FCC TEST REPORT
for
NEO-TELECOM CORPORATION

ECOSTONE
Model No.: GDI-EGST700, GDI-EGST701, GDI-EGST702, GDI-EGST703, GDI-EGST704, GDI-EGST705, GDI-EGST706, GDI-EGST707, GDI-EGST708, GDI-EGST709, GDI-EGST710

Prepared for	:	NEO-TELECOM CORPORATION
Address	:	7/F, 674-24, Anyang Dong, Manan Gu, Anyang City, Kyunggi Do, 430-831, South Korea

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Report Number	:	R011406530E
Date of Test	:	Jul. 01~ 18, 2014
Date of Report	:	Jul. 21, 2014

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TEST REPORT

Applicant	:	NEO-TELECOM CORPORATION
Manufacturer	:	NEO-TELECOM CORPORATION
EUT	:	ECOSTONE
Model No.	:	GDI-EGST700, GDI-EGST701, GDI-EGST702, GDI-EGST703, GDI-EGST704, GDI-EGST705, GDI-EGST706, GDI-EGST707, GDI-EGST708, GDI-EGST709, GDI-EGST710
Serial No.	:	N.A.
Trade Mark	:	N.A.
Rating	:	DC 5V Via Adapter

Measurement Procedure Used:

FCC Part15 Subpart C, Paragraph 15.207, 15.247 & 15.209

The device described above is tested by Shenzhen Anbotek Compliance Laboratory Limited to determine the maximum emission levels emanating from the device and the severe levels of the device can endure and its performance criterion. The measurement results are contained in this test report and Shenzhen Anbotek Compliance Laboratory Limited is assumed full of responsibility for the accuracy and completeness of these measurements. Also, this report shows that the EUT (Equipment Under Test) is technically compliant with the FCC Part 15 Subpart C requirements.
This report applies to above tested sample only and shall not be reproduced in part without
written approval of Shenzhen Anbotek Compliance Laboratory Limited.

Date of Test : Jul. 01~ 18, 2014

Prepared by : Rock zeng
(Tested Engineer / Rock Zeng)

Reviewer : Amy Ding
(Project Manager / Amy Ding)

Approved & Authorized Signer : Tom Chen
(Manager / Tom Chen)

1. GENERAL INFORMATION

1.1 Description of Device (EUT)

EUT	:	ECOSTONE
Model Number	:	GDI-EGST700, GDI-EGST701, GDI-EGST702, GDI-EGST703, GDI-EGST704, GDI-EGST705, GDI-EGST706, GDI-EGST707, GDI-EGST708, GDI-EGST709, GDI-EGST710 (Note: All samples are the same except the model number and appearance, so we prepare "GDI-EGST700" for EMC test only.)
Test Power Supply	:	DC 5V
Adapter	:	Model: SK05G-0500100U Input: 100-240V~, 50/60Hz, 0.2A Output: 5V⎓, 1A
Frequency	:	2402~2480MHz
Antenna Specification	:	PCB Antenna: 0dBi
Modulation	:	GFSK, π/4DQPSK, 8DPSK
Applicant	:	NEO-TELECOM CORPORATION
Address	:	7/F, 674-24, Anyang Dong, Manan Gu, Anyang City, Kyunggi Do, 430-831, South Korea
Manufacturer	:	NEO-TELECOM CORPORATION
Address	:	7/F, 674-24, Anyang Dong, Manan Gu, Anyang City, Kyunggi Do, 430-831, South Korea
Factory	:	NEO-TELECOM CORPORATION
Address	:	7/F, 674-24, Anyang Dong, Manan Gu, Anyang City, Kyunggi Do, 430-831, South Korea
Date of receipt	:	Jun. 30, 2014
Date of Test	:	Jul. 01~ 18, 2014

1.2 Auxiliary Equipment Used during Test

Mobile Phone	:	Manufacturer: SONY M/N: GT-N7100

1.3 Description of Test Facility

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

CNAS - LAB Code: L3503
Shenzhen Anbotek Compliance Laboratory Limited., Laboratory has been assessed and in compliance with CNAS/CL01: 2006 accreditation criteria for testing laboratories (identical to ISO/IEC 17025:2005 General Requirements) for the Competence of Testing Laboratories.

FCC-Registration No.: 752021
Shenzhen Anbotek Compliance Laboratory Limited, EMC Laboratory has been registed 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 752021, July 10, 2013.

IC-Registration No.: 8058A-1
Shenzhen Anbotek Compliance Laboratory Limited., EMC Laboratory has been registered and fully described in a report filed with the (IC) Industry Canada. The acceptance letter from the IC is maintained in our files. Registration 8058A, February 22, 2013.

Test Location
All Emissions tests were performed at
Shenzhen Anbotek Compliance Laboratory Limited. at 1/F., Building 1, SEC Industrial Park, No.0409 Qianhai Road, Nanshan District, Shenzhen, Guangdong, China

1.4 Measurement Uncertainty

Radiation Uncertainty	:	Ur = 4.3dB
Conduction Uncertainty	:	Uc = 3.4dB

2. Test Procedure

GENERAL: This report shall NOT be reproduced except in full without the written approval of Shenzhen Anbotek Compliance Laboratory Limited. The EUT was transmitting a test signal during the testing.

RADIATION INTERFERENCE: The test procedure used was ANSI STANDARD C63.4-2009 using a spectrum analyzer with a pre-selector. The analyzer was calibrated in dB above a microvolt at the output of the antenna. The resolution bandwidth was 100KHz and the video bandwidth was 300KHz up to 1.0GHz and 1.0MHz with a video BW of 3.0MHz above 1.0GHz. The ambient temperature of the EUT was 74.3oF with a humidity of 69%.

FORMULA OF CONVERSION FACTORS: The Field Strength at 3m was established by adding the meter reading of the spectrum analyzer (which is set to read in units of dBuV) to the antenna correction factor supplied by the antenna manufacturer. The antenna correction factors are stated in terms of dB. The gain of the Preselector was accounted for in the Spectrum Analyzer Meter Reading.

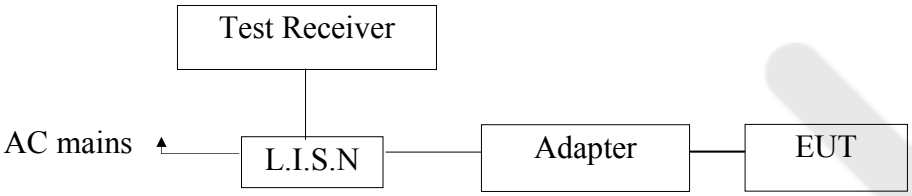
Example:
Freq (MHz) METER READING + ACF = FS
20 dBuV + 10.36 dB = 30.36 dBuV/m @ 3m

ANSI STANDARD C63.4-2009 10.1.7 MEASUREMENT PROCEDURES: The EUT was placed on a table 80 cm high and with dimensions of 1m by 1.5m. The EUT was placed in the center of the table (1.5m side). The table used for radiated measurements is capable of continuous rotation.
When an emission was found, the table was rotated to produce the maximum signal strength. At this point, the antenna was raised and lowered from 1m to 4m. The antenna was placed in both the horizontal and vertical planes.

3. Conducted Emission

3.1 Block Diagram of Test Setup

3.1.1. Block diagram of connection between the EUT and simulators



3.2 Power Line Conducted Emission Measurement Limits (15.207)

Frequency MHz	Limits dB(μV)	
	Quasi-peak Level	Average Level
0.15 ~ 0.50	66 ~ 56*	56 ~ 46*
0.50 ~ 5.00	56	46
5.00 ~ 30.00	60	50

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

3.3 Configuration of EUT on Measurement

The following equipments are installed on Power Line Conducted Emission Measurement to meet the commission requirement and operating regulations in a manner which tends to maximize its emission characteristics in a normal application.

3.4 Operating Condition of EUT

3.4.1. Setup the EUT and simulator as shown as Section 3.1.

3.4.2. Turn on the power of all equipment.

3.4.3. Let the EUT work in test mode (Charging to adapter) and measure it.

3.5 Test Procedure

The EUT system is connected to the power mains through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm coupling impedance for the EUT system. Please refer the block diagram of the test setup and photographs. Both sides of AC line are checked to find out the maximum conducted emission. In order to find the maximum emission levels, the relative positions of equipment and all of the interface cables shall be changed according to FCC ANSI C63.4-2003 on Conducted Emission Measurement.

The bandwidth of test receiver (ESCI) set at 9KHz.

The frequency range from 150KHz to 30MHz is checked.

The test results are reported on Section 3.6.

Test Equipment

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Two-Line V-network	Rohde & Schwarz	ENV216	100055	Apr. 23, 2014	1 Year
2.	EMI Test Receiver	Rohde & Schwarz	ESCI	100627	Apr. 23, 2014	1 Year
3.	RF Switching Unit	Compliance Direction	RSU-M2	38303	Apr. 23, 2014	1 Year

3.6 Power Line Conducted Emission Measurement Results

PASS.

The frequency range from 150KHz to 30 MHz is investigated.

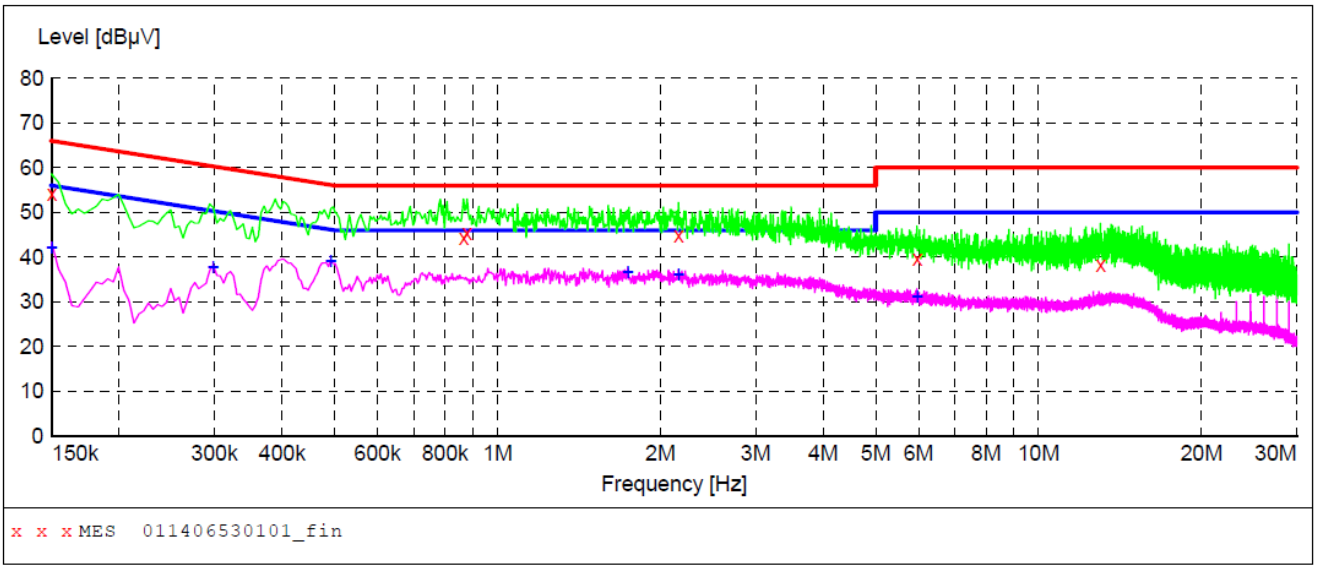
Please refer the following pages.

CONDUCTED EMISSION TEST DATA

Test Site:	1# Shielded Room
Operating Condition:	Charging to adapter
Test Specification:	DC 5V via adapter AC 120V, 60Hz
Comment:	Live Line
	Tem:25℃ Hum:50%

SCAN TABLE: "Voltage(150K~30M)FIN"

Short Description: 150K-30M Disturbance Voltages



MEASUREMENT RESULT: "011406530101_fin"

7/2/2014 8:11PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.150000	54.30	20.1	66	11.7	QP	L1	GND
0.865500	44.40	20.1	56	11.6	QP	L1	GND
0.879000	45.50	20.1	56	10.5	QP	L1	GND
2.161000	44.90	20.3	56	11.1	QP	L1	GND
5.963500	39.50	20.5	60	20.5	QP	L1	GND
13.015000	38.30	20.7	60	21.7	QP	L1	GND

MEASUREMENT RESULT: "011406530101_fin2"

7/2/2014 8:11PM

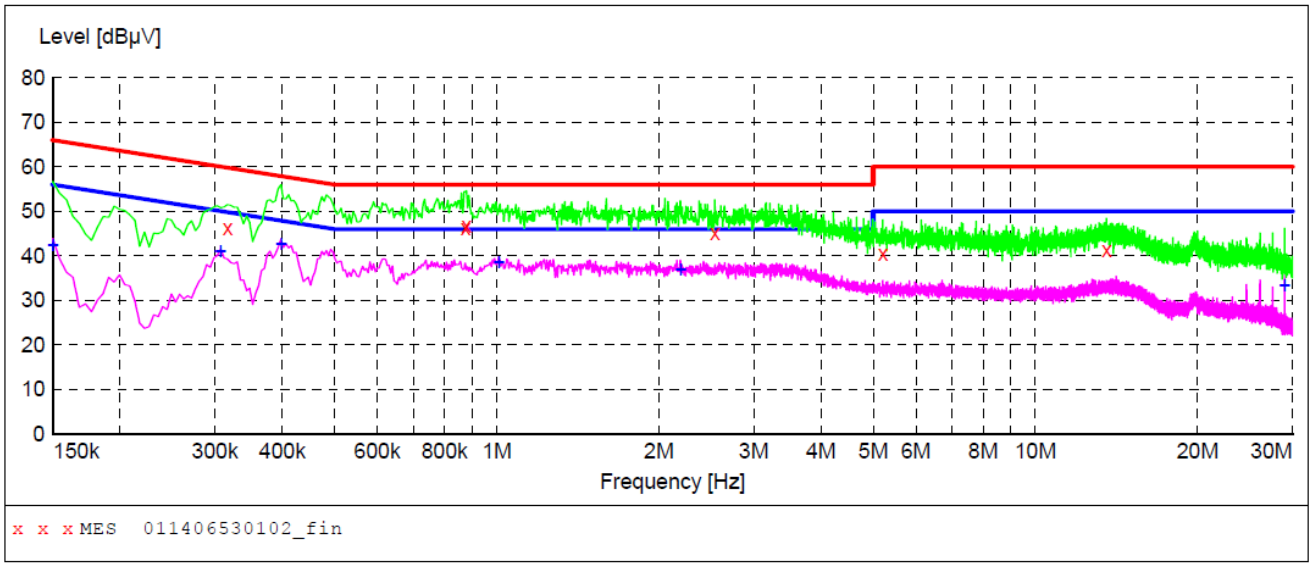
Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.150000	42.20	20.1	56	13.8	AV	L1	GND
0.298500	37.70	20.1	50	12.6	AV	L1	GND
0.492000	39.20	20.1	46	6.9	AV	L1	GND
1.742500	36.50	20.3	46	9.5	AV	L1	GND
2.161000	36.10	20.3	46	9.9	AV	L1	GND
5.963500	31.20	20.5	50	18.8	AV	L1	GND

CONDUCTED EMISSION TEST DATA

Test Site:	1# Shielded Room
Operating Condition:	Charging to adapter
Test Specification:	DC 5V via adapter AC 120V, 60Hz
Comment:	Neutral Line
	Tem:25℃ Hum:50%

SCAN TABLE: "Voltage(150K~30M)FIN"

Short Description: 150K-30M Disturbance Voltages



MEASUREMENT RESULT: "011406530102_fin"

7/2/2014 8:14PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.316500	46.30	20.1	60	13.5	QP	N	GND
0.874500	46.20	20.1	56	9.8	QP	N	GND
0.879000	46.90	20.1	56	9.1	QP	N	GND
2.539000	45.00	20.4	56	11.0	QP	N	GND
5.212000	40.60	20.5	60	19.4	QP	N	GND
13.555000	41.40	20.7	60	18.6	QP	N	GND

MEASUREMENT RESULT: "011406530102_fin2"

7/2/2014 8:14PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.150000	42.50	20.1	56	13.5	AV	N	GND
0.307500	40.90	20.1	50	9.1	AV	N	GND
0.397500	42.80	20.1	48	5.1	AV	N	GND
1.009000	38.70	20.2	46	7.3	AV	N	GND
2.192500	36.90	20.3	46	9.1	AV	N	GND
29.030500	33.30	20.9	50	16.7	AV	N	GND

4. Radiation Interference

4.1 Requirements (15.247, 15.209):

4.1.1. Test Limits (< 30 MHZ)

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meter)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30

4.1.2. Test Limits (≥ 30 MHZ)

FIELD STRENGTH of Fundamental: @3M	FIELD STRENGTH of Harmonics	S15.209 30 - 88 MHz	40 dBuV/m
902-928 MHZ		88 - 216 MHz	43.5
2.4-2.4835 GHz		216 - 960 MHz	46
94 dBμV/m @3m	54 dBμV/m @3m	ABOVE 960 MHz	54dBuV/m

For range 9KHz~30MHz, The measured value is really too low to be recorded.

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in 15.209, whichever is the lesser attenuation.

4.2 Test Procedure

The EUT is placed on a turn table which is 0.8 meter high above the ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT is set 3 meters away from the receiving antenna which is mounted on a antenna tower. The antenna can be moved up and down from 1 to 4 meters to find out the maximum emission level. Rotated the EUT through three orthogonal axes to determine the maximum emissions, both horizontal and vertical polarization of the antenna are set on test. The EUT is tested in 9*6*6 Chamber.

For 30MHz to 1000MHz:
Set the spectrum analyzer as:
RBW = 120kHz, VBW =300kHz,
Detector= Quasi-Peak
Trace mode= Max hold.
Sweep- auto couple.

For Above 1GHz:
Set the spectrum analyzer as:
RBW = 1MHz, VBW =3MHz,
Detector= Peak
Trace mode= Max hold.
Sweep- auto couple.

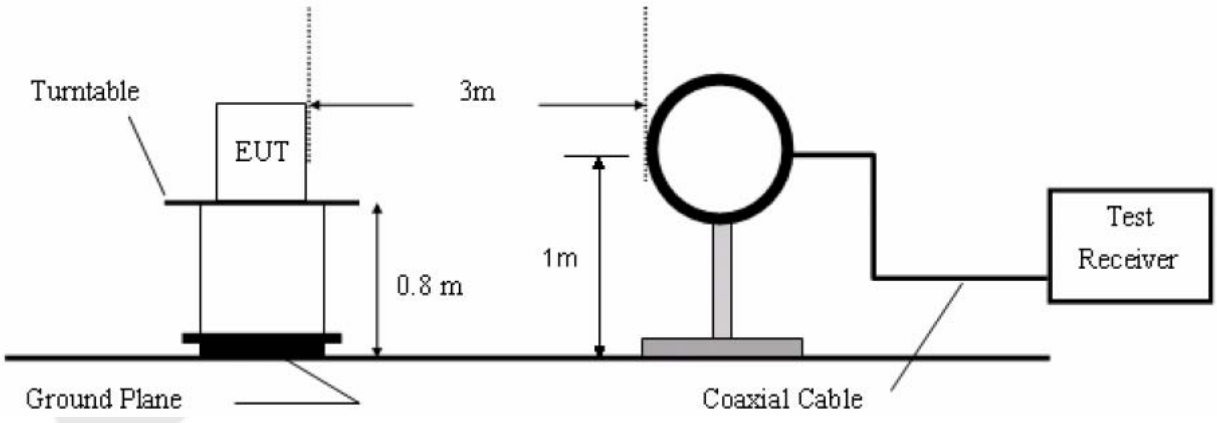
Set the spectrum analyzer as:
RBW =1MHz, VBW =10Hz
Detector= Average
Trace mode= Max hold.
Sweep- auto couple.

