

FCC Test Report

Part 15 subpart C

Client Information:

Applicant: Ingigolab Pte. LTD

Applicant add.: 1 Coleman Street #08-07 The Adelphi Singapore 179803

Product Information:

EUT Name: Cardberry card

Model No.: Cardberry_nRF51

Brand Name: electronic card

FCC ID: 2ALWTCardberrynRF51

Standards: FCC PART 15 Subpart C: 2016 section 15.247

Test procedure used: ANSI C63.10-2013

Prepared By:

Shenzhen ZCT Technology Co.,Ltd.

Add. : 3/F., Building 5, Hongsheng Industrial Zone, Bao'an Road, Xixiang Street, Bao'an District, Shenzhen, Guangdong, China.

Date of Receipt: Apr. 01, 2017

Date of Test: Apr. 01~11, 2017

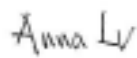
Date of Issue: Apr. 12, 2017

Test Result: Pass

This device described above has been tested by Shenzhen ZCT Technology Co.,Ltd. and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

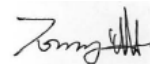
*This test report must not be used by the client to claim product endorsement by any agency of the U.S. government.

Test Engineer:



(Anna Lv)

Reviewed By:



(Tomy Wu)

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2 Test Summary

2.1 Compliance with FCC Part 15 subpart C

Test	Test Requirement	Standard Paragraph	Result
Antenna Requirement	FCC Part 15 C:2016	Section 15.247(c)	PASS
Conduction Emissions	FCC Part 15 C:2016	Section 15.207(a)	PASS
Radiated Emissions	FCC Part 15 C:2016	Section 15.247(d)	PASS
Occupied Bandwidth	FCC Part 15 C:2016	Section 15.247(a)(2)	PASS
Peak power density	FCC Part 15 C:2016	Section 15.247(e)	PASS
Maximum Peak Output Power	FCC Part 15 C:2016	Section 15.247(b)(1)	PASS
Band edge	FCC Part 15 C:2016	Section 15.247(d)	PASS
Conducted Spurious Emissions	FCC Part 15 C:2016	Section 15.247(d)	PASS
Note:			
(1)	Reference to the KDB 558074 D01 DTS Meas Guidance v03r05.		
(2)	Reference to ANSI C63.10:2013.		

2.2 Test Location

All tests were performed at:

Dongguan Yaxu (AiT) Technology Limited
No.22, Jinqianling Third Street, Jitigang, Huangjiang,Dongguan, Guangdong, China
Tel.: +86.769.82020499 Fax.: +86.769.82020495

The FCC Registration No. of Dongguan Yaxu (AiT) Technology Limited is 248337.

2.3 Measurement Uncertainty

All measurements involve certain levels of uncertainties, The following measurements uncertainty Levels have estimated based on ANSI C63.10:2013, the maximum value of the uncertainty as below

No.	Item	Uncertainty
1	Conducted Emission Test	1.20dB
2	Radiated Emission Test	3.30dB

3 General Information

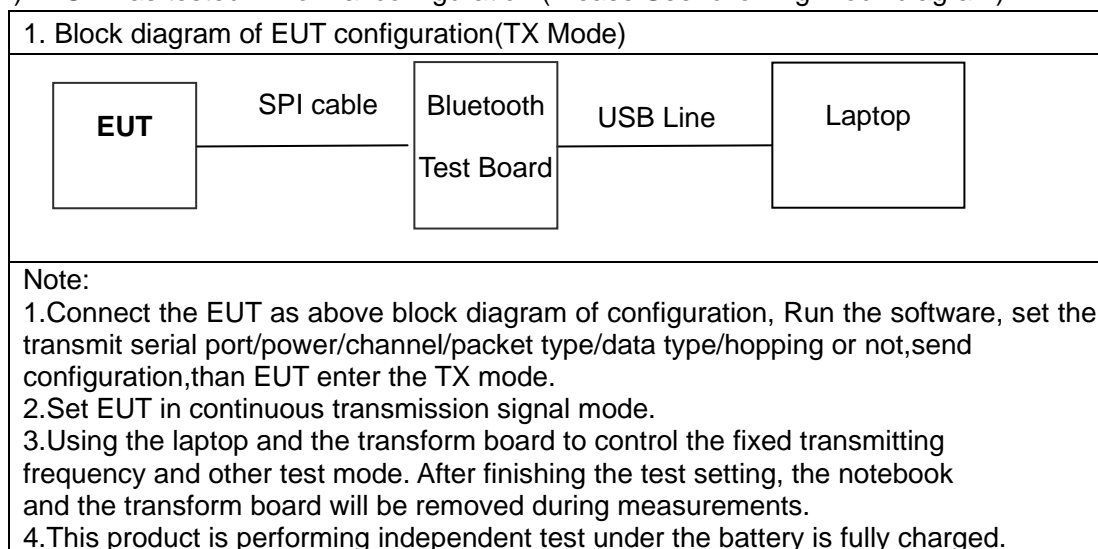
3.1 General Description of EUT

Manufacturer:	Ingigolab Pte. LTD
Manufacturer Address:	1 Coleman Street #08-07 The Adelphi Singapore 179803
EUT Name:	Cardberry card
Model No:	Cardberry_nRF51
Derivative model No.:	--
Brand Name:	electronic card
Operation frequency:	2402 MHz to 2480 MHz
NUMBER OF CHANNEL:	40
Modulation Technology:	GFSK(1Mbps)
Bluetooth version:	Bluetooth 4.0 single Smart (BLE)
Antenna Type:	FPCB Antenna
Antenna Gain:	Maximum 0dBi
Power Supply Range:	DC power
Power Supply:	DC power from cardberry, AC 120V/60Hz for adapter
Power Cord:	N/A
Output power (max) :	2.89dBm
Model description:	Therefore only one model Cardberry_nRF51 was tested in this report.
Note:	
1.	For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

Description of Channel:			
Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	2402	20	2442
01	2404	21	2444
02	2406	22	2446
03	2408	23	2448
04	2410	24	2450
05	2412	25	2452
06	2414	26	2454
07	2416	27	2456
08	2418	28	2458
09	2420	29	2460
10	2422	30	2462
11	2424	31	2464
12	2426	32	2466
13	2428	33	2468
14	2430	34	2470
15	2432	35	2472
16	2434	36	2474
17	2436	37	2476
18	2438	38	2478
19	2440	39	2480

3.2 Description of Test conditions

- (1) EUT was tested in normal configuration (Please See following Block diagram)



- (2) E.U.T. test conditions:

15.31(e): For intentional radiators, measurements of the variation of the input power or the adiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

- (3) Test frequencies:

According to the 15.31(m) Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and. If required reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table:

Frequency range over which device operates	Number of frequencies	Location in the range of operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near top and 1 near bottom
More than 10 MHz	3	1 near top, 1 near middle and 1 near bottom

- (4) Frequency range of radiated measurements:

According to the 15.33, the test range will be up to the tenth harmonic of the highest fundamental frequency.

- (5) The radiation measurements are performed in X, Y, Z axis positioning. And found the X axis positioning which it is worse case, only the test worst case mode is recorded in the report.

3.3 Test Peripheral List

No.	Equipment	Manufacturer	EMC Compliance	Model No.	Serial No.	Power cord	signal cable
1	Lap top	ASUS	N/A	X401A	X16-96072	N/A	N/A
2	Adapter (laptop)	ASUS	N/A	EXA0703 YH	N/A	1.8m/unshielded /detachable	N/A
3	Bluetooth Test Board	N/A	N/A	N/A	N/A	N/A	N/A
4	Adapter	N/A	N/A	SCO602B TA	N/A	0.8m x 2 wires unscreened	N/A

3.4 EUT Peripheral List

No.	Equipment	Manufacturer	EMC Compliance	Model No.	Serial No.	Power cord	Remark
1	USB cable	N/A	N/A	N/A	N/A	0.4m/unshielded /detachable	N/A
2	Cardberry	N/A	N/A	N/A	N/A	N/A	N/A

4 Equipments List for All Test Items

No	Test Equipment	Manufacturer	Model No	Serial No	Cal. Date	Cal. Due Date
1	Spectrum Analyzer	ADVANTEST	R3182	150900201	2016.06.29	2017.06.28
2	EMI Measuring Receiver	Schaffner	SCR3501	235	2016.06.29	2017.06.28
3	Low Noise Pre Amplifier	Tsj	MLA-10K01-B01-27	1205323	2016.06.29	2017.06.28
4	Low Noise Pre Amplifier	Tsj	MLA-0120-A02-34	2648A04738	2016.06.29	2017.06.28
5	TRILOG Super Broadband test Antenna	SCHWARZBECK	VULB9160	9160-3206	2016.06.29	2017.06.28
6	Broadband Horn Antenna	SCHWARZBECK	BBHA9120D	452	2016.06.29	2017.06.28
7	SHF-EHF Horn Antenna	SCHWARZBECK	BBHA9170	BBHA9170367	2016.06.29	2017.06.28
8	50Ω Coaxial Switch	Anritsu	MP59B	6200264416	2016.06.29	2017.06.28
9	EMI Test Receiver	R&S	ESCI	100124	2016.06.29	2017.06.28
10	LISN	Kyoritsu	KNW-242	8-837-4	2016.06.29	2017.06.28
11	LISN	Kyoritsu	KNW-407	8-1789-3	2016.06.29	2017.06.28
12	50Ω Coaxial Switch	Anritsu	MP59B	6200264417	2016.06.29	2017.06.28
13	Loop Antenna	ARA	PLA-1030/B	1029	2016.06.29	2017.06.28
14	EMI Test Receiver	Rohde & Schwarz	ESIB26	100394	2016.06.29	2017.06.28
15	Radiated Cable 1# (30MHz-1GHz)	FUJIKURA	5D-2W	01	2016.06.29	2017.06.28
16	Radiated Cable 2# (1GHz -25GHz)	FUJIKURA	10D2W	02	2016.06.29	2017.06.28
17	Conducted Cable 1#(9KHz-30MHz)	FUJIKURA	1D-2W	01	2016.06.29	2017.06.28
18	SMA Antenna connector (Impedance:50OHM, cable loss:0.5dBm)	Dosin	Dosin-SMA	N/A	N/A	N/A
19	Semi an-echoic chamber	SAEMC	9*6*6	N/A	2015.03.17	2017.03.17

Note: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

5 Test Result

5.1 Antenna Requirement

5.1.1 Standard requirement

15.203 requirement: For intentional device, according to 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.

5.1.2 EUT Antenna

The antenna is FPCB Antenna board and no consideration of replacement. Antenna gain is maximum 0 dBi from 2.4GHz to 2.5GHz.

5.2 Conduction Emissions Measurement

5.2.1 Applied procedures / Limit

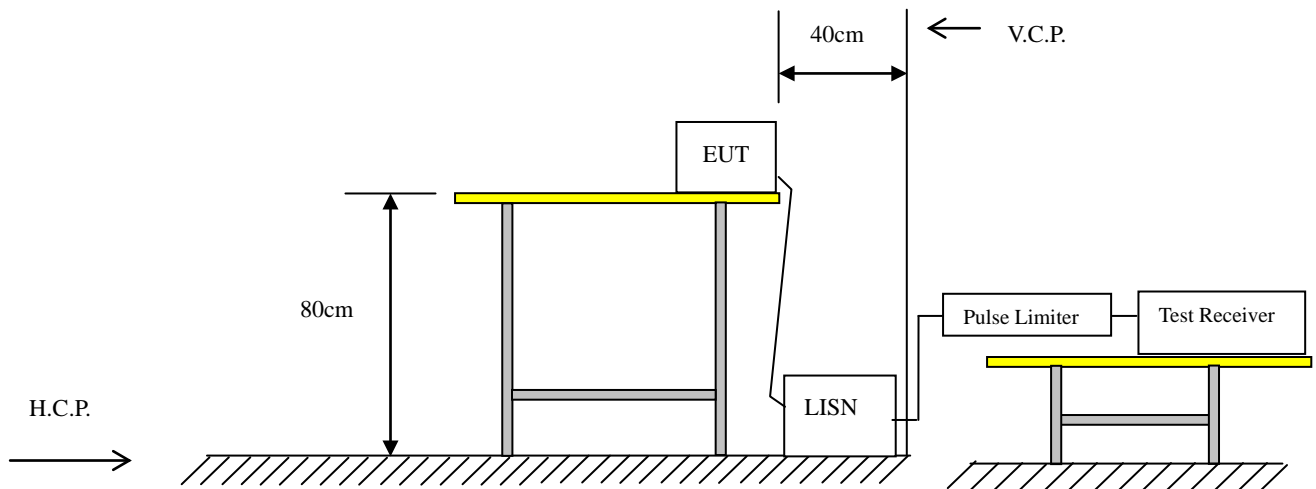
Frequency of Emission (MHz)	Conducted Limit (dB μ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

Note: Decreases with the logarithm of the frequency.

