FCC TEST REPORT
for
TI Asahi Co., Ltd.

Total Station
Model No.: R-2501N, R-2502N, R-2503N, R-2505N, R-2501DN, R-2502DN, R-2503DN, R-2505DN

Prepared for	:	TI Asahi Co., Ltd.
Address	:	4-3-4 Ueno, Iwatsuki-ku, Saitama-shi, Saitama, 339-0073, Japan

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Report Number	:	201307922F
Date of Test	:	Oct. 09, 2013~ Mar. 30, 2014
Date of Report	:	Apr. 02, 2014

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APPENDIX I (External Photos) (2 Pages)
APPENDIX Ⅱ (Internal Photos) (5 Pages)

TEST REPORT

Applicant	:	TI Asahi Co., Ltd.
Manufacturer	:	TI Precision Shanghai Co., Ltd.
EUT	:	Total Station
Model No.	:	R-2501N, R-2502N, R-2503N, R-2505N, R-2501DN, R-2502DN, R-2503DN, R-2505DN
Serial No.	:	N/A
Rating	:	DC 7.4V, 0.3-1.1A
Trade Mark	:	N/A

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 : Oct. 09, 2013~ Mar. 30, 2014

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

Reviewer : Sally zhang
(Project Manager / Sally Zhang)

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

1. GENERAL INFORMATION

1.1. Description of Device (EUT)

EUT	:	Total Station
Model Number	:	R-2501N, R-2502N, R-2503N, R-2505N, R-2501DN, R-2502DN, R-2503DN, R-2505DN (Note: The models are the same except the appearance and model number, so we prepare R-2502DN for the EMC test.)
Test Power Supply	:	DC 7.4V Liion Battery
Frequency	:	2402~2480MHz
Antenna Specification	:	1 dBi Stub Antenna
Modulation	:	GFSK, π /4DQPSK, 8DPSK
Applicant	:	TI Asahi Co., Ltd.
Address	:	4-3-4 Ueno, Iwatsuki-ku, Saitama-shi, Saitama, 339-0073, Japan
Manufacturer	:	TI Precision Shanghai Co., Ltd.
Address	:	No. 158, Beiyang Road, Songjiang District, Shanghai, China
Date of receiver	:	Oct. 09, 2013
Date of Test	:	Oct. 09, 2013~ Mar. 30, 2014

1.2. Auxiliary Equipment Used during Test

N/A

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-1, Feb. 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.

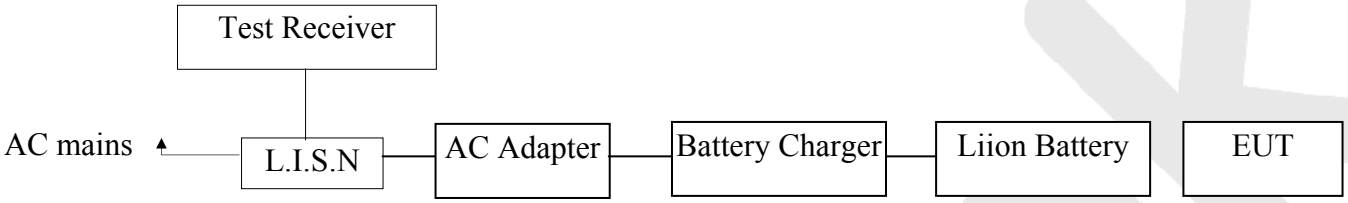
Example:
Freq (MHz) METER READING + ACF = FS
20 dBuV + 10.36 dB = 30.36 dBuV/m @ 3m

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 Limits

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) 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 C63.4-2009 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, 2013	1 Year
2.	EMI Test Receiver	Rohde & Schwarz	ESCI	100627	Apr. 23, 2013	1 Year
3.	RF Switching Unit	Compliance Direction	RSU-M2	38303	Apr. 23, 2013	1 Year

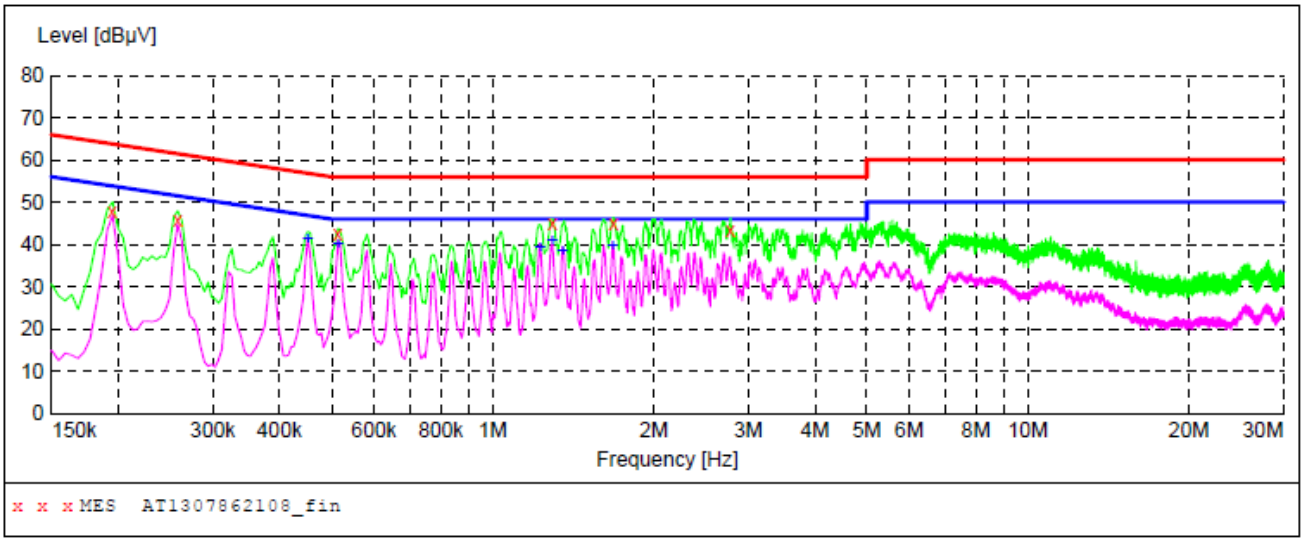
3.6. Power Line Conducted Emission Measurement Results

PASS.
The frequency range from 150KHz to 30 MHz is investigated.
The test curves are shown in the following pages

CONDUCTED EMISSION TEST DATA

Test Site:	1# Shielded Room
Operating Condition:	Charging
Test Specification:	AC 120V/60Hz
Comment:	Live Line
	Tem:25℃ Hum:50%

SCAN TABLE: "Voltage(150K~30M)FIN"
Short Description: 150K-30M Disturbance Voltages



MEASUREMENT RESULT: "AT1307862108_fin"

10/16/2013 1:42PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.195000	47.90	10.1	64	15.9	QP	L1	GND
0.258000	45.70	10.1	62	15.8	QP	L1	GND
0.514500	42.50	10.1	56	13.5	QP	L1	GND
1.292500	44.90	10.2	56	11.1	QP	L1	GND
1.679500	44.90	10.3	56	11.1	QP	L1	GND
2.782000	43.30	10.4	56	12.7	QP	L1	GND

MEASUREMENT RESULT: "AT1307862108_fin2"

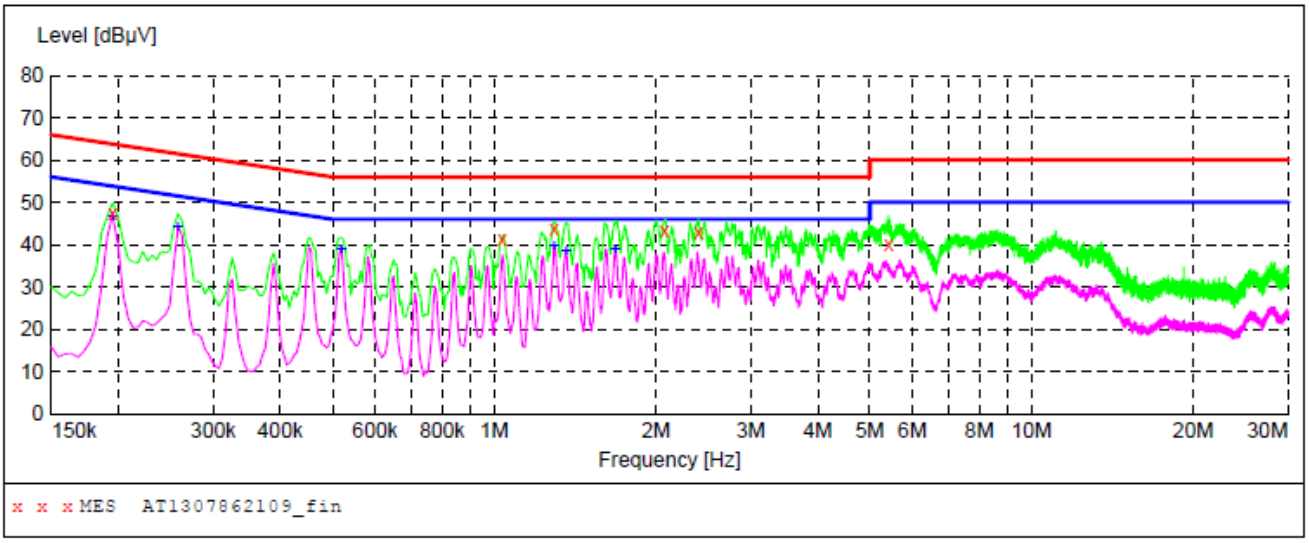
10/16/2013 1:42PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.451500	41.20	10.1	47	5.6	AV	L1	GND
0.514500	40.20	10.1	46	5.8	AV	L1	GND
1.225000	39.10	10.2	46	6.9	AV	L1	GND
1.292500	40.80	10.2	46	5.2	AV	L1	GND
1.351000	38.60	10.2	46	7.4	AV	L1	GND
1.675000	39.70	10.3	46	6.3	AV	L1	GND

CONDUCTED EMISSION TEST DATA

Test Site:	1# Shielded Room
Operating Condition:	Charging
Test Specification:	AC 120V/60Hz
Comment:	Neutral Line
	Tem:25℃ Hum:50%

SCAN TABLE: "Voltage(150K~30M)FIN"
Short Description: 150K-30M Disturbance Voltages



MEASUREMENT RESULT: "AT1307862109_fin"

10/16/2013 1:45PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.195000	47.40	10.1	64	16.4	QP	N	GND
1.036000	41.30	10.2	56	14.7	QP	N	GND
1.292500	43.90	10.2	56	12.1	QP	N	GND
2.075500	43.40	10.3	56	12.6	QP	N	GND
2.399500	43.10	10.3	56	12.9	QP	N	GND
5.419000	40.20	10.5	60	19.8	QP	N	GND

MEASUREMENT RESULT: "AT1307862109_fin2"

10/16/2013 1:45PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.195000	46.60	10.1	54	7.2	AV	N	GND
0.258000	44.40	10.1	52	7.1	AV	N	GND
0.519000	38.70	10.1	46	7.3	AV	N	GND
1.292500	39.70	10.2	46	6.3	AV	N	GND
1.360000	38.40	10.2	46	7.6	AV	N	GND
1.679500	39.00	10.3	46	7.0	AV	N	GND

4. Radiation Interference

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:	FIELD STRENGTH of Harmonics	S15.209	
902-928 MHZ		30 - 88 MHz	40 dBuV/m @3M
2.4-2.4835 GHz		88 - 216 MHz	43.5
94 dBμV/m @3m	54 dBμV/m @3m	216 - 960 MHz	46
		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. Both horizontal and vertical polarization of the antenna are set on test.

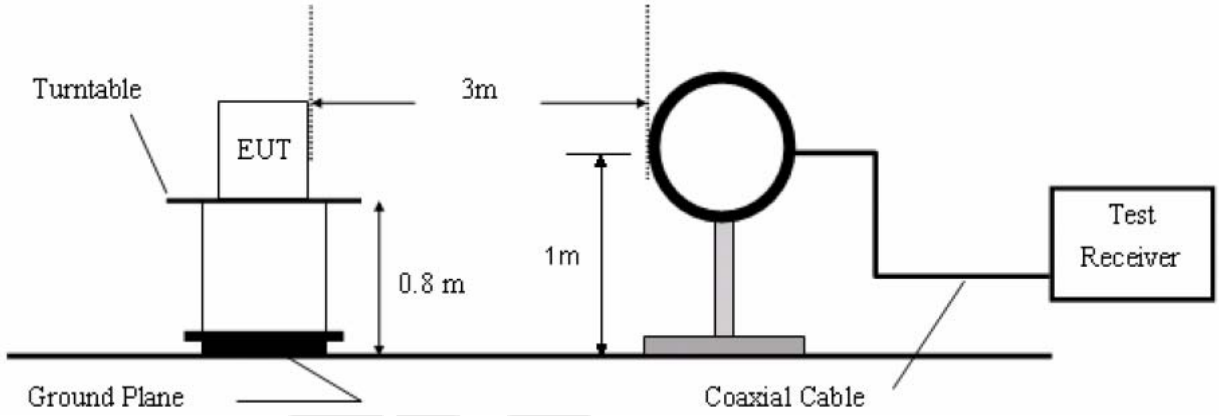
All readings from 30MHz to 1GHz are quasi-peak values with a resolution bandwidth of 120kHz. All reading are above 1GHz, peak & average values with a resolution bandwidth of 1MHz. The EUT is tested in 9*6*6 Chamber.
The test results are listed in Section 3.3.

Test Equipment

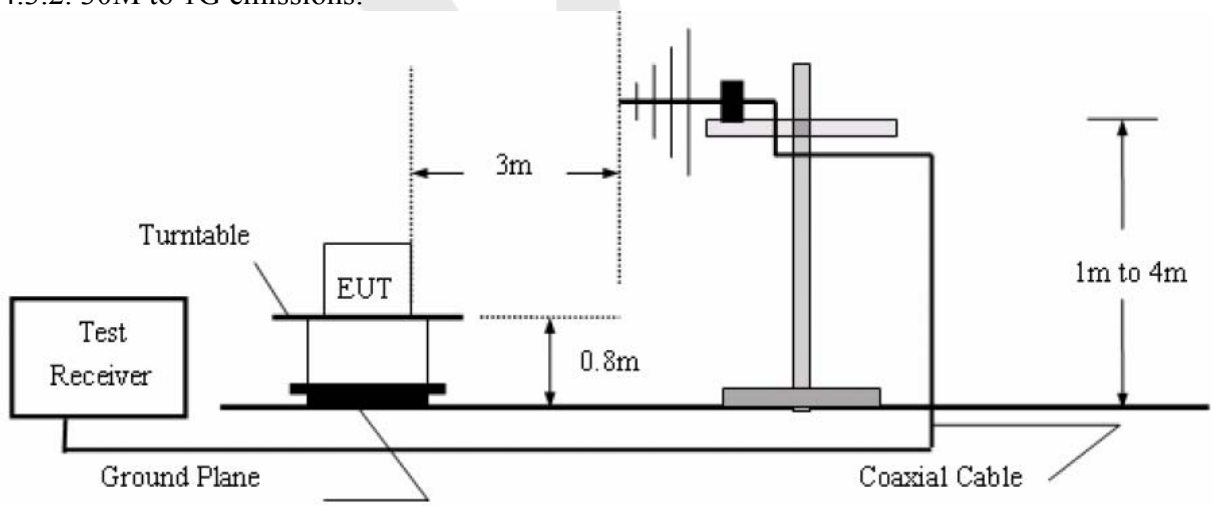
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Spectrum Analysis	Rohde & Schwarz	ESU	1302.6005.26	05/28/2013	1 Year
2.	EMI Test Receiver	Rohde & Schwarz	ESU	1302.6005.26	05/28/2013	1 Year
3.	Pre-Amlifier	HP	8447D	2944A07999	05/28/2013	1 Year
4.	Bilog Antenna	Schwarzbeck	VULB9163	142	05/28/2013	1 Year
5.	Loop Antenna	ARA	PLA-1030/B	1029	05/28/2013	1 Year
6.	Horn Antenna	Schwarzbeck	BBHA9170	BBHA9170399	05/28/2013	1 Year
7.	Horn Antenna	Schwarzbeck	BBHA9120	D143	05/28/2013	1 Year

