

FCC PART 15C TEST REPORT FOR CERTIFICATION
On Behalf of

Continental Automotive GmbH

CAR RADIO

Model Number: CRD4512UBA-OR

Additional Model: CR4512UBA-OR, TR4512UBA-OR, CRD4512UBA/AGC,

CR4512UBA/AGC, CR4511UA-OR, CRD4512UBA/KOM,

CRD4512UBA/CLA, CR4512UBA/CLA, CRD4512UBA/SDF,

CR4512UBA/SDF, CRD4612UBA, CR4612UBA, CRD4612UBA/KOM,

CRD4612UBA/PRI

FCC ID: Y7O-CRD4512UBA-OR

Prepared for:	Continental Automotive GmbH
	Philipsstrasse 1, Wetzlar, Germany
Prepared By:	EST Technology Co., Ltd.
	Chilingxiang, Qishantou, Santun, Houjie, Dongguan, Guangdong, China
	Tel: 86-769-83081888-808

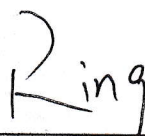
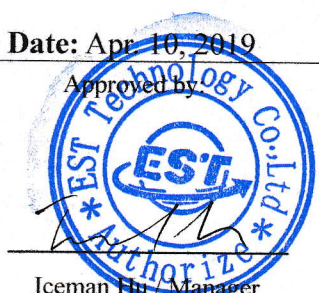
Report Number:	ESTE-R1904024
Date of Test:	Mar. 11~Apr. 08, 2019
Date of Report:	Apr. 10, 2019

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EST Technology Co., Ltd.

Applicant:	Continental Automotive GmbH		
Address:	Philipsstrasse 1, Wetzlar, Germany		
Manufacturer:	Continental Automotive GmbH		
Address:	Philipsstrasse 1, Wetzlar, Germany		
E.U.T:	CAR RADIO		
Model Number:	CRD4512UBA-OR		
Additional Model:	CR4512UBA-OR, TR4512UBA-OR, CRD4512UBA/AGC, CR4512UBA/AGC, CR4511UA-OR, CRD4512UBA/KOM, CRD4512UBA/CLA, CR4512UBA/CLA, CRD4512UBA/SDF, CR4512UBA/SDF, CRD4612UBA, CR4612UBA, CRD4612UBA/KOM, CRD4612UBA/PRI (Except for the trademark and model name, the rest is identical.)		
Power Supply:	DC 12V		
Test Voltage:	DC 12V		
Trade Name:	Continental, AGCO, KUBOTA, Komatsu Forest, Claas, SDF, PRINOTH		
Date of Receipt:	Mar. 11, 2019	Date of Test:	Mar. 11~Apr. 08, 2019
Test Specification:	FCC Rules and Regulations Part 15 Subpart C:2018 ANSI C63.10:2013		
Test Result:	The device described above is tested by EST Technology Co., Ltd. The measurement results were contained in this test report and EST Technology Co., Ltd. was assumed full responsibility for the accuracy and completeness of these measurements. Also, this report shows that the EUT to be technically compliance with the FCC Rules and Regulations Part 15 Subpart C requirements. This report applies to above tested sample only and shall not be reproduced in part without written approval of EST Technology Co., Ltd.		
Prepared by:		Reviewed by:	
 Ring / Assistant		 Tony / Engineer	
		Date: Apr. 10, 2019 Approved by:  Iceman Hu / Manager	
Other Aspects:			
None.			
Abbreviations: OK/P=passed fail/F=failed n.a/N=not applicable E.U.T=equipment under tested			
This test report is based on a single evaluation of one sample of above mentioned products ,It is not permitted to be duplicated in extracts without written approval of EST Technology Co., Ltd.			

1. GENERAL INFORMATION

1.1. Description of Device (EUT)

Product Name	:	CAR RADIO
FCC ID	:	Y7O-CRD4512UBA-OR
Model Number	:	CRD4512UBA-OR
Operation frequency	:	2402MHz~2480MHz
Number of channel	:	40
Antenna	:	Internal antenna (Antenna Gain: 0 dBi)
Modulation	:	BLE
Sample Type	:	Prototype production

2. SUMMARY OF TEST

2.1. Summary of test result

Description of Test Item	Standard	Results
Power Line Conducted Emission	FCC Part 15: 15.207 ANSI C63.10:2013	N/A
Radiated Emission	FCC Part 15: 15.209 ANSI C63.10:2013 KDB 558074	PASS
Band Edge Compliance	FCC Part 15: 15.247 ANSI C63.10:2013 KDB 558074	PASS
6dB Bandwidth	FCC Part 15: 15.247 ANSI C63.10:2013 KDB 558074	PASS
Peak Output Power	FCC Part 15: 15.247 ANSI C63.10:2013 KDB 558074	PASS
Power Spectral Density	FCC Part 15: 15.247 ANSI C63.10:2013 KDB 558074	PASS
Antenna requirement	FCC Part 15: 15.203	PASS
Note: KDB 558074 D01 15.247 Meas Guidance v05		

2.2. Test Facilities

EMC Lab : Certified by CNAS, CHINA
Registration No.: L5288
Date of registration: November 13, 2017

Certificated by FCC, USA
Designation Number: CN1215
Test Firm Registration Number: 722932
Date of registration: November 21, 2017

Certificated by A2LA, USA
Registration No.: 4366.01
Date of registration: November 07, 2017

Certificated by Industry Canada
CAB identifier No.: CN0035
Date of registration: January 04, 2019

Certificated by VCCI, Japan
Registration No.: R-13663; C-14103
Date of registration: July 25, 2017
This Certificate is valid until: July 24, 2020

Certificated by TUV Rheinland, Germany
Registration No.: UA 50413872 0001
Date of registration: July 31, 2018

Certificated by TUV/PS, Shenzhen
Registration No.: SCN1017
Date of registration: January 27, 2011

Certificated by Intertek ETL SEMKO
Registration No.: 2011-RTL-L2-64
Date of registration: April 28, 2011

Certificated by Nemko, Hong Kong
Registration No.: 175193
Date of registration: May 4, 2011

Name of Firm : EST Technology Co., Ltd.

Site Location : Chilingxiang, Qishantou, Santun, Houjie, Dongguan, Guangdong, China

2.3. Measurement uncertainty

Test Item	Uncertainty
Uncertainty for Conduction emission test	$\pm 3.48\text{dB}$
Uncertainty for spurious emissions test (30MHz-1GHz)	$\pm 4.60\text{ dB(Polarize: H)}$
	$\pm 4.68\text{ dB(Polarize: V)}$
Uncertainty for spurious emissions test (1GHz to 18GHz)	$\pm 4.96\text{dB}$
Uncertainty for radio frequency	7×10^{-8}
Uncertainty for conducted RF Power	0.20dB
Uncertainty for Power density test	0.26dB

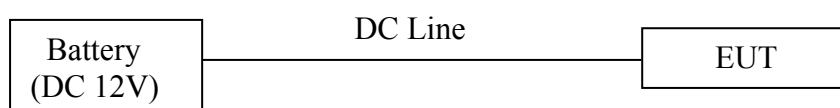
Note: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

2.4. Assistant equipment used for test

2.4.1. N/A

2.5. Block Diagram

For radiated emissions test: EUT was placed on a turn table, which is 0.8 (or 1.5) meter high above ground. EUT was beset into Bluetooth test mode by software before test.



(EUT: CAR RADIO)

2.6. Test mode

A special test software was used to control EUT work in Continuous TX mode(100% duty cycle), and select test channel, wireless mode and data rate.

Mode	Channel	Frequency
BT 4.0-BLE GFSK	Low	2402MHz
	Middle	2440MHz
	High	2480MHz

2.7. Channel List

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
1	2402	2	2404
3	2406	4	2408
5	2410	6	2412
7	2414	8	2416
9	2418	10	2420
11	2422	12	2424
13	2426	14	2428
15	2430	16	2432
17	2434	18	2436
19	2438	20	2440
21	2442	22	2444
23	2446	24	2448
25	2450	26	2452
27	2454	28	2456
29	2458	30	2460
31	2462	32	2464
33	2466	34	2468
35	2470	36	2472
37	2474	38	2476
39	2478	40	2480

2.8. Test Equipment

2.8.1. For conducted emission test

Equipment	Manufacturer	Model No.	Serial No.	Calibration Body	Last Cal.	Next Cal.
EMI Test Receiver	Rohde & Schwarz	ESHS30	832354	CEPREI	June 15,18	1 Year
Artificial Mains Network	Rohde & Schwarz	ENV216	101260	CEPREI	June 15,18	1 Year
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	101100	CEPREI	June 15,18	1 Year
Test Software	Audix	e3-6.111221a	N/A	N/A	N/A	N/A

2.8.2. For radiated emission test(9 kHz-30MHz)

Equipment	Manufacturer	Model No.	Serial No.	Calibration Body	Last Cal.	Next Cal.
EMI Test Receiver	Rohde & Schwarz	ESR7	101780	CEPREI	June 15,18	1 Year
Active Loop Antenna	SCHWARZB ECK	FMZB 1519B	1519B-088	N/A	Aug. 01,18	1 Year
Test Software	Audix	e3-6.111221a	N/A	N/A	N/A	N/A

2.8.3. For radiated emissions test (30-1000MHz)

Equipment	Manufacturer	Model No.	Serial No.	Calibration Body	Last Cal.	Next Cal.
EMI Test Receiver	Rohde & Schwarz	ESR7	101780	CEPREI	June 15,18	1 Year
Bilog Antenna	Teseq	CBL 6111D	27090	CEPREI	June 15,18	1 Year
Test Software	Audix	e3-6.111221a	N/A	N/A	N/A	N/A

2.8.4. For radiated emission test(above 1GHz)

Equipment	Manufacturer	Model No.	Serial No.	Calibration Body	Last Cal.	Next Cal.
Horn Antenna	SCHWARZB ECK	BBHA 9120 D	BBHA9120D1002	CEPREI	June 18,18	1 Year
Horn Antenna	SCHWARZB ECK	BBHA9170	BBHA9170242	CEPREI	June 18,18	1 Year
Signal Amplifier	SCHWARZB ECK	BBV9718	9718-212	CEPREI	June 15,18	1 Year
Spectrum Analyzer	Rohde & Schwarz	FSV	103173	CEPREI	June 15,18	1 Year
PSA Series Spectrum Analyzer	Agilent	E4447A	MY50180031	CEPREI	June 15,18	1 Year
Test Software	Audix	e3-6.111221a	N/A	N/A	N/A	N/A

2.8.5. For connect EUT antenna terminal test

Equipment	Manufacturer	Model No.	Serial No.	Calibration Body	Last Cal.	Next Cal.
Spectrum Analyzer	Rohde & Schwarz	FSV	103173	CEPREI	June 15,18	1 Year
Spectrum Analyzer	Agilent	E4408B	MY44211 139	CEPREI	June 15,18	1 Year

3 POWER LINE CONDUCTED EMISSION TEST

3.1 Limit

Frequency	Maximum RF Line Voltage	
	Quasi-Peak Level dB(μ V)	Average Level dB(μ V)
150kHz ~ 500kHz	66 ~ 56*	56 ~ 46*
500kHz ~ 5MHz	56	46
5MHz ~ 30MHz	60	50

Notes: 1. * Decreasing linearly with logarithm of frequency.

2. The lower limit shall apply at the transition frequencies.

3.2 Test Procedure

The EUT was placed on a non-metallic table, 80cm above the ground plane. The EUT Power connected to the power mains through a line impedance stabilization network (L.I.S.N. 1#). This provides a 50 ohm coupling impedance for the EUT (Please refer the block diagram of the test setup and photographs). The 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 ANSI C63.10: 2013 on Conducted Emission Test.

The bandwidth of test receiver (R & S ESHS30) is set at 10kHz.

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

3.3. Test Result

N/A.

4 RADIATED EMISSION TEST

4.1 Limit

4.1.1 15.209 limits

Frequency (MHz)	Field Strength($\mu\text{V/m}$)	Distance(m)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

- Remark : (1) Emission level $\text{dB}\mu\text{V} = 20 \log \text{Emission level } \mu\text{V/m}$
 (2) The smaller limit shall apply at the cross point between two frequency bands.
 (3) Distance is the distance in meters between the measuring instrument, antenna and the closest point of any part of the device or system.

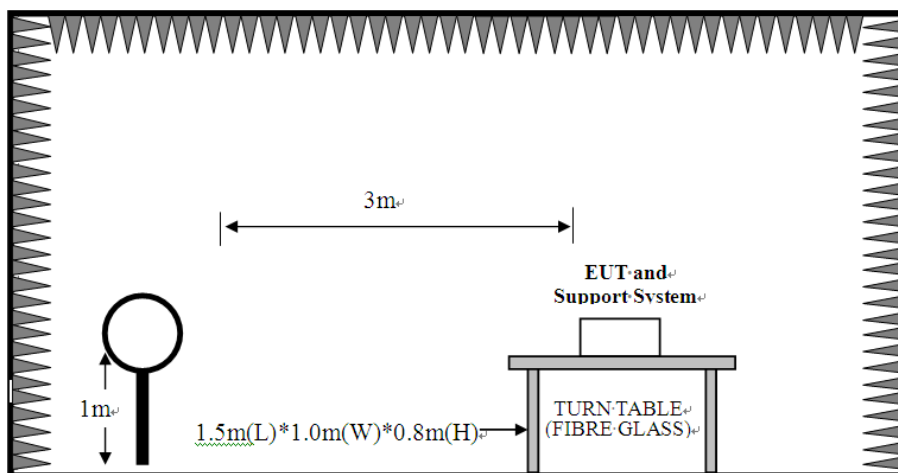
4.1.2 15.205 Restricted bands of operation

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
¹ 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	(²)

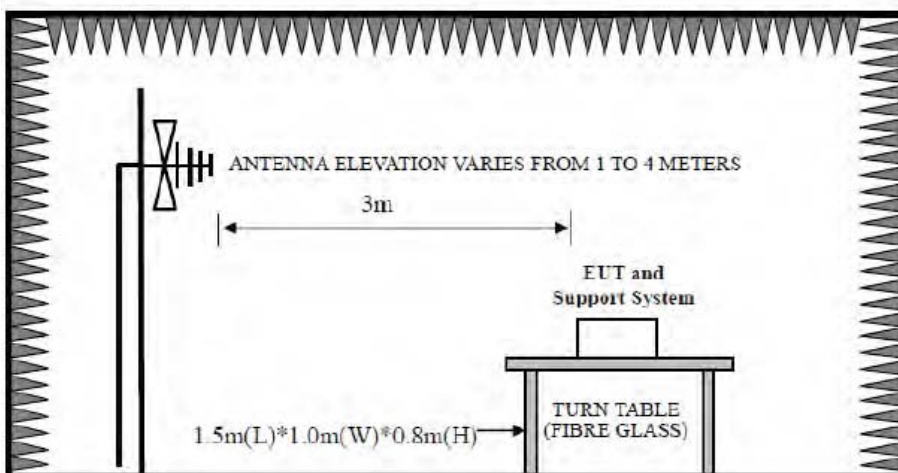
All the emissions appearing within 15.205 restricted frequency bands shall not exceed the limits shown in 15.209, all the other emissions shall be at least 20dB below the fundamental emissions, or comply with 15.209 limits.

4.2. Block Diagram of Test setup

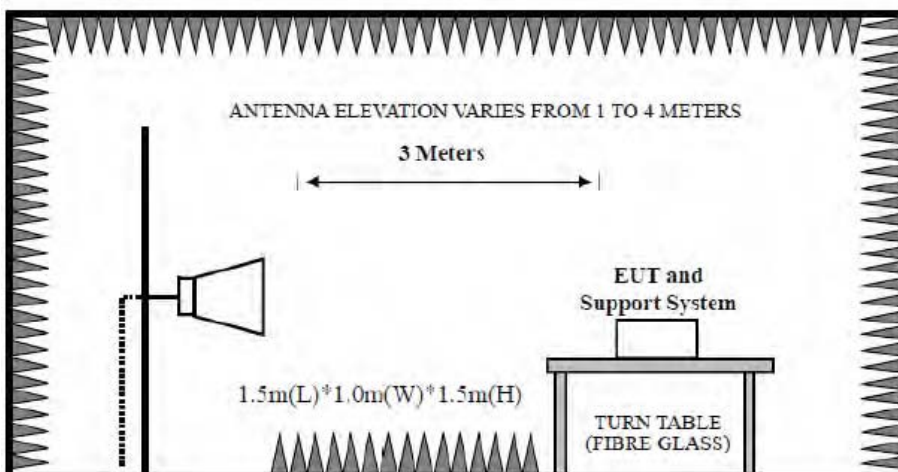
9kHz~30MHz



30~1000MHz



Above 1GHz



4.3. Test Procedure

EUT was placed on a turn table, which is 0.8 meter high above ground for 9kHz~1000MHz test, and which is 1.5 meter high above ground for above 1GHz test. The turn table can rotate 360 degrees to determine the position of the maximum emission level. Power on the EUT and let it working in test mode, then test it. 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 between 1 meter and 4 meters to find out the maximum emission level. Both horizontal and vertical polarization of the antenna are set on test.

The test frequency analyzer system was set to Peak Detect (300Hz RBW in 9kHz to 150kHz and 10kHz RBW in 150kHz to 30MHz) Function and Specified Bandwidth with Maximum Hold Mode.