5.2.2 Test procedure

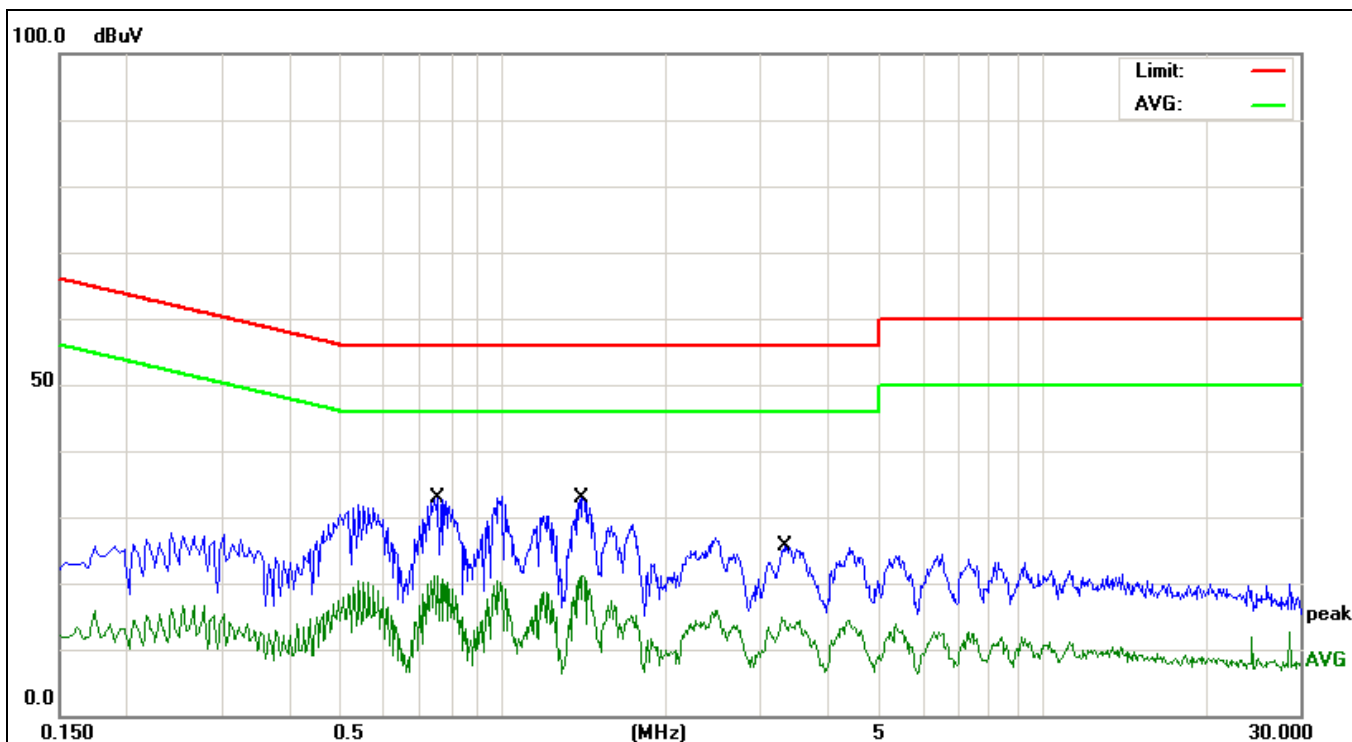
EUT was placed upon a wooden test table 0.8m above the horizontal metal reference plane and 0.4m from the Vertical ground plane, and it was connected to an AMN. The closest distance between the boundary of the EUT and the surface of the AMN is 0.8m. All peripherals were connected to another AMN, and placed at a distance of 10cm from each other. A spectrum and receiver was connected to the RF output port of the AMN. Both average and quasi-peak value were detected.

5.2.3 Test setup



5.2.4 Test results

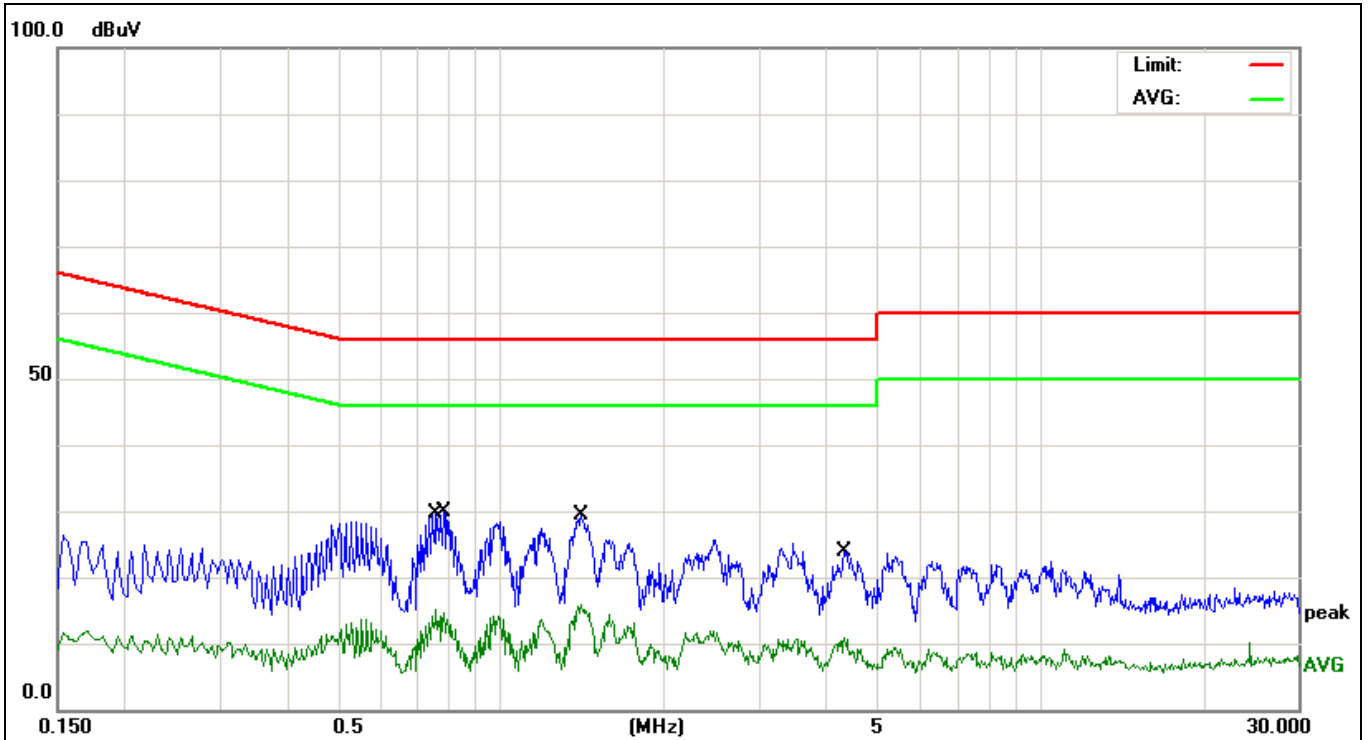
EUT:	CARDBERRY CARD	Model Name. :	CARDBERRY_NRF51
Temperature:	26 °C	Relative Humidity:	54%
Pressure:	1010hPa	Test Date :	2017-04-10
Test Mode:	TX CH00 (worst case)	Phase :	Line
Test Voltage :	DC power from cardberry, AC 120V/60Hz for adapter		



Remark: Factor = LISN factor + Cable Loss + Pulse limiter factor.

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector
1		0.7580	22.86	9.97	32.83	56.00	-23.17	QP
2		0.7580	11.09	9.97	21.06	46.00	-24.94	AVG
3	*	1.3980	22.98	9.96	32.94	56.00	-23.06	QP
4		1.4060	11.08	9.96	21.04	46.00	-24.96	AVG
5		3.2900	4.72	10.04	14.76	46.00	-31.24	AVG
6		3.3140	15.50	10.04	25.54	56.00	-30.46	QP

EUT:	CARDBERRY CARD	Model Name. :	CARDBERRY_NRF51
Temperature:	26 °C	Relative Humidity:	54%
Pressure:	1010hPa	Test Date :	2017-04-10
Test Mode:	TX CH00 (worst case)	Phase :	Neutral
Test Voltage :	DC power from cardberry, AC 120V/60Hz for adapter		



Remark: Factor = LISN factor + Cable Loss + Pulse limiter factor.

No. Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector
1	0.7580	5.11	9.97	15.08	46.00	-30.92	AVG
2 *	0.7820	19.86	9.96	29.82	56.00	-26.18	QP
3	1.4060	19.33	9.96	29.29	56.00	-26.71	QP
4	1.4060	6.03	9.96	15.99	46.00	-30.01	AVG
5	4.3300	13.77	10.08	23.85	56.00	-32.15	QP
6	4.3300	0.77	10.08	10.85	46.00	-35.15	AVG

5.3 Radiated Emissions Measurement

5.3.1 Applied procedures / Limit

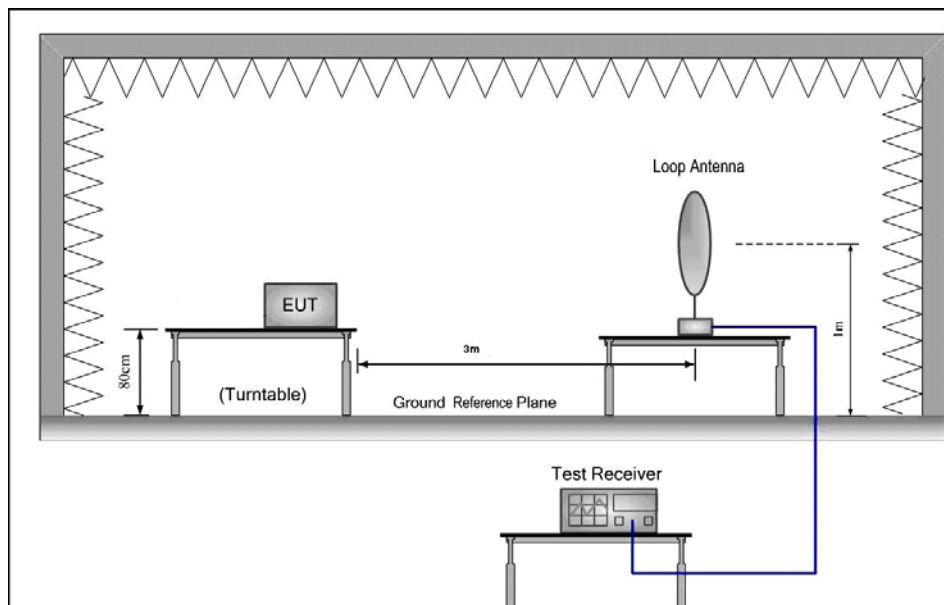
15.247(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that 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 Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Frequency of Emission (MHz)	Field Strength		Measurement Distance (meters)
	$\mu\text{V/m}$	$\text{dB}\mu\text{V/m}$	
0.009-0.49	2400/F(kHz)		300
0.49-1.705	24000/F(kHz)		30
1.705-30	30		30
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

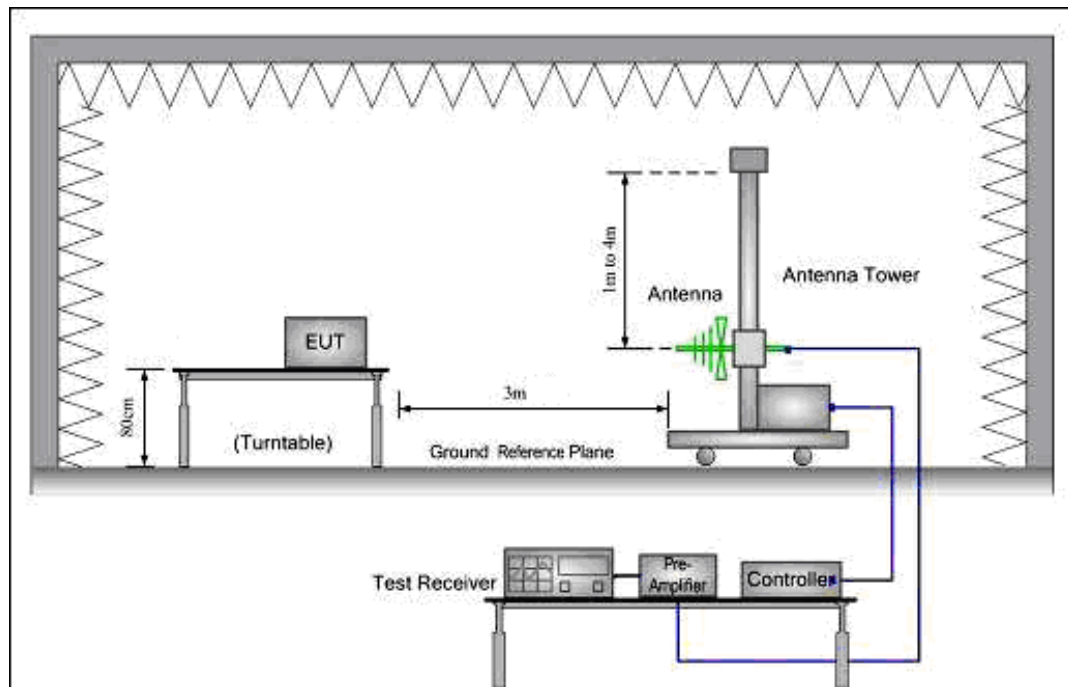
5.3.2 Test setup

Test Configuration:

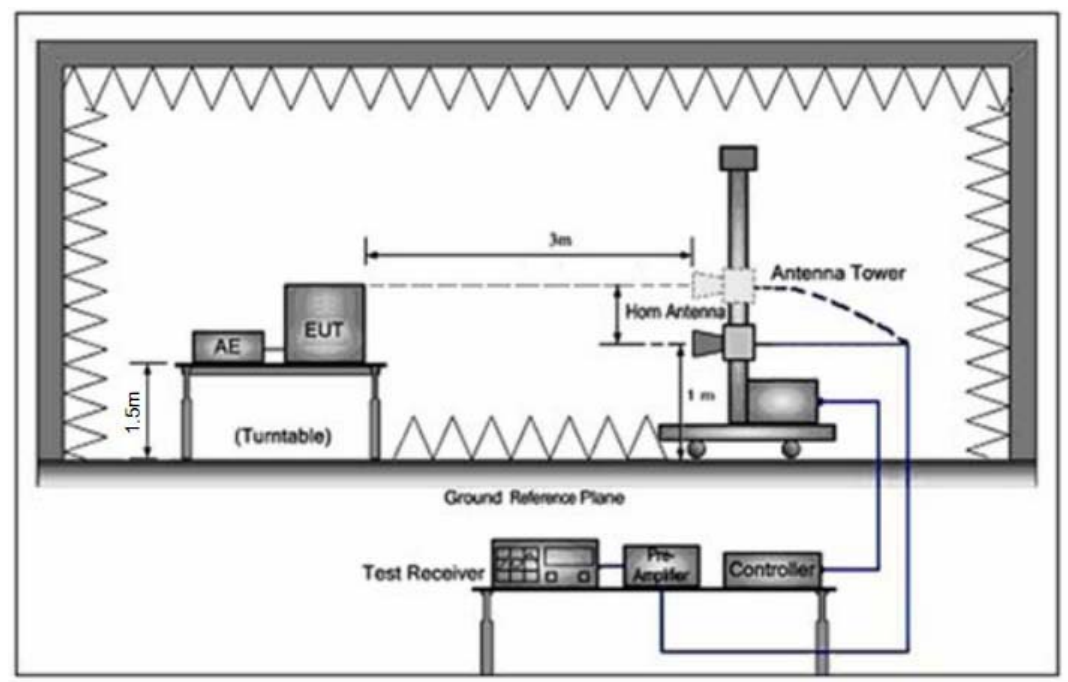
- 1) 9 kHz to 30 MHz emissions:



2) 30 MHz to 1 GHz emissions:



3) 1 GHz to 25 GHz emissions:



5.3.3 Test procedure

- a. EUT was placed upon a wooden test table which was placed on the turn table and operating in the mode as mentioned above. For emissions testing at or below 1 GHz, the table height shall be 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and Vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter, for the test frequency of above 1GHz, horn antenna opening in the test would have been facing the EUT when rise or fall) and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet. The resolution bandwidth and video bandwidth of the test receiver was 1MHz and 1MHz for Peak detection at frequency above 1GHz.
- g. Test the EUT in the lowest channel (2402MHz), the middle channel (2440MHz), the Highest channel (2480MHz)
- h. The radiation measurements are performed in X, Y, Z axis positioning. And found the X axis positioning which it is worse case, only the test worst case mode is recorded in the report.
- i. Repeat above procedures until all frequencies measured was complete.

For measurement at frequency 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.

In 18GHz to 25GHz, The EUT was checked by Horn ANT. But the test result at least have 20dB margin.

The EUT was tested in Chamber Site.

5.3.4 Test Result

Radiated Emissions Test Data Below 30MHz

EUT:	CARDBERRY CARD	Model Name :	CARDBERRY_NRF51
Temperature:	25 °C	Test Data	2017-04-10
Pressure:	1005 hPa	Relative Humidity:	60%
Test Mode :	TX(1Mbps worst case)	Test Voltage :	DC power from cardberry, AC 120V/60Hz for adapter
Measurement Distance	3 m	Frenqucy Range	9KHz to 30MHz
RBW/VBW	9KHz~150KHz/RB 200Hz for QP, 150KHz~30MHz/RB 9KHz for QP		

No emission found between lowest internal used/generated frequencies to 30MHz.

Radiated Emissions Test Data Below 1GHz

EUT:	CARDBERRY CARD	Model Name :	CARDBERRY_NRF51
Temperature:	25 °C	Test Data	2017-04-10
Pressure:	1010 hPa	Relative Humidity:	60%
Test Mode :	TX (1Mbps) CH00 (worst case)	Test Voltage :	DC power from cardberry, AC 120V/60Hz for adapter
Measurement Distance	3 m	Frenqucy Range	30MHz to 1GHz
RBW/VBW	100KHz / 300KHz for spectrum, RBW=120KHz for receiver.		

(a) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
35.4992	45.74	-16.78	28.96	40.00	-11.04	QP
45.6948	51.88	-17.93	33.95	40.00	-6.05	QP
77.8653	48.46	-19.14	29.32	40.00	-10.68	QP
164.9074	36.20	-14.76	21.44	43.50	-22.06	QP
396.2414	30.77	-6.43	24.34	46.00	-21.66	QP
807.4290	30.51	2.35	32.86	46.00	-13.14	QP

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
46.0164	33.40	-14.34	19.06	40.00	-20.94	QP
66.4989	37.69	-17.88	19.81	40.00	-20.19	QP
83.8156	39.47	-18.04	21.43	40.00	-18.57	QP
187.0958	39.61	-13.17	26.44	43.50	-17.06	QP
258.3264	42.75	-12.95	29.80	46.00	-16.20	QP
731.9203	32.09	-0.61	31.48	46.00	-14.52	QP

Note: '*' means the worst case

Measurement Level = Reading Level + Factor

Factor= Ant Factor + Cable Loss - Pre-amplifier

Radiated Emissions Test Data Above 1GHz

EUT:	CARDBERRY CARD	Model Name :	CARDBERRY_NRF51
Temperature:	25 °C	Test Data	2017-04-10
Pressure:	1010 hPa	Relative Humidity:	60%
Test Mode :	TX(1Mbps)	Test Voltage :	DC power from cardberry, AC 120V/60Hz for adapter
Measurement Distance	3 m	Frenqucy Range	1GHz to 25GHz
RBW/VBW	Spurious emission: 1MHz/1MHz for Peak, 1MHz/10Hz for Average. non-restricted band: 100KHz/300KHz for Peak.		

(a) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4804.000	51.08	5.06	56.14	74.00	-17.86	peak
4804.000	38.76	5.06	43.82	54.00	-10.18	AVG
7206.000	45.25	7.03	52.28	74.00	-21.72	peak
7206.000	33.47	7.03	40.50	54.00	-13.50	AVG
9608.000	40.36	10.63	50.99	74.00	-23.01	peak
9608.000	31.64	10.63	42.27	54.00	-11.73	AVG
12010.000	34.93	17.35	52.28	74.00	-21.72	peak
12010.000	26.38	17.35	43.73	54.00	-10.27	AVG

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4804.000	50.77	5.06	55.83	74.00	-18.17	peak
4804.000	36.59	5.06	41.65	54.00	-12.35	AVG
7206.000	44.15	7.03	51.18	74.00	-22.82	peak
7206.000	32.41	7.03	39.44	54.00	-14.56	AVG
9608.000	41.33	10.63	51.96	74.00	-22.04	peak
9608.000	32.97	10.63	43.60	54.00	-10.40	AVG
12010.000	36.44	17.35	53.79	74.00	-20.21	peak
12010.000	28.31	17.35	45.66	54.00	-8.34	AVG

Note:

13~25GHz at least have 20dB margin. No recording in the test report.

Measurement Level = Reading Level + Factor

Factor= Ant Factor + Cable Loss - Pre-amplifier

Low Channel 00: 2402 MHz

Data rate: 1Mbps

Shenzhen ZCT Technology Co., Ltd.

3/F., Building 5, Hongsheng Industrial Zone, Bao'an Road, Xixiang Street, Bao'an District, Shenzhen, Guangdong, China.

Tel: 400-805-1899 Fax: 86-755-23702323; <http://www.renzhengjiance.com>

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(a) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4880.000	51.33	5.14	56.47	74.00	-17.53	peak
4880.000	36.25	5.14	41.39	54.00	-12.61	AVG
7320.000	44.63	7.54	52.17	74.00	-21.83	peak
7320.000	32.43	7.54	39.97	54.00	-14.03	AVG
9760.000	41.06	11.36	52.42	74.00	-21.58	peak
9760.000	31.60	11.36	42.96	54.00	-11.04	AVG
12200.000	33.69	18.73	52.42	74.00	-21.58	peak
12200.000	25.49	18.73	44.22	54.00	-9.78	AVG

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4880.000	50.62	5.14	55.76	74.00	-18.24	peak
4880.000	38.53	5.14	43.67	54.00	-10.33	AVG
7320.000	44.48	7.54	52.02	74.00	-21.98	peak
7320.000	31.71	7.54	39.25	54.00	-14.75	AVG
9760.000	40.86	11.36	52.22	74.00	-21.78	peak
9760.000	31.65	11.36	43.01	54.00	-10.99	AVG
12200.000	35.97	18.73	54.70	74.00	-19.30	peak
12200.000	27.58	18.73	46.31	54.00	-7.69	AVG

Note:

13~25GHz at least have 20dB margin. No recording in the test report.

Measurement Level = Reading Level + Factor

Factor= Ant Factor + Cable Loss - Pre-amplifier

Middle Channel 19: 2440 MHz

Data rate: 1Mbps

(a) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4960.000	50.16	5.22	55.38	74.00	-18.62	peak
4960.000	37.21	5.22	42.43	54.00	-11.57	AVG
7440.000	44.49	8.06	52.55	74.00	-21.45	peak
7440.000	32.26	8.06	40.32	54.00	-13.68	AVG
9920.000	40.97	12.10	53.07	74.00	-20.93	peak
9920.000	31.66	12.10	43.76	54.00	-10.24	AVG
12400.000	32.85	19.56	52.41	74.00	-21.59	peak
12400.000	25.31	19.56	44.87	54.00	-9.13	AVG

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4960.000	51.53	5.22	56.75	74.00	-17.25	peak
4960.000	36.83	5.22	42.05	54.00	-11.95	AVG
7440.000	44.66	8.06	52.72	74.00	-21.28	peak
7440.000	32.53	8.06	40.59	54.00	-13.41	AVG
9920.000	40.74	12.10	52.84	74.00	-21.16	peak
9920.000	30.69	12.10	42.79	54.00	-11.21	AVG
12400.000	34.67	19.56	54.23	74.00	-19.77	peak
12400.000	25.81	19.56	45.37	54.00	-8.63	AVG

Note:

13~25GHz at least have 20dB margin. No recording in the test report.

Measurement Level = Reading Level + Factor

Factor= Ant Factor + Cable Loss - Pre-amplifier

High Channel 39: 2480 MHz

Data rate: 1Mbps

5.3.5 TEST RESULTS (Restricted Bands Requirements)

EUT:	CARDBERRY CARD	Model Name :	CARDBERRY_NRF51
Temperature:	25 °C	Test Data	2017-04-10
Pressure:	1010 hPa	Relative Humidity:	60%
Test Mode :	TX(1Mbps)	Test Voltage :	DC power from cardberry, AC 120V/60Hz for adapter
RBW/VBW	1MHz/1MHz for Peak, 1MHz/10Hz for Average.		
Note:	1. The transmitter was setup to transmit at the lowest channel. Then the field strength was measured at 2310-2390 MHz. 2. The transmitter was setup to transmit at the highest channel. Then the field strength was measured at 2483.5-2500 MHz. 3. The data of 2390MHz and 2483.5MHz was the worst.		