Test Equipment

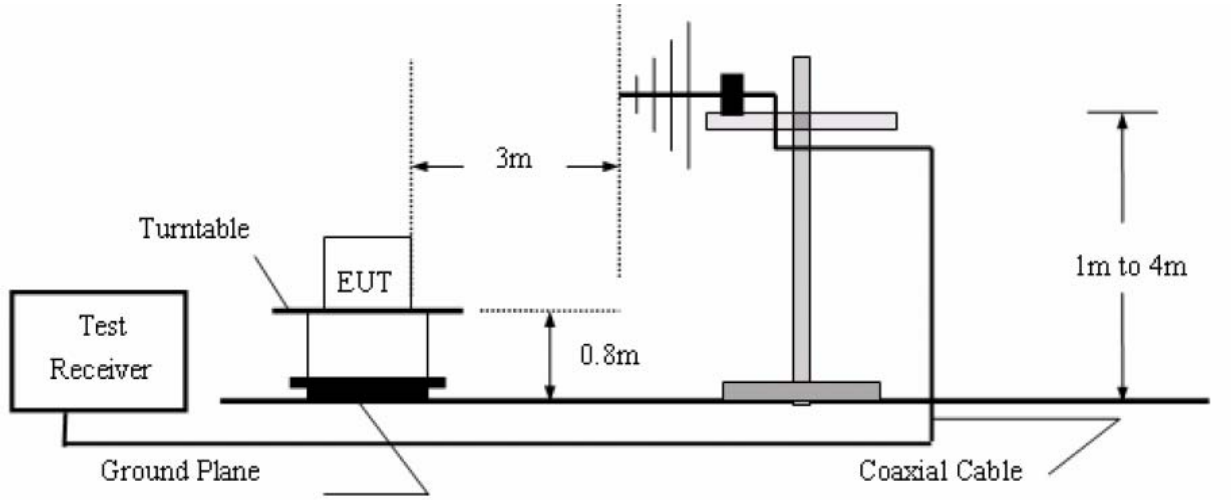
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Spectrum Analysis	Agilent	E4407B	US39390582	Aug. 09, 2013	1 Year
2.	Preamplifier	Instruments corporation	EMC011830	980100	Aug. 09, 2013	1 Year
3.	EMI Test Receiver	Rohde & Schwarz	ESPI	101604	Apr. 23, 2014	1 Year
4.	Double Ridged Horn Antenna	Instruments corporation	GTH-0118	351600	Aug. 09, 2013	3 Year
5.	Bilog Broadband Antenna	Schwarzbeck	VULB9163	VULB 9163-289	Apr. 23, 2013	3 Year
6.	Loop Antenna	ARA	PLA-1030/B	1029	Apr. 23, 2013	3 Year
7.	Pre-amplifier	SONOMA	310N	186860	Apr. 23, 2014	1 Year
8.	EMI Test Software EZ-EMC	SHURPLE	N/A	N/A	N/A	N/A

4.3 Test Configuration

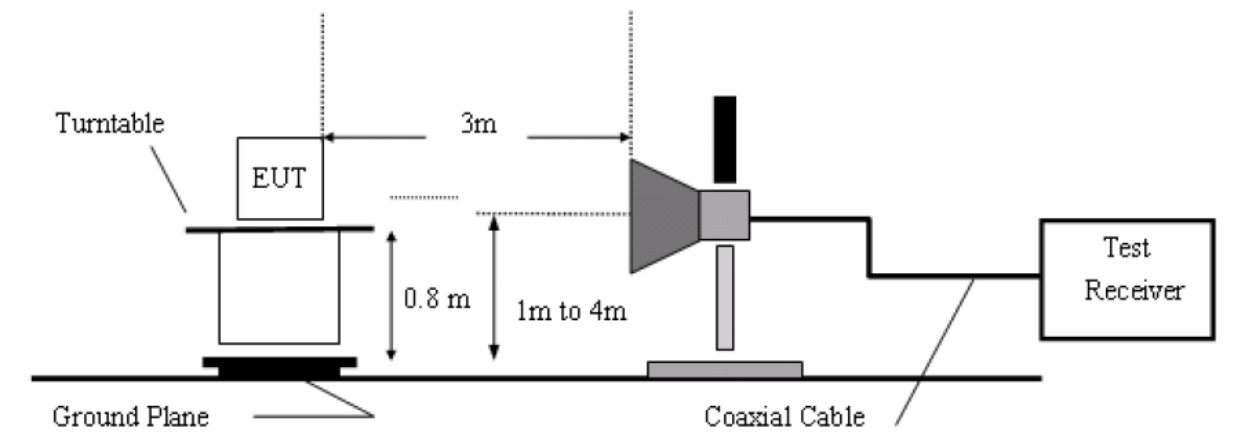
4.3.1. 9k to 30MHz emissions:



4.3.2. 30M to 1G emissions:



4.3.3. 1G to 40G emissions:

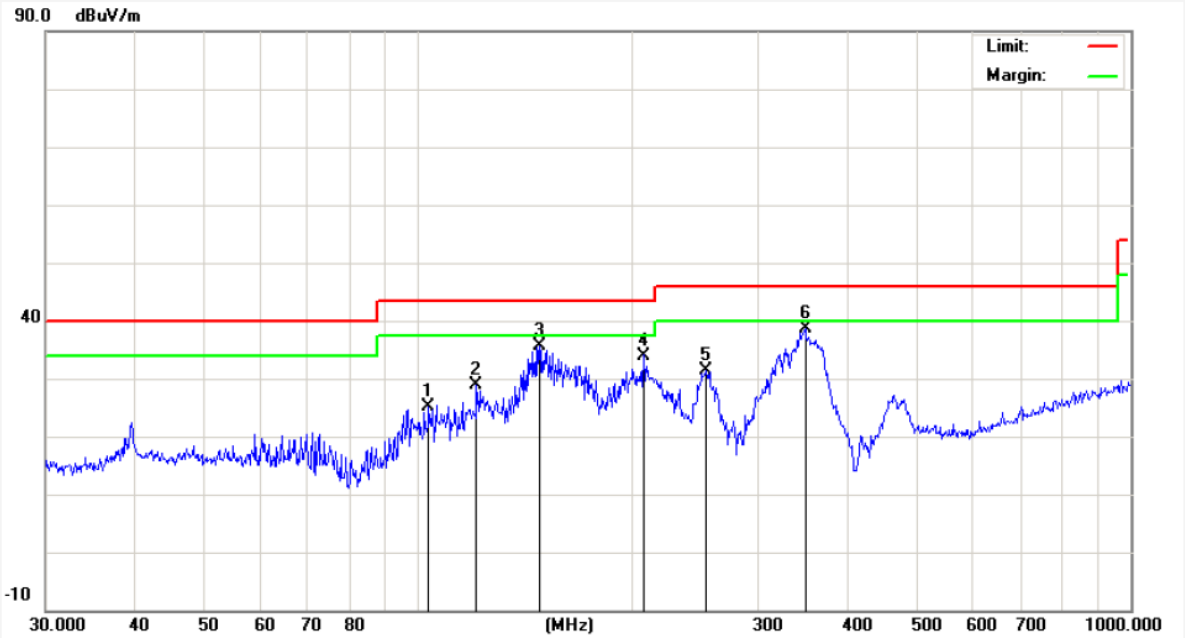


4.4 Test Results

PASS.

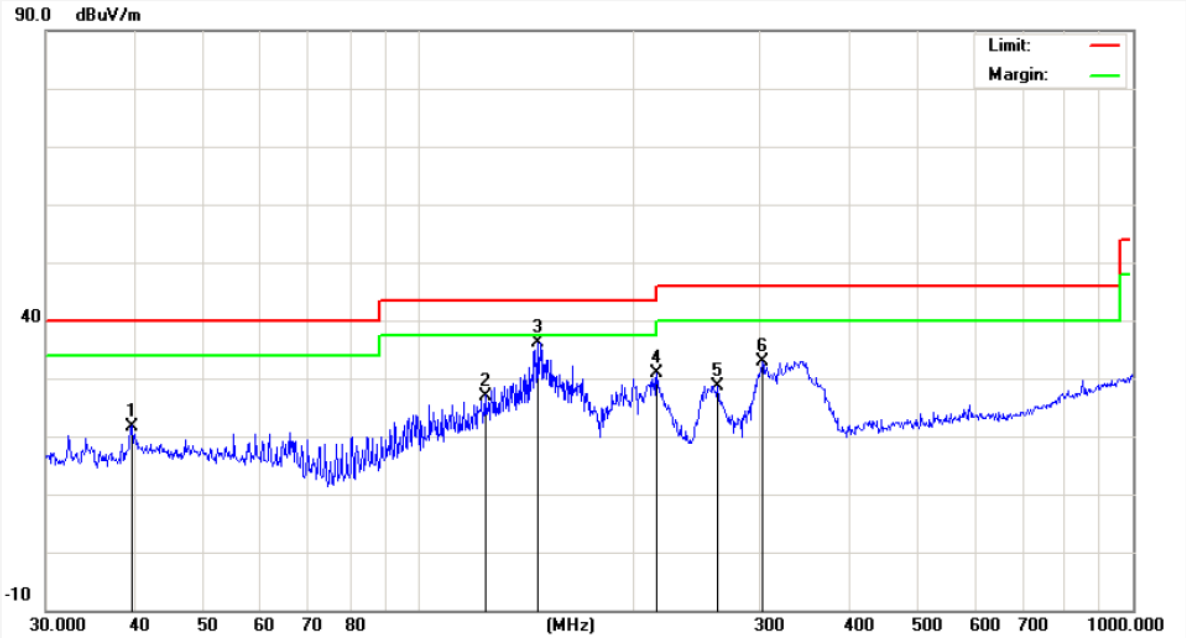
The EUT was tested on (Charging to adapter, Audio Mode, BT Mode) modes, only the worst data of (BT Mode) are attached in the following pages.

Job No.:	**011406530E**	**Polarization:**	**Horizontal**
Standard:	**(RE)FCC PART 15C _3m**	**Power Source:**	**DC 5V**
Test item:	**Radiation Test (30~1000MHz)**	**Temp.(C)/Hum.(%RH):**	**24.3(C)/55%RH**
Test Mode:	**BT Mode**	**Distance:**	**3m**



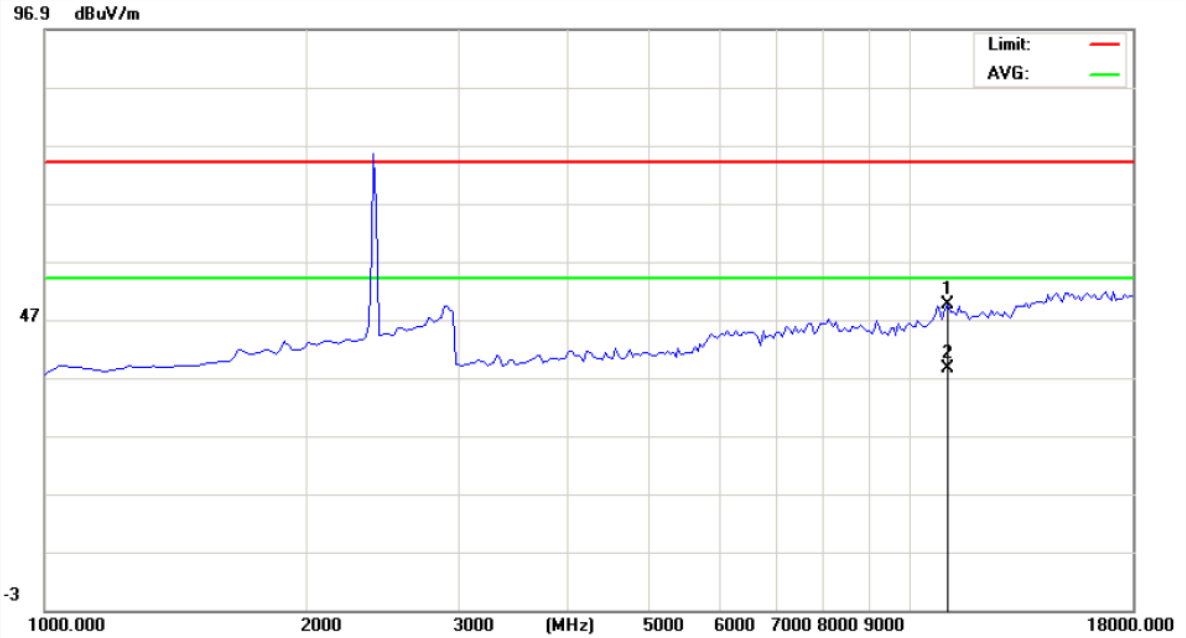
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/	Over Limit (dB)	Detector	Height (cm)	degree (deg)	Remark
1	103.4419	45.81	-20.71	25.10	43.50	-18.40	peak			
2	120.6991	50.23	-21.43	28.80	43.50	-14.70	peak			
3	147.9214	59.06	-23.37	35.69	43.50	-7.81	QP	100	0	
4	207.1226	54.60	-20.60	34.00	43.50	-9.50	peak			
5	252.9482	50.12	-18.67	31.45	46.00	-14.55	peak			
6	349.2500	52.53	-14.00	38.53	46.00	-7.47	peak			

Job No.:	**011406530E**	**Polarization:**	**Vertical**
Standard:	**(RE)FCC PART 15C _3m**	**Power Source:**	**DC 5V**
Test item:	**Radiation Test (30~1000MHz)**	**Temp.(C)/Hum.(%RH):**	**24.3(C)/55%RH**
Test Mode:	**BT Mode**	**Distance:**	**3m**



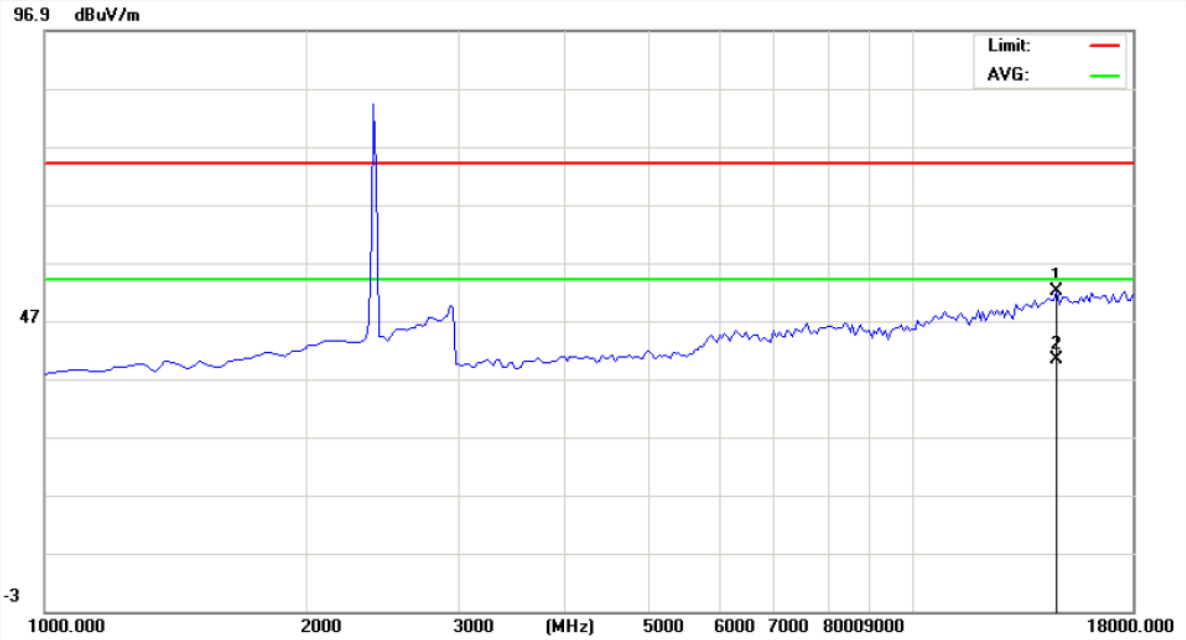
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/	Over Limit (dB)	Detector	Height (cm)	degree (deg)	Remark
1	39.5757	36.28	-14.53	21.75	40.00	-18.25	peak			
2	123.6985	43.88	-16.88	27.00	43.50	-16.50	peak			
3	146.3735	54.44	-18.40	36.04	43.50	-7.46	QP	100	360	
4	215.2678	46.18	-15.29	30.89	43.50	-12.61	peak			
5	261.9753	42.82	-14.12	28.70	46.00	-17.30	peak			
6	302.4812	47.62	-14.64	32.98	46.00	-13.02	peak			

Job No.:	**011406530E**	**Polarization:**	**Horizontal**
Standard:	**(RE)FCC PART 15C_Class B_3m**	**Power Source:**	**DC 5V**
Test item:	**Radiation Test (Above 1GHz)**	**Temp.(C)/Hum.(%RH):**	**24.3(C)/55%RH**
Test Mode:	**TX(2402 MHz)**	**Distance:**	**3m**



