NCC Test Report

Equipment	:	**PXC 550-II**
Model No.	:	**SEBT5**
Brand Name	:	**SENNHEISER**
Applicant	:	**Sennheiser electronic GmbH & Co. KG**
Address	:	**Am Labor 1, 30900 Wedemark, Germany**
Standard	:	**LP0002 Section 3.10.1 (2018-01-10)**
Received Date	:	**May 29, 2019**
Tested Date	:	**Dec. 07 ~ Dec. 10, 2015 (for original test)** **Jun 05 ~ Jul. 12, 2019 (for new test)**

We, International Certification Corp., would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. The test results contained in this report refer exclusively to the product. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.

Reviewed by: **Approved by:**

Along Chen / Assistant Manager **Gary Chang / Manager**

Testing Laboratory 2732

Table of Contents

1 GENERAL DESCRIPTION 5

1.1 Information 5
1.2 Local Support Equipment List 7
1.3 Test Setup Chart 7
1.4 Test Equipment List and Calibration Data 8
1.5 Test Standards 11
1.6 Deviation from Test Standard and Measurement Procedure 11
1.7 Measurement Uncertainty 11

2 TEST CONFIGURATION 12

2.1 Testing Condition 12
2.2 The Worst Test Modes and Channel Details 12

3 TRANSMITTER TEST RESULTS 13

3.1 Conducted Emissions 13
3.2 6dB and Occupied Bandwidth 16
3.3 RF Output Power 18
3.4 Power Spectral Density 20
3.5 Emissions in Restricted Frequency Bands 22
3.6 Emissions in non-restricted Frequency Bands 32

4 RECEIVER TEST RESULTS 35

4.1 Conducted Emissions 35
4.2 Radiated Emissions 38

5 TEST LABORATORY INFORMATION 44

Release Record

Report No.	Version	Description	Issued Date
TR5D0103-02AE	Rev. 01	Initial issue	Jul. 19, 2019

Summary of Test Results

NCC Rules	Test Items	Measured	Result
2.3	AC Power Line Conducted Emissions	[dBuV]: 0.156MHz 49.29 (Margin -16.36dB) - QP	Pass
3.10.1(5) 2.8	Radiated Emissions	[dBuV/m at 3m]: 4960.00MHz 48.83 (Margin -5.17dB) - AV	Pass
3.10.1.2(1)(C)	Maximum Output Power	Power [dBm]: 5.11	Pass
3.10.1.6(2)(A)	6dB Bandwidth	Meet the requirement of limit	Pass
3.10.1.6(2)(B)	Power Spectral Density	Meet the requirement of limit	Pass
3.10.1(4)	Antenna Requirement	Meet the requirement of limit	Pass

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

1 General Description

1.1 Information

This report is issued as a supplementary report to the original project no. TR5D0103AE. The modification is concerned with following item:

- ✧ Applicant / Model / Product name changed.
- ✧ Usb cable and audio cable length changed.
- ✧ Passive NFC tag is removed
- ✧ Apple MFi is added.

In this report, conducted Emissions and radiated emission below 1GHz tests had been re-tested and other test results were kept as same as mentioned on original report.

1.1.1 Specification of the Equipment under Test (EUT)

RF General Information				
Frequency Range (MHz)	**Bluetooth Mode**	**Ch. Freq. (MHz)**	**Channel Number**	**Data Rate**
2400-2483.5	V4.2 LE	2402-2480	0-39 [40]	1 Mbps
Note 1: Bluetooth LE (Low energy) uses GFSK modulation.				

1.1.2 Antenna Details

Ant. No.	Type	Gain (dBi)	Connector	Remark
1	Inverted F	4.2	N/A	---

1.1.3 Power Supply Type of Equipment under Test (EUT)

Power Supply Type	3.7Vdc from battery

1.1.4 Accessories

Accessories		
No.	**Equipment**	**Description**
1	USB cable	廠牌:SENNHEISER 型號: USB CHARGING CABLE 1200MM, BLACK 線長:1.28m, shielded cable without core.
2	Audio cable	廠牌: SENNHEISER 型號: Audio cable 3.5 to 2.5 mm jack 線長:1.45m, non-shielded without core

1.1.5 Channel List

Frequency band (MHz)				2400~2483.5			
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
37	2402	9	2422	18	2442	28	2462
0	2404	10	2424	19	2444	29	2464
1	2406	38	2426	20	2446	30	2466
2	2408	11	2428	21	2448	31	2468
3	2410	12	2430	22	2450	32	2470
4	2412	13	2432	23	2452	33	2472
5	2414	14	2434	24	2454	34	2474
6	2416	15	2436	25	2456	35	2476
7	2418	16	2438	26	2458	36	2478
8	2420	17	2440	27	2460	39	2480

1.1.6 Test Tool and Duty Cycle

Test tool	BlueTest3, Version: 2.5.0.93
Duty cycle of test signal (%)	67.48%
Duty Factor (dB)	1.71

1.1.7 Power Setting

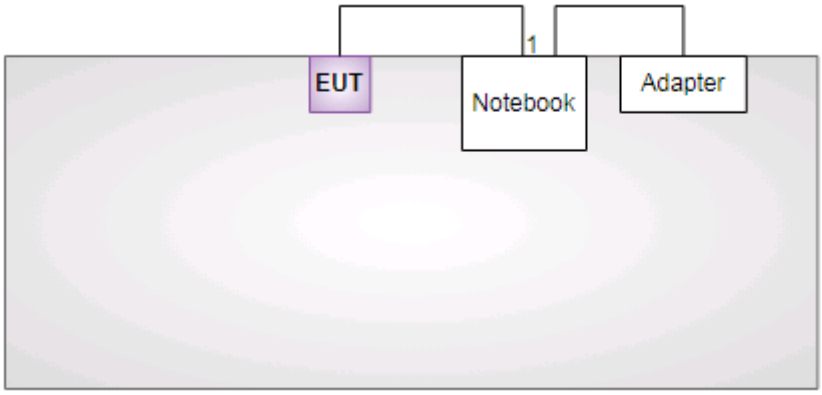
Modulation Mode	Test Frequency (MHz)		
	2402	2440	2480
GFSK/1Mbps	Default	Default	Default

1.2 Local Support Equipment List

Support Equipment List					
No.	**Equipment**	**Brand**	**Model**	**FCC ID**	**Remarks**
1	Notebook	DELL	Latitude E5420	DoC	

1.3 Test Setup Chart

Test Setup Diagram (Charging with Notebook)



No.	Signal cable / Length (m)
1	USB, 1.28m shielded without core

1.4 Test Equipment List and Calibration Data

Test Item	Radiated Emission				
Test Site	966 chamber 2 / (03CH02-WS)				
Test Date	Dec. 07 ~ Dec. 10, 2015				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	R&S	FSV40	101499	Dec. 31, 2014	Dec. 30, 2015
Receiver	R&S	ESR3	101657	Jan. 15, 2015	Jan. 14, 2016
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-523	Nov. 09, 2015	Nov. 08, 2016
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1095	Oct. 07, 2015	Oct. 06, 2016
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Nov. 04, 2015	Nov. 03, 2016
Loop Antenna	R&S	HFH2-Z2	11900	Nov. 16, 2015	Nov. 15, 2016
Preamplifier	Burgeon	BPA-530	100218	Nov. 03, 2015	Nov. 02, 2016
Preamplifier	Agilent	83017A	MY39501309	Sep. 22, 2015	Sep. 21, 2016
Preamplifier	EMC	EMC184045B	980192	Sep. 01, 2015	Aug. 31, 2016
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16140/4	Dec. 16, 2014	Dec. 15, 2015
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16018/4	Dec. 16, 2014	Dec. 15, 2015
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16015/4	Dec. 16, 2014	Dec. 15, 2015
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-003	Dec. 16, 2014	Dec. 15, 2015
LF cable 10M	EMCC	CFD400-E	CFD400-001	Jun. 17, 2015	Jun. 16, 2016
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	RF Conducted				
Test Site	(TH01-WS)				
Test Date	Dec. 07 ~ Dec. 10, 2015				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	R&S	FSV40	101063	Feb. 03, 2015	Feb. 02, 2016
Power Meter	Anritsu	ML2495A	1241002	Sep. 21, 2015	Sep. 20, 2016
Power Sensor	Anritsu	MA2411B	1207366	Sep. 21, 2015	Sep. 20, 2016
Measurement Software	Sporton	Sporton_1	1.3.30	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Conducted Emission				
Test Site	Conduction room 1 / (CO01-WS)				
Test Date	Jun. 05 ~ Jun. 13, 2019				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Receiver	R&S	ESR3	101657	Jan. 08, 2019	Jan. 07, 2020
LISN	R&S	ENV216	101579	Mar. 08, 2019	Mar. 07, 2020
LISN (Support Unit)	SCHWARZBECK	Schwarzbeck 8127	8127-666	Nov. 29, 2018	Nov. 28, 2019
RF Cable-CON	Woken	CFD200-NL	CFD200-NL-001	Oct. 23, 2018	Oct. 23, 2019
50 ohm terminal (Support Unit)	NA	50	04	May 28, 2019	May 27, 2020
Measurement Software	AUDIX	e3	6.120210k	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Emission				
Test Site	966 chamber1 / (03CH01-WS)				
Test Date	Jun. 05 ~ Jun. 13, 2019				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	R&S	FSV40	101498	Dec. 27, 2018	Dec. 26, 2019
Receiver	R&S	ESR3	101658	Dec. 11, 2018	Dec. 10, 2019
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-522	Jul. 18, 2018	Jul. 17, 2019
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1096	Dec. 18, 2018	Dec. 17, 2019
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Nov. 15, 2018	Nov. 14, 2019
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 09, 2018	Nov. 08, 2019
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Oct. 08, 2018	Oct. 07, 2019
Preamplifier	EMC	EMC02325	980225	Jul. 20, 2018	Jul. 19, 2019
Preamplifier	Agilent	83017A	MY39501308	Oct. 04, 2018	Oct. 03, 2019
Preamplifier	EMC	EMC184045B	980192	Aug. 09, 2018	Aug. 08, 2019
RF Cable	EMC	EMC104-SM-SM-8000	181106	Oct. 08, 2018	Oct. 07, 2019
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16019/4	Oct. 08, 2018	Oct. 07, 2019
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16014/4	Oct. 08, 2018	Oct. 07, 2019
LF cable 1M	EMC	EMCCFD400-NM-NM-1000	160502	Oct. 08, 2018	Oct. 07, 2019
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-001	Oct. 08, 2018	Oct. 07, 2019
LF cable 10M	Woken	CFD400NL-LW	CFD400NL-002	Oct. 08, 2018	Oct. 07, 2019
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	RF Conducted				
Test Site	(TH01-WS)				
Test date	Jul. 12, 2019				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	R&S	FSV40	101063	Apr. 17, 2019	Apr. 16, 2020
Power Meter	Anritsu	ML2495A	1241002	Oct. 09, 2018	Oct. 08, 2019
Power Sensor	Anritsu	MA2411B	1207366	Oct. 09, 2018	Oct. 08, 2019
Measurement Software	Sporton	Sporton_1	1.3.30	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

1.5 Test Standards

According to the specification of EUT, the EUT must comply with following standards and KDB documents.