4.3. Test Configuration:

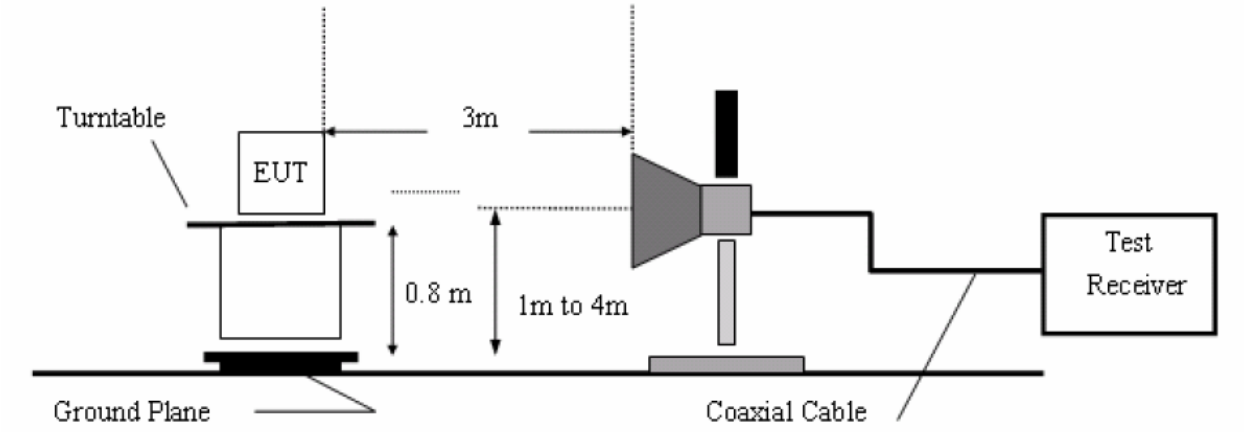
4.3.1. 9k to 30MHz emissions:



4.3.2. 30M to 1G emissions:



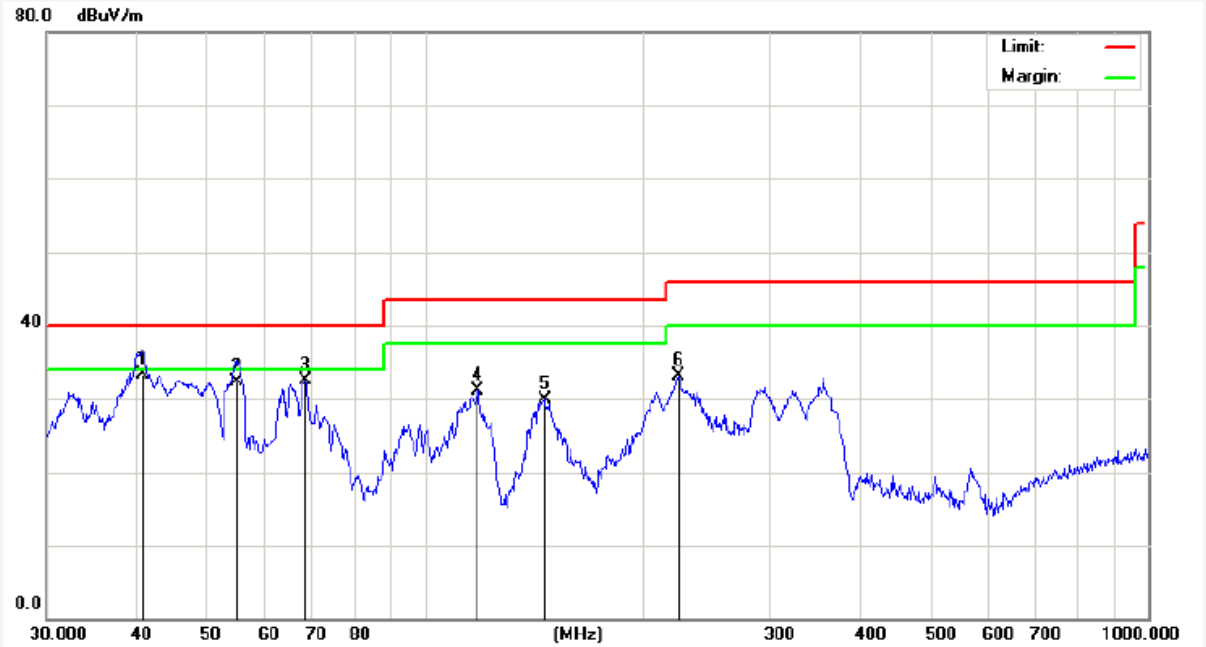
4.3.3. 1G to 40G emissions:



4.4. Test Results

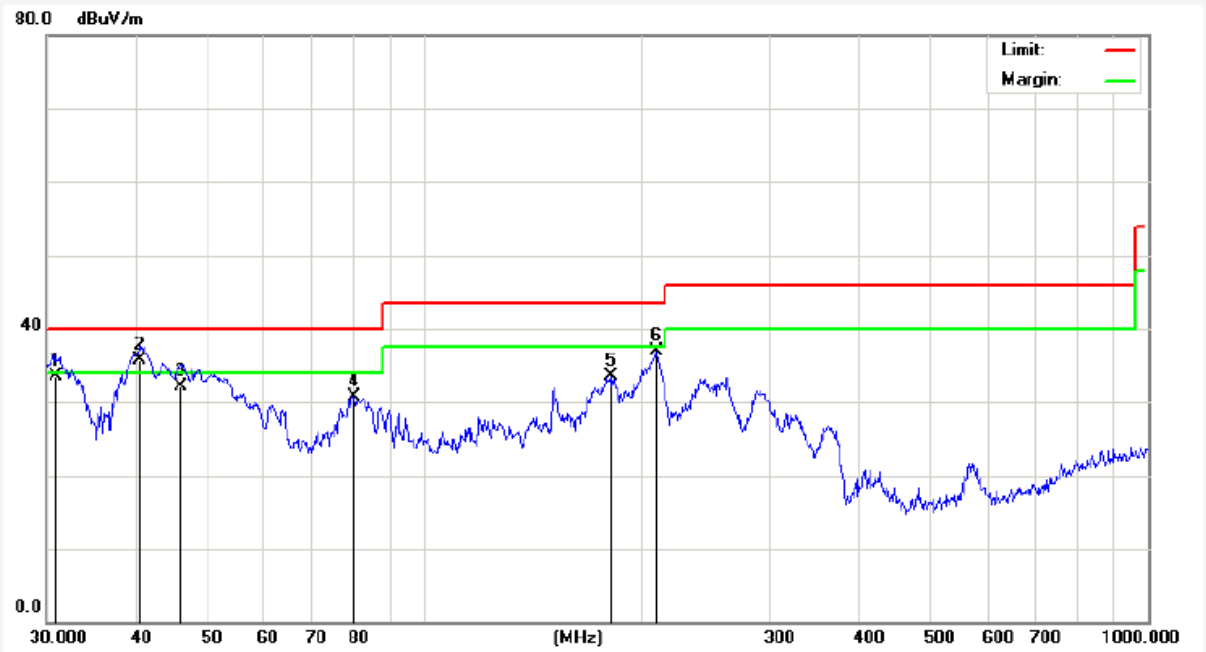
PASS.
Please refer the following pages.
Data:

Job No.:	**AT1307862F**	**Polarization:**	**Horizontal**
Standard:	**(RE)FCC PART 15C_Class B_3m**	**Power Source:**	**AC 120V/60Hz**
Test item:	**Radiation Test (30~1000MHz)**	**Temp.(C)/Hum.(%RH):**	**24.3(C)/55%RH**
Note:	**Charging**	**Distance:**	**3m**



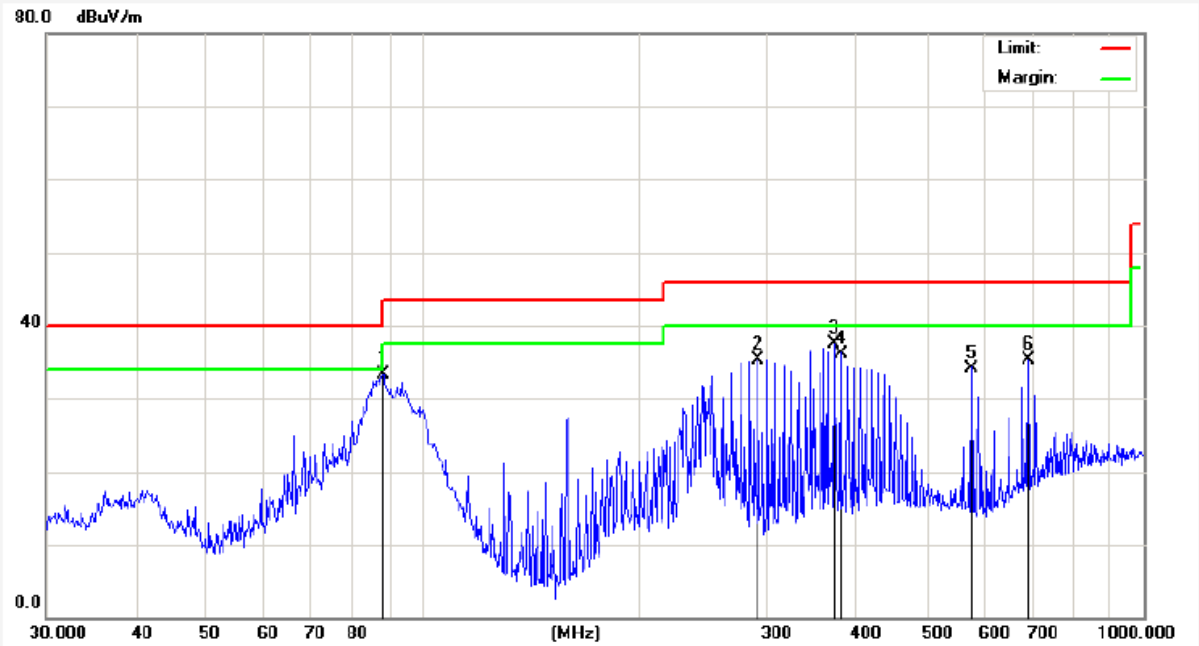
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/	Over Limit (dB)	Detector	Height (cm)	degree (deg)	Remark
1	40.7014	54.28	-20.97	33.31	40.00	-6.69	QP	100	0	
2	54.8348	60.17	-27.83	32.34	40.00	-7.66	QP	100	360	
3	68.3907	63.75	-31.24	32.51	40.00	-7.49	peak			
4	118.1861	63.11	-32.00	31.11	43.50	-12.39	peak			
5	146.3735	64.04	-34.06	29.98	43.50	-13.52	peak			
6	224.5192	63.04	-29.89	33.15	46.00	-12.85	peak			

Job No.:	**AT1307862F**	**Polarization:**	**Vertical**
Standard:	**(RE)FCC PART 15C_Class B_3m**	**Power Source:**	**AC 120V/60Hz**
Test item:	**Radiation Test (30~1000MHz)**	**Temp.(C)/Hum.(%RH):**	**24.3(C)/55%RH**
Note:	**Charging**	**Distance:**	**3m**



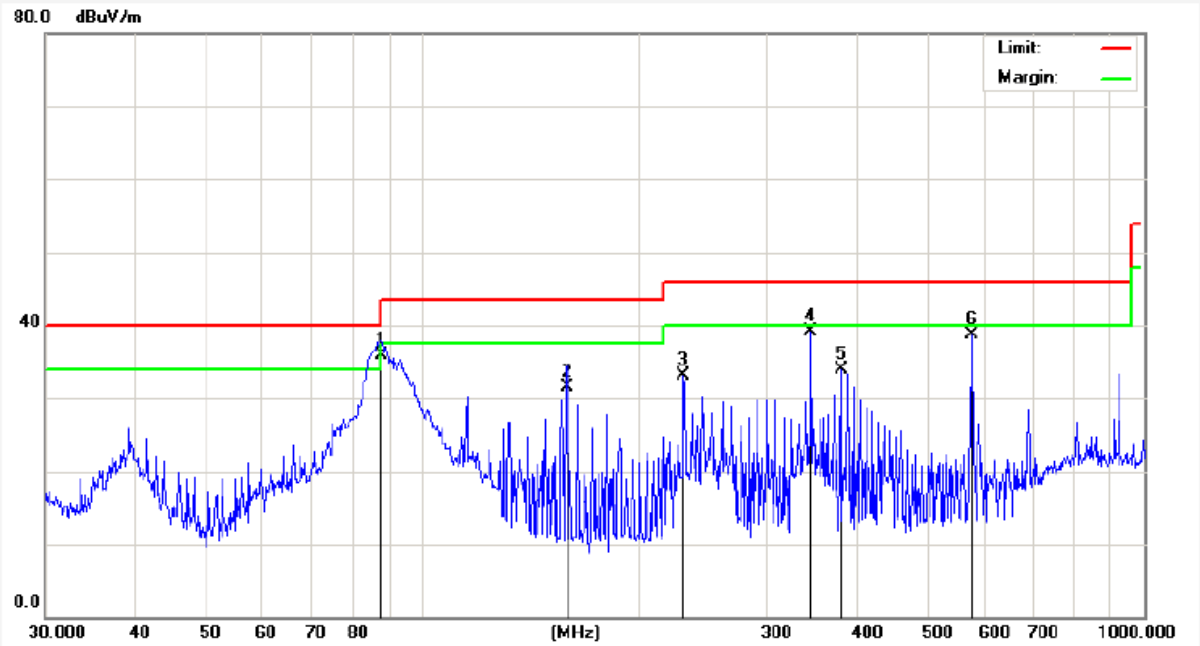
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/	Over Limit (dB)	Detector	Height (cm)	degree (deg)	Remark
1	30.8535	57.57	-24.16	33.41	40.00	-6.59	QP	100	0	
2	40.4172	56.53	-20.77	35.76	40.00	-4.24	QP	100	360	
3	46.0162	56.91	-24.72	32.19	40.00	-7.81	QP	100	0	
4	79.8002	62.58	-31.80	30.78	40.00	-9.22	peak			
5	180.6487	60.77	-27.26	33.51	43.50	-9.99	peak			
6	209.3129	62.67	-25.84	36.83	43.50	-6.67	peak			

Job No.:	**AT1307862F**	**Polarization:**	**Horizontal**
Standard:	**(RE)FCC PART 15C_Class B_3m**	**Power Source:**	**DC 7.4V Liion Battery**
Test item:	**Radiation Test (30~1000MHz)**	**Temp.(C)/Hum.(%RH):**	**24.3(C)/55%RH**
Note:	**BT Mode**	**Distance:**	**3m**



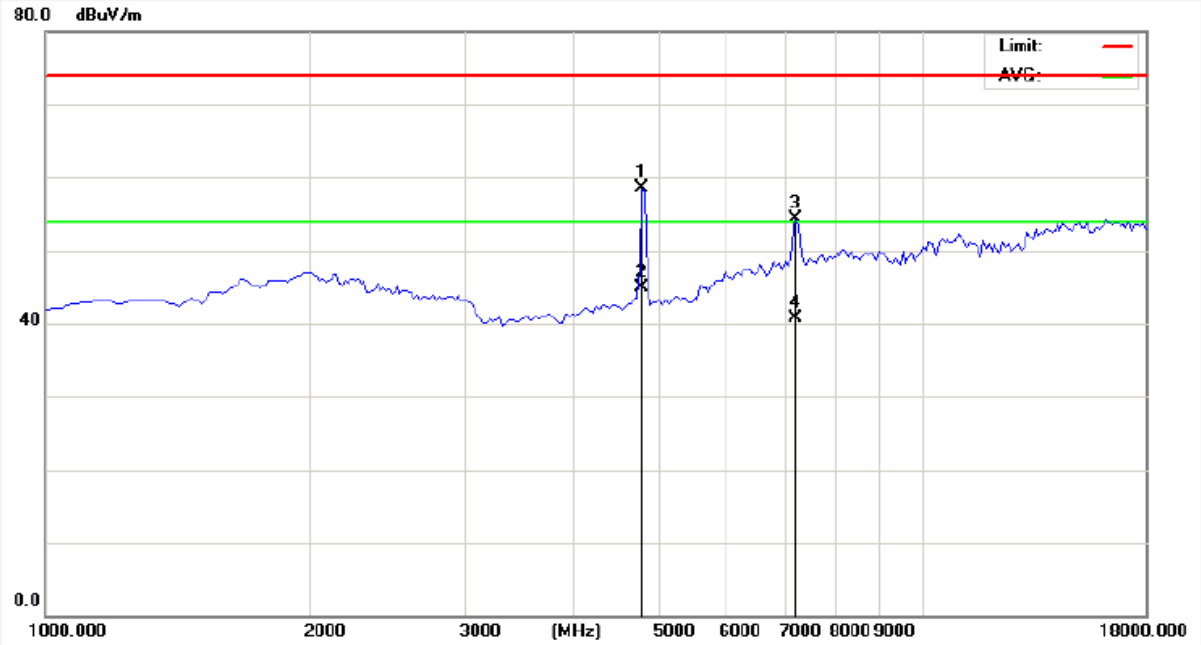
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/	Over Limit (dB)	Detector	Height (cm)	degree (deg)	Remark
1	88.0328	66.59	-33.32	33.27	43.50	-10.23	peak			
2	292.0581	63.18	-27.78	35.40	46.00	-10.60	peak			
3	372.0045	61.04	-23.55	37.49	46.00	-8.51	peak			
4	379.9141	59.62	-23.42	36.20	46.00	-9.80	peak			
5	576.6443	56.42	-22.22	34.20	46.00	-11.80	peak			
6	691.9867	53.96	-18.75	35.21	46.00	-10.79	peak			

Job No.:	**AT1307862F**	**Polarization:**	**Vertical**
Standard:	**(RE)FCC PART 15C_Class B_3m**	**Power Source:**	**DC 7.4V Liion Battery**
Test item:	**Radiation Test (30~1000MHz)**	**Temp.(C)/Hum.(%RH):**	**24.3(C)/55%RH**
Note:	**BT Mode**	**Distance:**	**3m**