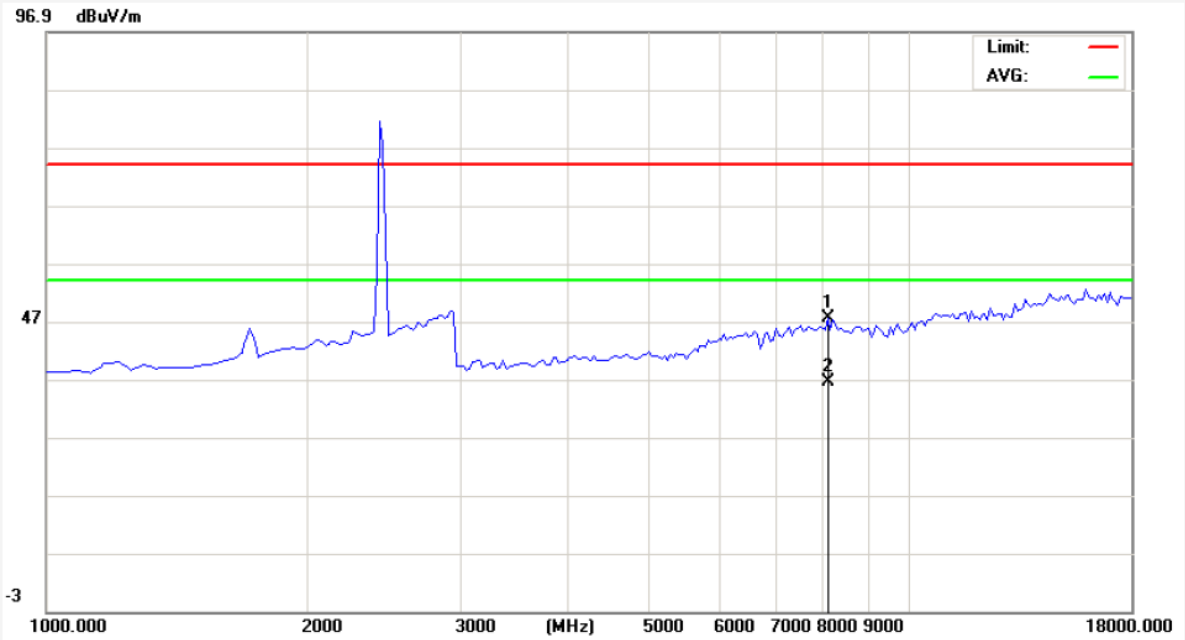
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/	Over Limit (dB)	Detector	Height (cm)	degree (deg)	Remark
1	11072.500	37.59	11.84	49.43	74.00	-24.57	peak			
2	11072.500	26.69	11.84	38.53	54.00	-15.47	AVG			

Job No.:	**011406530E**	**Polarization:**	**Vertical**
Standard:	**(RE)FCC PART 15C_Class B_3m**	**Power Source:**	**DC 5V**
Test item:	**Radiation Test (Above 1GHz)**	**Temp.(C)/Hum.(%RH):**	**24.3(C)/55%RH**
Test Mode:	**TX(2402 MHz)**	**Distance:**	**3m**



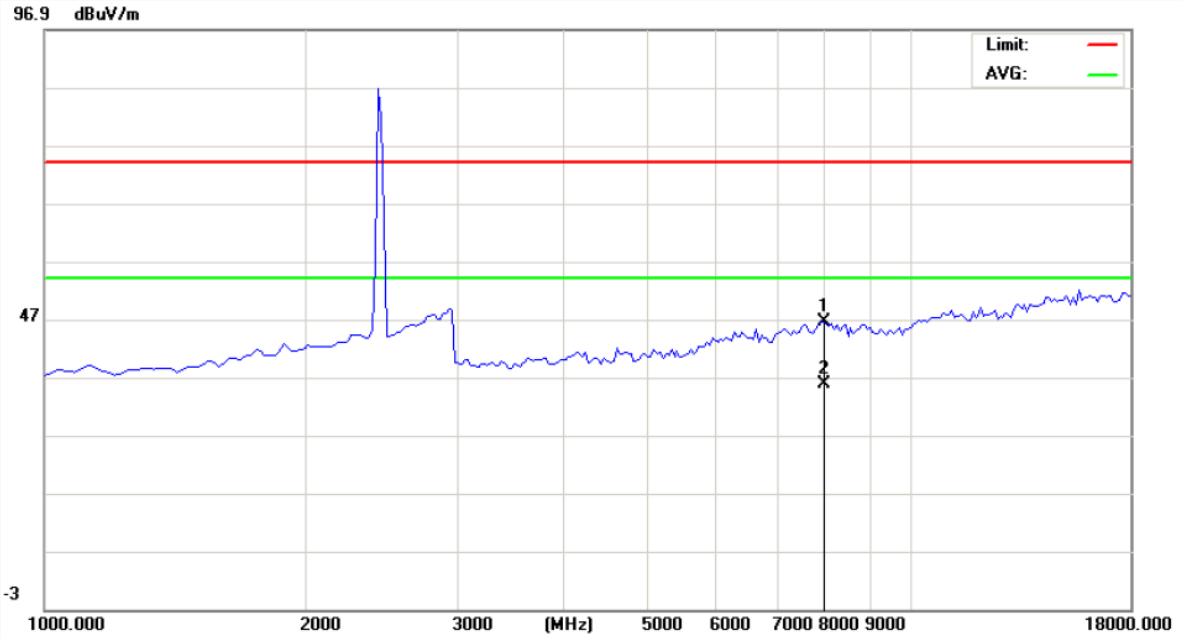
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/	Over Limit (dB)	Detector	Height (cm)	degree (deg)	Remark
1	14727.500	40.13	11.83	51.96	74.00	-22.04	peak			
2	14727.500	28.50	11.83	40.33	54.00	-13.67	AVG			

Job No.:	**011406530E**	**Polarization:**	**Horizontal**
Standard:	**(RE)FCC PART 15C_Class B_3m**	**Power Source:**	**DC 5V**
Test item:	**Radiation Test (Above 1GHz)**	**Temp.(C)/Hum.(%RH):**	**24.3(C)/55%RH**
Test Mode:	**TX(2441 MHz)**	**Distance:**	**3m**



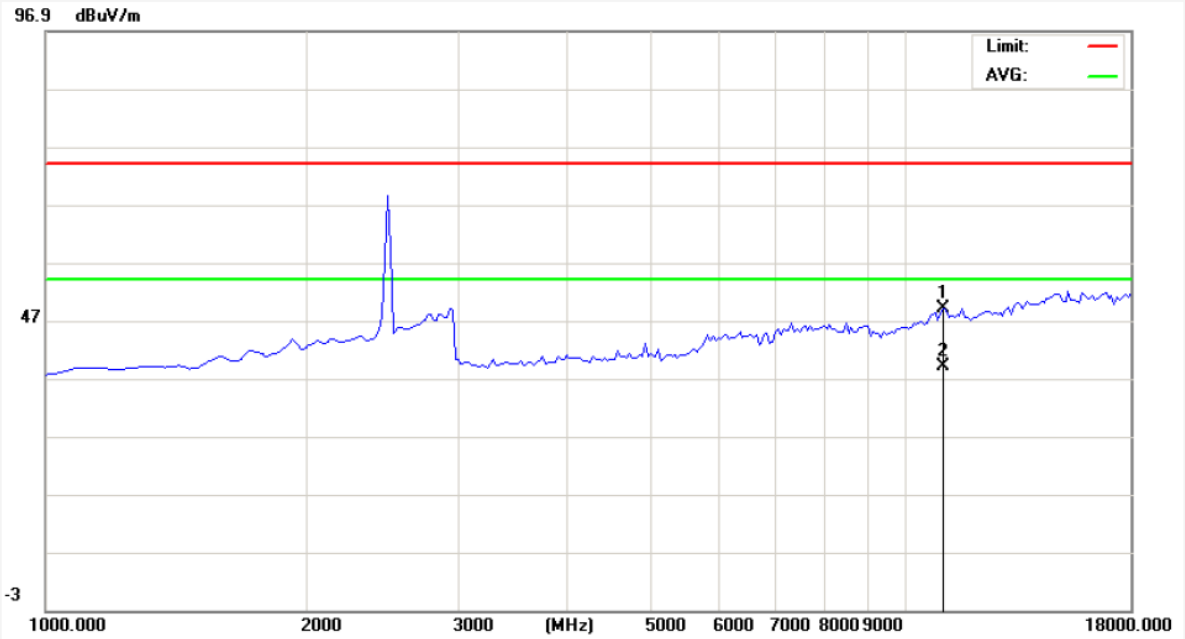
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/	Over Limit (dB)	Detector	Height (cm)	degree (deg)	Remark
1	8055.000	37.84	9.67	47.51	74.00	-26.49	peak			
2	8055.000	26.78	9.67	36.45	54.00	-17.55	AVG			

Job No.:	**011406530E**	**Polarization:**	**Vertical**
Standard:	**(RE)FCC PART 15C_Class B_3m**	**Power Source:**	**DC 5V**
Test item:	**Radiation Test (Above 1GHz)**	**Temp.(C)/Hum.(%RH):**	**24.3(C)/55%RH**
Test Mode:	**TX(2441 MHz)**	**Distance:**	**3m**



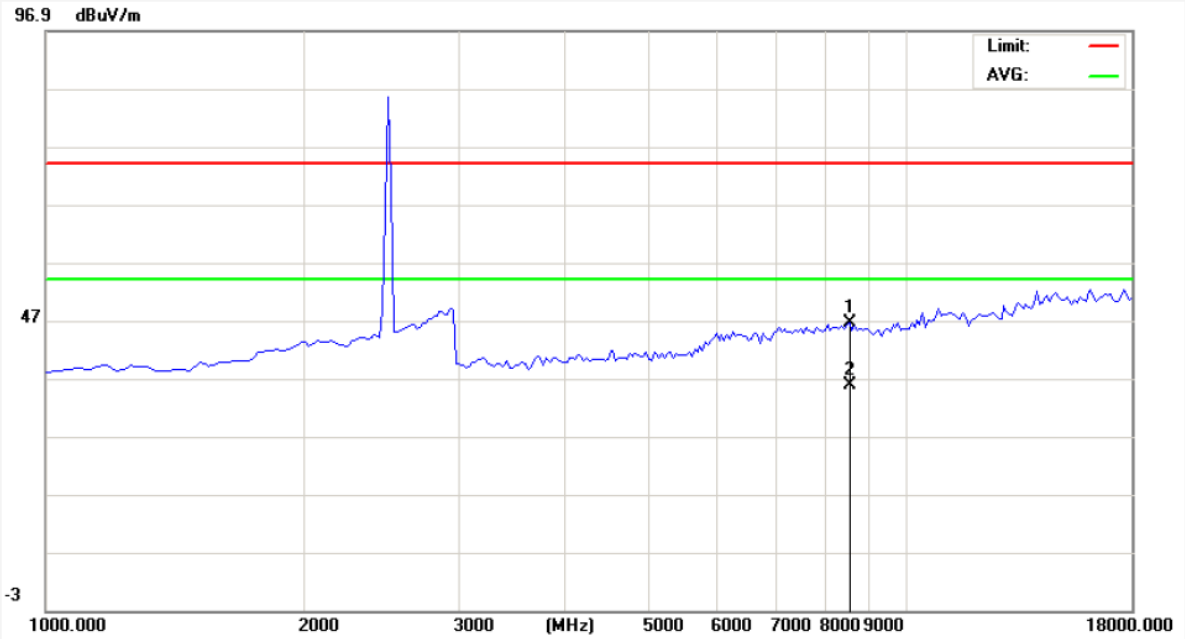
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/	Over Limit (dB)	Detector	Height (cm)	degree (deg)	Remark
1	8012.500	36.83	9.67	46.50	74.00	-27.50	peak			
2	8012.500	25.99	9.67	35.66	54.00	-18.34	AVG			

Job No.:	**011406530E**	**Polarization:**	**Horizontal**
Standard:	**(RE)FCC PART 15C_Class B_3m**	**Power Source:**	**DC 5V**
Test item:	**Radiation Test (Above 1GHz)**	**Temp.(C)/Hum.(%RH):**	**24.3(C)/55%RH**
Test Mode:	**TX(2480 MHz)**	**Distance:**	**3m**



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/	Over Limit (dB)	Detector	Height (cm)	degree (deg)	Remark
1	10987.500	37.23	11.89	49.12	74.00	-24.88	peak			
2	10987.500	27.09	11.89	38.98	54.00	-15.02	AVG			

Job No.:	**011406530E**	**Polarization:**	**Vertical**
Standard:	**(RE)FCC PART 15C_Class B_3m**	**Power Source:**	**DC 5V**
Test item:	**Radiation Test (Above 1GHz)**	**Temp.(C)/Hum.(%RH):**	**24.3(C)/55%RH**
Test Mode:	**TX(2480 MHz)**	**Distance:**	**3m**



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/	Over Limit (dB)	Detector	Height (cm)	degree (deg)	Remark
1	8522.500	36.80	9.64	46.44	74.00	-27.56	peak			
2	8522.500	26.04	9.64	35.68	54.00	-18.32	AVG			

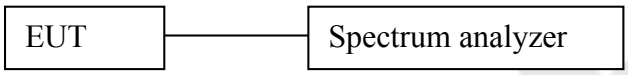
5. CHANNEL SEPARATION TEST

5.1 Measurement Procedure

The EUT must have its hopping function enabled. Using the following spectrum analyzer settings:

1. Span= Wide enough to capture the peaks of two adjacent channels
2. Set the RBW = 30 kHz.
3. Set the VBW = 100 kHz.
4. Sweep time = auto couple.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

5.2 Test SET-UP



5.3 Test Equipment

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Spectrum Analysis	Agilent	E4407B	US39390582	Aug. 09, 2013	1 Year
2.	Preamplifier	Instruments corporation	EMC011830	980100	Aug. 09, 2013	1 Year
3.	EMI Test Receiver	Rohde & Schwarz	ESPI	101604	Apr. 23, 2014	1 Year
4.	Double Ridged Horn Antenna	Instruments corporation	GTH-0118	351600	Aug. 09, 2013	3 Year
5.	Bilog Broadband Antenna	Schwarzbeck	VULB9163	VULB 9163-289	Apr. 23, 2013	3 Year
6.	Pre-amplifier	SONOMA	310N	186860	Apr. 23, 2014	1 Year
7.	EMI Test Software EZ-EMC	SHURPLE	N/A	N/A	N/A	N/A

5.4 Test Results

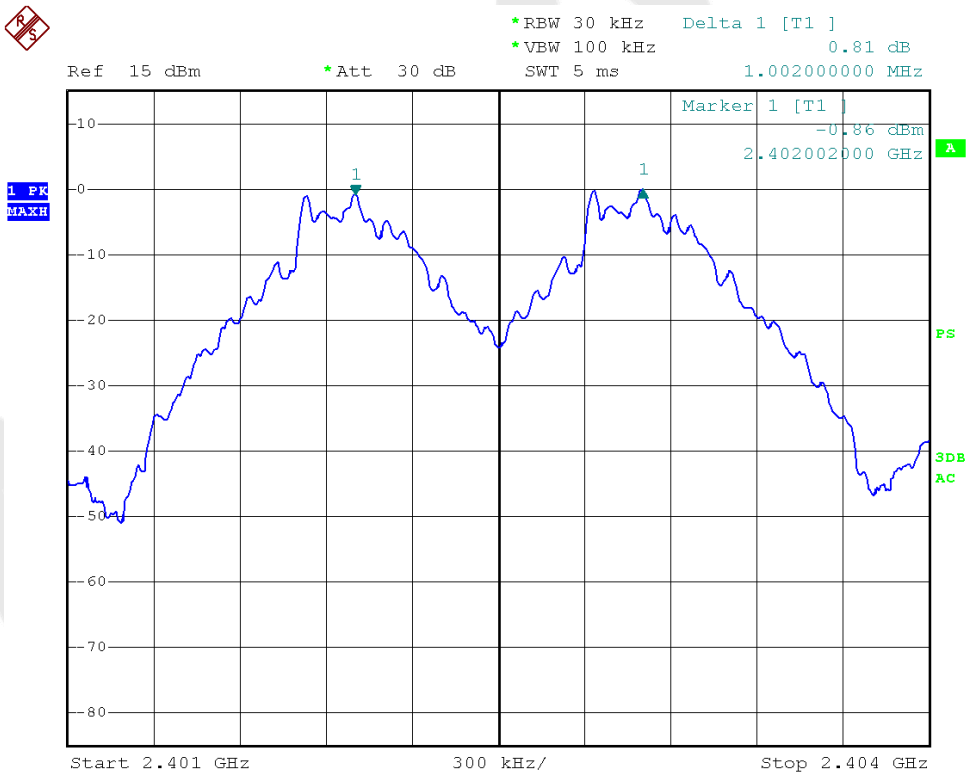
Test Item	:	Frequency Separation	Test Mode	:	CH Low ~ CH High
Test Voltage	:	DC 5V	Temperature	:	24℃
Test Result	:	PASS	Humidity	:	55%RH

Channel	Frequency (MHz)	Separation Read Value (kHz)	Limit (kHz)	Modulation Mode
Low	2401	1002	882	GFSK
Mid	2441	1002	852	GFSK
High	2480	1002	882	GFSK
Low	2401	1002	828	π/4DQPSK
Mid	2441	1002	844	π/4DQPSK
High	2480	1002	844	π/4DQPSK
Low	2401	1002	828	8DPSK
Mid	2441	1002	844	8DPSK
High	2480	1002	844	8DPSK

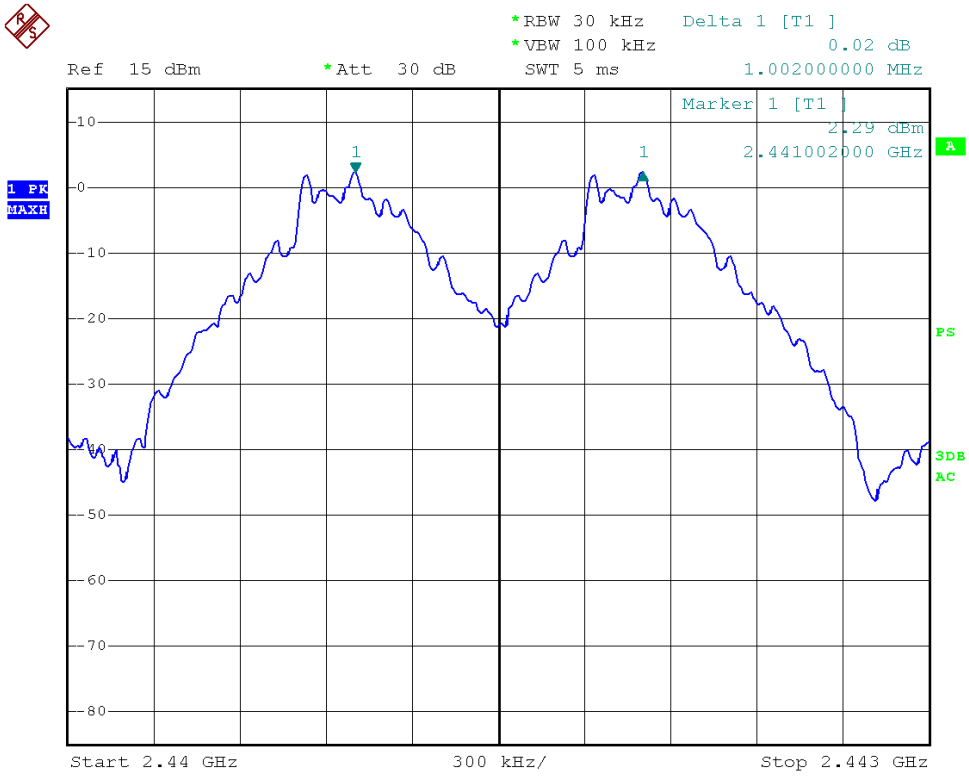
Remark:
1. The limit of modulation (π/4DQPSK, 8DPSK) is 2/3 of 20dB BW;