LP0002 Section 3.10.1 (2018-01-10)
ANSI C63.10-2013
FCC KDB 558074 D01 15.247 Meas Guidance v05r02

1.6 Deviation from Test Standard and Measurement Procedure

None

1.7 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

Measurement Uncertainty	
Parameters	**Uncertainty**
Bandwidth	±34.134 Hz
Conducted power	±0.808 dB
Power density	±0.463 dB
Conducted emission	±2.670 dB
AC conducted emission	±2.90 dB
Radiated emission ≤ 1GHz	±3.62 dB
Radiated emission > 1GHz	±5.60 dB

2 Test Configuration

2.1 Testing Condition

Test Item	Test Site	Ambient Condition	Tested By
AC Conduction	CO01-WS	20°C / 56%	Peter Lin
Radiated Emissions ≤ 1GHz	03CH01-WS	26°C / 62%	Akun Chung
Radiated Emissions > 1GHz	03CH02-WS	20-21°C / 67-68%	Morgan Chen
RF Conducted	TH01-WS	22°C / 63%	Alex Huang

- FCC site registration No.: 657002
- IC site registration No.: 10807A-2

2.2 The Worst Test Modes and Channel Details

Test item	Mode	Test Frequency (MHz)	Data Rate	Mode	Test Configuration
AC Power Line Conducted Emissions	BT LE	2480	1Mbps	TX	---
Radiated Emissions ≤ 1GHz	BT LE	2480	1Mbps	TX	---
Radiated Emissions > 1GHz	BT LE	2402, 2440, 2480	1Mbps	TX	---
Maximum Output Power	BT LE	2402, 2440, 2480	1Mbps	TX	---
6dB bandwidth					
Power spectral density					

NOTE:

1. The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The **X-plane** results were found as the worst case and were shown in this report.
2. Two test configurations (charging with notebook & charging with adapter) had been covered during the pretest, and found that **charging with notebook** was the worst case and was selected for final test.

Test item	Mode	Test Frequency (MHz)	Data Rate	Mode	Test Configuration
AC Power Line Conducted Emissions	BT LE	2480	1Mbps	RX	---
Radiated Emissions	BT LE	2480	1Mbps	RX	---

NOTE:

1. The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The **X-plane** results were found as the worst case and were shown in this report.
2. Two test configurations (charging with notebook & charging with adapter) had been covered during the pretest, and found that **charging with notebook** was the worst case and was selected for final test.

3 Transmitter Test Results

3.1 Conducted Emissions

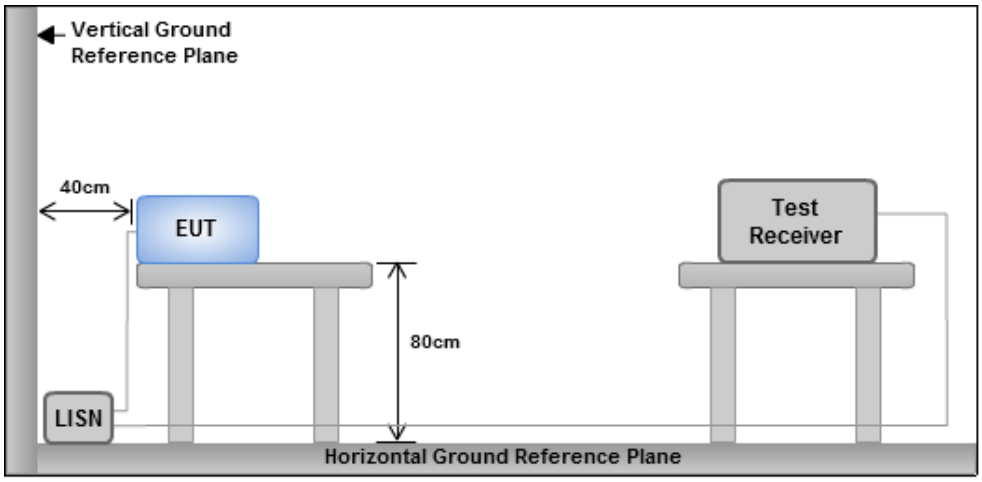
3.1.1 Limit of Conducted Emissions

Conducted Emissions Limit		
Frequency Emission (MHz)	**Quasi-Peak**	**Average**
0.15-0.5	66 - 56 *	56 - 46 *
0.5-5	56	46
5-30	60	50
Note 1: * Decreases with the logarithm of the frequency.		

3.1.2 Test Procedures

1. The device is placed on a test table, raised 80 cm above the reference ground plane. The vertical conducting plane is located 40 cm to the rear of the device.
2. The device is connected to line impedance stabilization network (LISN) and other accessories are connected to other LISN. Measured levels of AC power line conducted emission are across the 50 Ω LISN port.
3. AC conducted emission measurements is made over frequency range from 150 kHz to 30 MHz.
4. This measurement was performed with AC 120V/60Hz

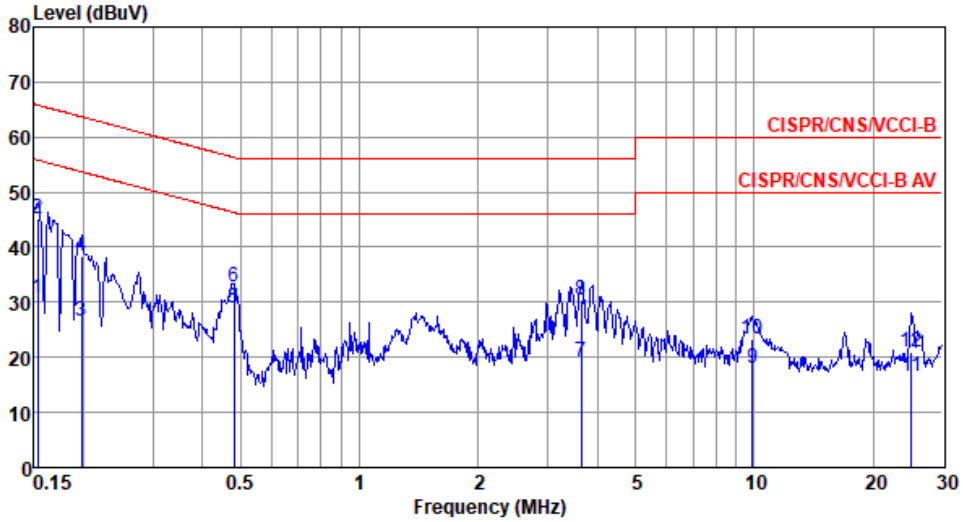
3.1.3 Test Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

3.1.4 Test Result of Conducted Emissions

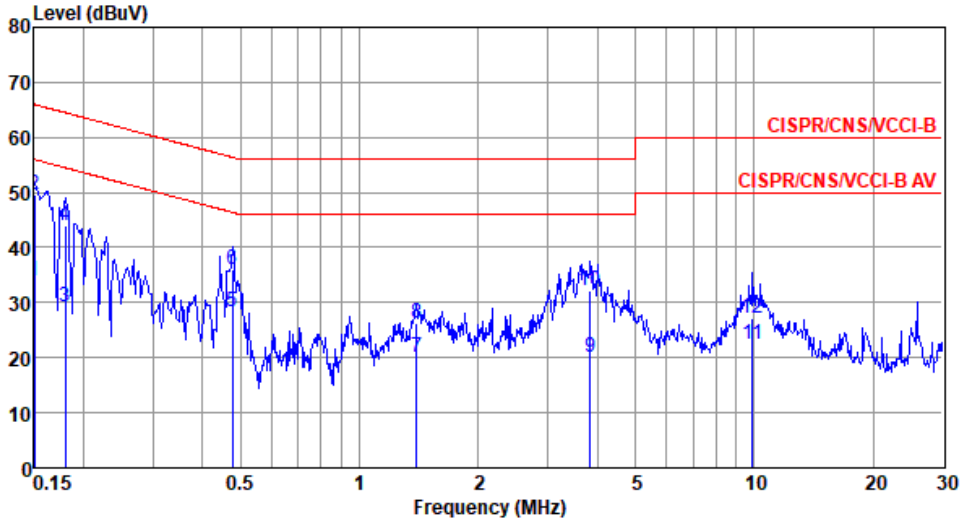
Modulation Mode	GFSK	Test Freq. (MHz)	2480
Power Phase	Line		



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.153	30.78	55.82	-25.04	21.20	9.53	0.05	Average
2	0.153	45.07	65.82	-20.75	35.49	9.53	0.05	QP
3	0.198	26.56	53.71	-27.15	16.95	9.54	0.07	Average
4	0.198	38.49	63.71	-25.22	28.88	9.54	0.07	QP
5*	0.481	29.02	46.32	-17.30	19.36	9.58	0.08	Average
6	0.481	32.63	56.32	-23.69	22.97	9.58	0.08	QP
7	3.642	19.18	46.00	-26.82	9.31	9.61	0.26	Average
8	3.642	30.31	56.00	-25.69	20.44	9.61	0.26	QP
9	9.913	17.98	50.00	-32.02	7.89	9.65	0.44	Average
10	9.913	23.39	60.00	-36.61	13.30	9.65	0.44	QP
11	25.055	16.65	50.00	-33.35	6.33	9.64	0.68	Average
12	25.055	21.09	60.00	-38.91	10.77	9.64	0.68	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

Modulation Mode	GFSK	Test Freq. (MHz)	2480
Power Phase	Neutral		



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.150	33.80	56.00	-22.20	24.18	9.57	0.05	Average
2*	0.150	49.53	66.00	-16.47	39.91	9.57	0.05	QP
3	0.180	29.35	54.50	-25.15	19.71	9.58	0.06	Average
4	0.180	44.05	64.50	-20.45	34.41	9.58	0.06	QP
5	0.476	28.46	46.41	-17.95	18.76	9.62	0.08	Average
6	0.476	35.95	56.41	-20.46	26.25	9.62	0.08	QP
7	1.396	19.94	46.00	-26.06	10.17	9.64	0.13	Average
8	1.396	26.32	56.00	-29.68	16.55	9.64	0.13	QP
9	3.840	19.97	46.00	-26.03	10.04	9.66	0.27	Average
10	3.840	32.06	56.00	-23.94	22.13	9.66	0.27	QP
11	9.913	22.49	50.00	-27.51	12.34	9.71	0.44	Average
12	9.913	27.14	60.00	-32.86	16.99	9.71	0.44	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

3.2 6dB and Occupied Bandwidth

3.2.1 Limit of 6dB Bandwidth

The minimum 6dB bandwidth shall be at least 500 kHz.