The bandwidth of the EMI test receiver (R&S ESVS10) is set at 120kHz for frequency range from 30MHz to 1000 MHz.

The bandwidth of the Spectrum's VBW is set at 1MHz and RBW is set at 1MHz for peak emissions measurement above 1GHz and 1MHz RBW, 10Hz VBW for average emissions measure above 1GHz

PEAK detector, 1MHz/1MHz for PAEK measurement,

PEAK detector, 1MHz/10Hz for Average measurement

The frequency range from 30MHz to 10th harmonic (25GHz) are checked.

4.4. Test Result

PASS (The testing data was attached in the next pages, only worse case is reported.)

All the emissions from 30MHz to 25 GHz were comply with 15.209 limits.

Note: 1、 For emissions above 1GHz, if peak level comply with average limit, then the average level is deemed to comply with average limit.

2、 The frequency 2402MHz 、 2440MHz and 2480 MHz is fundamental frequency which no limit, the limit on plots is automatically generated by the software, it's not fundamental limit, we can't remove it.

4.5. Test Data

9 kHz – 30 MHz

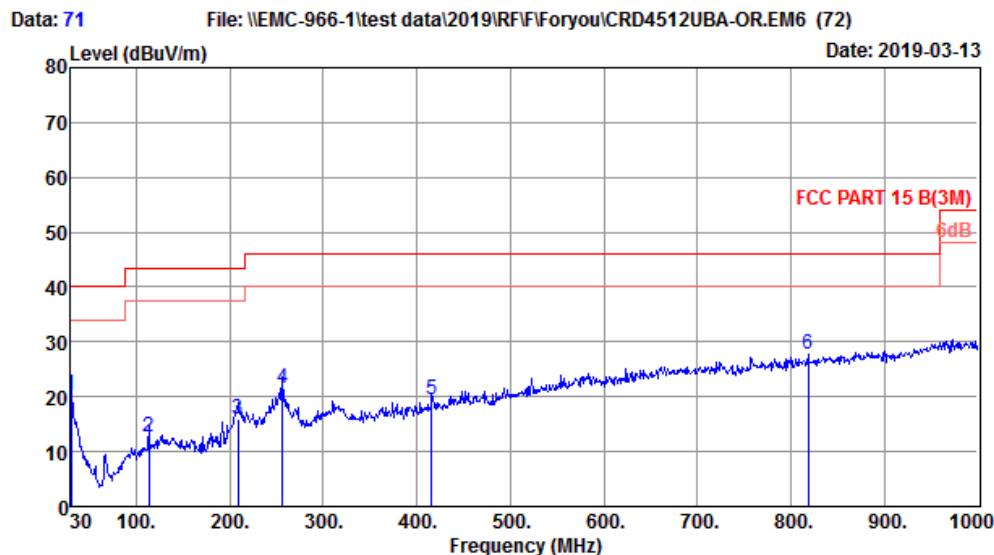
Pass

Note: The amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

30-1000 MHz

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Site no. : 1# 966 Chamber Data no. : 71
 Dis. / Ant. : 3m 37062 Ant. pol. : HORIZONTAL
 Limit : FCC PART 15 B(3M)
 Env. / Ins. : Temp:19.2'; Humi:48.5%; Press:101.9kPa
 Engineer : ZERO
 EUT : CAR RADIO
 Power : DC 12V
 M/N : CRD4512UBA-OR
 Test Mode : TX Mode

	Freq. (MHz)	ANT Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	30.00	18.50	0.14	1.80	20.44	40.00	19.56	QP
2	113.42	11.03	0.94	0.71	12.68	43.50	30.82	QP
3	208.48	8.67	1.35	5.94	15.96	43.50	27.54	QP
4	256.01	13.30	1.67	6.72	21.69	46.00	24.31	QP
5	416.06	16.48	2.16	0.95	19.59	46.00	26.41	QP
6	818.61	23.19	3.70	0.96	27.85	46.00	18.15	QP

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading.
 2. Margin= Limit - Emission Level.
 3. The emission levels that are 20dB below the official limit are not reported.

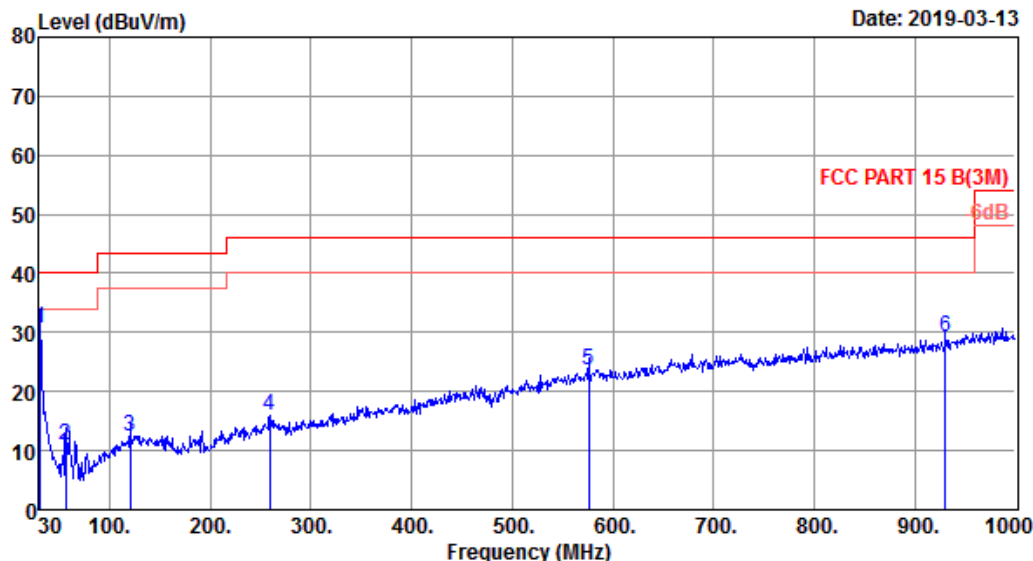
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Data: 72

File: \\EMC-966-1\\test data\\2019\\RF\\F\\Foryou\\CRD4512UBA-OR.EM6 (72)

Date: 2019-03-13



Site no. : 1# 966 Chamber Data no. : 72
 Dis. / Ant. : 3m 37062 Ant. pol. : VERTICAL
 Limit : FCC PART 15 B(3M)
 Env. / Ins. : Temp:19.2';Humi:48.5%;Press:101.9kPa
 Engineer : ZERO
 EUT : CAR RADIO
 Power : DC 12V
 M/N : CRD4512UBA-OR
 Test Mode : TX Mode

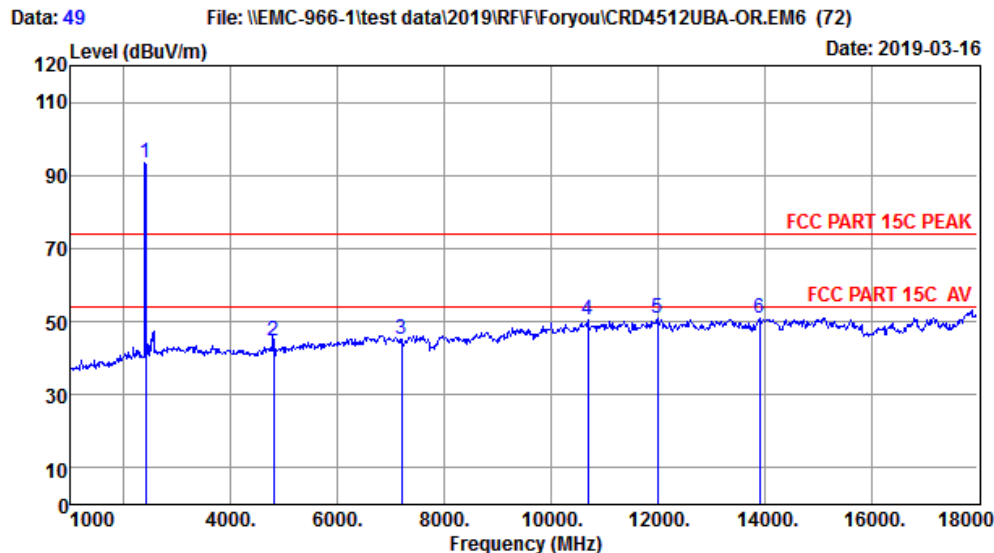
	Freq. (MHz)	ANT Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	30.97	17.50	0.14	12.98	30.62	40.00	9.38	QP
2	56.19	5.70	0.36	4.85	10.91	40.00	29.09	QP
3	120.21	11.40	0.94	0.11	12.45	43.50	31.05	QP
4	258.92	13.60	1.69	0.58	15.87	46.00	30.13	QP
5	576.11	19.76	2.91	1.04	23.71	46.00	22.29	QP
6	930.16	24.20	4.19	0.87	29.26	46.00	16.74	QP

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading.
 2. Margin= Limit - Emission Level.
 3. The emission levels that are 20dB below the official limit are not reported.

1000-18000MHz

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Site no. : 1# 966 Chamber Data no. : 49
 Dis. / Ant. : 3m 9120D 1-18G Ant. pol. : HORIZONTAL
 Limit : FCC PART 15C PEAK
 Env. / Ins. : Temp:27.3';Humi:54%;Press:101.52kPa
 Engineer : Seven
 EUT : CAR RADIO
 Power : DC 12V
 M/N : CRD4512UBA-OR
 Test Mode : GFSK TX 2402MHz

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Amp Factor (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	2402.00	27.26	4.03	33.23	95.48	93.54	74.00	-19.54	Peak
2	4804.00	31.16	6.02	33.38	40.83	44.63	74.00	29.37	Peak
3	7206.00	36.05	7.37	31.47	33.20	45.15	74.00	28.85	Peak
4	10690.00	39.54	9.80	32.16	33.10	50.28	74.00	23.72	Peak
5	11999.00	39.30	10.80	30.20	31.12	51.02	74.00	22.98	Peak
6	13903.00	40.93	11.79	30.94	29.23	51.01	74.00	22.99	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss - Amp Factor + Reading.
 2. Margin= Limit - Emission Level.
 3. The emission levels that are 20dB below the official limit are not reported.

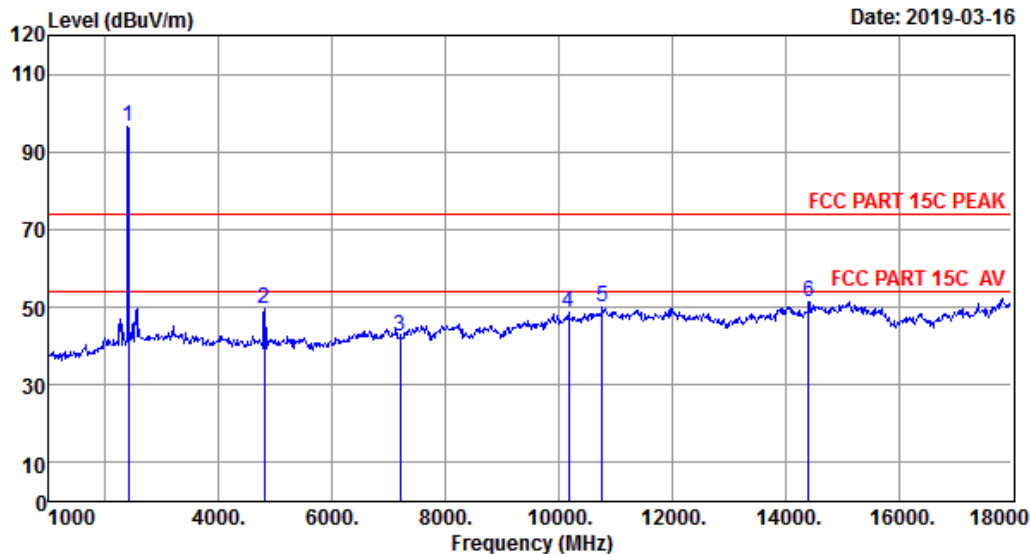
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Data: 50

File: \\EMC-966-1\test data\2019\RF\F\Foryou\CRD4512UBA-OR.EM6 (72)

Date: 2019-03-16



Site no. : 1# 966 Chamber Data no. : 50
 Dis. / Ant. : 3m 9120D 1-18G Ant. pol. : VERTICAL
 Limit : FCC PART 15C PEAK
 Env. / Ins. : Temp:27.3'; Humi:54%; Press:101.52kPa
 Engineer : Seven
 EUT : CAR RADIO
 Power : DC 12V
 M/N : CRD4512UBA-OR
 Test Mode : GFSK TX 2402MHz

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Amp Factor (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	2402.00	27.26	4.03	33.23	98.42	96.48	74.00	-22.48	Peak
2	4804.00	31.16	6.02	33.38	45.68	49.48	74.00	24.52	Peak
3	7206.00	36.05	7.37	31.47	30.66	42.61	74.00	31.39	Peak
4	10180.00	38.78	9.29	32.62	33.21	48.66	74.00	25.34	Peak
5	10775.00	39.67	9.85	31.89	32.22	49.85	74.00	24.15	Peak
6	14413.00	41.06	12.17	30.74	28.95	51.44	74.00	22.56	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss - Amp Factor + Reading.
 2. Margin= Limit - Emission Level.
 3. The emission levels that are 20dB below the official limit are not reported.

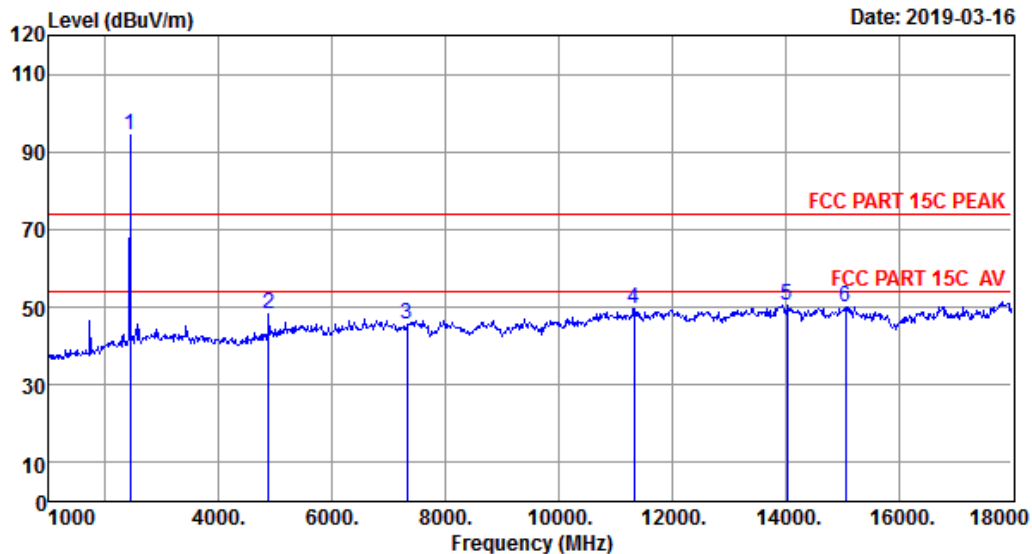
EST Technology

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Data: 51

File: \\EMC-966-1\test data\2019\RF\F\Foryou\CRD4512UBA-OR.EM6 (72)

Date: 2019-03-16



Site no. : 1# 966 Chamber Data no. : 51
 Dis. / Ant. : 3m 9120D 1-18G Ant. pol. : HORIZONTAL
 Limit : FCC PART 15C PEAK
 Env. / Ins. : Temp:27.3'; Humi:54%; Press:101.52kPa
 Engineer : Seven
 EUT : CAR RADIO
 Power : DC 12V
 M/N : CRD4512UBA-OR
 Test Mode : GFSK TX 2440MHz

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Amp Factor (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	2440.00	27.33	4.03	33.39	96.37	94.34	74.00	-20.34	Peak
2	4880.00	31.39	6.10	33.02	43.71	48.18	74.00	25.82	Peak
3	7320.00	36.19	7.62	31.20	32.82	45.43	74.00	28.57	Peak
4	11336.00	39.76	9.97	30.65	30.45	49.53	74.00	24.47	Peak
5	14039.00	41.10	12.10	31.09	28.22	50.33	74.00	23.67	Peak
6	15059.00	40.82	12.15	31.09	28.14	50.02	74.00	23.98	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss - Amp Factor + Reading.
 2. Margin= Limit - Emission Level.
 3. The emission levels that are 20dB below the official limit are not reported.

