK	8DPSK
	
2402 - 2480 MHz (Hopping)	*2402 - 2480 MHz (Hopping)*

4.8. Time of Occupancy (Dwell Time)

TEST CONFIGURATION



TEST PROCEDURE

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:
a) Span: Zero span, centered on a hopping channel.
b) RBW shall be ≥ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
c) Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
d) Detector function: Peak.
e) Trace: Max hold.

LIMIT

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a pe-riod of 0.4 seconds multiplied by the number of hopping channels employed.

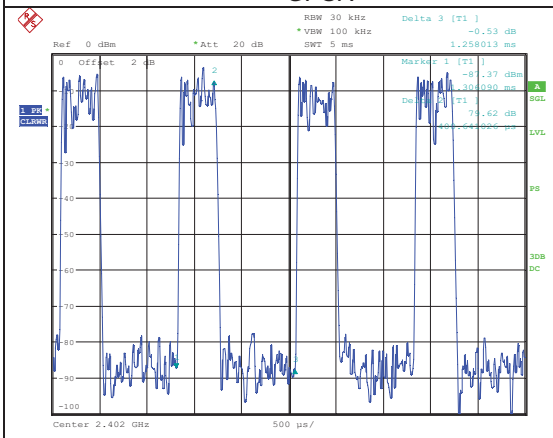
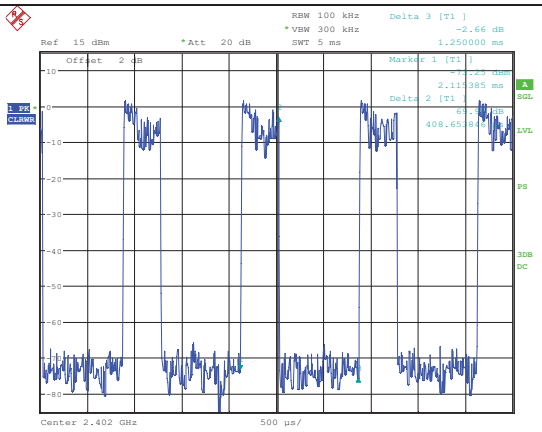
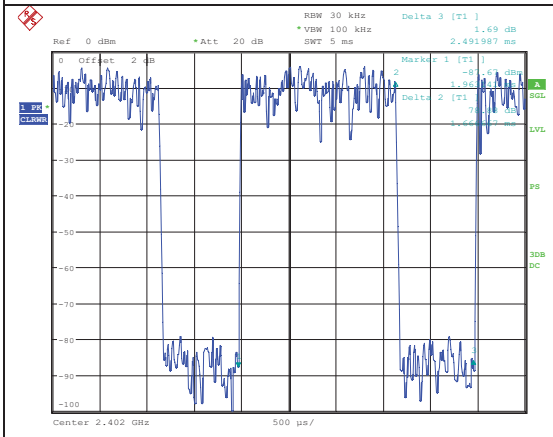
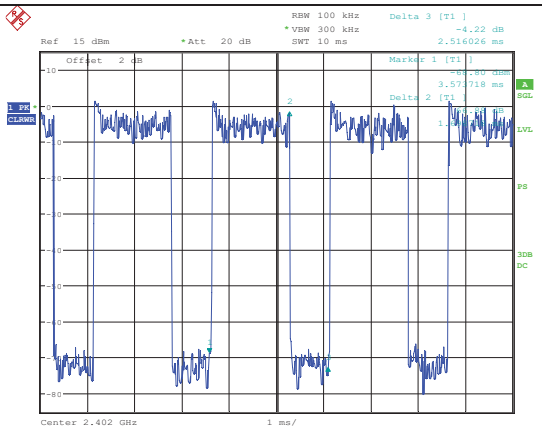
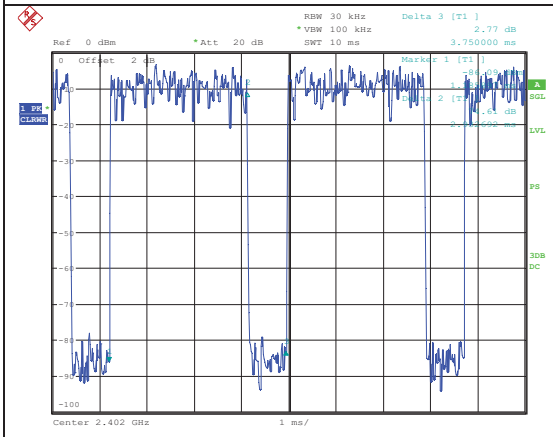
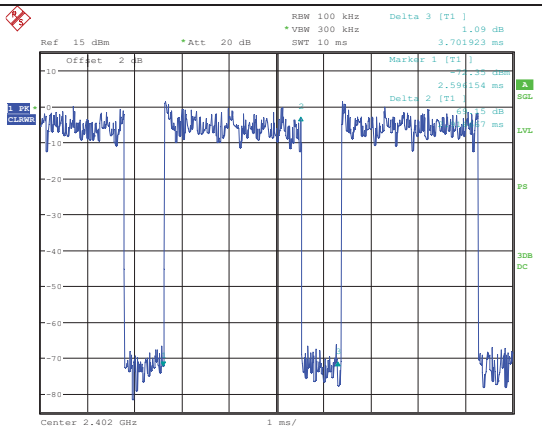
TEST RESULTS

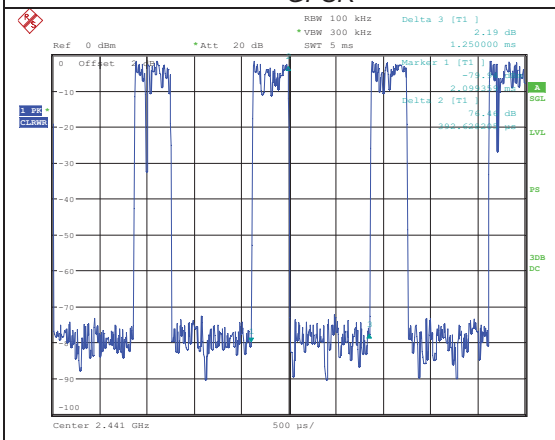
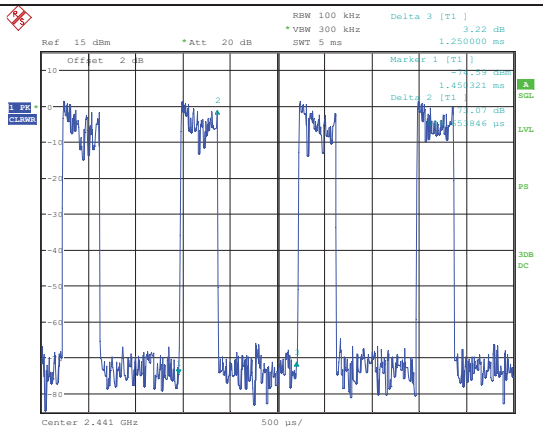
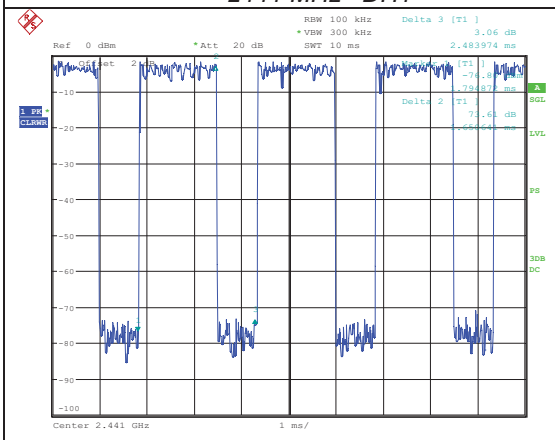
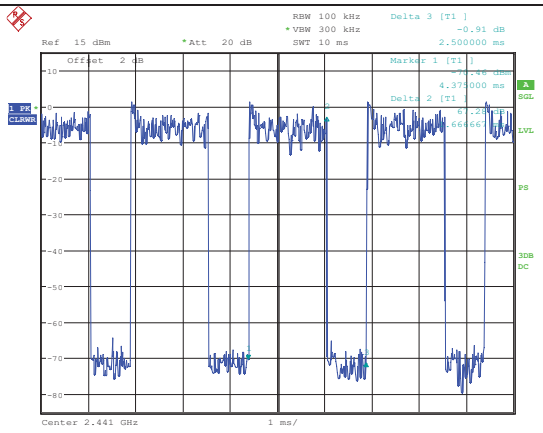
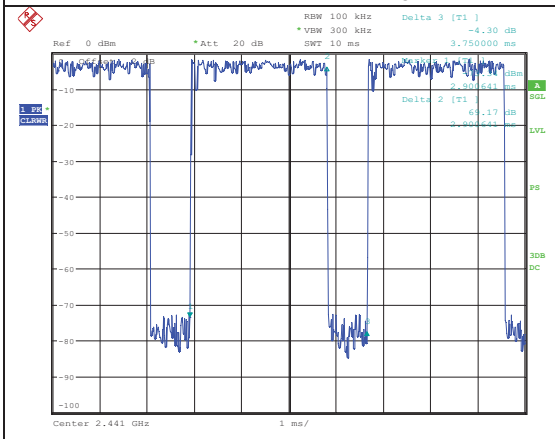
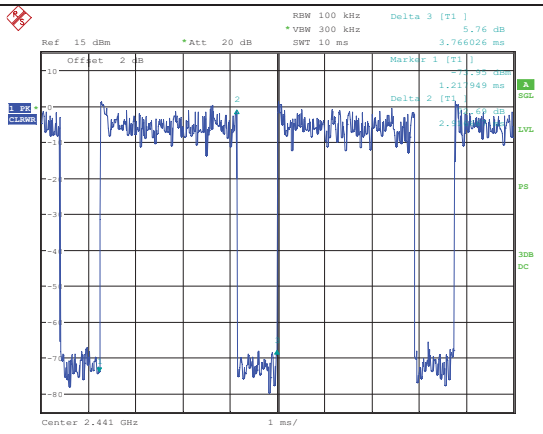
The Dwell Time=Burst Width*Total Hops. The detailed calculations are showed as follows:
The duration for dwell time calculation:0.4[s]*hopping number=0.4[s]*79[ch]=31.6[s*ch];
The burst width [ms/hop/ch], which is directly measured, refers to the duration on one channel hop.
The hops per second for all channels: The selected EUT Conf uses a slot type of 5-Tx&1-Rx and a hopping rate of 1600 [ch*hop/s] for all channels. So the final hopping rate for all channels is 1600/6=266.67 [ch*hop/s]
The hops per second on one channel: 266.67 [ch*hops/s]/79 [ch]=3.38 [hop/s];
The total hops for all channels within the dwell time calculation duration: 3.38 [hop/s]*31.6[s*ch]=106.67 [hop*ch];
The dwell time for all channels hopping: 106.67 [hop*ch]*Burst Width [ms/hop/ch].