3.2.2 Test Procedures

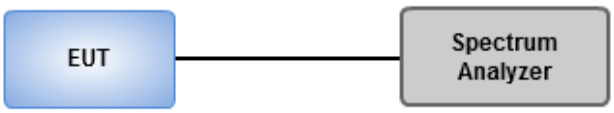
6dB Bandwidth

1. Set resolution bandwidth (RBW) = 100 kHz, Video bandwidth = 300 kHz.
2. Detector = Peak, Trace mode = max hold.
3. Sweep = auto couple, Allow the trace to stabilize.
4. 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 6dB relative to the maximum level measured in the fundamental emission.

Occupied Bandwidth

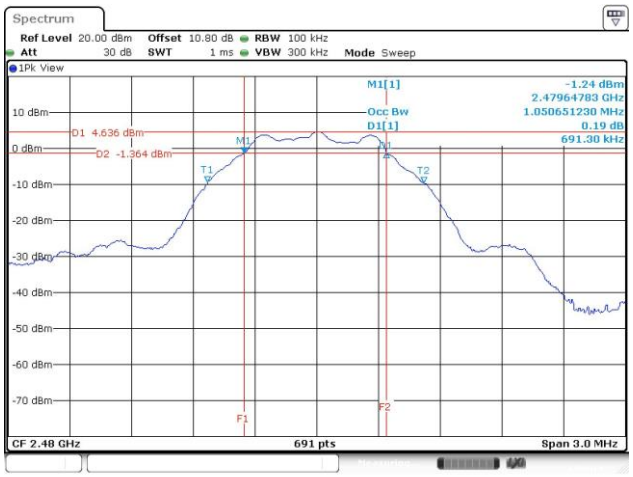
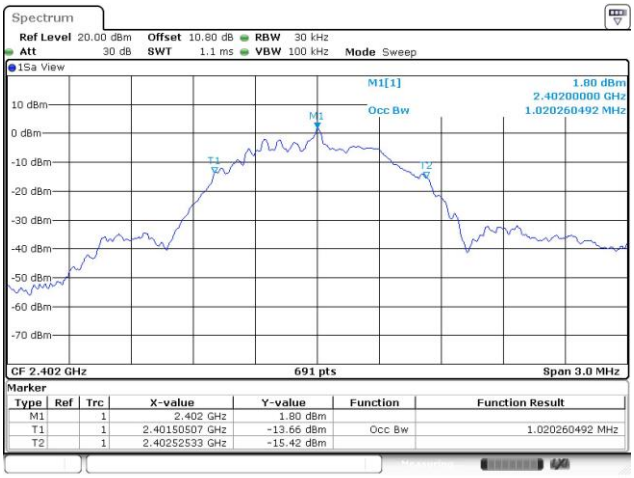
1. Set resolution bandwidth (RBW) = 30 kHz, Video bandwidth = 100 kHz.
2. Detector = Sample, Trace mode = max hold.
3 Sweep = auto couple, Allow the trace to stabilize.
4. Use the OBW measurement function of spectrum analyzer to measure the occupied bandwidth.

3.2.3 Test Setup



3.2.4 Test Result of 6dB and Occupied Bandwidth

Mode	Freq. (MHz)	6dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	Limit of 6dB Bandwidth (kHz)
BT LE	2402	0.696	1.02	500
BT LE	2440	0.691	1.02	500
BT LE	2480	0.691	1.02	500

Worst Plots	
6dB Bandwidth	**99% Occupied Bandwidth**
	

3.3 RF Output Power

3.3.1 Limit of RF Output Power

Conducted power shall not exceed 1Watt.

☒ Antenna gain <= 6dBi, no any corresponding reduction is in output power limit.

☐ Antenna gain > 6dBi

☐ Non Fixed, point to point operations.
The conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dB

☐ Fixed, point to point operations
Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point Operations, 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 6 dBi.

Systems operating in the 5725–5850 MHz band that are used exclusively for fixed, point-to-point operations ,no any corresponding reduction is in transmitter peak output power

3.3.2 Test Procedures

☒ Maximum Peak Conducted Output Power

☐ **Spectrum analyzer**

1. Set RBW = 1MHz, VBW = 3MHz, Detector = Peak.
2. Sweep time = auto, Trace mode = max hold, Allow trace to fully stabilize.
3. Use the spectrum analyzer channel power measurement function with the band limits set equal to the DTS bandwidth edges.

☒ **Power meter**

1. A broadband Peak RF power meter is used for output power measurement. The video bandwidth of power meter is greater than DTS bandwidth of EUT. If duty cycle of test signal is not 100 %, trigger and gating function of power meter will be enabled to capture transmission burst for measuring output power.

☒ Maximum Conducted Average Output Power (For reference only)

☒ **Power meter**

1. A broadband Average RF power meter is used for output power measurement. The video bandwidth of power meter is greater than DTS bandwidth of EUT. If duty cycle of test signal is not 100 %, trigger and gating function of power meter will be enabled to capture transmission burst for measuring output power.

3.3.3 Test Setup

3.3.4 Test Result of Maximum Output Power

Mode	Freq. (MHz)	Peak Power			Antenna gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)
		Power (mW)	Power (dBm)	Limit (dBm)			
BT LE	2402	2.291	3.60	30	4.2	7.80	36
BT LE	2440	2.636	4.21	30	4.2	8.41	36
BT LE	2480	3.243	**5.11**	30	4.2	9.31	36

Mode	Freq. (MHz)	AV Power (mW)	AV Power (dBm)	Limit (dBm)
BT LE	2402	2.01	3.04	---
BT LE	2440	2.35	3.71	---
BT LE	2480	2.86	4.57	---

Note: Average power is for reference only

3.3.5 Verification and Comparison of Conducted Output Power

Mode	Freq. (MHz)	Peak Output Power (dBm)		Difference (dB)	Limit (dB)
		Original device	Variant device		
BT LE	2402	3.60	2.36	1.24	+ / - 2 dB
BT LE	2440	4.21	4.03	0.18	+ / - 2 dB
BT LE	2480	5.11	3.94	1.17	+ / - 2 dB

Mode	Freq. (MHz)	Average Output Power (dBm)		Difference (dB)	Limit (dB)
		Original device	Variant device		
BT LE	2402	3.04	1.94	1.10	+ / - 2 dB
BT LE	2440	3.71	3.65	0.06	+ / - 2 dB
BT LE	2480	4.57	3.56	1.01	+ / - 2 dB

3.4 Power Spectral Density

3.4.1 Limit of Power Spectral Density

Power spectral density shall not be greater than 8 dBm in any 3 kHz band.

3.4.2 Test Procedures

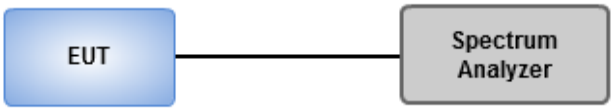
☒ Maximum peak conducted output power was used to demonstrate compliance to the fundamental output power limit.

1. Set the RBW = 3kHz, VBW = 10kHz.
2. Detector = Peak, Sweep time = auto couple.
3. Trace mode = max hold, allow trace to fully stabilize.
4. Use the peak marker function to determine the maximum amplitude level.

☐ Maximum (average) conducted output power was used to demonstrate compliance to the fundamental output power limit.

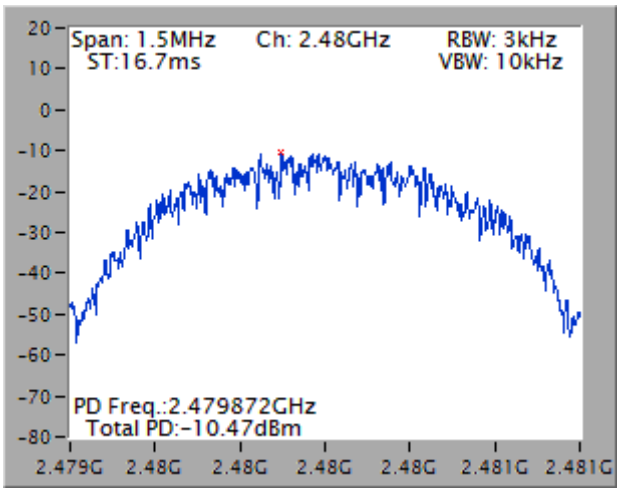
1. Set the RBW = 100kHz, VBW = 300 kHz.
2. Detector = RMS, Sweep time = auto couple.
3. Set the sweep time to: ≥ 10 x (number of measurement points in sweep) x (maximum data rate per stream).
4. Perform the measurement over a single sweep.
5. Use the peak marker function to determine the maximum amplitude level.\

3.4.3 Test Setup



3.4.4 Test Result of Power Spectral Density

Mode	Freq. (MHz)	Total Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)
BT LE	2402	-12.17	8
BT LE	2440	-11.26	8
BT LE	2480	-10.47	8

Worst Plot


3.5 Emissions in Restricted Frequency Bands

3.5.1 Limit of Emissions in Restricted Frequency Bands

Restricted Band Emissions Limit			
Frequency Range (MHz)	**Field Strength (uV/m)**	**Field Strength (dBuV/m)**	**Measure Distance (m)**
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1:
Qusai-Peak value is measured for frequency below 1GHz except for 9–90 kHz, 110–490 kHz frequency band. Peak and average value are measured for frequency above 1GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit
Note 2:
Measurements may be performed at a distance other than what is specified provided. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, Frequency at or above 30 MHz: 20 dB/decade Frequency below 30 MHz: 40 dB/decade.