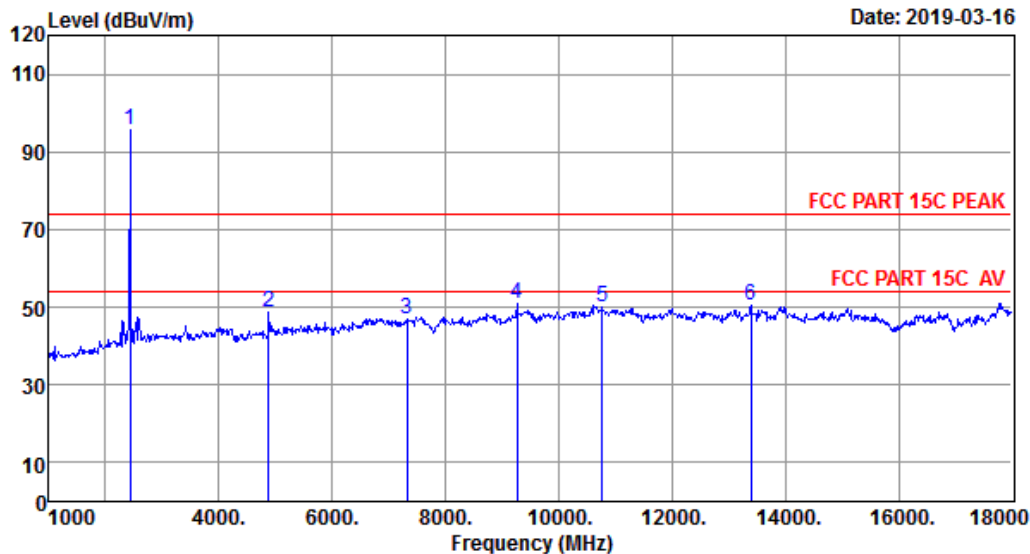
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Data: 52

File: \\EMC-966-1\test data\2019\RF\Foryou\CRD4512UBA-OR.EM6 (72)

Date: 2019-03-16



Site no. : 1# 966 Chamber Data no. : 52
 Dis. / Ant. : 3m 9120D 1-18G Ant. pol. : VERTICAL
 Limit : FCC PART 15C PEAK
 Env. / Ins. : Temp:27.3'; Humi:54%; Press:101.52kPa
 Engineer : Seven
 EUT : CAR RADIO
 Power : DC 12V
 M/N : CRD4512UBA-OR
 Test Mode : GFSK TX 2440MHz

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Amp Factor (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	2440.00	27.33	4.03	33.39	97.56	95.53	74.00	-21.53	Peak
2	4880.00	31.39	6.10	33.02	44.40	48.87	74.00	25.13	Peak
3	7320.00	36.19	7.62	31.20	34.37	46.98	74.00	27.02	Peak
4	9262.00	37.02	8.94	31.66	36.56	50.86	74.00	23.14	Peak
5	10775.00	39.67	9.85	31.89	32.31	49.94	74.00	24.06	Peak
6	13393.00	40.06	11.58	30.87	29.61	50.38	74.00	23.62	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss - Amp Factor + Reading.
 2. Margin= Limit - Emission Level.
 3. The emission levels that are 20dB below the official limit are not reported.

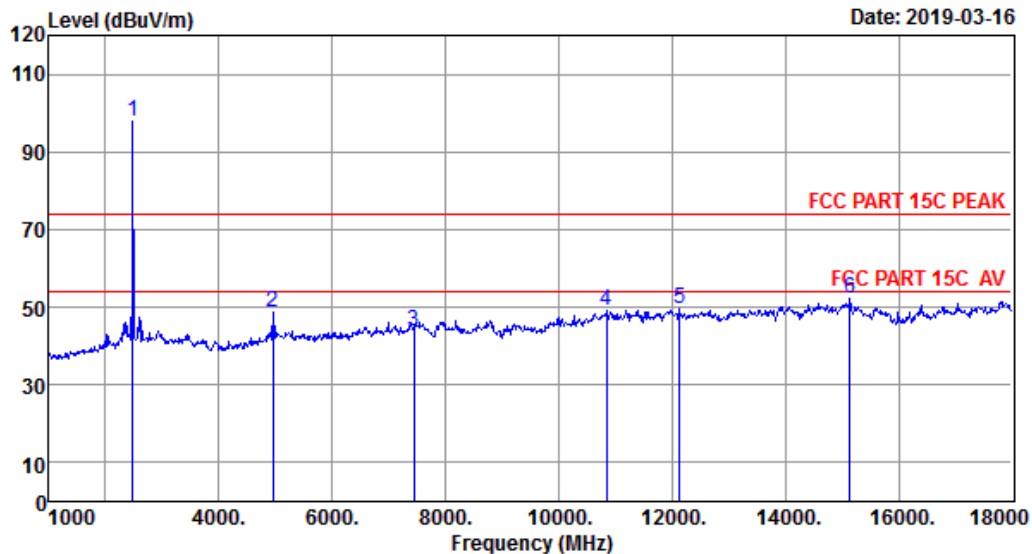
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Data: 53

File: \\EMC-966-1\test data\2019\RF\F\Foryou\CRD4512UBA-OR.EM6 (72)

Date: 2019-03-16



Site no. : 1# 966 Chamber Data no. : 53
 Dis. / Ant. : 3m 9120D 1-18G Ant. pol. : VERTICAL
 Limit : FCC PART 15C PEAK
 Env. / Ins. : Temp:27.3'; Humi:54%; Press:101.52kPa
 Engineer : Seven
 EUT : CAR RADIO
 Power : DC 12V
 M/N : CRD4512UBA-OR
 Test Mode : GFSK TX 2480MHz

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Amp Factor (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	2480.00	27.38	4.03	33.56	100.17	98.02	74.00	-24.02	Peak
2	4960.00	31.68	6.10	33.40	44.12	48.50	74.00	25.50	Peak
3	7440.00	36.34	7.66	31.10	31.01	43.91	74.00	30.09	Peak
4	10843.00	39.77	9.80	31.84	31.64	49.37	74.00	24.63	Peak
5	12135.00	39.31	10.61	30.67	30.14	49.39	74.00	24.61	Peak
6	15144.00	40.53	12.43	31.13	30.27	52.10	74.00	21.90	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss - Amp Factor + Reading.
 2. Margin= Limit - Emission Level.
 3. The emission levels that are 20dB below the official limit are not reported.

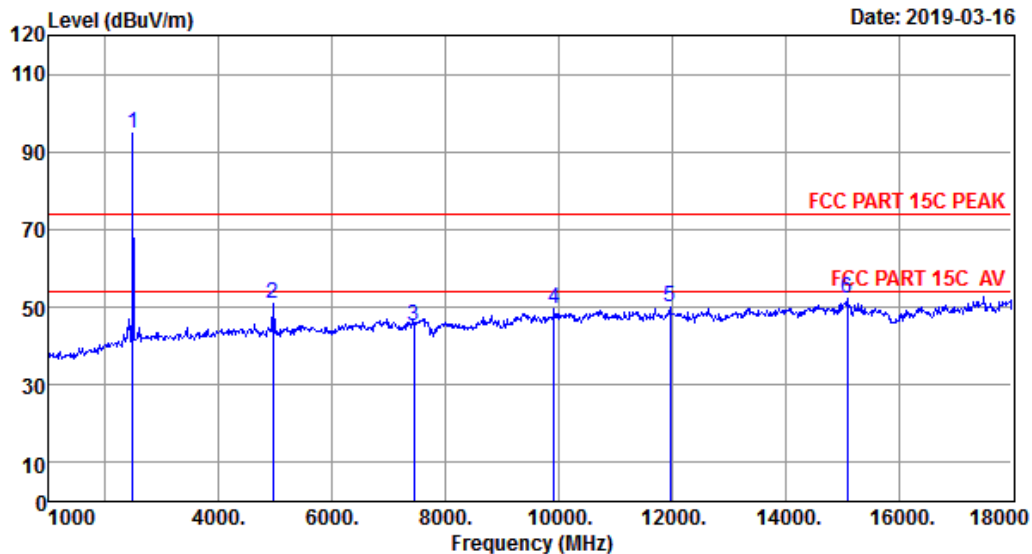
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Data: 54

File: \\EMC-966-1\test data\2019\RF\F\Foryou\CRD4512UBA-OR.EM6 (72)

Date: 2019-03-16



Site no. : 1# 966 Chamber Data no. : 54
 Dis. / Ant. : 3m 9120D 1-18G Ant. pol. : HORIZONTAL
 Limit : FCC PART 15C PEAK
 Env. / Ins. : Temp:27.3'; Humi:54%; Press:101.52kPa
 Engineer : Seven
 EUT : CAR RADIO
 Power : DC 12V
 M/N : CRD4512UBA-OR
 Test Mode : GFSK TX 2480MHz

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Amp Factor (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	2480.00	27.38	4.03	33.56	96.98	94.83	74.00	-20.83	Peak
2	4960.00	31.68	6.10	33.40	46.65	51.03	74.00	22.97	Peak
3	7440.00	36.34	7.66	31.10	32.09	44.99	74.00	29.01	Peak
4	9925.00	38.36	9.34	32.98	34.82	49.54	74.00	24.46	Peak
5	11965.00	39.32	10.72	30.30	30.24	49.98	74.00	24.02	Peak
6	15093.00	40.71	12.18	31.10	30.35	52.14	74.00	21.86	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss - Amp Factor + Reading.
 2. Margin= Limit - Emission Level.
 3. The emission levels that are 20dB below the official limit are not reported.

18000MHz – 25000MHz

Pass

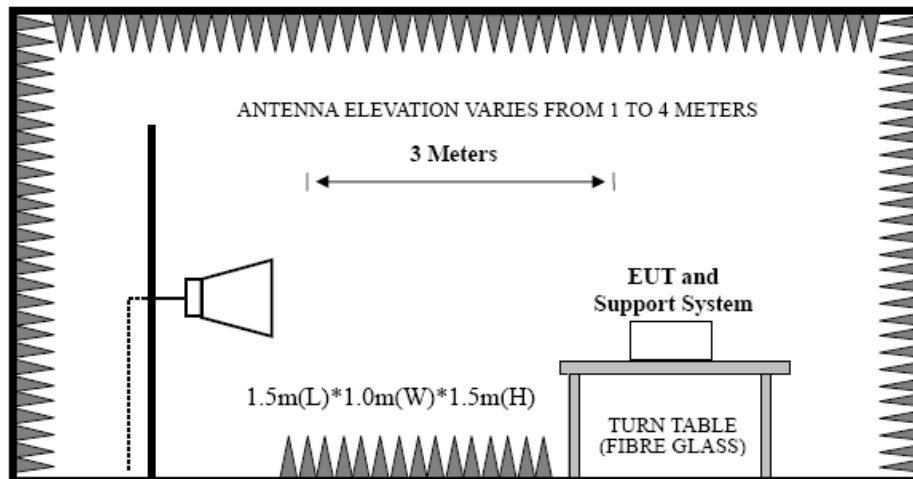
Note: The amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

5 BAND EDGE COMPLIANCE TEST

5.1 Limit

All the lower and upper band-edges emissions appearing within 2310MHz to 2390MHz and 2483.5MHz to 2500MHz restricted frequency bands shall not exceed the limits shown in 15.209, all the other emissions outside operation frequency band 2400MHz to 2483.5MHz shall be at least 20dB below the fundamental emissions, or comply with 15.209 limits

5.2 Block Diagram of Test setup



5.3 Test Procedure

1. The EUT is placed on a turntable, which is 1.5m above the ground plane and worked at highest radiated power.
2. The turntable was rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission.
4. Set the spectrum analyzer in the following setting in order to capture the lower and upper band-edges of the emission:

Peak : RBW = 1MHz, VBW = 1MHz, Detector=PEAK detector, Sweep time = auto.

AV : RBW = 1MHz, VBW = 10Hz, Detector=PEAK detector, Sweep time = auto.

5.4 Test Result

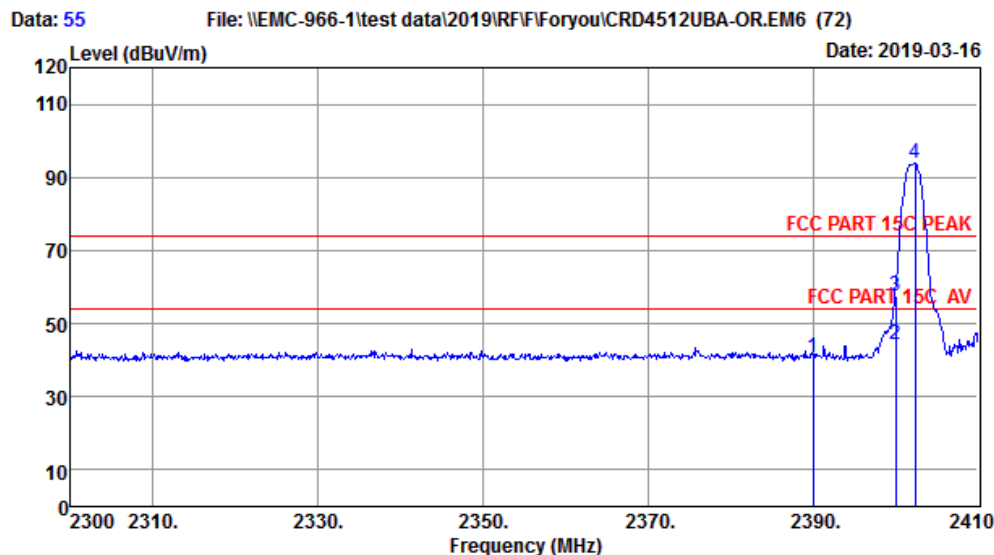
PASS (The testing data was attached in the next pages, only worse case is reported.)

- Note: 1、 For emissions above 1GHz, if peak level comply with average limit, then the average level is deemed to comply with average limit.
- 2、 The frequency 2402MHz and 2480 MHz is fundamental frequency which no limit, the limit on plots is automatically generated by the software, it's not fundamental limit, we can't remove it.

5.5 Test Data

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 Dis. / Ant. : 3m 9120D 1-18G Ant. pol. : HORIZONTAL
 Limit : FCC PART 15C PEAK
 Env. / Ins. : Temp:27.3';Humi:54%;Press:101.52kPa
 Engineer : Seven
 EUT : CAR RADIO
 Power : DC 12V
 M/N : CRD4512UBA-OR
 Test Mode : GFSK TX 2402MHz

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Amp Factor (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	2390.00	27.26	4.00	33.24	42.68	40.70	74.00	33.30	Peak
2	2400.00	27.26	4.03	33.23	46.26	44.32	54.00	9.68	Average
3	2400.00	27.26	4.03	33.23	59.44	57.50	74.00	16.50	Peak
4	2402.41	27.26	4.03	33.23	95.82	93.88	74.00	-19.88	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss - Amp Factor + Reading.
 2. Margin= Limit - Emission Level.
 3. The emission levels that are 20dB below the official limit are not reported.

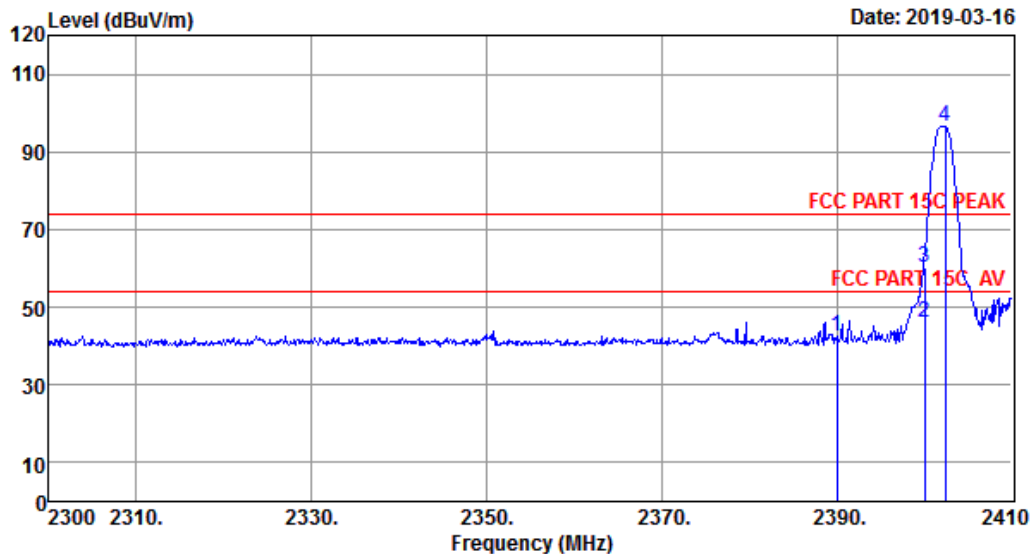
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Data: 56

File: \\EMC-966-1\test data\2019\RF\F\Foryou\CRD4512UBA-OR.EM6 (72)

Date: 2019-03-16



Site no. : 1# 966 Chamber Data no. : 56
 Dis. / Ant. : 3m 9120D 1-18G Ant. pol. : VERTICAL
 Limit : FCC PART 15C PEAK
 Env. / Ins. : Temp:27.3'; Humi:54%; Press:101.52kPa
 Engineer : Seven
 EUT : CAR RADIO
 Power : DC 12V
 M/N : CRD4512UBA-OR
 Test Mode : GFSK TX 2402MHz

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Amp Factor (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	2390.00	27.26	4.00	33.24	44.27	42.29	74.00	31.71	Peak
2	2400.00	27.26	4.03	33.23	48.15	46.21	54.00	7.79	Average
3	2400.00	27.26	4.03	33.23	62.19	60.25	74.00	13.75	Peak
4	2402.41	27.26	4.03	33.23	98.56	96.62	74.00	-22.62	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss - Amp Factor + Reading.
 2. Margin= Limit - Emission Level.
 3. The emission levels that are 20dB below the official limit are not reported.