Test Mode	Ant.Pol. H/V	Freq. (MHz)	Reading		Ant/CF CF(dB)	Act		Limit	
			Peak (dBuv)	AV (dBuv)		Peak (dBuv/m)	AV (dBuv/m)	Peak (dBuv/m)	AV (dBuv/m)
TX Data rate 1Mbps	H	2390	42.92	28.65	-5.79	37.13	22.86	74.00	54.00
	V	2390	43.55	30.44	-5.79	37.76	24.65	74.00	54.00
	H	2483.5	44.38	31.22	-4.98	39.40	26.24	74.00	54.00
	V	2483.5	45.93	32.02	-4.98	40.95	27.04	74.00	54.00

5.4 BANDWIDTH TEST

5.4.1 Applied procedures / Limit

15.247(a) (2) Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

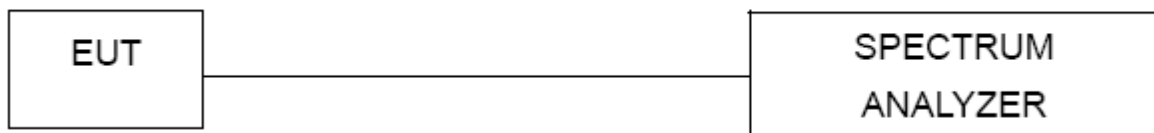
5.4.2 Test procedure

- The testing follows FCC KDB publication No. 558074 D01 DTS Meas. Guidance v03r05
- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- Spectrum Setting: RBW= 100KHz, VBW \geq 3 \times RBW, Sweep time = Auto, Detector Function = Peak, centering on a hopping channel Trace = Max Hold.
- Mark the peak frequency and -6 dB points bandwidth.

5.4.3 Deviation from standard

No deviation.

5.4.4 Test setup

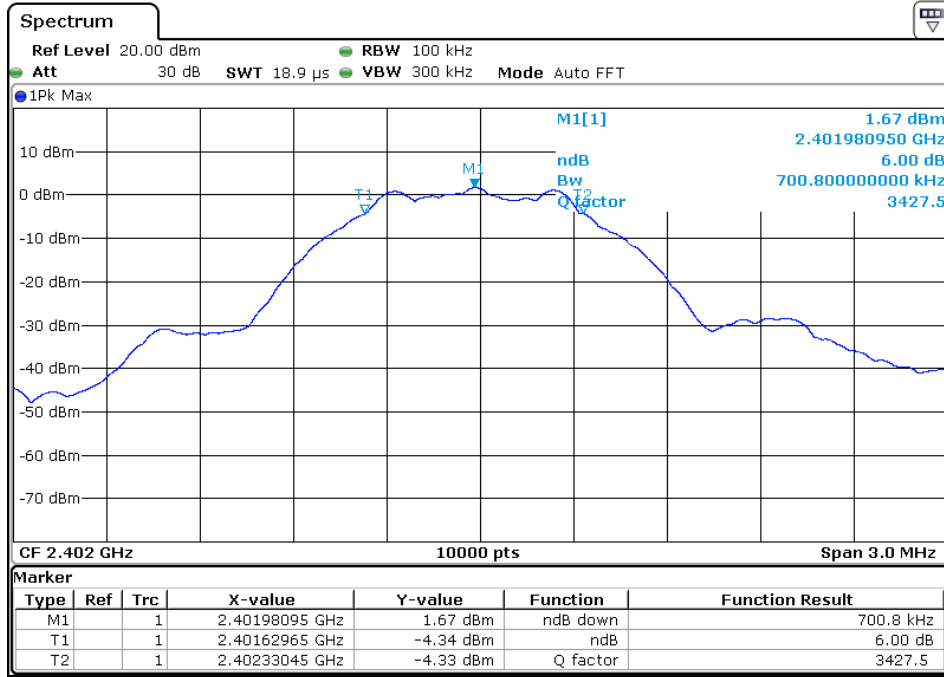


5.4.5 Test results

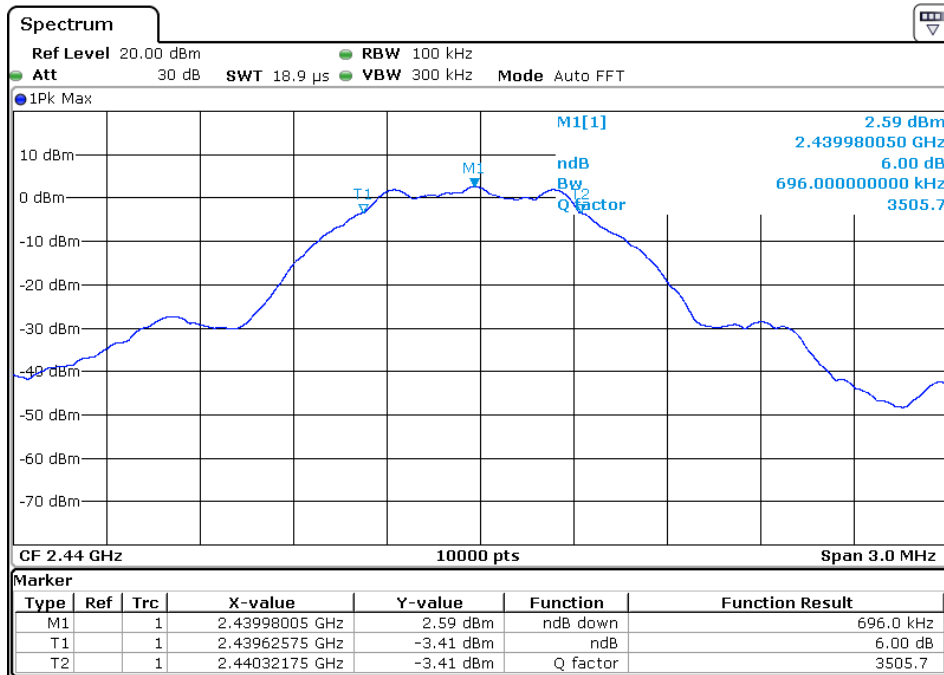
EUT:	CARDBERRY CARD	Model Name :	CARDBERRY_NRF51
Temperature:	26 °C	Relative Humidity:	53%
Pressure:	1010 hPa	Test Power :	DC power from cardberry, AC 120V/60Hz for adapter
Test Mode :	TX(1Mbps)		

Test Mode	Test Channel	Frequency (MHz)	6 dB Bandwidth (KHz)	Limit (kHz)
Data rate 1Mbps	CH00	2402	700.8	≥ 500
	CH19	2440	696.0	≥ 500
	CH39	2480	702.0	≥ 500

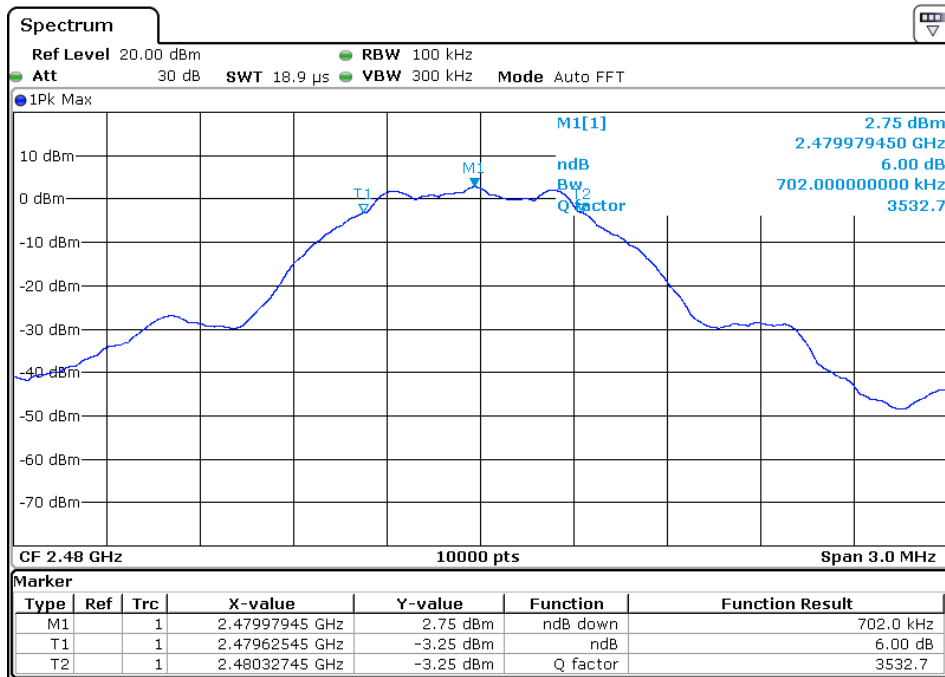
(1Mbps)
The Lowest Channel 00: 2402 MHz



(1Mbps)
The Middle Channel 19: 2440 MHz



(1Mbps)
The High Channel 39: 2480MHz



5.5 Peak Power Density

5.5.1 Applied procedures / Limit

15.247(a) (e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

5.5.2 Test procedure

- a. The testing follows Measurement procedure 10.2 Method PKPSD of FCC KDB publication No. 558074 D01 DTS Meas. Guidance v03r05
- b. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- c. Connected the antenna port to the Spectrum Analyzer, set the Spectrum Analyzer as center frequency to channel center frequency, span=1.5 times the bandwidth, detector = peak
 $3\text{kHz} \leq \text{RBW} \leq 100\text{kHz}$, $\text{VBW} \geq 3 \times \text{RBW kHz}$, Sweep time=Auto.
- d. Trace mode = max hold. Mark the peak.
- e. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

5.5.3 Deviation from standard

No deviation.

5.5.4 Test results

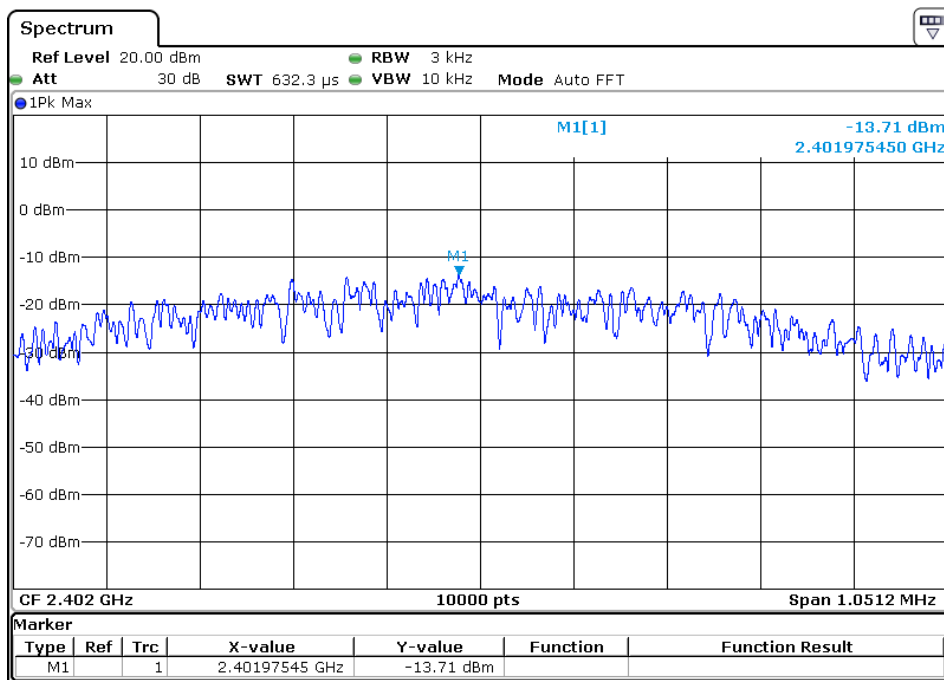
EUT:	CARDBERRY CARD	Model Name :	CARDBERRY_NRF51
Temperature:	24 °C	Relative Humidity:	53%
Pressure:	1010 hPa	Test Power :	DC power from cardberry, AC 120V/60Hz for adapter
Test Mode :	TX(1Mbps)		

Test Mode	Channel frequency (MHz)	Power Density	Limit (dBm/3kHz)	Result
		PSD 3kHz (dBm/3kHz)		
TX (1Mbps)	2402	-13.71	8	Pass
	2440	-12.82	8	Pass
	2480	-12.91	8	Pass

Note: The cable loss is 1.0dB

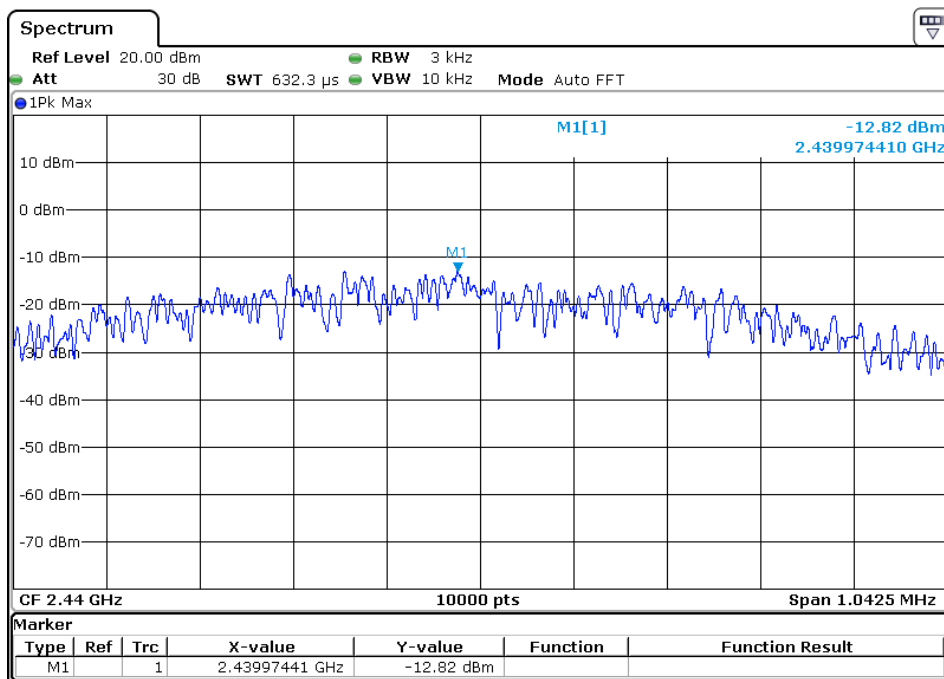
PSD 3kHz (1Mbps)