3.5.2 Test Procedures

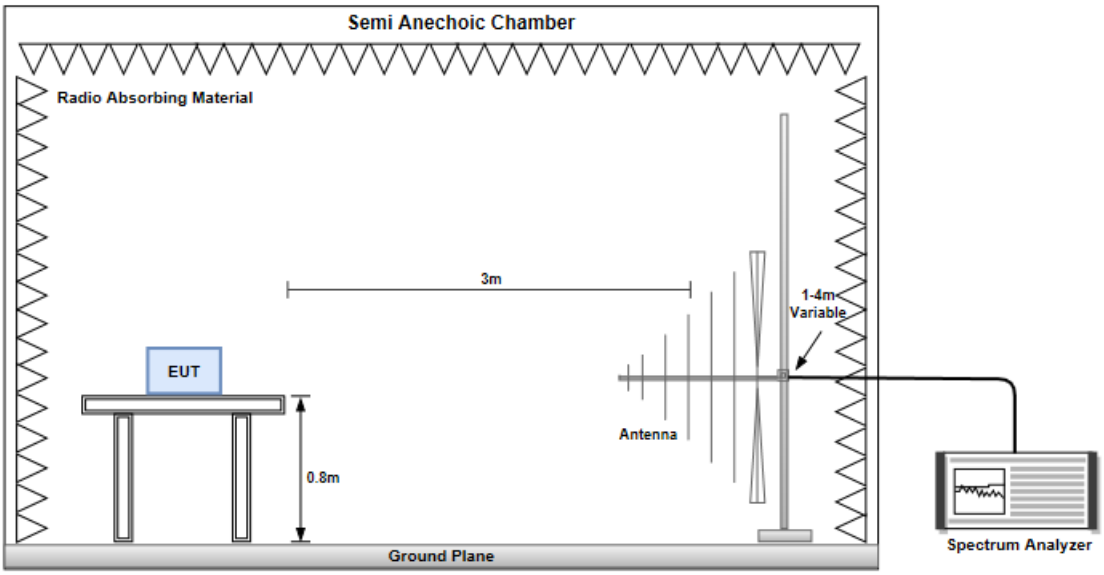
1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. The EUT is placed at test table. For emissions testing at or below 1 GHz, the table height is 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height is 1.5 m
2. Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m ~ 4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3 m.
3. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

Note:

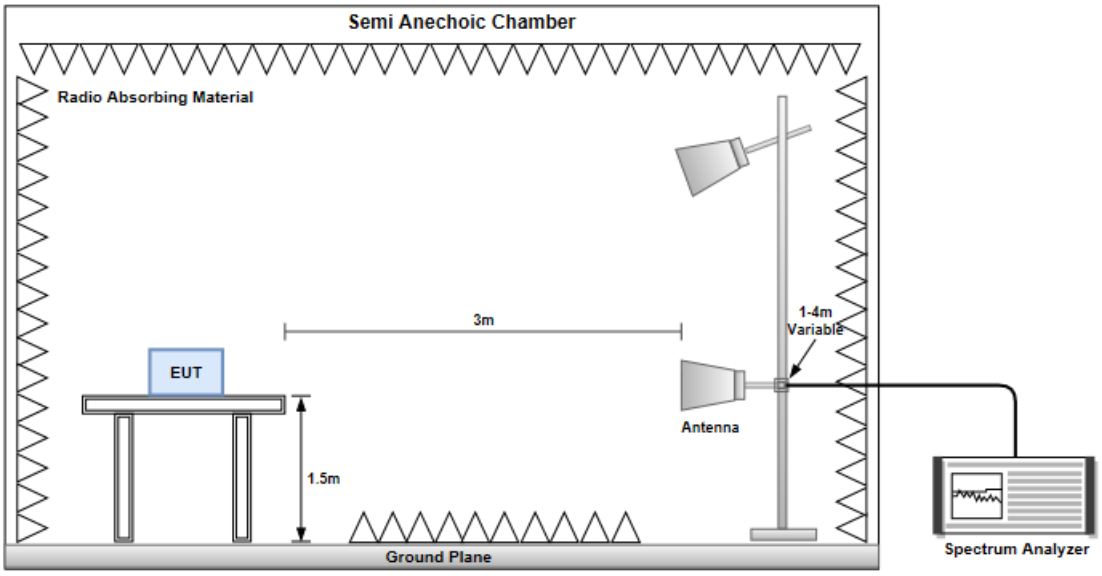
1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
2. RBW=1MHz, VBW=3MHz and Peak detector is for peak measured value of radiated emission above 1GHz.
3. RBW=1MHz, VBW=1/T and Peak detector is for average measured value of radiated emission above 1GHz.

3.5.3 Test Setup

Radiated Emissions below 1 GHz

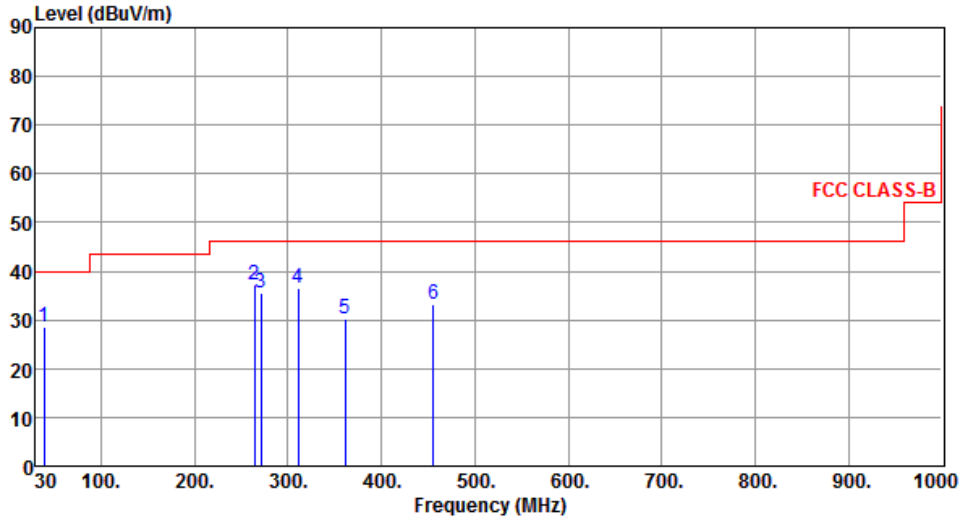


Radiated Emissions above 1 GHz



3.5.4 Transmitter Radiated Unwanted Emissions (Below 1GHz)

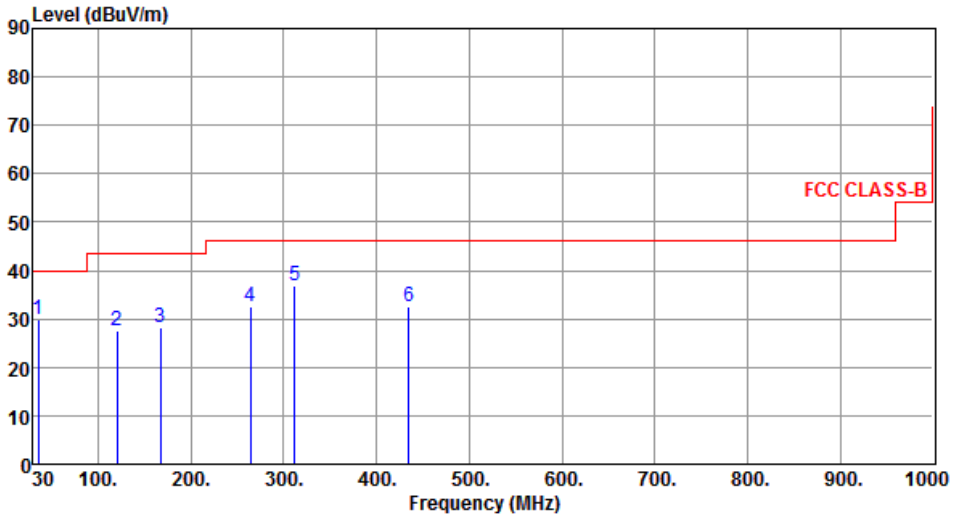
Modulation	GFSK	**Test Freq. (MHz)**	2480
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	38.57	28.54	40.00	-11.46	36.81	-8.27	Peak	---	---
2	264.58	37.22	46.00	-8.78	46.05	-8.83	Peak	---	---
3	271.58	35.58	46.00	-10.42	44.08	-8.50	Peak	---	---
4	311.25	36.54	46.00	-9.46	44.06	-7.52	Peak	---	---
5	361.29	30.25	46.00	-15.75	36.33	-6.08	Peak	---	---
6	455.74	33.21	46.00	-12.79	36.99	-3.78	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Vertical		

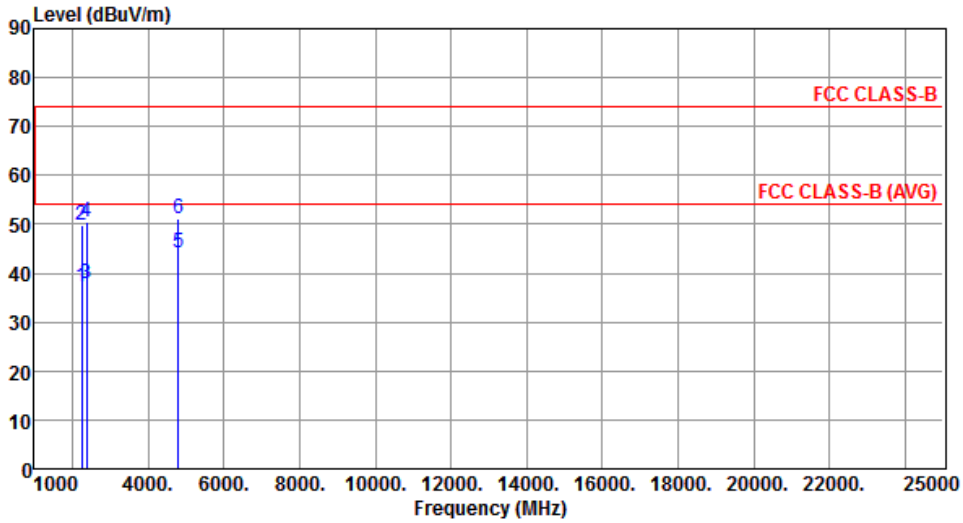


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	35.75	29.84	40.00	-10.16	38.41	-8.57	Peak	---	---
2	120.28	27.44	43.50	-16.06	38.03	-10.59	Peak	---	---
3	166.85	28.25	43.50	-15.25	36.59	-8.34	Peak	---	---
4	264.58	32.58	46.00	-13.42	41.41	-8.83	Peak	---	---
5	311.50	36.89	46.00	-9.11	44.40	-7.51	Peak	---	---
6	434.58	32.58	46.00	-13.42	36.84	-4.26	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

