6.6 Restricted Band Emission Limit

6.6.1. Standard Applicable

15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

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\)
13.36-13.41			

\1\ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

\2\ Above 38.6

According to §15.247 (d): 20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

6.6.2. Measuring Instruments and Setting

Please refer to section 6 of equipment list in this report. The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10^{th} carrier harmonic
RB / VB (Emission in restricted band)	1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average
RB / VB (Emission in non-restricted band)	1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB/VB 200Hz/1KHz for QP/AVG
Start ~ Stop Frequency	150kHz~30MHz / RB/VB 9kHz/30KHz for QP/AVG
Start ~ Stop Frequency	30MHz~1000MHz / RB/VB 120kHz/1MHz for QP

6.6.3. Test Procedures

1) Sequence of testing 9 kHz to 30 MHz

Setup:

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

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

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

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

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

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

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

--- The antenna height is 0.8 meter.

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

Final measurement:

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

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

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

2) Sequence of testing 30 MHz to 1 GHz

Setup:

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

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

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

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

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

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

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

--- The antenna is polarized vertical and horizontal.

--- The antenna height changes from 1 to 3 meter.

--- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement:

--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meter.

--- The final measurement will be done with QP detector with an EMI receiver.

--- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

3) Sequence of testing 1 GHz to 18 GHz

Setup:

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

--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.

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

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

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

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

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

--- The antenna is polarized vertical and horizontal.

--- The antenna height scan range is 1 meter to 2.5 meter.

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

Final measurement:

--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meter. This procedure is repeated for both antenna polarizations.

--- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and Average detector.

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

4) Sequence of testing above 18 GHz

Setup:

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

--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.

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

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

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

--- The measurement distance is 1 meter.

--- The EUT was set into operation.

Premeasurement:

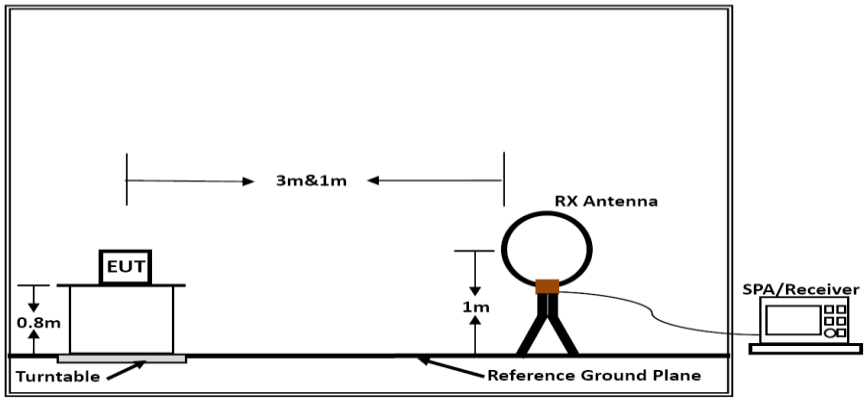
--- The antenna is moved spherical over the EUT in different polarizations of the antenna.

Final measurement:

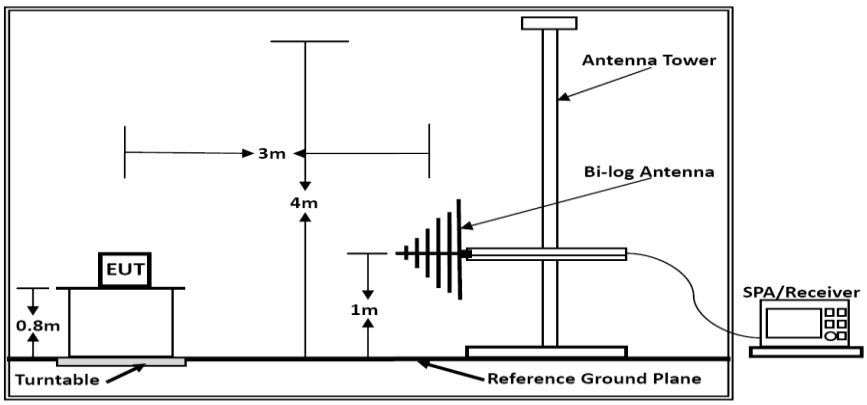
--- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak and Average detector.

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

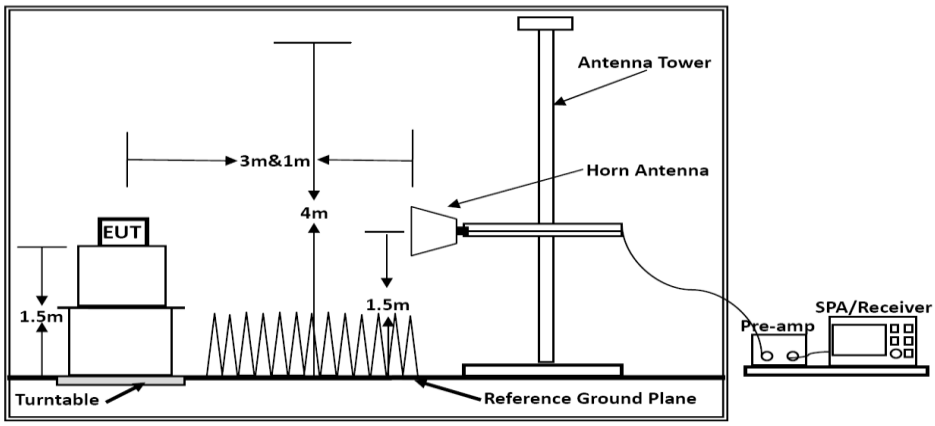
6.6.4. Test Setup Layout



Below 30MHz



Below 1GHz



Above 1GHz

Above 10 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade form 3m to 1.5m.

Distance extrapolation factor = 20 log (specific distanc [3m] / test distance [1.5m]) (dB);
Limit line = specific limits (dBuV) + distance extrapolation factor [6 dB].

6.6.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

6.6.6. Results of Radiated Emissions (9 kHz~30MHz)

Temperature	25℃	Humidity	60%
Test Engineer	Chaz	Configurations	BT

Freq. (MHz)	Level (dBuV)	Over Limit (dB)	Over Limit (dBuV)	Remark
-	-	-	-	See Note

Note:

The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.

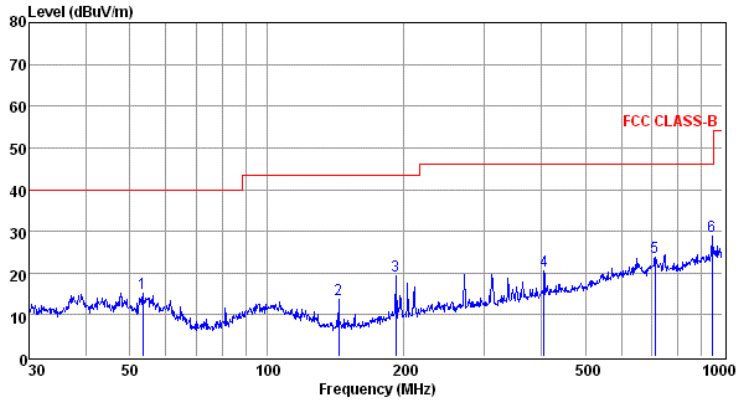
Distance extrapolation factor = 40 log (specific distance / test distance) (dB);
Limit line = specific limits (dBuV) + distance extrapolation factor.

PASS.

Only record the worst test result in this report.

The test data please refer to following page.

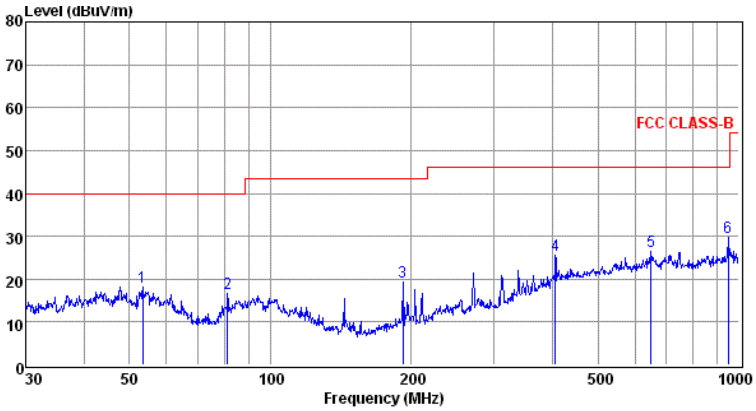
Below 1GHz (Low Channel)



Env./Ins: 24℃/56%
pol: VERTICAL

	Freq	Reading	CabLos	Antfac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	53.32	1.70	0.46	13.10	15.26	40.00	-24.74	QP
2	143.83	4.61	0.71	8.22	13.54	43.50	-29.96	QP
3	191.75	8.03	0.86	10.56	19.45	43.50	-24.05	QP
4	406.09	4.10	1.17	15.18	20.45	46.00	-25.55	QP
5	711.67	3.09	1.63	18.96	23.68	46.00	-22.32	QP
6	948.76	5.40	1.91	21.41	28.72	46.00	-17.28	QP

Note: 1. All readings are Quasi-peak values.
2. Measured= Reading + Antenna Factor + Cable Loss
3. The emission that ate 20db blow the offficial limit are not reported



Env./Ins: 24℃/56%
pol: HORIZONTAL

	Freq	Reading	CabLos	Antfac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	53.32	4.70	0.46	13.10	18.26	40.00	-21.74	QP
2	80.93	7.14	0.65	8.87	16.66	40.00	-23.34	QP
3	191.75	8.03	0.86	10.56	19.45	43.50	-24.05	QP
4	406.09	9.10	1.17	15.18	25.45	46.00	-20.55	QP
5	649.66	6.20	1.58	18.63	26.41	46.00	-19.59	QP
6	948.76	6.40	1.91	21.41	29.72	46.00	-16.28	QP

Note: 1. All readings are Quasi-peak values.
2. Measured= Reading + Antenna Factor + Cable Loss
3. The emission that ate 20db blow the offficial limit are not reported

****Note:*

Pre-scan all mode and recorded the worst case results in this report (TX-Low Channel(1Mbps)).
Emission level (dBuV/m) = 20 log Emission level (uV/m).

Above 1GHz

Note: All the modes have been tested and recorded worst mode in the report.