The Lowest Channel 00: 2402MHz

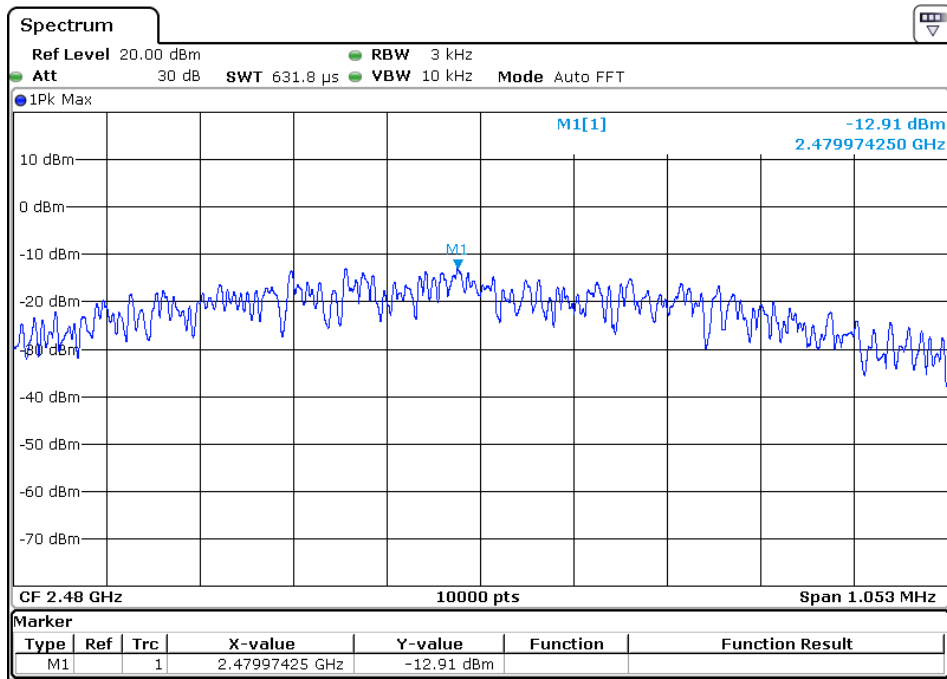


PSD 3kHz (1Mbps)

The Middle Channel 19: 2440MHz



PSD 3kHz (1Mbps)
The High Channel 39: 2480MHz



5.6 Maximum Peak Output Power

5.6.1 Applied procedures / Limit

15.247(b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

5.6.2 Test procedure

- The testing follows FCC KDB publication No. 558074 D01 DTS Meas. Guidance v03r05
- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- Spectrum Setting: RBW \square Bandwidth, VBW \square 3 \times RBW, Sweep time = Auto, Span \square 3 \times RBW,
- Detector = peak. Trace mode = max hold.
- Use peak marker function to determine the peak amplitude level.

5.6.3 Deviation from standard

No deviation.

5.6.4 Test setup



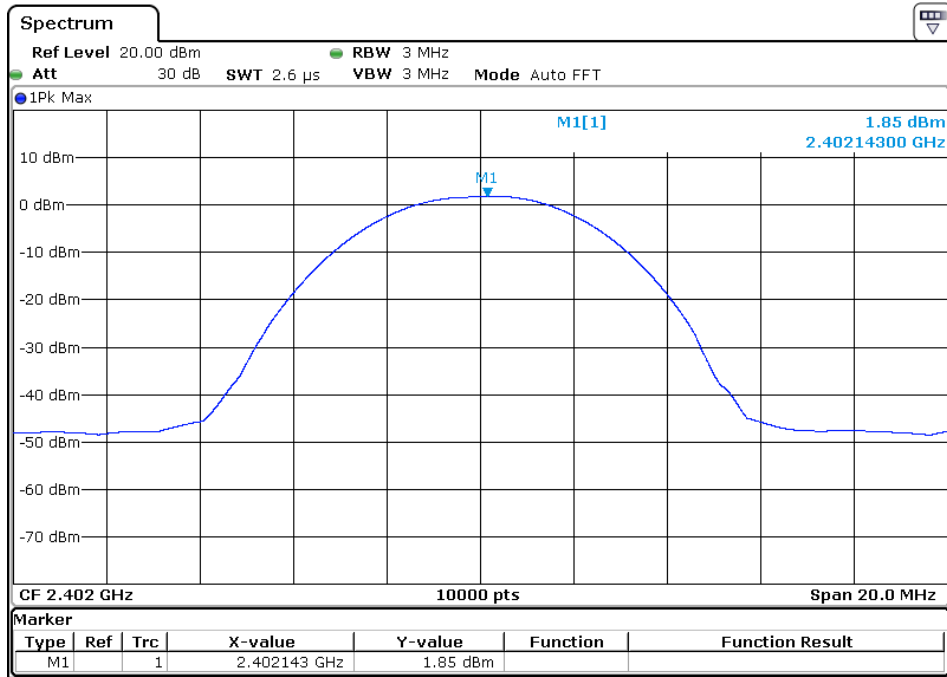
5.6.5 Test results

EUT:	CARDBERRY CARD	Model Name :	CARDBERRY_NRF51
Temperature:	26 °C	Relative Humidity:	60%
Pressure:	1010 hPa	Test Voltage :	DC power from cardberry, AC 120V/60Hz for adapter
Test Mode :	TX (1Mbps)		
Note: N/A			

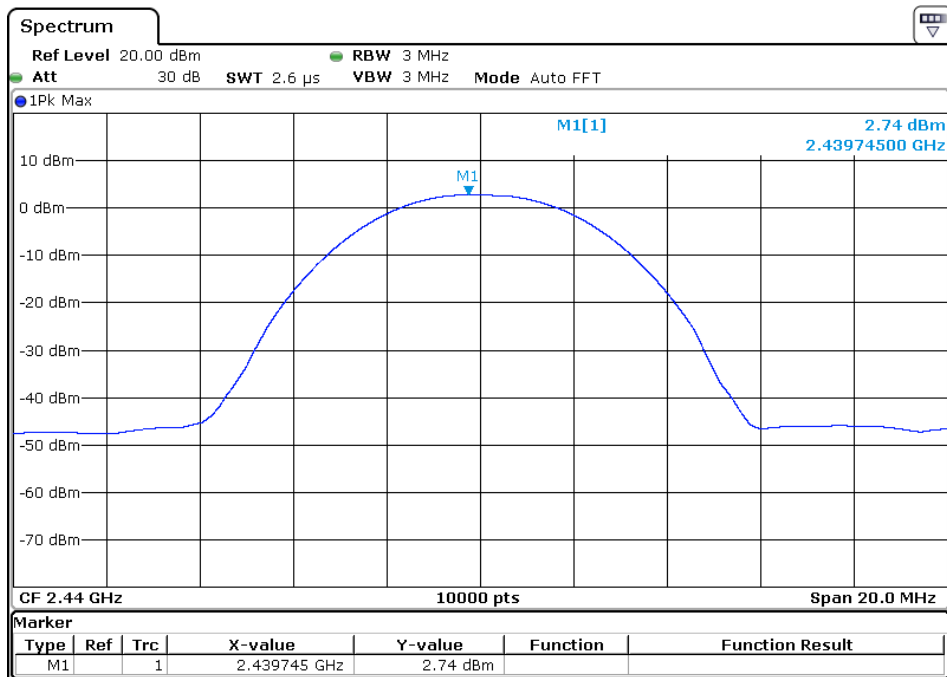
Test Mode	Frequency	Peak Output Power (dBm)	Limit (dBm)	Result
Data rate 1Mbps	2402 MHz	1.85	30	Pass
	2440 MHz	2.74	30	Pass
	2480 MHz	2.89	30	Pass

Note: The cable loss is 1.0dB

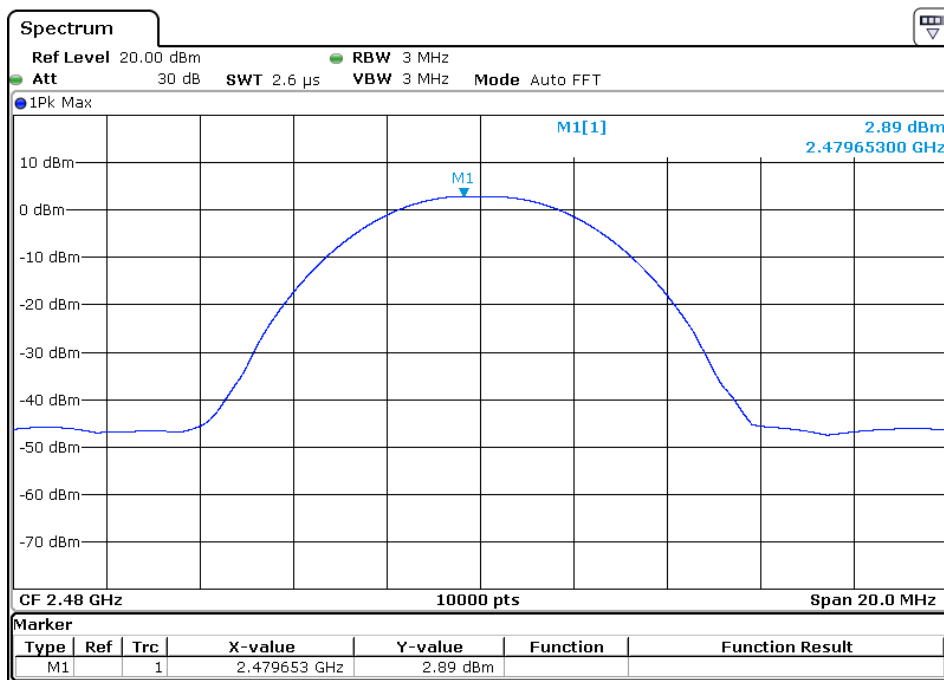
(1Mbps)
The Lowest Channel 00: 2402MHz



(1Mbps)
The Middle Channel 19: 2440MHz



(1Mbps)
The High Channel 39: 2480MHz



5.7 Band edge

5.7.1 Applied procedures / Limit

15.247(d) 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 Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

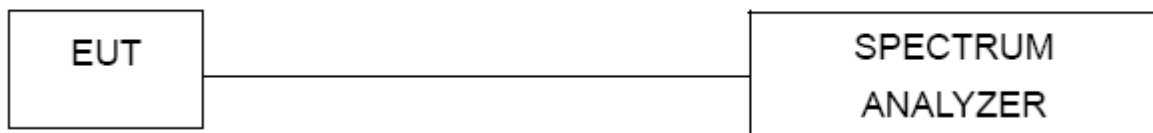
5.7.2 Test procedure

- a. The testing follows FCC KDB publication No. 558074 D01 DTS Meas. Guidance v03r05
- b. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- c. Spectrum Setting: RBW=100kHz, VBW \geq 300kHz, Sweep time=Auto, Detector Function=Peak.
- d. The band edges was measured and recorded Result:
The Lower Edges attenuated more than 20dB.
The Upper Edges attenuated more than 20dB.

5.7.3 Deviation from standard

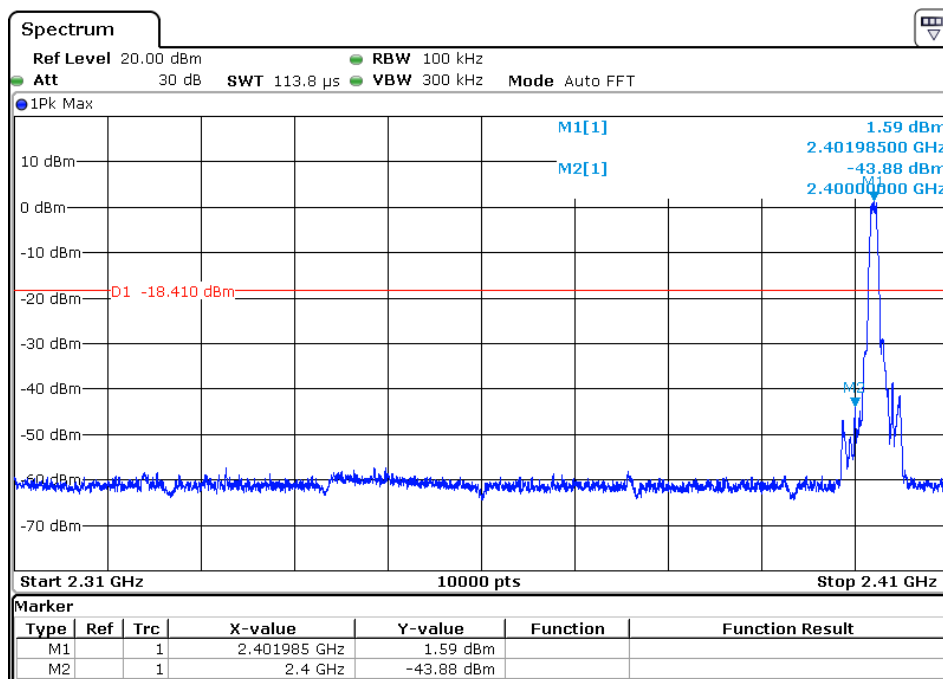
No deviation.