3.5.5 Transmitter Radiated Unwanted Emissions (Above 1GHz) for GFSK

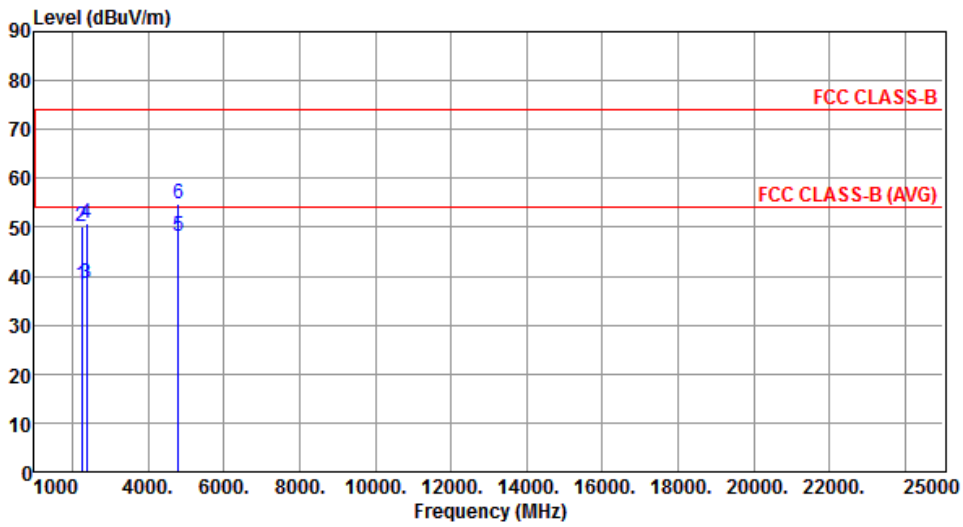
Modulation	GFSK	**Test Freq. (MHz)**	2402
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2246.00	37.12	54.00	-16.88	40.36	-3.24	Average	113	33
2	2246.00	49.98	74.00	-24.02	53.22	-3.24	Peak	113	33
3	2390.00	37.87	54.00	-16.13	40.57	-2.70	Average	113	33
4	2390.00	50.59	74.00	-23.41	53.29	-2.70	Peak	113	33
5	4804.00	44.02	54.00	-9.98	39.09	4.93	Average	255	239
6	4804.00	51.12	74.00	-22.88	46.19	4.93	Peak	255	239

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

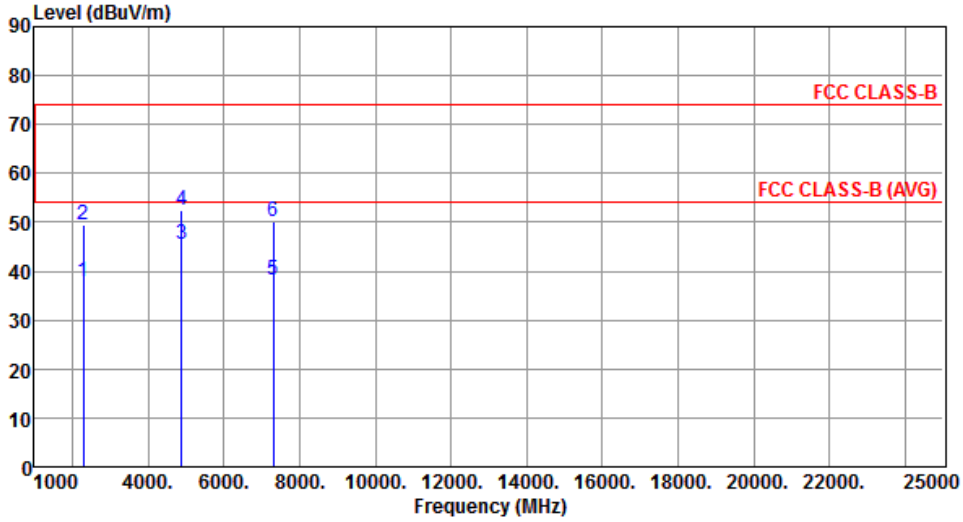
Modulation	GFSK	Test Freq. (MHz)	2402
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2246.00	38.12	54.00	-15.88	41.36	-3.24	Average	107	278
2	2246.00	50.12	74.00	-23.88	53.36	-3.24	Peak	107	278
3	2390.00	38.40	54.00	-15.60	41.10	-2.70	Average	107	278
4	2390.00	50.85	74.00	-23.15	53.55	-2.70	Peak	107	278
5	4804.00	48.18	54.00	-5.82	43.25	4.93	Average	185	220
6	4804.00	54.95	74.00	-19.05	50.02	4.93	Peak	185	220

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

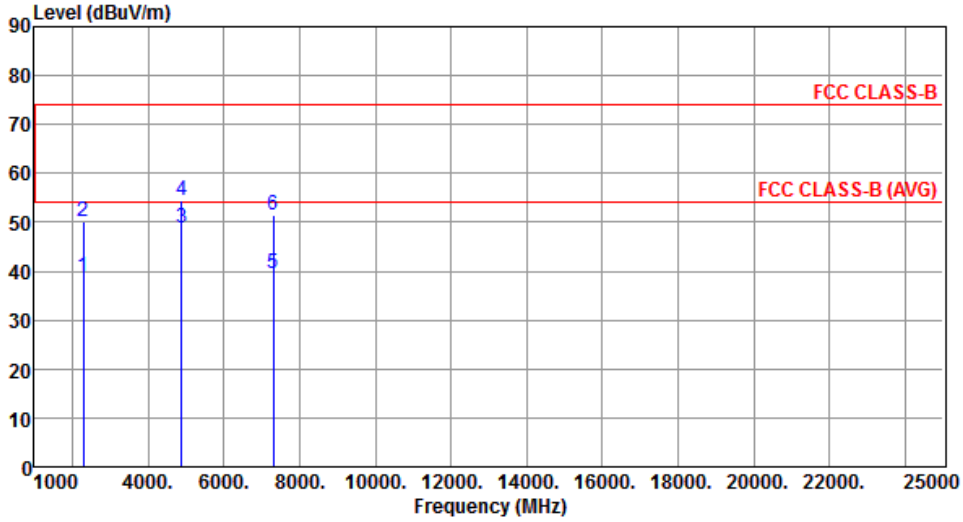
Modulation	GFSK	Test Freq. (MHz)	2440
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2284.00	37.92	54.00	-16.08	41.01	-3.09	Average	110	170
2	2284.00	49.43	74.00	-24.57	52.52	-3.09	Peak	110	170
3	4880.00	45.50	54.00	-8.50	40.40	5.10	Average	135	96
4	4880.00	52.51	74.00	-21.49	47.41	5.10	Peak	135	96
5	7320.00	38.22	54.00	-15.78	28.32	9.90	Average	155	129
6	7320.00	50.19	74.00	-23.81	40.29	9.90	Peak	155	129

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

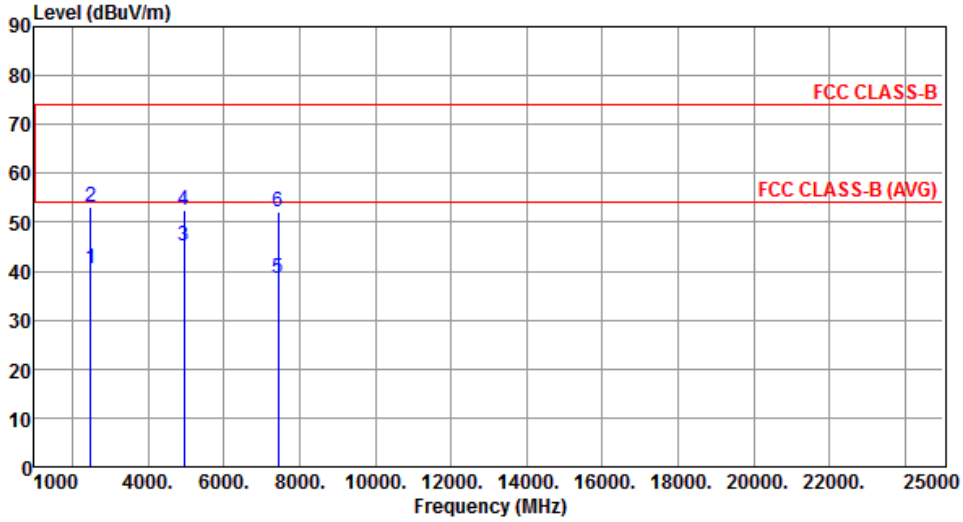
Modulation	GFSK	Test Freq. (MHz)	2440
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2284.00	39.01	54.00	-14.99	42.10	-3.09	Average	162	266
2	2284.00	50.12	74.00	-23.88	53.21	-3.09	Peak	162	266
3	4880.00	48.80	54.00	-5.20	43.70	5.10	Average	122	65
4	4880.00	54.36	74.00	-19.64	49.26	5.10	Peak	122	65
5	7320.00	39.58	54.00	-14.42	29.68	9.90	Average	146	266
6	7320.00	51.58	74.00	-22.42	41.68	9.90	Peak	146	266

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

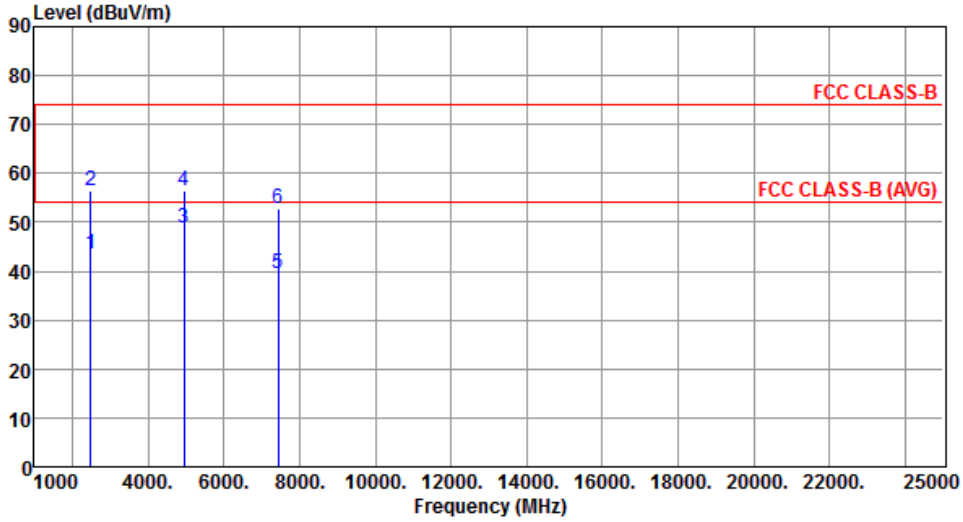
Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2483.50	40.43	54.00	-13.57	42.80	-2.37	Average	124	173
2	2483.50	53.08	74.00	-20.92	55.45	-2.37	Peak	124	173
3	4960.00	45.33	54.00	-8.67	40.06	5.27	Average	177	15
4	4960.00	52.46	74.00	-21.54	47.19	5.27	Peak	177	15
5	7440.00	38.46	54.00	-15.54	28.32	10.14	Average	252	229
6	7440.00	51.98	74.00	-22.02	41.84	10.14	Peak	252	229

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2483.50	43.51	54.00	-10.49	45.88	-2.37	Average	100	271
2	2483.50	56.39	74.00	-17.61	58.76	-2.37	Peak	100	271
3	4960.00	48.83	54.00	-5.17	43.56	5.27	Average	158	254
4	4960.00	56.38	74.00	-17.62	51.11	5.27	Peak	158	254
5	7440.00	39.46	54.00	-14.54	29.32	10.14	Average	146	32
6	7440.00	52.68	74.00	-21.32	42.54	10.14	Peak	146	32

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

3.6 Emissions in non-restricted Frequency Bands

3.6.1 Emissions in non-restricted frequency bands limit

The peak output power measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz.