Modulation Mode: GFSK

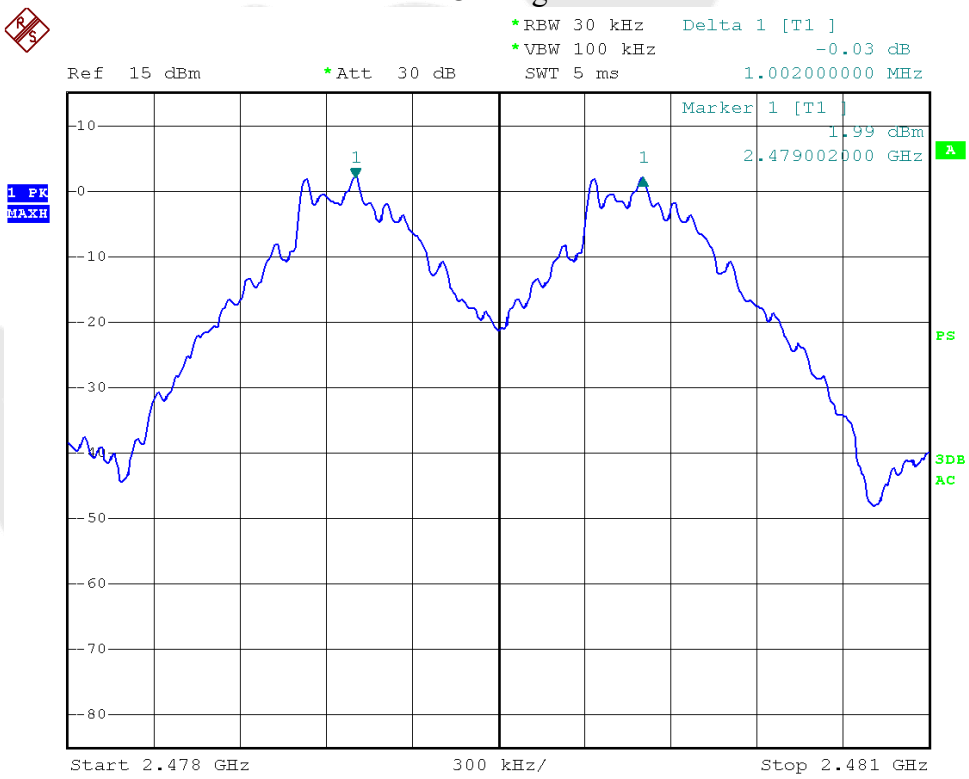
CH Low



CH Mid

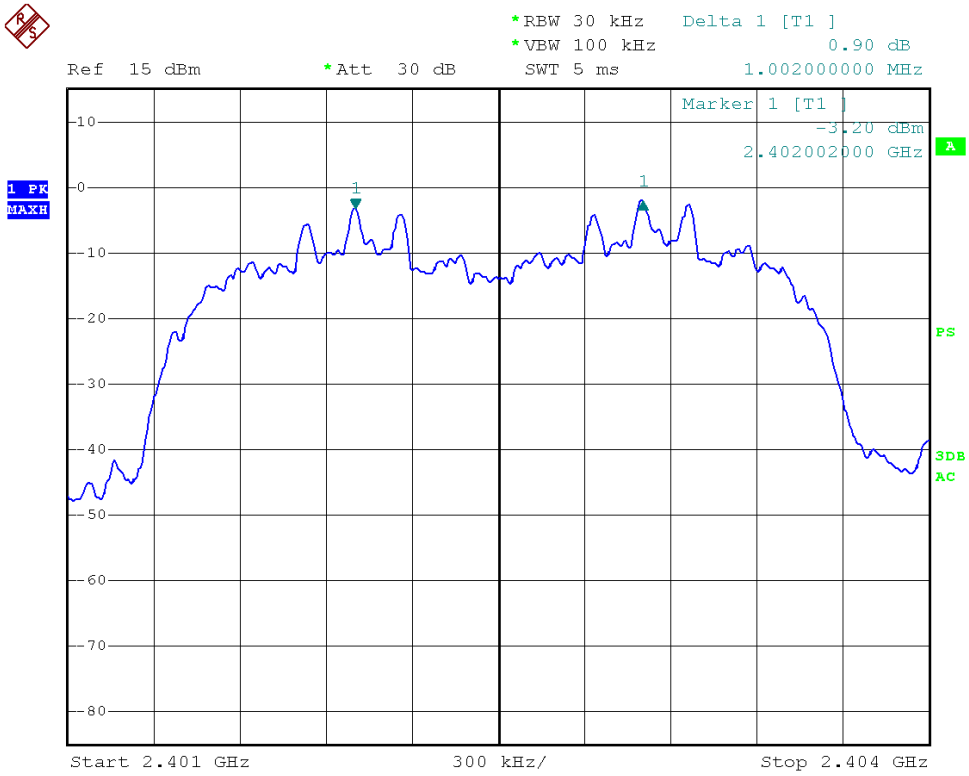


CH High

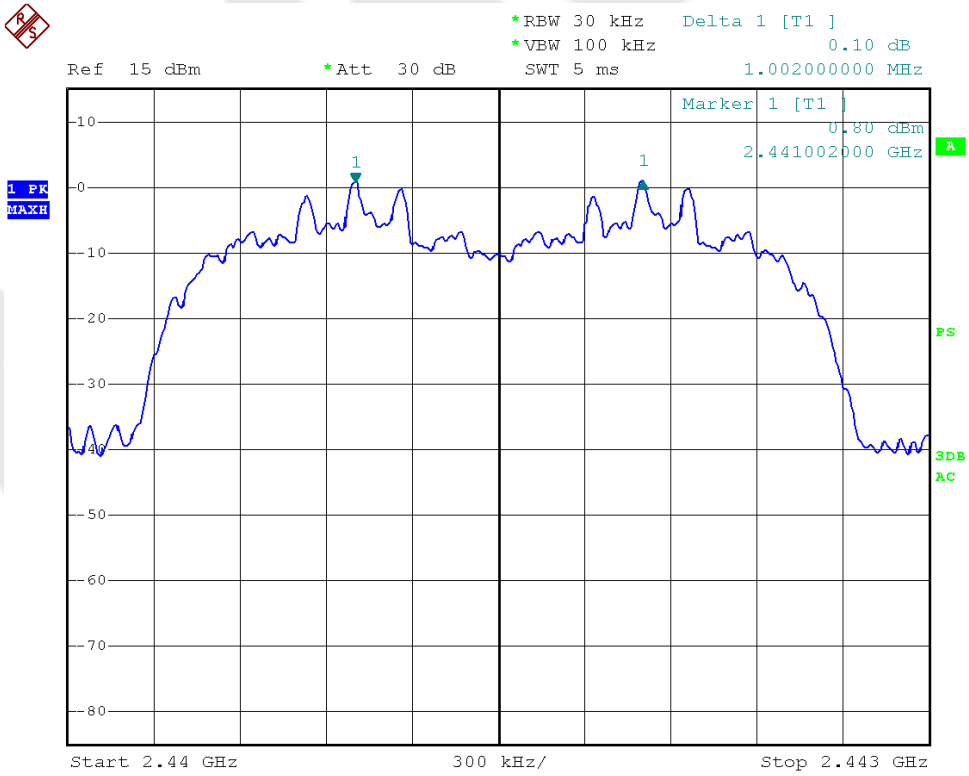


Modulation Mode: π /4DQPSK& 8DPSK

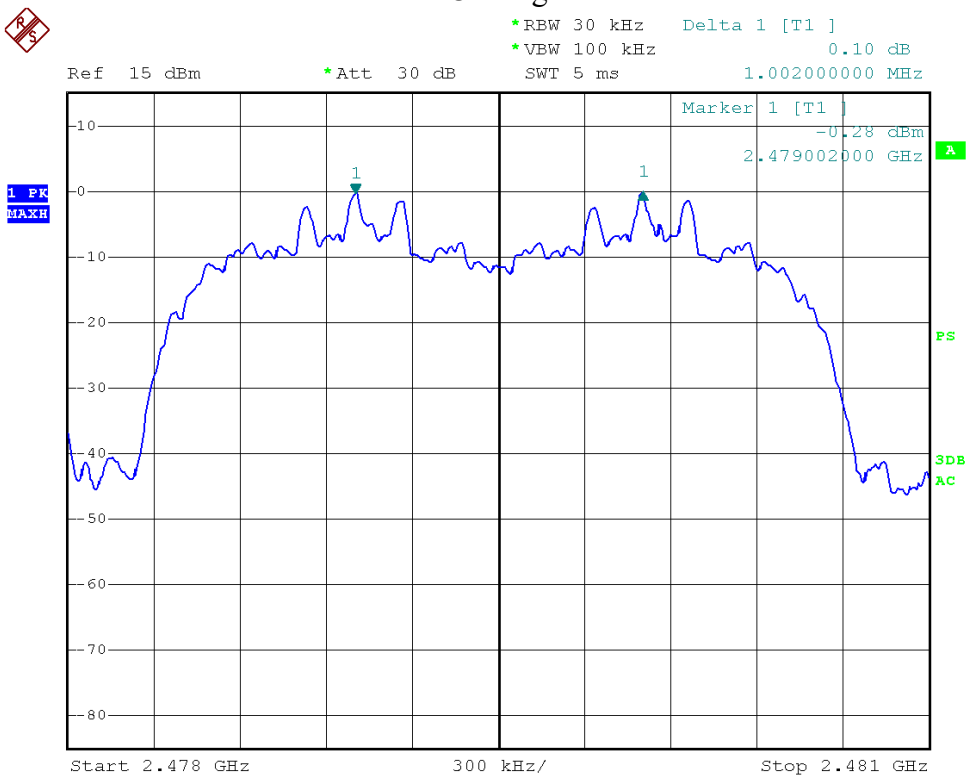
CH Low



CH Mid



CH High

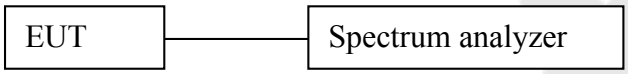

*RBW 30 kHz
*VBW 100 kHz
SWT 5 ms
Delta 1 [T1]
0.10 dB
1.002000000 MHz
Ref 15 dBm
*Att 30 dB
Marker 1 [T1]
-0.28 dBm
2.479002000 GHz
1 PK
MAXH
A
PS
3DB
AC
10
0
-10
-20
-30
-40
-50
-60
-70
-80
Start 2.478 GHz
300 kHz/
Stop 2.481 GHz

6. 20DB BANDWIDTH TEST

6.1 Measurement Procedure

Using the following spectrum analyzer settings:
1. Span= approximately 2 to 3 times the 20dB bandwidth, centered on a hopping channel.
2. Set the RBW = 30 kHz.
3. Set the VBW = 100 kHz.
4. Sweep time = auto couple.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

6.2 Test SET-UP



6.3 Test Equipment

Same as the equipment listed in 5.3.

6.4 Test Results

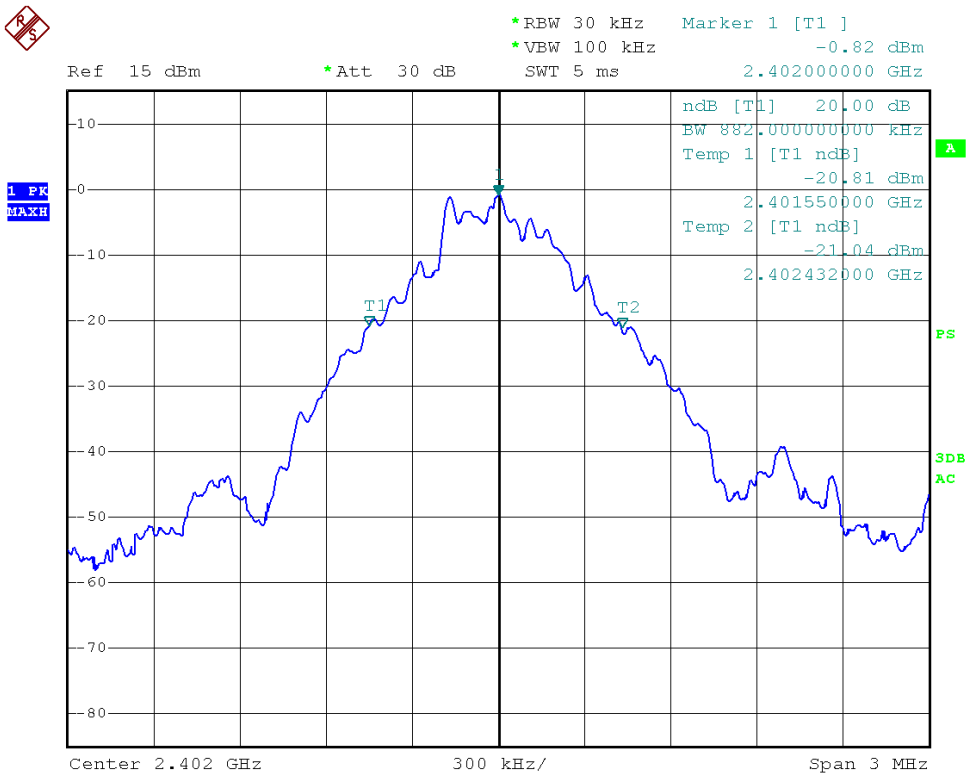
Test Item	:	20dB BW	Test Mode	:	CH Low ~ CH High
Test Voltage	:	DC 5V	Temperature	:	24℃
Test Result	:	PASS	Humidity	:	55%RH

Channel	Frequency (MHz)	20dB Down BW(kHz)	Modulation Mode
Low	2401	882	GFSK
Mid	2441	852	GFSK
High	2480	882	GFSK
Low	2401	1242	π/4DQPSK
Mid	2441	1266	π/4DQPSK
High	2480	1266	π/4DQPSK
Low	2401	1242	8DPSK
Mid	2441	1266	8DPSK
High	2480	1266	8DPSK

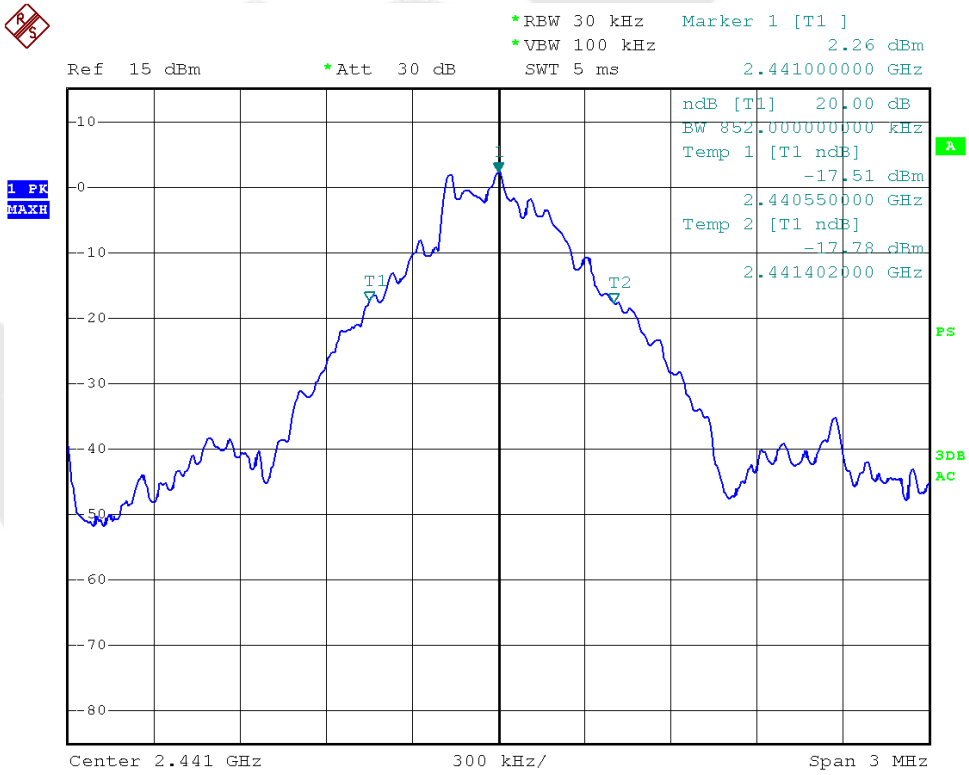
Remark: The results of modulationsπ/4DQPSK and 8DPSK are the same.