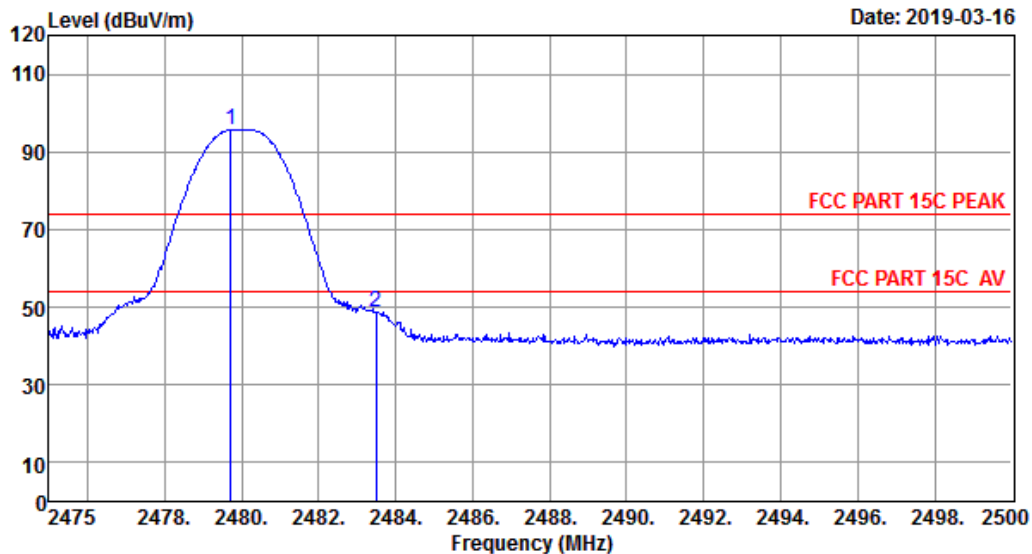
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Data: 57

File: \\EMC-966-1\test data\2019\RF\Foryou\CRD4512UBA-OR.EM6 (72)

Date: 2019-03-16



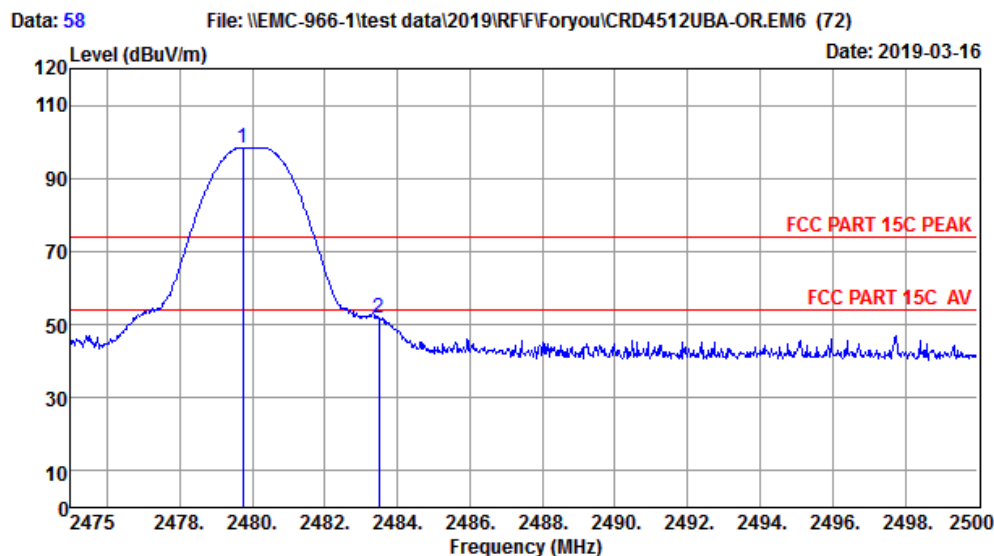
Site no. : 1# 966 Chamber Data no. : 57
 Dis. / Ant. : 3m 9120D 1-18G Ant. pol. : HORIZONTAL
 Limit : FCC PART 15C PEAK
 Env. / Ins. : Temp:27.3'; Humi:54%; Press:101.52kPa
 Engineer : Seven
 EUT : CAR RADIO
 Power : DC 12V
 M/N : CRD4512UBA-OR
 Test Mode : GFSK TX 2480MHz

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Amp Factor (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	2479.73	27.38	4.03	33.56	97.81	95.66	74.00	-21.66	Peak
2	2483.50	27.38	4.03	33.56	50.66	48.51	74.00	25.49	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss - Amp Factor + Reading.
 2. Margin= Limit - Emission Level.
 3. The emission levels that are 20dB below the official limit are not reported.

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Site no. : 1# 966 Chamber Data no. : 58
 Dis. / Ant. : 3m 9120D 1-18G Ant. pol. : VERTICAL
 Limit : FCC PART 15C PEAK
 Env. / Ins. : Temp:27.3'; Humi:54%; Press:101.52kPa
 Engineer : Seven
 EUT : CAR RADIO
 Power : DC 12V
 M/N : CRD4512UBA-OR
 Test Mode : GFSK TX 2480MHz

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Amp Factor (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	2479.75	27.38	4.03	33.56	100.62	98.47	74.00	-24.47	Peak
2	2483.50	27.38	4.03	33.56	53.91	51.76	74.00	22.24	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss - Amp Factor + Reading.
 2. Margin= Limit - Emission Level.
 3. The emission levels that are 20dB below the official limit are not reported.

6 6dB Bandwidth Test

6.1 Limit

For direct sequence systems, the minimum 6dB bandwidth shall be at least 500kHz

6.2 Test Procedure

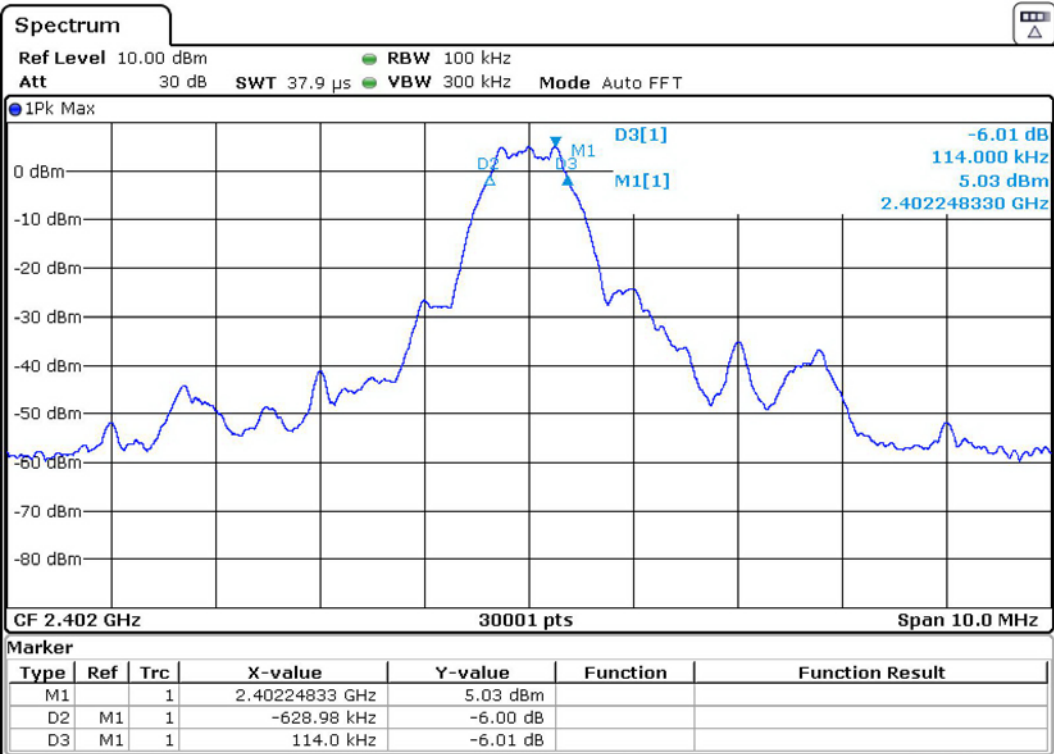
- 1, The transmitter output (antenna port) was connected to the spectrum analyzer. Connect EUT antenna terminal to the spectrum analyzer with a low loss SMA cable.
- 2, Follow the test procedure as described in KDB 558074
 - (1). Set resolution bandwidth (RBW) = 100 kHz.
 - (2). Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
 - (3). Detector = Peak.
 - (4). Trace mode = max hold.
 - (5). Sweep = auto couple.
 - (6). Allow the trace to stabilize.
 - (7). Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

6.3 Test Result

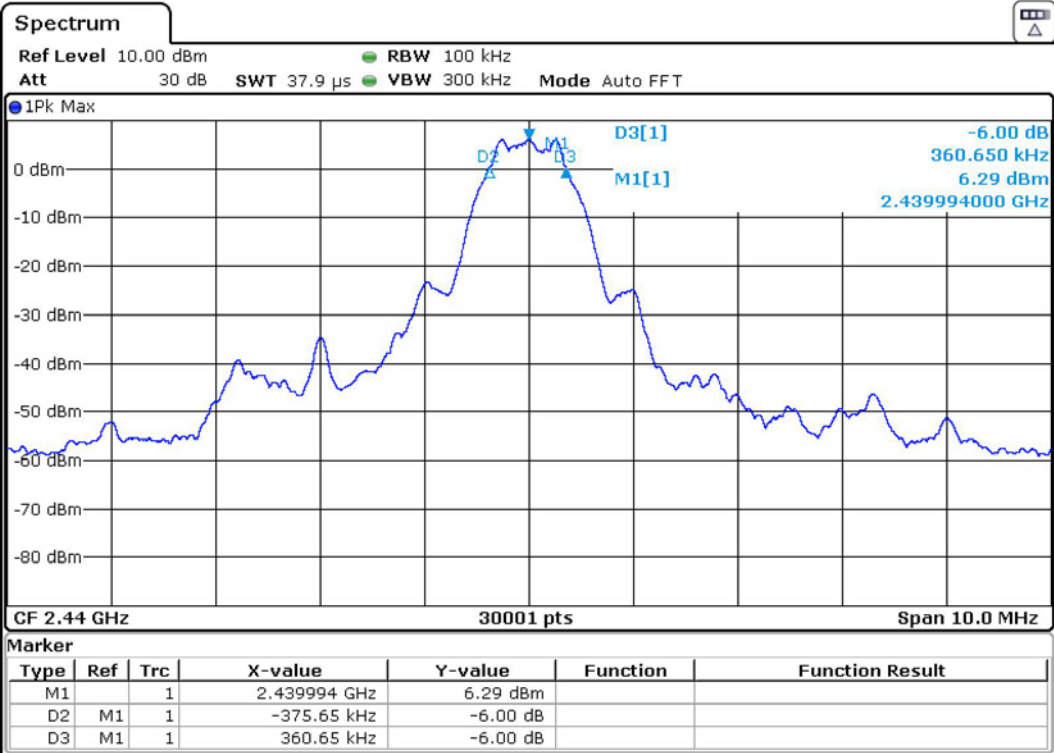
EUT: CAR RADIO			
M/N: CRD4512UBA-OR			
Test date: 2019-03-20		Test site: RF Site	Tested by: Seven
Test Mode	CH	6dB bandwidth (MHz)	Limit (KHz)
BT 4.0-BLE GFSK	CH1	0.74298	>500
	CH20	0.73620	>500
	CH40	0.74797	>500
Conclusion : PASS			

6.4 Test Data

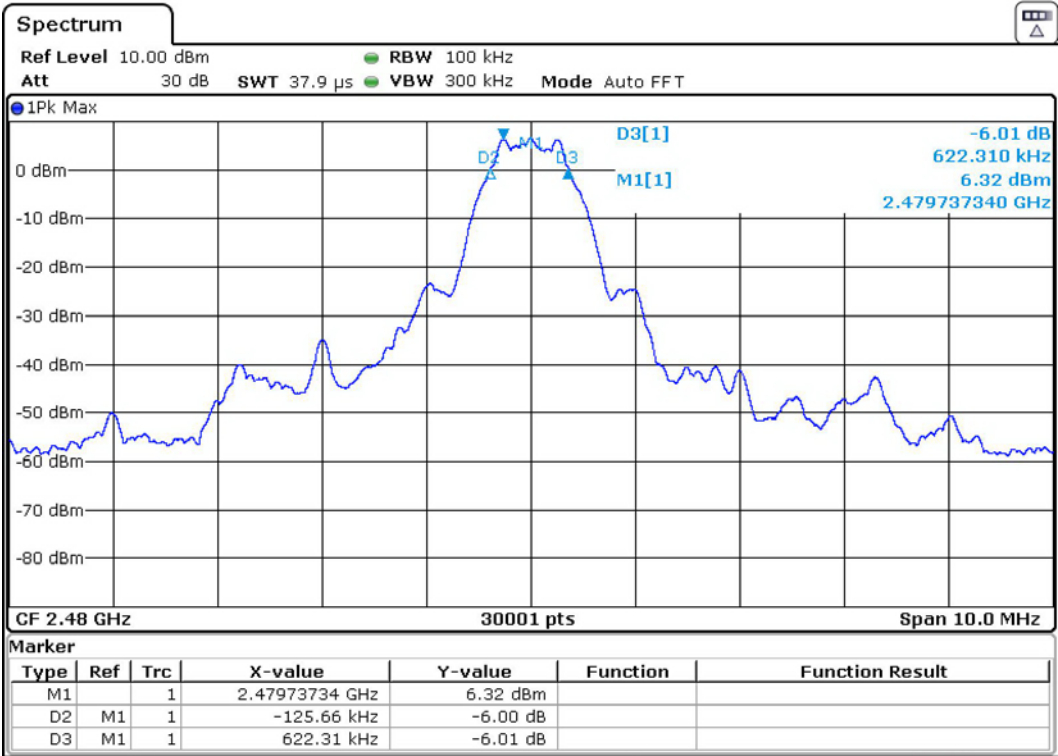
Test Mode: BT 4.0-BLE GFSK 2402MHz



Test Mode: BT 4.0-BLE GFSK 2440MHz



Test Mode: BT 4.0-BLE GFSK 2480MHz



7 OUTPUT POWER TEST

7.1 Limit

For systems using digital modulation in the 2400—2483.5MHz, The Peak out put Power shall not exceed 1W(30dBm)

7.2 Test Procedure

- 1, The transmitter output (antenna port) was connected to the spectrum analyzer. Connect EUT antenna terminal to the spectrum analyzer with a low loss SMA cable.
- 2, Follow the test procedure as described in KDB 558074
 - (1). Set the RBW $\geq$ DTS bandwidth.
 - (2). Set VBW $\geq$ 3 x RBW.
 - (3). Set span $\geq$ 3 x RBW.
 - (4). Sweep time = auto couple.
 - (5). Detector = peak.
 - (6). Trace mode = max hold.
 - (7). Allow trace to fully stabilize.
 - (8). Use peak marker function to determine the peak amplitude level.

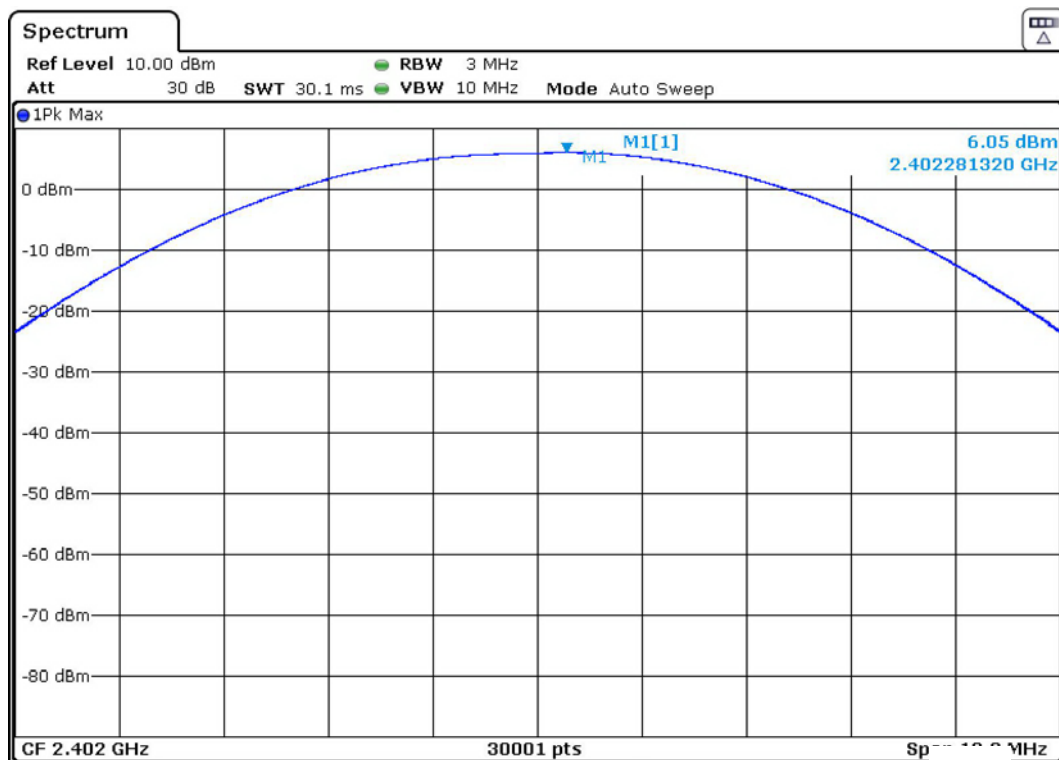
Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