5.7.4 Test setup

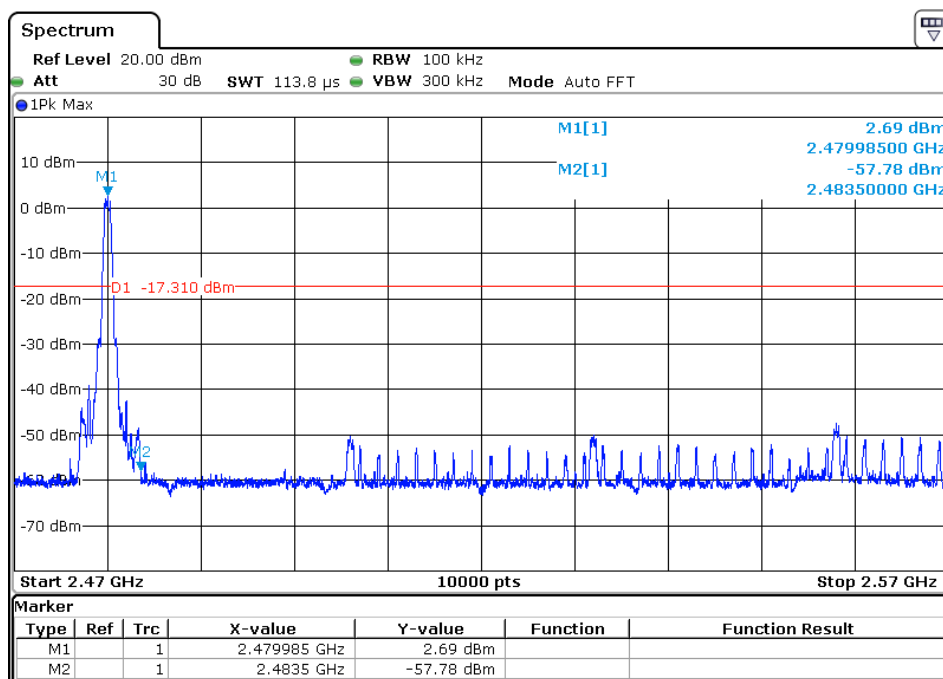


5.7.5 Test results

(1Mbps) The Lowest Channel 00: 2402MHz



(1Mbps) The High Channel 39: 2480MHz



5.8 Conducted Spurious Emissions

5.8.1 Applied procedures / Limit

15.247(d) 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 Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

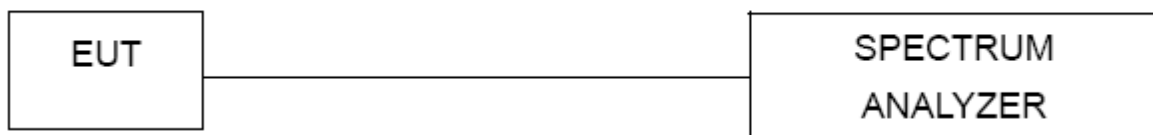
5.8.2 Test procedure

- The testing follows FCC KDB publication No. 558074 D01 DTS Meas. Guidance v03r05
- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- Spectrum Setting: RBW=100kHz, VBW=300kHz, Sweep time=Auto, Detector Function=Peak, sweep points \geq investigated frequency range/RBW.

5.8.3 Deviation from standard

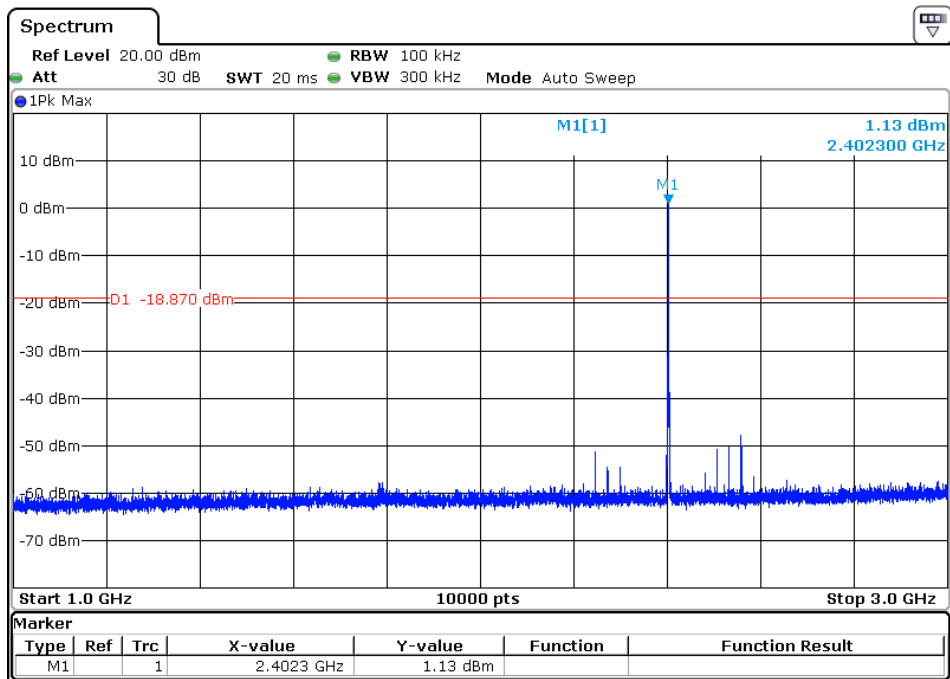
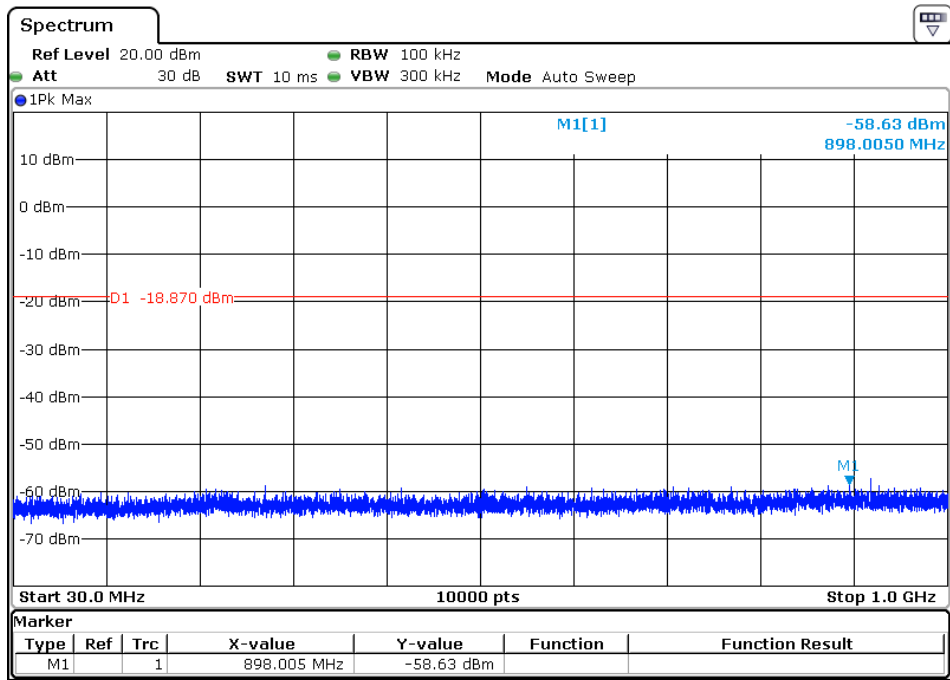
No deviation.

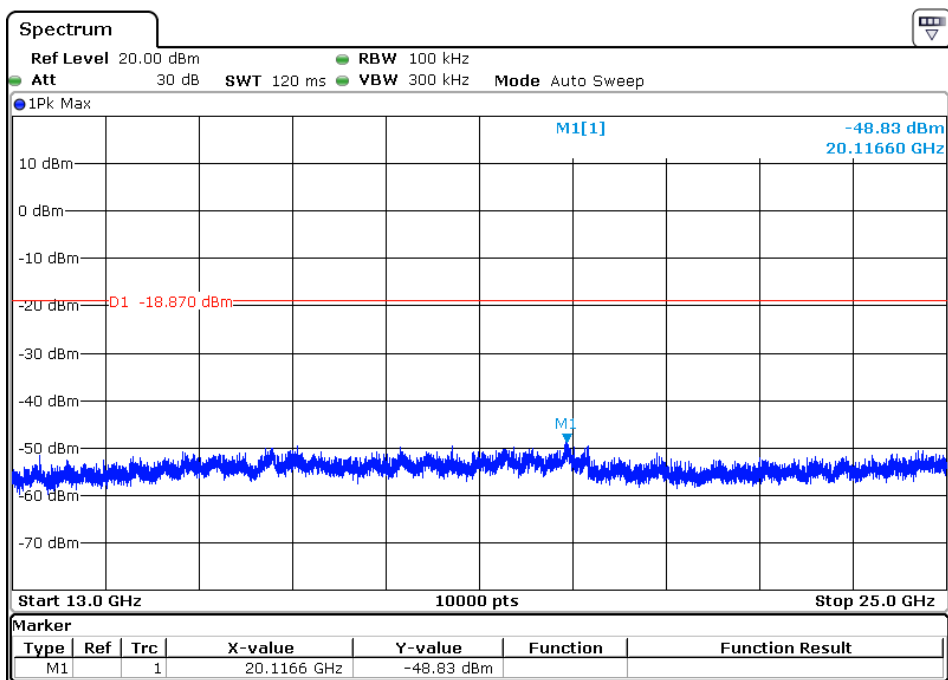
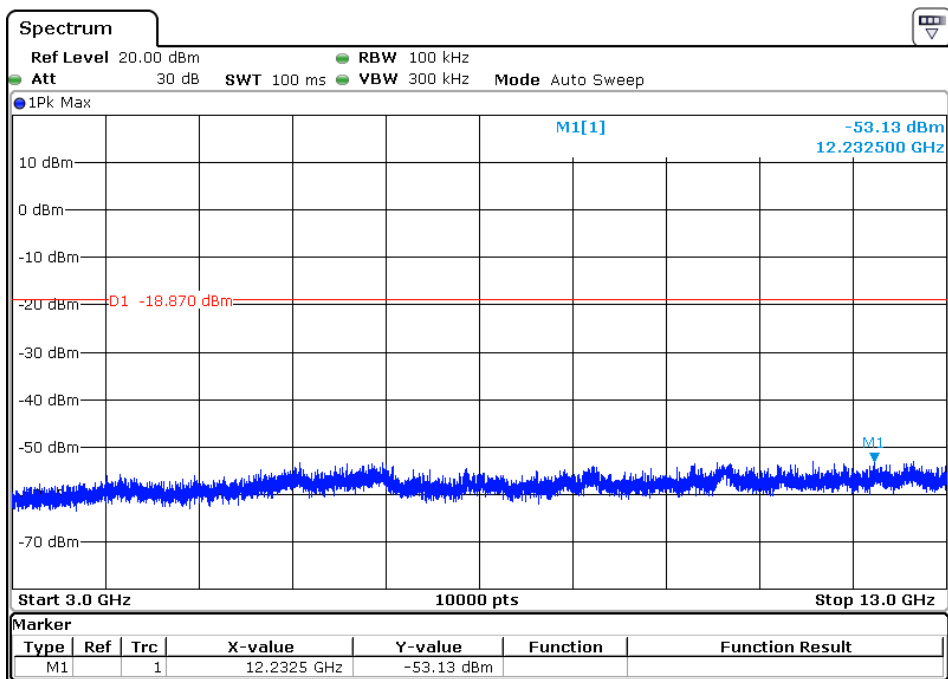
5.8.4 Test setup