Modulation Mode: GFSK

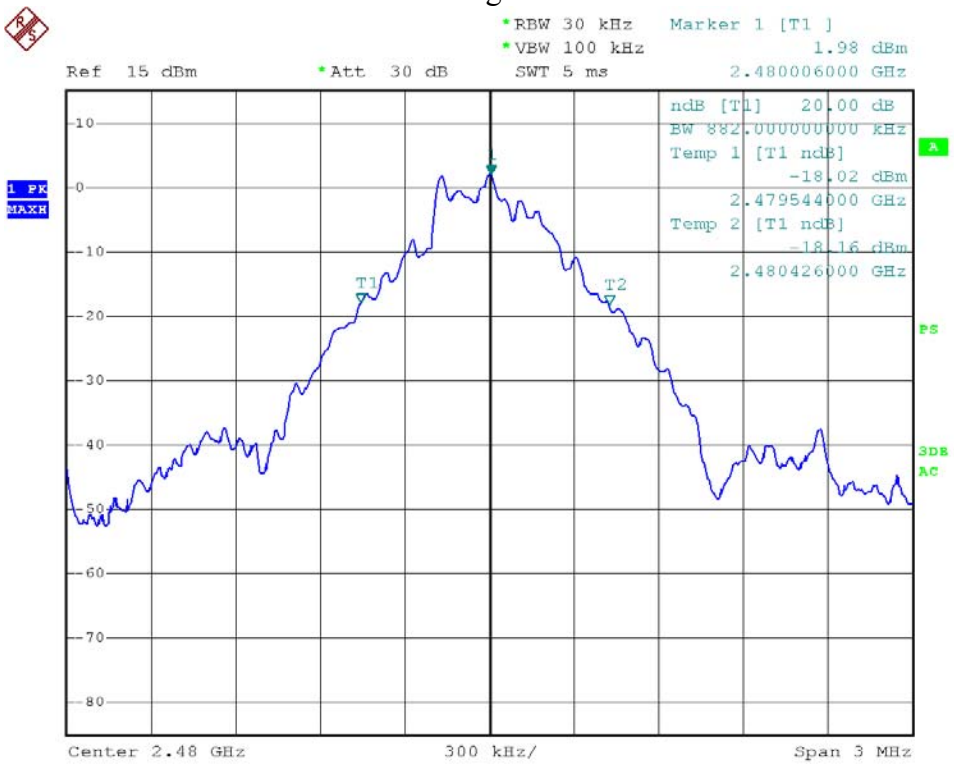
CH Low



CH Middle

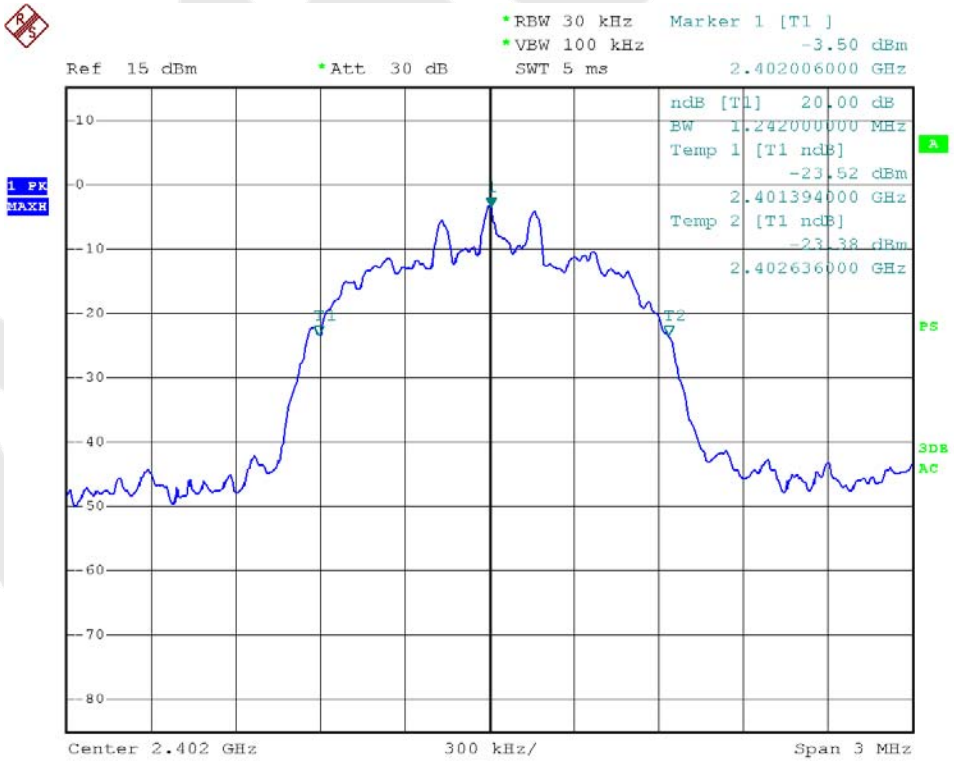


CH High

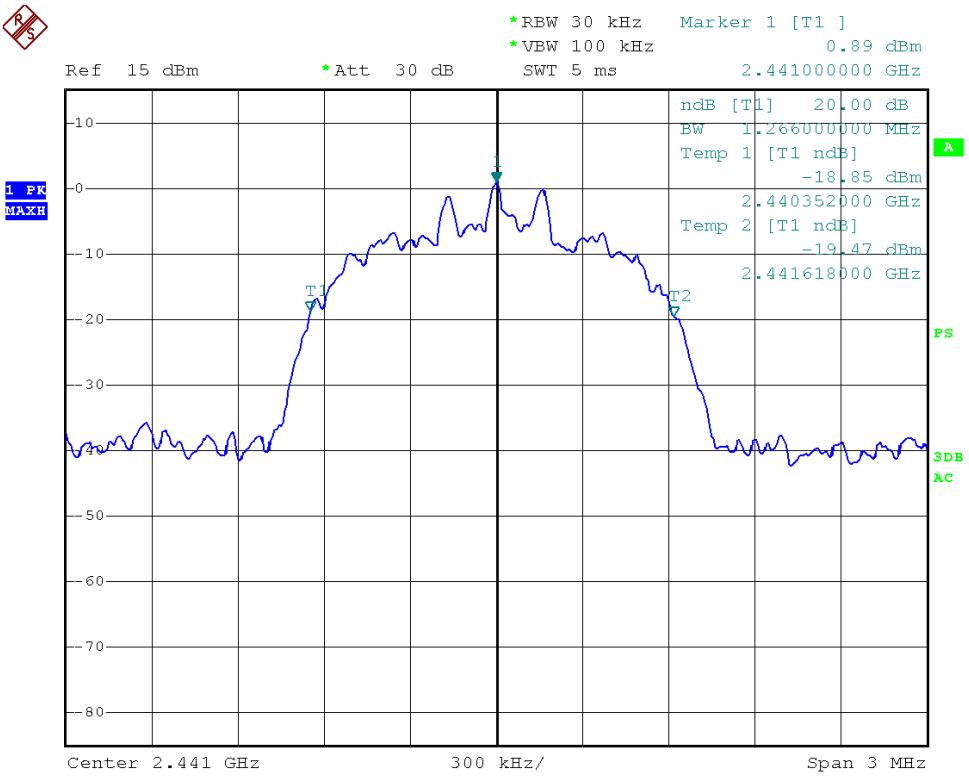


Modulation Mode: π /4DQPSK & 8DPSK

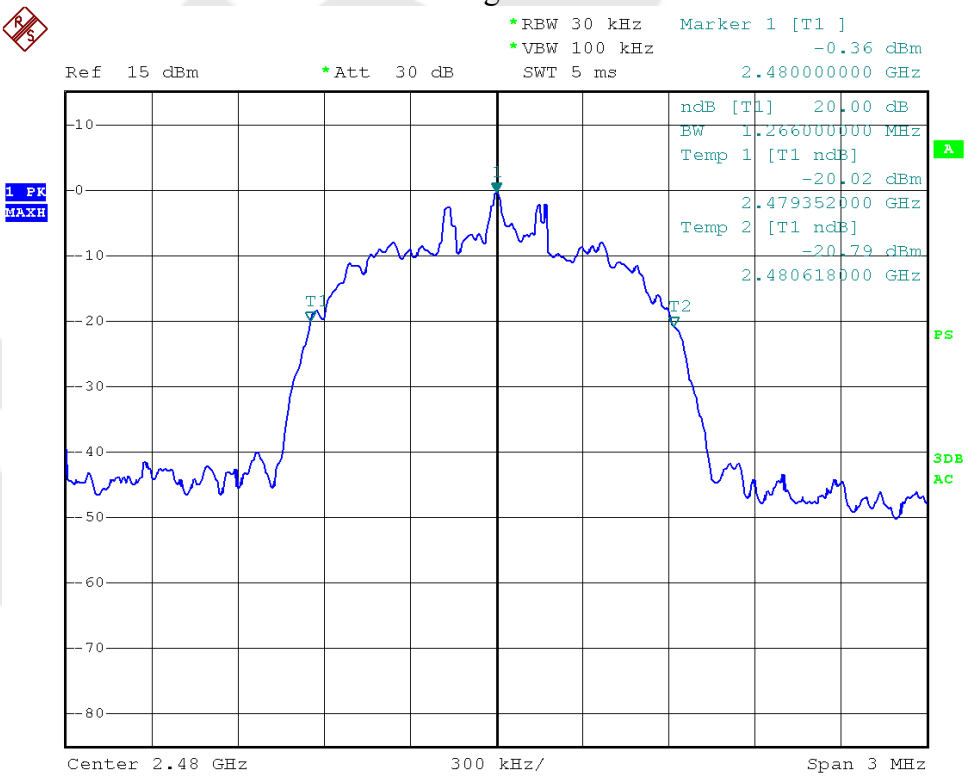
CH Low



CH Middle



CH High

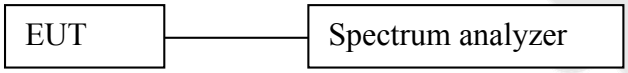


7. QUANTITY OF HOPPING CHANNEL TEST

7.1 Measurement Procedure

The EUT must have its hopping function enabled. Using the following spectrum analyzer setting:
1. Span= the frequency band of operation
2. Set the RBW = 1 MHz.
3. Set the VBW = 1 MHz.
4. Sweep time = auto couple.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

7.2 Test SET-UP



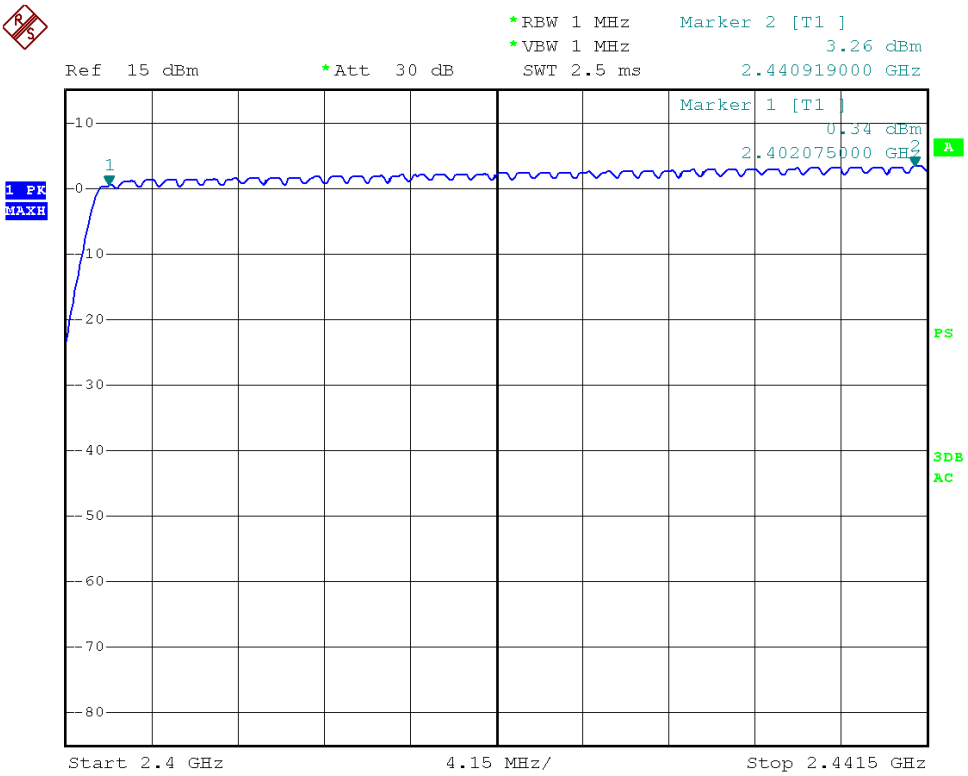
7.3 Test Equipment

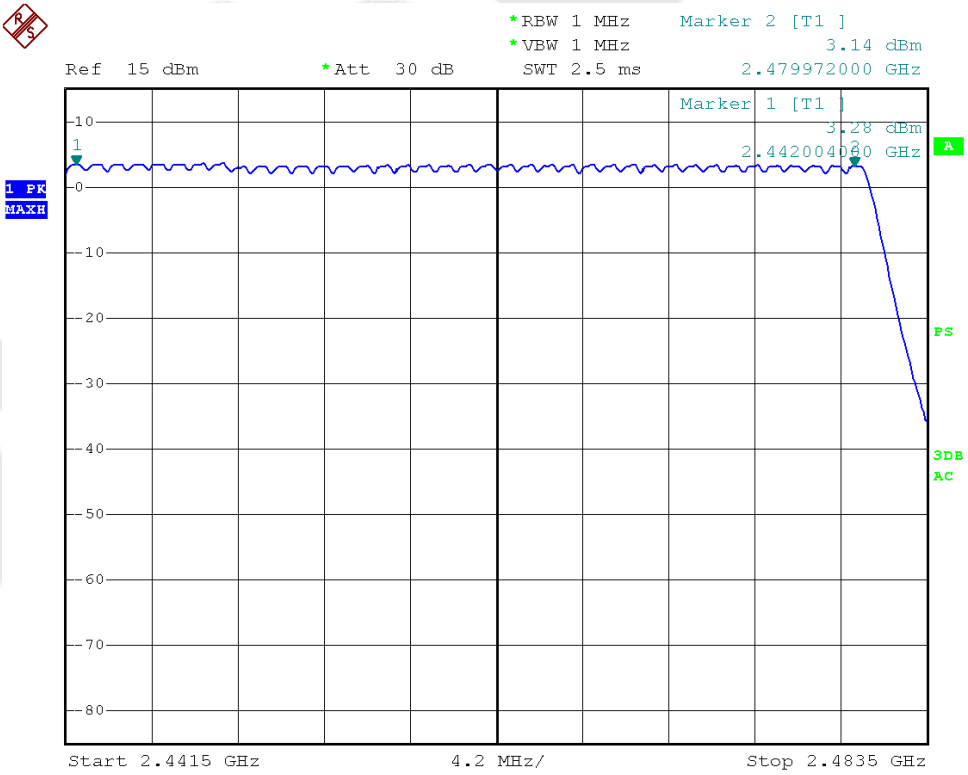
Same as the equipment listed in 5.3.

7.4 Test Results

Test Item	:	Number of Hopping Frequency	Test Mode	:	CH Low ~ CH High
Test Voltage	:	DC 5V	Temperature	:	24℃
Test Result	:	PASS	Humidity	:	55%RH

Hopping Channel Frequency Range	Quantity of Hopping Channel	Quantity of Hopping Channel
2402-2480	79	＞15


*RBW 1 MHz
*VBW 1 MHz
SWT 2.5 ms
Marker 2 [T1]
3.26 dBm
2.440919000 GHz
Ref 15 dBm
*Att 30 dB
Marker 1 [T1]
0.34 dBm
2.402075000 GHz
1 PK
MAXH
A
PS
3DB
AC
Start 2.4 GHz
4.15 MHz/
Stop 2.4415 GHz


*RBW 1 MHz
*VBW 1 MHz
SWT 2.5 ms
Marker 2 [T1]
3.14 dBm
2.479972000 GHz
Ref 15 dBm
*Att 30 dB
Marker 1 [T1]
3.28 dBm
2.442004000 GHz
1 PK
MAXH
A
PS
3DB
AC
Start 2.4415 GHz
4.2 MHz/
Stop 2.4835 GHz

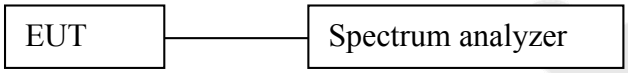
8. DWELL TIME TEST

8.1 Measurement Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

1. Span= zero span, centered on a hopping channel
2. Set the RBW = 1 MHz.
3. Set the VBW = 1 MHz.
4. Sweep time = as necessary to capture the entire dwell time per hopping channel.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

8.2 Test SET-UP



8.3 Test Equipment

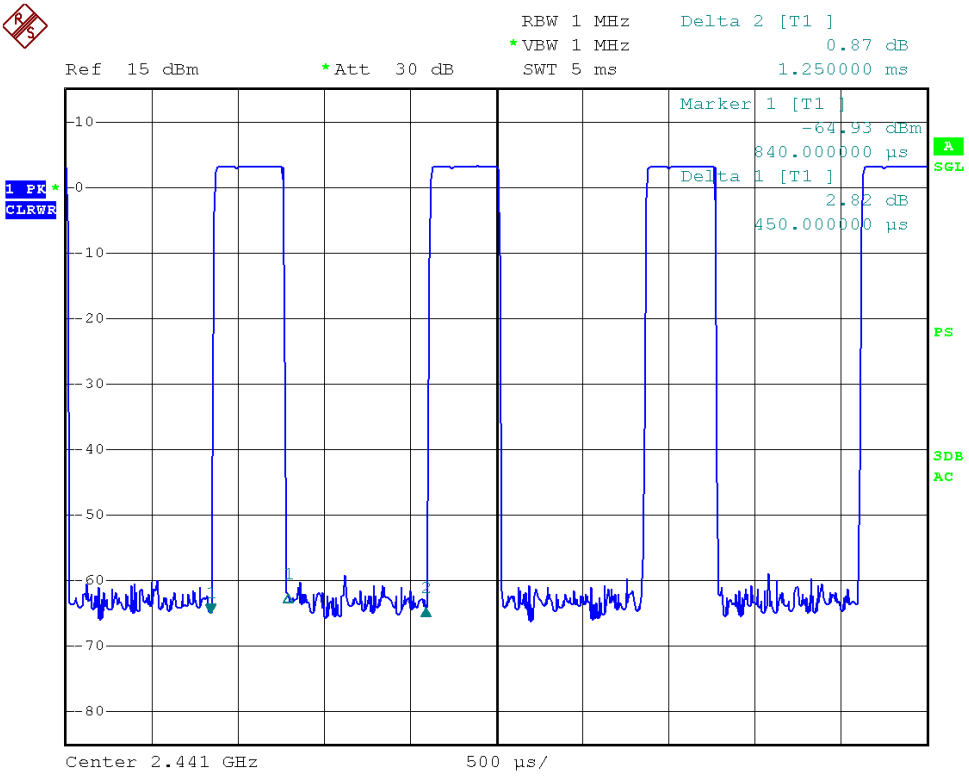
Same as the equipment listed in 5.3.