3.6.2 Test Procedures

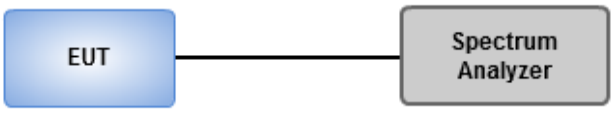
Reference Level Measurement

1. Set the RBW = 100 kHz, VBW = 300 kHz, Detector = peak.
2. Set Sweep time = auto couple, Trace mode = max hold.
3. Allow trace to fully stabilize.
4. Use the peak marker function to determine the maximum amplitude level.

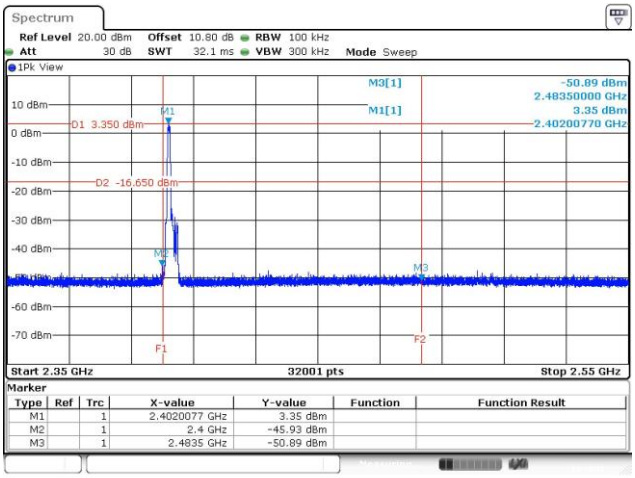
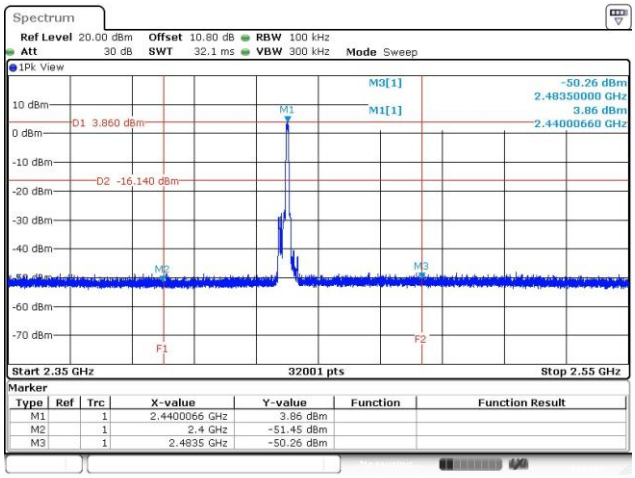
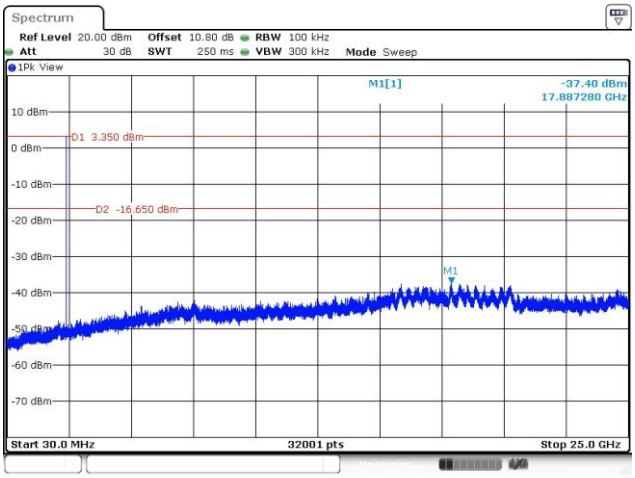
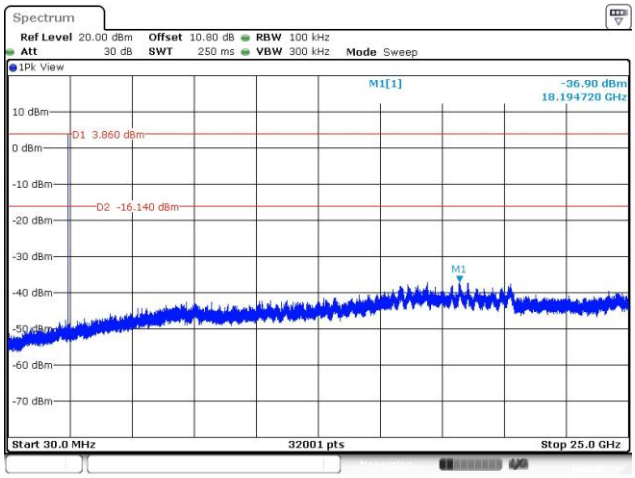
Unwanted Emissions Level Measurement

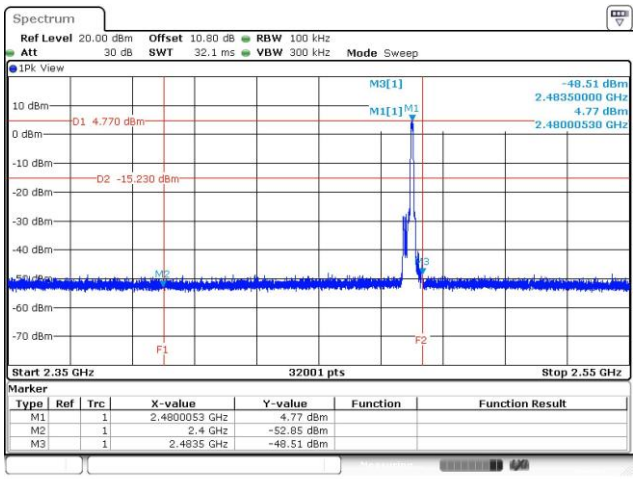
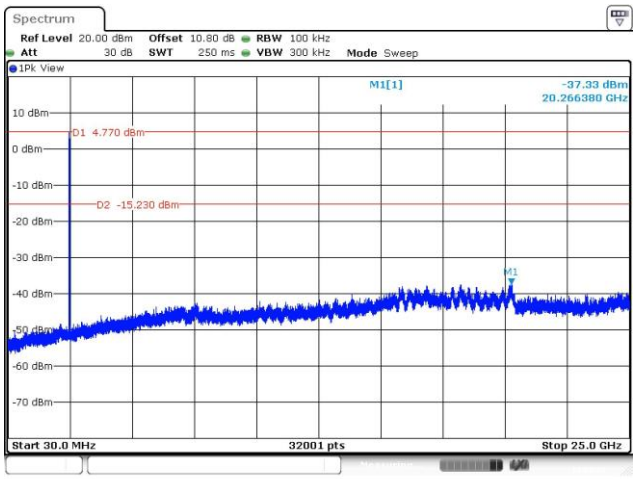
1. Set RBW = 100 kHz, VBW = 300 kHz, Detector = peak.
2. Trace Mode = max hold, Sweep = auto couple.
3. Allow the trace to stabilize.
4. Use peak marker function to determine maximum amplitude of all unwanted emissions within any 100 kHz bandwidth.

3.6.3 Test Setup



3.6.4 Test Result of Emissions in non-restricted Frequency Bands

TX Freq 2402MHz / 30MHz~25GHz (down 20dBc)	TX Freq 2440MHz / 30MHz~25GHz (down 20dBc)
	
	

TX Freq 2480MHz / 30MHz~25GHz (down 20dBc)	---
	---
	---

4 Receiver Test Results

4.1 Conducted Emissions

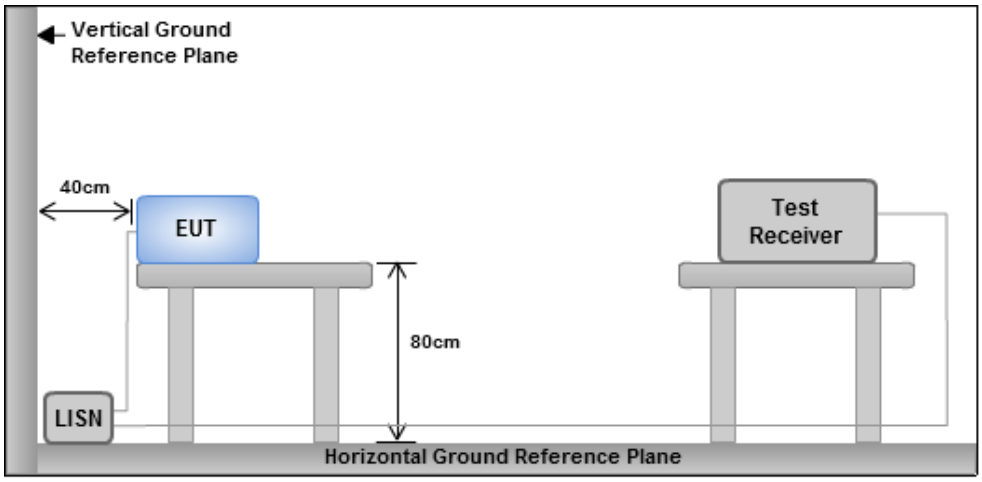
4.1.1 Limit of Conducted Emissions

Conducted Emissions Limit		
Frequency Emission (MHz)	**Quasi-Peak**	**Average**
0.15-0.5	66 - 56 *	56 - 46 *
0.5-5	56	46
5-30	60	50
Note 1: * Decreases with the logarithm of the frequency.		