7.3 Test Result

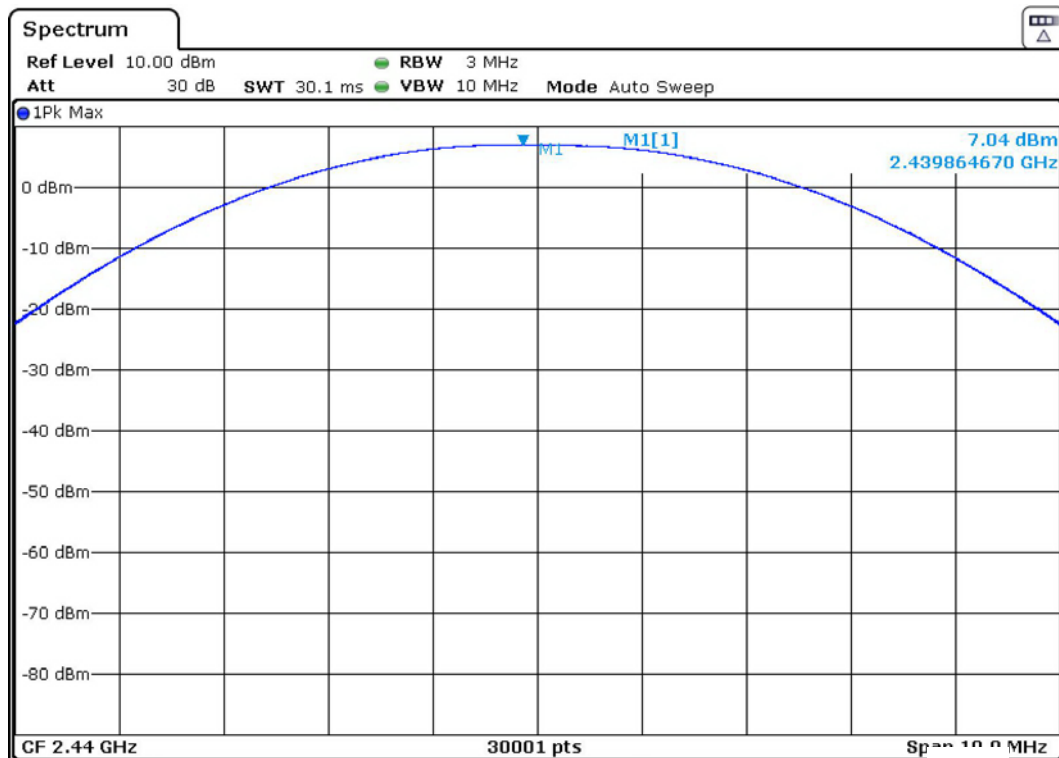
EUT: CAR RADIO			
M/N: CRD4512UBA-OR			
Test date: 2019-03-20		Test site: RF Site	Tested by: Seven
Pass			
Test Mode	CH	Peak output Power (dBm)	Limit (dBm)
BT 4.0-BLE GFSK	CH1	6.05	30
	CH20	7.04	30
	CH40	7.26	30
Conclusion : PASS			

7.4 Test Data

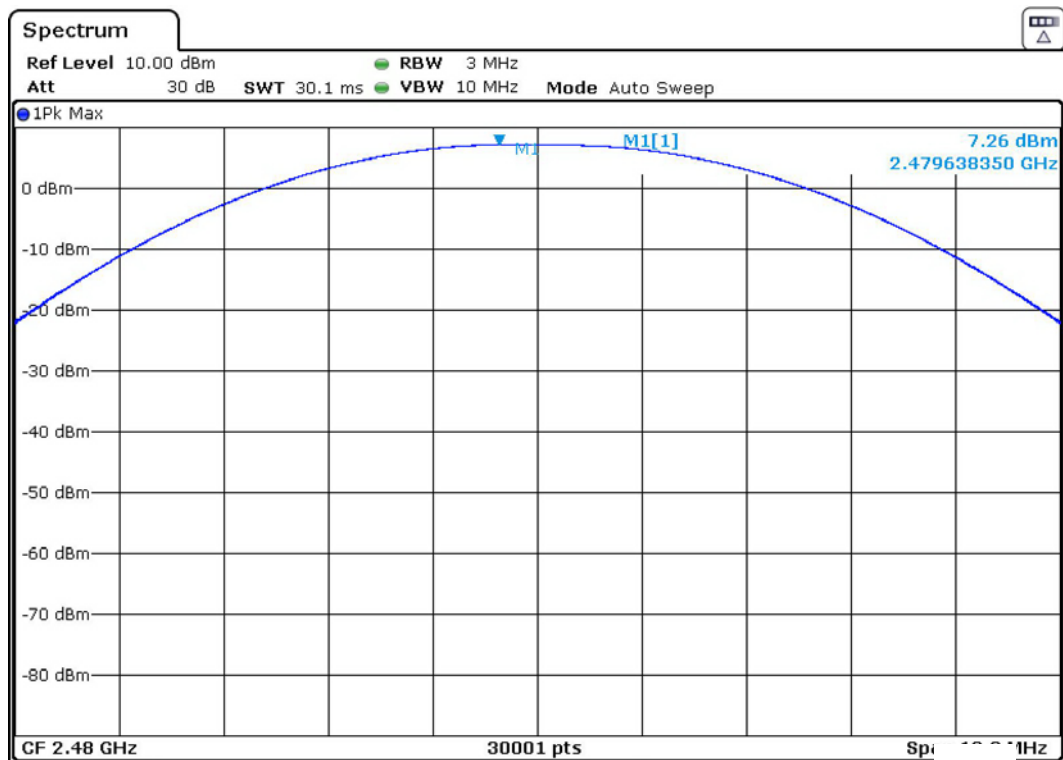
Test Mode: BT 4.0-BLE GFSK 2402MHz



Test Mode: BT 4.0-BLE GFSK 2440MHz



Test Mode: BT 4.0-BLE GFSK 2480MHz



8 POWER SPECTRAL DENSITY TEST

8.1 Limit

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission.

8.2 Test Procedure

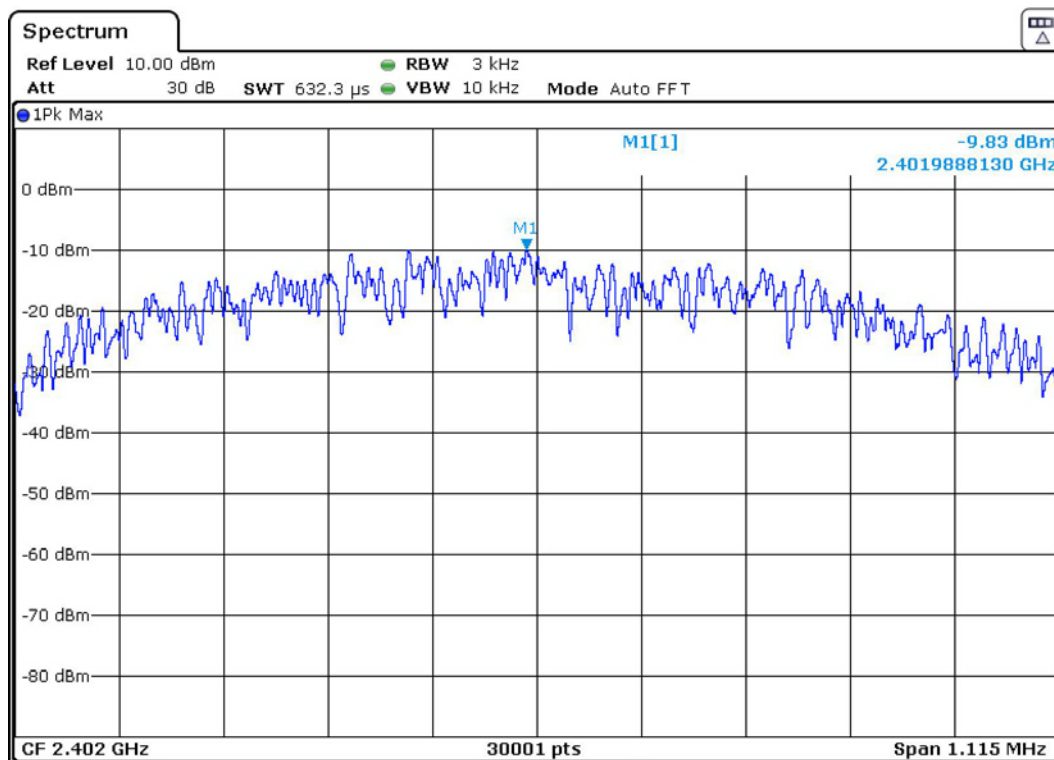
- 1, The transmitter output (antenna port) was connected to the spectrum analyzer. Connect EUT antenna terminal to the spectrum analyzer with a low loss SMA cable.
- 2, Follow the test procedure as described in KDB 558074
 - (1). Set analyzer center frequency to DTS channel center frequency.
 - (2). Set the span to 1.5 times the DTS bandwidth.
 - (3). Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
 - (4). Set the VBW $\geq 3 \text{ RBW}$.
 - (5). Detector = peak.
 - (6). Sweep time = auto couple.
 - (7). Trace mode = max hold.
 - (8). Allow trace to fully stabilize.
 - (9). Use the peak marker function to determine the maximum amplitude level.
 - (10). If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

8.3 Test Result

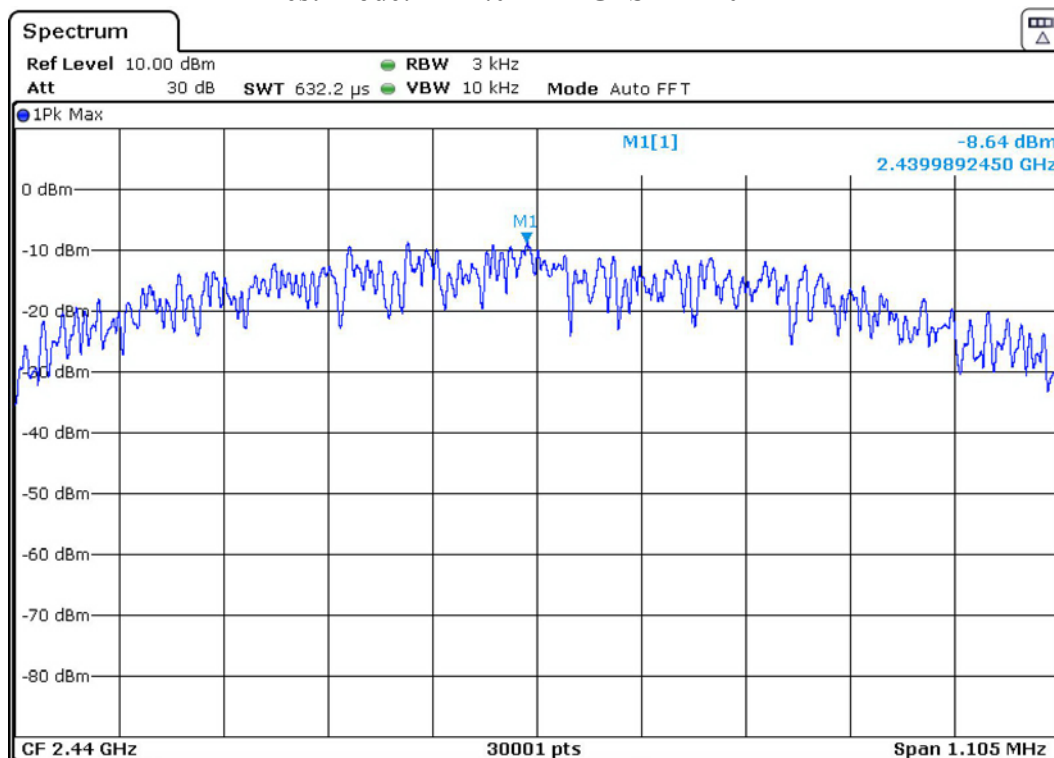
EUT: CAR RADIO			
M/N: CRD4512UBA-OR			
Test date: 2019-3-20		Test site: RF Site	Tested by: Seven
Pass			
Test Mode	CH	Power density (dBm/3kHz)	Limit (dBm/3kHz)
BT 4.0-BLE GFSK	CH1	-9.83	8
	CH20	-8.64	8
	CH40	-8.38	8
Conclusion : PASS			

8.4 Test Data

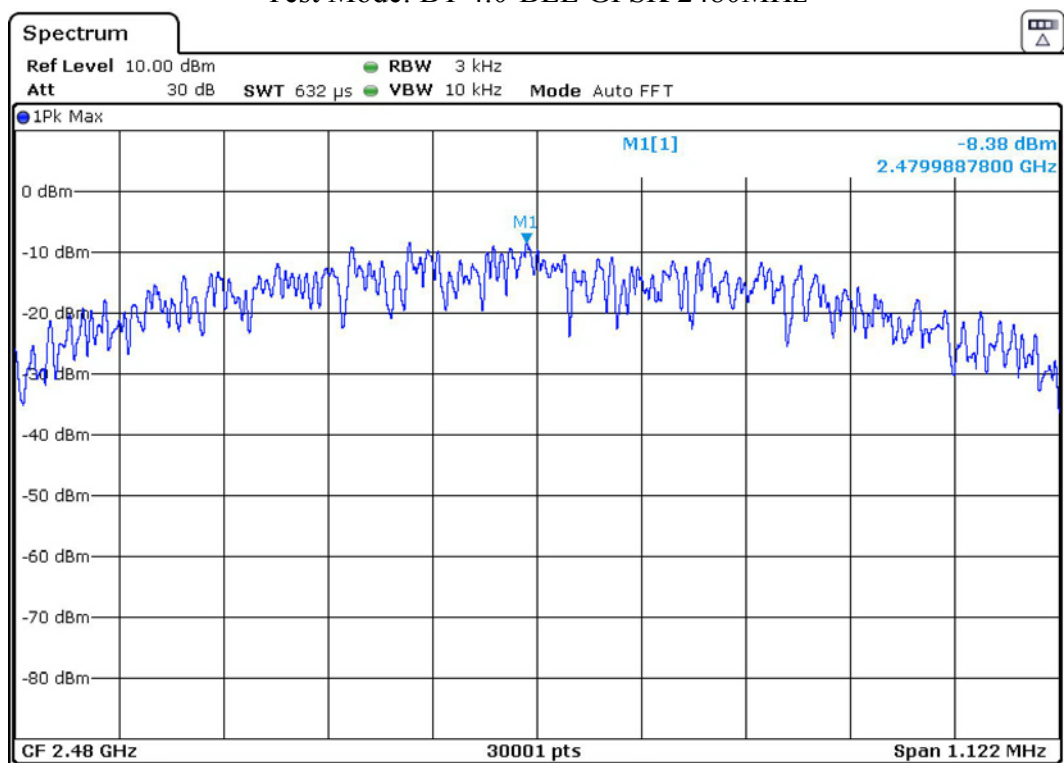
Test Mode: BT 4.0-BLE GFSK 2402MHz



Test Mode: BT 4.0-BLE GFSK 2440MHz



Test Mode: BT 4.0-BLE GFSK 2480MHz



9 CONDUCTED SPURIOUS EMISSION BAND EDGES TEST

9.1 Limit

In any 100kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power.

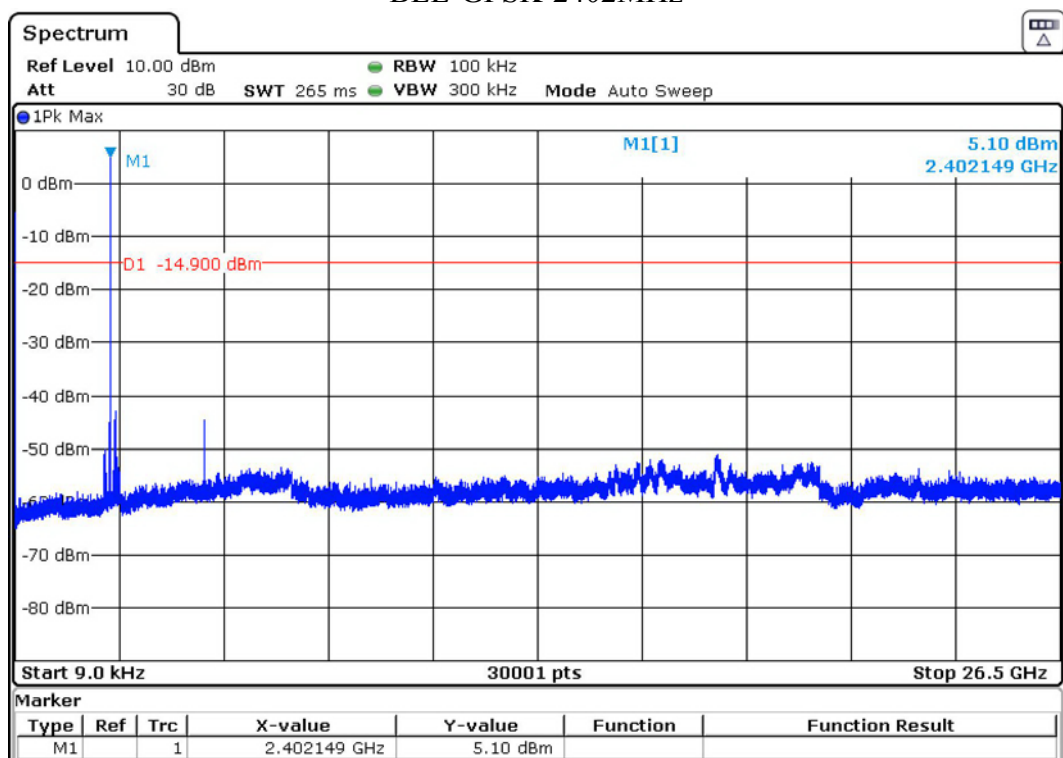
9.2 Test Procedure

The transmitter output was connected to a spectrum analyzer, The resolution bandwidth is set to 100 kHz, The video bandwidth is set to 300 kHz for frequency range from 30MHz to 1000 MHz; The resolution bandwidth is set to 1 MHz, The video bandwidth is set to 3 MHz for frequency range from 1000MHz to 25000 MHz.