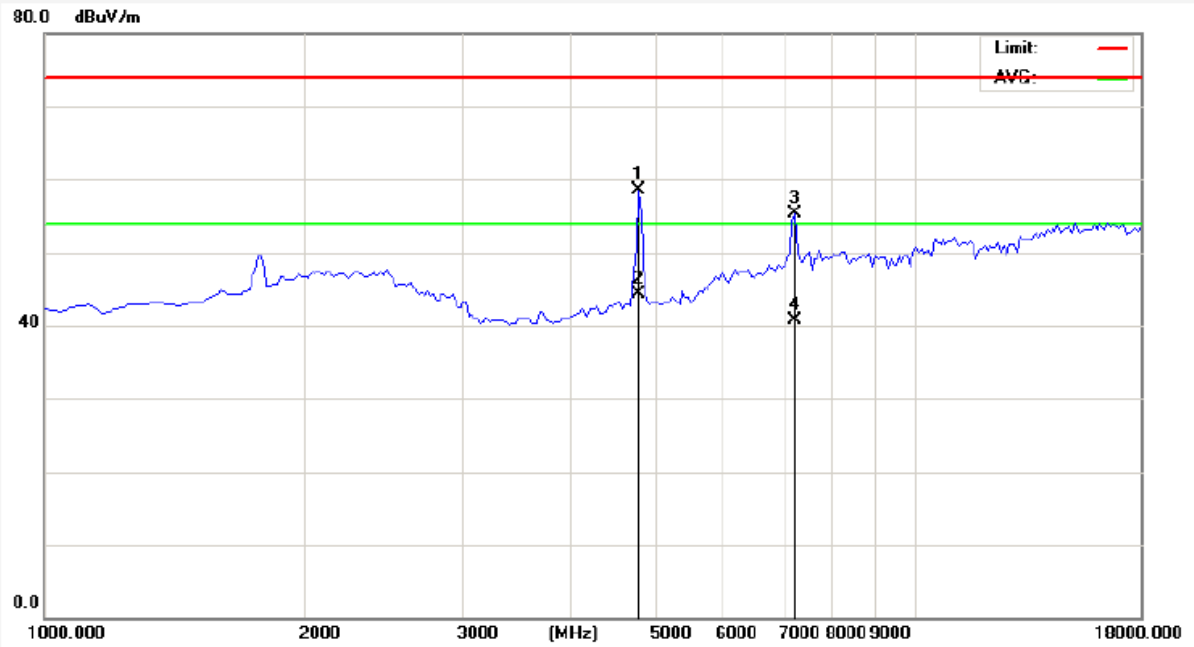
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/	Over Limit (dB)	Detector	Height (cm)	degree (deg)	Remark
1	87.7248	65.52	-29.54	35.98	40.00	-4.02	QP	100	0	
2	158.6676	59.96	-28.51	31.45	43.50	-12.05	QP	100	360	
3	230.0985	57.99	-24.81	33.18	46.00	-12.82	peak			
4	345.5951	62.25	-23.14	39.11	46.00	-6.89	peak			
5	379.9141	56.28	-22.42	33.86	46.00	-12.14	peak			
6	576.6443	59.48	-20.69	38.79	46.00	-7.21	peak			

Job No.:	**AT1307862F**	**Polarization:**	**Horizontal**
Standard:	**(RE)FCC PART 15C_Class B_3m**	**Power Source:**	**DC 7.4V Liion Battery**
Test item:	**Radiation Test (Above 1GHz)**	**Temp.(C)/Hum.(%RH):**	**24.3(C)/55%RH**
Note:	**BT Mode (2402 MHz)**	**Distance:**	**3m**



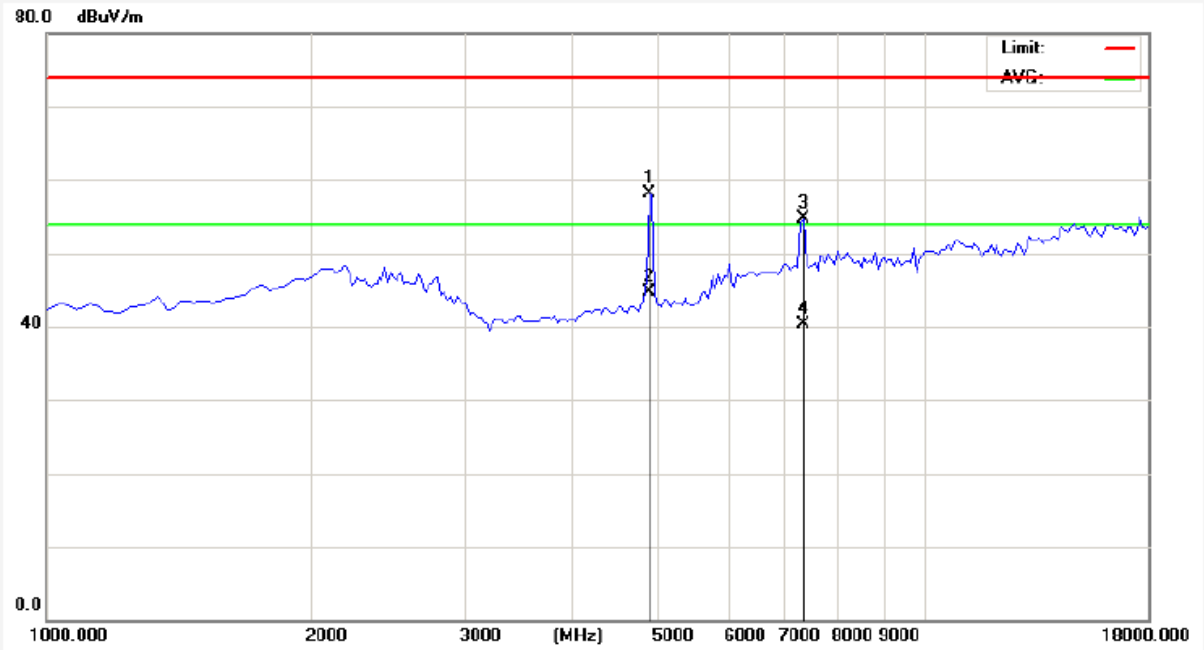
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/	Over Limit (dB)	Detector	Height (cm)	degree (deg)	Remark
1	4825.000	55.08	3.34	58.42	74.00	-15.58	peak			
2	4825.000	41.53	3.34	44.87	54.00	-9.13	AVG			
3	7205.000	45.87	8.43	54.30	74.00	-19.70	peak			
4	7205.000	32.23	8.43	40.66	54.00	-13.34	AVG			

Job No.:	**AT1307862F**	**Polarization:**	**Vertical**
Standard:	**(RE)FCC PART 15C_Class B_3m**	**Power Source:**	**DC 7.4V Liion Battery**
Test item:	**Radiation Test (Above 1GHz)**	**Temp.(C)/Hum.(%RH):**	**24.3(C)/55%RH**
Note:	**BT Mode (2402 MHz)**	**Distance:**	**3m**



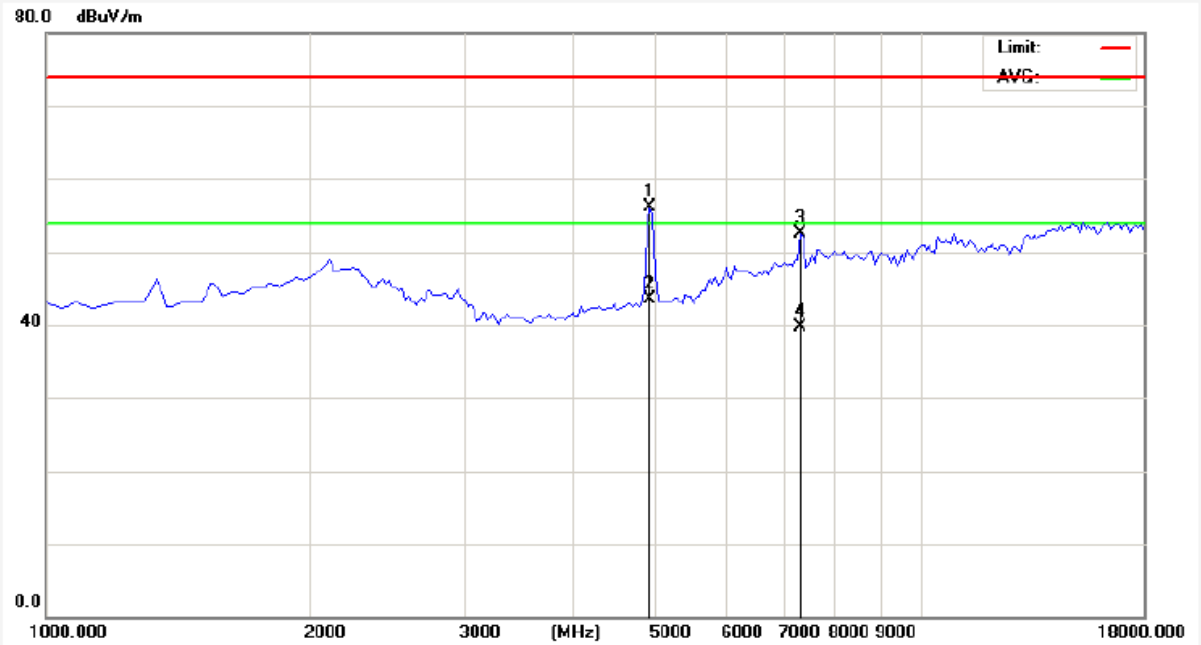
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/	Over Limit (dB)	Detector	Height (cm)	degree (deg)	Remark
1	4825.000	55.19	3.34	58.53	74.00	-15.47	peak			
2	4825.000	40.94	3.34	44.28	54.00	-9.72	AVG			
3	7247.500	46.83	8.48	55.31	74.00	-18.69	peak			
4	7247.500	32.13	8.48	40.61	54.00	-13.39	AVG			

Job No.:	**AT1307862F**	**Polarization:**	**Horizontal**
Standard:	**(RE)FCC PART 15C_Class B_3m**	**Power Source:**	**DC 7.4V Liion Battery**
Test item:	**Radiation Test (Above 1GHz)**	**Temp.(C)/Hum.(%RH):**	**24.3(C)/55%RH**
Note:	**BT Mode (2441 MHz)**	**Distance:**	**3m**



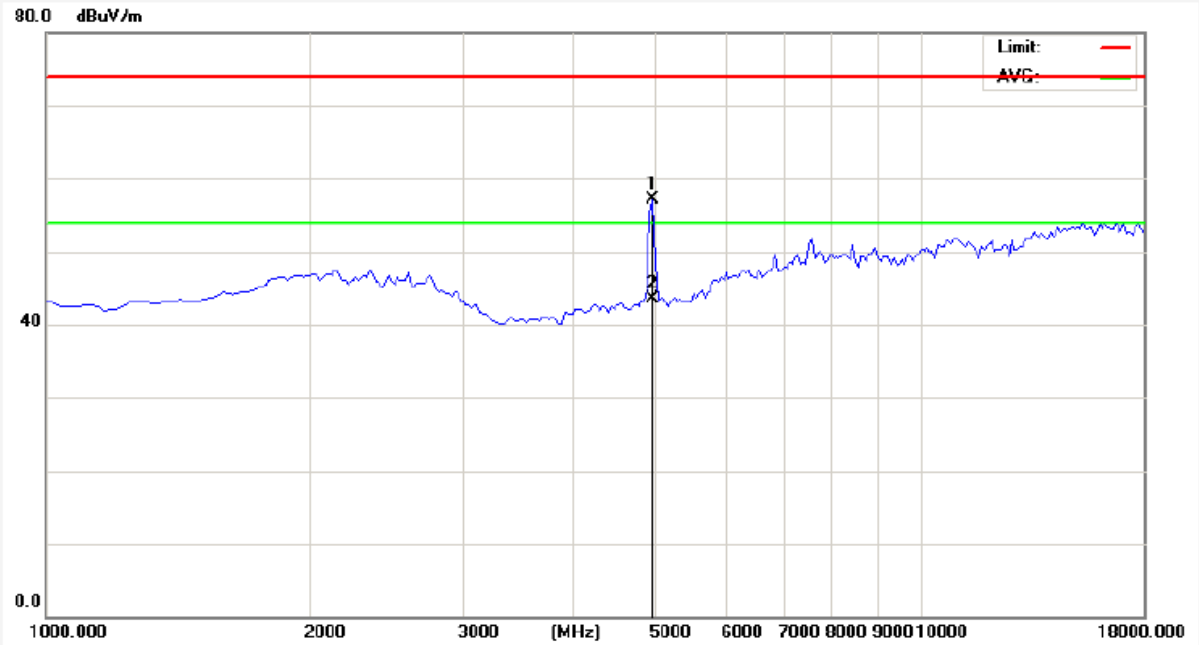
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/	Over Limit (dB)	Detector	Height (cm)	degree (deg)	Remark
1	4867.500	54.66	3.41	58.07	74.00	-15.93	peak			
2	4867.500	41.21	3.41	44.62	54.00	-9.38	AVG			
3	7332.500	46.17	8.58	54.75	74.00	-19.25	peak			
4	7332.500	31.74	8.58	40.32	54.00	-13.68	AVG			

Job No.:	**AT1307862F**	**Polarization:**	**Vertical**
Standard:	**(RE)FCC PART 15C_Class B_3m**	**Power Source:**	**DC 7.4V Liion Battery**
Test item:	**Radiation Test (Above 1GHz)**	**Temp.(C)/Hum.(%RH):**	**24.3(C)/55%RH**
Note:	**BT Mode (2441 MHz)**	**Distance:**	**3m**



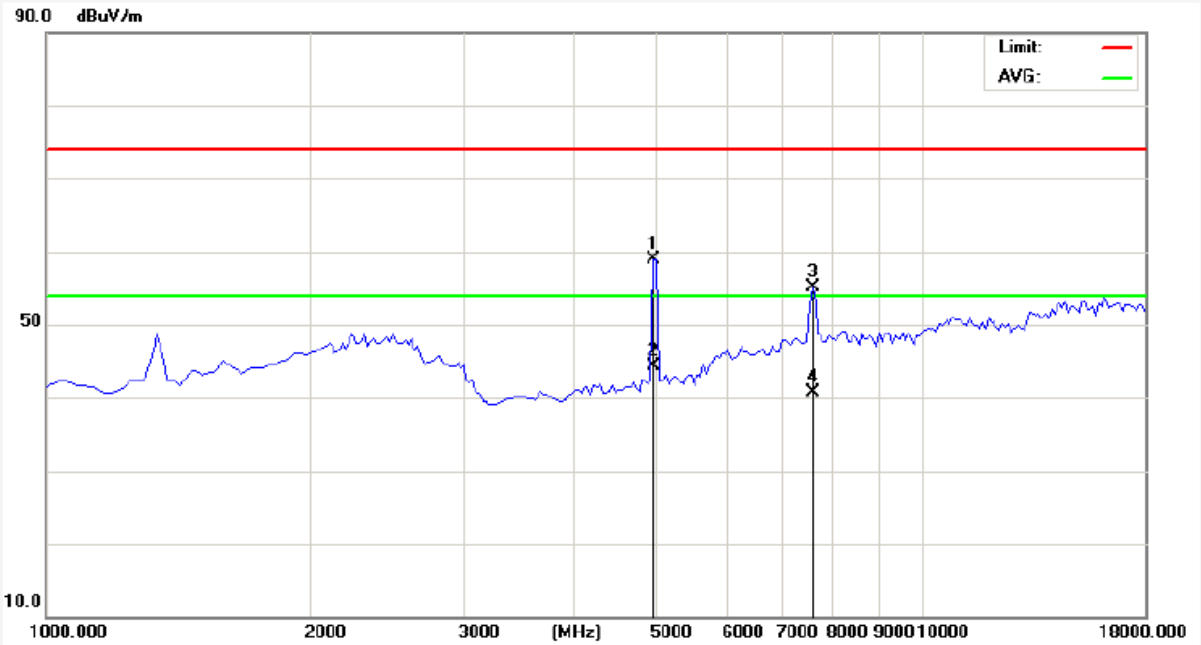
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/	Over Limit (dB)	Detector	Height (cm)	degree (deg)	Remark
1	4910.000	52.52	3.49	56.01	74.00	-17.99	peak			
2	4910.000	39.93	3.49	43.42	54.00	-10.58	AVG			
3	7332.500	43.92	8.58	52.50	74.00	-21.50	peak			
4	7332.500	31.14	8.58	39.72	54.00	-14.28	AVG			

Job No.:	**AT1307862F**	**Polarization:**	**Horizontal**
Standard:	**(RE)FCC PART 15C_Class B_3m**	**Power Source:**	**DC 7.4V Liion Battery**
Test item:	**Radiation Test (Above 1GHz)**	**Temp.(C)/Hum.(%RH):**	**24.3(C)/55%RH**
Note:	**BT Mode (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	4952.500	53.56	3.57	57.13	74.00	-16.87	peak			
2	4952.500	39.91	3.57	43.48	54.00	-10.52	AVG			