The worst test result for GFSK, Channel 0 / 2402 MHz

Freq. MHz	Reading dBuv	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuv/m	Limit dBuv/m	Margin dB	Remark	Pol.
4804.00	61.50	33.06	35.04	3.94	63.46	74	-10.54	Peak	Horizontal
4804.00	43.40	33.06	35.04	3.94	45.36	54	-8.64	Average	Horizontal
4804.00	57.02	33.06	35.04	3.94	58.98	74	-15.02	Peak	Vertical
4804.00	46.16	33.06	35.04	3.94	48.12	54	-5.88	Average	Vertical

The worst test result for GFSK, Channel 39 / 2441 MHz

Freq. MHz	Reading dBuv	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuv/m	Limit dBuv/m	Margin dB	Remark	Pol.
4882.00	60.73	33.16	35.15	3.96	62.70	74	-11.30	Peak	Horizontal
4882.00	44.48	33.16	35.15	3.96	46.45	54	-7.55	Average	Horizontal
4882.00	55.06	33.16	35.15	3.96	57.03	74	-16.97	Peak	Vertical
4882.00	41.15	33.16	35.15	3.96	43.12	54	-10.88	Average	Vertical

The worst test result for GFSK, Channel 78 / 2480 MHz

Freq. MHz	Reading dBuv	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuv/m	Limit dBuv/m	Margin dB	Remark	Pol.
4960.00	56.54	33.26	35.14	3.98	58.64	74	-15.36	Peak	Horizontal
4960.00	45.91	33.26	35.14	3.98	48.01	54	-5.99	Average	Horizontal
4960.00	55.62	33.26	35.14	3.98	57.72	74	-16.28	Peak	Vertical
4960.00	40.81	33.26	35.14	3.98	42.91	54	-11.09	Average	Vertical

Notes:

1). Measuring frequencies from 9k~10th harmonic (ex. 26GHz), No emission found between lowest internal used/generated frequency to 30 MHz.

2). Radiated emissions measured in frequency range from 9k~10th harmonic (ex. 26GHz) were made with an instrument using Peak detector mode.

3). 18~25GHz at least have 20dB margin. No recording in the test report.

6.7. AC Power line conducted emissions

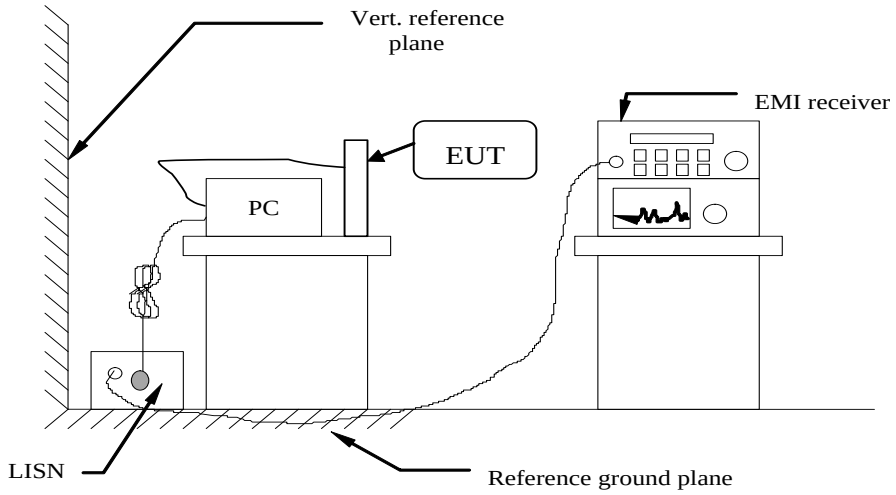
6.7.1 Standard Applicable

According to §15.207 (a): For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

* Decreasing linearly with the logarithm of the frequency

6.7.2 Block Diagram of Test Setup

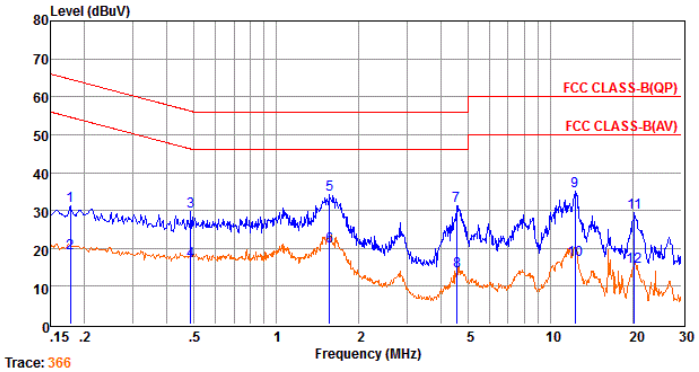


6.7.3 Test Results

PASS.

The test data please refer to following page.

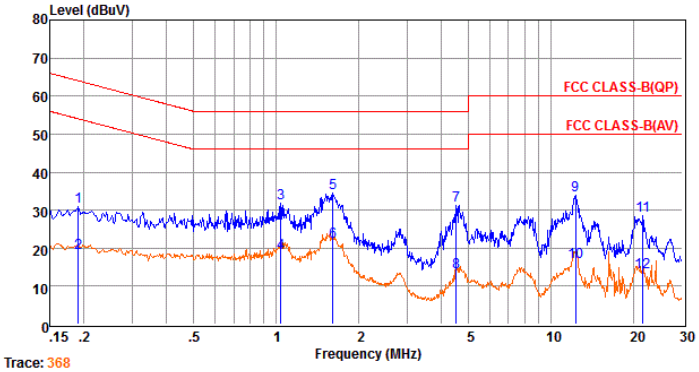
Test Results for AC 120V/60Hz @ GFSK (worst case)



Trace: 366
Env. Ins: 24*/56%
Pol: LINE

	Freq	Reading	LISNFac	CabLos	Aux2Fac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB	dB	dB	dBuV	dBuV	dB
1	0.18	11.67	9.61	0.02	10.00	31.30	64.59	-33.29	QP
2	0.18	-0.80	9.61	0.02	10.00	18.83	54.59	-35.76	Average
3	0.49	9.98	9.62	0.04	10.00	29.64	56.23	-26.59	QP
4	0.49	-3.12	9.62	0.04	10.00	16.54	46.23	-29.69	Average
5	1.56	14.38	9.64	0.05	10.00	34.07	56.00	-21.93	QP
6	1.56	0.73	9.64	0.05	10.00	20.42	46.00	-25.58	Average
7	4.55	11.43	9.65	0.06	10.00	31.14	56.00	-24.86	QP
8	4.55	-5.74	9.65	0.06	10.00	13.97	46.00	-32.03	Average
9	12.25	15.22	9.70	0.09	10.00	35.01	60.00	-24.99	QP
10	12.25	-2.84	9.70	0.09	10.00	16.95	50.00	-33.05	Average
11	20.16	9.44	9.76	0.12	10.00	29.32	60.00	-30.68	QP
12	20.16	-4.84	9.76	0.12	10.00	15.04	50.00	-34.96	Average

Remarks: 1. Measured = Reading +Cable Loss +Aux2 Fac.
2. The emission levels that are 20dB below the official limit are not reported.



Trace: 368
Env. Ins: 24*/56%
Pol: NEUTRAL

	Freq	Reading	LISNFac	CabLos	Aux2Fac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB	dB	dB	dBuV	dBuV	dB
1	0.19	11.18	9.61	0.02	10.00	30.81	64.02	-33.21	QP
2	0.19	-0.79	9.61	0.02	10.00	18.84	54.02	-35.18	Average
3	1.04	12.19	9.63	0.05	10.00	31.87	56.00	-24.13	QP
4	1.04	-0.83	9.63	0.05	10.00	18.85	46.00	-27.15	Average
5	1.61	14.87	9.63	0.05	10.00	34.55	56.00	-21.45	QP
6	1.61	2.09	9.63	0.05	10.00	21.77	46.00	-24.23	Average
7	4.53	11.55	9.66	0.06	10.00	31.27	56.00	-24.73	QP
8	4.53	-6.11	9.66	0.06	10.00	13.61	46.00	-32.39	Average
9	12.25	14.14	9.73	0.09	10.00	33.96	60.00	-26.04	QP
10	12.25	-3.41	9.73	0.09	10.00	16.41	50.00	-33.59	Average
11	21.60	8.72	9.83	0.12	10.00	28.67	60.00	-31.33	QP
12	21.60	-6.29	9.83	0.12	10.00	13.66	50.00	-36.34	Average

Remarks: 1. Measured = Reading +Cable Loss +Aux2 Fac.
2. The emission levels that are 20dB below the official limit are not reported.

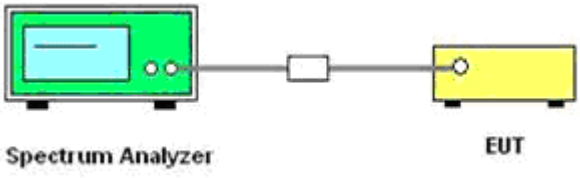
Note: Pre-scan all modes and recorded the worst case results in this report.

6.8. Band-edge measurements for radiated emissions

6.8.1 Standard Applicable

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

6.8.2. Test Setup Layout



6.8.3. Measuring Instruments and Setting

Please refer to section 6 of equipment list in this report. The following table is the setting of Spectrum Analyzer.

6.8.4. Test Procedures

According to KDB 412172 section 1.1 Field Strength Approach (linear terms):

$eirp = p_t \times g_t = (E \times d)^2/30$

Where:

p_t = transmitter output power in watts,

g_t = numeric gain of the transmitting antenna (unitless),

E = electric field strength in V/m,

d = measurement distance in meters (m).

$erp = eirp/1.64 = (E \times d)^2/(30 \times 1.64)$

Where all terms are as previously defined.

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

7. Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level (see 12.2.5 for guidance on determining the applicable antenna gain)
8. Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies ≤ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000 MHz).
9. For devices with multiple antenna-ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (e.g., Watts, mW).
10. Compare the resultant electric field strength level to the applicable regulatory limit.
11. Perform radiated spurious emission test duress until all measured frequencies were complete.