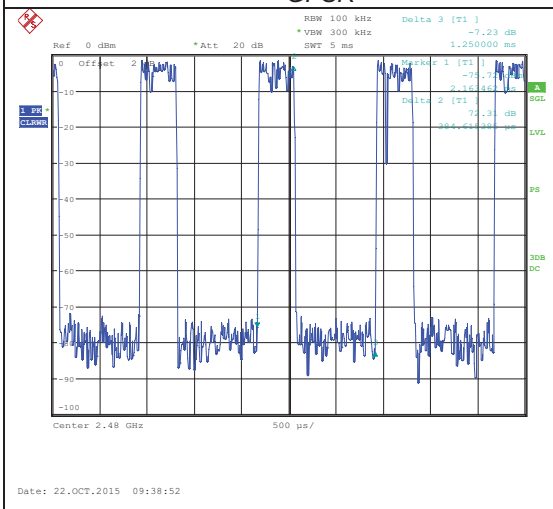
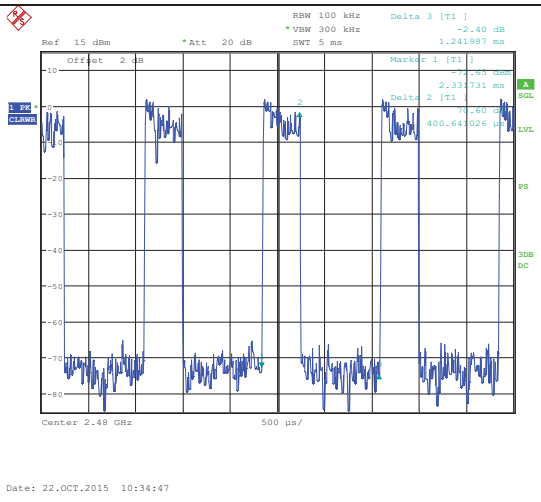
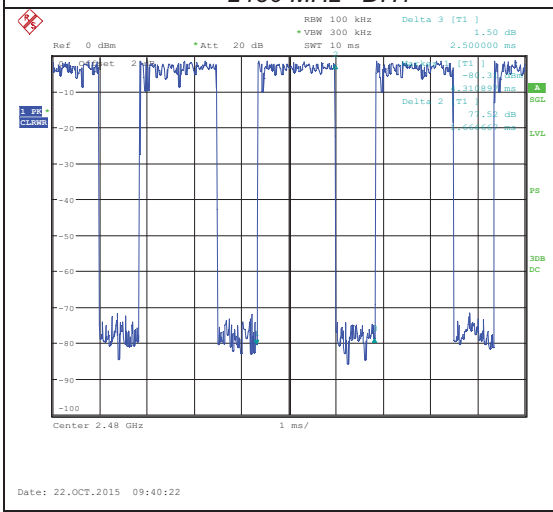
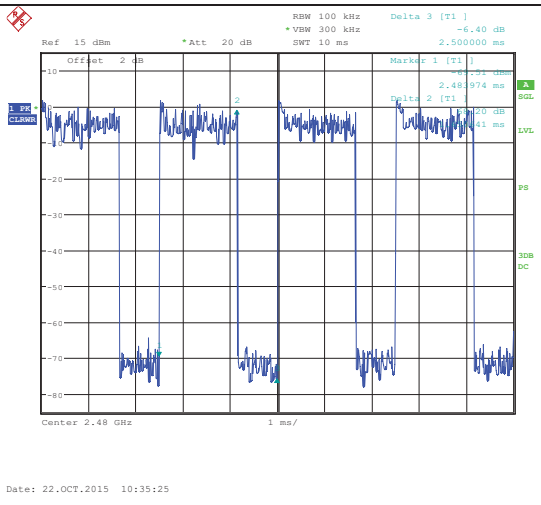
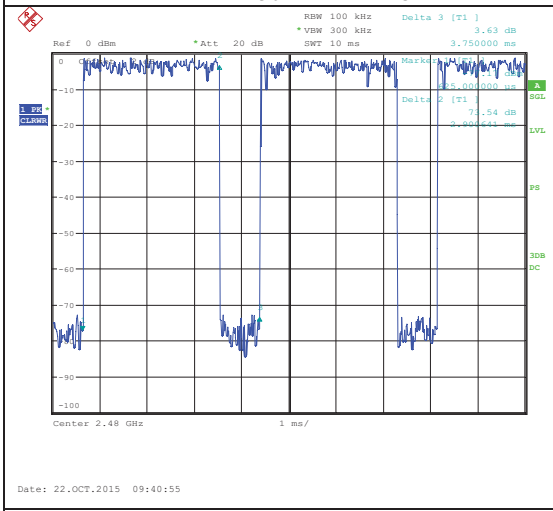
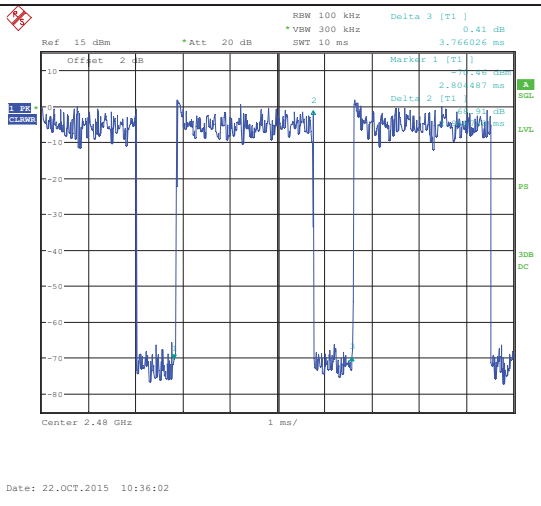
Mode	Frequency (MHz)	Burst Type	Pulse Width (ms)	Dwell Time (S)	Limit (S)	Verdict
GFSK	2402	DH1	0.401	0.128	0.4	PASS
		DH3	1.667	0.267	0.4	PASS
		DH5	2.983	0.318	0.4	PASS
	2441	DH1	0.393	0.126	0.4	PASS
		DH3	1.651	0.264	0.4	PASS
		DH5	2.901	0.309	0.4	PASS
	2480	DH1	0.385	0.123	0.4	PASS
		DH3	1.667	0.267	0.4	PASS
		DH5	2.901	0.309	0.4	PASS
8DPSK	2402	DH1	0.409	0.131	0.4	PASS
		DH3	1.667	0.267	0.4	PASS
		DH5	2.919	0.311	0.4	PASS
	2441	DH1	0.409	0.131	0.4	PASS
		DH3	1.667	0.267	0.4	PASS
		DH5	2.919	0.311	0.4	PASS
	2480	DH1	0.401	0.128	0.4	PASS
		DH3	1.651	0.264	0.4	PASS
		DH5	2.949	0.315	0.4	PASS

Remark:
1. Dwell Time Calculate formula:
DH1: Dwell time=Pulse time (ms) × (1600 ÷ 2 ÷ 79) ×31.6 Second
DH3: Dwell time=Pulse time (ms) × (1600 ÷ 4 ÷ 79) ×31.6 Second

DH5: Dwell time=Pulse Time (ms) × (1600 ÷ 6 ÷ 79) ×31.6 Second
2. The test results including the cable lose.
3. Test Plots for following page

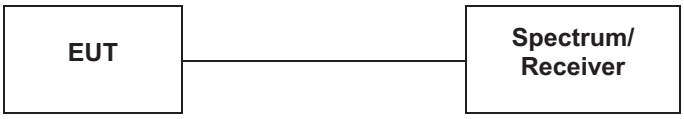
Time of occupancy (dwell time)	
GFSK	*8DPSK*
	
2402 MHz –DH1	*2402 MHz –DH1*
	
2402 MHz –DH3	*2402 MHz –DH3*
	
2402 MHz –DH5	*2402 MHz –DH5*

Time of occupancy (dwell time)	
GFSK	*8DPSK*
	
Date: 22.OCT.2015 09:30:27	Date: 22.OCT.2015 10:22:00
2441 MHz –DH1	*2441 MHz –DH1*
	
Date: 22.OCT.2015 09:31:29	Date: 22.OCT.2015 10:22:54
2441 MHz –DH3	*2441 MHz –DH3*
	
Date: 22.OCT.2015 09:32:06	Date: 22.OCT.2015 10:23:35
2441 MHz –DH5	*2441 MHz –DH5*

Time of occupancy (dwell time)	
GFSK	*8DPSK*
	
2480 MHz –DH1	*2480 MHz –DH1*
	
2480 MHz –DH3	*2480 MHz –DH3*
	
2480 MHz –DH5	*2480 MHz –DH5*

4.9. Spurious RF Conducted Emission

TEST CONFIGURATION



TEST PROCEDURE

The Spurious RF conducted emissions compliance of RF radiated emission should be measured by following the guidance in ANSI C63.10-2013 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization etc. Set RBW=100kHz and VBW= 300KHz to measure the peak field strength , and measurement frequency range from 9KHz to 26.5GHz.

LIMIT

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

TEST RESULTS

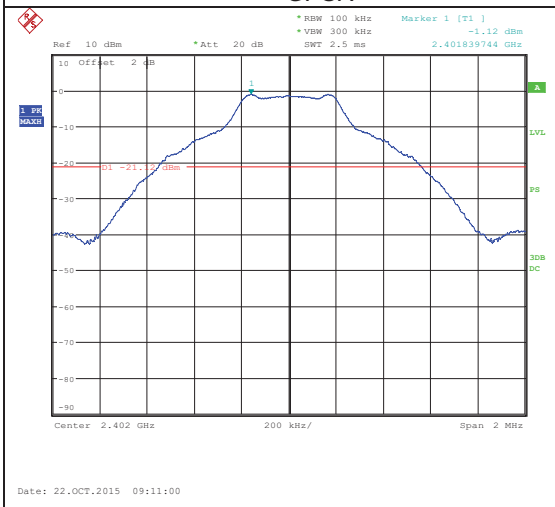
Test Mode	Frequency (MHz)	Frequency Range (MHz)	RF Conductd Spurious Emission (dBc)	Limits (dBc)	Verdict
GFSK	2402	2401 – 2403	---	---	PASS
		0.000009 – 0.00015	<-20dBc	-20	
		0.00015 - 30	<-20dBc	-20	
		30 - 1000	<-20dBc	-20	
		1000 - 8000	<-20dBc	-20	
		8000 - 16000	<-20dBc	-20	
		16000 - 26500	<-20dBc	-20	
	2441	2438.5 –2443.5	---	---	PASS
		0.000009 – 0.00015	<-20dBc	-20	
		0.00015 - 30	<-20dBc	-20	
		30 - 1000	<-20dBc	-20	
		1000 - 8000	<-20dBc	-20	
		8000 - 16000	<-20dBc	-20	
		16000 - 26500	<-20dBc	-20	
	2480	2477.5 –2482.5	---	---	PASS
		0.000009 – 0.00015	<-20dBc	-20	
		0.00015 - 30	<-20dBc	-20	
		30 - 1000	<-20dBc	-20	
		1000 - 8000	<-20dBc	-20	
		8000 - 16000	<-20dBc	-20	
		16000 - 26500	<-20dBc	-20	
8DPSK	2402	2399.5 –2404.5	---	---	PASS
		0.000009 – 0.00015	<-20dBc	-20	
		0.00015 - 30	<-20dBc	-20	
		30 - 1000	<-20dBc	-20	
		1000 - 8000	<-20dBc	-20	
		8000 - 16000	<-20dBc	-20	
		16000 - 26500	<-20dBc	-20	
	2441	2438.5 –2443.5	---	---	PASS
		0.000009 – 0.00015	<-20dBc	-20	
		0.00015 - 30	<-20dBc	-20	
		30 - 1000	<-20dBc	-20	
		1000 - 8000	<-20dBc	-20	
		8000 - 16000	<-20dBc	-20	
		16000 - 26500	<-20dBc	-20	

	2480	2477.5 –2482.5	---	---	PASS
		0.000009 – 0.00015	<-20dBc	-20	
		0.00015 - 30	<-20dBc	-20	
		30 - 1000	<-20dBc	-20	
		1000 - 8000	<-20dBc	-20	
		8000 - 16000	<-20dBc	-20	
		16000 - 26500	<-20dBc	-20	

Remark:
1. We test Frequency Separation at difference Packet Type (DH1, DH3 and DH5), recorded worst case at DH1.
2. The test results including the cable lose.
3. Test Plots for following page