8.4 Test Results

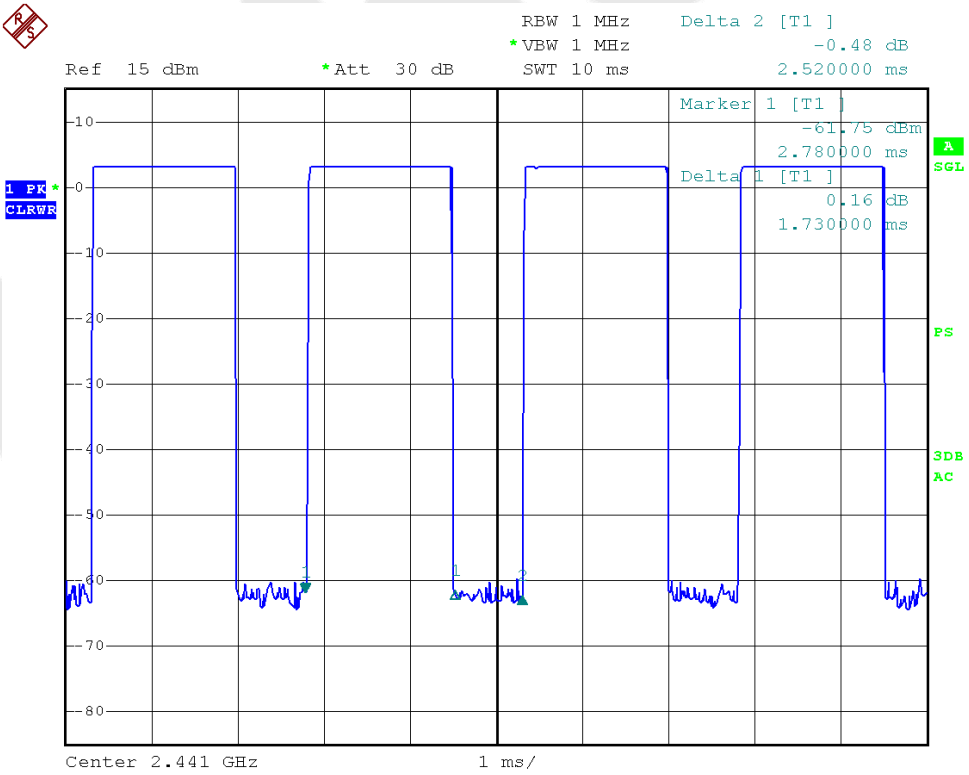
Test Item	:	Time of Occupancy	Test Mode	:	CH Low ~ CH High
Test Voltage	:	DC 5V	Temperature	:	24℃
Test Result	:	PASS	Humidity	:	55%RH

Package Type	*Pulse width (ms)*	Time slot length(ms)	Dwell time (ms)	Limit (s)
DH1	0.450	time slot length *1600/2 /79 * 31.6	144.00	0.4
DH3	1.730	time slot length *1600/4 /79 * 31.6	276.80	0.4
DH5	2.970	time slot length *1600/6 /79 * 31.6	316.80	0.4

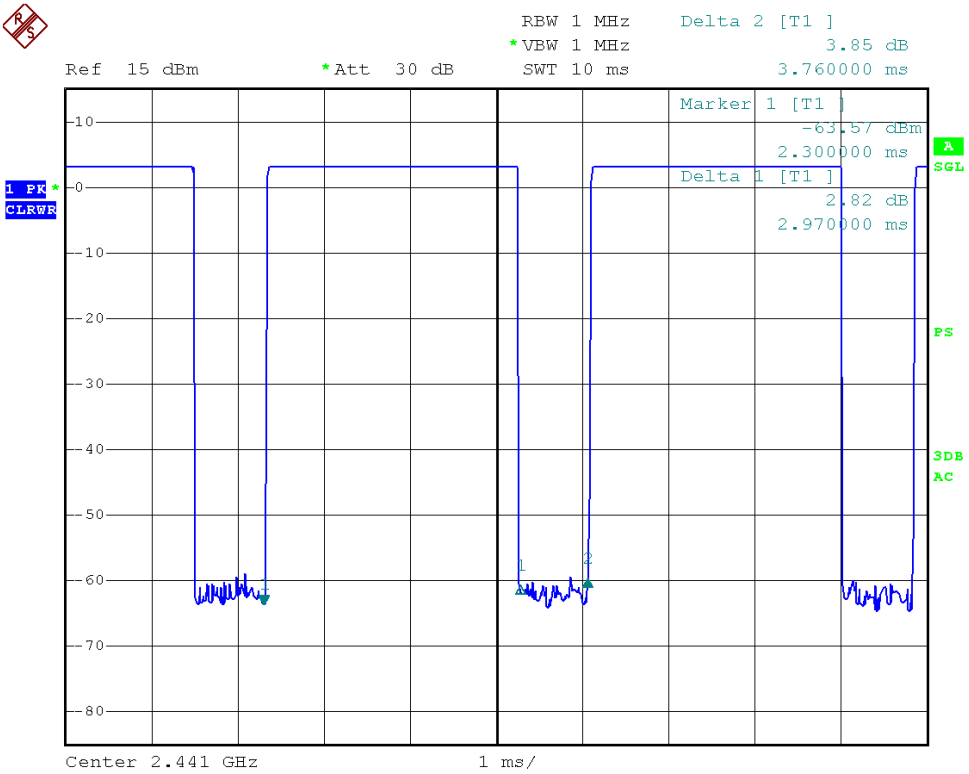
DH1


RBW 1 MHz
*VBW 1 MHz
SWT 5 ms
Delta 2 [T1]
0.87 dB
1.250000 ms
Ref 15 dBm
*Att 30 dB
Marker 1 [T1]
-64.93 dBm
840.000000 µs
Delta 1 [T1]
2.82 dB
450.000000 µs
1 PK
CLRWR
A
SGL
PS
3DB
AC
Center 2.441 GHz
500 µs/

DH3


RBW 1 MHz
*VBW 1 MHz
SWT 10 ms
Delta 2 [T1]
-0.48 dB
2.520000 ms
Ref 15 dBm
*Att 30 dB
Marker 1 [T1]
-61.75 dBm
2.780000 ms
Delta 1 [T1]
0.16 dB
1.730000 ms
1 PK
CLRWR
A
SGL
PS
3DB
AC
Center 2.441 GHz
1 ms/

DH5


RBW 1 MHz
*VBW 1 MHz
SWT 10 ms
Delta 2 [T1]
3.85 dB
3.760000 ms
Ref 15 dBm
*Att 30 dB
Marker 1 [T1]
-63.57 dBm
2.300000 ms
Delta 1 [T1]
2.82 dB
2.970000 ms
1 PK
CLRWR
A
SGL
PS
3DB
AC
Center 2.441 GHz
1 ms/

9. MAX IMUM PEAK OUTPUT POWER TEST

9.1 Measurement Procedure

a. Check the calibration of the measuring instrument(SA) using either an internal calibrator or a known signal from an external generator.
b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
c. The center frequency of the spectrum analyzer is set to the fundamental frequency and using proper RBW and VBW setting.
d. Measure the captured power within the band and recording the plot.
e. Repeat above procedures until all frequencies required were complete.

Using the following spectrum analyzer settings:

1. Span= approximately 5 times the 20dB bandwidth, centered on a hopping channel
2. Set the RBW = 3 MHz.
3. Set the VBW = 3 MHz.
4. Sweep time = auto couple.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

9.2 Test SET-UP

9.3 Test Equipment

Same as the equipment listed in 5.3.

9.4 Test Results

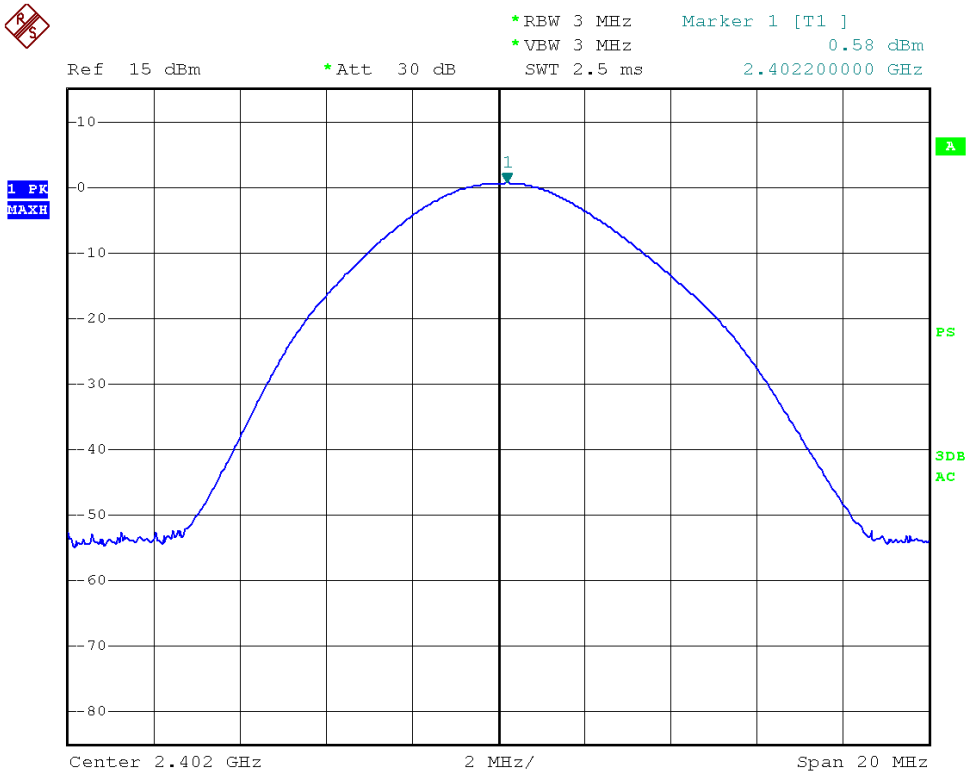
Test Item	:	Max. peak output power	Test Mode	:	CH Low ~ CH High
Test Voltage	:	DC 5V	Temperature	:	24℃
Test Result	:	PASS	Humidity	:	55%RH

Channel Frequency (MHz)	Peak Power output(mW)	Peak Power output(dBm)	Peak Power Limit(mW)	Results	Modulation
2402	1.14	0.58	1000	PASS	GFSK
2441	**2.16**	**3.34**	1000	PASS	GFSK
2480	2.13	3.29	1000	PASS	GFSK
2402	0.83	-0.83	125	PASS	π/4DQPSK
2441	1.82	2.61	125	PASS	π/4DQPSK
2480	1.54	1.88	125	PASS	π/4DQPSK
2402	0.83	-0.83	125	PASS	8DPSK
2441	1.82	2.61	125	PASS	8DPSK
2480	1.54	1.88	125	PASS	8DPSK

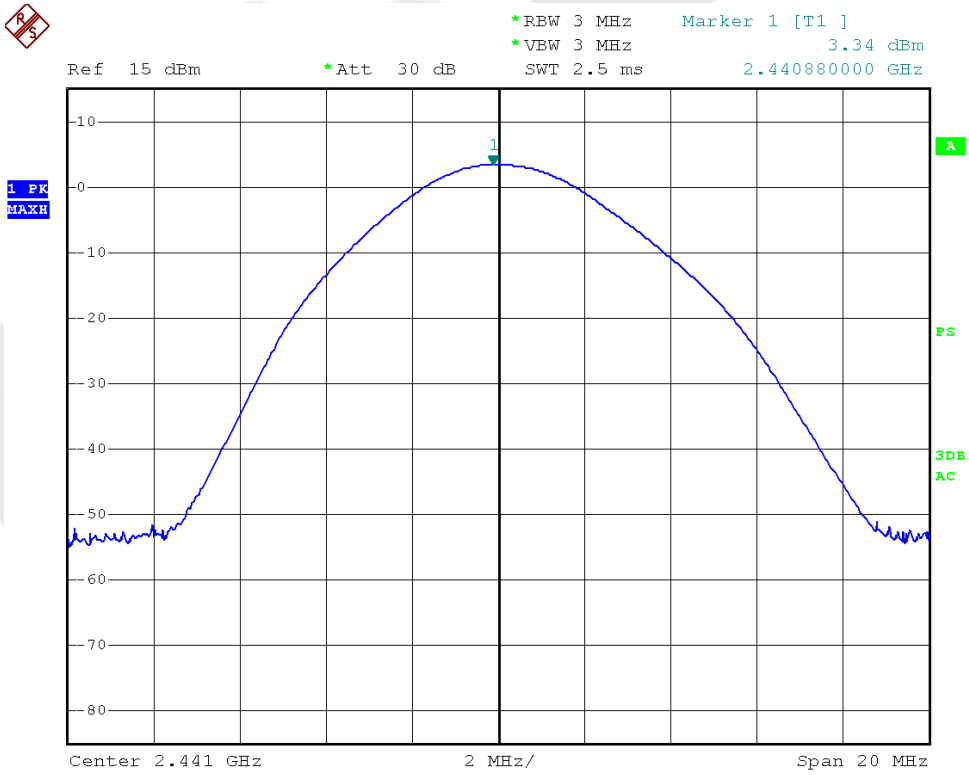
Remark: The results of modulationsπ/4DQPSK and 8DPSK are the same.

Modulation Mode: GFSK

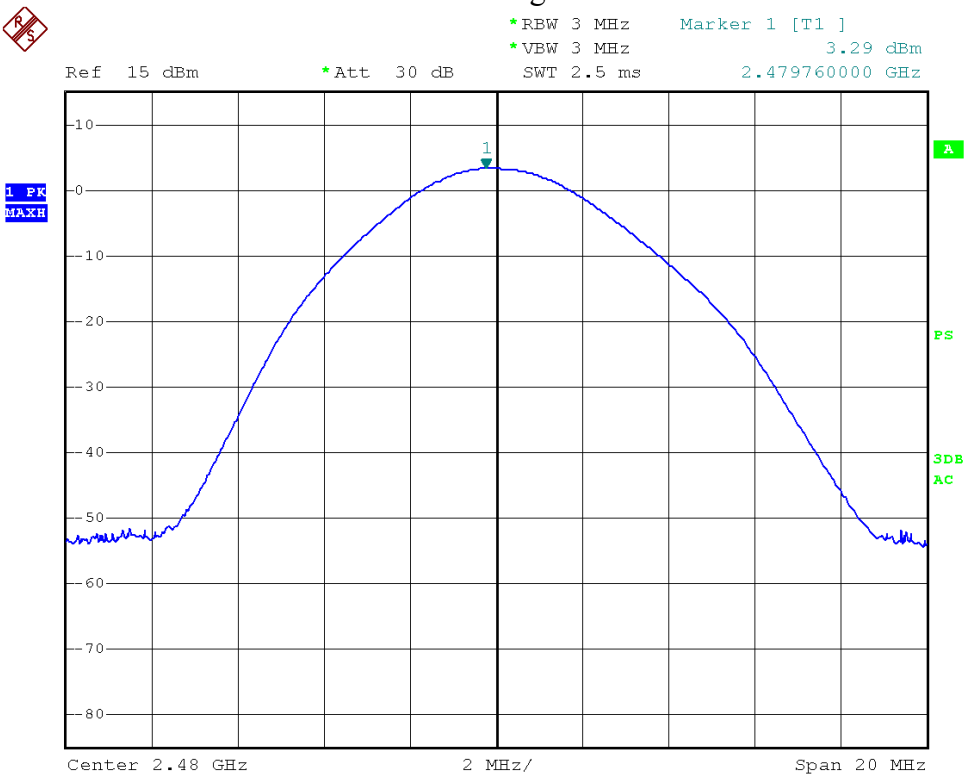
CH Low



CH Mid

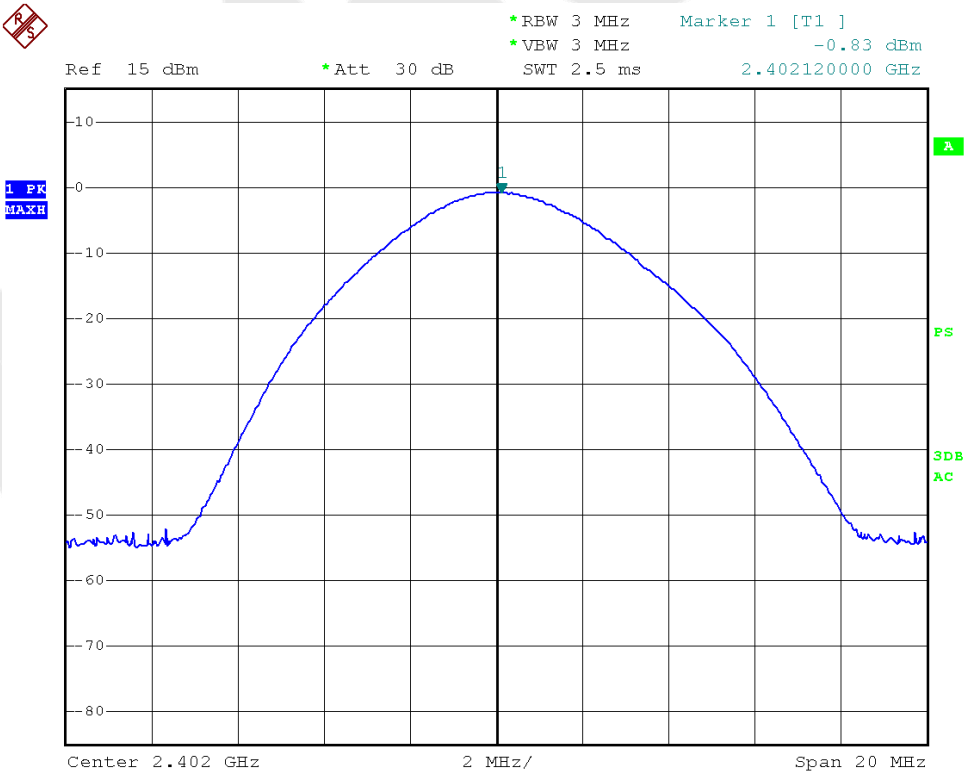


CH High

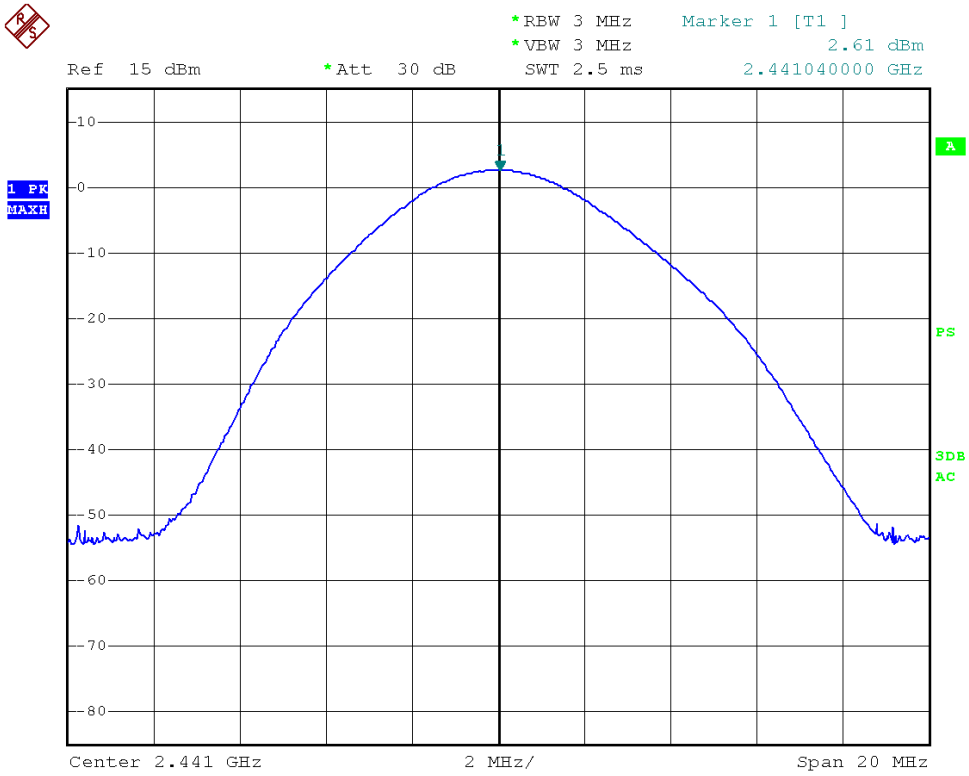


Modulation Mode: π/4DQPSK & 8DPSK

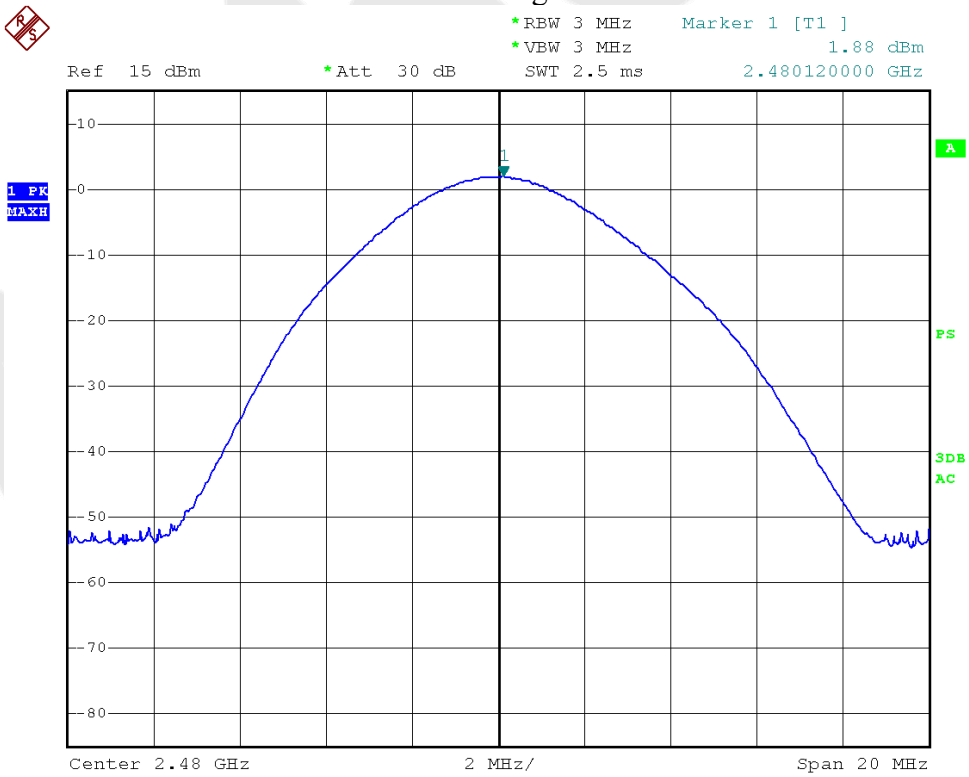
CH Low



CH Mid



CH High

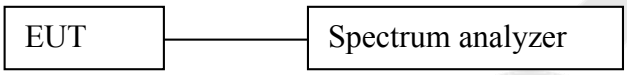


10. BAND EDGE TEST

10.1 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Put it on the Rotated table and 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 100kHz with a convenient frequency span including 100kHz bandwidth from band edge, for Radiated emissions restricted band RBW= 1 MHz, VBW= 3 MHz.
4. Measurement 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. Report above procedures until all measured frequencies were complete.