4.1.2 Test Procedures

5. The device is placed on a test table, raised 80 cm above the reference ground plane. The vertical conducting plane is located 40 cm to the rear of the device.
6. The device is connected to line impedance stabilization network (LISN) and other accessories are connected to other LISN. Measured levels of AC power line conducted emission are across the 50 Ω LISN port.
7. AC conducted emission measurements is made over frequency range from 150 kHz to 30 MHz.
8. This measurement was performed with AC 120V/60Hz

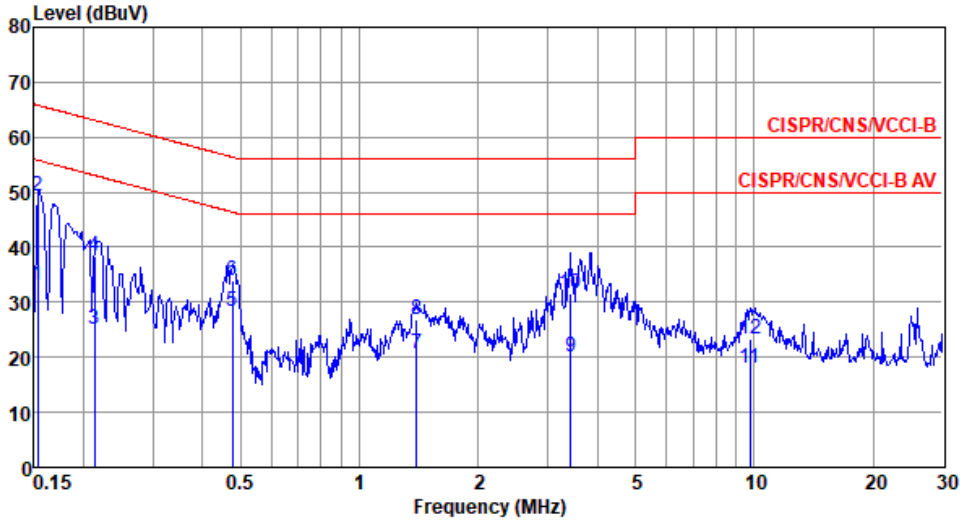
4.1.3 Test Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

4.1.4 Test Result of Conducted Emissions

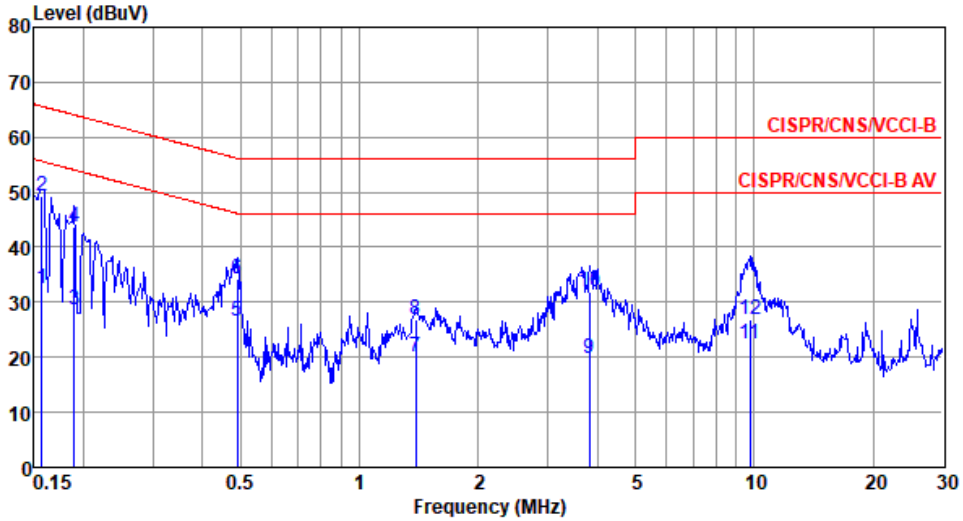
Modulation Mode	GFSK	Test Freq. (MHz)	2480
Power Phase	Line		



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.153	33.13	55.82	-22.69	23.55	9.53	0.05	Average
2*	0.153	49.20	65.82	-16.62	39.62	9.53	0.05	QP
3	0.213	24.99	53.10	-28.11	15.38	9.54	0.07	Average
4	0.213	38.49	63.10	-24.61	28.88	9.54	0.07	QP
5	0.476	28.40	46.41	-18.01	18.74	9.58	0.08	Average
6	0.476	33.89	56.41	-22.52	24.23	9.58	0.08	QP
7	1.396	20.70	46.00	-25.30	10.97	9.60	0.13	Average
8	1.396	26.93	56.00	-29.07	17.20	9.60	0.13	QP
9	3.436	20.04	46.00	-25.96	10.18	9.61	0.25	Average
10	3.436	31.59	56.00	-24.41	21.73	9.61	0.25	QP
11	9.757	18.01	50.00	-31.99	7.92	9.65	0.44	Average
12	9.757	23.28	60.00	-36.72	13.19	9.65	0.44	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

Modulation Mode	GFSK	Test Freq. (MHz)	2480
Power Phase	Neutral		



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.156	32.55	55.65	-23.10	22.93	9.57	0.05	Average
2*	0.156	49.29	65.65	-16.36	39.67	9.57	0.05	QP
3	0.189	28.65	54.06	-25.41	19.00	9.58	0.07	Average
4	0.189	43.60	64.06	-20.46	33.95	9.58	0.07	QP
5	0.491	26.47	46.14	-19.67	16.77	9.62	0.08	Average
6	0.491	34.34	56.14	-21.80	24.64	9.62	0.08	QP
7	1.388	20.03	46.00	-25.97	10.26	9.64	0.13	Average
8	1.388	26.98	56.00	-29.02	17.21	9.64	0.13	QP
9	3.820	19.81	46.00	-26.19	9.88	9.66	0.27	Average
10	3.820	31.89	56.00	-24.11	21.96	9.66	0.27	QP
11	9.757	22.32	50.00	-27.68	12.17	9.71	0.44	Average
12	9.757	26.83	60.00	-33.17	16.68	9.71	0.44	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

4.2 Radiated Emissions

4.2.1 Limit of Radiated Emissions

Restricted Band Emissions Limit			
Frequency Range (MHz)	**Field Strength (uV/m)**	**Field Strength (dBuV/m)**	**Measure Distance (m)**
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1:
Qusai-Peak value is measured for frequency below 1GHz except for 9–90 kHz, 110–490 kHz frequency band. Peak and average value are measured for frequency above 1GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit
Note 2:
Measurements may be performed at a distance other than what is specified provided. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, Frequency at or above 30 MHz: 20 dB/decade Frequency below 30 MHz: 40 dB/decade.

4.2.2 Test Procedures

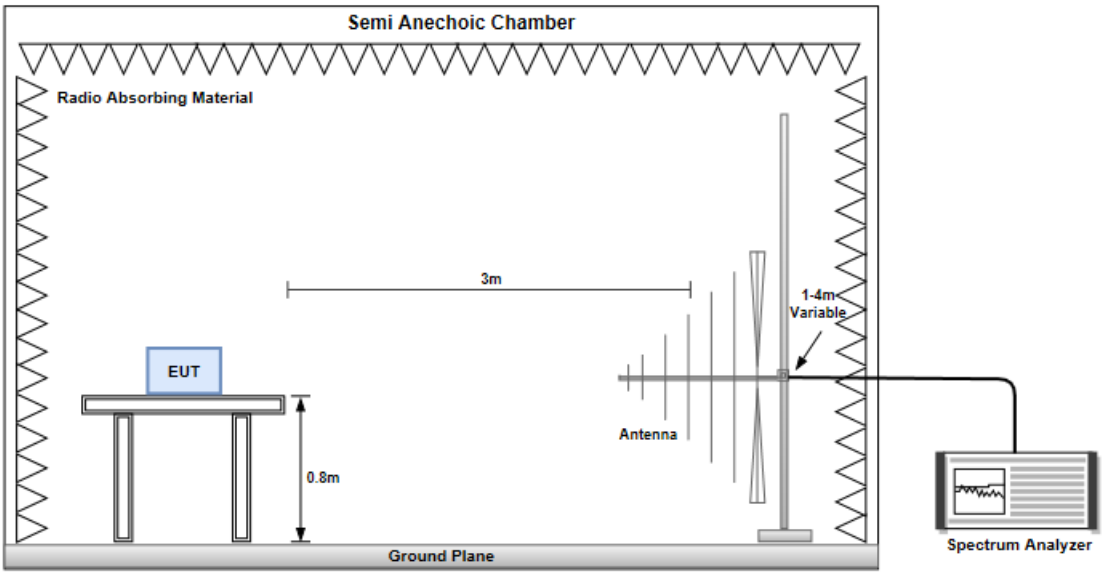
1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. The EUT is placed at test table. For emissions testing at or below 1 GHz, the table height is 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height is 1.5 m
2. Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m ~ 4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3 m.
3. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

Note:

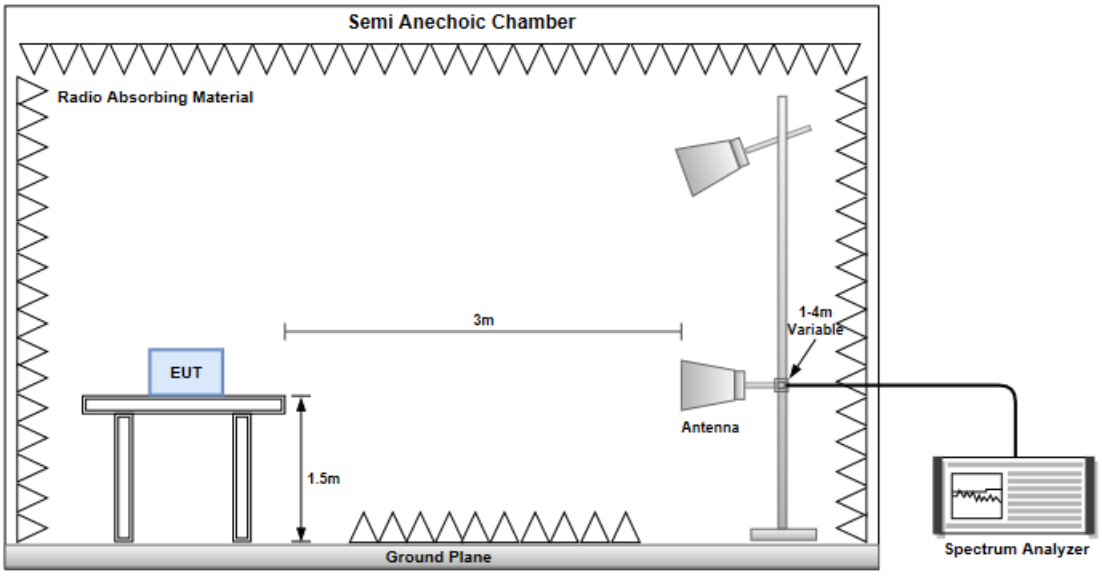
1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
2. RBW=1MHz, VBW=3MHz and Peak detector is for peak measured value of radiated emission above 1GHz.
3. RBW=1MHz, VBW=3MHz and RMS detector is for average measured value of radiated emission above 1GHz.