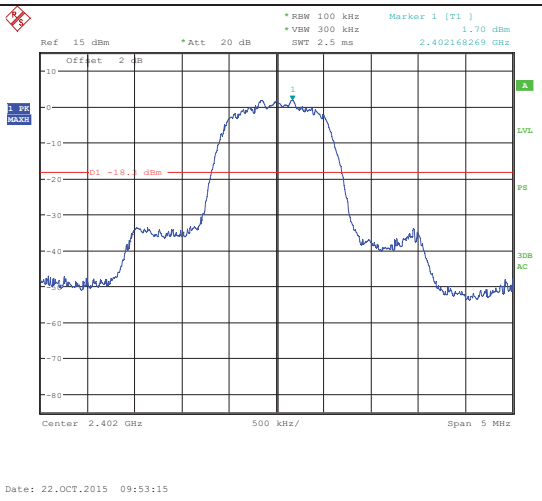
RF Conductd Spurious Emission

GFSK



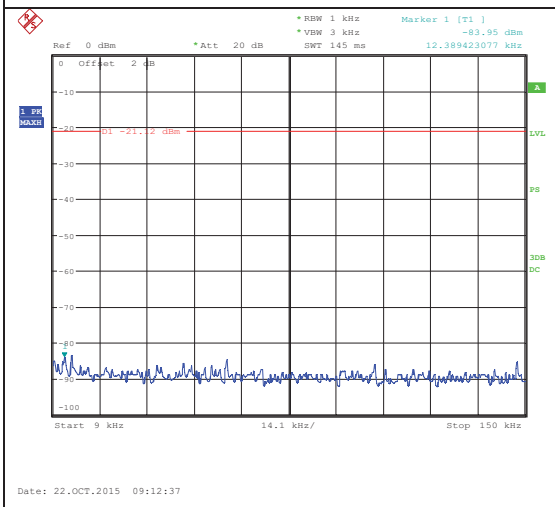
2401 MHz – 2403 MHz

8DPSK

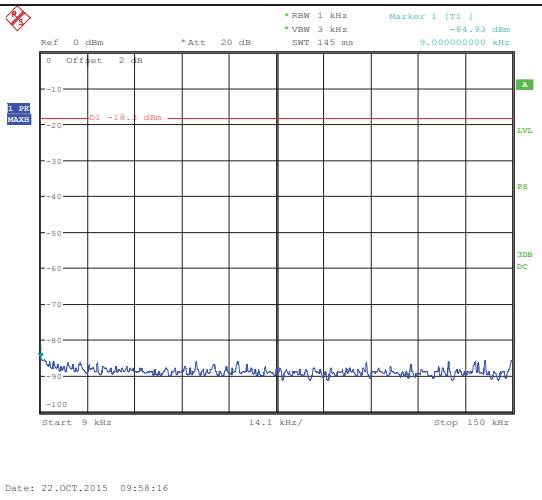


2399.5 MHz –2404.5 MHz

2402 MHz



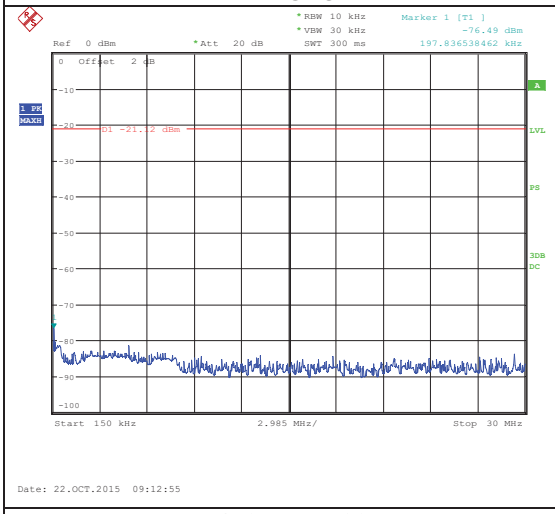
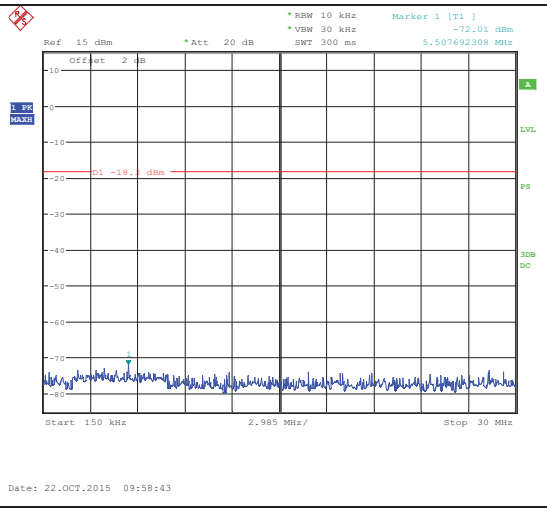
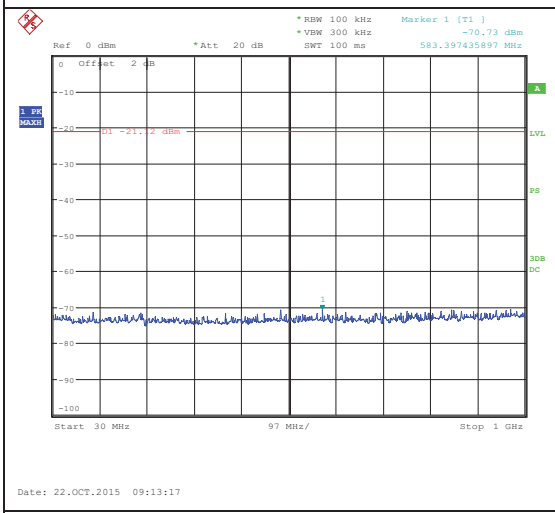
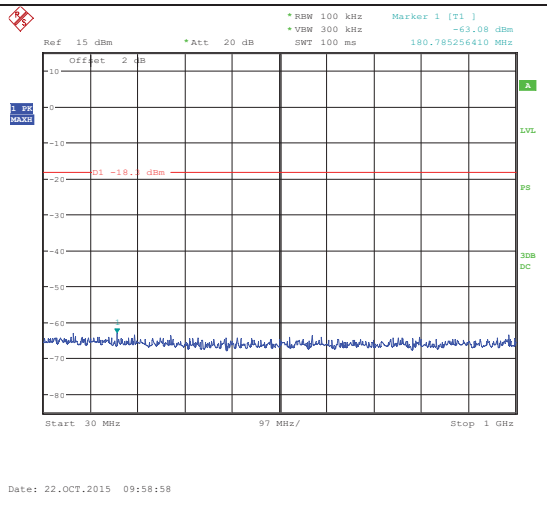
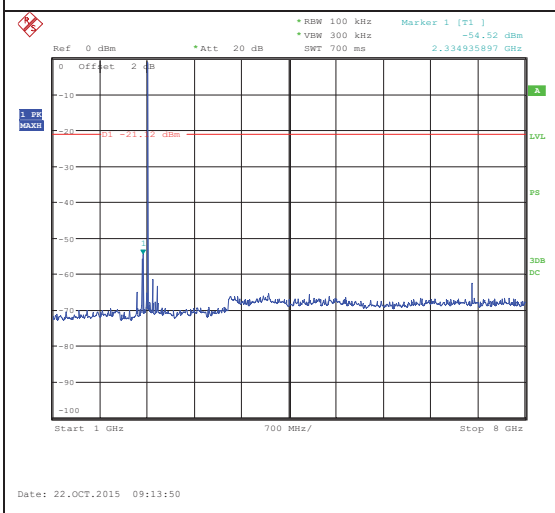
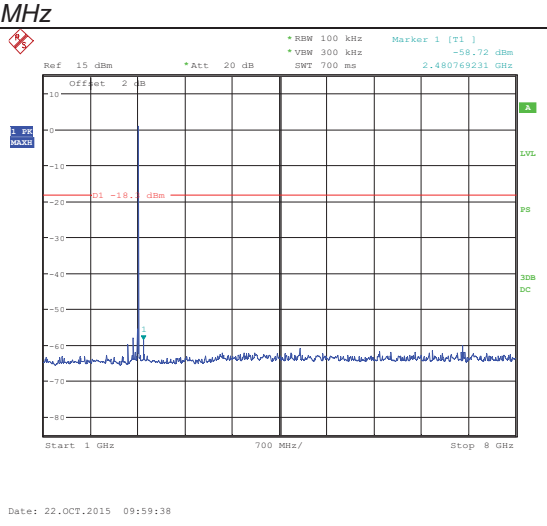
9 KHz – 150 KHz



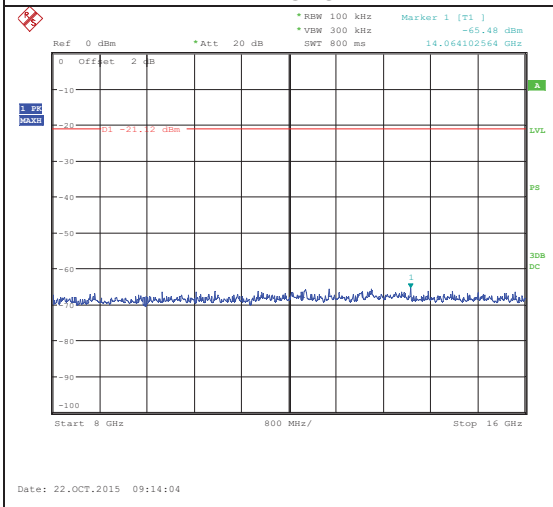
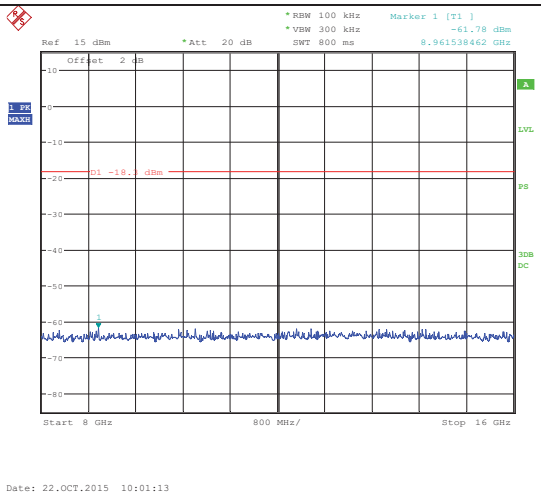
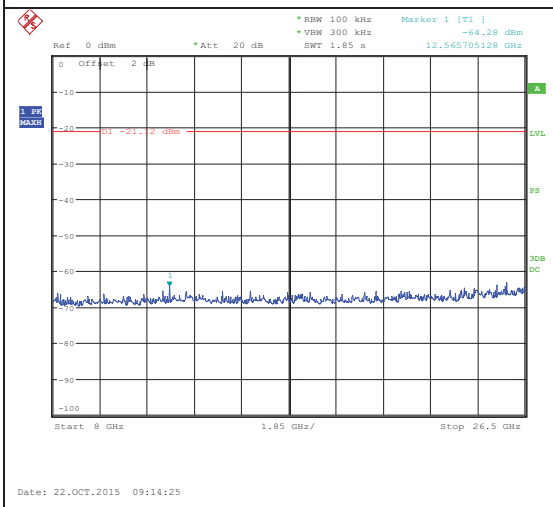
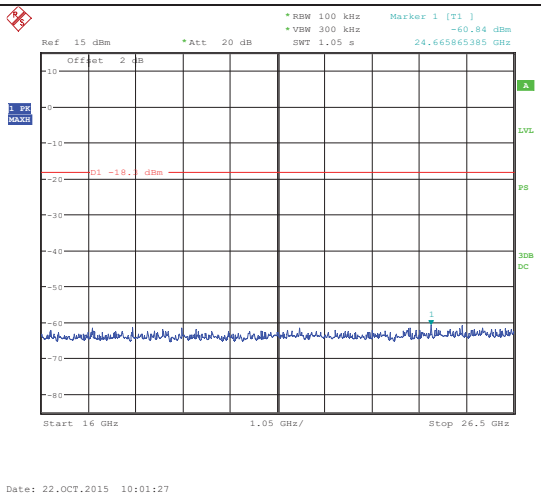
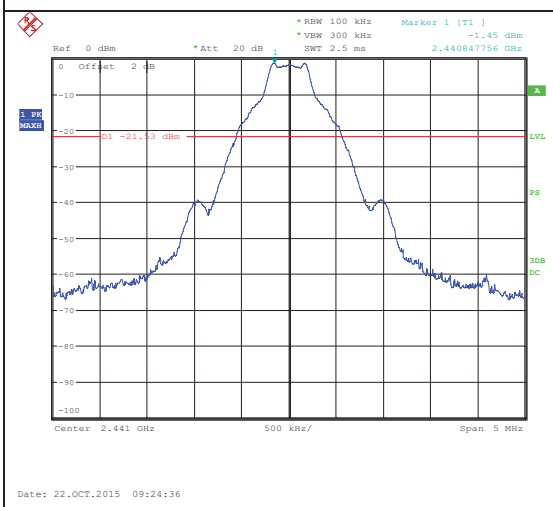
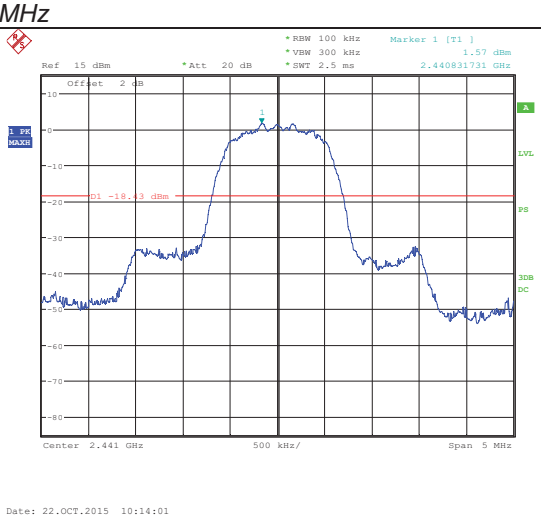
9 KHz – 150 KHz