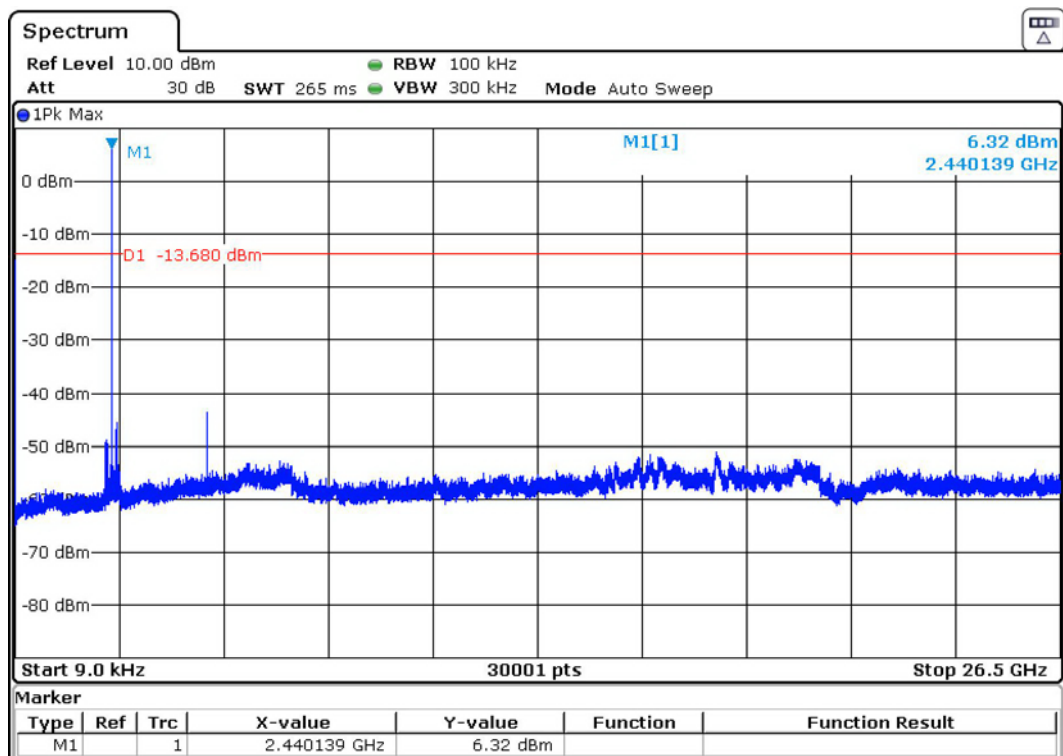
9.3 Test Result

PASS (The testing data was attached in the next pages,only worse case is reported.)

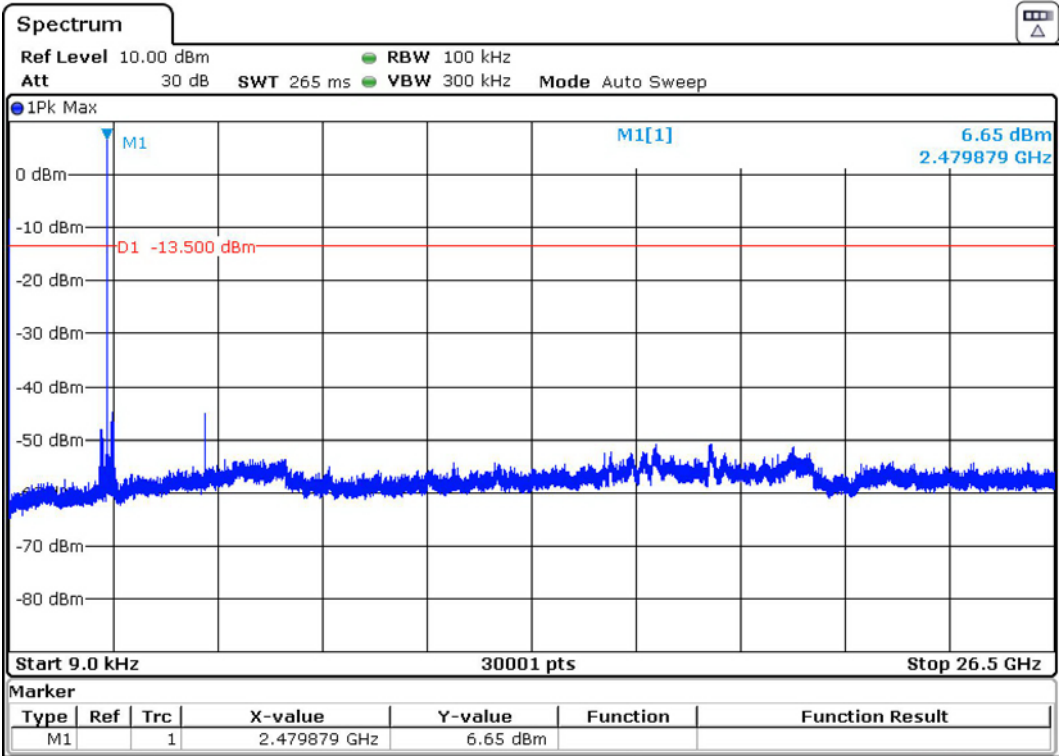
BLE-GFSK-2402MHz



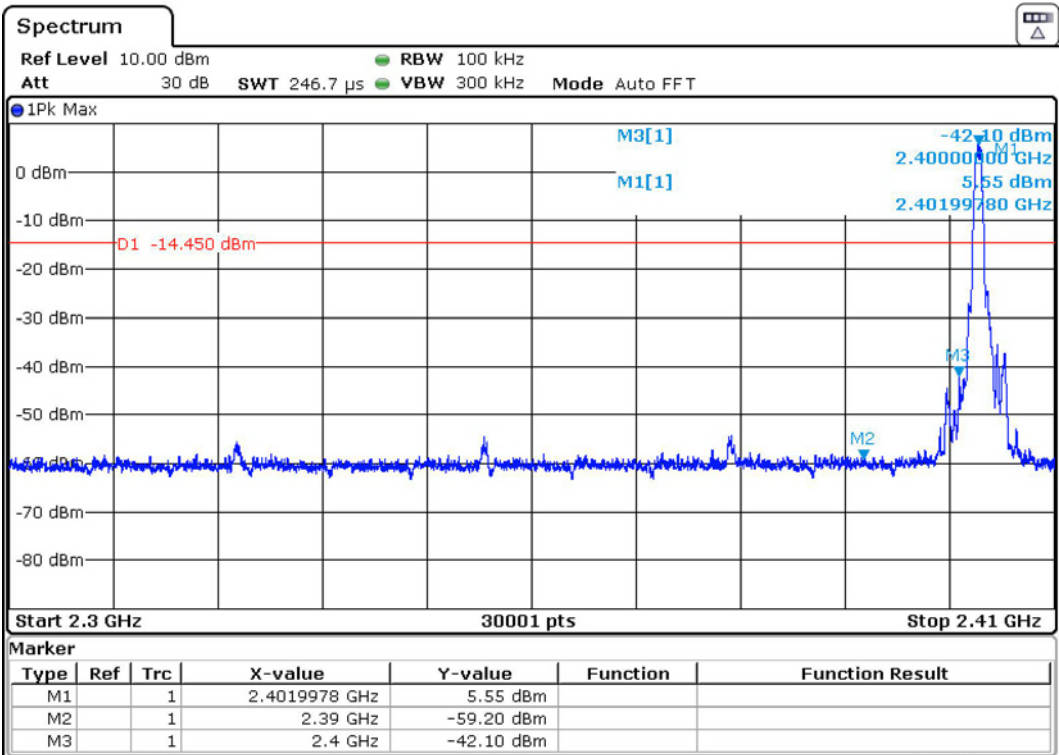
BLE-GFSK-2440MHz



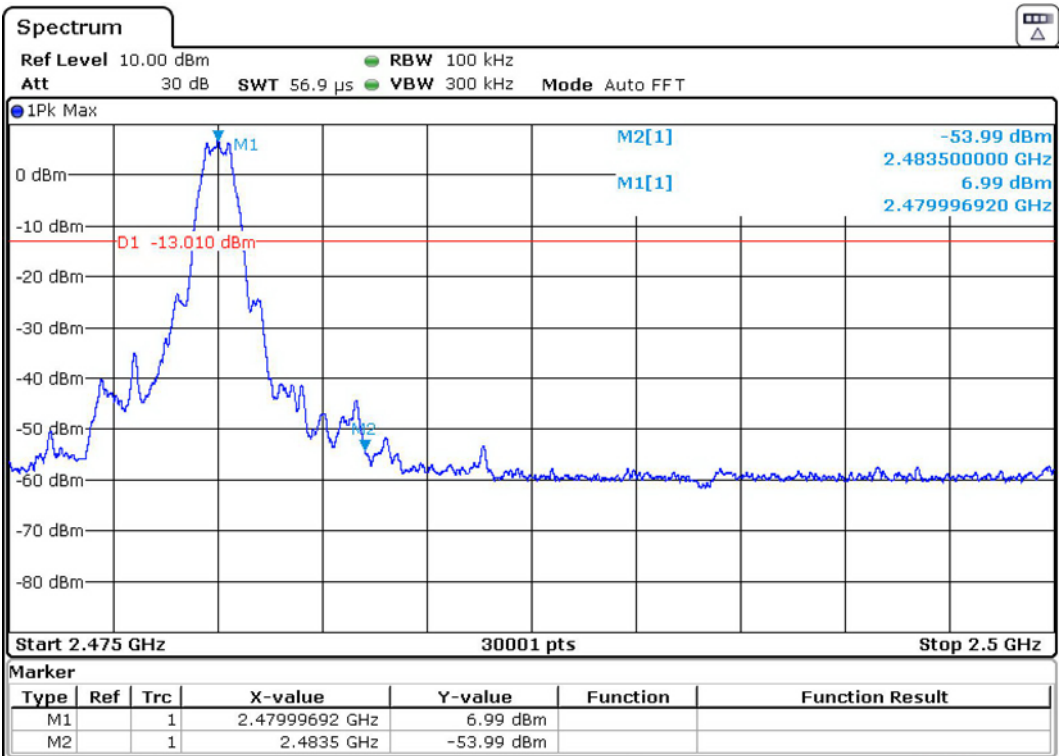
BLE-GFSK-2480MHz



BAND EDGES
BLE-GFSK 2402MHz



BLE-GFSK 2480MHz



10 ANTENNA REQUIREMENTS

10.1 Limit

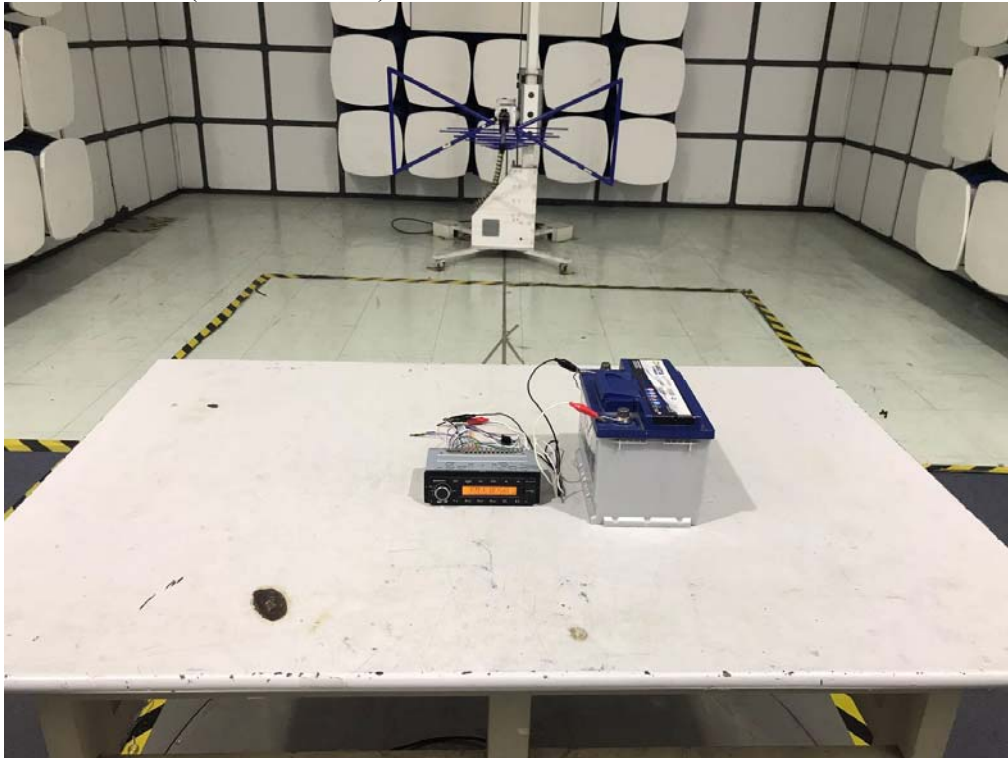
For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

10.2 Result

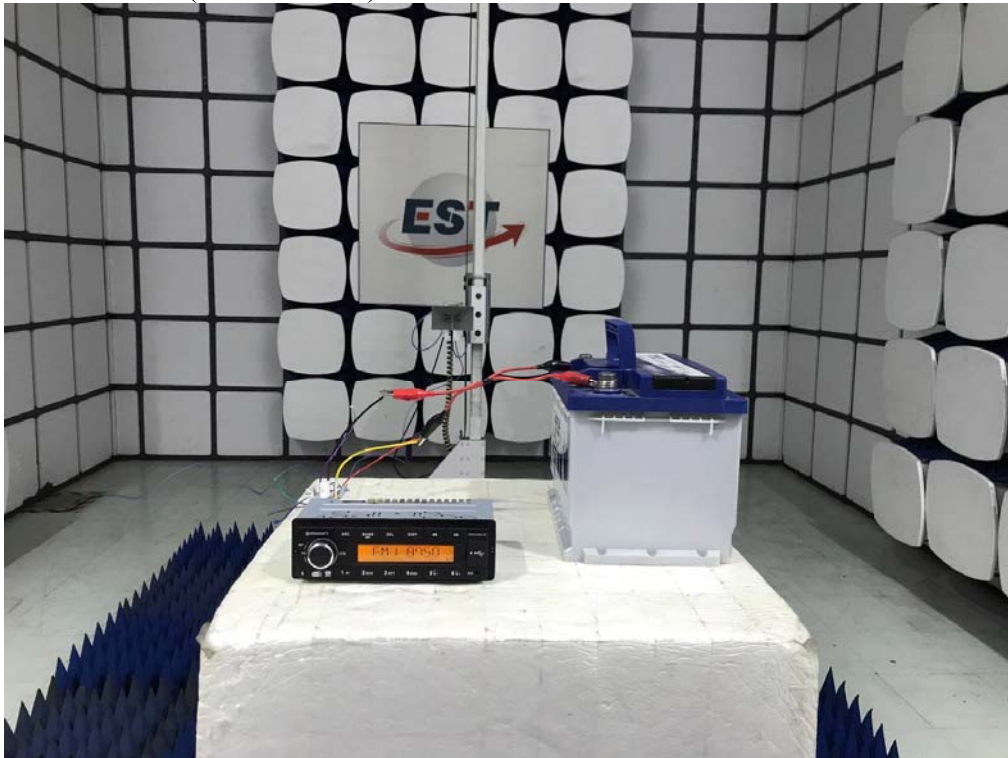
The antennas used for this product are Internal antenna and that no antenna other than that furnished by the responsible party shall be used with the device, the maximum peak gain of the transmit antenna is only 0 dBi.