6.8.5. Test Results

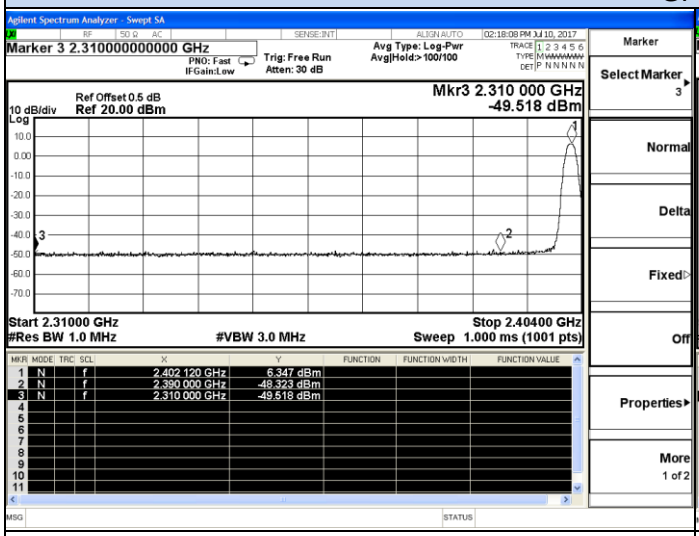
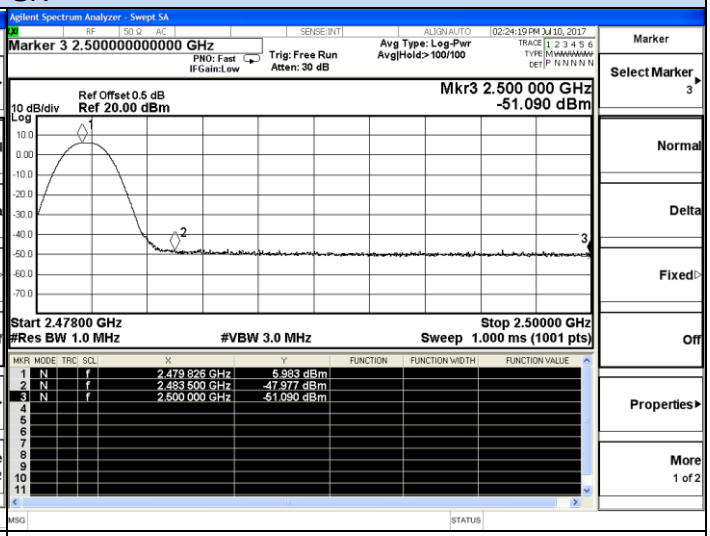
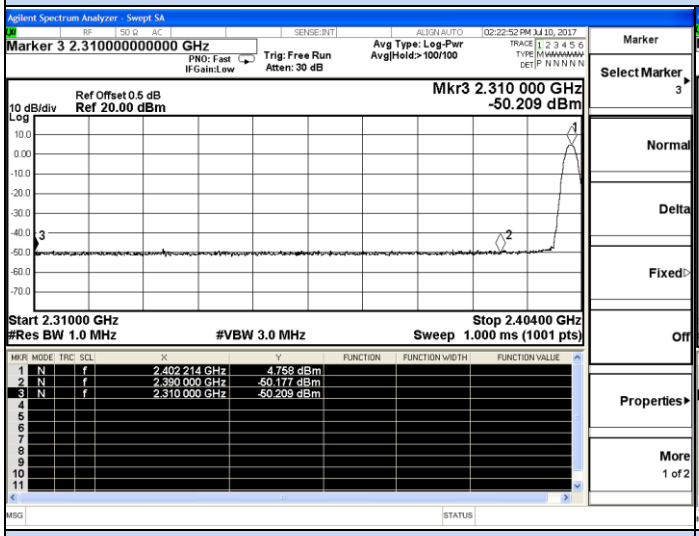
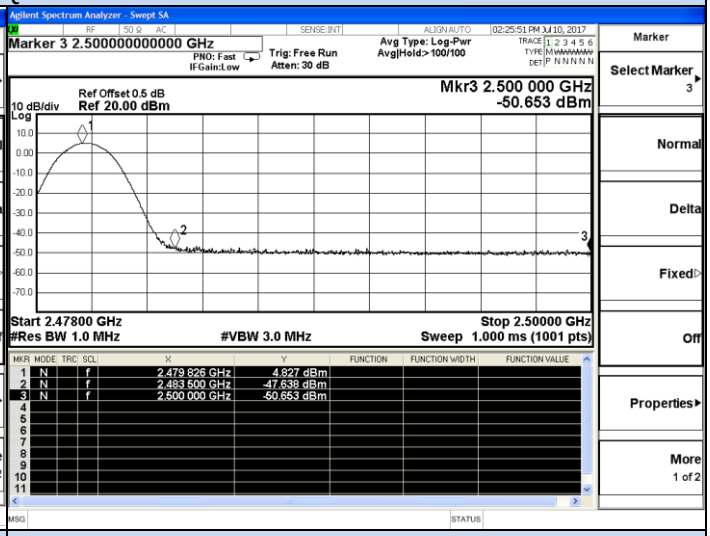
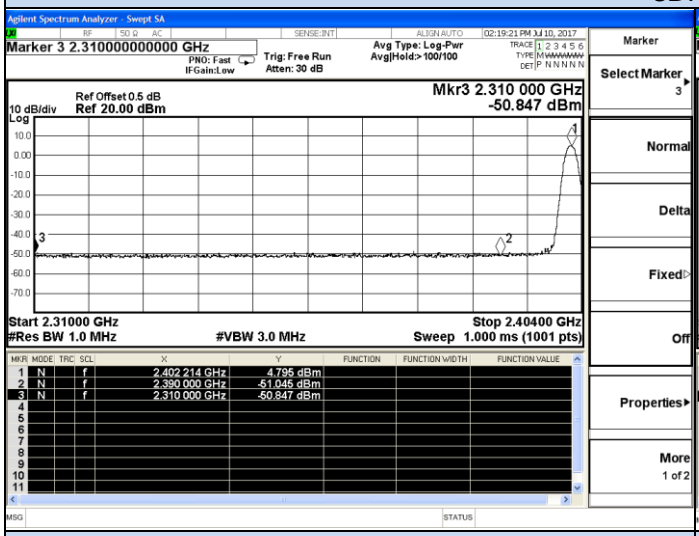
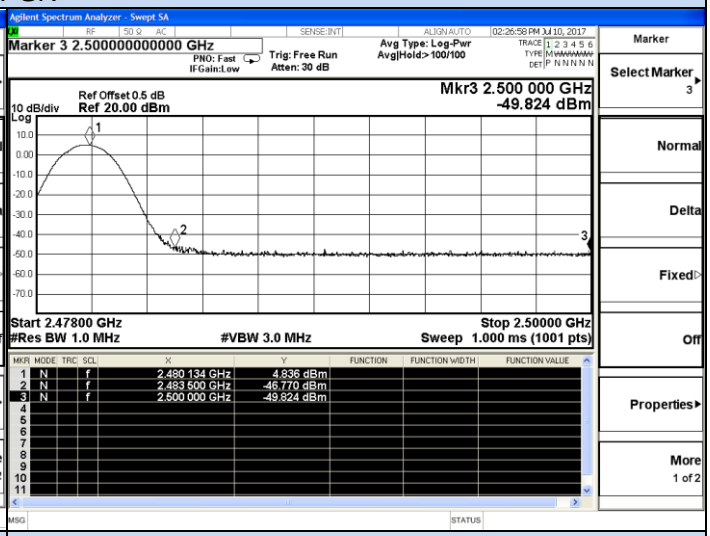
GFSK – Non-Hopping							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
2310.000	-49.518	2.00	0.0	47.742	Peak	74.00	PASS
2310.000	-62.589	2.00	0.0	34.671	AV	54.00	PASS
2390.000	-48.323	2.00	0.0	48.937	Peak	74.00	PASS
2390.000	-61.926	2.00	0.0	35.334	AV	54.00	PASS
2483.500	-47.977	2.00	0.0	49.283	Peak	74.00	PASS
2483.500	-60.404	2.00	0.0	36.856	AV	54.00	PASS
2500.000	-51.090	2.00	0.0	46.170	Peak	74.00	PASS
2500.000	-61.761	2.00	0.0	35.499	AV	54.00	PASS