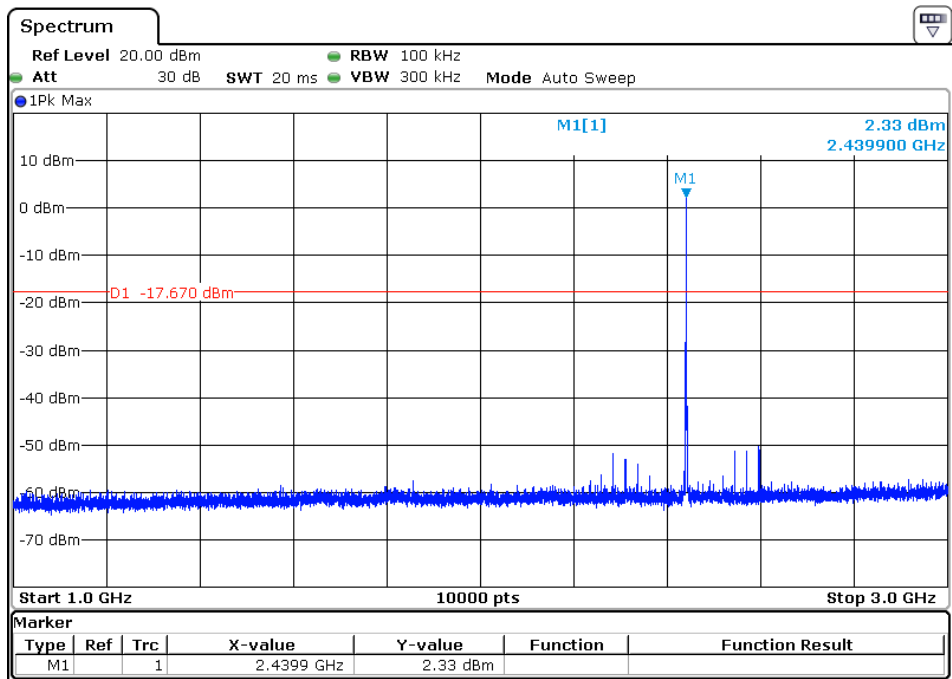
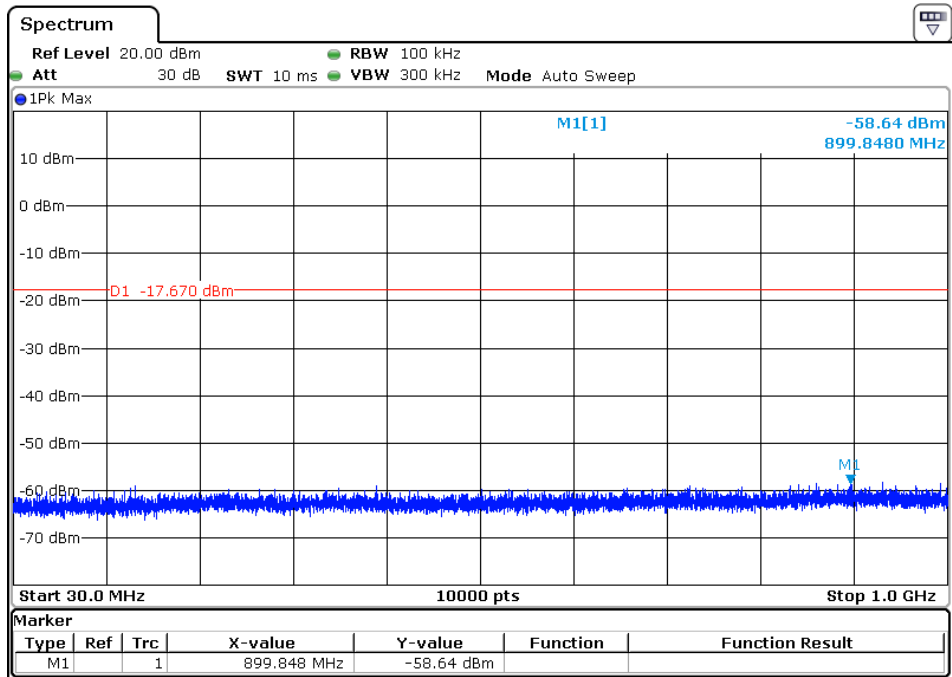
5.8.5 Test results

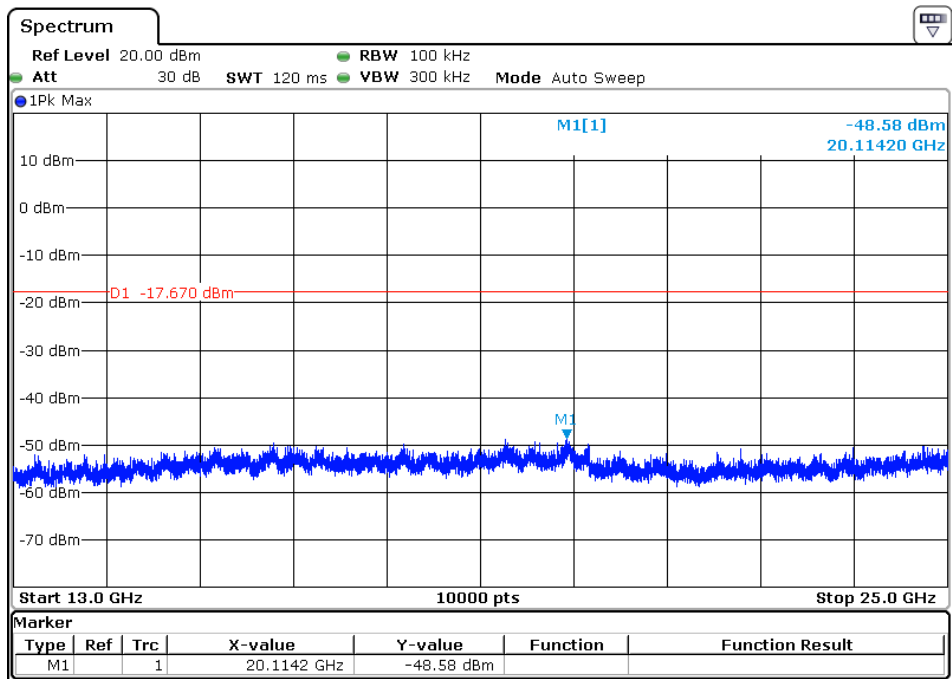
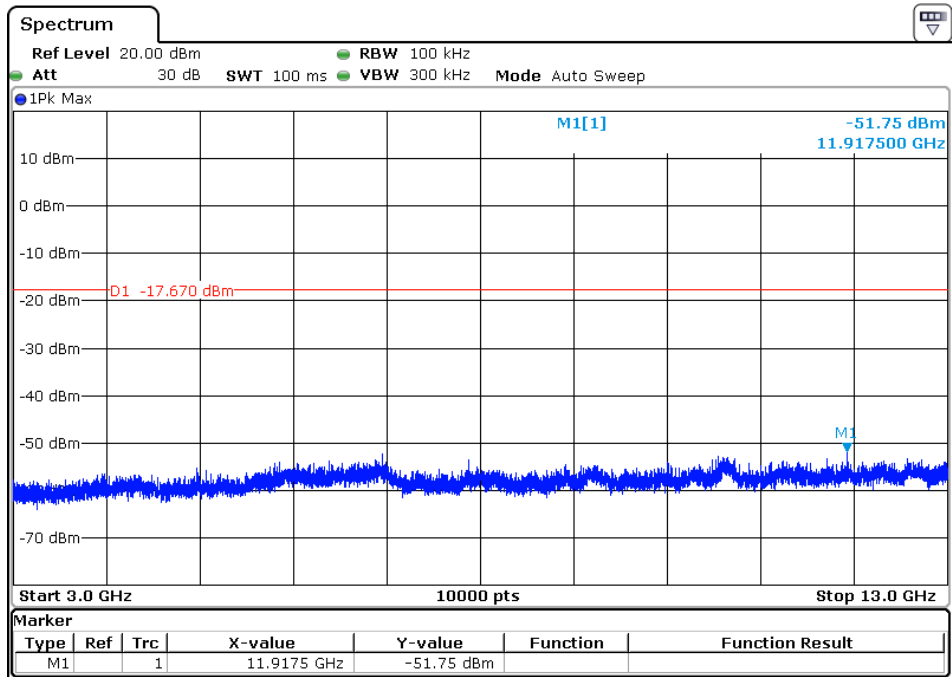
The Lowest Channel 00 (1Mbps): 2402MHz



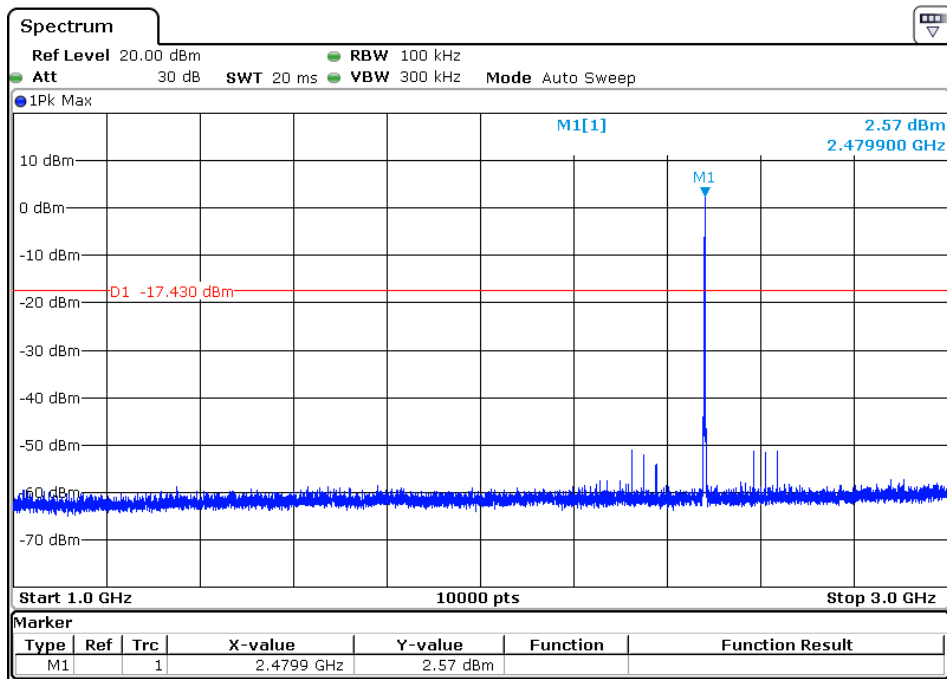
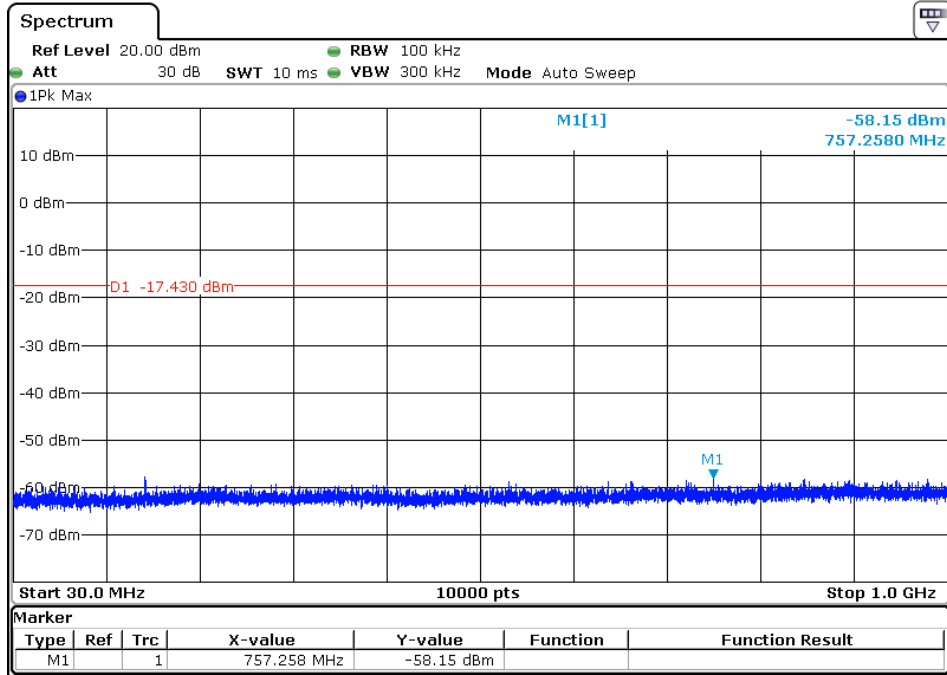