11 TEST SETUP PHOTO

Radiated Test (30-1000 MHz)

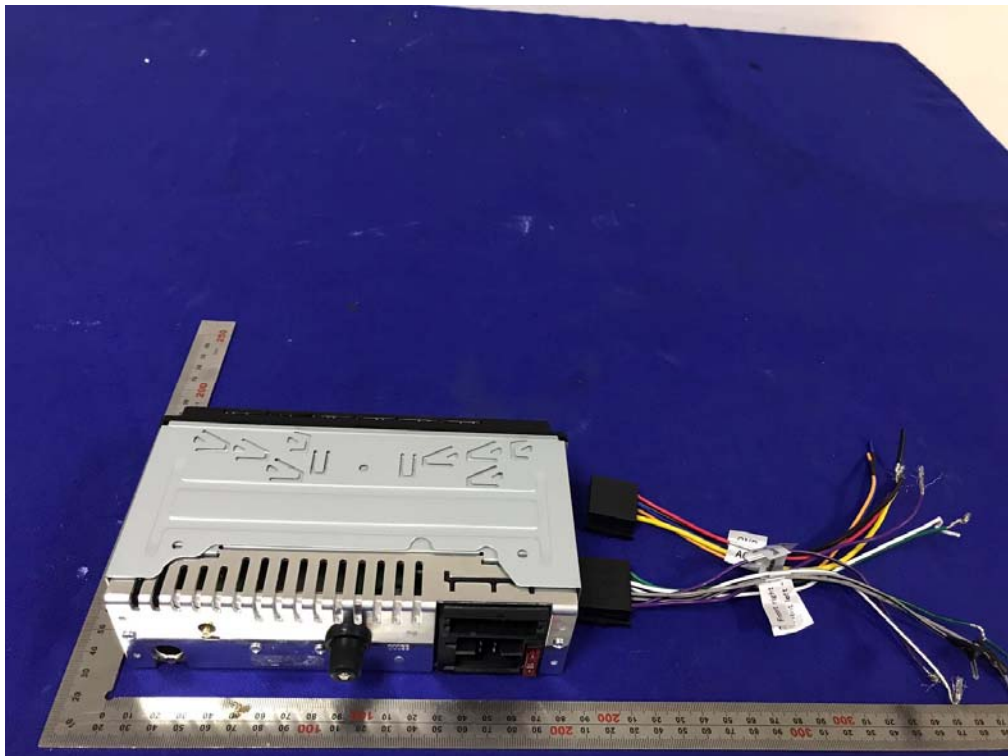


Radiated Test (Above 1GHz)

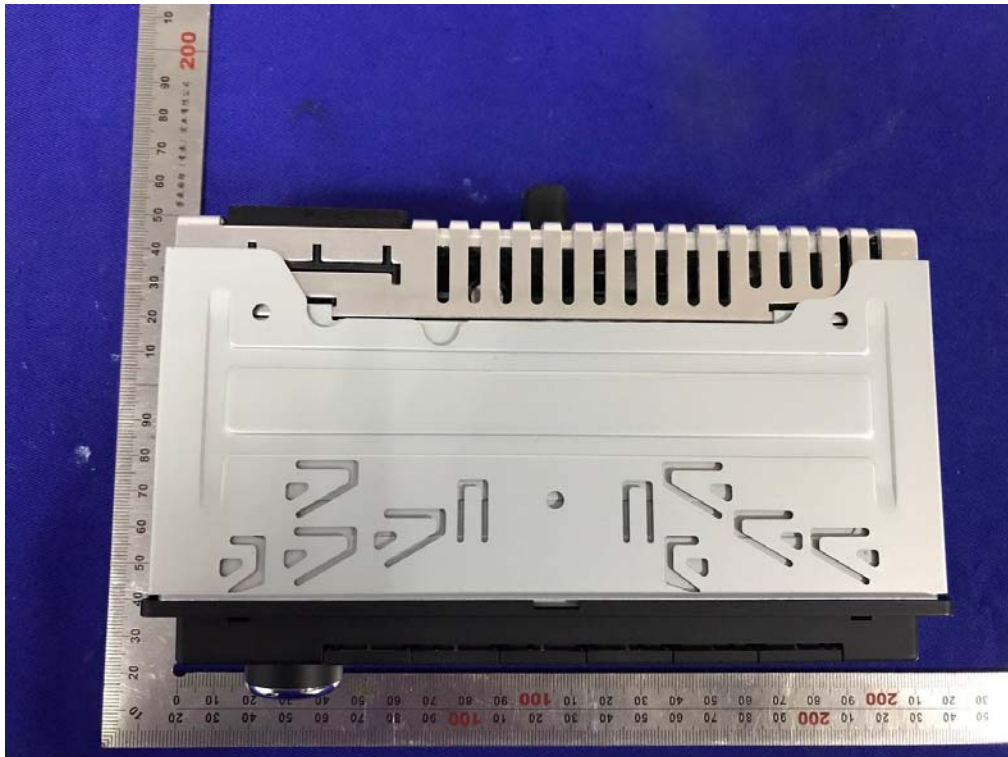


12 PHOTO EUT

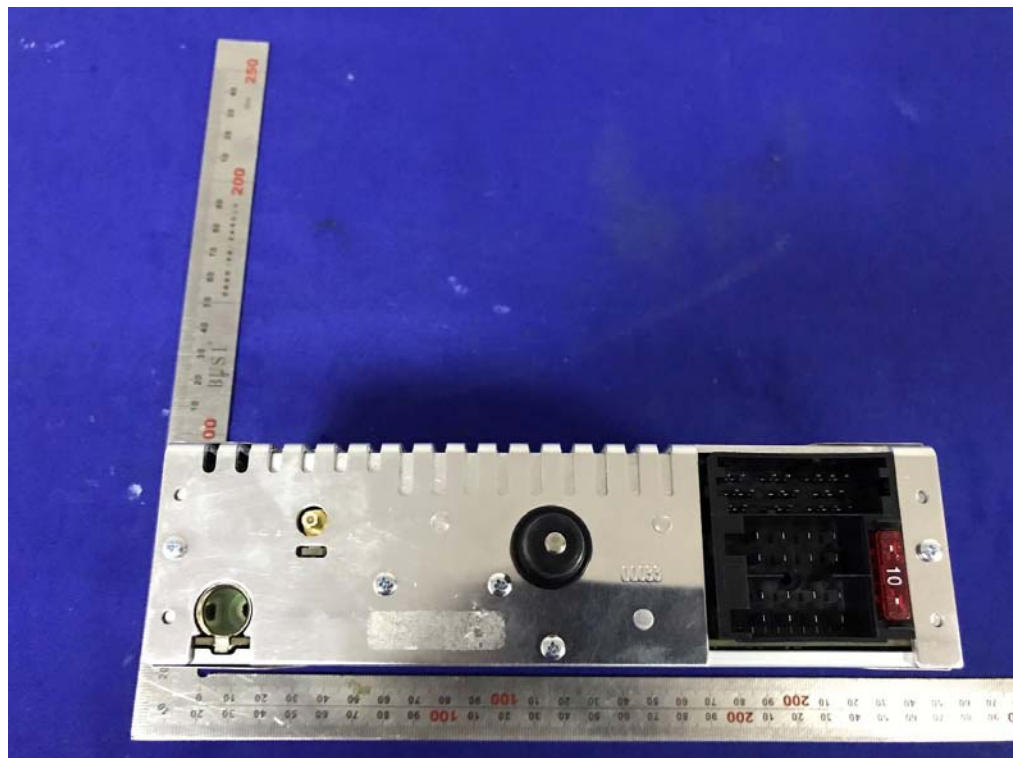
External Photos M/N: CRD4512UBA-OR



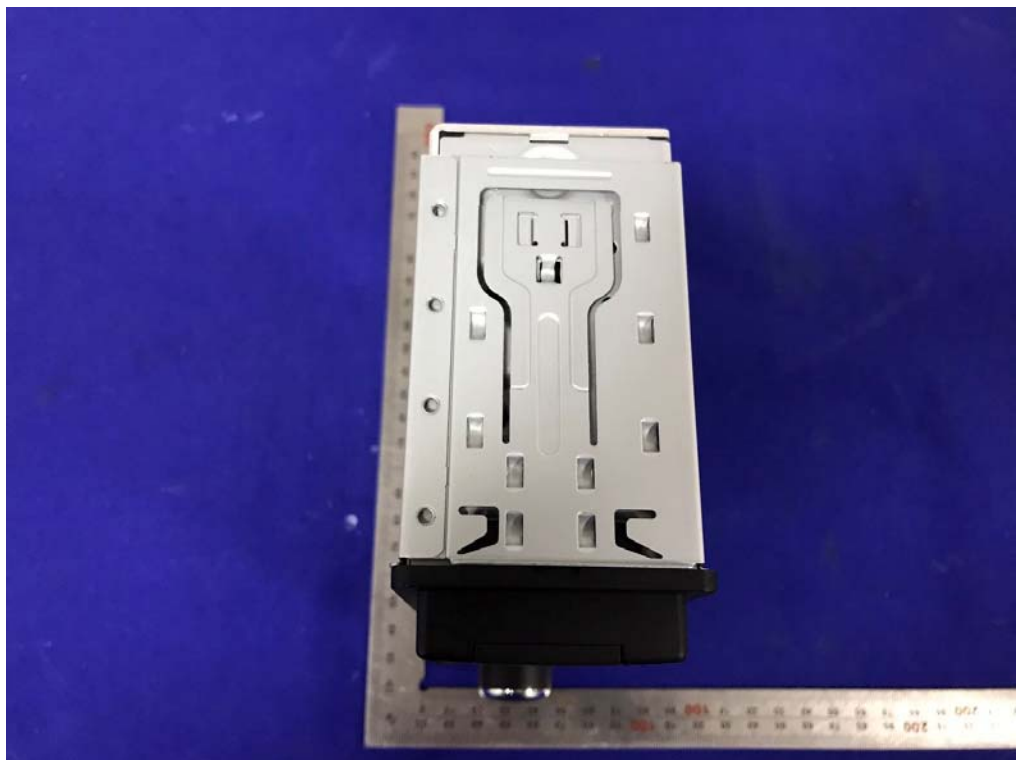
External Photos
M/N: CRD4512UBA-OR



External Photos
M/N: CRD4512UBA-OR



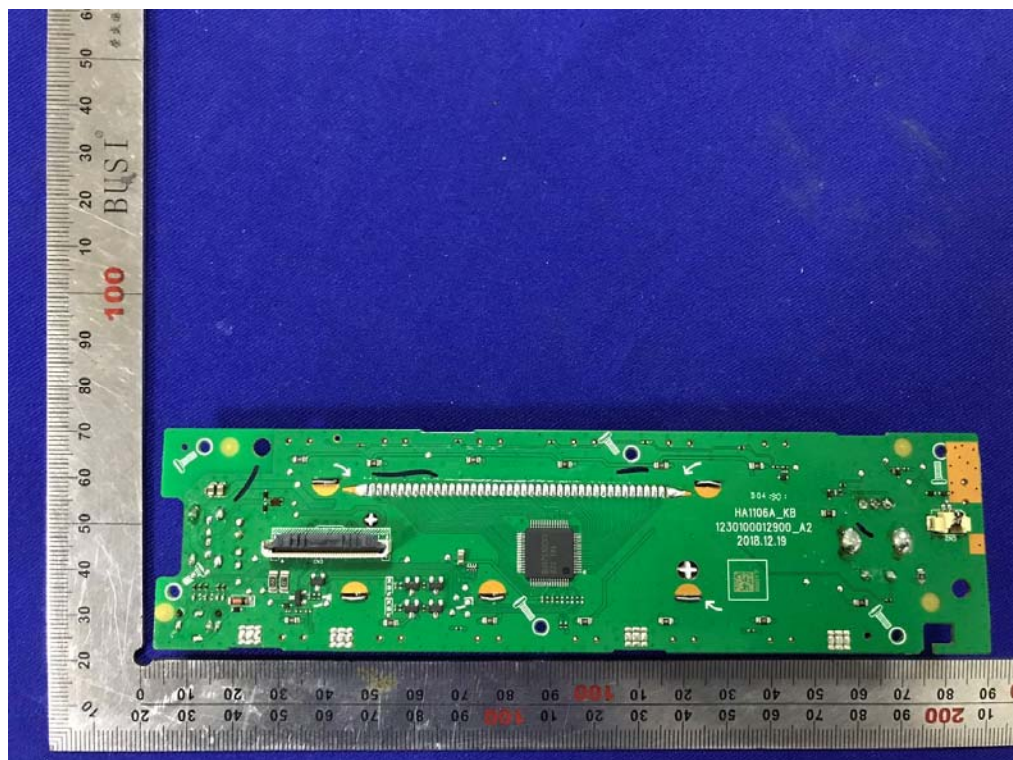
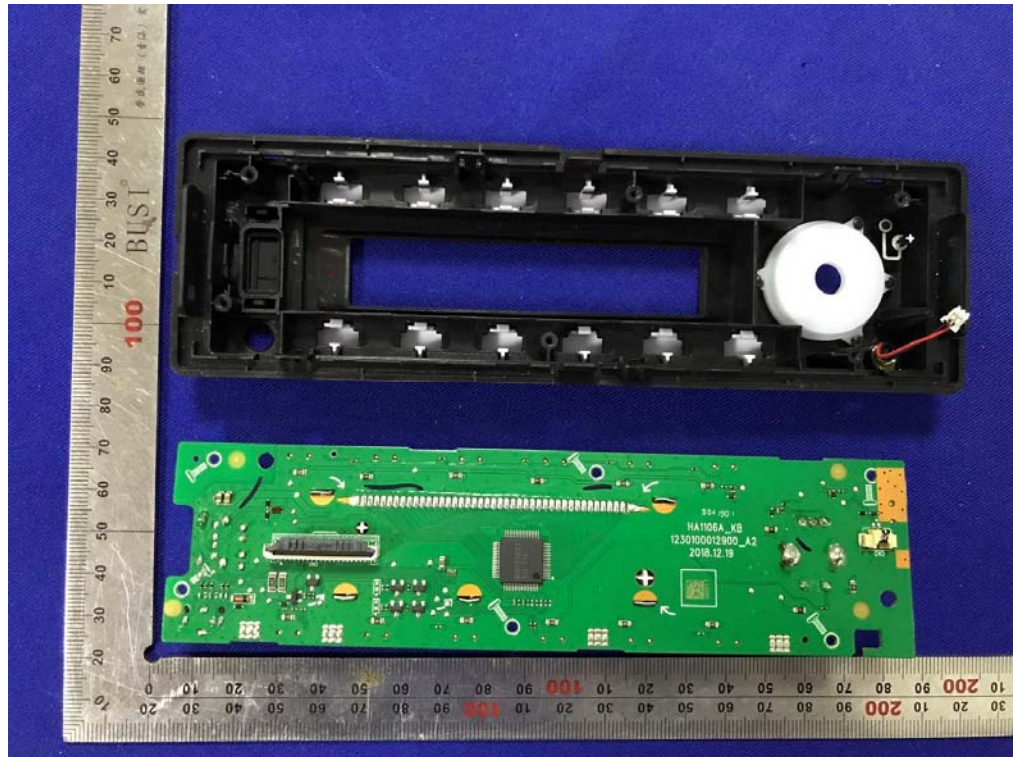
External Photos
M/N: CRD4512UBA-OR