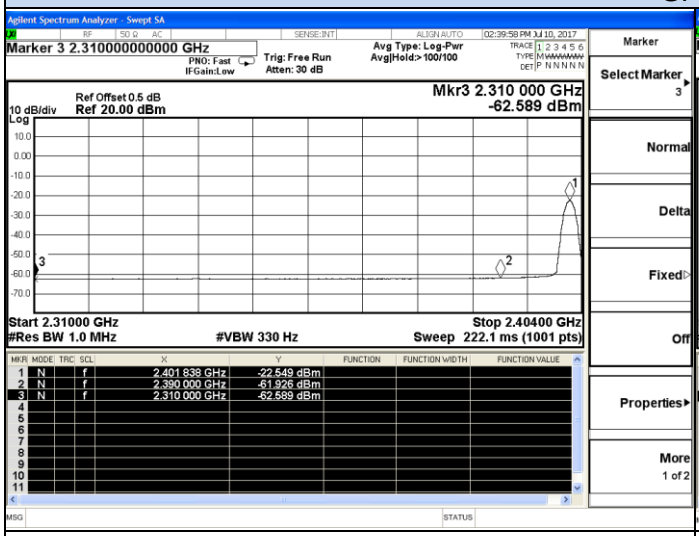
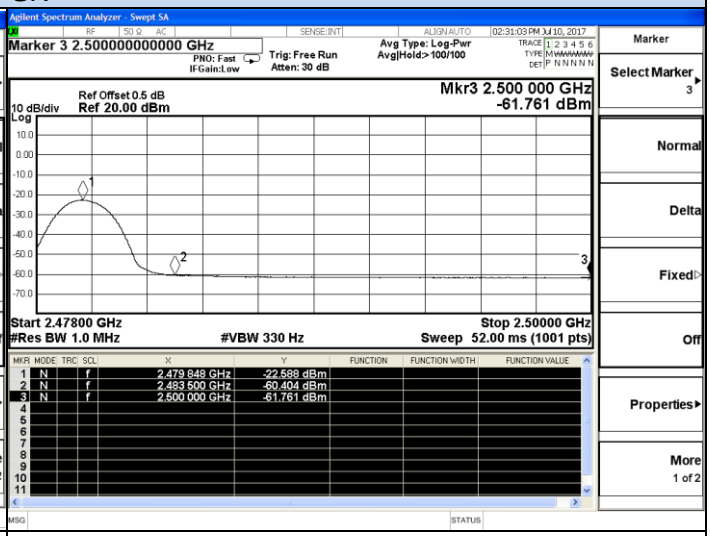
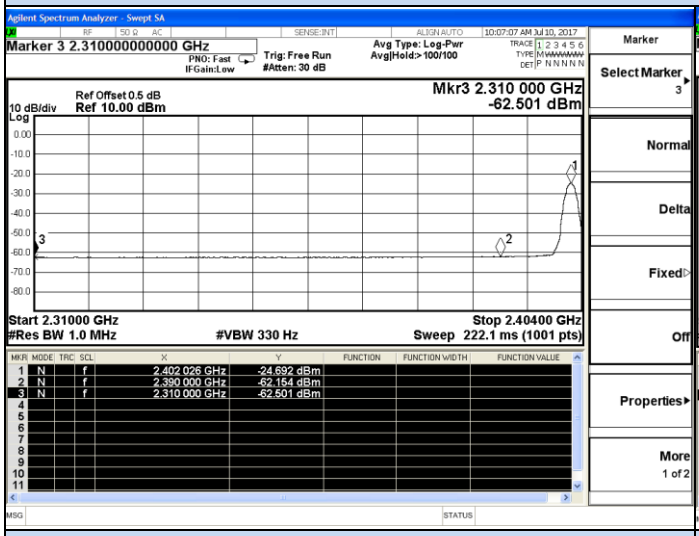
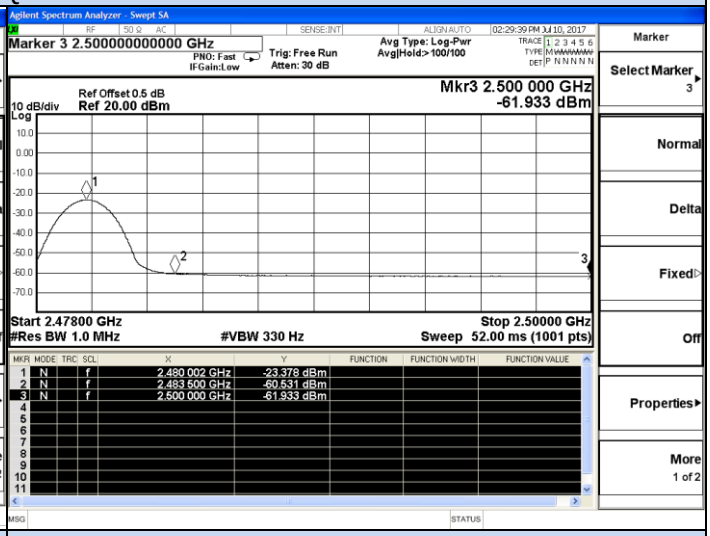
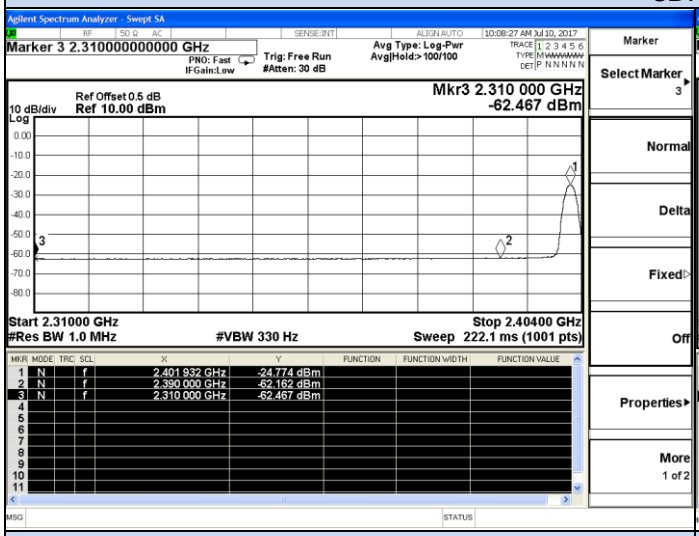
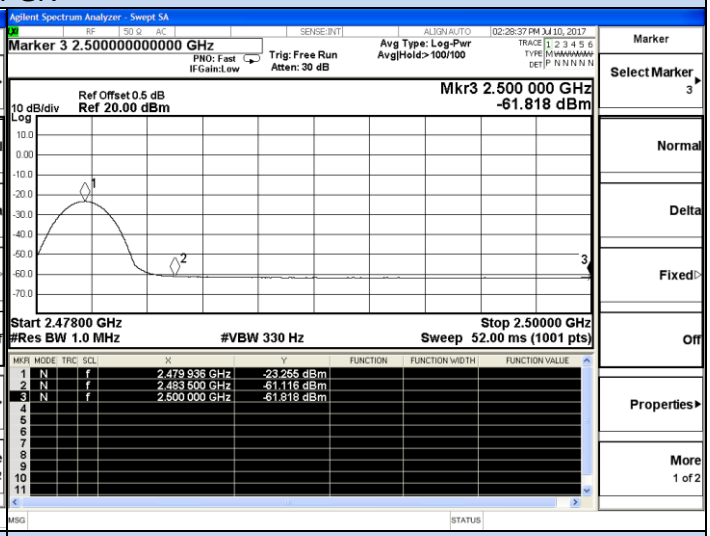
π/4DQPSK – Non-Hopping							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
2310.000	-50.209	2.00	0.0	47.051	Peak	74.00	PASS
2310.000	-62.501	2.00	0.0	34.759	AV	54.00	PASS
2390.000	-50.177	2.00	0.0	47.083	Peak	74.00	PASS
2390.000	-62.154	2.00	0.0	35.106	AV	54.00	PASS
2483.500	-47.638	2.00	0.0	49.622	Peak	74.00	PASS
2483.500	-60.531	2.00	0.0	36.729	AV	54.00	PASS
2500.000	-50.653	2.00	0.0	46.607	Peak	74.00	PASS
2500.000	-61.933	2.00	0.0	35.327	AV	54.00	PASS

8DPSK – Non-Hopping							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
2310.000	-50.847	2.00	0.0	46.413	Peak	74.00	PASS
2310.000	-62.467	2.00	0.0	34.793	AV	54.00	PASS
2390.000	-51.045	2.00	0.0	46.215	Peak	74.00	PASS
2390.000	-62.162	2.00	0.0	35.098	AV	54.00	PASS
2483.500	-46.770	2.00	0.0	50.490	Peak	74.00	PASS
2483.500	-61.116	2.00	0.0	36.144	AV	54.00	PASS
2500.000	-49.824	2.00	0.0	47.436	Peak	74.00	PASS
2500.000	-61.818	2.00	0.0	35.442	AV	54.00	PASS

Remark:

1. *Measured at difference Packet Type for each mode and recorded worst case for each mode.*
2. *Measured at Hopping and Non-Hopping mode, recorded worst at Non-Hopping mode.*
3. *The other emission levels were very low against the limit.*
4. *The average measurement was not performed when the peak measured data under the limit of average detection.*
5. *Detector AV is setting spectrum/receiver. RBW=1MHz/VBW=330Hz/Sweep time=Auto/Detector=Peak;*
6. *Since the out-of-band characteristics of the EUT transmit antenna will often be unknown, the use of a conservative antenna gain value is necessary. Thus, when determining the EIRP based on the measured conducted power, the upper bound on antenna gain for a device with a single RF output shall be selected as the maximum in-band gain of the antenna across all operating bands, or 2 dBi, whichever is greater. However, for devices that operate in multiple frequency bands while using the same transmit antenna, the highest gain of the antenna within the operating band nearest in frequency to the restricted band emission being measured may be used in lieu of the overall highest gain when the emission is at a frequency that is within 20 percent of the nearest band edge frequency, but in no case shall a value less than 2 dBi be used.*
7. *Please refer to following test plots;*

Band-edge measurements for radiated emissions	
GFSK	
	
Channel 0 / 2402 MHz – Non-Hopping – Peak	*Channel 78 / 2480 MHz – Non-Hopping – Peak*
π/4DQPSK	
	
Channel 0 / 2402 MHz – Non-Hopping – Peak	*Channel 78 / 2480 MHz – Non-Hopping – Peak*
8DPSK	
	
Channel 0 / 2402 MHz – Non-Hopping – Peak	*Channel 78 / 2480 MHz – Non-Hopping – Peak*

Band-edge measurements for radiated emissions	
GFSK	
	
Channel 0 / 2402 MHz – Non-Hopping – AV	*Channel 78 / 2480 MHz – Non-Hopping –AV*
π/4DQPSK	
	
Channel 0 / 2402 MHz – Non-Hopping –AV	*Channel 78 / 2480 MHz – Non-Hopping –AV*
8DPSK	
	
Channel 0 / 2402 MHz – Non-Hopping –AV	*Channel 78 / 2480 MHz – Non-Hopping –AV*

6.9. Pseudorandom frequency hopping sequence

6.9.1 Standard Applicable

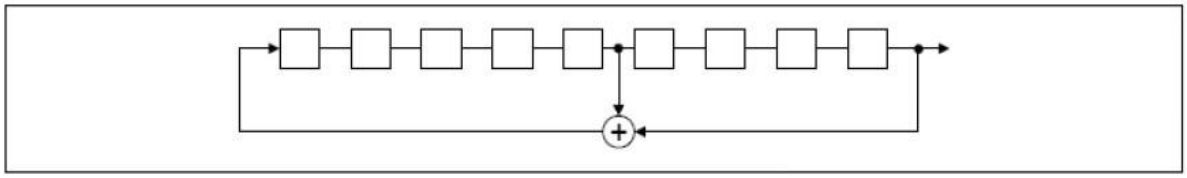
For 47 CFR Part 15C sections 15.247 (a) (1) requirement:

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

6.9.2 EUT Pseudorandom Frequency Hopping Sequence Requirement

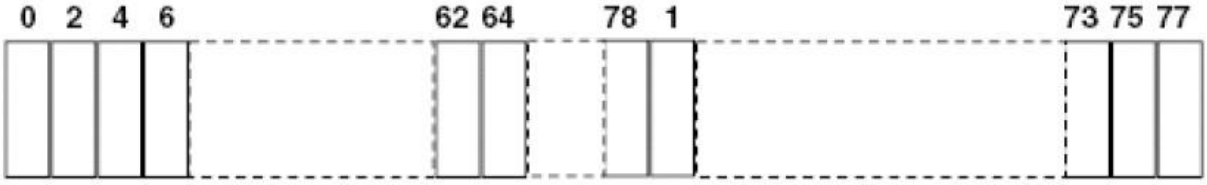
The pseudorandom frequency hopping sequence may be generated in a nice-stage shift register whose 5th first stage. The sequence begins with the first one of 9 consecutive ones, for example: the shift register is initialized with nine ones.