2402 MHz

RF Conductd Spurious Emission

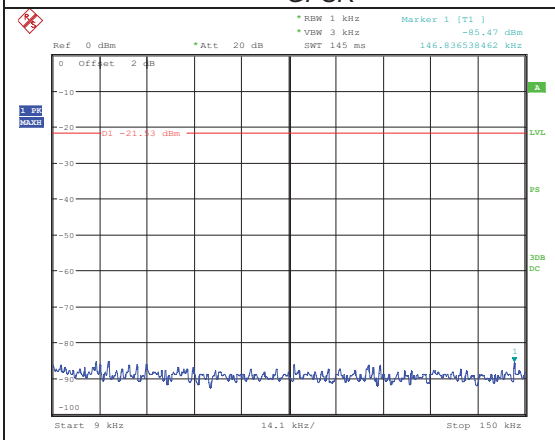
GFSK	8DPSK
	
150 KHz – 30 MHz	150 KHz – 30 MHz
2402 MHz	
	
30 MHz – 1000 MHz	30 MHz – 1000 MHz
2402 MHz	
	
1 GHz – 8 GHz	1 GHz – 8 GHz
2402 MHz	

RF Conductd Spurious Emission

GFSK	8DPSK
	
8 GHz – 16 GHz	8 GHz – 16 GHz
2402 MHz	
	
16 GHz – 26.5 GHz	16 GHz – 26.5 GHz
2402 MHz	
	
2438.5 MHz – 2443.5 MHz	2438.5 MHz – 2443.5 MHz
2441 MHz	

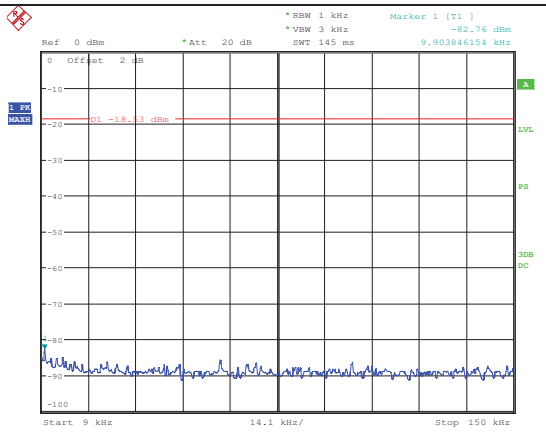
RF Conductd Spurious Emission

GFSK



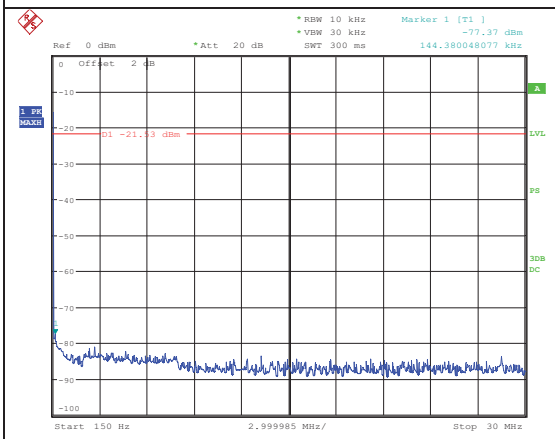
9 KHz – 150 KHz

8DPSK

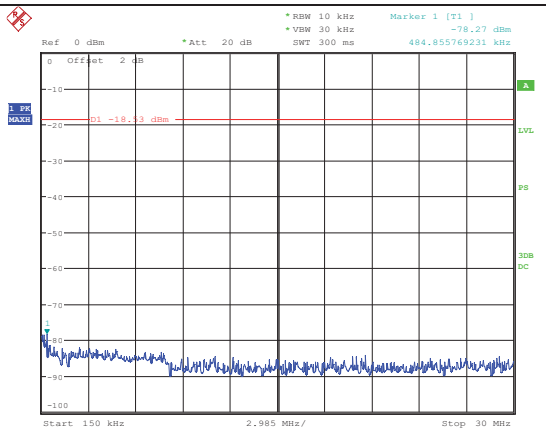


9 KHz – 150 KHz

2441 MHz

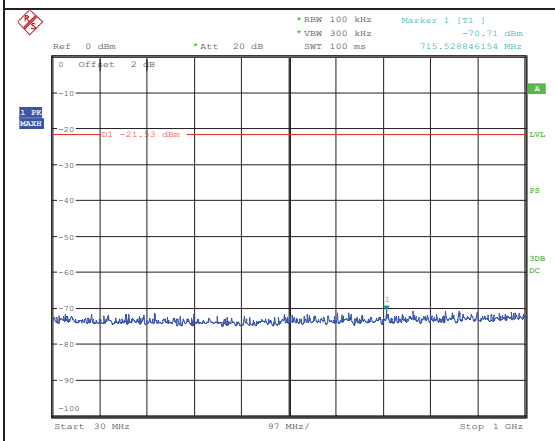


150 KHz – 30 MHz

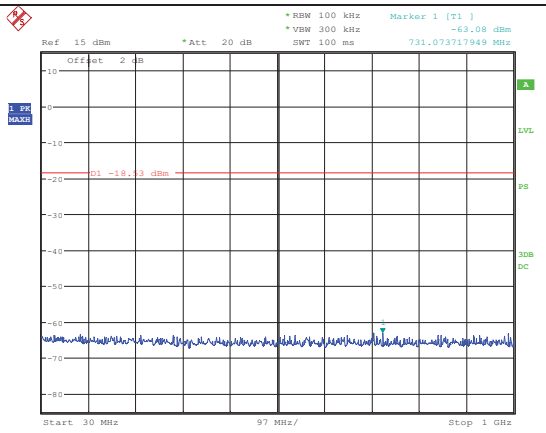


150 KHz – 30 MHz

2441 MHz



30 MHz – 1000 MHz

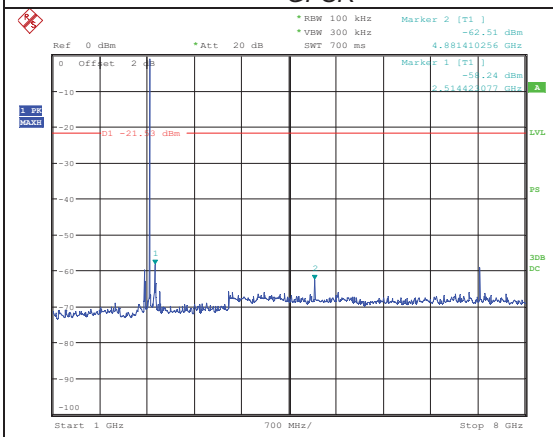


30 MHz – 1000 MHz

2441 MHz

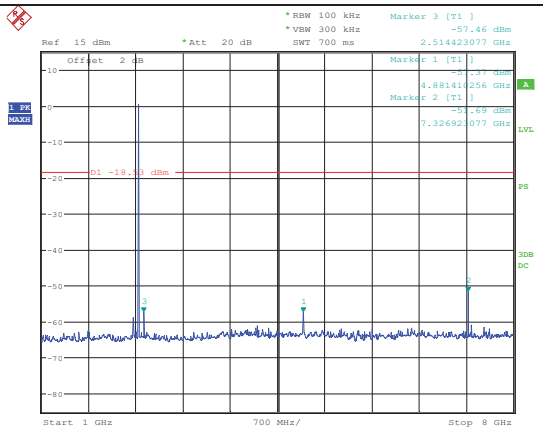
RF Conductd Spurious Emission

GFSK



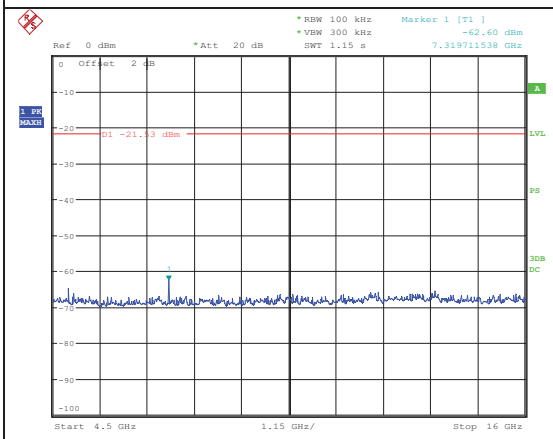
1 GHz – 8 GHz

8DPSK

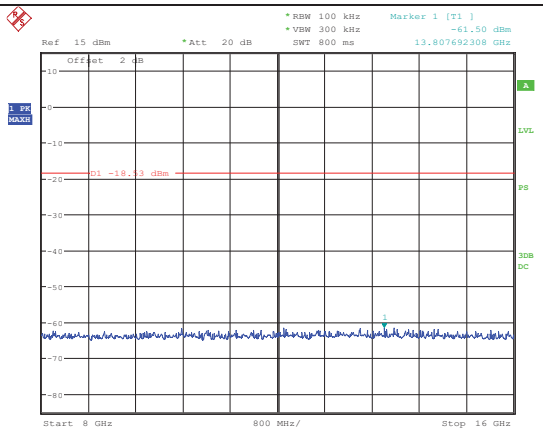


1 GHz – 8 GHz

2441 MHz

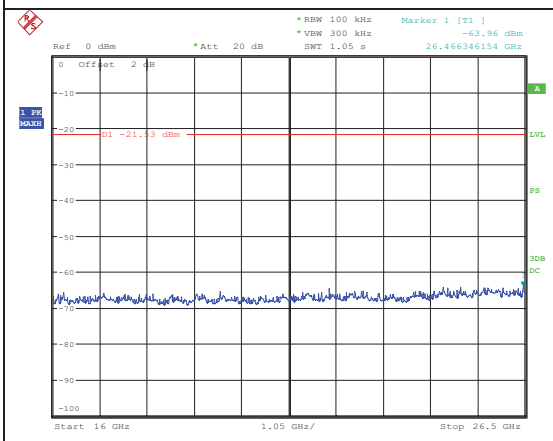


8 GHz – 16 GHz

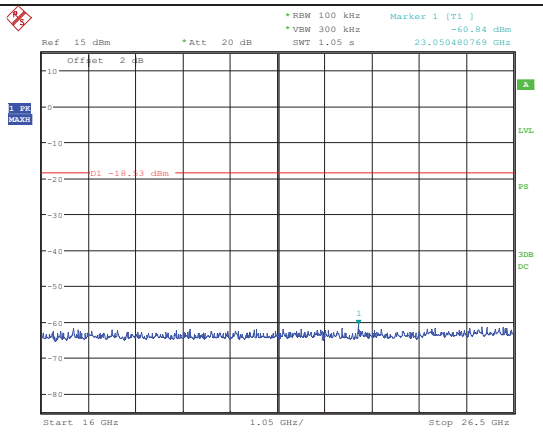


8 GHz – 16 GHz

2441 MHz



16 GHz – 26.5 GHz

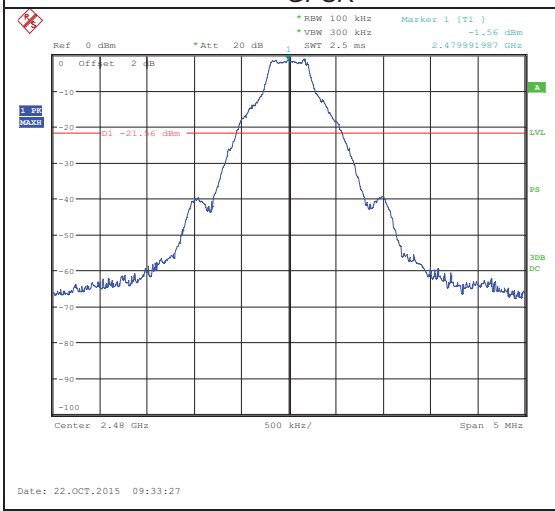


16 GHz – 26.5 GHz

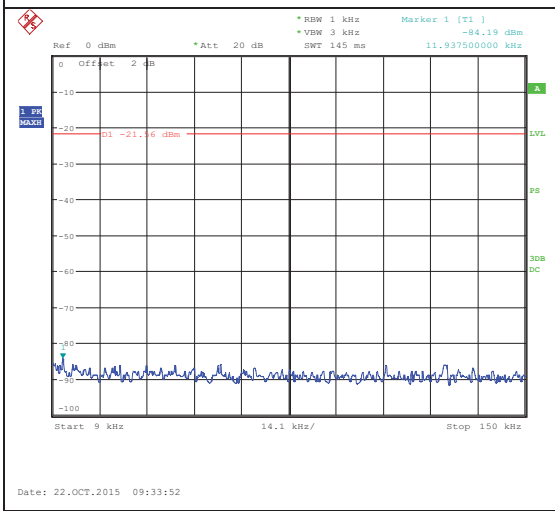
2441 MHz

RF Conductd Spurious Emission

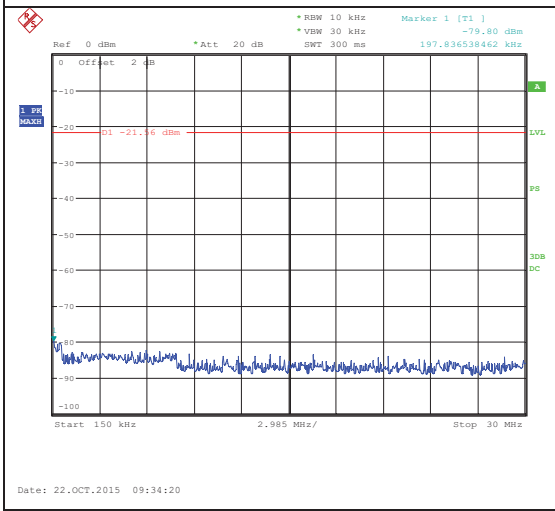
GFSK



2477.5 MHz – 2482.5 MHz



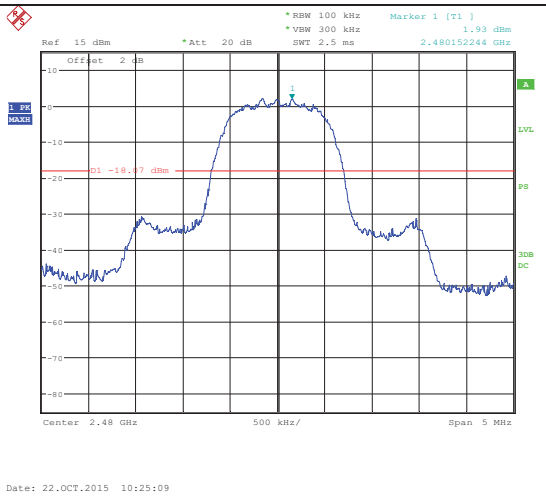
9 KHz – 150 KHz



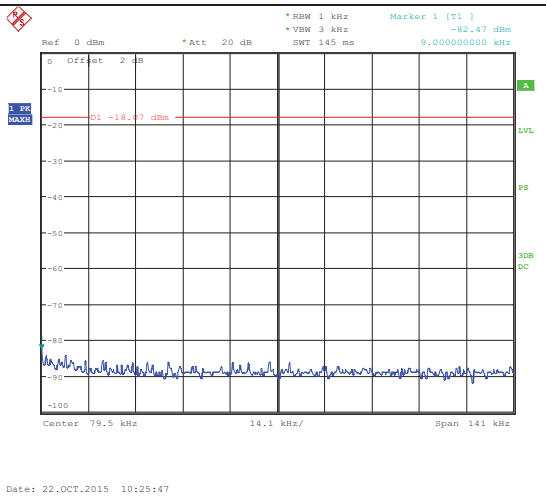
150 KHz – 30 MHz

2480 MHz

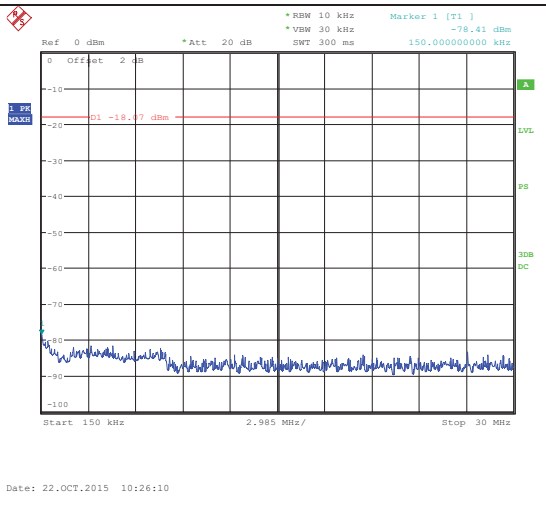
8DPSK



2477.5 MHz – 2482.5 MHz



9 KHz – 150 KHz

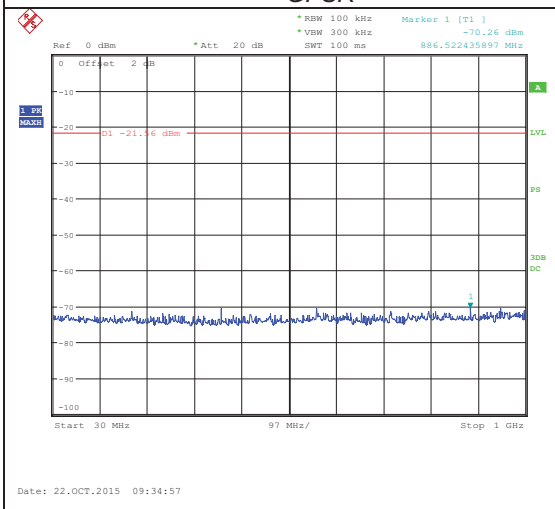


150 KHz – 30 MHz

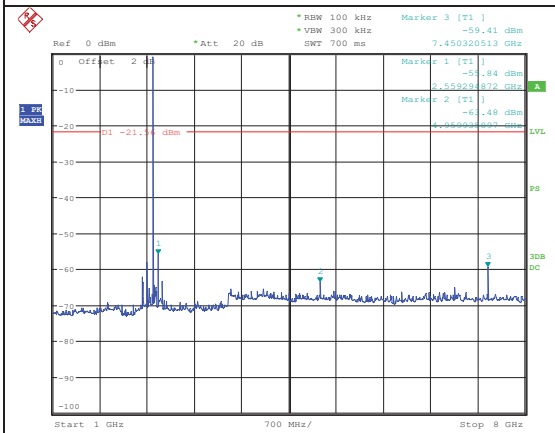
2480 MHz

RF Conductd Spurious Emission

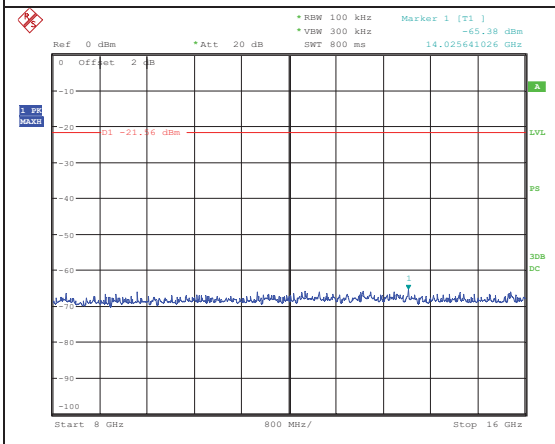
GFSK



30 MHz – 1000 MHz



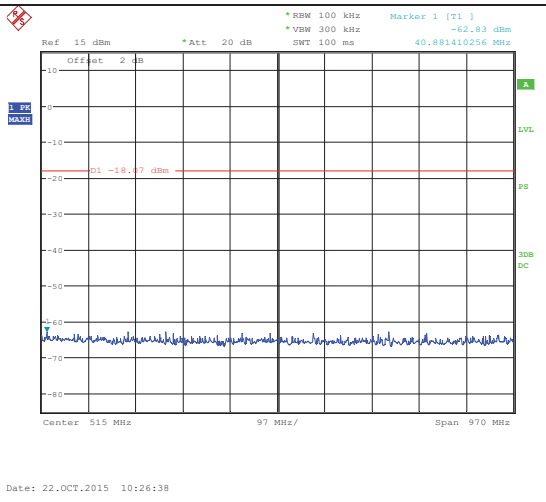
1 GHz – 8 GHz



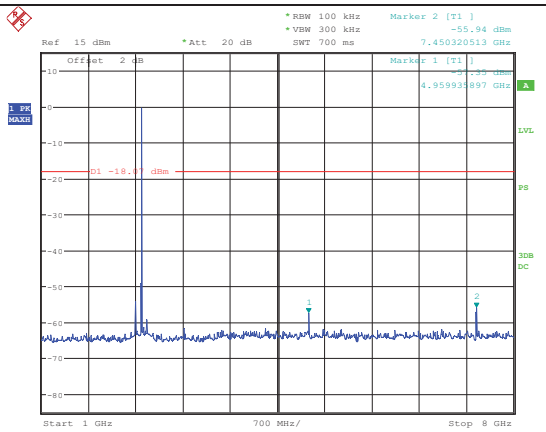
8 GHz – 16 GHz

2480 MHz

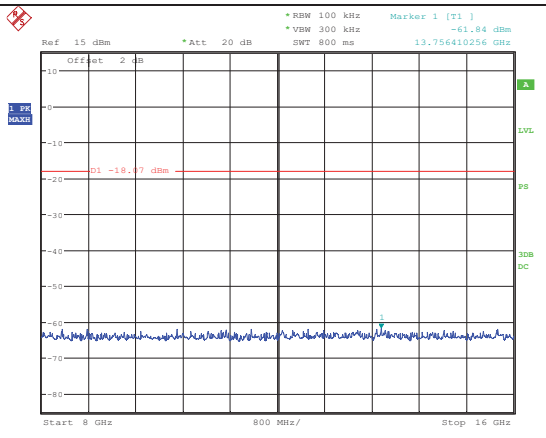
8DPSK



30 MHz – 1000 MHz

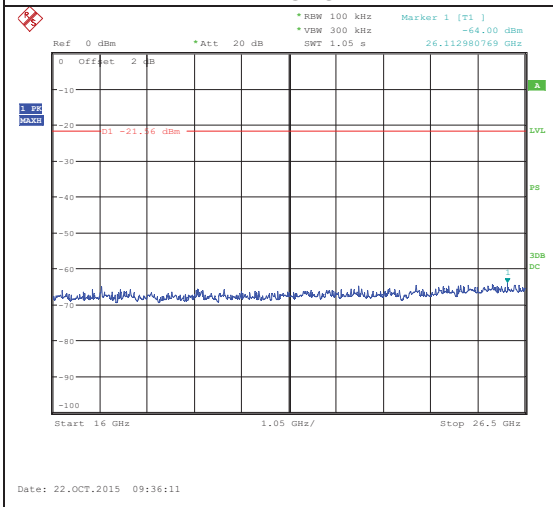
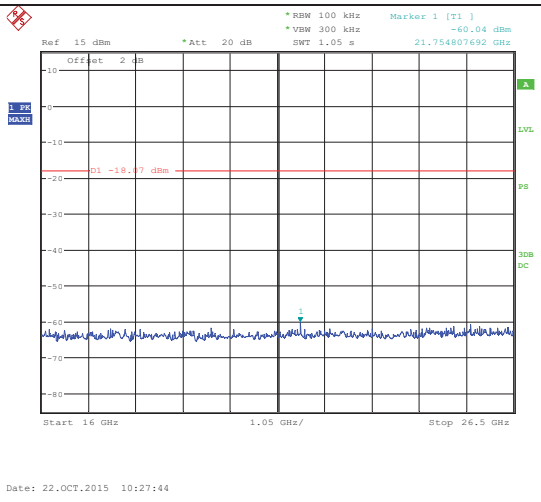


1 GHz – 8 GHz



8 GHz – 16 GHz

2480 MHz

RF Conductd Spurious Emission	
GFSK	*8DPSK*
	
16 GHz – 26.5 GHz	*16 GHz – 26.5 GHz*
2480 MHz	

4.10. Pseudorandom Frequency Hopping Sequence

TEST APPLICABLE

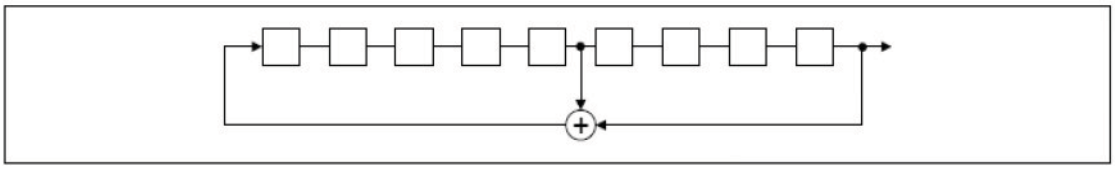