10.2 Test SET-UP



10.3 Test Equipment

Same as the equipment listed in 5.3.

10.4 Test Results

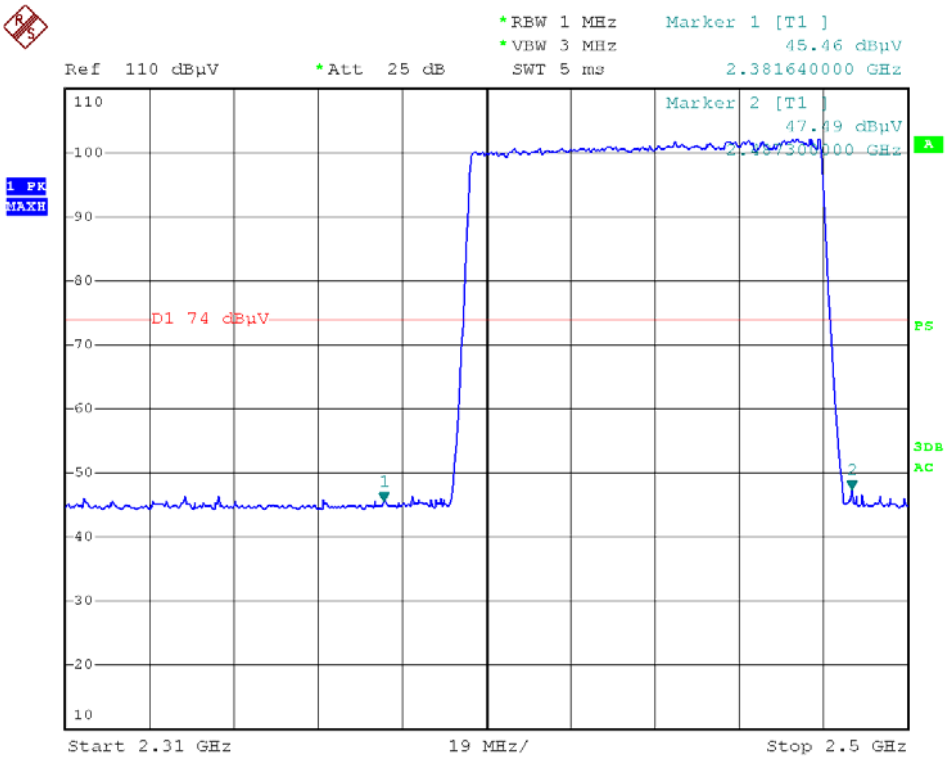
Pass.

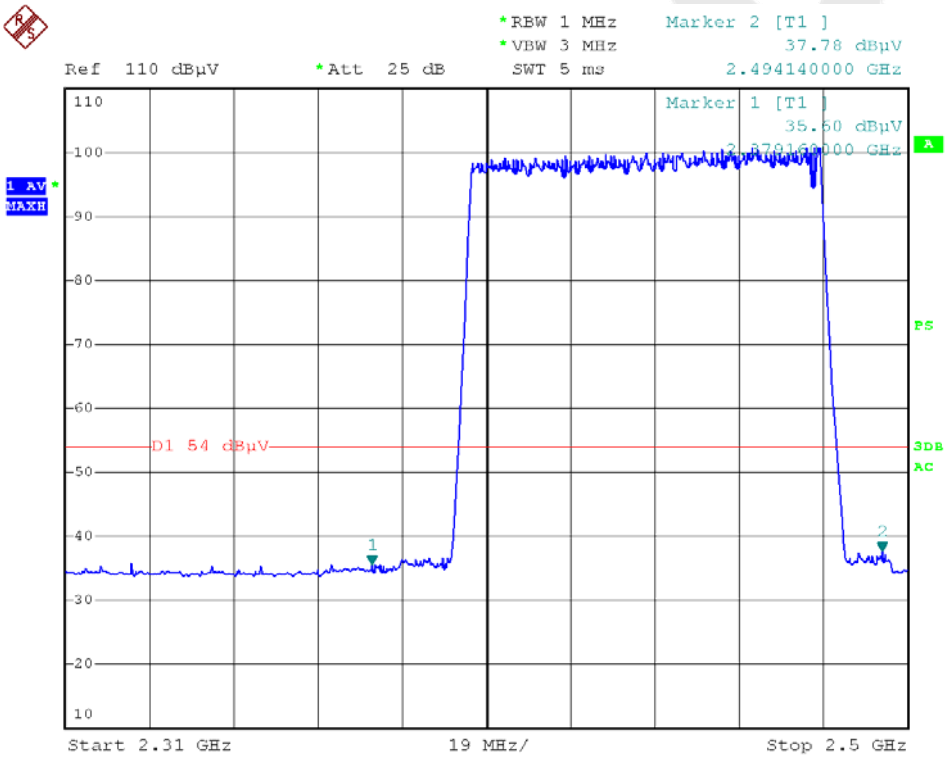
Please refer the following data.

Test Item	:	Band eadge	Test Mode	:	CH Low ~ CH High
Test Voltage	:	DC 5V	Temperature	:	24℃
Test Result	:	PASS	Humidity	:	55%RH

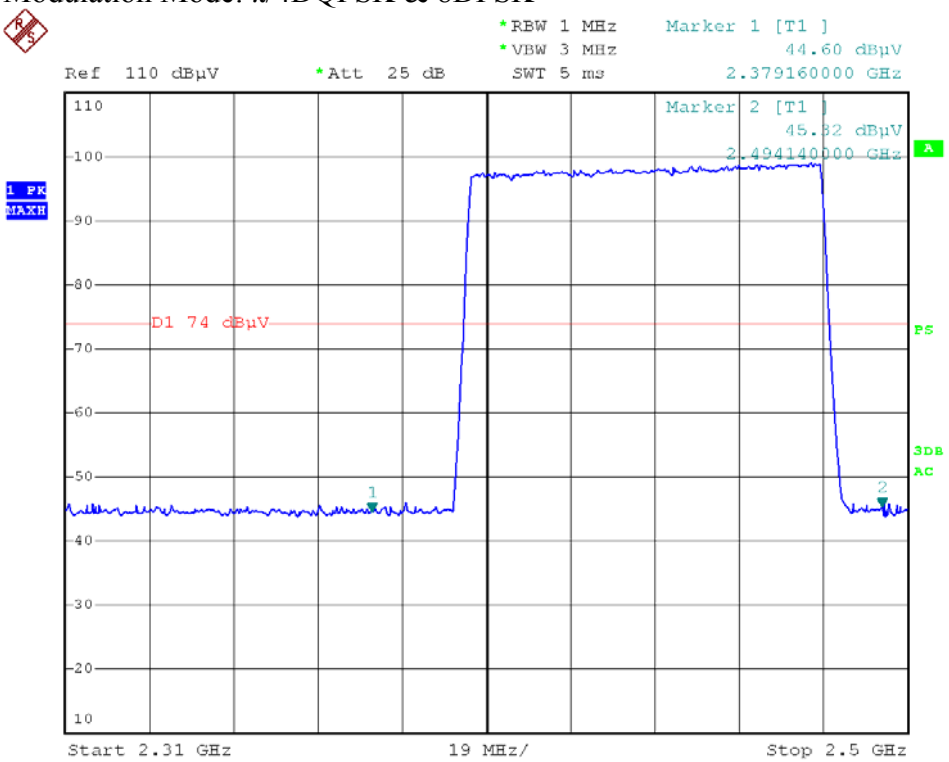
For Hopping Mode:

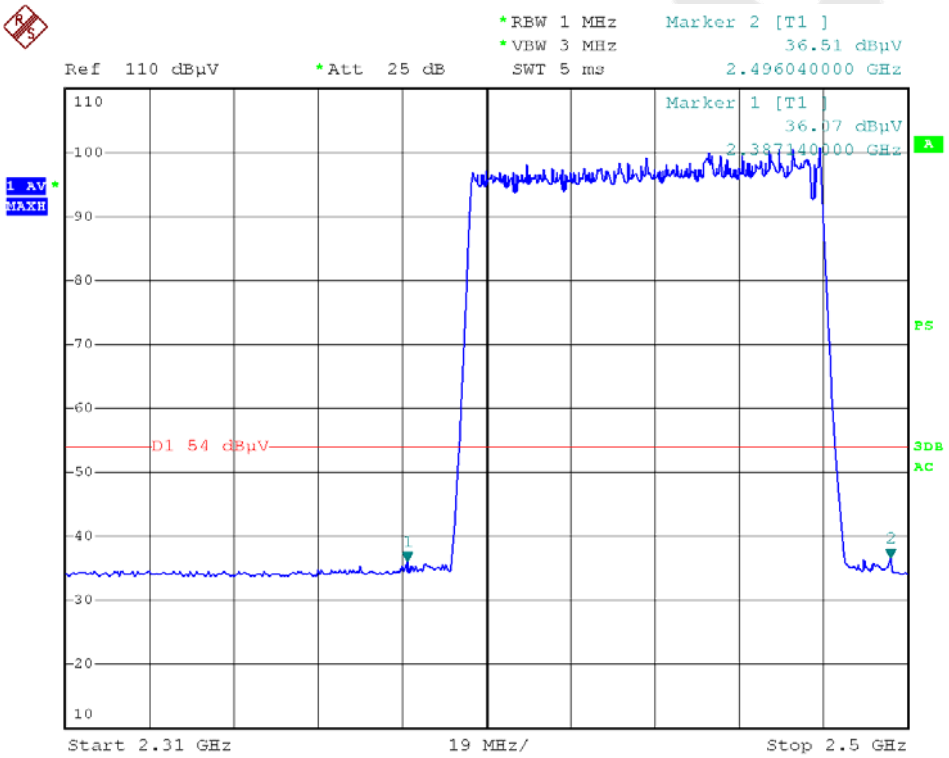
Modulation Mode: GFSK





Modulation Mode: π/4DQPSK & 8DPSK





Test Item	:	Band eadge	Test Mode	:	CH Low ~ CH High
Test Voltage	:	DC 5V	Temperature	:	24℃
Test Result	:	PASS	Humidity	:	55%RH

For Non-Hopping Mode:

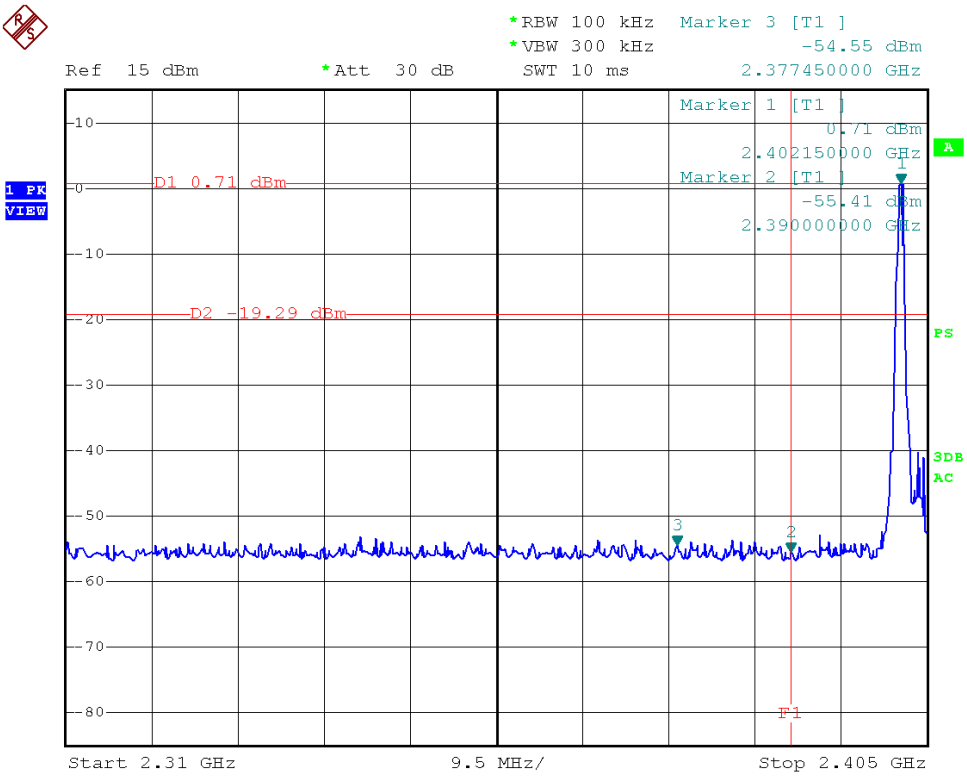
1. Conducted Test

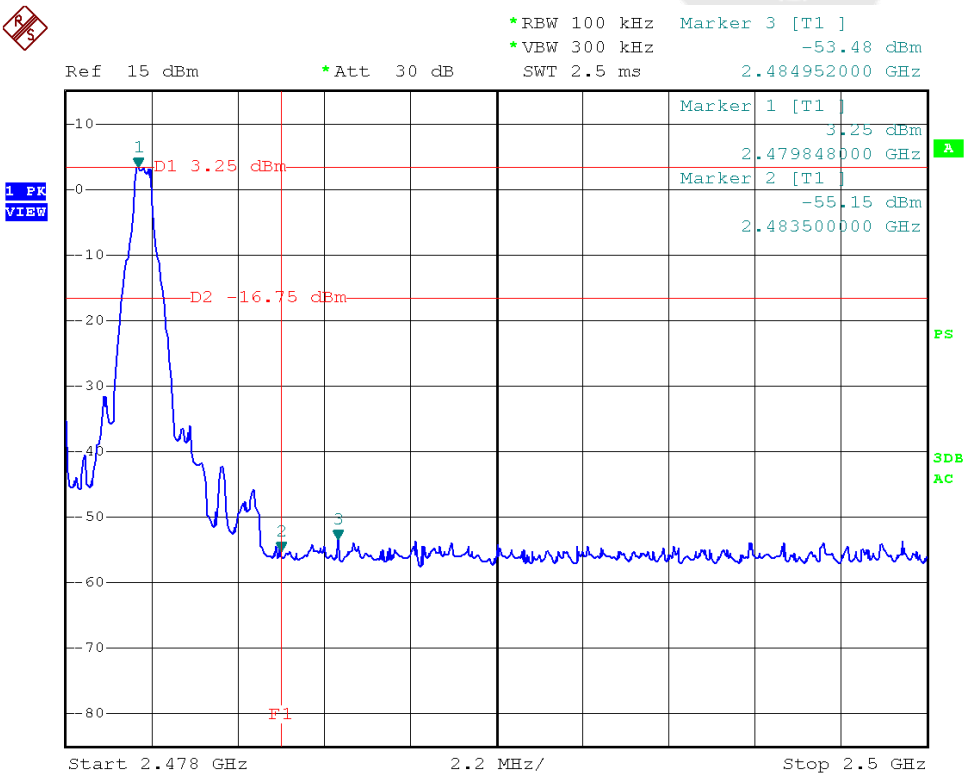
Frequency (MHz)	Peak Power Output(dBm)	Emission read Value(dBm)	Result of Band edge(dBc)	Band edge Limit(dBc)	Modulation
<2400	0.71	-54.55	55.26	>20dBc	GFSK
	-2.47	-53.29	50.82	>20dBc	π/4DQPSK
	-2.47	-53.29	50.82	>20dBc	8DPSK
>2483.5	3.25	-53.48	56.73	>20dBc	GFSK
	0.33	-52.73	53.06	>20dBc	π/4DQPSK
	0.33	-52.73	53.06	>20dBc	8DPSK

2. Radiated emission Test

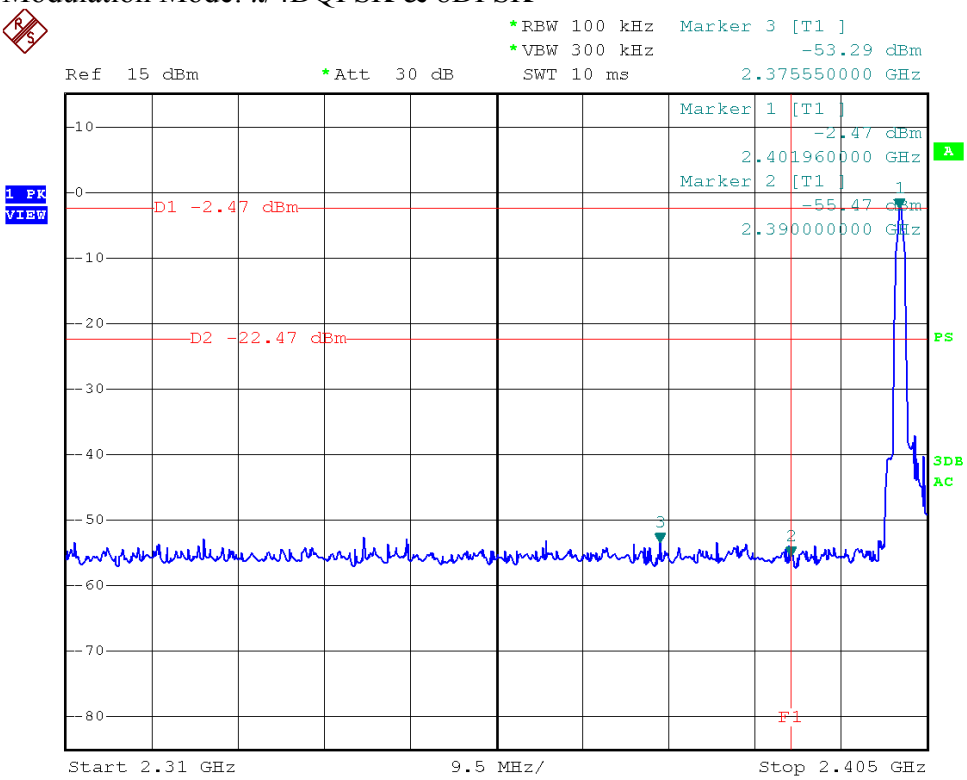
Frequency (MHz)	Antenna polarization (H/V)	Emission (dBuV/m)		Band edge Limit (dBuV/m)		Modulation
		PK	AV	PK	AV	
<2400	V	57.34	37.33	74.00	54.00	GFSK
	V	53.75	37.79	74.00	54.00	π/4DQPSK
	V	53.21	36.58	74.00	54.00	8DPSK
>2483.5	V	50.49	38.71	74.00	54.00	GFSK
	V	53.57	37.56	74.00	54.00	π/4DQPSK
	V	50.80	38.92	74.00	54.00	8DPSK