4.2.3 Test Setup

Radiated Emissions below 1 GHz

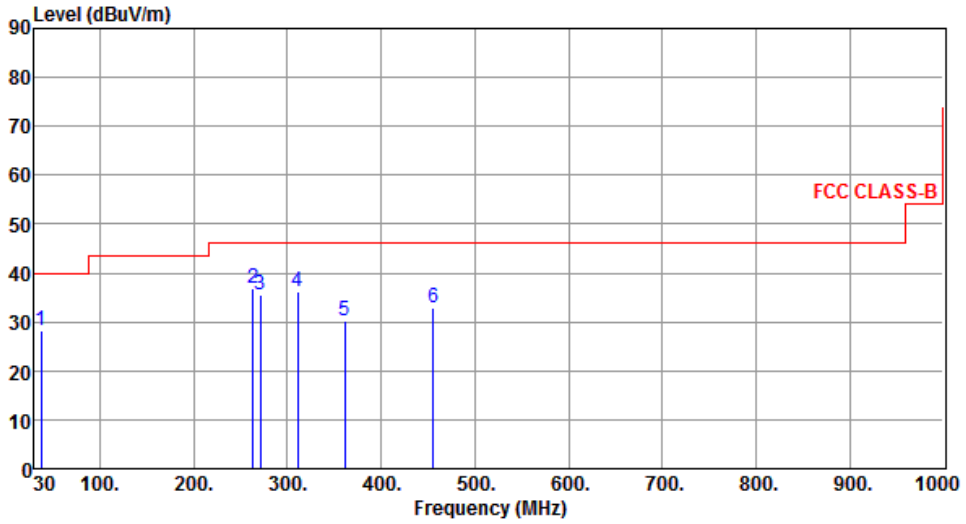


Radiated Emissions above 1 GHz



4.2.4 Receiver Emissions (Below 1GHz)

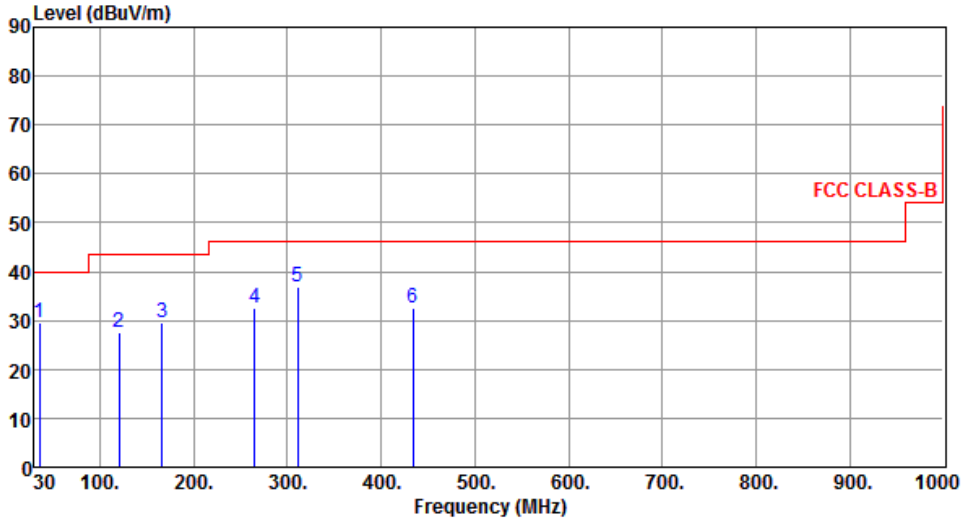
Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	37.47	28.17	40.00	-11.83	36.62	-8.45	Peak	---	---
2	263.32	36.80	46.00	-9.20	45.69	-8.89	Peak	---	---
3	270.85	35.44	46.00	-10.56	43.98	-8.54	Peak	---	---
4	311.17	36.24	46.00	-9.76	43.76	-7.52	Peak	---	---
5	361.24	30.11	46.00	-15.89	36.19	-6.08	Peak	---	---
6	455.75	32.89	46.00	-13.11	36.67	-3.78	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Vertical		

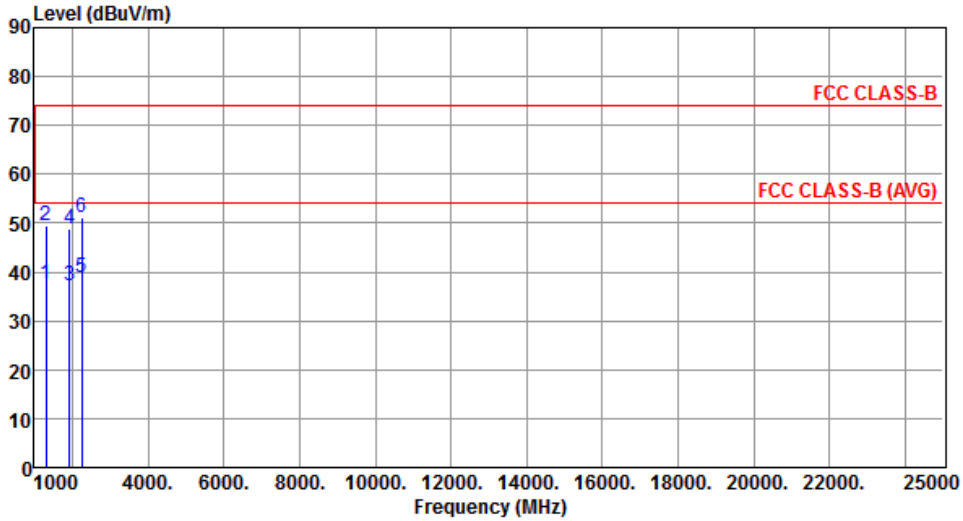


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	35.41	29.47	40.00	-10.53	38.08	-8.61	Peak	---	---
2	120.11	27.55	43.50	-15.95	38.16	-10.61	Peak	---	---
3	166.57	29.54	43.50	-13.96	37.88	-8.34	Peak	---	---
4	265.24	32.44	46.00	-13.56	41.24	-8.80	Peak	---	---
5	311.41	36.71	46.00	-9.29	44.22	-7.51	Peak	---	---
6	433.88	32.42	46.00	-13.58	36.69	-4.27	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

4.2.5 Receiver Emissions (Above 1GHz)

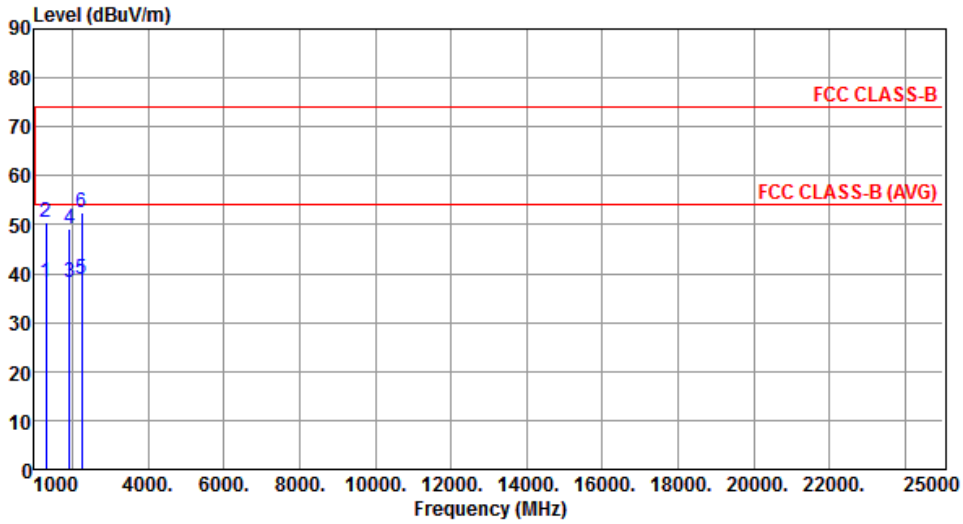
Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1300.00	37.48	54.00	-16.52	44.39	-6.91	Average	335	225
2	1300.00	49.34	74.00	-24.66	56.25	-6.91	Peak	335	225
3	1937.00	37.09	54.00	-16.91	41.50	-4.41	Average	155	189
4	1937.00	48.84	74.00	-25.16	53.25	-4.41	Peak	155	189
5	2241.00	38.70	54.00	-15.30	41.95	-3.25	Average	215	329
6	2241.00	51.13	74.00	-22.87	54.38	-3.25	Peak	215	329

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1300.00	38.12	54.00	-15.88	45.03	-6.91	Average	225	210
2	1300.00	50.36	74.00	-23.64	57.27	-6.91	Peak	225	210
3	1937.00	38.25	54.00	-15.75	42.66	-4.41	Average	211	220
4	1937.00	49.19	74.00	-24.81	53.60	-4.41	Peak	185	226
5	2241.00	38.95	54.00	-15.05	42.20	-3.25	Average	220	16
6	2241.00	52.37	74.00	-21.63	55.62	-3.25	Peak	220	16

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

5 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corp, it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan Hsiang. Location map can be found on our website http://www.icertifi.com.tw.

Linkou	**Kwei Shan**	**Kwei Shan Site II**
Tel: 886-2-2601-1640	Tel: 886-3-271-8666	Tel: 886-3-271-8640
No. 30-2, Ding Fwu Tsuen, Lin Kou District, New Taipei City, Taiwan, R.O.C.	No. 3-1, Lane 6, Wen San 3rd St., Kwei Shan Hsiang, Tao Yuan Hsien 333, Taiwan, R.O.C.	No. 14-1, Lane 19, Wen San 3rd St., Kwei Shan Hsiang, Tao Yuan Hsien 333, Taiwan, R.O.C.

If you have any suggestion, please feel free to contact us as below information

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