For 47 CFR Part 15C section 15.247 (a)(1) requirement:

Frequency hopping systems shall have hopping channel carrier fre-quencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hop-ping channel, whichever is greater. Al-ternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier fre-quencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to chan-nel frequencies that are selected at the system hopping rate from a pseudo ran-domly ordered list of hopping fre-quencies. Each frequency must be used equally on the average by each trans-mitter. The system receivers shall have input bandwidths that match the hop-ping channel bandwidths of their cor-responding transmitters and shall shift frequencies in synchronization with the transmitted signals.

EUT Pseudorandom Frequency Hopping Sequence Requirement

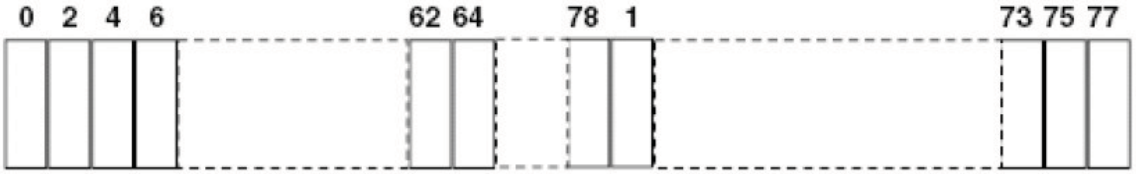
The pseudorandom frequency hopping sequence may be generated in a nice-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage.And the result is fed back to the input of the frist stage.The sequence begins with the frist one of 9 consecutive ones,for example:the shift register is initialized with nine ones.

- Number of shift register stages:9
- Length of pseudo-random sequence:29-1=511 bits
- Longest sequence of zeros:8(non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

An explame of pseudorandom frequency hopping sequence as follows:



Each frequency used equally one the average by each transmitter.
The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitter and shift frequencies in synchronization with the transmitted signals.

4.11. Antenna Requirement

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 (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.

Refer to statement below for compliance

The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed.

Measurement

The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module.For normal BT devices, the GFSK mode is used.

Measurement parameters

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	1MHz
Video bandwidth:	3MHz
Trace-Mode:	Max hold

Limits

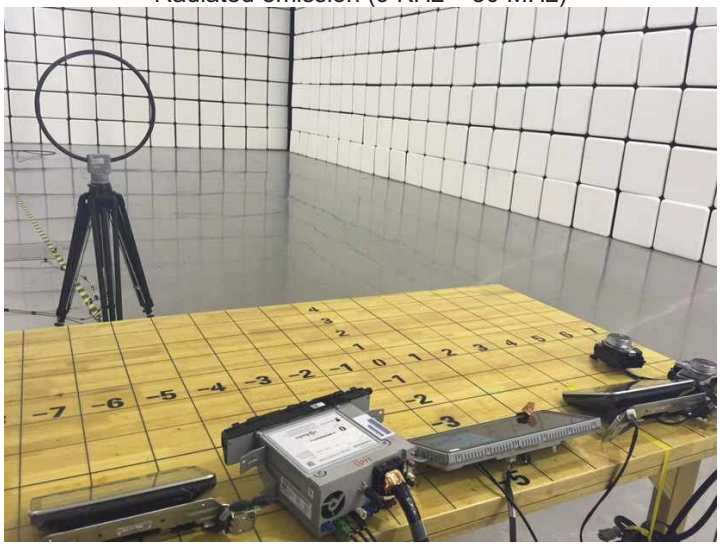
FCC	IC
Antenna Gain	
6 dBi	

Results

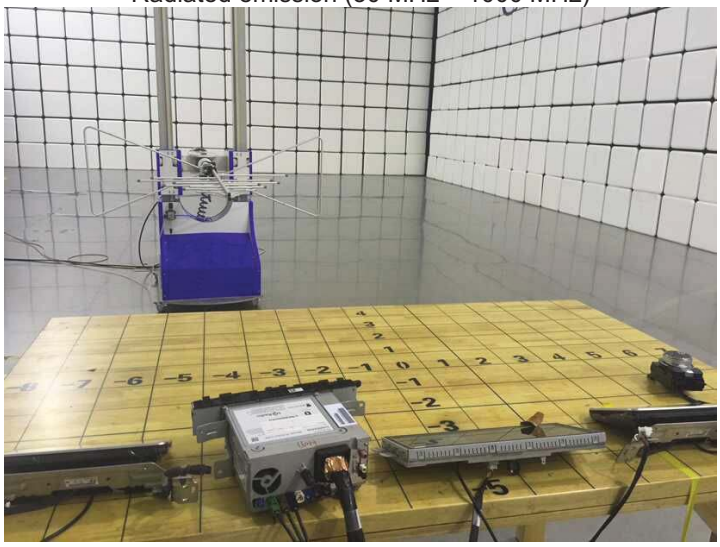
Maximum Gain [dBi]	0.1
Declare by Manufacturer	

5. Test Setup Photos of the EUT

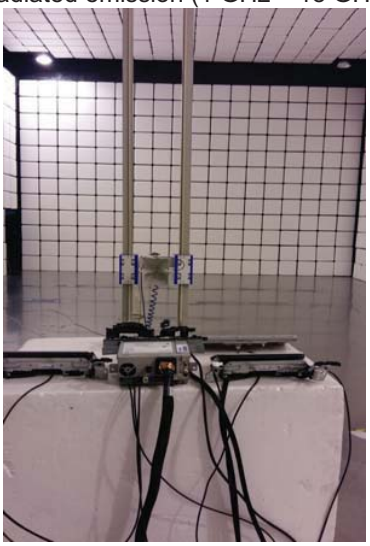
Radiated emission (9 KHz – 30 MHz)



Radiated emission (30 MHz – 1000 MHz)