Job No.:	**AT1307862F**	**Polarization:**	**Vertical**
Standard:	**(RE)FCC PART 15C_Class B_3m**	**Power Source:**	**DC 7.4V Liion Battery**
Test item:	**Radiation Test (Above 1GHz)**	**Temp.(C)/Hum.(%RH):**	**24.3(C)/55%RH**
Note:	**BT Mode (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	4952.500	55.37	3.57	58.94	74.00	-15.06	peak			
2	4952.500	40.82	3.57	44.39	54.00	-9.61	AVG			
3	7545.000	46.22	8.86	55.08	74.00	-18.92	peak			
4	7545.000	31.82	8.86	40.68	54.00	-13.32	AVG			

5. CHANNEL SEPARATION TEST

5.1. Measurement Procedure

The EUT was operating in hopping mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

5.2. Test SET-UP

EUT —— Spectrum analyzer

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, 2013	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, 2013	1 Year
7.	EMI Test Software EZ-EMC	SHURPLE	N/A	N/A	N/A	N/A

Radiation Uncertainty : Ur = 4.3dB

5.4. Test Results

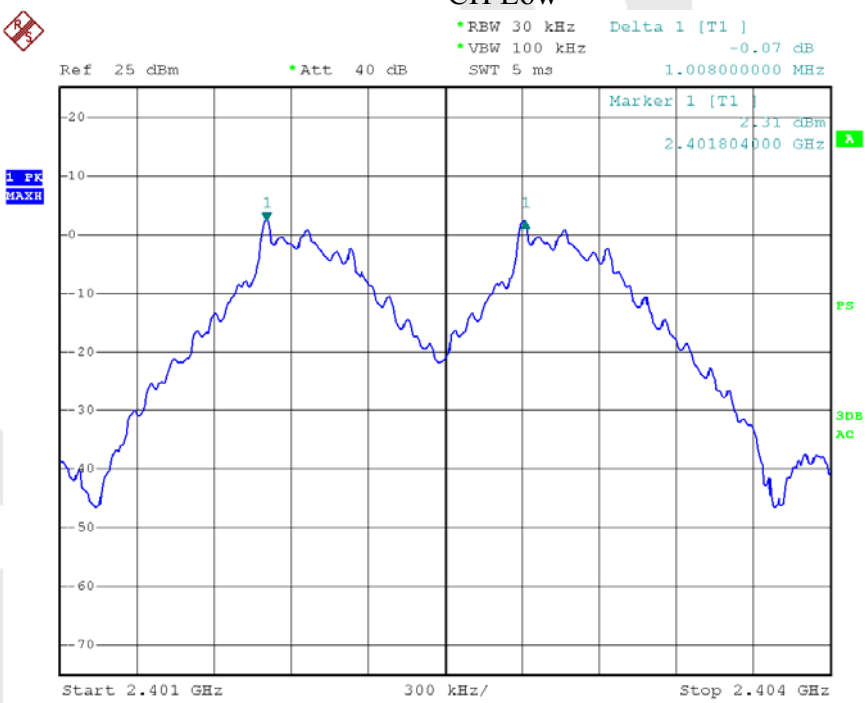
Test Item	:	Frequency Separation	Test Mode	:	CH Low ~ CH High
Test Voltage	:	DC 7.4V Liion Battery	Temperature	:	24℃
Test Result	:	PASS	Humidity	:	55%RH

Channel	Frequency (MHz)	Separation Read Value (kHz)	Limit (kHz)	Modulation Mode
Low	2401	1008	798	GFSK
Mid	2441	1002	798	GFSK
High	2480	1002	804	GFSK
Low	2401	1002	828	π /4DQPSK
Mid	2441	1002	820	π /4DQPSK
High	2480	1002	820	π /4DQPSK
Low	2401	1002	828	8DPSK
Mid	2441	1002	820	8DPSK
High	2480	1002	820	8DPSK

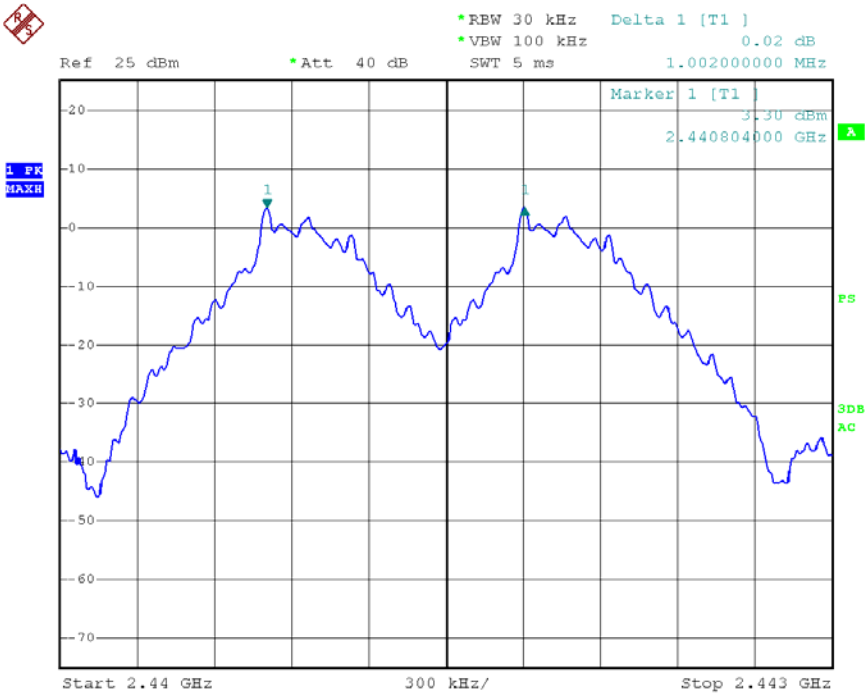
Remark:
1. The limit of modulation (π /4DQPSK, 8DPSK) is 2/3 of 20dB BW;

Modulation Mode: GFSK

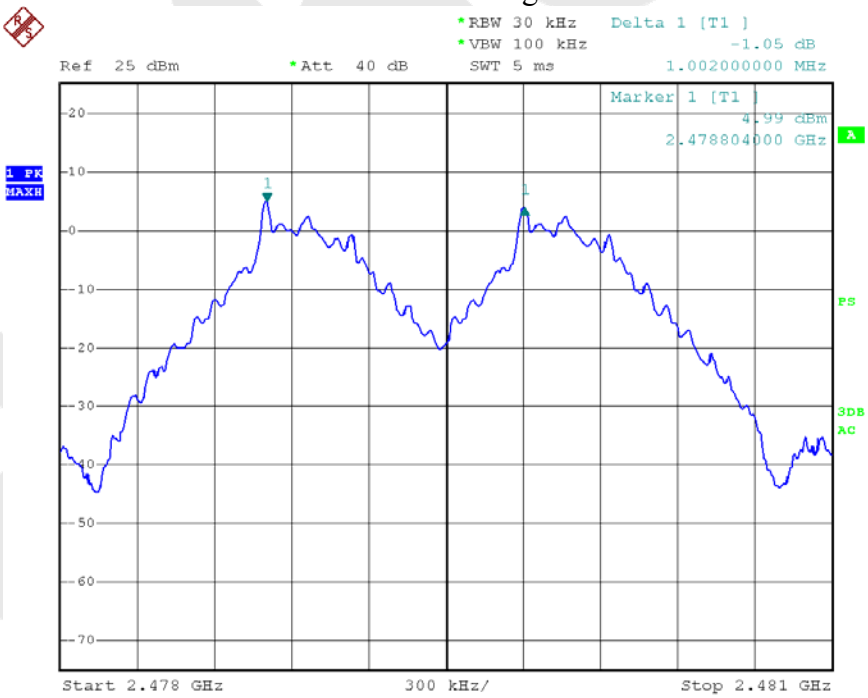
CH Low



CH Mid

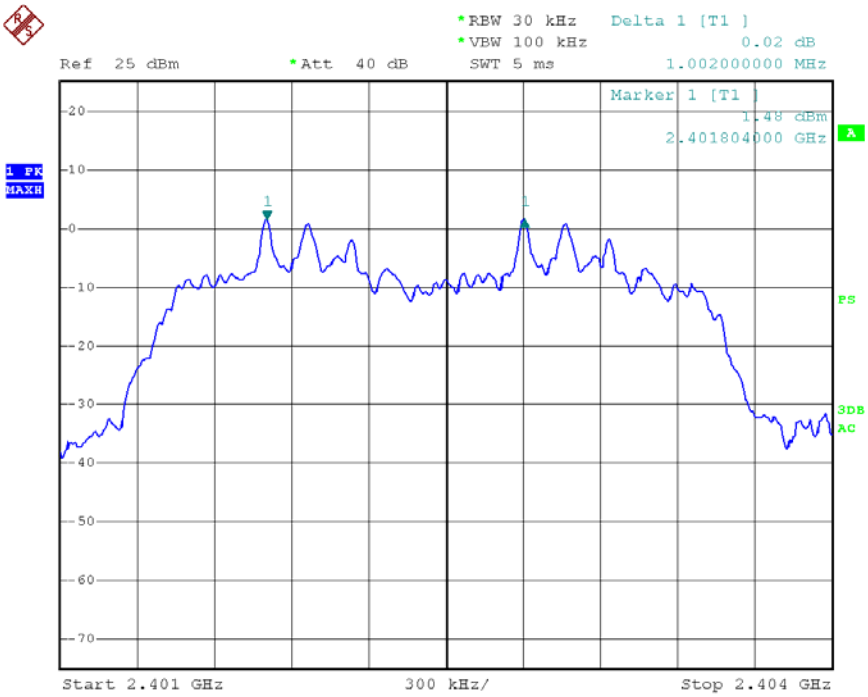


CH High

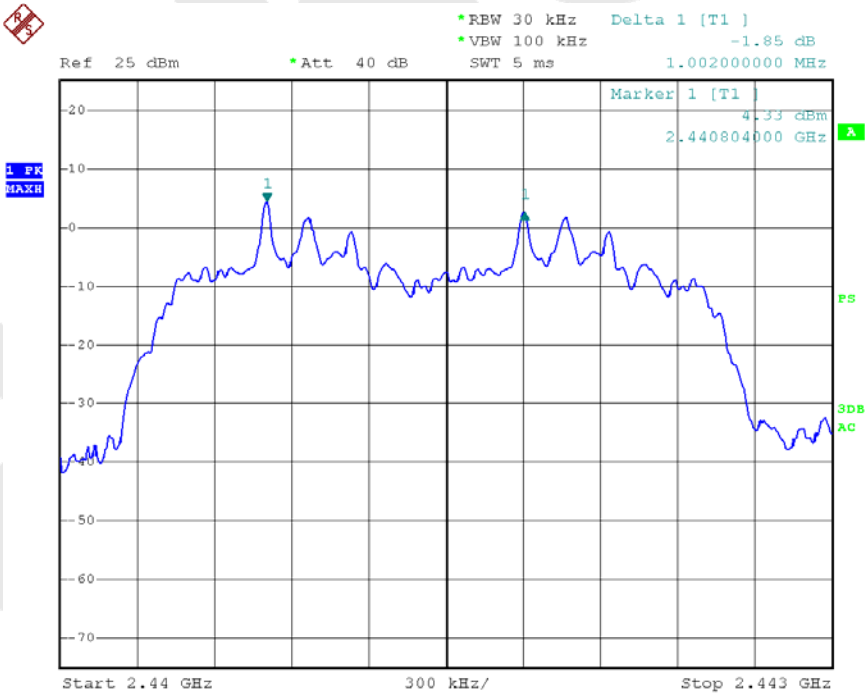


Modulation Mode: π /4DQPSK & 8DPSK

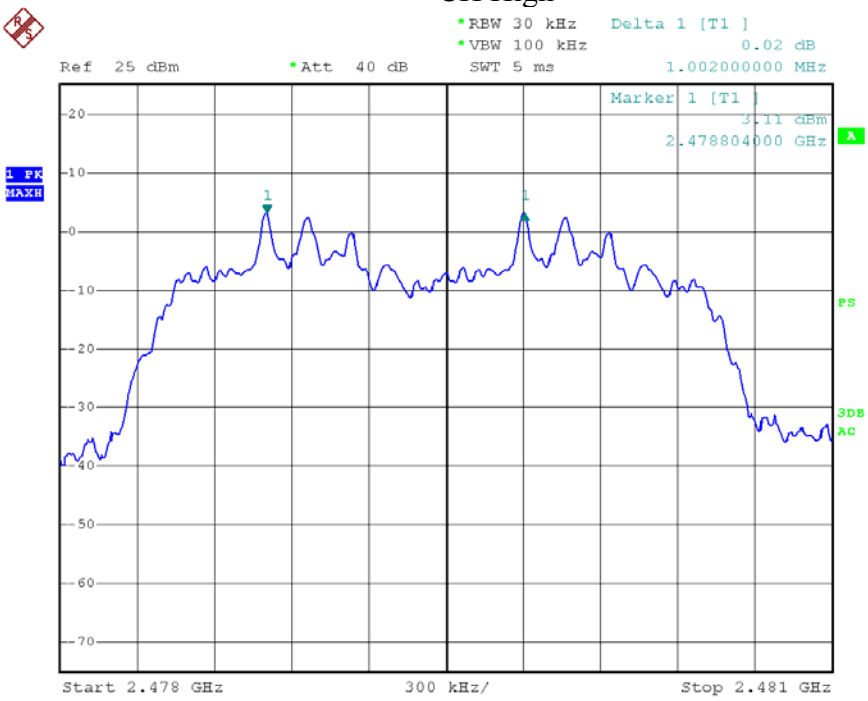
CH Low



CH Mid



CH High

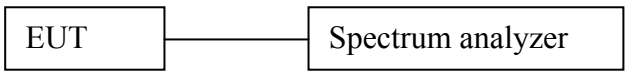

RBW 30 kHz
VBW 100 kHz
SWT 5 ms
Delta 1 [T1]
0.02 dB
1.002000000 MHz
Ref 25 dBm
Att 40 dB
Marker 1 [T1]
3.11 dBm
2.478804000 GHz
1 PK MAXH
A
PS
3DB AC
Start 2.478 GHz
300 kHz/
Stop 2.481 GHz

6. 20DB BANDWIDTH TEST

6.1. Measurement Procedure

The EUT was operating in hopping mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

6.2. Test SET-UP



6.3. 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, 2013	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, 2013	1 Year
7.	EMI Test Software EZ-EMC	SHURPLE	N/A	N/A	N/A	N/A

Radiation Uncertainty : Ur = 4.3dB

6.4. Test Results

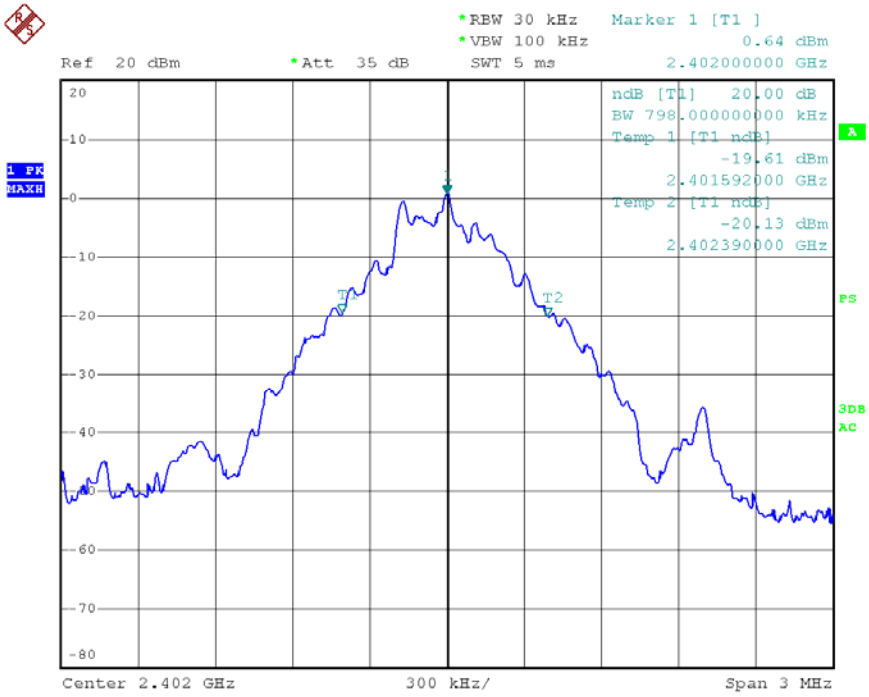
Test Item	:	20dB BW	Test Mode	:	CH Low ~ CH High
Test Voltage	:	DC 7.4V Liion Battery	Temperature	:	24℃
Test Result	:	PASS	Humidity	:	55%RH

Channel	Frequency (MHz)	20dB Down BW(kHz)	Modulation Mode
Low	2401	798	GFSK
Mid	2441	798	GFSK
High	2480	804	GFSK
Low	2401	1242	π /4DQPSK
Mid	2441	1230	π /4DQPSK
High	2480	1230	π /4DQPSK
Low	2401	1242	8DPSK
Mid	2441	1230	8DPSK
High	2480	1230	8DPSK

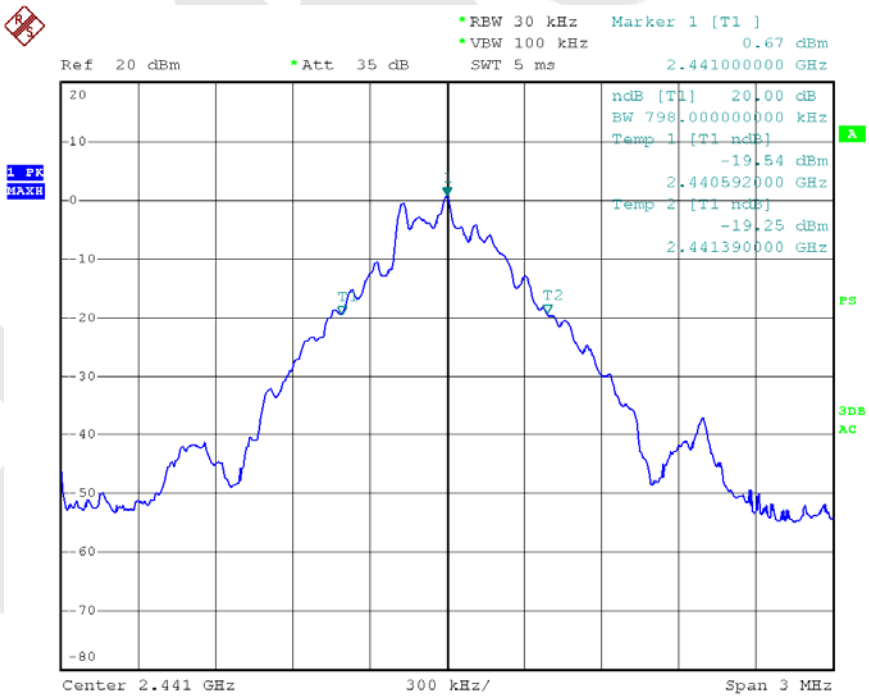
Remark: The results of modulations π /4DQPSK and 8DPSK are the same.