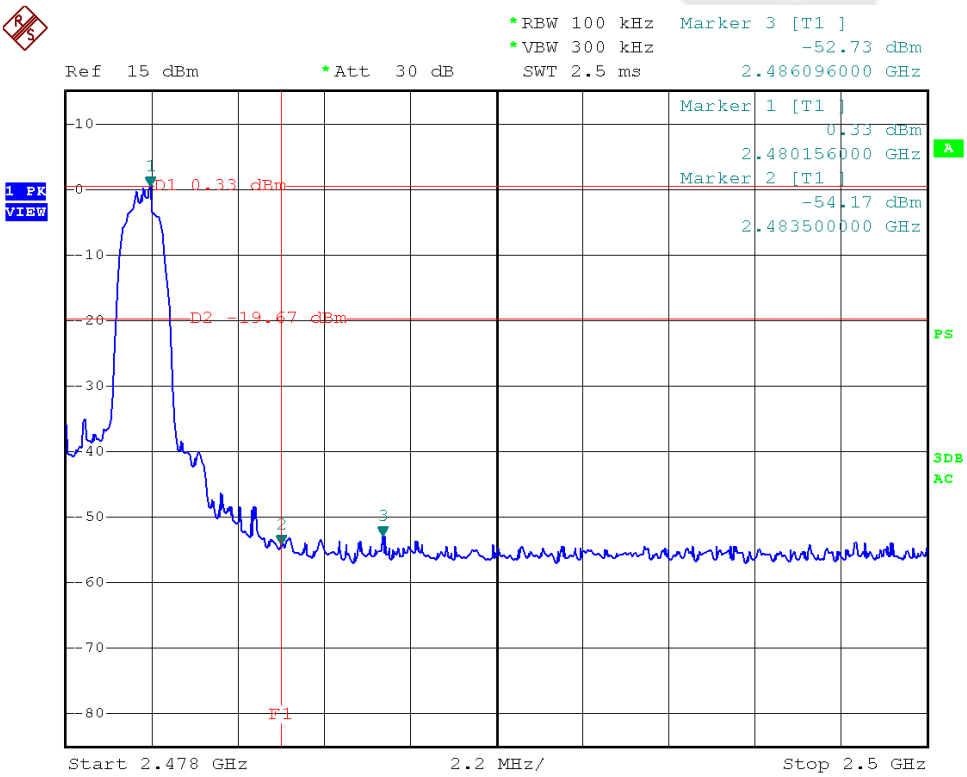
Modulation Mode: GFSK





Modulation Mode: π/4DQPSK & 8DPSK





11. ANTENNA APPLICATION

11.1 Antenna requirement

The EUT'S antenna is met the requirement of FCC part 15C section 15.203 and 15.247.

FCC part 15C section 15.247 requirements:
Systems operating in the 2402-2480MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

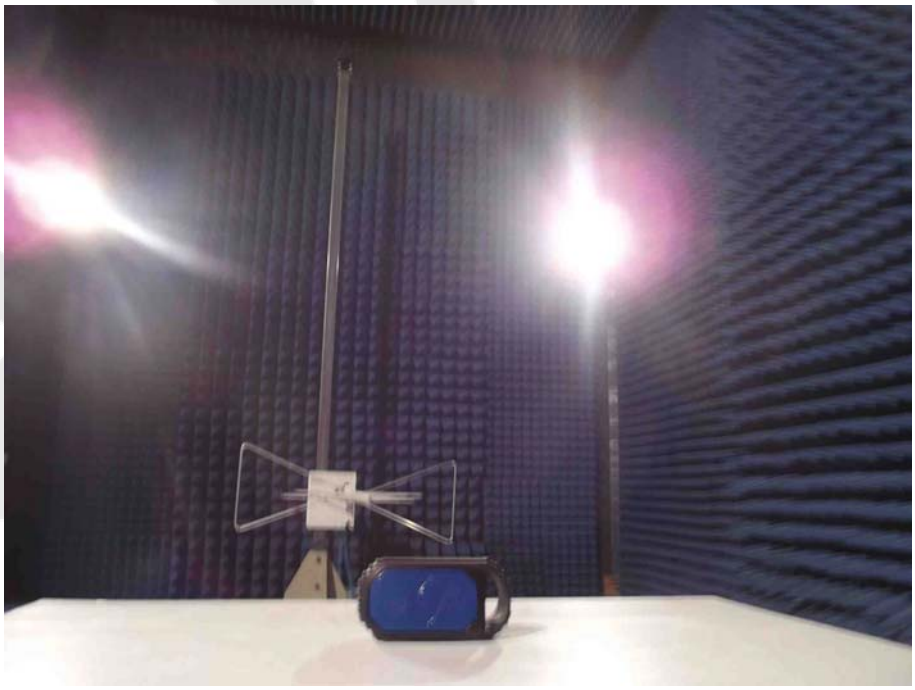
11.2 Result

The EUT's antenna used a chip antenna and integrated on PCB, The antenna's gain is 0dBi and meets the requirement.

12. PHOTOGRAPH

12.1 Photo of Power Line Conducted Emission Measurement

12.2 Photo of Radiation Emission Test



APPENDIX I (EXTERNAL PHOTOS)

Figure 1
The EUT-Overall View

Figure 2
The EUT-Top View

Figure 3
The EUT-Bottom View

Figure 4
The EUT-Front View

Figure 5
The EUT-Back View

Figure 6
The EUT-Right View

Figure 7
The EUT-Left View

APPENDIX Ⅱ(INTERNAL PHOTOS)

Figure 8
The EUT-Inside View

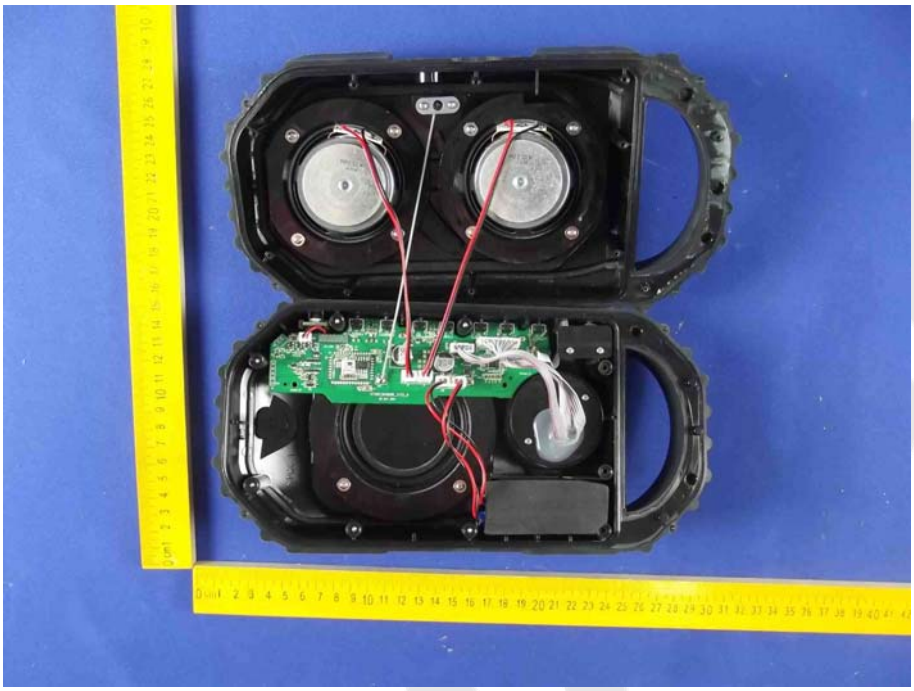


Figure 9
PCB of the EUT-Front View

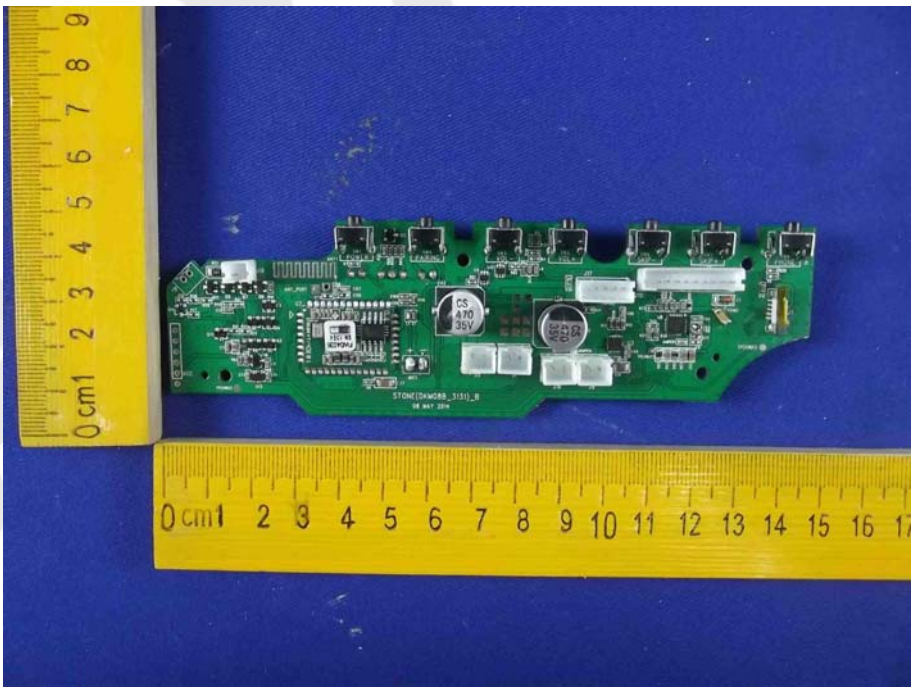


Figure 10
PCB of the Module View

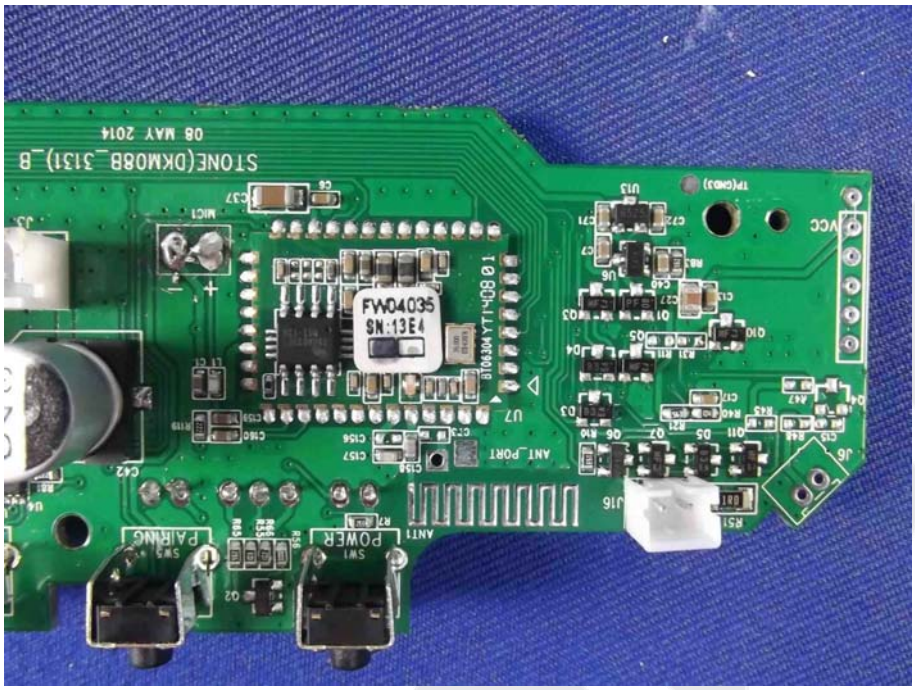


Figure 11
PCB of the EUT-Back View

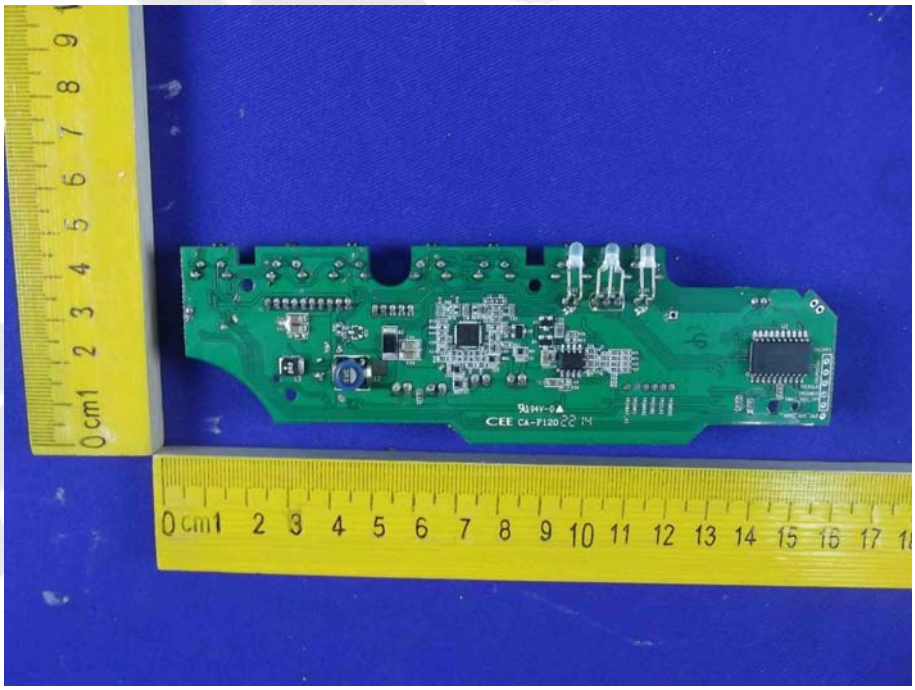


Figure 12
PCB of the EUT-Front View

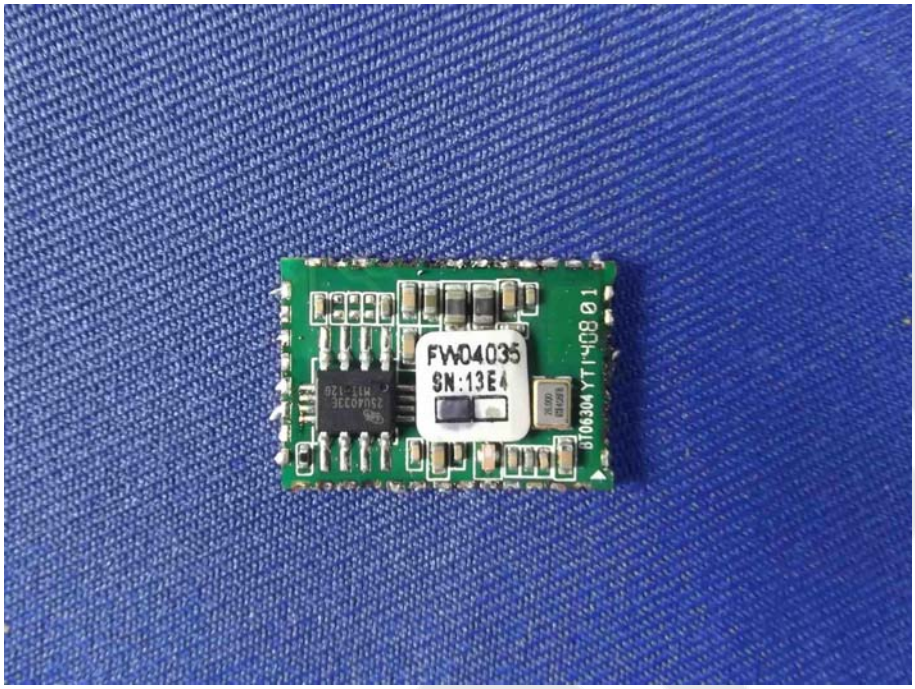
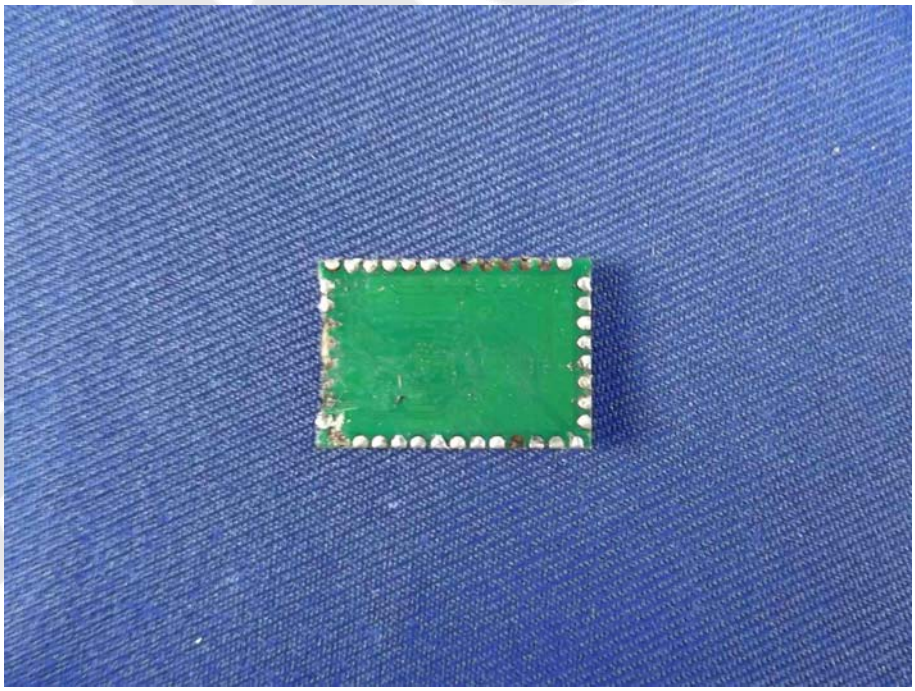



Figure 13
PCB of the EUT-Front View