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



Linear Feedback Shift Register for Generation of the PRBS sequence

An example of pseudorandom frequency hopping sequence as follows:



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

6.10. Antenna requirement

6.10.1 Standard Applicable

According to antenna requirement of §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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be re-placed by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

And according to §15.247(4)(1), system operating in the 2400-2483.5MHz bands 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 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

6.10.2 Antenna Connected Construction

6.10.2.1. Standard Applicable

According to § 15.203 & RSS-Gen, 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.

6.10.2.2. Antenna Connector Construction

The directional gains of antenna used for transmitting is 2.0 dBi, and the antenna is an internal antenna connect to PCB board and no consideration of replacement. Please see EUT photo for details.

6.10.2.3. Results: Compliance.

Measurement

The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module.

Conducted power refers ANSI C63.10:2013 Output power test procedure for frequency-hopping spread-spectrum (FHSS) devices.

Radiated power refers to ANSI C63.10:2013 Radiated emissions tests.

Measurement parameters:

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

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

Limits:

FCC	IC
Antenna Gain	
6.0dBi	

Tnom	Vnom	lowest channel 2402 MHz	middle channel 2441 MHz	highest channel 2480 MHz
Conducted power [dBm] Measured with GFSK modulation		3.43	3.30	3.15
Radiated power [dBm] Measured with GFSK modulation		5.31	5.11	5.05
Gain [dBi] Calculated		1.88	1.81	1.90
Measurement uncertainty			± 1.6 dB (cond.) / ± 3.8 dB (rad.)	

Result: -/-

7.TEST SETUP PHOTOGRAPHS

7.1. Photo of Radiated Emissions Measurement (X Position)

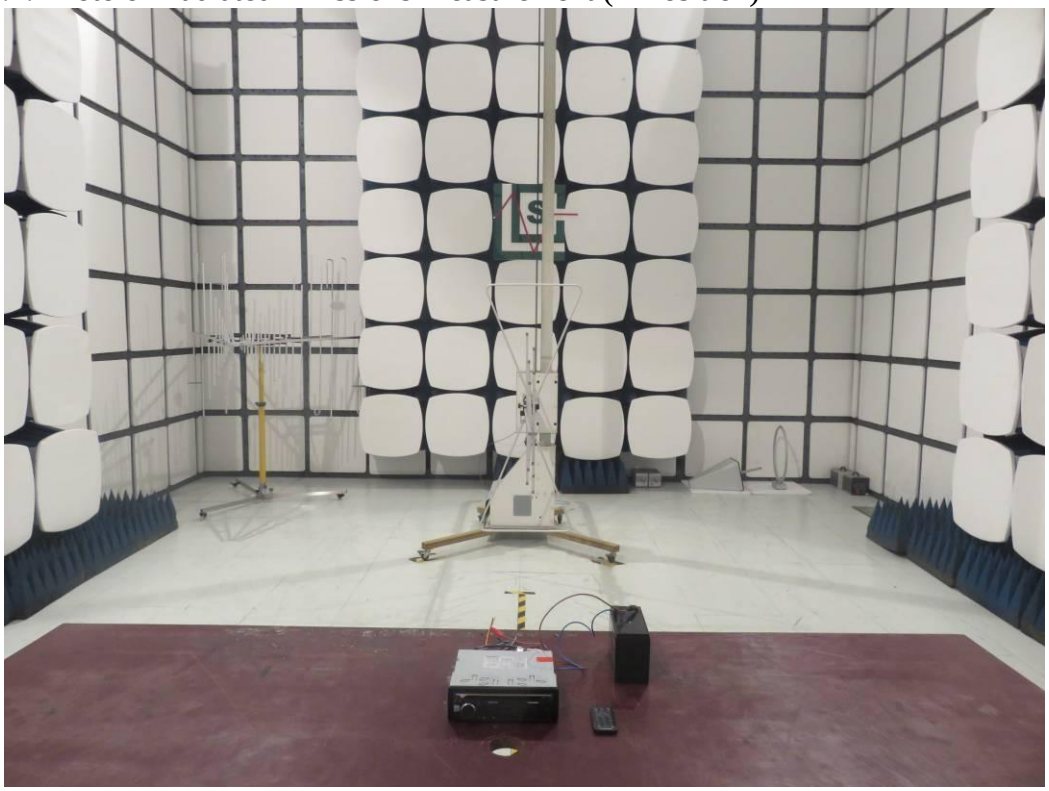


Fig.1

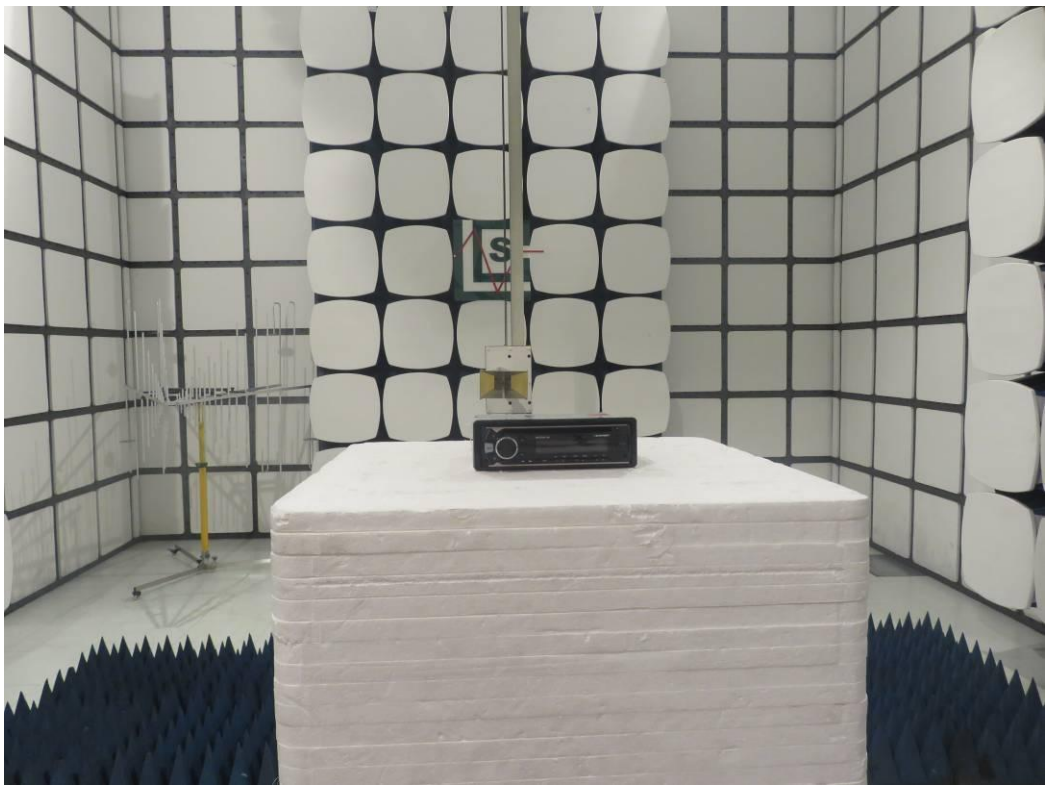
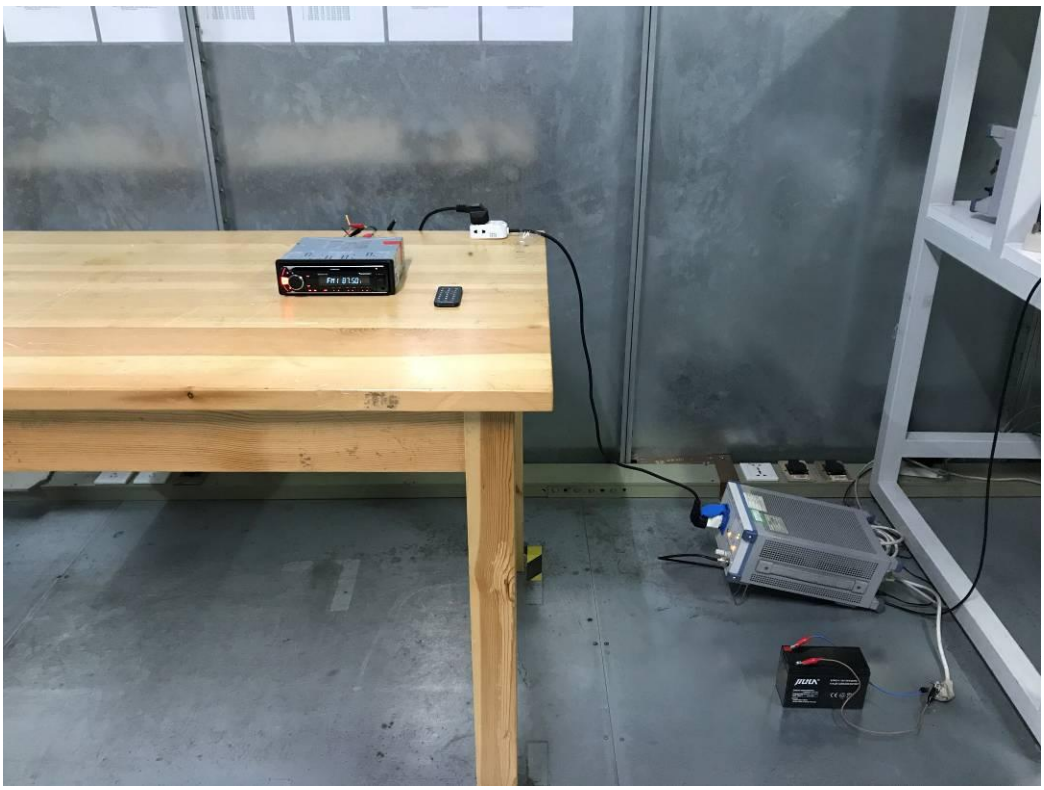