Modulation Mode: GFSK

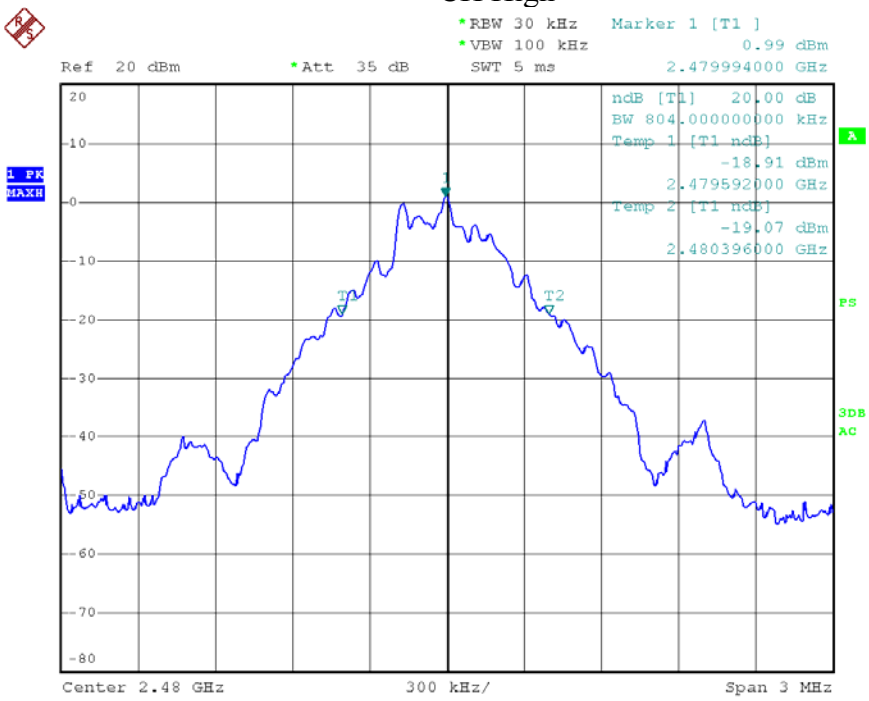
CH Low



CH Mid

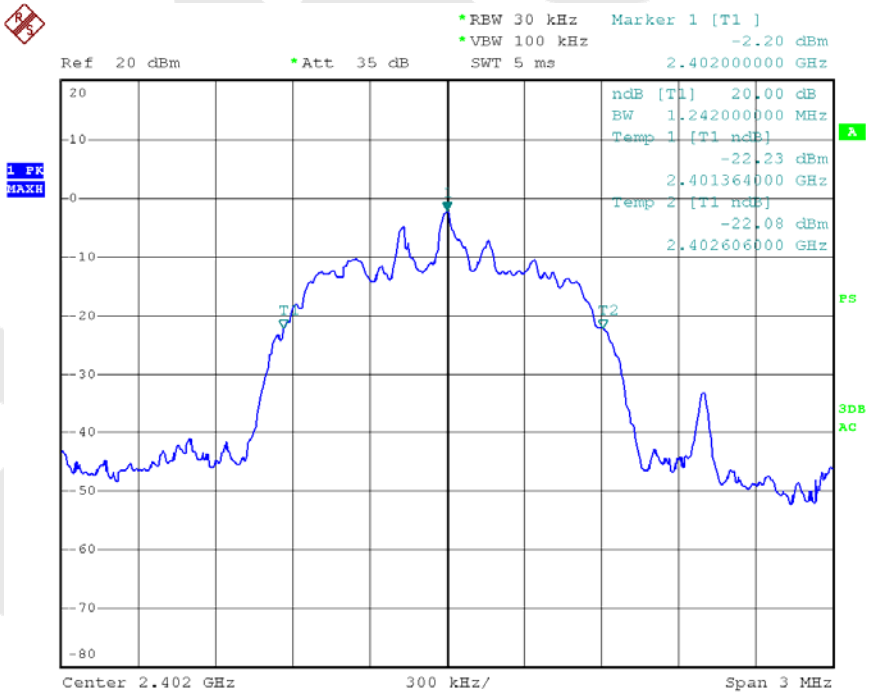


CH High

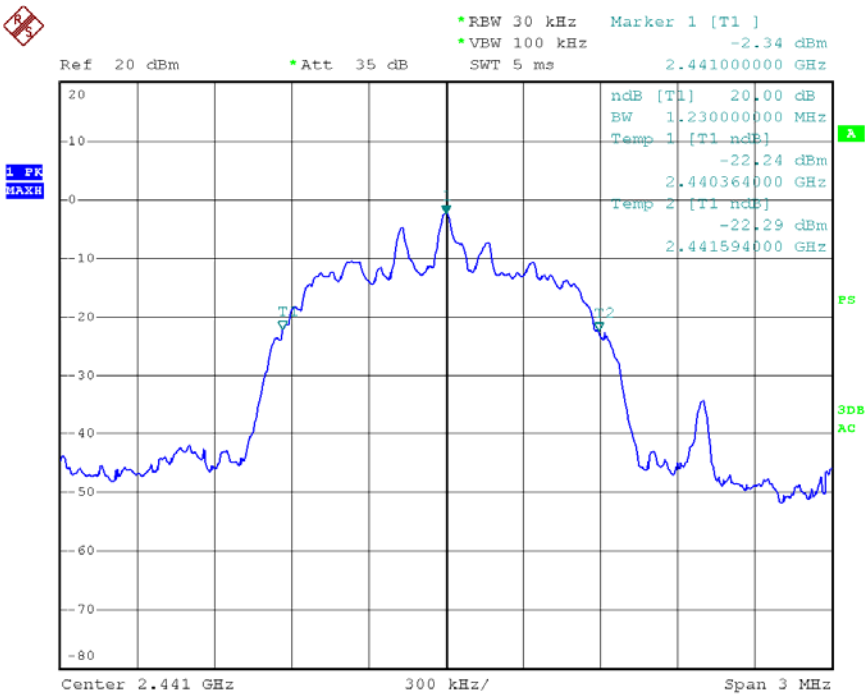


Modulation Mode: π /4DQPSK & 8DPSK

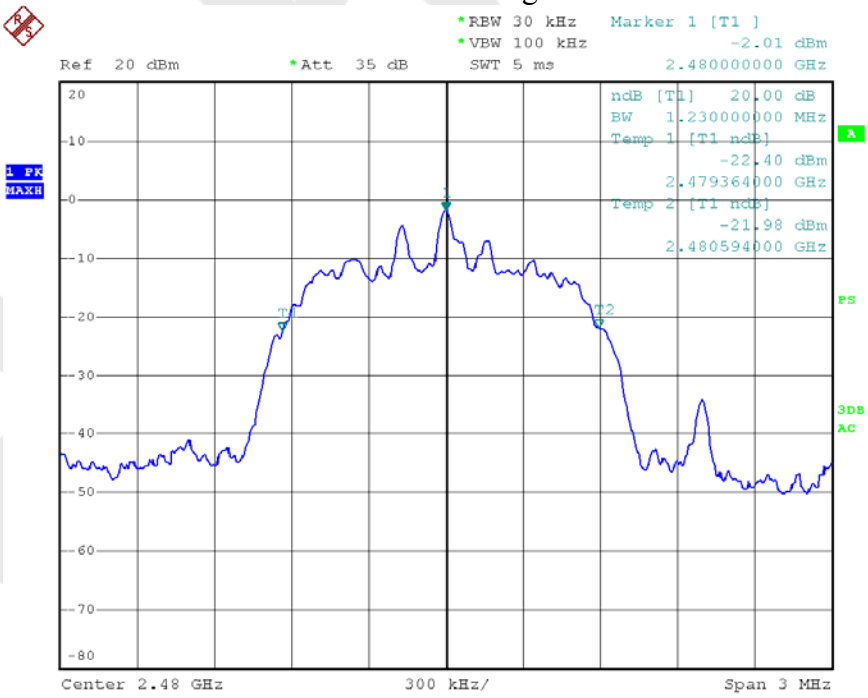
CH Low



CH Mid



CH High



7. QUANTITY OF HOPPING CHANNEL TEST

7.1. Measurement Procedure

The EUT was operating in hopping mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

7.2. Test SET-UP

EUT —— Spectrum analyzer

7.3. Test Equipment

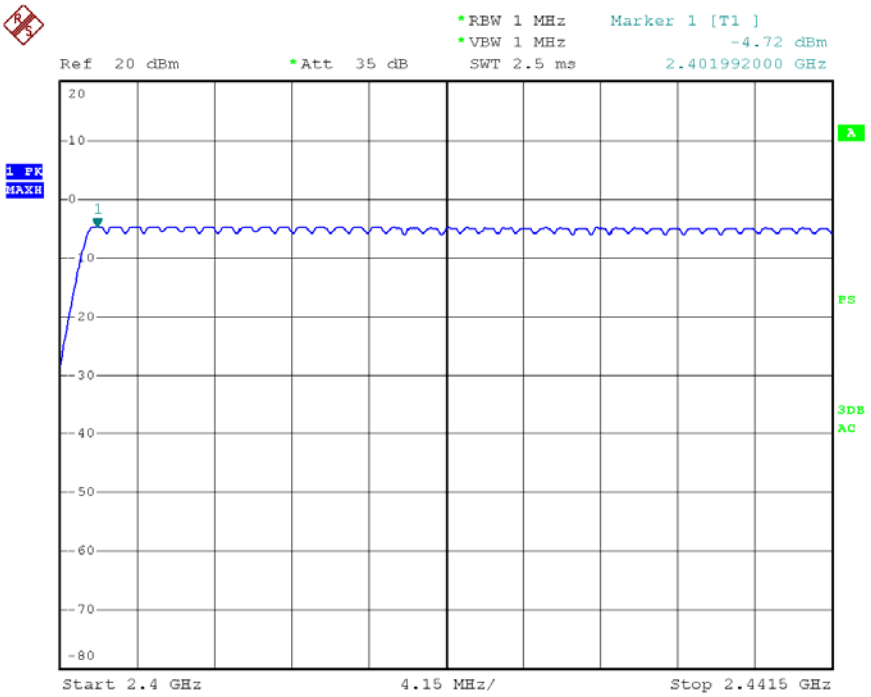
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Spectrum Analysis	Agilent	E4407B	US39390582	Aug. 09, 2013	1 Year
2.	Preamplifier	Instruments corporation	EMC011830	980100	Aug. 09, 2013	1 Year
3.	EMI Test Receiver	Rohde & Schwarz	ESPI	101604	Apr. 23, 2013	1 Year
4.	Double Ridged 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, 2013	1 Year
7.	EMI Test Software EZ-EMC	SHURPLE	N/A	N/A	N/A	N/A

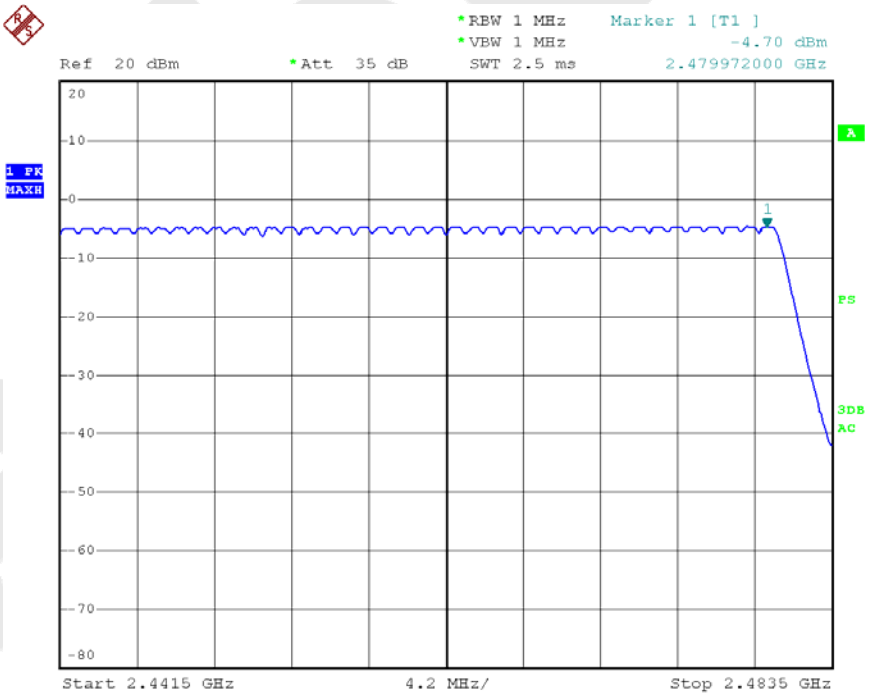
Radiation Uncertainty : Ur = 4.3dB

7.4. Test Results

Test Item	:	Number of Hopping Frequency	Test Mode	:	CH Low ~ CH High
Test Voltage	:	DC 7.4V Liion Battery	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 1 [T1]
-4.72 dBm
2.401992000 GHz
Ref 20 dBm
*Att 35 dB
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 1 [T1]
-4.70 dBm
2.479972000 GHz
Ref 20 dBm
*Att 35 dB
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 was operating in hopping mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

8.2. Test SET-UP

EUT —— Spectrum analyzer

8.3. 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, 2013	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, 2013	1 Year
7.	EMI Test Software EZ-EMC	SHURPLE	N/A	N/A	N/A	N/A