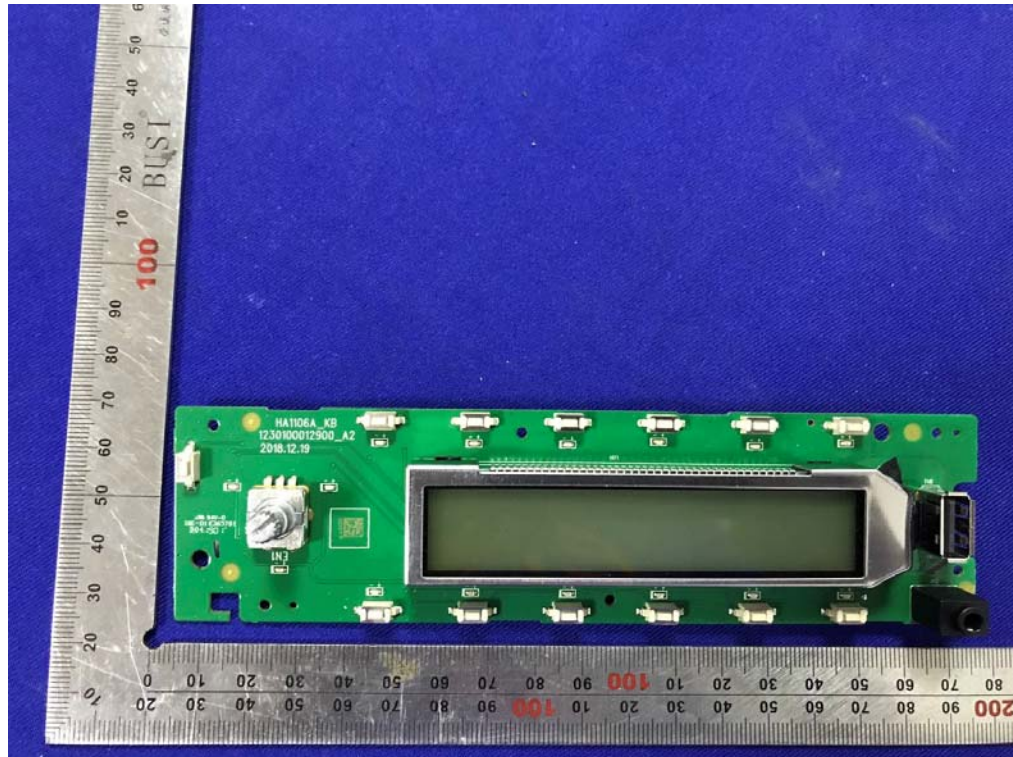
Internal Photos
M/N: CRD4512UBA-OR



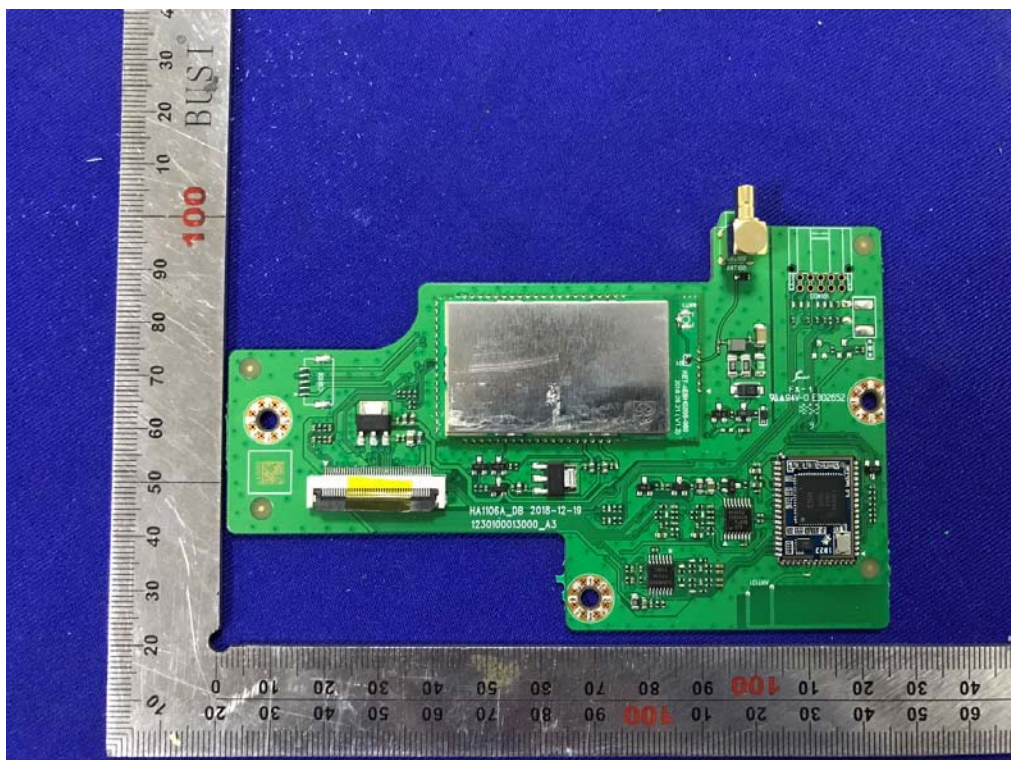
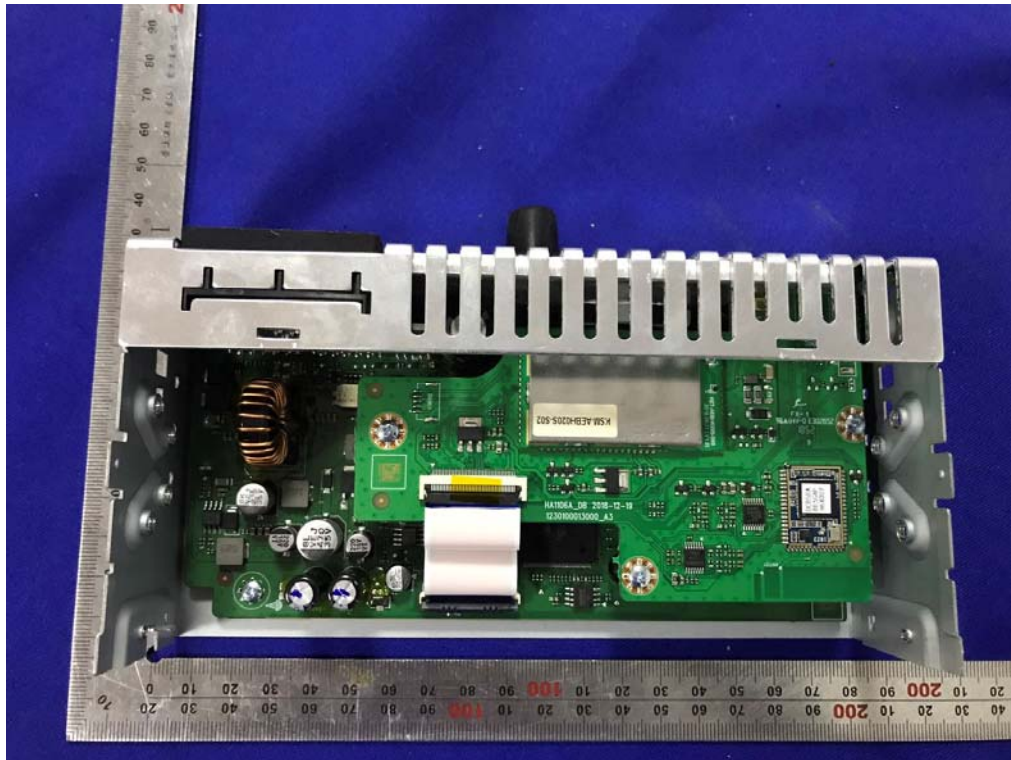
Internal Photos
M/N: CRD4512UBA-OR



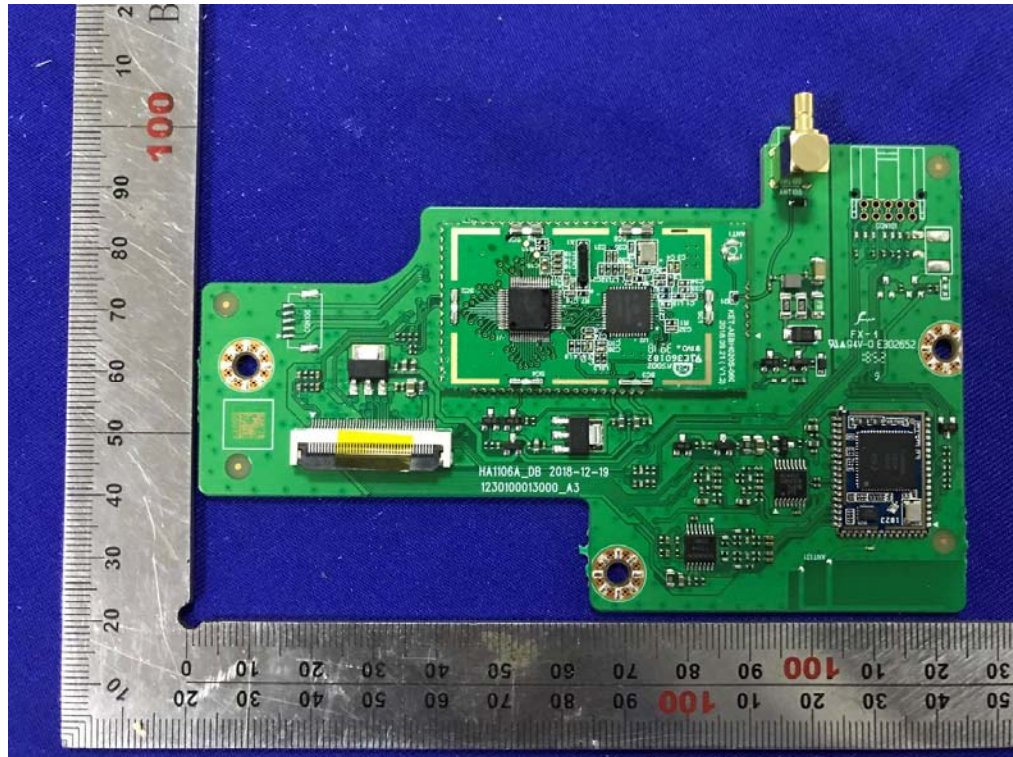
Internal Photos
M/N: CRD4512UBA-OR



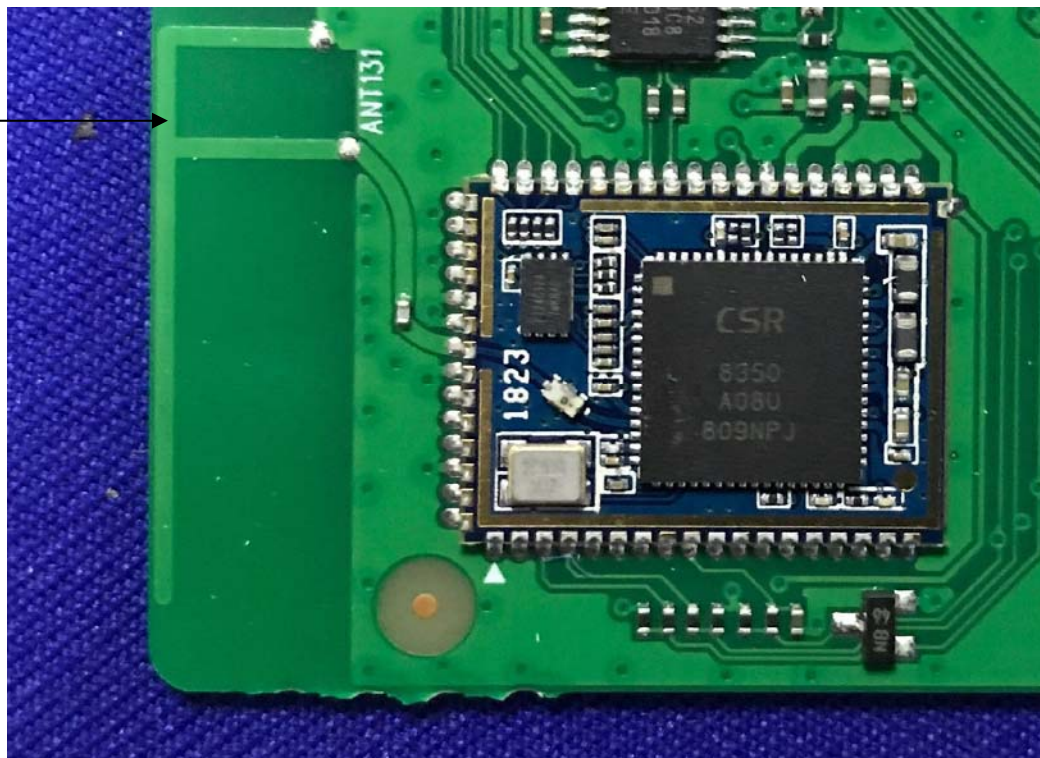
Internal Photos
M/N: CRD4512UBA-OR



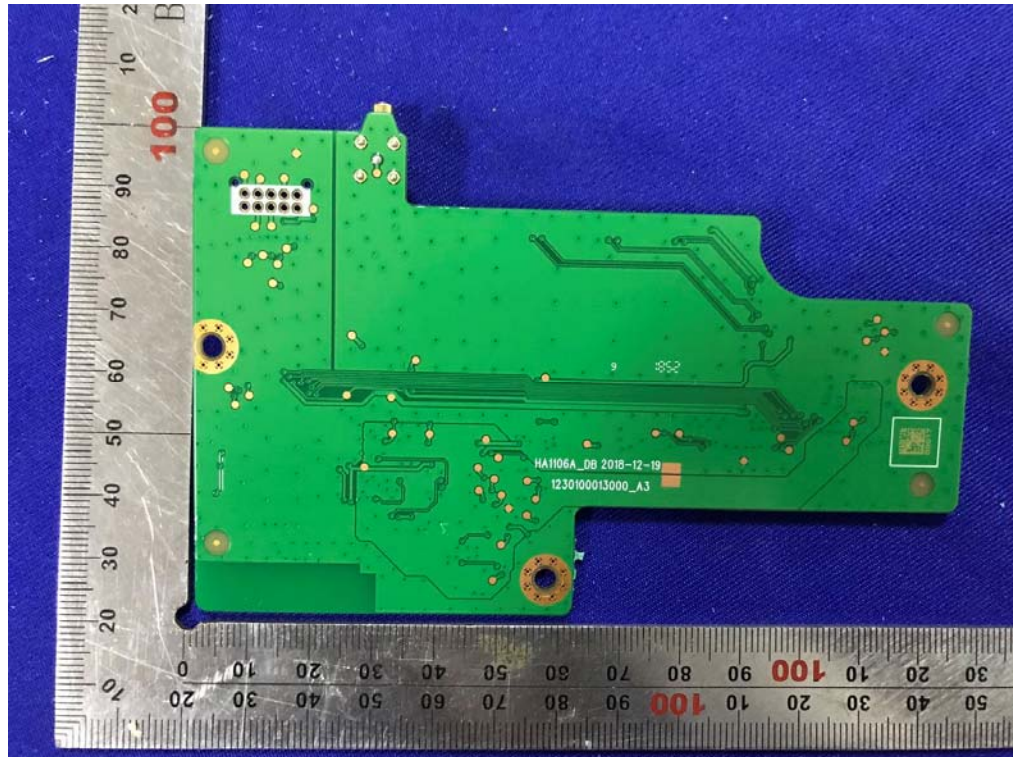
Internal Photos
M/N: CRD4512UBA-OR



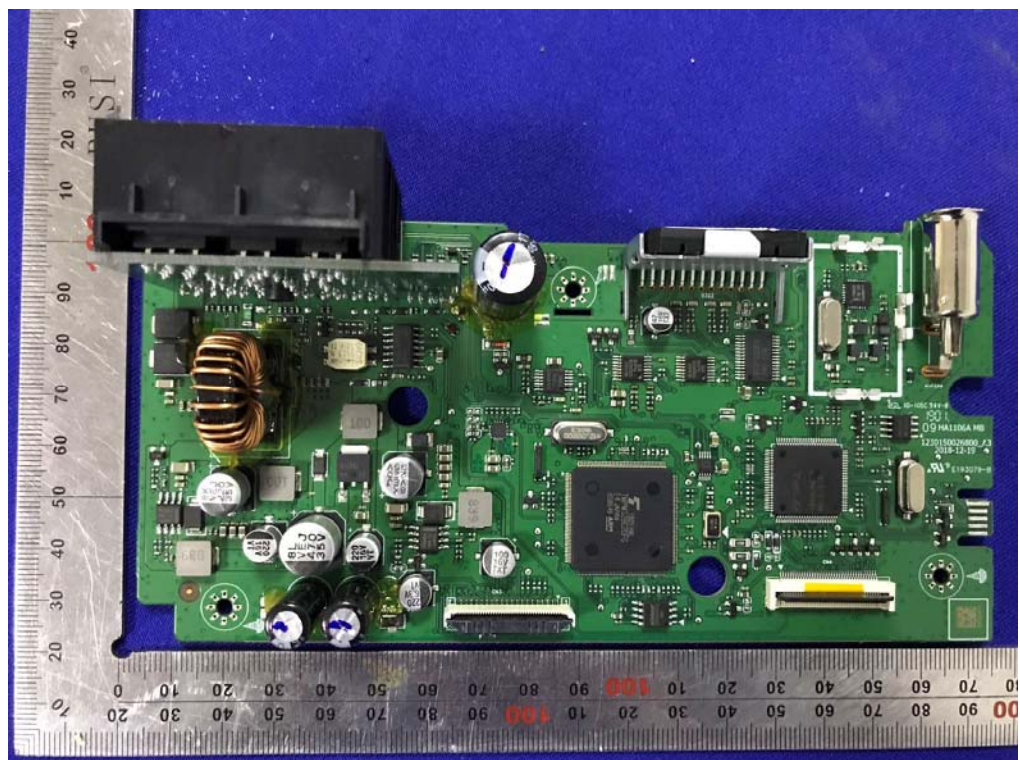
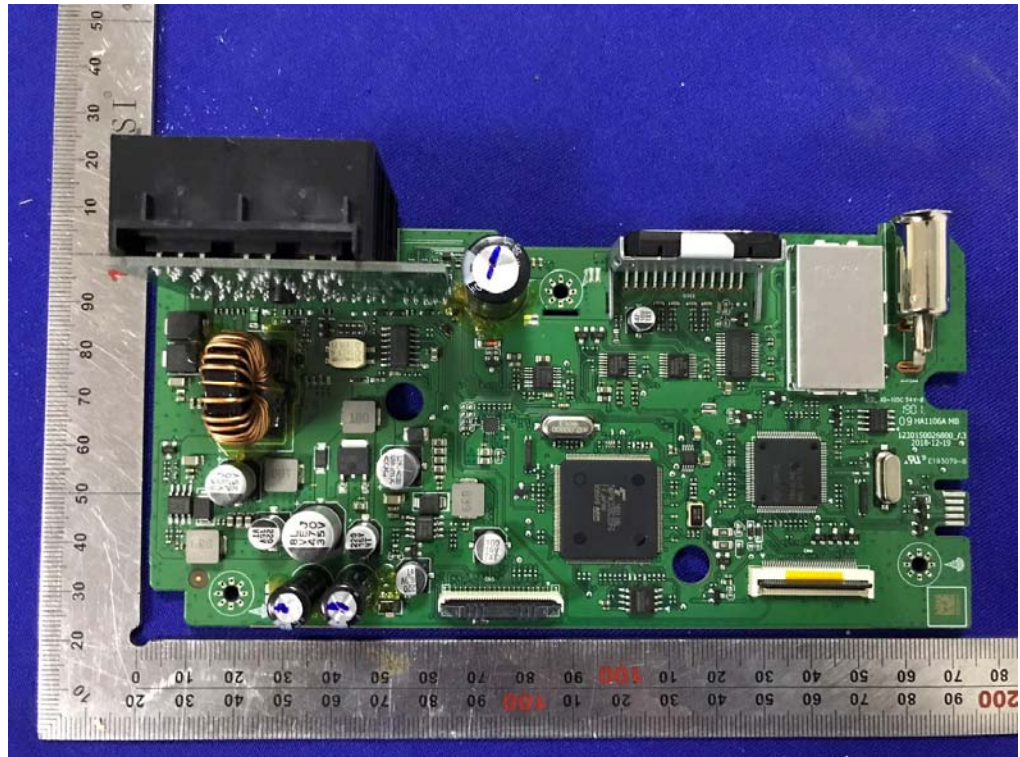
BLE
Antenna



Internal Photos
M/N: CRD4512UBA-OR



Internal Photos
M/N: CRD4512UBA-OR



Internal Photos
M/N: CRD4512UBA-OR