Fig.2

7.2. Photo of Line Conducted Emissions



8.EUT PHOTOGRAPHS

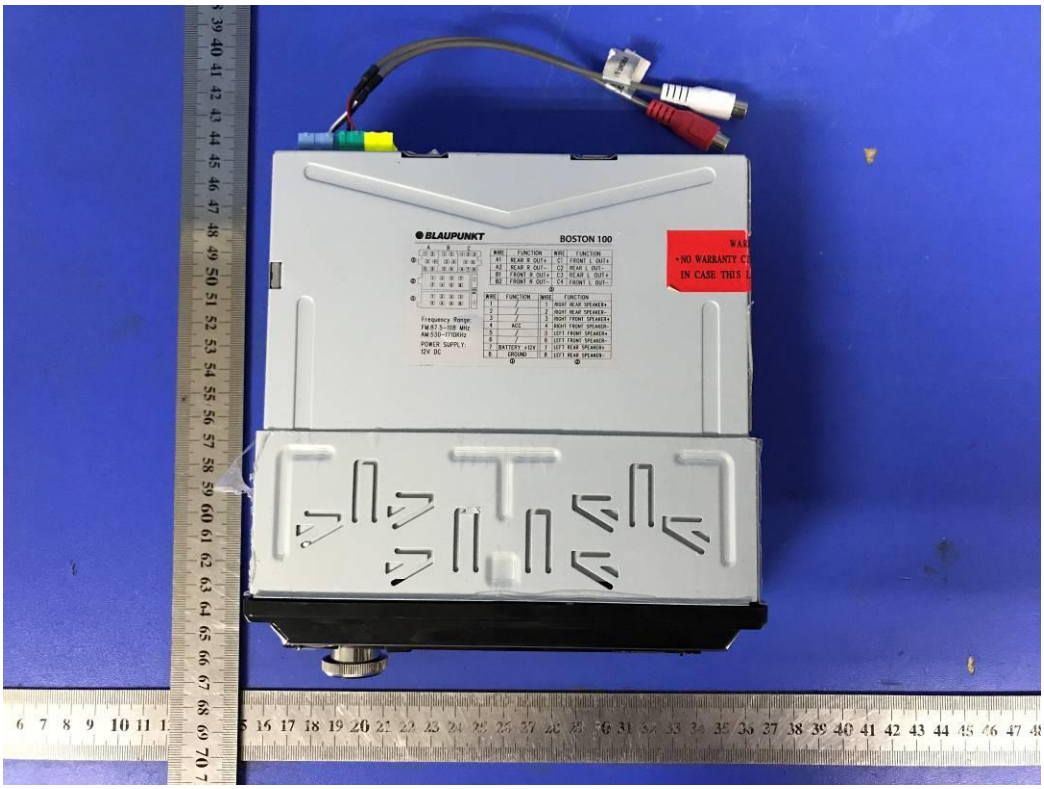


Fig.1

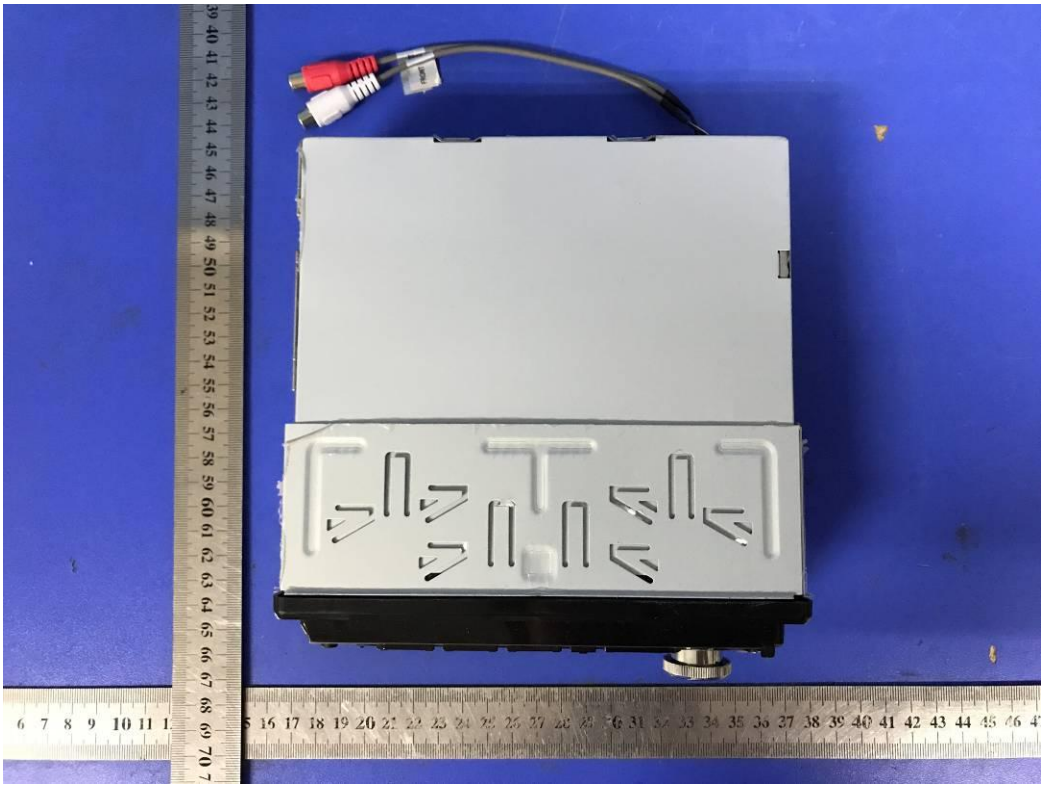


Fig.2


WARRANTY LABEL
CLAIM CAN BE ACCEPTED
LABEL IS DAMAGED

Fig.3

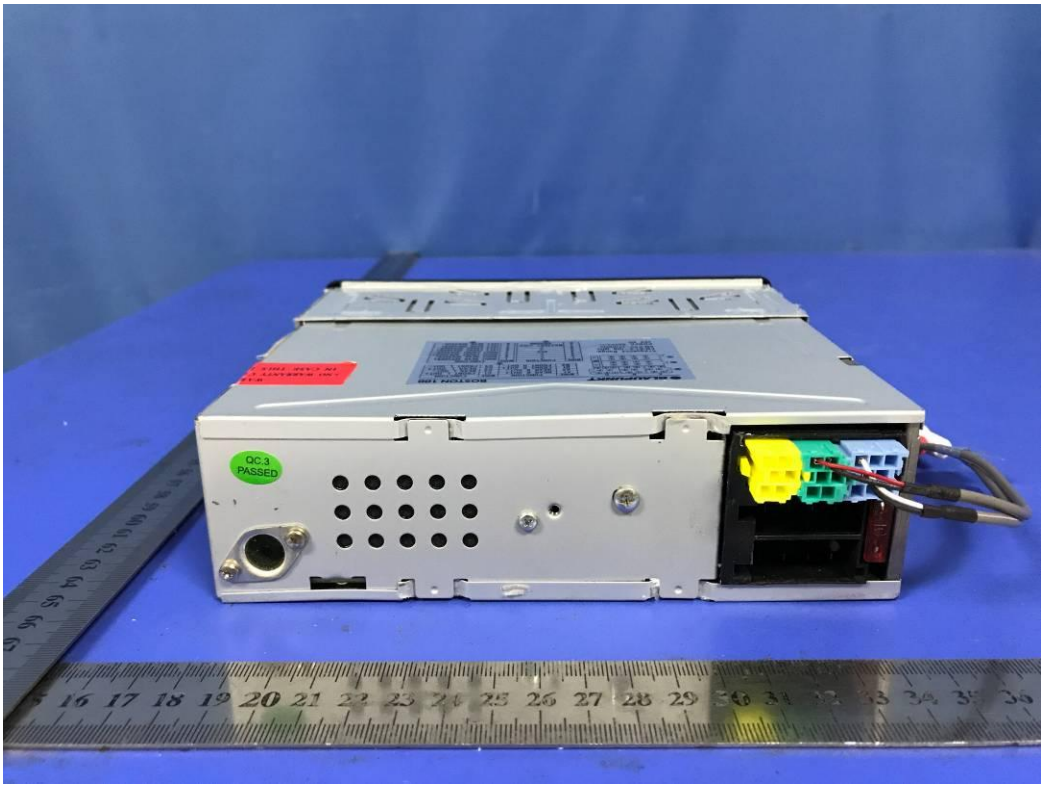