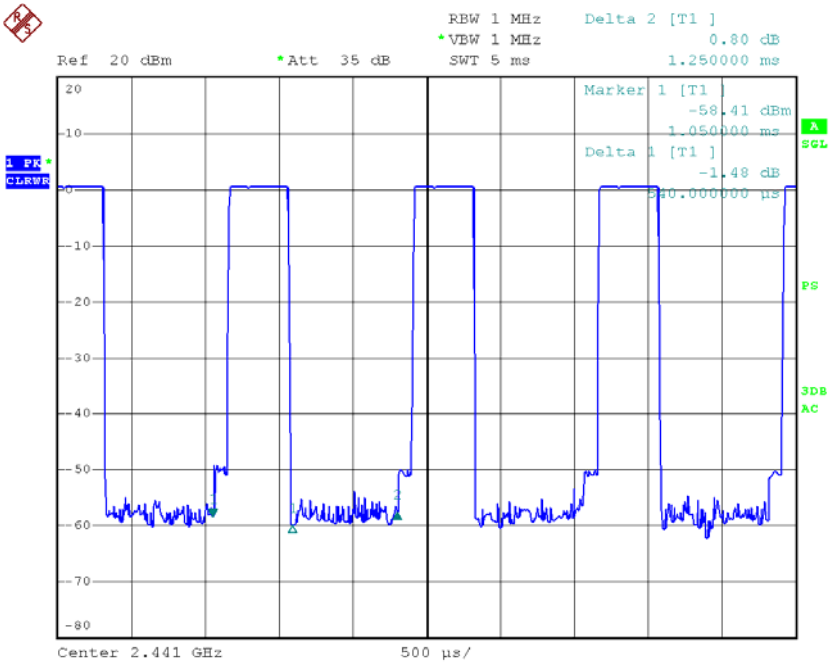
Radiation Uncertainty : Ur = 4.3dB

8.4. Test Results

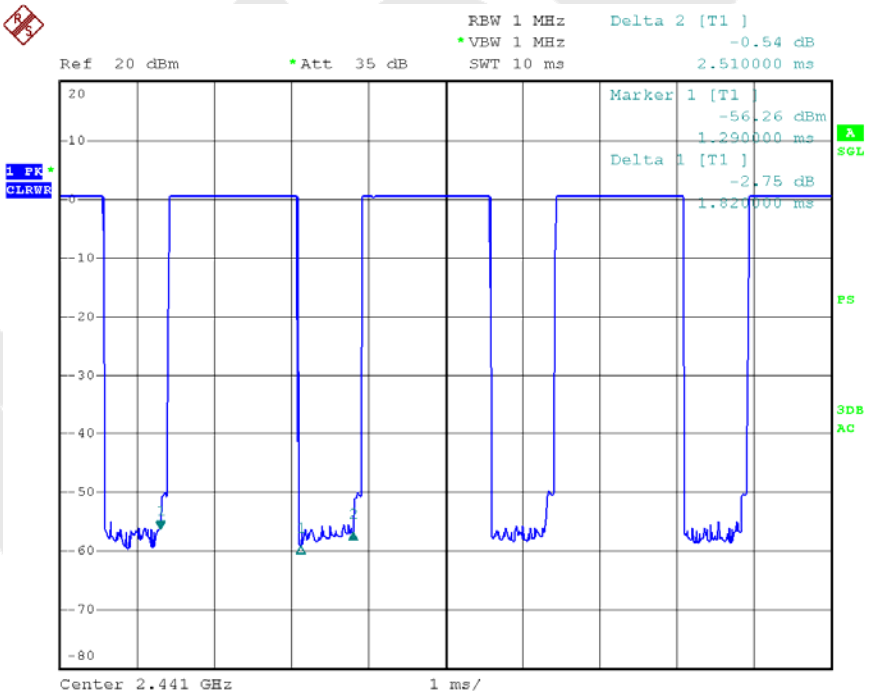
Test Item : Time of Occupancy
Test Voltage : DC 7.4V Liion Battery
Test Result : PASS
Test Mode : CH Low ~ CH High
Temperature : 24℃
Humidity : 55%RH

Package Type	***Pulse width (ms)***	**Time slot length(ms)**	**Dwell time (ms)**	**Limit (s)**
DH1	0.540	time slot length *1600/2 /79 * 31.6	172.80	*0.4*
DH3	1.820	time slot length *1600/4 /79 * 31.6	291.20	*0.4*
DH5	3.100	time slot length *1600/6 /79 * 31.6	330.67	*0.4*

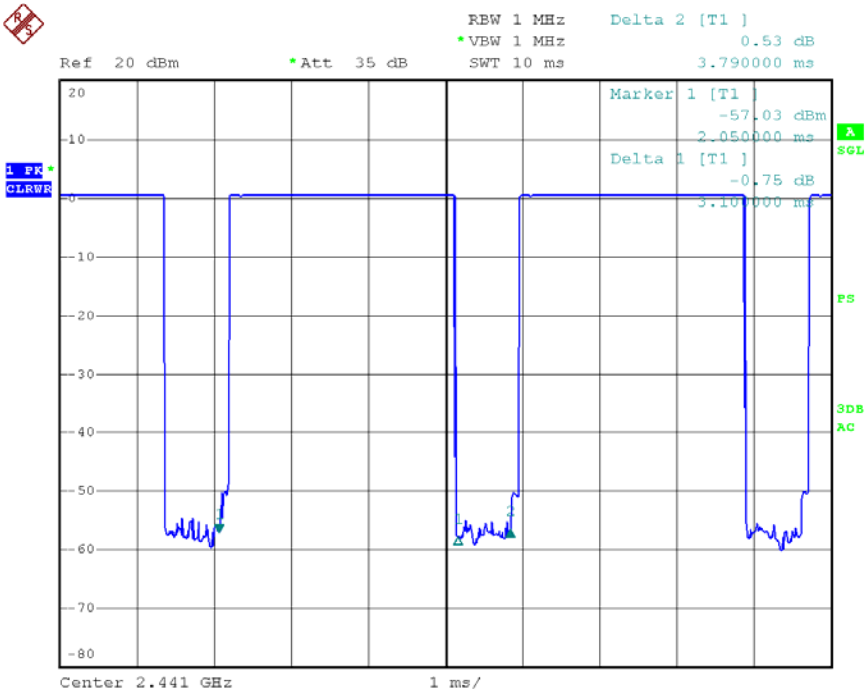
DH1


RBW 1 MHz
*VBW 1 MHz
SWT 5 ms
Delta 2 [T1]
0.80 dB
1.250000 ms
Ref 20 dBm
*Att 35 dB
Marker 1 [T1]
-58.41 dBm
1.050000 ms
Delta 1 [T1]
-1.48 dB
540.000000 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]
-0.54 dB
2.510000 ms
Ref 20 dBm
*Att 35 dB
Marker 1 [T1]
-56.26 dBm
1.290000 ms
Delta 1 [T1]
-2.75 dB
1.820000 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
Ref 20 dBm
Att 35 dB
Delta 2 [T1]
0.53 dB
3.790000 ms
Marker 1 [T1]
-57.03 dBm
2.050000 ms
Delta 1 [T1]
-0.75 dB
3.101000 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.

9.2. Test SET-UP

EUT —— Spectrum analyzer

9.3. 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, 2013	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, 2013	1 Year
7.	EMI Test Software EZ-EMC	SHURPLE	N/A	N/A	N/A	N/A

Radiation Uncertainty : Ur = 4.3dB

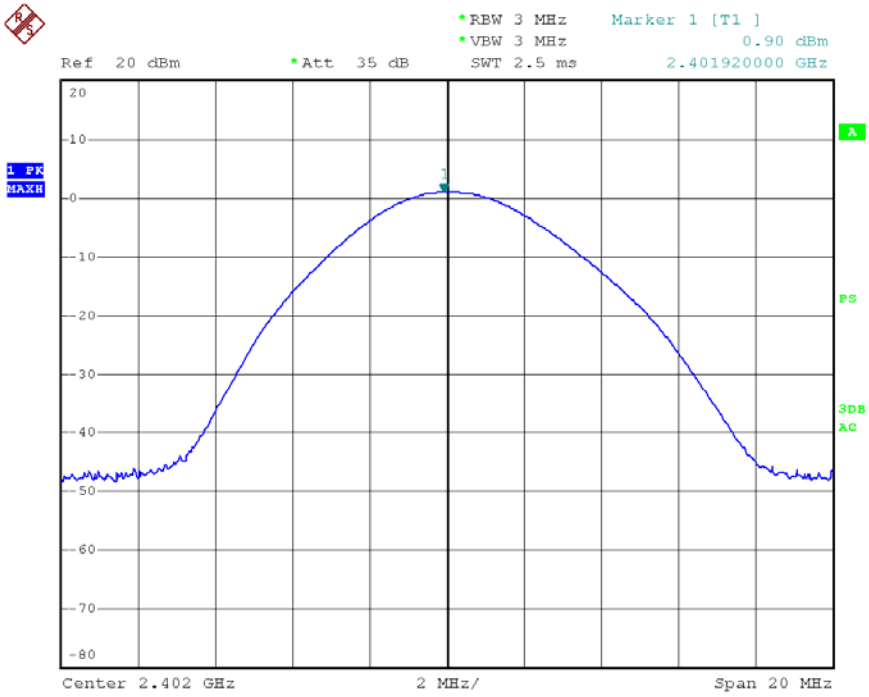
9.4. Test Results

Test Item	:	Max. peak output power	Test Mode	:	CH Low ~ CH High
Test Voltage	:	DC 7.4V Liion Battery	Temperature	:	24℃
Test Result	:	PASS	Humidity	:	55%RH

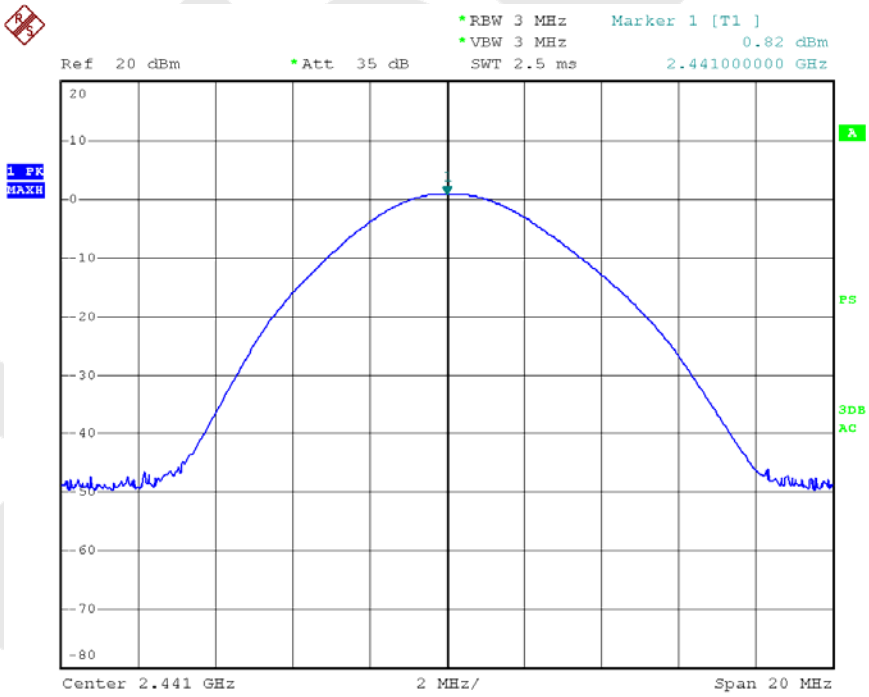
Channel Frequency (MHz)	Peak Power output(mW)	Peak Power output(dBm)	Peak Power Limit(mW)	Results	Modulation
2402	1.24	0.90	125	PASS	GFSK
2441	1.21	0.82	125	PASS	GFSK
2480	**1.33**	**1.21**	125	PASS	GFSK
2402	0.77	-1.19	125	PASS	π /4DQPSK
2441	0.71	-1.54	125	PASS	π /4DQPSK
2480	0.75	-1.26	125	PASS	π /4DQPSK
2402	0.77	-1.19	125	PASS	8DPSK
2441	0.71	-1.54	125	PASS	8DPSK
2480	0.75	-1.26	125	PASS	8DPSK

Modulation Mode: GFSK

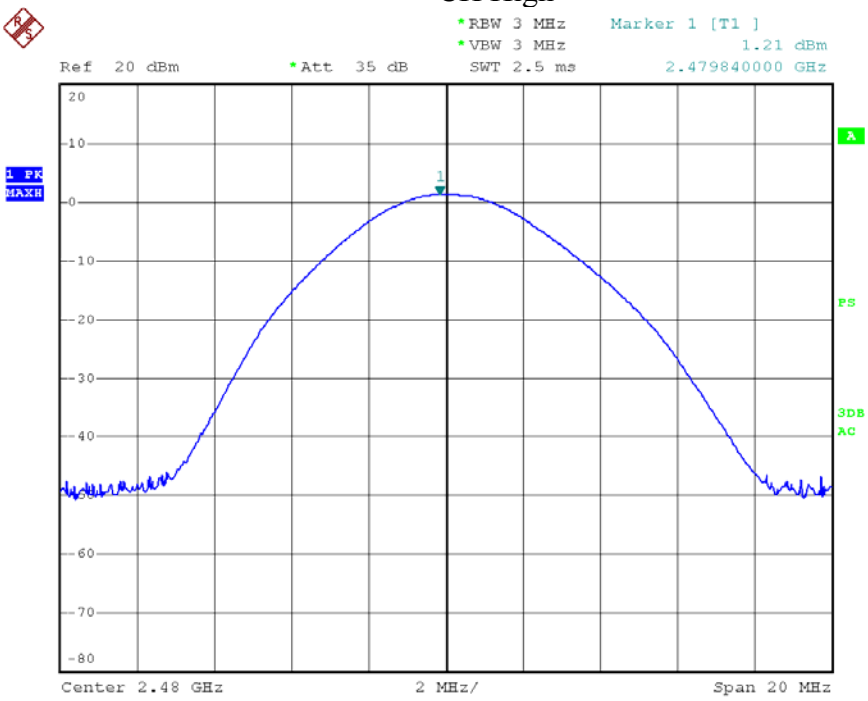
CH Low



CH Mid

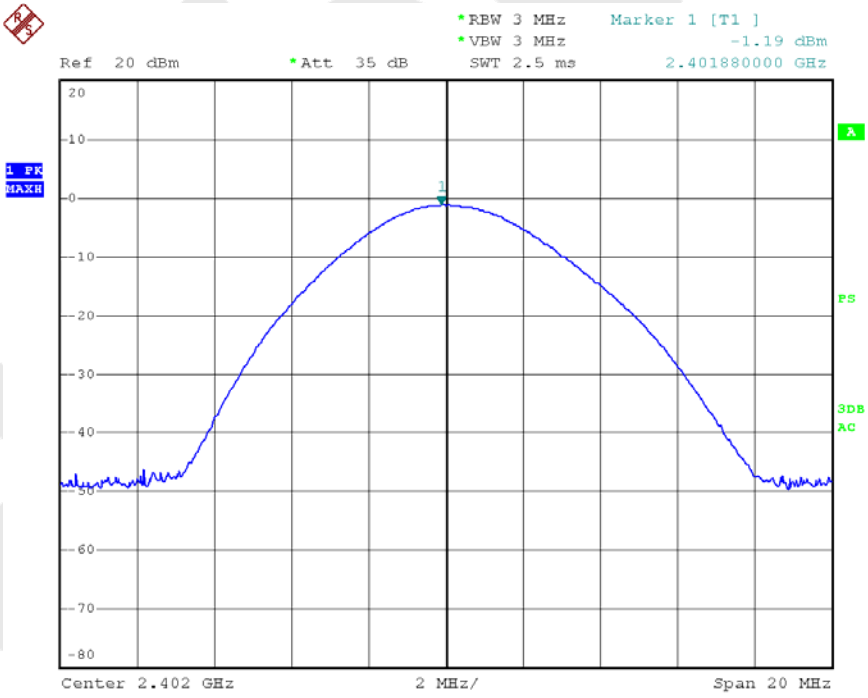


CH High

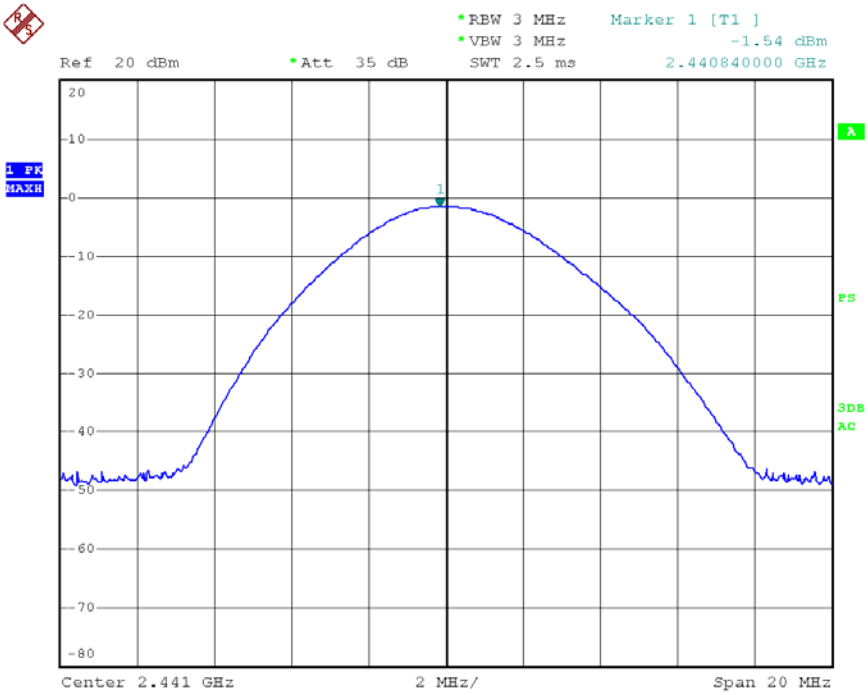


Modulation Mode: π /4DQPSK & 8DPSK

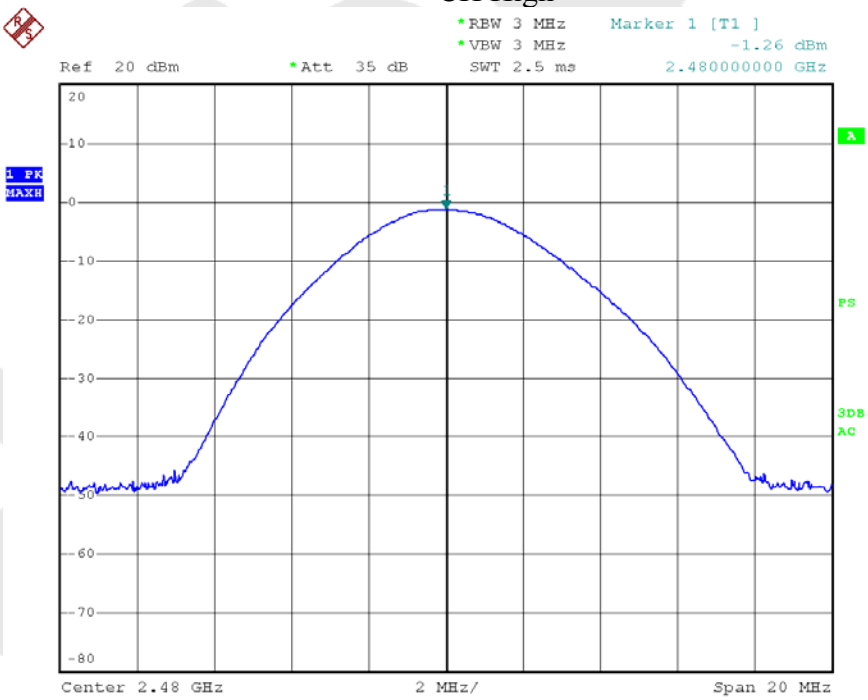
CH Low



CH Mid



CH High



10. BAND EDGE TEST

10.1. Measurement Procedure

1. The EUT was Operating in hopping mode or could be controlled its channel. Printed out test result from the spectrum by hard copy function.
2. The EUT was placed on a turn table which is 0.8m above ground plane.
3. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
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 measured were complete.