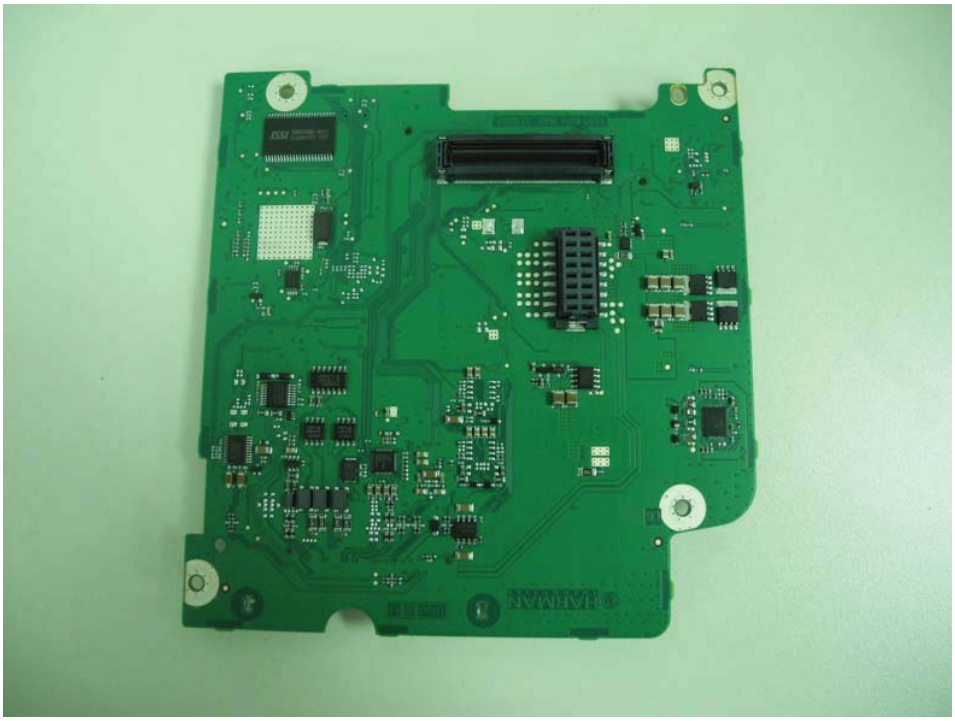


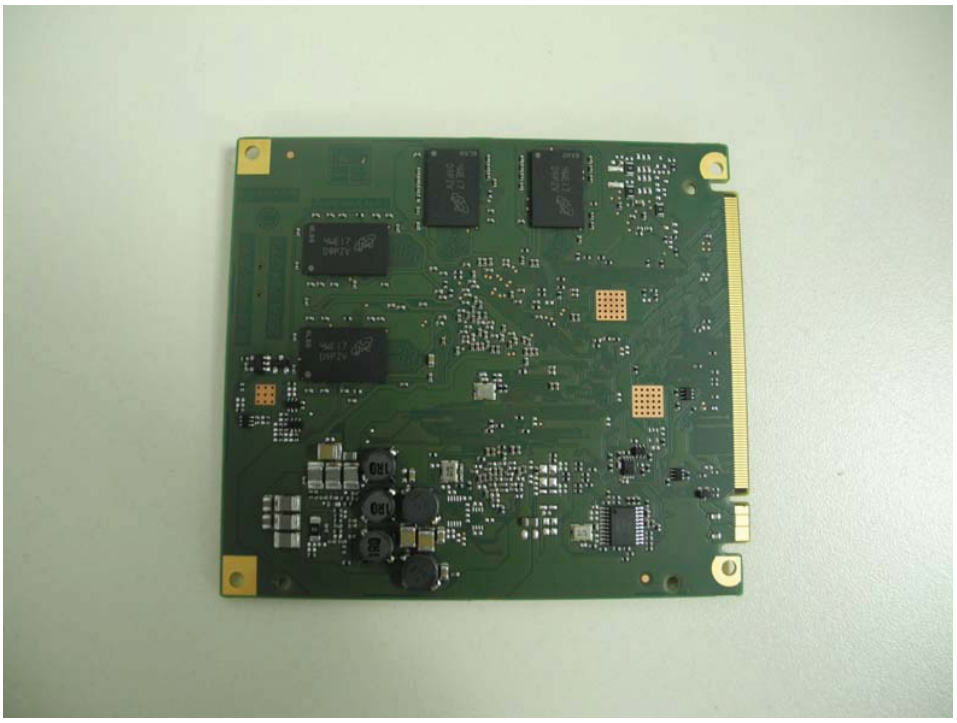
Radiated emission (1 GHz – 18 GHz)

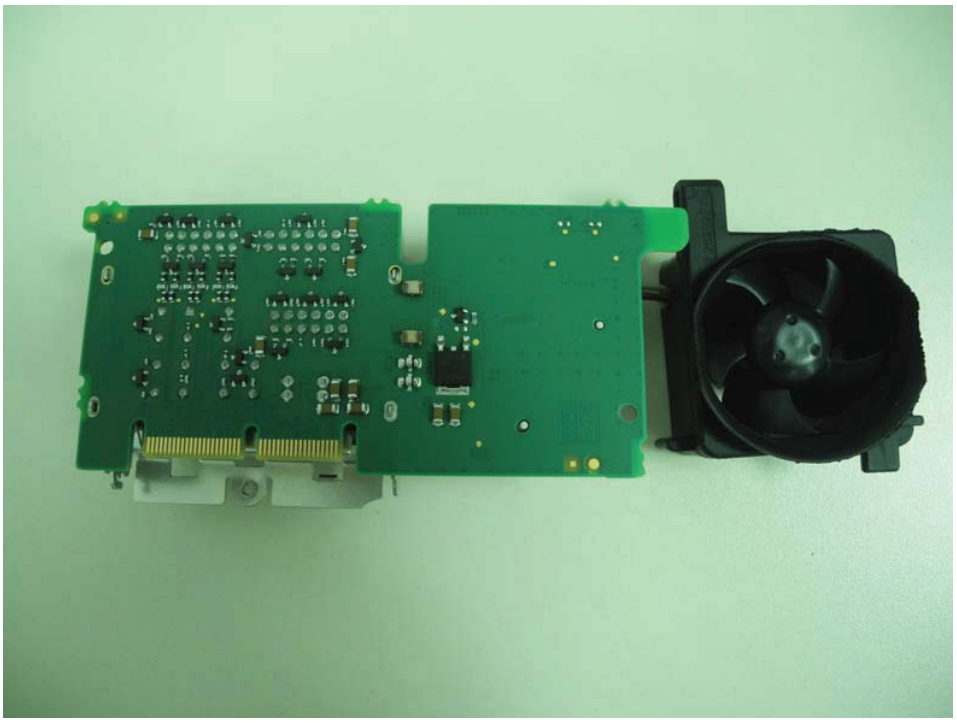


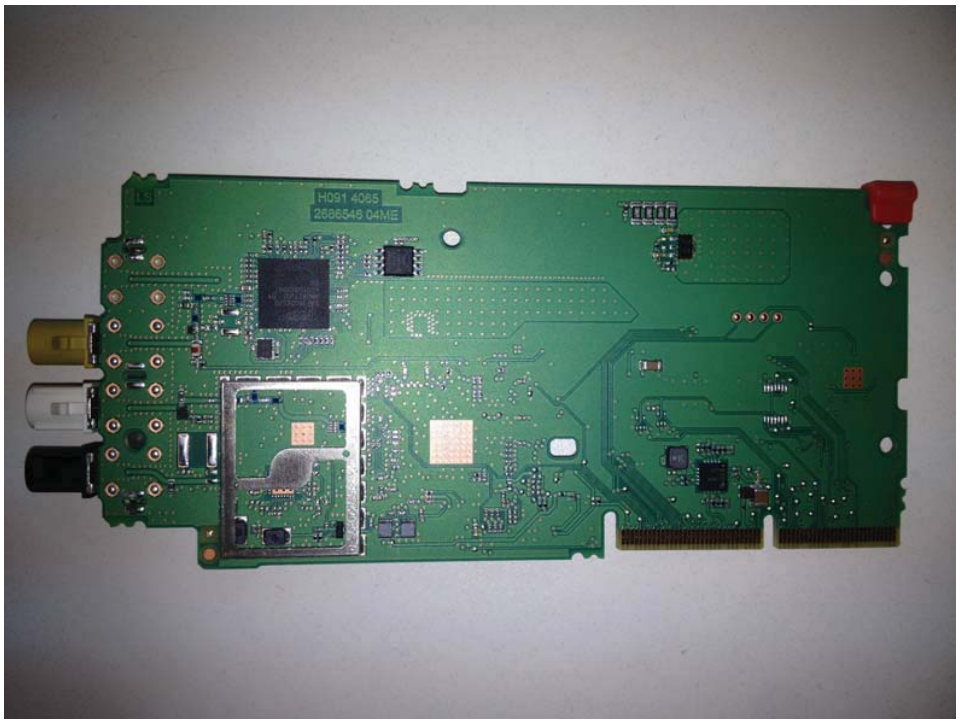
6. External Photos of the EUT

7. Internal Photos of the EUT





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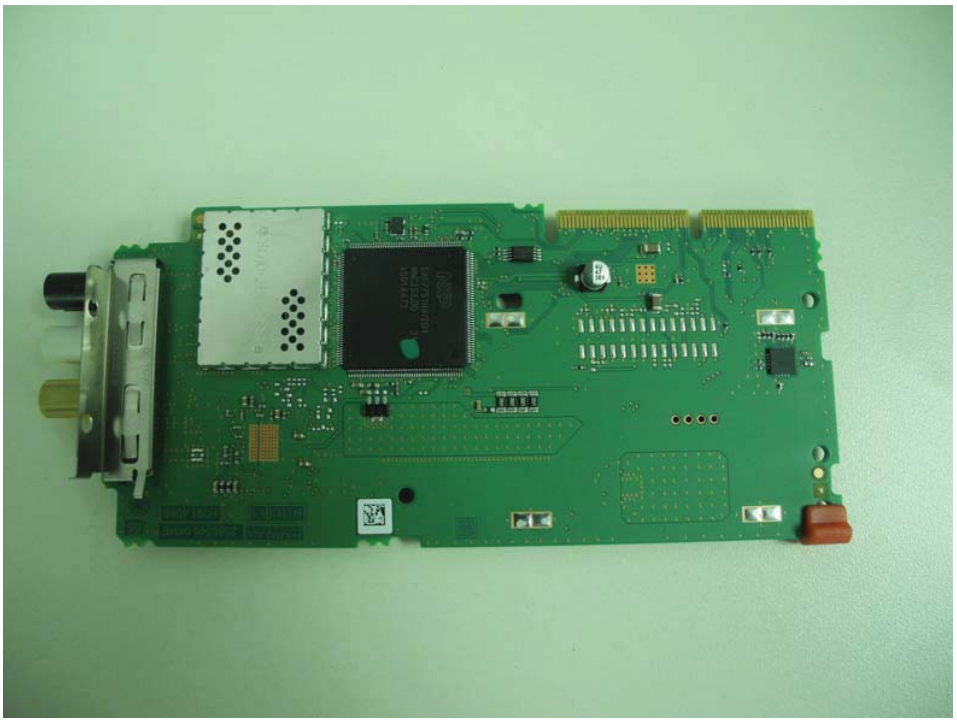