QC.3
PASSED

Fig.4

Fig.5

Fig.6

Fig.7

Fig.8

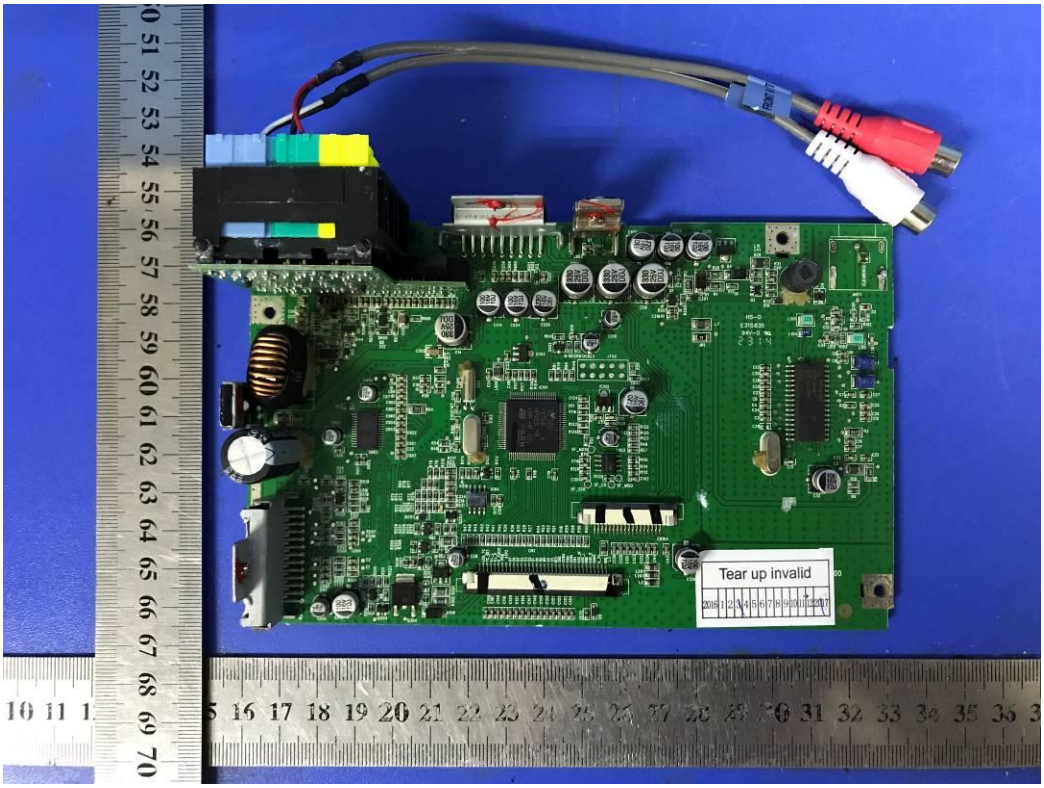


Fig.9

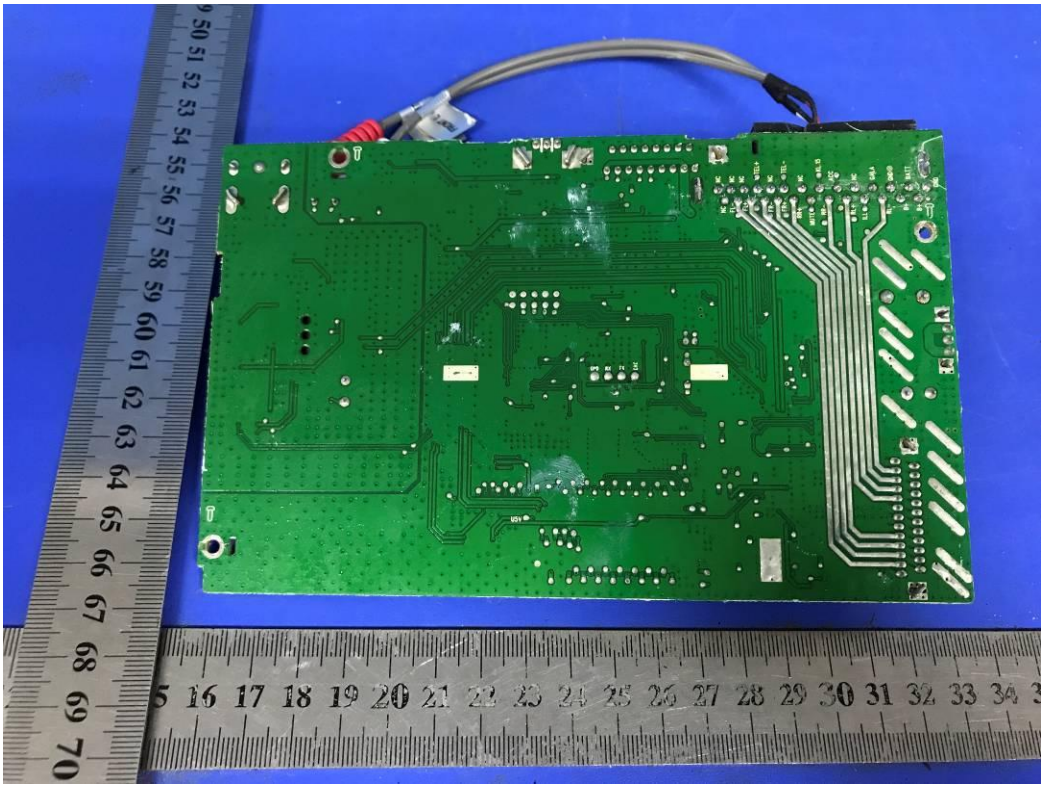


Fig.10

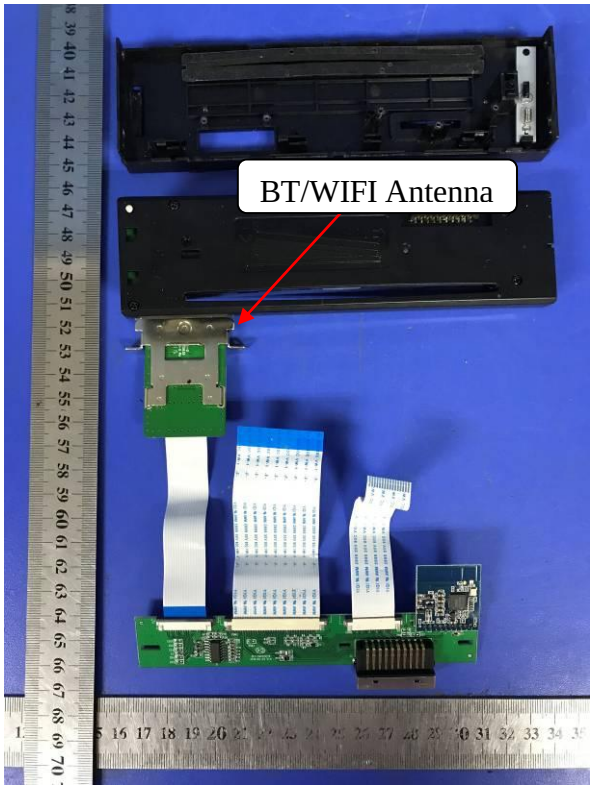


Fig.11

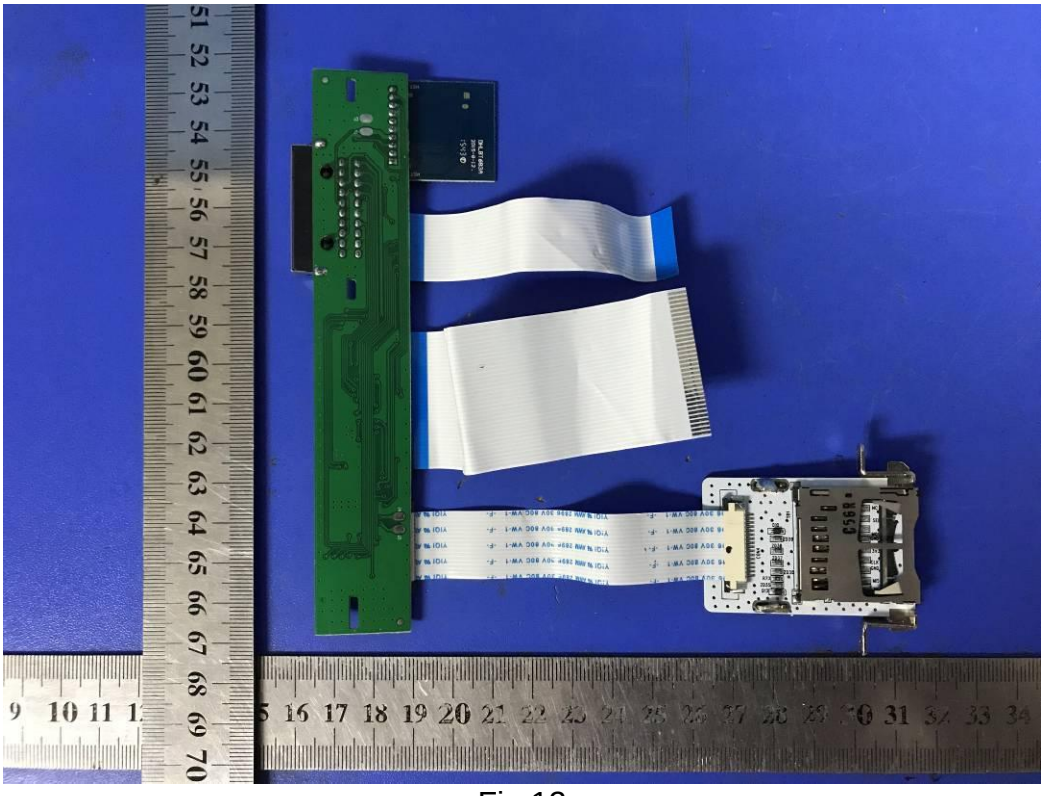


Fig.12

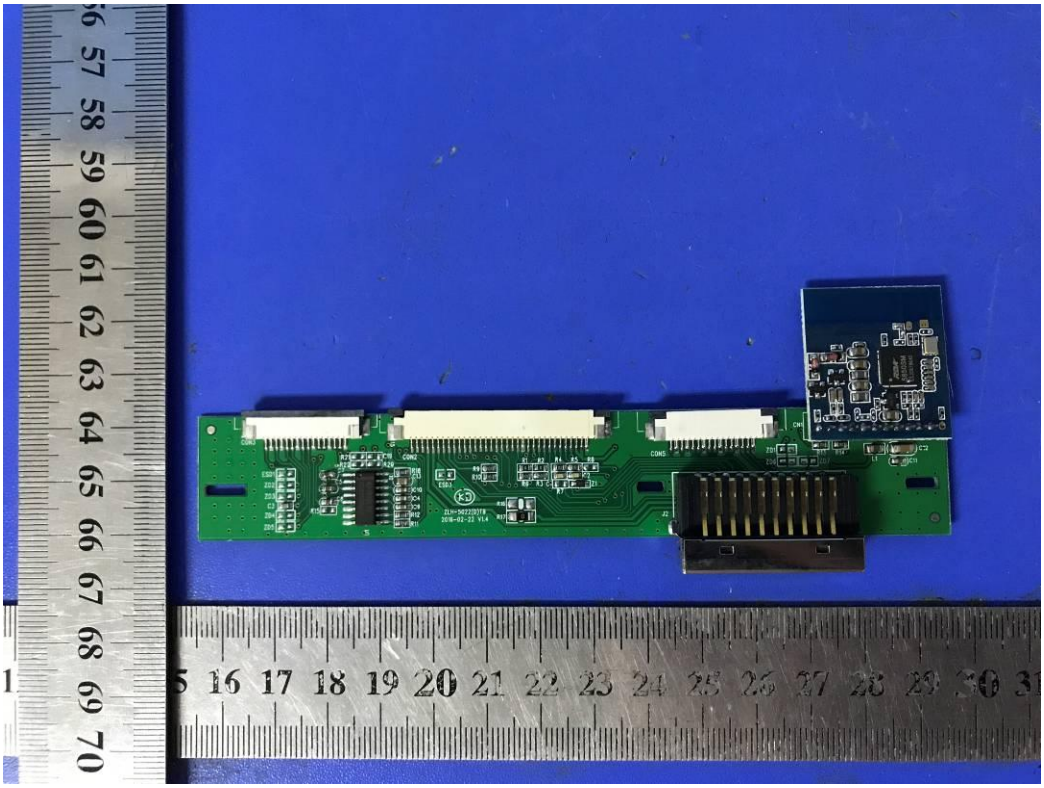