10.2. Test SET-UP

Same as the radiated emission test.

10.3. 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, 2013	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, 2013	1 Year
7.	EMI Test Software EZ-EMC	SHURPLE	N/A	N/A	N/A	N/A

Radiation Uncertainty : Ur = 4.3dB

10.4. Test Results

Pass.

Please refer the following data.

Test Item	:	Band eadge	Test Mode	:	CH Low ~ CH High
Test Voltage	:	DC 7.4V Liion Battery	Temperature	:	24℃
Test Result	:	PASS	Humidity	:	55%RH

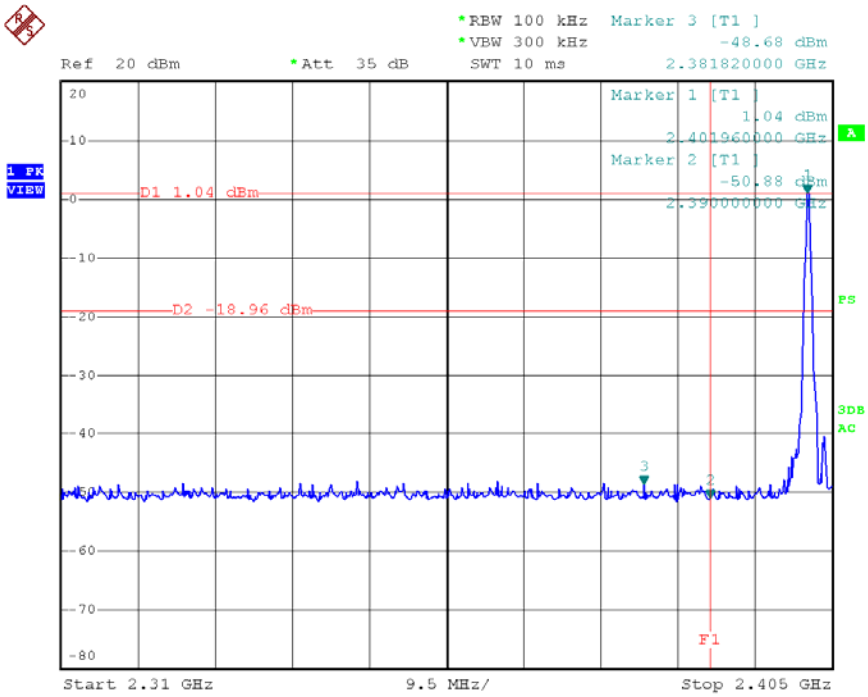
1. Conducted Test

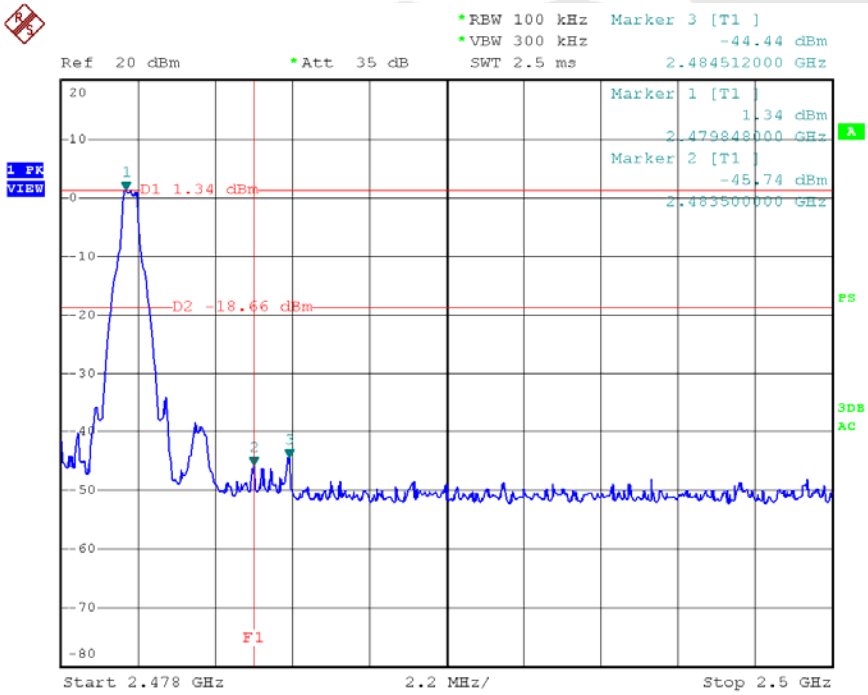
Frequency (MHz)	Peak Power Output(dBm)	Emission read Value(dBm)	Result of Band edge(dBc)	Band edge Limit(dBc)	Modulation
<2400	1.04	-48.68	49.72	>20dBc	GFSK
	-1.61	-45.16	43.55	>20dBc	π /4DQPSK
	-1.61	-45.16	43.55	>20dBc	8DPSK
>2483.5	1.34	-45.74	47.08	>20dBc	GFSK
	-1.74	-47.92	46.18	>20dBc	π /4DQPSK
	-1.74	-47.92	46.18	>20dBc	8DPSK

2. Radiated emission Test

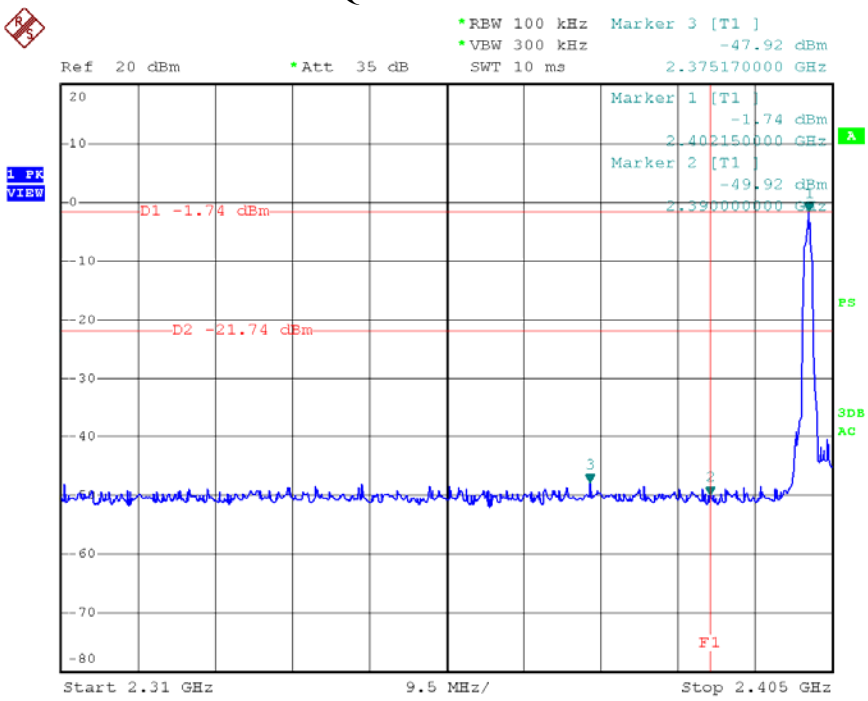
Frequency (MHz)	Antenna polarization (H/V)	Emission (dBuV/m)		Band edge Limit (dBuV/m)		Modulation
		PK	AV	PK	AV	
<2400	V	57.22	37.29	74.00	54.00	GFSK
	V	53.19	38.06	74.00	54.00	π /4DQPSK
	V	52.12	35.77	74.00	54.00	8DPSK
>2483.5	V	51.03	38.12	74.00	54.00	GFSK
	V	53.11	36.65	74.00	54.00	π /4DQPSK
	V	50.95	38.74	74.00	54.00	8DPSK

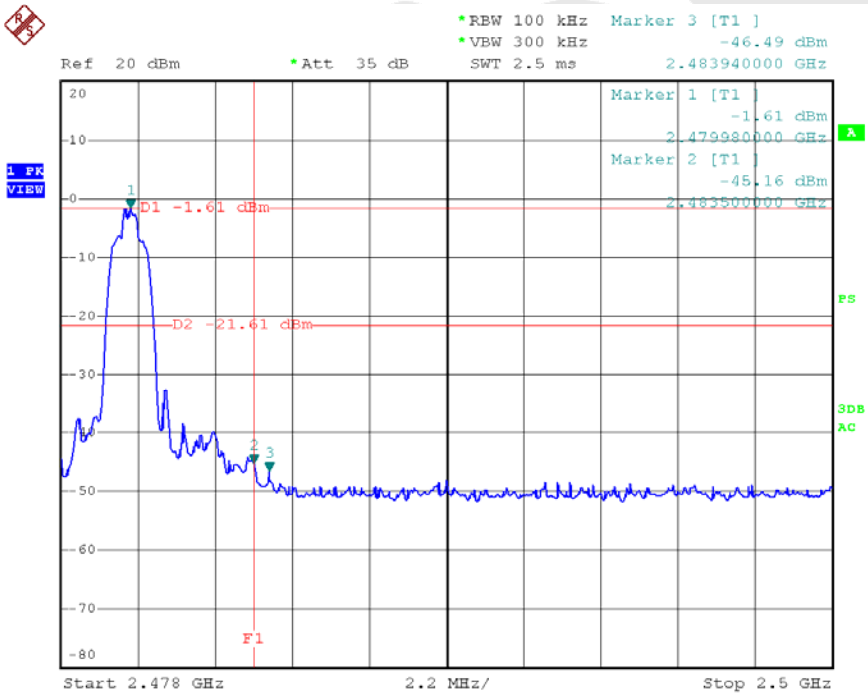
Modulation Mode: GFSK





Modulation Mode: π /4DQPSK & 8DPSK





11. ANTENNA APPLICATION

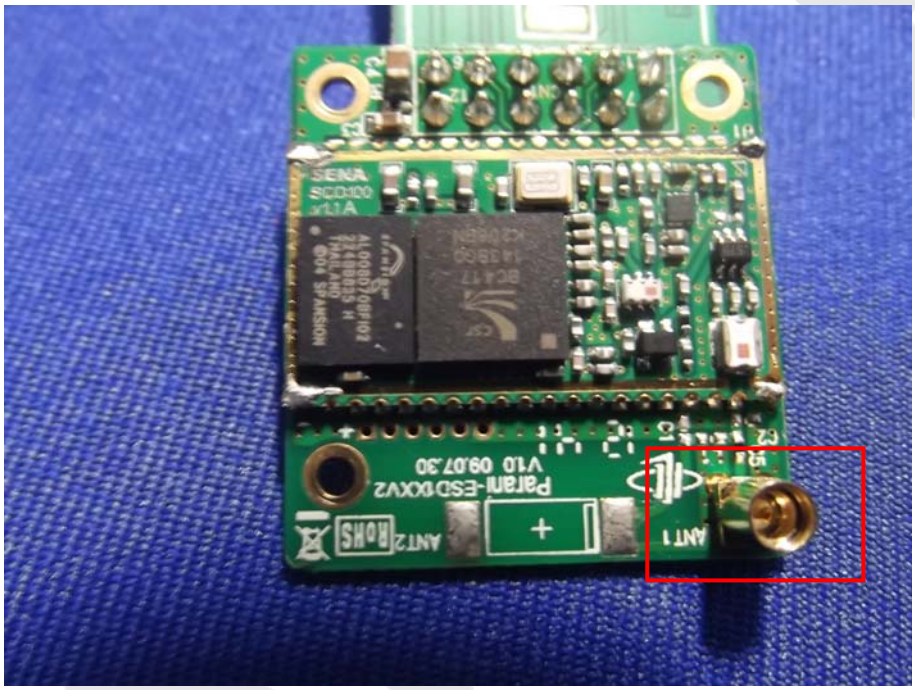
11.1. Antenna requirement

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

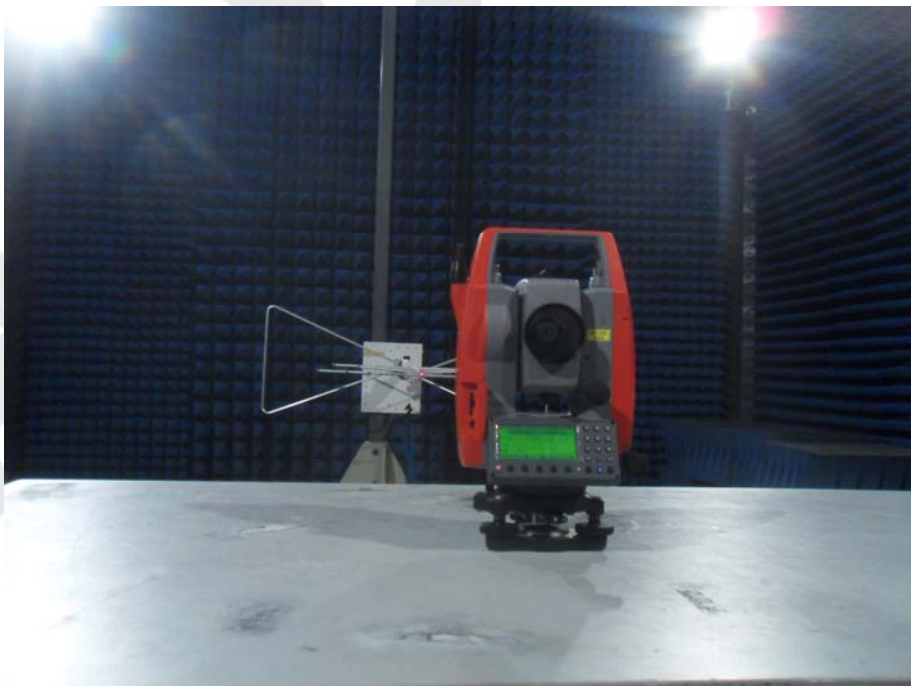
The EUT's antenna used a chip antenna and integrated on PCB, The antenna's gain is 0dBi and meets the requirement.