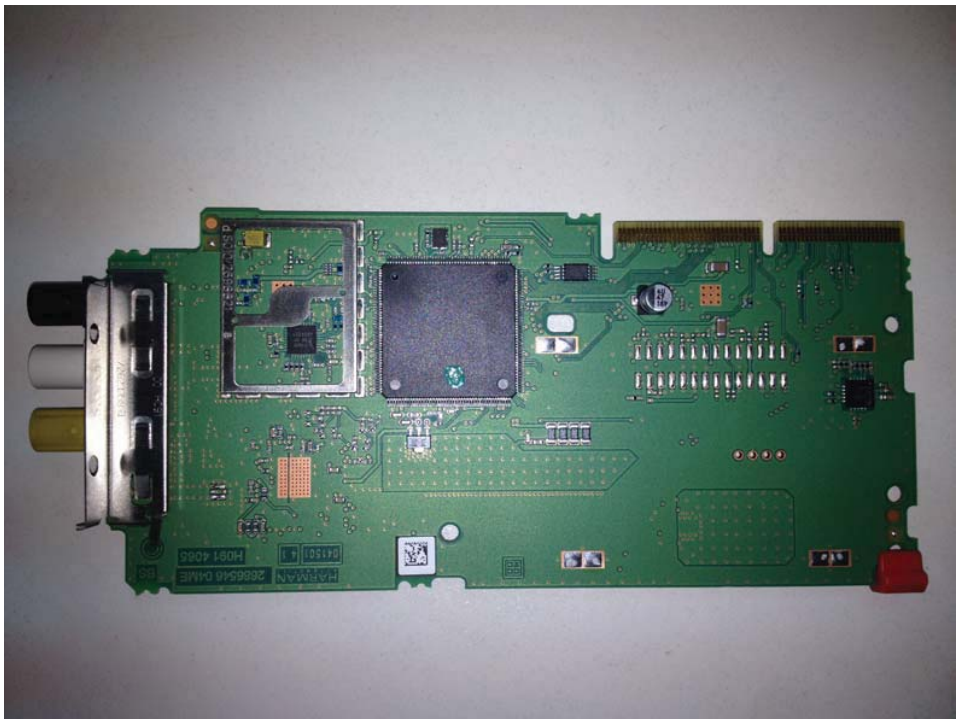

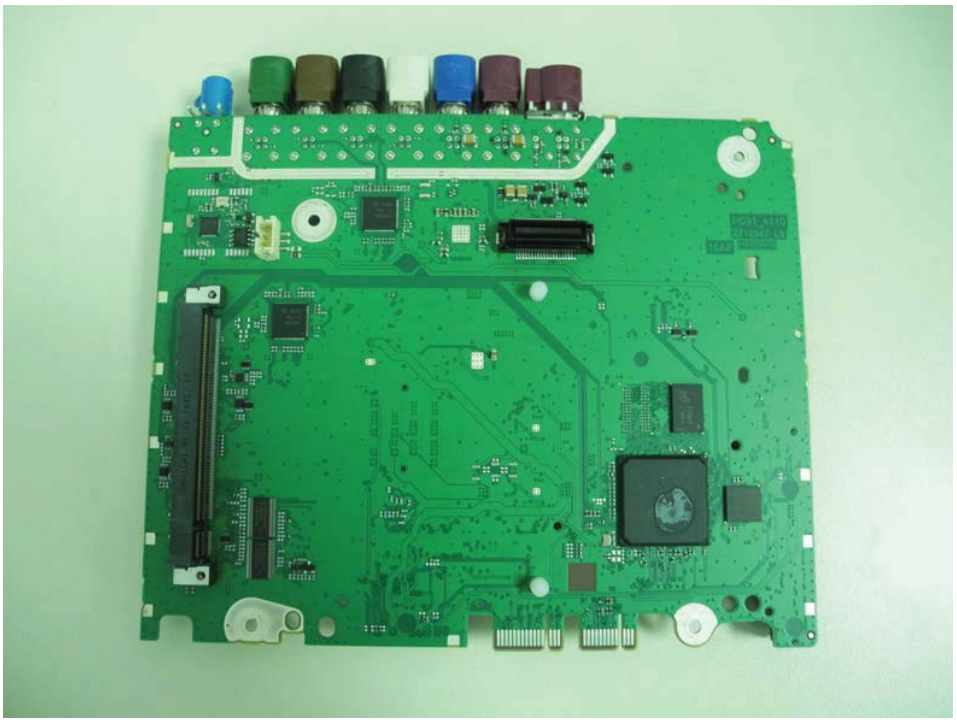

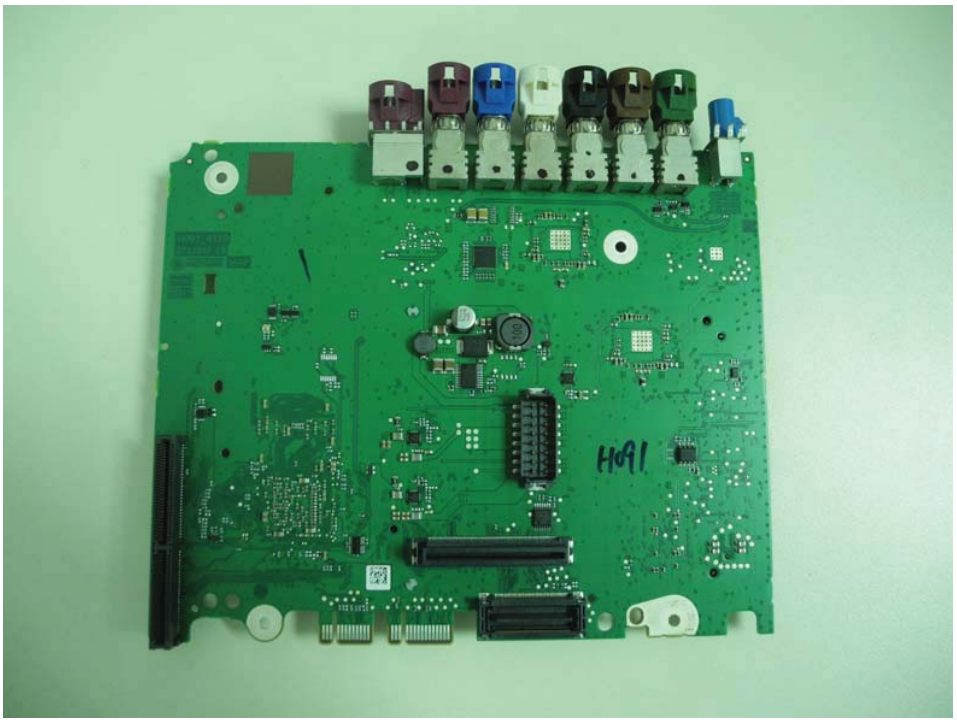
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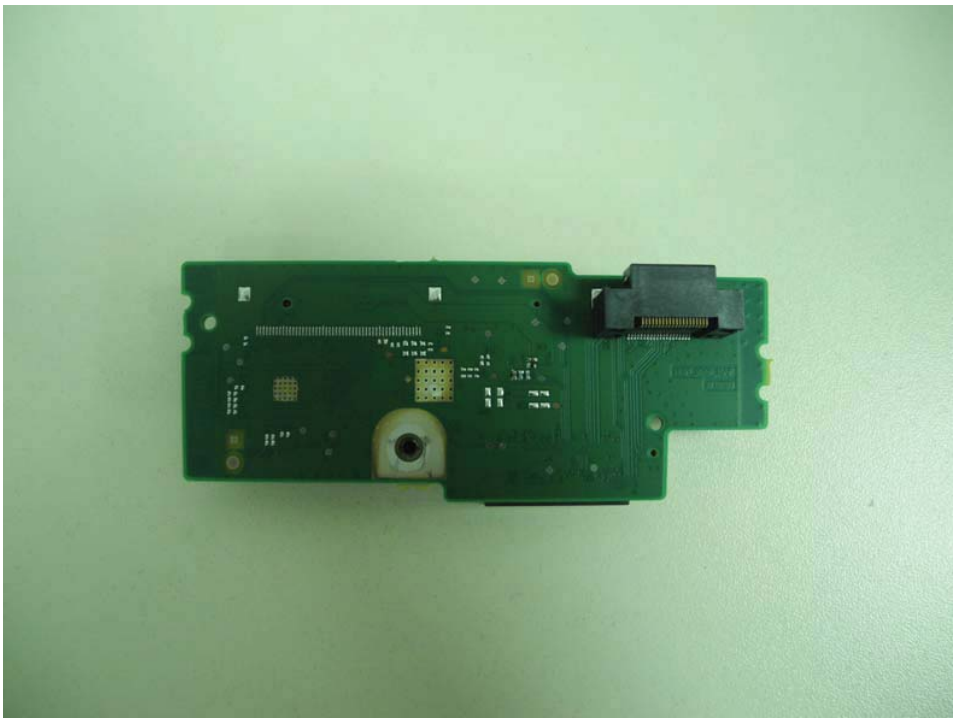
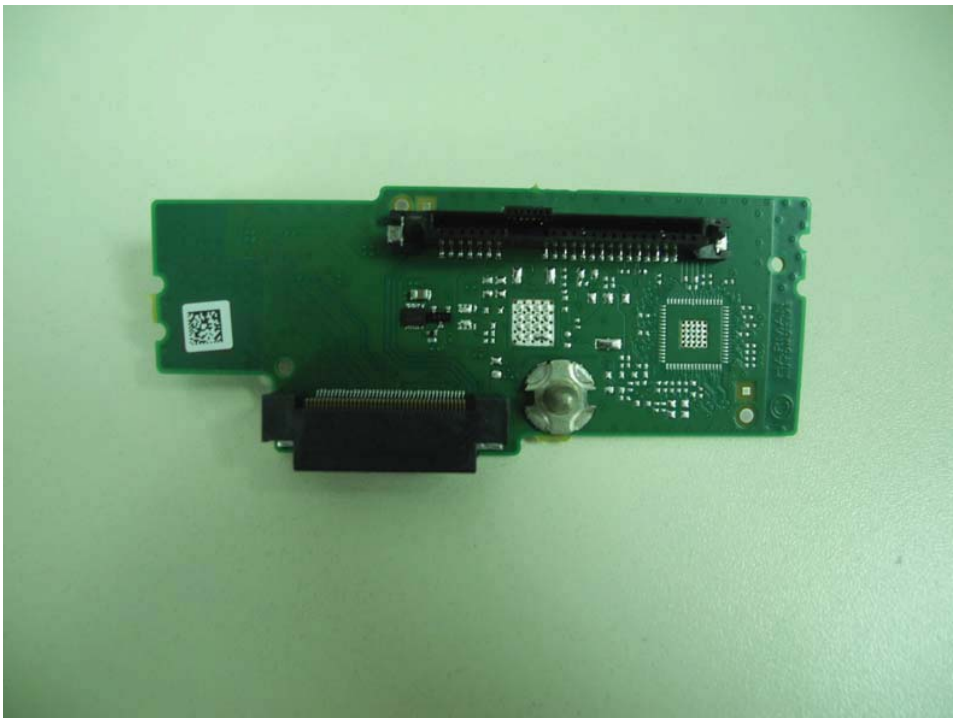
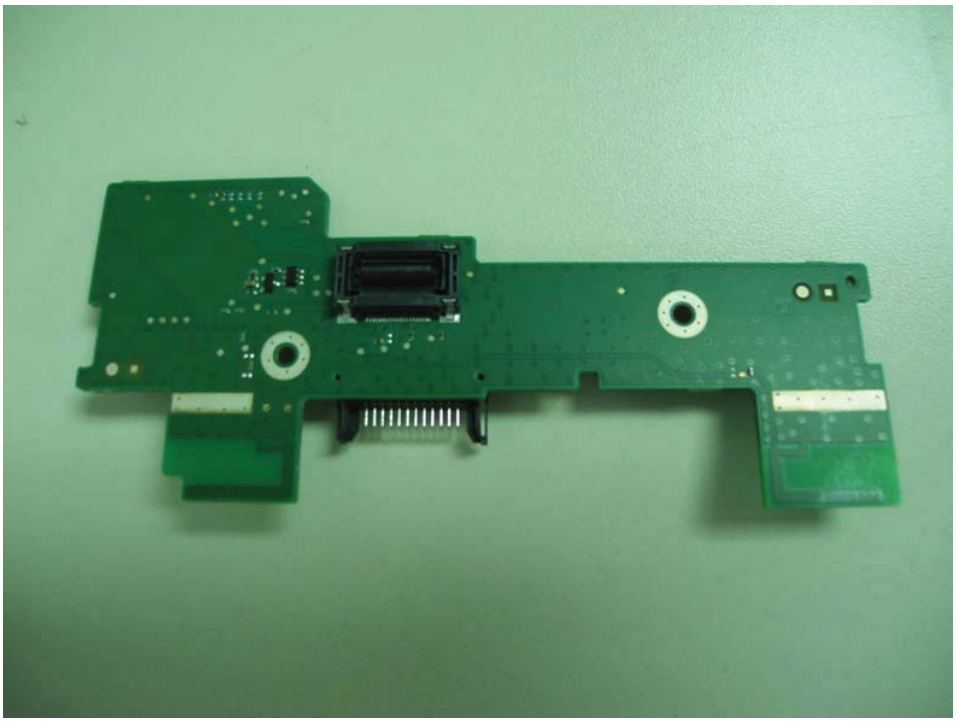
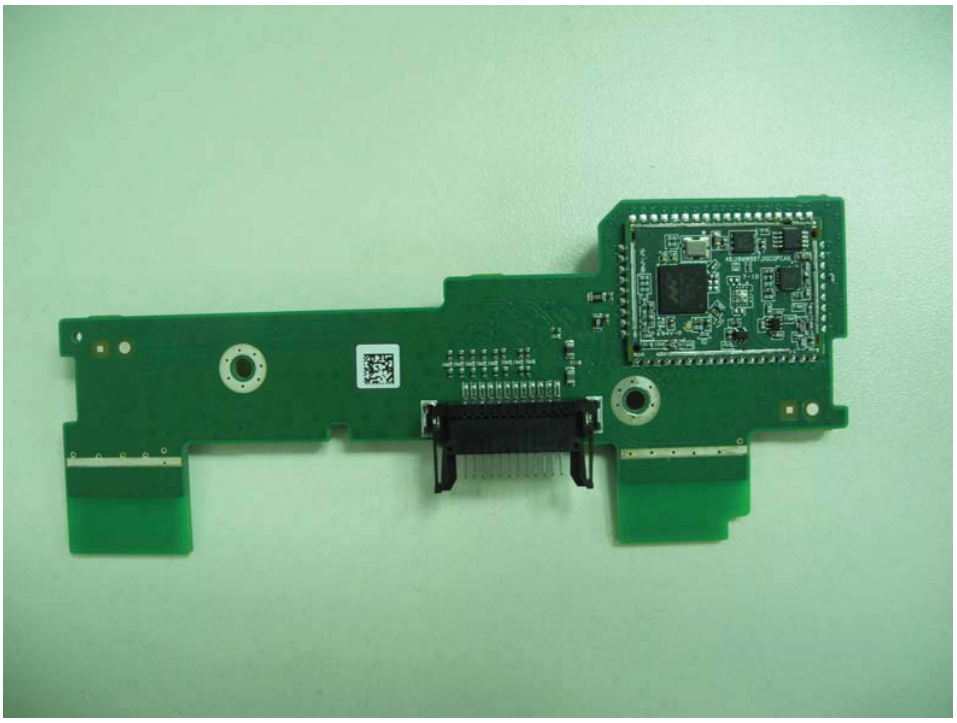
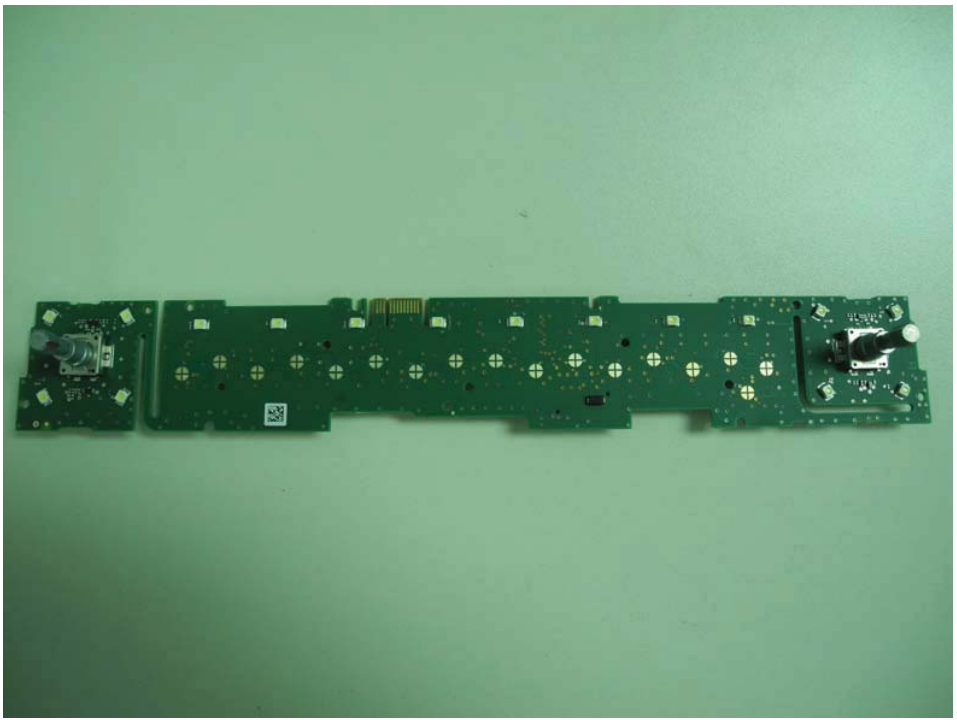
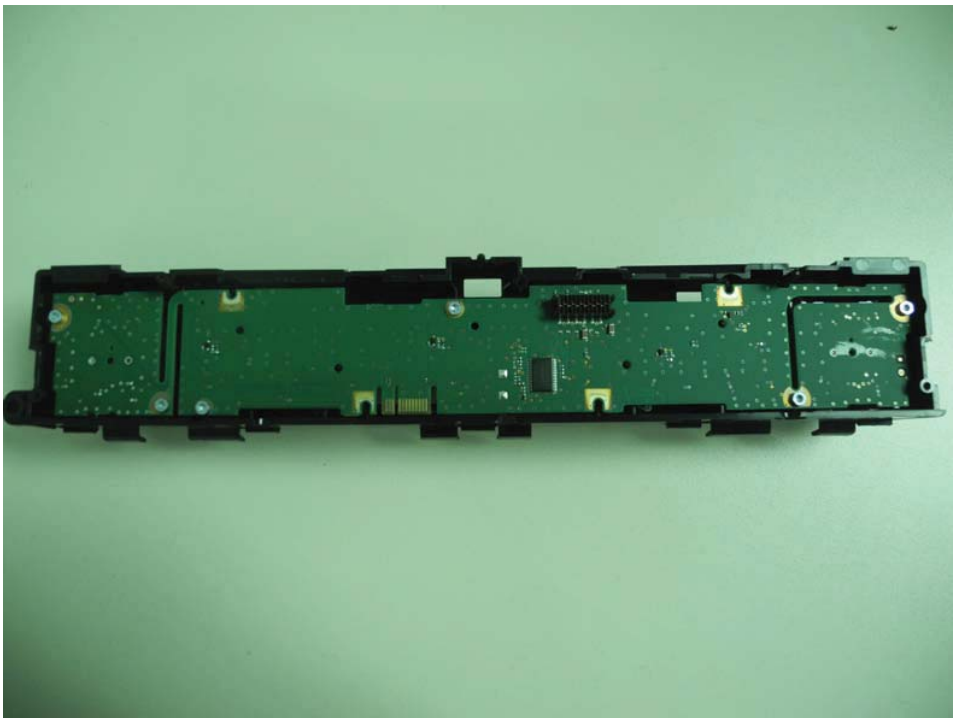