Fig.13

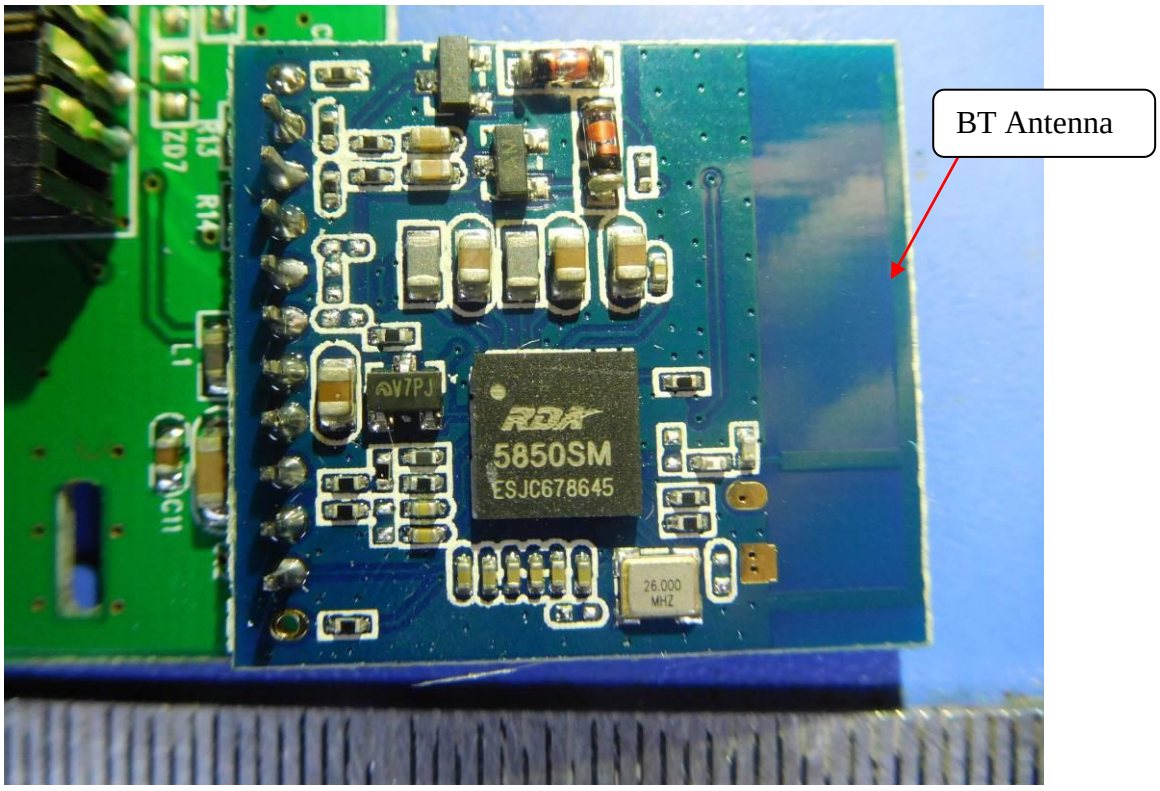


Fig.14

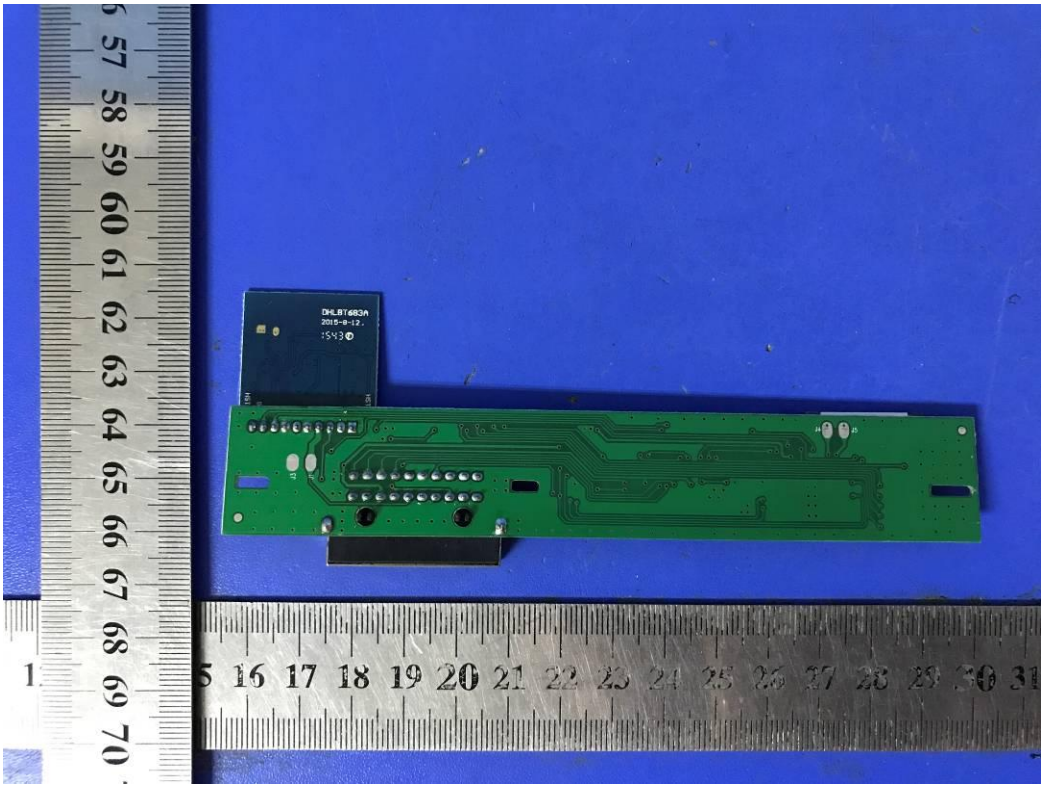


Fig.15

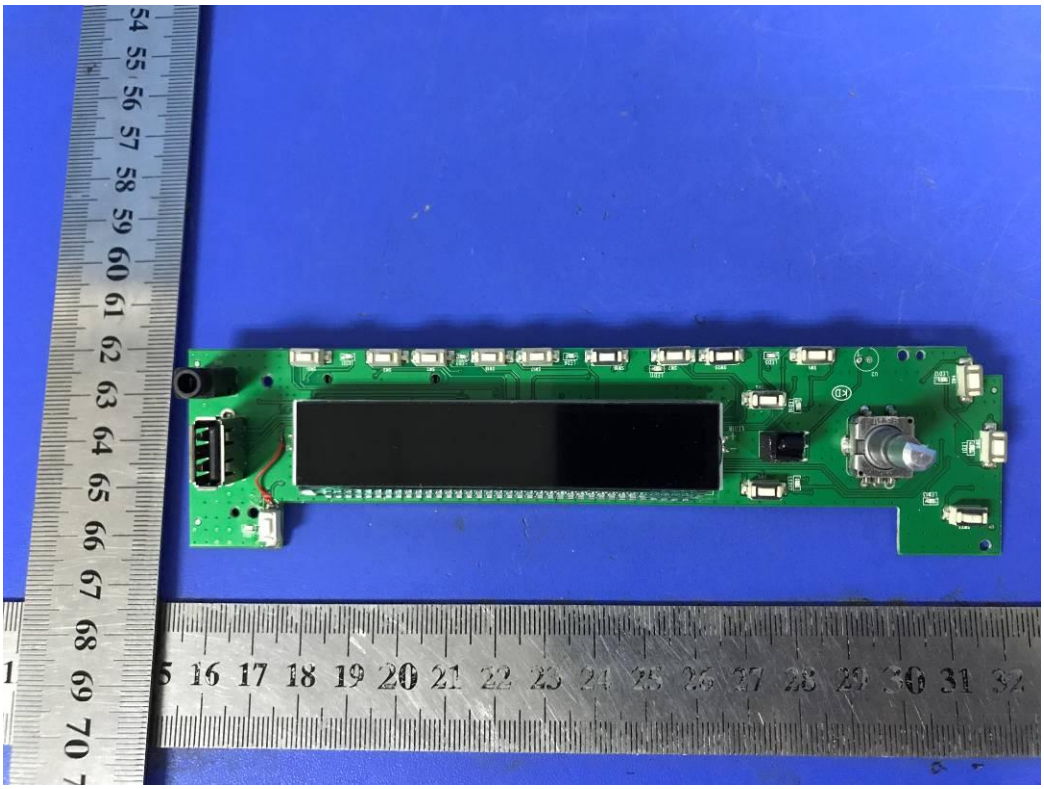


Fig.16

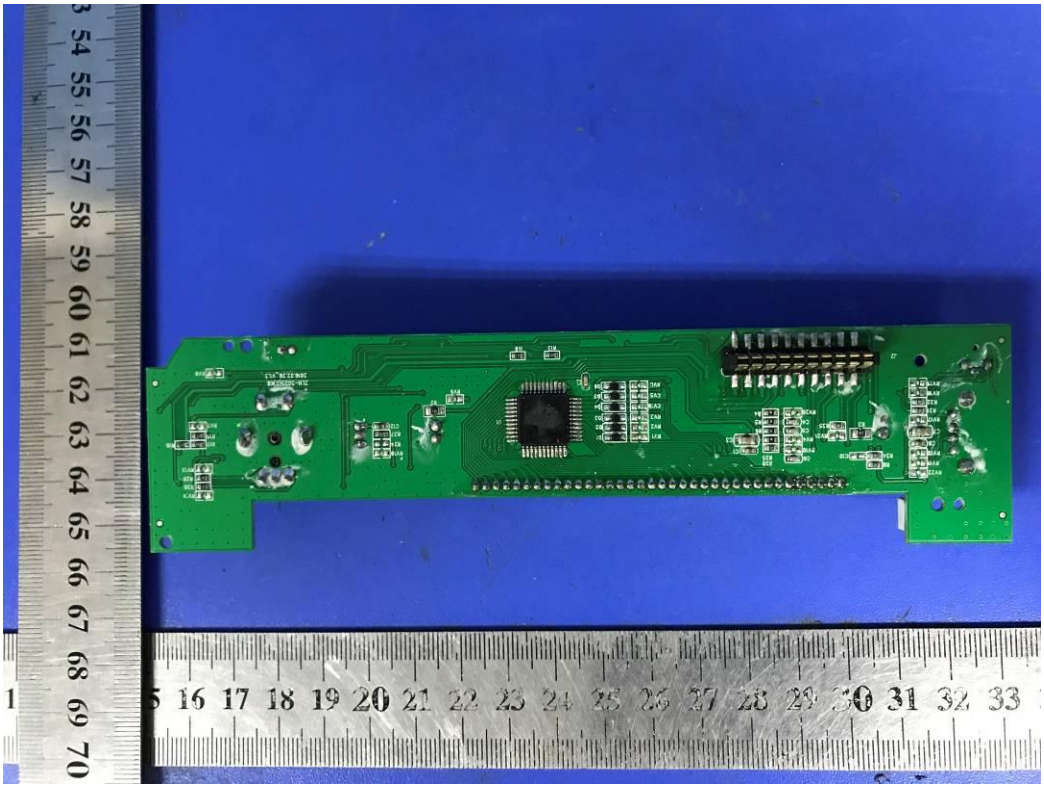


Fig.17

----------THE END OF TEST REPORT----------