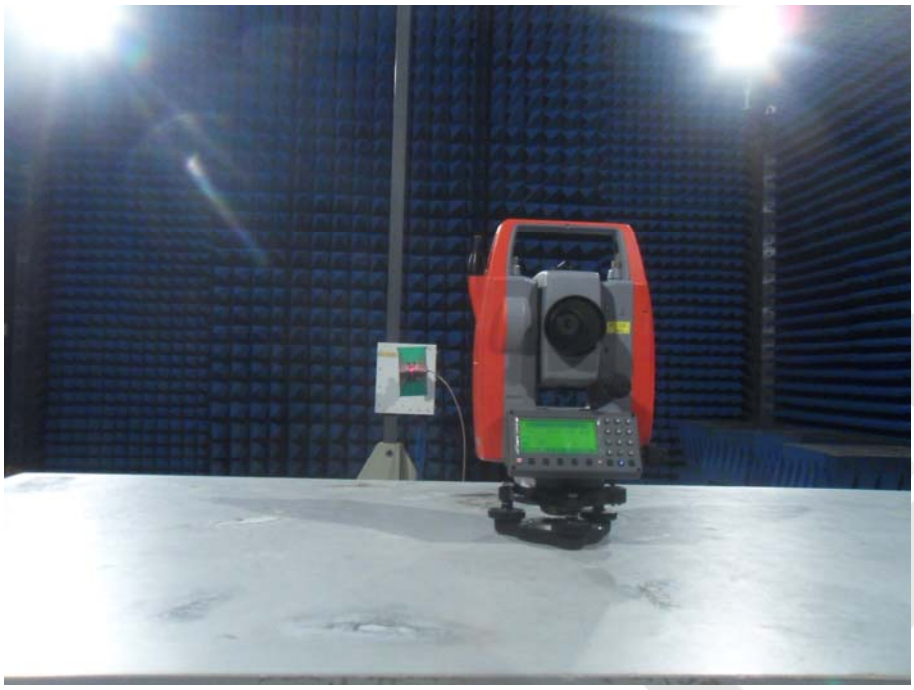


12. PHOTOGRAPH

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-Front View

Figure 3
The EUT-Back View

APPENDIX Ⅱ(Internal Photos)

Figure 4
The EUT-Inside View

Figure 5
PCB of the EUT-Front View

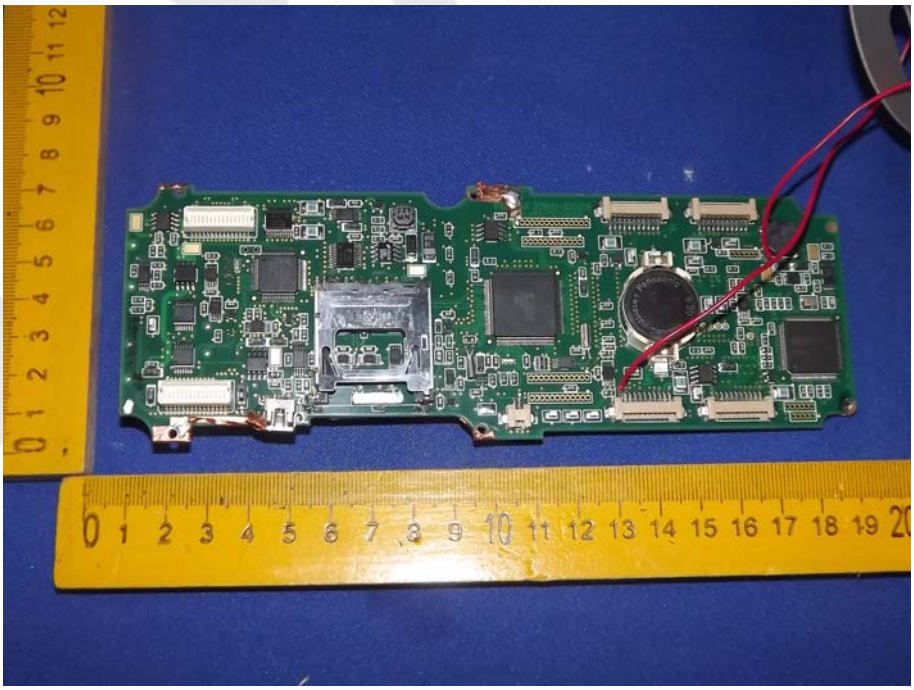


Figure 6
PCB of the EUT-Back View

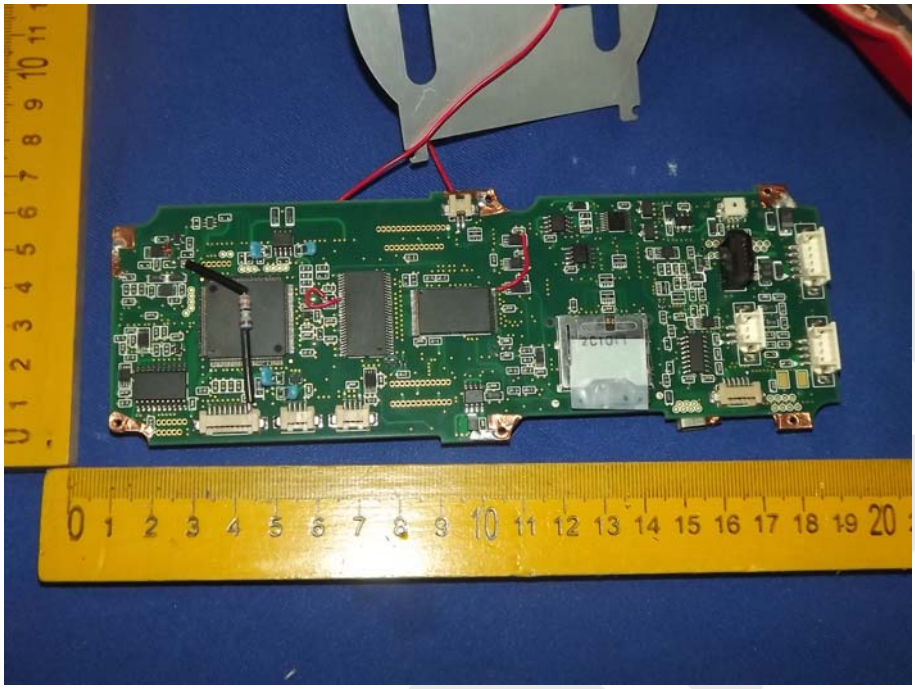


Figure 7
PCB of the EUT-Front View

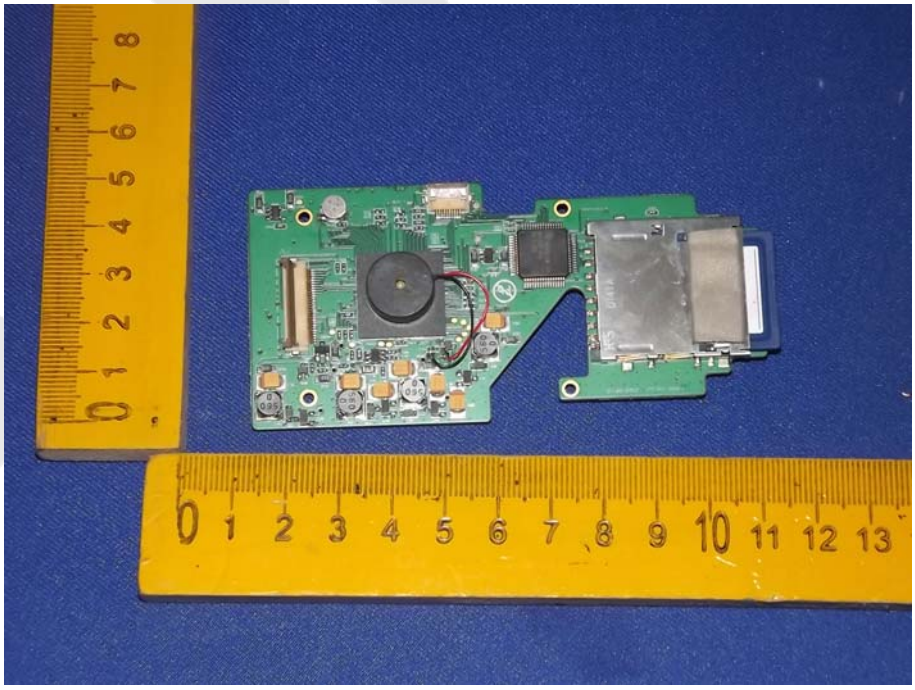


Figure 8
PCB of the EUT-Back View

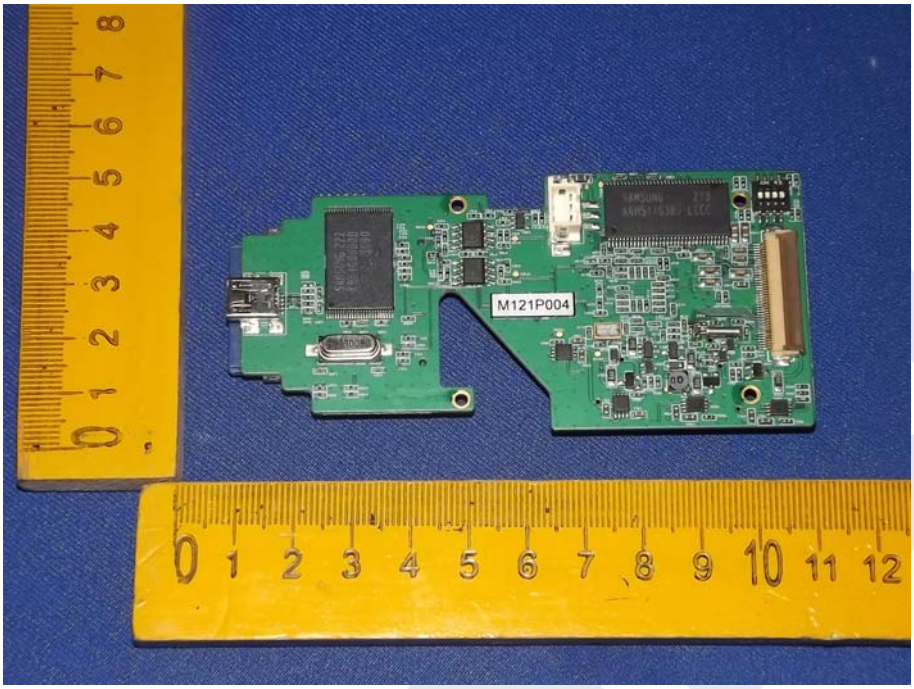


Figure 9
PCB of the EUT-Front View

Figure 10
PCB of the EUT-Back View

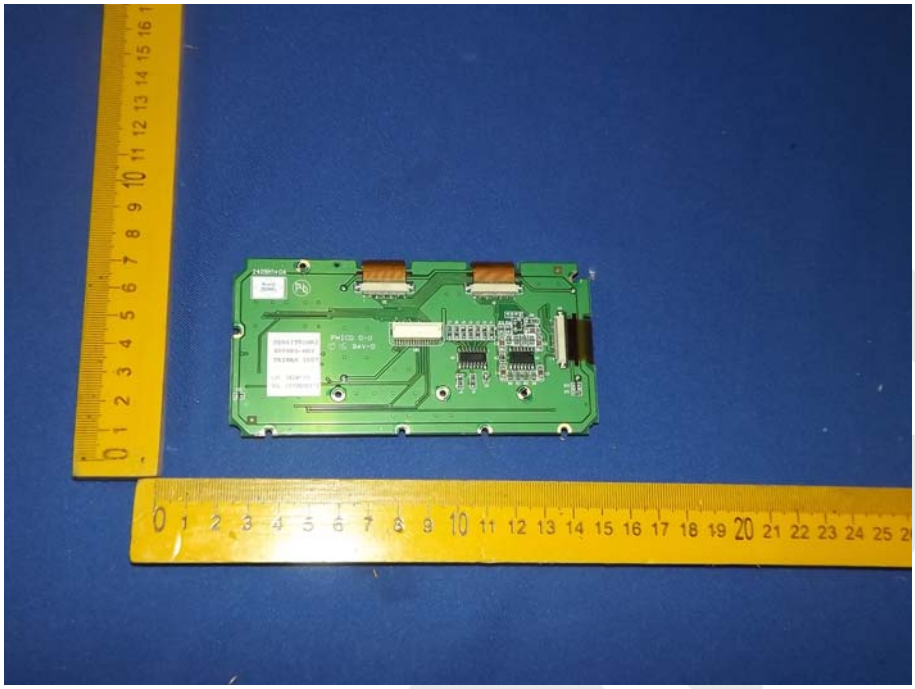


Figure 11
PCB of the EUT-Front View

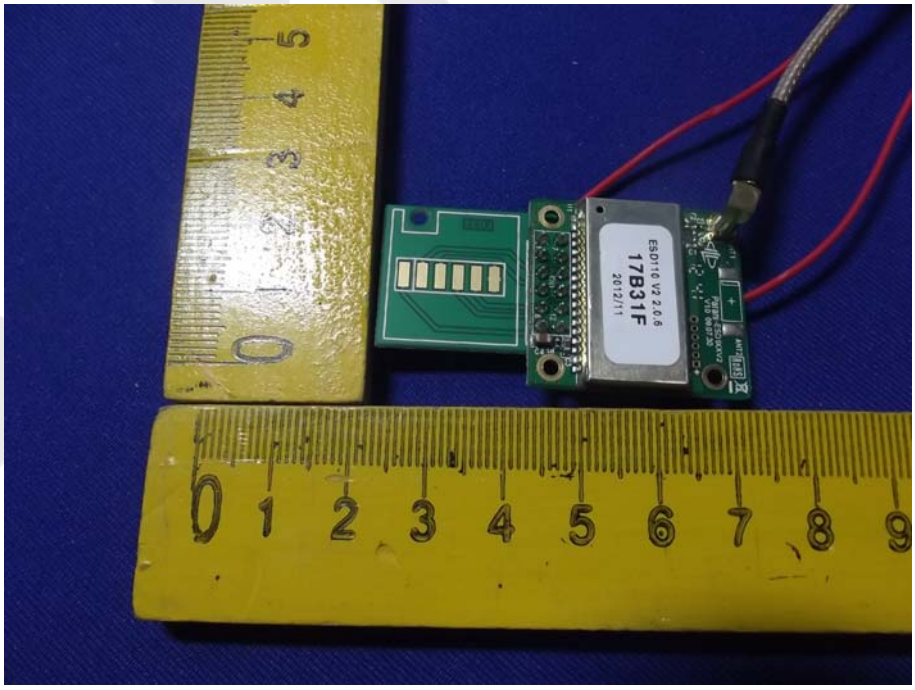


Figure 12
PCB of the EUT-Back View

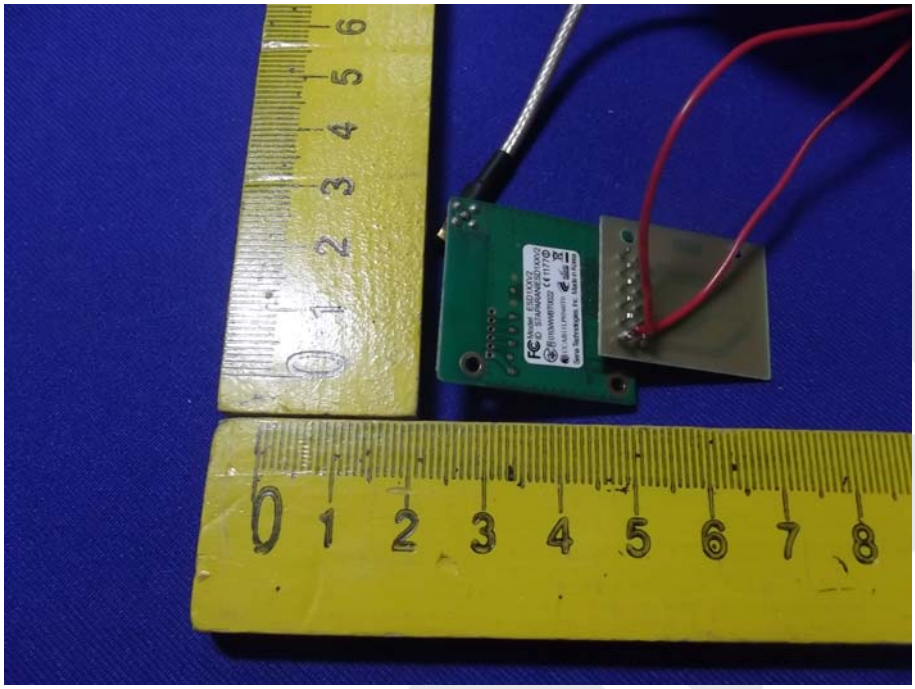
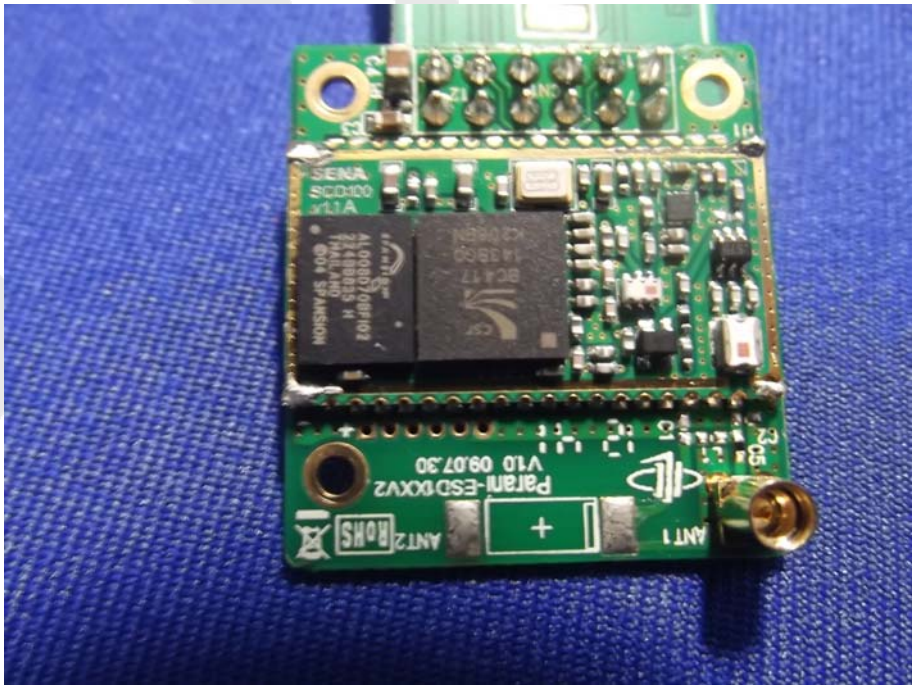



Figure 13
PCB of the BT Module View