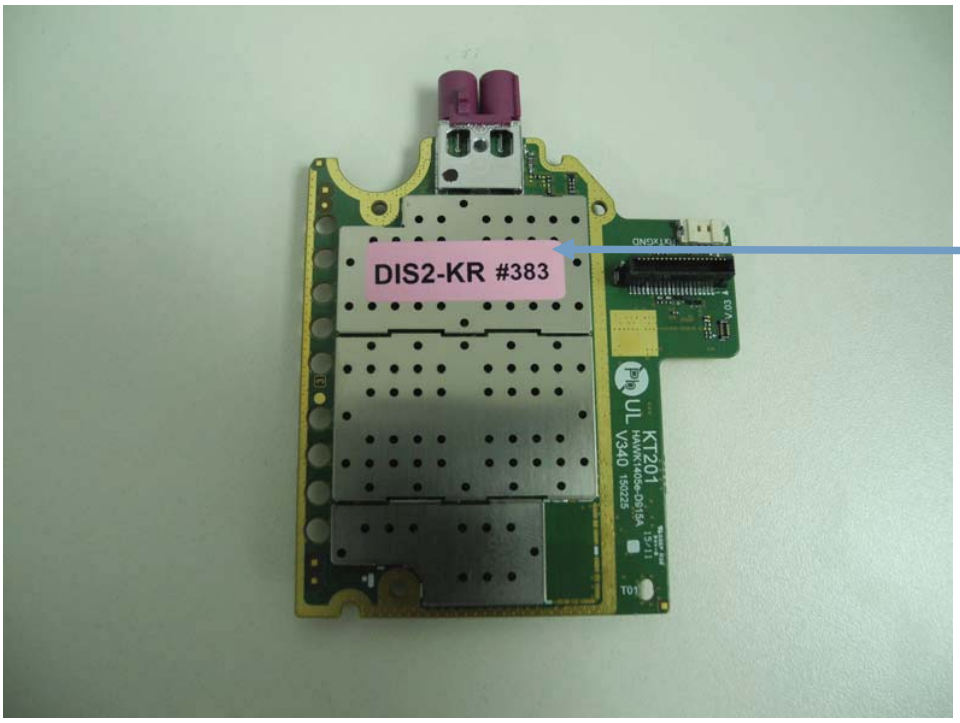









TOSHIBA
DISK DRIVE MQ01AAD020C
DRIVE REV ANL AAZ0 AK001W
DC+5V 1.4A DATE:27JAN2015
S/N 15RGPFBMT K1C HDKDA01L0A90 T
8455MB (CYL16383,H16,S63)
200GB(LBA 390,721 968Sectors)
TOSHIBA CORPORATION
MADE IN PHILIPPINES
DO NOT COVER
BREATHING HOLE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LTE Modular
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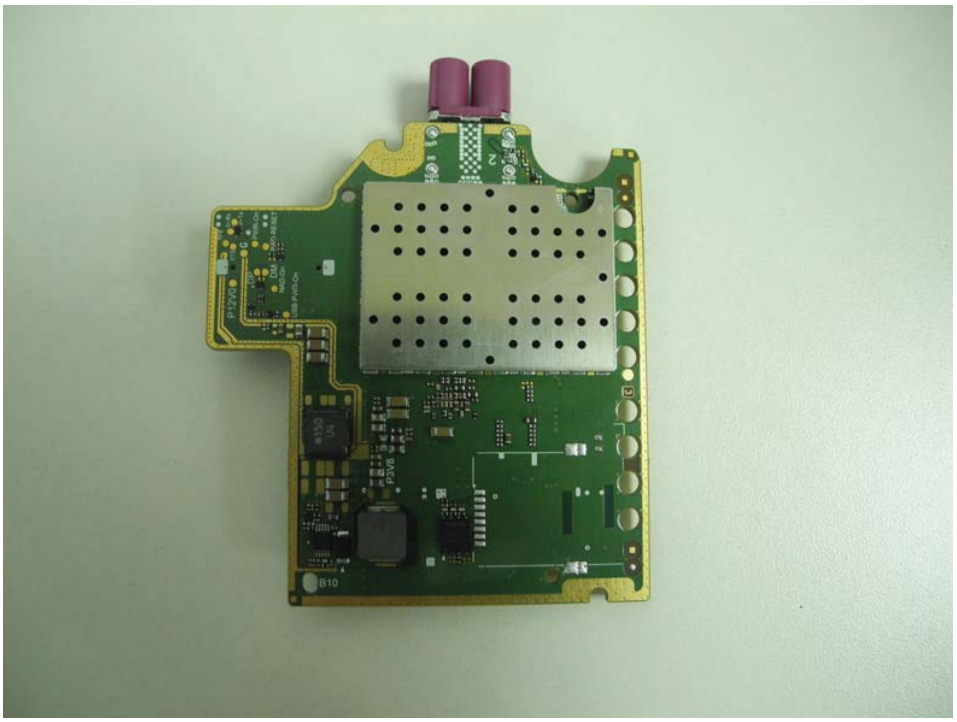

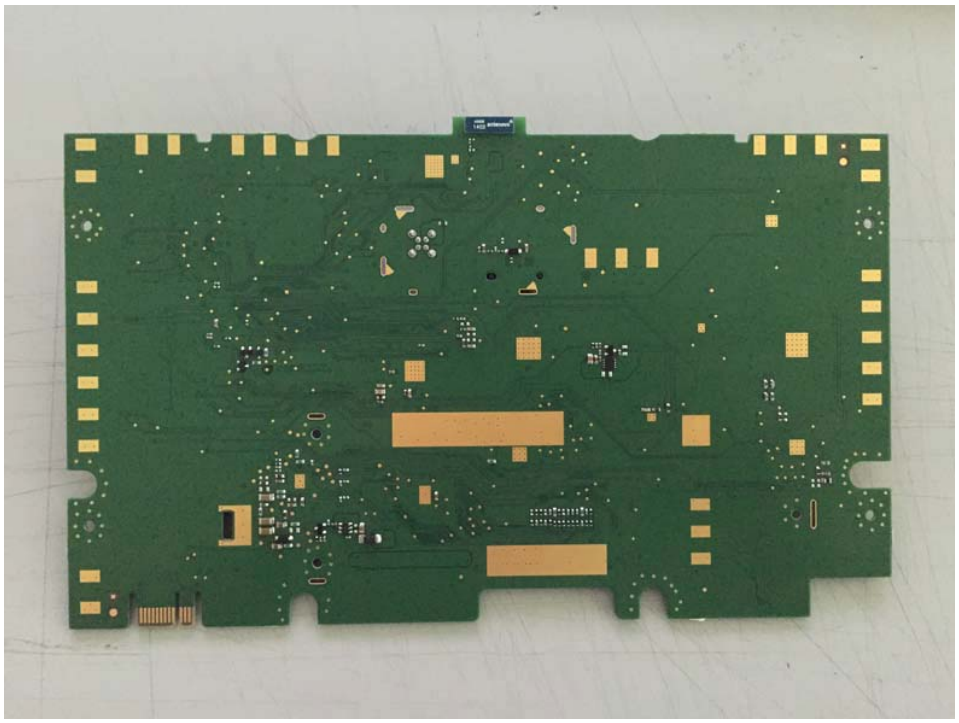

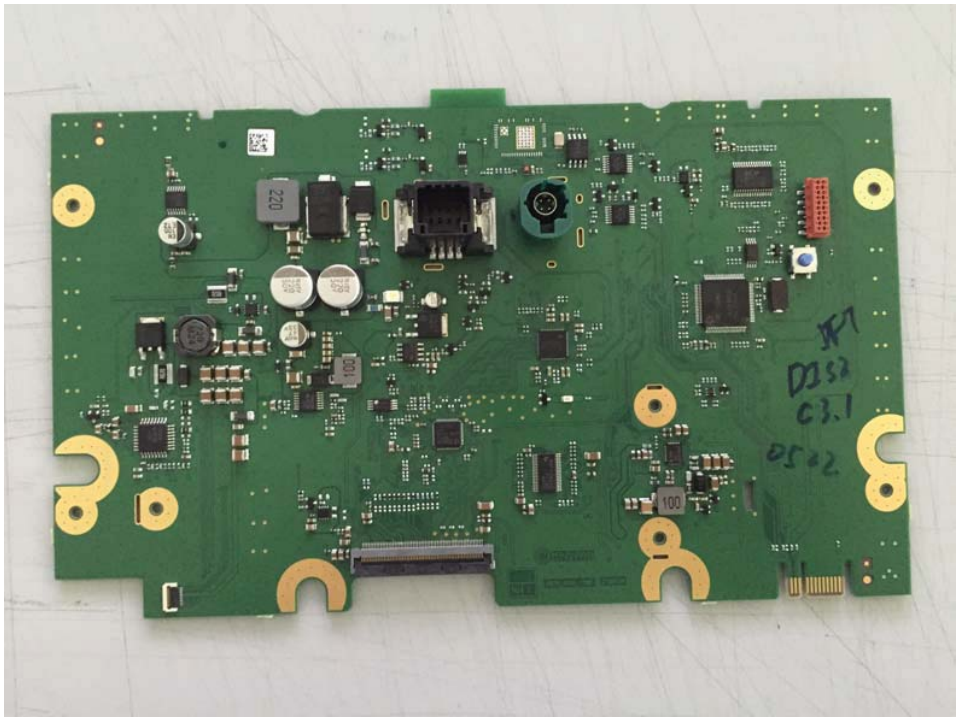

.....End of Report.....