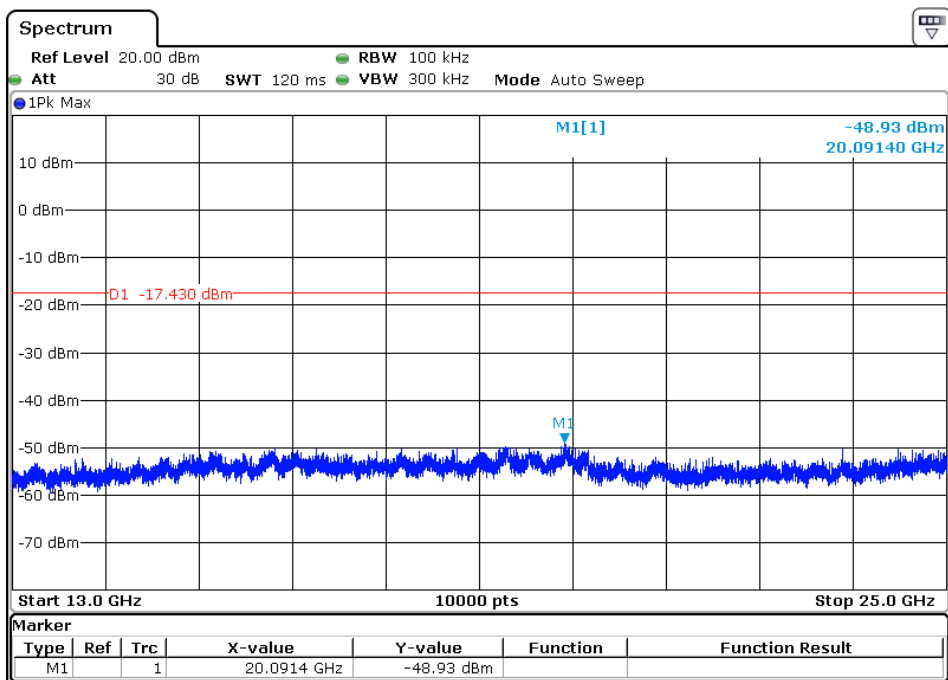
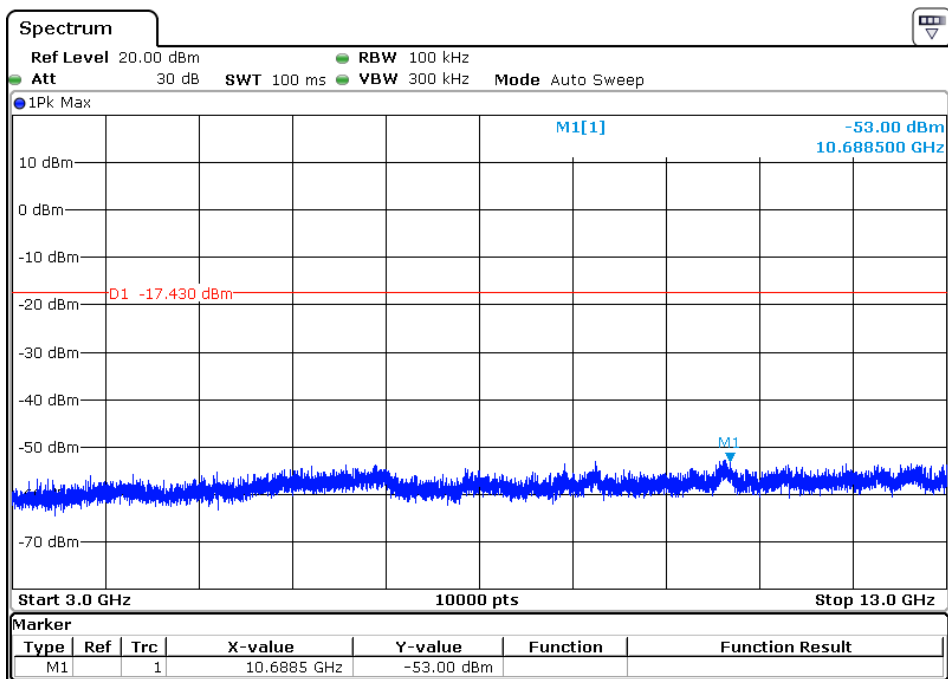
The Middle Channel 19(1Mbps): 2440MHz





The High Channel 39(1Mbps): 2480MHz





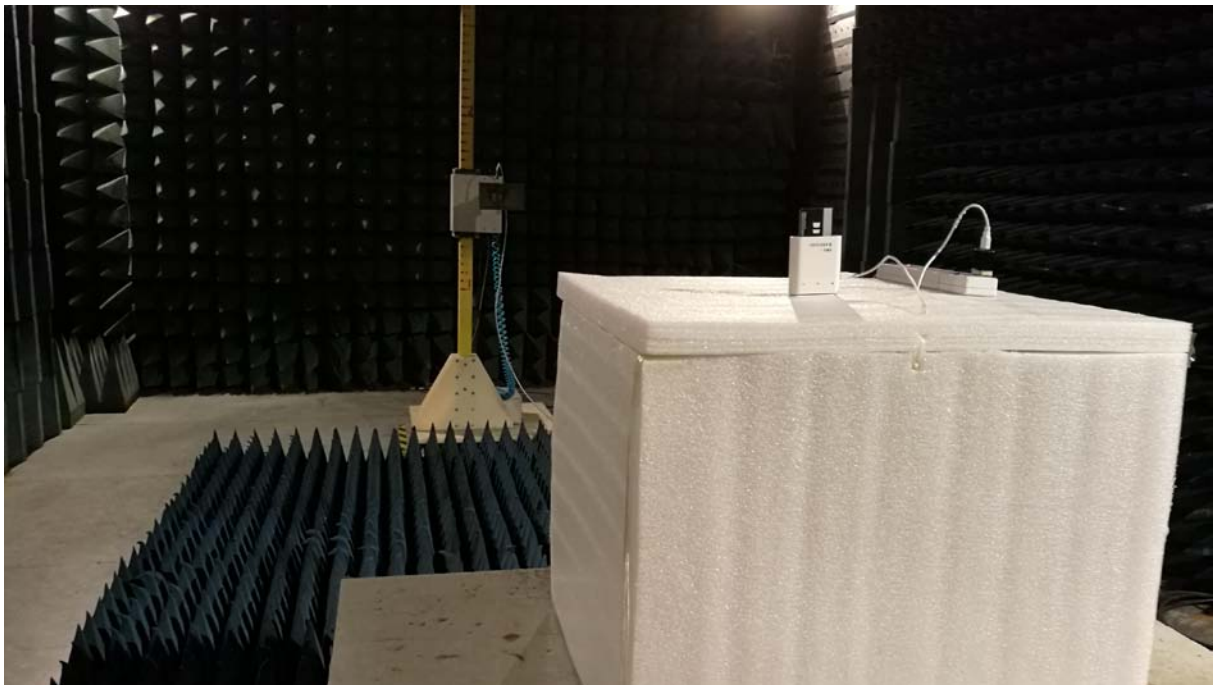
6 Photographs

6.1 Radiated Spurious Emission Test Setup

Below 1GHz:



Above 1GHz:



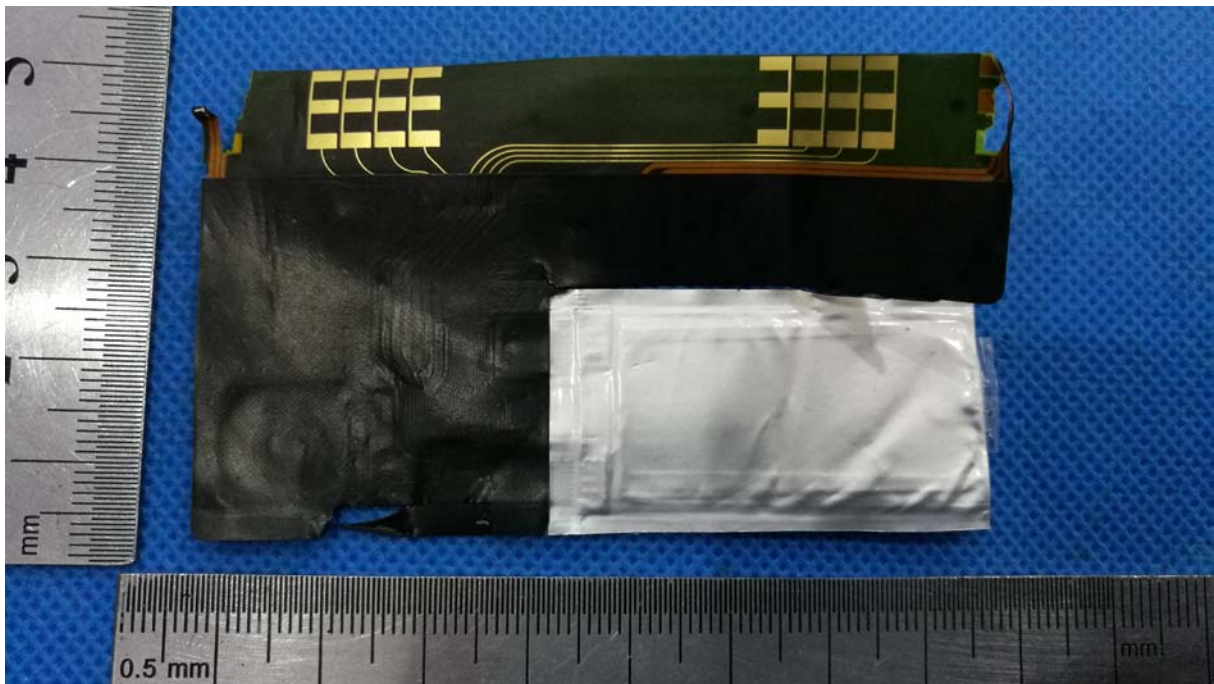
6.2 Conducted Emission Test Setup

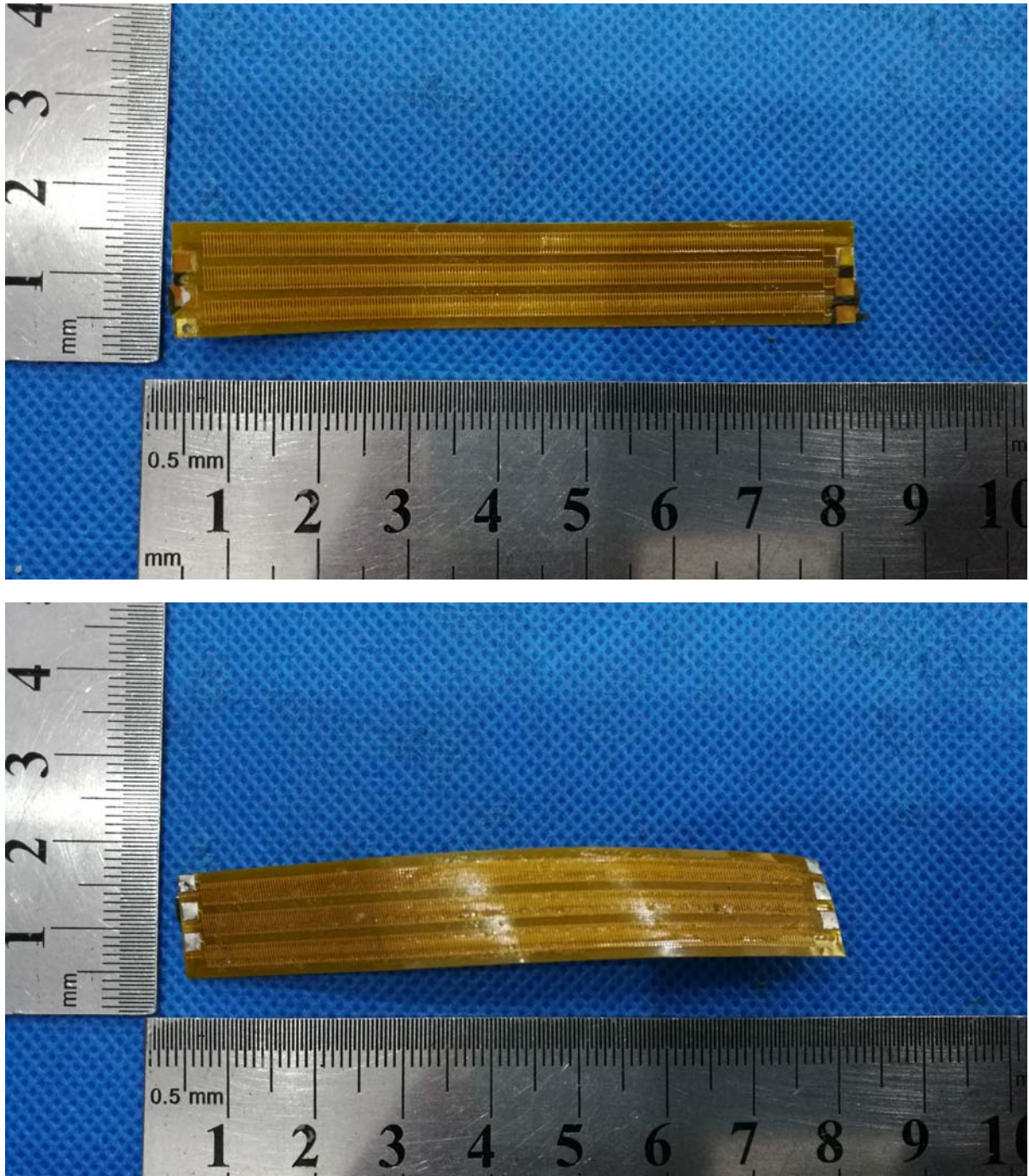


7 APPENDIX-Photographs of EUT Constructional Details









** End of report **